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ARE YOU BIM READY?

Owners are increasingly demanding that their projects be designed using BIM software such as Autodesk Revit® and Navisworks Manage®. Your associates in these projects are sending you Revit files. Are you fully capable of delivering the project to your client’s satisfaction? Are you truly BIM ready?

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The National Institute of Building Sciences holds a strong commitment to advancing the facilities and infrastructure industries to yield higher performance and higher quality structures while ensuring the optimized use of resources, both human and financial. We believe that moving into the information age is critical and it starts with ensuring human interfaces are optimized. No one can continue doing business as we have always done it and expect better results.

To that end, the Institute is walking the walk by re-looking at its interface with its members and customers. We will be launching a new membership system over the next several months that will allow you a more interactive relationship with the Institute. If we are to have an impact in reforming an industry, it must first start at home.

We are also implementing a new conference format beginning in January 2013. The conference will be designed in such a way to ensure our members will be able to find out what all the councils of the Institute are undertaking. We are not over-packing the sessions but allowing you as a member or potential member to be able to attend sessions from all the councils and receive a good overview of all efforts. However, you can also still focus on a specific area of interest.

We also believe that moving the conference to January will ease up some of the stress and competition that attendees experienced in the past when the conference was held at the end of the year. This will also give the Institute the opportunity to reflect on the accomplishments of the previous year as well as discuss plans for the year ahead. More information about the conference can be found here: www.nibs.org/conference.

The Institute sees the buildingSMART alliance™ as providing the information backbone that will help link all our programs. The information age is here and the integration of information is far more powerful than the islands of information that used to be commonplace. We are now beginning to see the power of information integration, yet we have a long way to go until we unlock the true opportunities of information interoperability.

The day when buildings and infrastructure are far more efficient in their use of raw materials and resources is not far away, but we must work for it. Much of the technology is becoming commonplace; we can tell our car to adjust temperature, play a specific song, drive and park itself. Why should we not expect that our buildings be high-performing, sustainable and with a reduced carbon footprint?

This will not come without re-engineering the way we currently do business. BIM, while not being a panacea, does offer us the opportunity to re-examine our business processes and implement new ways of communicating. Developing buildings electronically first and working out problems while they are in that state will eliminate change orders. We can also predict the total cost of operating and maintaining the facility for its entire life, as is described in our cover story.

Many of the impediments to this transformation are simply mindset changes. While these changes are not easy to accomplish, we hope that this, our tenth edition of the Journal of Building Information Modeling, will help you in your quest to improve the way you do business and spark in you the ideas that will help others also see that there is a better way.

Henry L. Green, Hon. AIA
President

Much of the technology is becoming commonplace; we can tell our car to adjust temperature, play a specific song, drive and park itself. Why should we not expect that our buildings be high-performing, sustainable and with a reduced carbon footprint?
Introducing the Arcat app.

Finding building product information just got even easier with the Arcat app for the iPhone® and iPad®. Just search for Arcat on the App Store® for your free download.

Scan for your free download.
While we appreciate the amazing support we have received, our initial assessment is that it is going to take a VERY long time to affect industry change at the rate we are currently moving.

The Alliance ultimately sees owners forcing the transformation. This is because they are not going to continue to accept spending billions on non-value added efforts in the industry.

The development of NBIMS-US™ Version 3 is going to start this summer. We see it as beginning the formative stages of the true transformation, with many more sectors bringing content to the standard.

The Alliance has also begun the development of education courses, not to conflict or compete with those already being provided by the Associated General Contractors of America, the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), the American Institute of Architects, or others, but focused on the overall open building information modeling efforts. The Alliance will incorporate a very strong buildingSMART alliance™ program along with enhanced education strategy sessions. I hope to see you there.

Dana (Deke) K. Smith, FAIA
Executive Director
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I WANT YOU! I LOVE THAT OLD POSTER, the finger pointed right at the reader. Who? Me? Yes, you! I WANT YOU! How do you duck that? You can’t. YOU cared enough to pick up or download this publication. YOU cared enough to read this column. I WANT YOU...to take the next step and get involved with the buildingSMART alliance®.

It is just about time to again crank up the United States National CAD Standard® (NCS) engine. This spring, we will start the next version and I expect that we will aim to publish it in the spring or summer of 2013, giving us a two-year revision cycle.

There are some things I know about already that will likely be balloted for Version 6: there has been a group working on making NCS more relevant for civil construction; there is a group working on NCS-compliant output from building information models (BIMs); and there is a new standard from the Adhesive and Sealant Council for symbology that belongs in NCS. I know that you will also have some thoughts on what needs to be updated or added, and we would like to hear your feedback on the last version, too. How is the website working for you? What do you like about it? What can we do better?

WHAT IS THE NCS?

The NCS, which is a product of the buildingSMART alliance®, is a consensus standard comprised of inter-related standards, guidelines and tools for uniformly organizing and presenting facility drawing information. It is the only comprehensive standard for facility planning, design, construction and operation drawings.

The NCS streamlines and simplifies the exchange of building design and construction data, from project development throughout the life of a facility. It coordinates the efforts of the architecture, engineering, construction, operations and owner (AECOO) communities by classifying electronic building design data consistently. This allows for streamlined communication among owners, and design and construction project teams. This can reduce costs and lead to greater efficiency.

The NCS project committee represents public and private interest categories that encompass the entire AECOO industry. This group performs a broad peer review of each version of the NCS.

I did a detailed breakdown of what is new in the NSC Version 5 in my column in the Fall 2010 issue of JBIM. The short and sweet of the improvements are, as follows:

1. Online documents are accessible 24/7 to licensees of the standard, making it easier to search and implement the standard.
2. An expanded and reorganized CAD Layer Guidelines includes new Discipline Designators for Distributed Energy.
3. An updated Uniform Drawing System includes new and revised symbols for elevation indicator, azimuth indicator, architectural scale, electrical symbols and other areas.
4. New Implementation Guidelines with clear phased approaches from management buy-in to establishing an employee training plan.

WHO DOES THE BUILDINGSMART ALLIANCE® BENEFIT?

BIM is transforming the AECOO industry. Working together as an industry, we can accomplish several objectives, including coordinated and comprehensive education, standards development, foundational technology and the development of best business process practices. These things cannot be accomplished by one office, one company, one association or one industry segment. Accomplishing these objectives, while also achieving interoperability, is the purpose of the buildingSMART alliance®. Specifics on how the Alliance can benefit property owners, facility managers, contractors, subcontractors, fabricators, designers, engineers and specifiers—the ENTIRE industry—are available at www.buildingsmartalliance.org. Here are a few main reasons why you should be involved:

- There is a strategic level primarily reserved for sponsors and associations who have a memorandum of agreement with the Alliance. This allows them to be on the Board of Direction and planning committee for the National Building Information Modeling Standard—United States™ (NBIMS-US™).
- There are local interest group meetings that you can attend in your area, giving you the chance to network with others associated with the buildingSMART alliance®.
- As a member you have access to the member portal. With this tool, members of buildingSMART alliance® are invited to participate in the development of projects that are helping transform the AECOO industry and which eventually may be developed into industry standards.
- Standards projects of the buildingSMART alliance®, such as NCS and NBIMS-US™, need your help in the development of ballot items as well as participation in the consensus process. Support from you is at the heart of our success. We appreciate each and everyone’s contribution. If you are not yet a member, consider joining the Alliance. There are many levels of involvement—one will fit you! When you do decide to get involved, let us hear from YOU!

R. Mark Butler
Chair,
United States National CAD Standard®
Project Committee
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Struggling with your dataloads?

When you’re struggling with duplication of dataloads, BIM is your solution. Use it to preload your Facilivue Facilities Management software with information that’s already been developed by your Design Team and your General Contractor. Remember, when you save time, you save money. And that will leave a smile on your face.

Omegavue supports the National Institute of Building Science and the Building Information Model Committees in their efforts to standardize BIM information – making it more effective and efficient for our clients.

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Facility software tools for people who care about time and effort.
I believe there are two types of practitioners: those who are satisfied with the status quo and those who seek to further the body of knowledge. We are seeking the latter to help with the transformation.

THE RELEASE OF THE NATIONAL BUILDING Information Modeling Standard-United States™ Version 2 (NBIMS-US™) is a major step forward for the facilities and infrastructure industry, but it is only the first step of many to change the way we do business. The Alliance hoped to take that step with the release of Version 1 in late 2007, but we found that it was simply too early in the BIM maturity process to identify any standard processes. Hence, Version 1 did not go through consensus and simply became the guide to how we would develop standards in the future. Well, the future is now here with Version 2 of NBIMS-US™.

The NBIMS-US™ project committee, to which anyone can become a member, is currently in a change management phase. The Rules of Governance are being examined for any improvements we can make to the process we use to gain industry wide consensus. In some cases, this means making adjustments because a designed process did not operate as well as planned. In other cases, this means changing a part of the process because we are smarter after going through the first round and we found a better way.

The process the Alliance is using has been in use for well over ten years and five versions of the National CAD Standard® (NCS). While we want to be in a position where our process is friendly towards the American National Standards Institute (ANSI) and the International Organization for Standardization (ISO), we do not necessarily want to take on everything that comes with those processes because we are so early in BIM maturity. In truth, standards need to be processes that are in place, proven and accepted before they can even be considered as a standard. The facilities and infrastructure community does not have much yet that fits into that category when it comes to BIM, but we do have some. In Version 2, we do have true standards at the center, on which we are building and which have gone through a recognized standards body. The NBIMS-US™ also has less “standards”; items that are not true standards but are business processes that we have a consensus on, to use collectively throughout the industry.

The NBIMS-US™ planning committee is made up of industry leaders from industry associations and sponsors. We need a continually wider base to support comprehensive planning for the future, so we offer several ways to become part of this group of critical and innovative thinkers. You can become a member of the planning committee either through sponsorship of our efforts or through a memorandum of agreement between the Alliance and a recognized nonprofit association representing a specific constituency. Even if you are not on the NBIMS-US™ planning committee, your feedback is critical to our collective success. You can reach out to any of the listed committee members with your ideas.

The reality is that the Alliance is not going to develop the new ways of doing business. This is the practitioner expert’s task. The hard part is coming up with the acceptable business processes that the architecture, engineering, construction, operations and owner (AECOO) community can all use, no matter what phase they are in on a project. I believe there are two types of practitioners: those who are satisfied with the status quo and those who seek to further the body of knowledge. We are seeking the latter to help with the transformation.

In the end, those who have implemented the transformational business processes will literally be the ones who survive. True, those who take the lead may end up taking more risk, but a lack of risk takers is a big reason why the facilities and infrastructure industry is lagging in the information age. As a group, we are more risk adverse than most.

Participating in the process of change is the best way, not only to understand the issues, but also to be recognized as a leader in the future of the facilities and infrastructure industry. Firms that can show a high level of participation will be seen as the innovators. They will not only get the future jobs because of that visibility, recognition and innovation, but because the transformation that will make them more competitive will also give them a leg up on the implementation and the advantages that provides.

We hope that the Journal of Building Information Modeling provides you, as a member of the AECOO community, the insight needed to become more involved and, ultimately, a leader.

David Morris
Chair,
National BIM Standard-United States™ Project Committee
“WE ARE AT A CRISIS HERE,” SAID University of Utah President Michael Young, referring to the critical infrastructure needs of the facilities on the campus. In the article, published in February of 2010, Young cited that 22 electrical outages in 2009 and 2008 left the university without power for more than 300 hours. In 2009, 105 days were recorded with no heat or hot water for 65 buildings due to a line break. In January of 2010, the same fate found an additional 44 buildings.

Young’s situation speaks to many of the issues and fears of asset managers and facility owners. Facility managers, as is the case with Young, plead for the necessary funds to sustain the old facilities they manage. However, what really is the issue?

• Is it a funding issue?
• Is it a budget issue?
• Is it a planning issue?
• Is it an ownership issue?
• Is it an investment issue?
• Is it a management issue?
• Is it a leadership issue?

With the appropriate tools and framework of knowledge, facilities management can address these questions and issues in a deliberate and effective way. New technology emerged in recent years that expanded our capabilities to exchange data. Some of these new technologies include building information modeling (BIM) and 3D modeling, among many other emergent tools.

When utilized correctly, these tools not only assist in the planning, design and construction part of facilities management to save limited funds, but also in the life-cycle management of assets and investments. Having these emergent, technological tools will assist with the management of assets. However, a framework of knowledge is also vital to the successful management of assets.

Let’s begin by defining the tools and framework required to address the mounting crisis facility managers face:

• **Total cost of ownership (TCO)** is a business case designed to uncover all the lifetime costs of acquiring, design and construction, operating and maintaining, and the recapitalization of an asset. TCO analysis reveals the difference between the price of something and its long-term cost.

• **Building information modeling (BIM)** 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.

• **What is the difference between BIM and 3D modeling?** 3D modeling is the process of developing mathematical representation of any 3D surface of an object via specialized software and is only part of the BIM concept. BIM incorporates all information about a project spatially and geometrically in specialized software.

• **Total enterprise asset management (TEAM)** is a single system that supports enterprise-wide asset management for the lifetime of the asset.

TCO addresses the very issues at the heart of any asset management program—how to manage assets effectively by revealing the true cost of ownership, from construction to demolition of the asset, while BIM assists with data transfer, data transparency and data awareness. Together, these create the TEAM approach to asset management.

**LESSONS LEARNED**

This section strives to impart knowledge on lessons learned while implementing BIM, TEAM and TCO. Historically, BIM incorporated and combined data for the design and construction of an asset is referred to in this article as Little BIM. Big BIM, for the purposes of this article, represents merging the design and construction of an asset with the maintenance and operations part and the recapitalization part of an asset.

Lessons learned from incorporating Big BIM (from Little BIM) and total cost of ownership encompasses the importance of being certain, or having certainty. Specifically, data and graphic information pertaining to the asset must be transparent and accurate—with certainty.

Certainty is a powerful concept that empowers the facility manager to make better decisions and increase return on investment. A high level of trust from investors and investment managers forms when the facility manager has a high level of certainty. So, how does a facility manager achieve certainty?

**CERTAINTY**

The TCO framework accounts for all of the types of costs comprised in the investment of assets. All costs function together to supply a leadership tool for decision-making. Through an asset’s life-cycle, points of certainty emerge to validate the most factual and accurate
option. The TCO framework recognizes three areas of certainty to ensure the decision: 1) certainty of delivery and inventory; 2) certainty of just-in-time decisions; and 3) certainty of best design and build (FIGURE 1).

1. CERTAINTY OF DELIVERY AND INVENTORY: This is the most critical transaction of the three lessons learned. For maintenance and operations (M&O) to perform effectively, a complete and accurate listing of ALL assets must be generated. Project delivery contains the who, what, when, where, why and how of the asset. Transparency and transmittal of this information from project delivery to M&O is critical. An asset-centric database, vital to the success of managing assets, begins with project delivery data.

An audit of the project delivery information is fundamental to ensure accuracy. An audit begins with the completed design and construction Revit model (FIGURE 2), followed by a comparison to the laser scan of the completed project. Laser scanning is the key to getting a complete audit. Any differences in the design and inventory are identified, resulting in total transparency to the owner. This allows for collaboration between the owner and builder to discuss details for design changes and permits the owner to verify actual construction with approved design. Replacing the walk through and checklists, inventory is verified prior to transferring to M&O. “As is” now replaces “as built” by utilizing the actual laser scans.

The verified information transferred from project delivery to the asset-centric database tracks ALL costs to an asset and informs M&O of future maintenance, repair and replacement needs. Management, with all asset information at hand, may formulate a strategy to focus on a few assets that have significant impact to the business purpose, such as electrical and roof systems. Project delivery and an asset-centric inventory certainty allows for M&O management of critical assets.

2. CERTAINTY OF JUST-IN-TIME DECISIONS: From certainty of delivery and inventory, an asset-centric database created from verified project delivery information is created. M&O tracks and monitors costs associated with the maintenance and repair of assets to the asset-centric database. In addition to all costs associated with the maintenance and repair of the asset, ALL information about the asset is also stored in the asset-centric database. These costs and other information about the asset include, but are not limited to, preventative maintenance, service requests, work orders, space information, building automation controls, metering information, manufacturing, warranty information, service manuals, part catalogues, projects, energy costs and routine maintenance. All of this data and information is available virtually at anytime and any place with 3D models and coordinates.

The asset-centric database is designed so that all of these elements flow into the asset database and can be seen virtually at any time. TABLE 1 (on page 16), is an example of a summary of the costs of an asset extracted from the asset-centric database. Triggers monitor the status of the asset.

Capturing all the data related to an asset in one central location is the starting point. This allows for certainty of making the correct decision at the most accurate time. Data about the performance of the asset is visible throughout the life of the asset. The first step is developing an asset-centric database that flows data about the asset to one central location. However, achieving certainty of just-in-time decisions requires more than data.

The Data Maturity Model (FIGURE 3), registered to Carnegie-Mellon University (CMU), is a development model that was created after researchers realized that acquiring the level of knowledge needed to make informed decisions in information technology took too long, was manual and highly reactive. The creators recognized that data existed in unconnected spreadsheets with inconsistent definitions and the integration of this data was hastily done in response to immediate business needs. CMU developed a way to utilize the data to make informed decisions and close the gap on the amount of time needed to make these decisions.

In facility management organizations, a similar challenge exists. Asset information is stored separately or not at all. Some knowledge is retained only within the experts in the organizations. However, assets historically outlast the experts (they retire or gain employment elsewhere). Using CMU’s approach, the best of both sides is achieved. Data is collected in one central place to ensure better, faster and more accurate decisions. The data then replaces the long-term experience.

In this model, it is important to note some key points from the study. The critical first step is to collect the right data points, or simply DATA, in one organized location. The data

![Figure 3. When using a data maturity model it is critical to collect the right data points.](image-url)
becomes INFORMATION when data is organized, tracked and compared. At this stage, information is organized to generate a trend analysis but is not a means for decision-making. Validating the information for consistency and correctness develops the KNOWLEDGE you have for an asset. The more you know about an asset brings UNDERSTANDING.

This level derives from applied knowledge and the learned experience of the asset in a particular environment. The final stage, WISDOM, is achieved once you understand the asset and have the highest level of judgment about the asset. At this stage, informed, accurate and timely decision-making occurs and results for your organization are reliable, defendable and useful.

Capturing all the data about an asset in one central location is the starting point. Translating the data to wisdom utilizing BIM and the asset-centric database permits a virtual view of the assets and allows for the right decision just-in-time. In the past, reliance on life-cycle, length of use and maintenance helped decide when to retrofit or replace. This meant that, in many situations, assets long exceeded their useful life or were over-maintained.

3. CERTAINTY OF BEST DESIGN BUILD: As asset expenditures and frequency of repairs are tracked in an asset-centric database, trends begin to emerge on the performance of an asset. For example, a newly installed carpet may be requiring more than usual maintenance and repair. This may indicate this carpet fails to meet the requirements of heavy traffic. Information about this carpet now transfers to future designs and this carpet will not be used again in heavy traffic areas. With data on the performance of an asset, an understanding of the best design for the environment or business purpose emerges.

These asset performance issues need to be remembered and used—both top performance issues and low performance issues. This information advises the design/build function in project delivery on exactly what assets perform the best in that environment. This certainty ensures the assets with the highest return on investment are cataloged and remembered, as well as safeguards that the assets with low performance are eliminated. This completes the total cost of ownership process.

RESULTS

Currently, asset managers strive to ensure the asset reaches the end of its useful life, pouring in thousands or possibly millions of wasted dollars to achieve this goal. This model may merit the same results as presented in the University of Utah’s case—a crisis. What if the asset manager instead strove to provide the best decision based on data and knowledge about the asset? Implementing total cost of ownership allows for a total awareness of the investment of the asset. This includes:

- Recognition of when to mitigate future excessive costs based on current maintenance and repair costs;
- Knowledge on how to lengthen the life of the investment;
- Wisdom to determine which assets are most economical in their business environment;
- Intelligence on future cash flow projections over any length of time;
- Knowledge to create a virtual annual plan for new and existing investments; and
- Insight on both unnecessary expenditures and resourceful expenditures.

At any point in time, asset managers demonstrate the successful execution of investment goals for an asset. Supervisors, over the different areas of expertise, gain knowledge and wisdom about the total asset, transforming the facility manager to an asset manager. Asset management brings a total awareness of an asset, and, in turn, allows organizations to see the best return on investment. Most importantly, the asset manager improves the relationship with the owner or investor, referred to as the “TCO squeeze play.”

The “TCO squeeze play,” if implemented properly, covers all three cost needs and positions all of the costs in relationship to the TCO principles. On one side, project delivery “squeezes” M&O dollars by:

1. Employing assets with the proven best performance; and
2. Guaranteeing certainty of no costs resulting later from misinformation on the inventory of assets.

On the other side, recapitalization "squeezes" M&O dollars by making the right decision at the right time. An M&O asset-centric database collects all of the assets and related costs. Remember, the information about the asset comes from project delivery. With accurate data about the asset (start date, cost, etc.) and accurate and current data and information about the maintenance and operations of the asset, the right decision point with certainty follows with a "just-in-time" decision. The best performing assets are fed back to project delivery in an asset catalog for reference for future replacements or projects.

The goal is now accomplished; a process of using the best assets in project delivery and having a recapitalization point where decisions are made just-in-time. It is worth repeating a second time. With these two cost controls in place, the M&O costs are "squeezed" to the lowest possible number. When the best performing assets are implemented in project delivery with certainty and just-in-time decisions are being made with certainty, then the least amount of funding is going to M&O. It works. TCO delivers to the owner the best possible long-term return on investment.

This is the TEAM approach. It can reduce time, increase decision-making accuracy and reduce overall long-term costs. Taking the benefits of the BIM principles together with the TCO principles creates the TEAM approach.

**BIM + TCO = TEAM**

Three costs, if mastered holistically, improve decision-making to the highest-level, achieving increased quality, lowered costs in each of the three areas (project delivery, maintenance and operations, and recapitalization) over an asset's life, and higher return on investments to the owner. There is a choice: experience President Young's crisis at the University of Utah or operate with the wisdom to make the right investment decisions for the assets you manage.

---

Douglas Christensen, APPA Fellow and Past President, is an expert on capital management and TCO principles. Ana Thiemer, from the University of Texas at Austin, provided content editing for this article.
Identifying and Overcoming Industry Challenges to Reach the BIM FM Vision

By Angela Lewis, PE, LEED AP, and Jim Whittaker, PE, CFM, FRICS

THIS IS THE VISION FOR BUILDING information modelling (BIM) for facility management (FM): click a 3D object in a BIM and instantly have current, user-specific asset data. Although such a BIM promises an opportunity to improve productivity, support proactive decision making and reduce costs, the industry must acknowledge the challenges that have to be overcome before facility managers, building operators and others will have a BIM that aligns with this vision. This article identifies five challenges along with recommendations to overcome them.

CHALLENGE #1: THE REACTIVE NATURE OF THE INDUSTRY

Facility management is not currently a data-driven industry. Decisions are often made reactively; reactive maintenance is the most common approach (Price 2006) and data of past energy consumption from utility bills is the primary method to track energy performance (Lewis et al. 2010). Thus, it is not surprising that maintenance is often underfunded (Bordass et al. 1997) and buildings are seen as a liability, not an asset (Alexander 1996).

RECOMMENDATION TO OVERCOME CHALLENGE #1

Transitioning from reactive to proactive practices may seem overwhelming. However, by nature people are motivated to be proactive. Proactive facility management requires redefining industry practices and using tools and data as intended. This requires training and buy-in across all levels of the organization. Specific actions that can help team members understand why change is necessary include:

- Providing opportunities for training;
- Rewarding the implementation of proactive practices; and
- Carefully evaluating the cost-benefit of reactive versus proactive decision making.

CHALLENGE #2: EXISTING FACILITY MANAGEMENT SOFTWARE IS OFTEN UNDERUTILIZED AND POORLY IMPLEMENTED

Computerized maintenance management systems are underutilized and often poorly implemented (Sapp 2008). Building automation systems often do not work properly, including systems with sophisticated control strategies that seek to reduce costs (Brambley et al. 2005; Bordass et al. 2001; Rios 2005). BIM FM requires interaction with existing systems. Thus, it is important to realize that the addition of new systems that support BIM FM will not fix a preexisting industry challenge.

RECOMMENDATION TO OVERCOME CHALLENGE #2

When implementing new facility management software, first develop a strategic plan about how the software will be used. The plan should include the type of data that will be collected, how the data will be used, who will use it and what key performance indicators will be reported. When setting the budget, be sure to include planning, implementation, data population, setup and configuration, and adequate training. Too often, software projects focus primarily on technology selection—not how the software will be used. Thus, funds run out before the system is populated with the data necessary to fully use the system and ensure users are properly trained. To overcome this challenge, clearly define processes, intended users and desired outcomes before selecting the technology.

CHALLENGE #3: ABUNDANCE OF DATA

It is prohibitively expensive to collect and maintain a database of all facility assets. Therefore, facility managers increasingly need to take on the role of a data analyst (IFMA 2011) to determine what data to collect, at what level of detail and who needs access. The data collected must be organized in a consistent manner to efficiently generate reports and make decisions.

RECOMMENDATION TO OVERCOME CHALLENGE #3

To determine what data to collect, use open standards and information exchanges such as Construction Operations Building information exchange (COBie) and the Specifiers’ Properties information exchange (SPie). Most information exchanges are still in development so, instead of developing proprietary or facility-specific data structures, get involved with the overall creation. Using open information exchanges developed based on industry consensus is beneficial because:

- An increasing number of software vendors are using them to support interoperability of products across the facility life-cycle; and
- The time and effort required to develop an information exchange is significant. Active involvement provides an excellent educational opportunity while providing the means to influence the development process.

CHALLENGE #4: CULTURAL CHANGE AND PERCEIVED VALUE OF BIM

As stated earlier, the facility management industry is accustomed to operating reactively. To some facility management professionals, BIM is just one more responsibility. Additionally, just because data is available, does not mean it will be used to make decisions. In order for BIM FM return-on-investment targets to be achieved, it is necessary to:

- Transition to more proactive, data-driven decision making processes; and
- Quantify the value of BIM to the facility management professional.
RECOMMENDATION TO OVERCOME CHALLENGE #4

Driving change within many organizations often includes training and emphasizing the answer to the question, “What’s in it for me?” As facility management organizations are comprised of diverse groups of stakeholders, answer the question from the perspective of multiple stakeholders. Build a case that the availability of data allows for better decision making and better decision making leads to better allocation of resources. While developing change management strategies, it is important to be cognizant that:

- Managers are managers and need good data to make decisions. Both managers and crafts persons should acknowledge that the data collected by the craft can greatly impact the ability of a manager to make accurate decisions.
- It is not uncommon to work with stakeholders to overcome the common misunderstanding that there is not enough time to collect data.

Proactive facility management requires redefining industry practices and using tools and data as intended. This requires training and buy-in across all levels of the organization.

CHALLENGE #5: COST OF INTEGRATION

Although the use of automation to generate reports and perform analysis can reduce costs, the cost of integration to generate some reports can be high and the process is currently quite complex. Sectors of the building industry that have had protocols to support interoperable data exchange since the mid-1990s still struggle with truly interoperable systems. It can be difficult to make the business case for interoperability because there can be unforeseen challenges during the integration process, increasing the cost to meet interoperability goals.

RECOMMENDATION TO OVERCOME CHALLENGE #5

Although the integration of technologies is important, if funds are limited consider starting by integrating facility management processes. After the processes are integrated, then integrate technologies. For example, the Massachusetts Institute of Technology (MIT) developed a process to integrate their customer support center with the building operations center. Although each center has a different core function—work order management and management of the building automation systems (BAS), respectively—integrating them created efficiencies. The customer support center was able to communicate quickly with the building operations center to determine if the temperature problem could be resolved through a change to the BAS, or if it was necessary to generate a work order for a technician to resolve the problem in the field.

MOVING FORWARD

The challenges to reach the BIM FM vision include the reactive nature of facility management, underutilized software, the abundance of data, the need for cultural change and the cost of integration. Although these are significant challenges, this article has provided some high-level recommendations to set a starting point to move forward. Leaders are needed to help develop and implement standards, communicate the long-term value and quantify the payback and return on investment of using BIM for facility management. How will you help lead this effort?

Angela Lewis is a Facility Diagnostics Specialist at Facility Engineering Associates and a PhD Candidate at the University of Reading. She can be reached at angela.lewis@feapc.com. Jim Whittaker is President of Facility Engineering Associates, headquartered in Fairfax, Virginia.

A full list of references for this article is available upon request. Please email ssavory@matrixgroupinc.net.
AS ONE OF THE LARGEST BUILDING OWNERS IN THE nation, the U.S. General Services Administration (GSA) is defining and testing its road map for building information modeling (BIM) during facility management (FM). This innovation will enable GSA to leverage facility data throughout the life-cycle of its capital assets to provide safe, healthy, effective and efficient work environments for our client agencies. This article will discuss the business needs for BIM during FM from an owner’s perspective; the steps that GSA has taken to define, develop, validate and incorporate BIM during FM; lessons learned from several pilot projects; and an overview of GSA’s BIM Guide Series 08: Facility Management. Finally, we will discuss current and future steps, and what is needed from the industry and software vendors to fully realize the vision of BIM and facility management.

WHY BIM FOR FACILITY MANAGEMENT?

As BIM becomes increasingly more prevalent in the design and construction industry, building information data is creating an organized, accessible format, providing opportunities to further leverage this data during building operations. GSA intends to use and update facility management data throughout the facility life-cycle—through small projects, operations and maintenance (O&M), and major renovations and alterations. With an approximate annual operating cost of $940 million across GSA’s portfolio, the maintenance of this data will create greater efficiencies such as having accurate as-built information to reduce the cost and time required for renovations; increasing customer satisfaction; and optimizing the O&M of GSA building systems to reduce energy usage.

One major use case for GSA is the population of a computerized maintenance and management system (CMMS) at project turnover. When a CMMS is used at a GSA facility, the CMMS is manually populated with facility information created during the design, construction and commissioning phases. Using BIM, data required by a CMMS will be created either in the design and construction BIMs or in an external format such as the Construction Operations Building information exchange (COBie). At project turnover, this data will then be loaded into a CMMS. The BIM for facility management is to be linked to the CMMS, as well as other systems, for visual coordination of facility assets with O&M data.

Effective facility data maintenance enables more effective work processes at multiple levels of GSA and across business lines.

For GSA maintenance workers:
- Eliminating additional trips to the same location; and
- Faster response times to emergency work orders.

For GSA building operators:
- Reduces time creating equipment inventories from plans, specifications and submittals; and
- Optimizes building performance by comparing actual to predicted energy performance.

For GSA design and construction teams:
- Reduces costs of re-documenting “as-built” conditions and field surveys for building renovation projects; and
- Better commissioning.

For GSA portfolio and leadership:
- Provide portfolio-wide access to information across building types and locations; and
- Enable better prediction and visualization of future renovation budgets and schedules.

Visualization of systems in BIM can help facility managers understand where equipment is located.
IMPLEMENTATION REQUIREMENTS

In 2007, GSA began mandating spatial program BIM during concept design. Building on these efforts, GSA's as-built BIM requirements will remain vendor neutral and based on open standards. At a minimum, the as-built BIM must have object elements of the major architectural, structural and mechanical, electrical and plumbing (MEP) systems. In addition to 3D geometry, all equipment shall have the following information:

- A BIM object global unique identifier;
- A BIM object location; and
- An Asset Identification Number - Human interpretable naming convention.

Deliverables shall be in Industry Foundation Classes (IFC)/COBie and native file formats. Additional COBie attributes will be required based on each project situation. A BIM Toolkit will also be required for each project to manage expectations of the project team. Through this process, the team members and GSA project management shall jointly agree on how, when, why, to what level and for which project outcomes BIM will be used.

CHALLENGES TO MAINTAINING INFORMATION THROUGHOUT THE PROJECT LIFE-CYCLE

One of the greatest challenges to BIM and facility management is defining the necessary processes to maintain the building information. A typical GSA facility will go through many small projects and work orders before a major renovation. In order to keep the information accurate, we must ensure that data is created, maintained and stored in a consistent way. Toward this end, GSA is developing standard information exchanges and implementing a central facility repository to house BIM and other facility information.

Requiring standard information exchanges and naming conventions will allow consistent data to be delivered to GSA. In 2010, GSA continued to work with BIM software vendors to implement IFC-based information exchanges for spatial validation, circulation, and security and energy analysis. To date, only Beck Technology's DProfiler™ has completed these information exchange requirements. As additional software vendors implement these requirements, design teams will have the widest possible number of software choices to meet GSA's BIM requirements.

Another major component to using BIM effectively for facility management is the establishment of a centralized repository of facility data. The data may actually be stored in multiple, linked repositories but the data must serve as a centralized resource, available to all appropriate users. As part of this central repository, GSA is implementing a BIM server to house all BIMs and provide access across GSA project teams. Additional collaboration with industry, however, is required to fully develop these functionalities and workflows.

PILOT PROJECTS

GSA has initiated several pilot projects to investigate the implementation of BIM for facility management. The pilot projects helped to define the business need for BIM and FM and illustrate the different software tools and project work flows for implementing BIM for FM. Lessons learned from these pilot projects included:

- Getting buy-in early from the building manager was key to understanding the priority of data to be modeled in BIM. This allowed GSA to get only essential facility management data, while meeting budget requirements.
- A BIM execution plan helped to define who would be entering data and how it would be used.
- Mock-ups of the user interface helped building managers understand how they could benefit from the data.

CONCLUSION

Through collaboration with internal stakeholders, GSA project teams and industry experts, GSA expects to obtain high-quality BIMs for use in facility management. While full adoption of BIM within facility management will be incremental, GSA has laid the foundation for the vision, technical paths and business processes, as well as the minimum technical requirements.
The State of Wisconsin: BIM – Digital FM Handover Pilot Projects

By Keith Beck, PE

THE STATE OF WISCONSIN IS NEARING completion of a series of pilot projects to verify the data exchange methods between architects and engineering (AE), contractor’s building information modeling (BIM) models and facility management (FM) applications. These pilot projects were necessary to increase our comfort level with the technology and process of data transfers and helped us determine what data and formats the state should require in the updated AE BIM Guidelines, scheduled to be issued in summer 2012.

HISTORY

In July 2009, the state of Wisconsin issued guidelines to AE firms requiring the use of BIM on all projects totaling more than $5 million and new construction projects of more than $2.5 million. In August 2011, we continued our effort in the BIM arena by completing an FM Handover Research and Findings Report. It documented our current FM handover practices; researched the best practices of AE and construction firms; provided an overview of industry technology trends and directions; and recommended the next steps be data exchange pilot projects.

THE CHALLENGE

While the state had been receiving models for BIM projects, we had not been analyzing the content or measuring the level of detail included in the model. To fully benefit from the BIM technology and become comfortable with data exchanges for FM handover, we needed to process these models. This would allow us to fully understand what improvements were needed and to standardize what data should be included.

Extensive research was done studying effective methods to export the pertinent data from the BIM models into our FM software applications. The Construction Operations Building information exchange (COBie) means and methods are becoming popular. However, the COBie tools have only recently become available. As such, only newer project submittals could offer COBie formatting and results from a fully formatted COBie project would not be available until project completion through the design phase. That is a process that typically takes years.

We knew we wanted results in a shorter time frame, so we decided to forge ahead and use existing projects that had been submitted with BIM models. From those projects, we identified those with owner/agencies that were interested in testing data exchanges and found AE/contractors that were willing to work with us. Finding a project meeting all of those criteria proved to be the toughest challenge.

SUMMARY OF PROJECTS REVIEWED

Each project we reviewed was unique. The size varied from a small administration building to a complex laboratory. Some had little or no useful data to be exchanged with our FM systems. Some FM groups were not interested in experimenting with data exchanges. Eventually, we did succeed in finding a project with a BIM model that included a considerable amount of proper objects with attribute data.

COBIE VS. INDUSTRY FOUNDATION CLASSES EXPORTS

Due to the lack of projects with COBie formatting, the COBie methods of data exchange would not work for this exercise. Furthermore, when we inquired about COBie exports from the models, we found very few AE/contractor firms that understood what we were asking for. Hence, the only export format that was easily obtainable was the raw Industry Foundation Classes (IFC) export, a text-based flat file containing all of the objects in the model.

EXAMINING DATA FROM IFC EXPORTS

Since the IFC exports are flat files, the data was processed using database tools with the structure of the IFC2X3 object model. This process of sorting and parsing the data allowed us to retrieve the properties and relationships of objects of interest. The resulting datasets revealed spaces, areas, boundary objects, objects contained in the spaces, and equipment listings. Figure 1 shows the hierarchy, quantity and relationships of the objects found in the model.

The next step was to present these findings to the FM groups to see if this data could be used in their operations. To our surprise, contrary to a single FM handover process, the FM staff preferred individual datasets. This format allowed them to see the data piece-by-piece and be fully aware of what data was being imported and where it was going within their computerized maintenance and management system (CMMS). As expected, once they saw the datasets, they immediately recognized the time savings for their respective operations in the elimination of data entry. The process also sparked some creativity for staff as they found other uses for the data.

In a concurrent effort, we were now requiring electronic submittal of construction documentation, grouped by the
specification section and equipment tag number. As a result, we had an opportunity to utilize the abbreviated equipment records exported from the model. Since these objects did not contain many properties, these datasets will be imported as key records in the CMMS, providing a location for attaching the electronic construction files (shop drawings, cut sheets, operations and maintenance manuals, etc.) submitted upon completion of the project. This effort also reduces data entry time and allows easy electronic access to these critical documents. **Figure 2** shows the datasets and their intended use.

<table>
<thead>
<tr>
<th>Equipment Records Transferred</th>
<th>Tag ID</th>
<th>Location</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attached Files</td>
<td>Shop Drawings</td>
<td>Operators Manual</td>
<td>Construction Verification Sheets</td>
</tr>
</tbody>
</table>

**RESULTS**

The results of these pilot projects revealed that significant data can be obtained from the BIM models of a project. We found that even without a fully formatted model it was worth the time and effort to examine current models and leverage the technology currently available. Additionally, we have found that a substantial amount of data can be obtained from the model using the IFC export, and importing the resulting datasets into an FM application can easily be accomplished.

Exporting the data from the BIM model reduced our cost of a building startup by eliminating manual data entry of spaces and equipment.

Despite the lack of complete properties for the equipment objects, there is significant value to using these records to link to construction-related documents. Both of these efficiency improvements justified the time and effort invested in these pilot projects. Subsequently, the process of piloting these projects afforded a thorough understanding of the technical process involved and provided the input we needed to develop the requirements and guidelines for future projects.

On a larger scale, in reviewing the models, we found that the degree of detail varied significantly. We learned we need to standardize and specify a thorough level of detail to our consultants, including the structure and relationships of the objects in the models. Project startup templates will help standardize the collection of these details and ensure each submittal meets our requirements.

Our efforts to complete these pilot projects revealed that there exists a substantial learning curve at all stages and for all parties involved in BIM: our internal staff, the AE, the contractor and the FM groups. Nevertheless, through this piloting process, we have developed a good understanding of what is necessary to accomplish FM handover processes for the state of Wisconsin’s facility infrastructure.

Keith Beck, PE, is the state of Wisconsin’s BIM-FM Handover champion. He was responsible for the development of the state’s FM Handover Research and Findings Report, which documented the state’s current facility information handover practices; researched the best practices; provided an overview of industry technology trends and directions, and recommended the next steps be data exchange pilot projects.

### BIM/CAVE: Immersive BIM Reviewing System

By Julian Kang, PhD

**CAVE FOR BIM**

It is reasonable to anticipate that the building information model (BIM) projected in a CAVE would facilitate the project team members to better monitor clashes between building components, discuss the constructability issues and make proactive decisions to increase productivity in the course of construction.

The CAVE mentioned earlier used Silicon Graphic Inc.’s (SGI) Graphic Library to project the image of the surrounding objects on the walls, ceiling and floor. The polygons depicting the surrounding objects were coded along with other functions of the CAVE system, and compiled into a binary code. This meant that users needed to recompile the computer application used for the CAVE each time they wanted to browse a new model.

Another CAVE system, developed at Virginia Polytechnic Institute and State University (Virginia Tech), used the OpenGL Performer.pfb file format to store the polygon data. The OpenGL Performer is a C++ simulation and visualization graphics library written by SGI. These file formats are not compatible with the major 3D modeling applications used in the architecture, engineering and construction (AEC) industry. Although efforts were made...
to transform the 3D model, for example, a model produced by AutoDesk 3D Studio into the CAVE system (www.svvt.edu/classes/ ESM4714/cave/prgintro.html), the robust transfer of a 3D model and associated information into the CAVE system is often “non-trivial at best,” as noted by the research team in the Immersive Environments Laboratory (IEL) at Pennsylvania State University.

It is then reasonable to assume that the process of transforming the BIM data into the CAVE system could also take time. One can also assume that engineering data attached to the BIM could be lost while transformed into the CAVE system if the conversion process is focused on transforming geometry-related data. Lack of interoperability between major BIM applications and CAVE systems, therefore, could hinder professionals in the construction industry from best utilizing the CAVE system to review the BIMs.

**BIM/CAVE: DESIGN**

Can we mimic the function of the CAVE system using commercial BIM applications so that we can review the BIM in the CAVE without having to convert the BIM data into the CAVE system? The CAVE system developed on top of Autodesk Navisworks would facilitate the project team to review the BIM created using Autodesk Revit Architecture, for example, because users can easily convert the Revit file into Navisworks without losing associated information.

In fall 2011, a research team at Texas A&M University developed a BIM/CAVE system using three video walls connected to three personal computers. Each video wall consisted of four 46-inch ultra-thin bezel displays. The research team used Navisworks to project the viewer-centered images of the surrounding objects on the video walls. A plug-in application that controls the camera location and aiming angle in the model was developed using the Navisworks Application Programming Interface (API). The plug-in application was also designed to enforce the computers to exchange the camera location in the 3D model over the network (FIGURE 1).

![Figure 1. The BIM/CAVE system developed at Texas A&M University using Navisworks.](image)

Each computer was supposed to get the same Navisworks model loaded. The computer located in the center was designated as the master computer to communicate with the user for the camera location in the model. Two computers at each side of the master computer monitored the camera location in the master computer and placed its camera at the same location in the model. Therefore, three identical Navisworks models loaded in three computers ended up having their cameras placed at the same location in each model. The plug-in application then adjusted the camera’s aiming angle and field of view according to the angle between the video walls (FIGURE 2).

**BIM/CAVE: EVALUATION**

Six BIM specialists in the construction industry were invited to take a look at the BIM/CAVE system developed at Texas A&M University. One architect, one BIM manager and four project managers examined how the BIM/CAVE system displayed the BIM and how it was responding to the user’s request for relocating the camera position in the model. All participants agreed that the BIM/CAVE system provided an immersive environment, to some extent.

One of the participants noted that the BIM/CAVE system would help everyone understand what a facility would look like, which leads to better decisions up front. He said, “this is definitely useful. The more you see of the model at one time, the better grasp you get.”

Another participant said that three video walls was a big step towards full immersion. The BIM/CAVE system can also work with more than three video walls; a system with nine video walls, for example, can create a cylindrical room that would fully surround users with viewer-centered images of the surrounding objects.

Experiment participants also addressed some challenges that practitioners may have to deal with. BIM is effectively used for clash detection between the mechanical, electrical and plumbing (MEP) and other building components. It is therefore critically important to be able to look at the MEP system in the BIM/CAVE. Without the top screen showing the objects on the ceiling, the users have to tilt the view in the BIM/CAVE in order to look at the MEP. Also, although the BIM/CAVE system uses video walls consisting of flat screens, it may not be portable enough to be installed at the job site.

The research team at Texas A&M University is currently updating their BIM/CAVE system in order to gain more control for timeline animation and element visibility.

*Julian Kang, PhD, is an Associate Professor in the Department of Construction Science at Texas A&M University.*
Best Business Practices and ROI for Facility and Asset Management

By Igor Starkov

BUILDING INFORMATION MODELING (BIM) for facility management (FM), or “life-cycle BIM” as I prefer to call it, has been discussed within our industry extensively over the past year. Every major FM expo had a track about BIM and FM and there are several LinkedIn groups discussing issues relevant to life-cycle BIM. Most of the attention was given to the technical implementation, such as how to export Construction Operations Building information exchange (COBie) files from Autodesk Revit Architecture building design software. This is a simple task and advanced technology firms are solving these issues.

The bigger challenge of implementing BIM for life-cycle facility management is not related to technology but in convincing facility owners about the necessity of investing funds in making “BIM for FM” happen. We see a lot of interest in this topic but mostly from facility directors or chief engineers. However, they usually have difficulties proving financial benefits of the new processes and tools to their bosses and do not have much political power within their organizations to push for the significant investment that BIM for FM requires.

We’re not just talking about a better hand-over and COBie; we’re talking about a conversion of the whole capital assets inventory into a BIM-enabled environment (Figure 1). This may take a decade for some large owners and millions of dollars of investment. Those millions of dollars can be paid off quickly, as we usually show our prospective clients using return on investment (ROI) calculations, but it requires strong leadership from the owner organization’s management team, an educated workforce, the right set of tools, and, most important—the reengineering of business processes (the toughest part). So, why are most owners still reluctant to implement life-cycle BIM? In my opinion, this is mostly because the ROI calculations we demonstrate are based on assumptions and “soft data.”

Proof of the benefits using “hard data” is difficult to show because even an advanced owner organization, like the University of Southern California (USC) (see the cover story of the Spring 2009 issue of the Journal of Building Information Modeling), which started piloting the life-cycle BIM approach more than three years ago, is still in the learning process and does not have enough “hard data” for benefits analysis.

Those of you who “did BIM” five or six years ago (medieval times for the BIM world), remember that owners were asking to show them proof that clash detection would deliver ROI on their construction project. Fortunately for the construction managers, convincing owners’ representatives was easier; they were investing project money to gain benefits for the project. With life-cycle BIM, the challenge is that the investment is required during the project while the benefits and cost savings are delivered to the FM group. The capital projects and FM groups do not typically share the same budgets or executive leadership, and in some cases even compete with each other for funding.

Fortunately, some of the largest owners are demonstrating the ability to face the challenges of the unproven ROI. Some have started pilot projects researching how to implement better practices for delivering FM-focused BIM on new projects, renovations and even BIMing existing facilities.

I am involved in several projects of this sort, including deployment of a BIM-centric Central Facility Repository at USC; a project “Facility Information Model with Integrated BIM/CAFM/CMMS/BAS/GIS” for the Federal Aviation Administration (FAA); and the “Life-cycle BIM-based Energy Performance Assessment with Facilities Management” project for the GSA. These projects use different approaches to make life-cycle BIM happen.

THE UNIVERSITY OF SOUTHERN CALIFORNIA

As mentioned earlier, USC proceeded with the life-cycle BIM even though there was no “hard data” available. This is mostly because USC’s Facilities Management department chose a visionary approach, supported by the university’s administration. There is also a close relationship between the USC facility management group and the USC School of Architecture. Students here created BIMs for close to 50 buildings on the USC campus. Figure 2 shows a model for one of the buildings on the USC campus: a variable air volume (VAV) box is highlighted in 3D, while its properties are displayed on the right, the real-time sensors data is shown on the left and the work orders for this VAV box are shown in the lower left corner.

Here is USC’s vision: “We anticipate being able to travel through a virtual building model, with the ability to focus on its MEP+F systems, to visualize real-time conditions of an entire system. These models would be accessible in a simple, yet flexible interface, while being completely bi-directionally

Continued on Page 30

Figure 1. Converting all your capital asset inventory is possible. You can do it!
WE ALL KNOW THAT CAUSE MARKETING matters to consumers. The dictionary defines cause marketing (or cause-related marketing) as a type of marketing involving the cooperative efforts of a “for profit” business and a nonprofit organization, for mutual benefit. In simple terms, cause marketing is a partnership. It is a win-win situation for both the company and the nonprofit. A good example of this is the little pink ribbon that is associated with Susan G. Komen for the Cure®. Every time someone purchases a product with the ribbon on it, the Komen Foundation gets a percentage of the sale. This is cause-related marketing.

So, what does cause marketing have to do with the buildingSMART alliance™ (bSa)? Lots! If we can have personal causes, why not have professional ones, too. And really, what greater “cause” for our industry is there? The bSa is setting the standards for building information modeling (BIM) and is transforming our industry for the better! As BIM professionals, they need our support, and aligning our company goals with the bSa is one of the first steps to creating a win-win partnership for all.

Our clients are demanding change and BIM is their answer. By being socially responsible, your clients and consumers will take notice. In this new era of social responsibility, what you don’t do can cost you. Cause marketing is now the norm and your clients want to know that you share their desire to make the industry and BIM better. The challenge is to make your socially responsible efforts a winning proposition for the nonprofit group you support, the community, your clients and your business.

So, why make the bSa your “cause?”

1. **The bSa is a related cause to your industry.** The bSa is BIM for all people. The bSa doesn’t discriminate. Your clients will appreciate that you are looking at the betterment of BIM for all people; that you are truly trying to help them and their projects; and that you’re not just looking at your piece of the BIM pie.

2. **Your affiliation with the bSa will help your business increase its visibility with BIM and show your clients your commitment to BIM best practices.** The bSa will customize a partnership that works for you. Your financial support is important and so too is your participation in this organization. The bSa needs volunteers and good messengers who will promote the organization and its services.

3. **Cause marketing works best when you and your employees feel great about the help you’re providing to a nonprofit group.** Work with an organization you and your team believe in. Companies can no longer just talk the BIM talk; there must be specific and clear actions that show our clients that a change is in effect and that you support the change. Your support of the bSa does just that!

I am not asking for your BIM trade secrets but what I am asking today is that you make bSa your “cause.” Make a t-shirt, wear a ribbon—whatever works for you. Just be proud to support this great organization and tell others to do so as well.

To learn more about making the bSa your business “cause partner” or if you are interested in starting an interest group, contact Deke Smith at dsmith@nibs.org or (202) 289-7800.

Cindy Baldwin, CGC, CM-BIM, LEED AP, is Principal of Operations at ACAI Associates, Inc. She has been with ACAI since 2003 and has 20 years of diverse project experience.
WHERE AS MOST PREVIOUS EFFORTS TO “solve” interoperability problems targeted single or small sets of exchanges, the Precast Concrete National BIM Standard™ is an industry-wide effort. It encompasses most of the major building model exchanges dealing with precast concrete elements throughout their life-cycle, addressing a range of contract delivery methods with different up-front workflows. Its development was sponsored by the Precast/Prestressed Concrete Institute (PCI) and the Charles Pankow Foundation (CPF). This article reports on a demonstration conducted to showcase the functionality the software companies are developing in support of the standard.

DEMONSTRATION

On October 25, 2011, at the PCI Convention in Salt Lake City, Utah, initial exchanges based on the Precast Concrete National BIM Standard™ were demonstrated. Six precast concrete software systems participated: Vectorworks Architect, Structureworks, Structureworks Part Tracker, Tekla Structures, Scia Engineer and Nemetschek Precast Part Manager. Six exchanges were made between these applications, using Industry Foundation Classes (IFC). Two additional applications were used to visualize the data exchanged: Solibri Model Viewer and Nemetschek IFC Viewer. The exchanges are shown in FIGURE 1.

EXCHANGE ONE: ARCHITECTURAL MODEL TO STRUCTURAL ENGINEERING

An architectural design model of part of a precast utility building was created in Vectorworks Architect software (FIGURE 2 A). The brick-walled building had two storeys, each with two slab bays in addition to a cast-in-place slab on grade. The architectural model of the structure was extracted, as shown in FIGURE 2 B. It defined each slab as a monolithic container for the second floor and generic double-tee slabs as placeholders for the roof slab.

This architectural model was exported to the IFC in two different representation formats: B-rep and extruded geometry, each for different uses. B-rep is a simple face set representation useful for volume calculations and clash detection. However, more complicated tasks such as editing and parametric model elaboration require extruded geometry. Each IFC file exported was visualized in Solibri Model Viewer to verify the model information.

EXCHANGE TWO: STRUCTURAL ENGINEER TO ARCHITECT FOR REVIEW

The structural engineer imported the architect’s design model into Scia Engineer and designed the element’s structural function. During the import, the engineer controlled which entities from the complete IFC file were converted into native structural members in the Scia Engineer format. The engineer performed various structural analysis tasks such as checking shear and bending stresses (FIGURE 3).
Based on the analysis results, the structural members were modified for structural integrity. In this case, two corner columns were extended with short shear walls. The revised, structurally sound model was passed back to the architect by exporting it into IFC and importing it into Vectorworks.

**EXCHANGES 3 AND 4: DESIGN MODEL TO PRECAST DETAILING SYSTEM**

Traditionally, designers provide precast concrete fabricators with 2D contract documents from which the fabricator prepares assembly and shop drawings. After detailing, the fabrication drawings are passed back to the designers for review. The rework and time spent generating the same information in two different sets of applications can be considerably reduced or eliminated by providing interoperability between design applications and detailing packages.

In the BIM workflow, the architectural design model is passed to the precast fabricator, who adds detailed information about connections, finishes, joints, etc. The detailed precast model should include all discrete components, in contrast to the monolithic elements in the architectural design model. **FIGURE 4** shows the details of the individual hollow core and double tee planks that replace the monolithic slabs seen in **FIGURE 2**.

The IFC model was imported into two different precast detailing systems: Tekla and StructureWorks. Some rebuilding of the parametric structure of the precast pieces was required in order to convert them to editable native form. This was dealt with explicitly in StructureWorks (a SolidWorks add-on). Tekla uses an object converter that partially automates the conversion process. The detailed model helps the precast detailer to generate general arrangement models and shop drawings that can be guaranteed to be consistent with the design drawings and the bill of material.

The detailed model is passed back to the designers for design intent validation and structural review (excluded from this demonstration). Different precasters each have their own standard member dimensions. Hence, there might be changes in the thickness and width of the precast elements added to the model during the detailing. It is important for the structural engineer to review the load bearing capacity of these modified pieces and also the temporary erection loads.

**EXCHANGES 5 AND 6: PRECAST DETAILED MODEL TO MANAGEMENT**

There are different downstream uses for the detailed precast model, such as coordination and clash detection, plant and part management, fabrication and erection. In practice, the general contractor merges the various subcontractors’ models and checks spatial coordination between systems to avoid clashes before construction begins. At this time or earlier, the contractor determines the construction sequencing and schedule.

The detailed precast model is passed to the plant management system to coordinate the fabrication and delivery of the precast pieces with other components. Production sequencing is applied throughout these steps so pieces are produced in the order they will be erected. Two different part management systems were included in the demonstration: the StructureWorks Piece Tracker and the Nemetschek Precast Part Manager.

**SUMMARY**

This demonstration offered an important example of the potential of “open BIM”, showing a sequence of exchanges over a significant portion of the precast concrete workflow. While the project was small and simple, the demonstration showed the functionality that precast concrete software companies can provide to support smooth and effective workflows. It also showed, by example, how exchange interfaces can support on-the-fly adjustments of exchanges, regarding types of geometry, level of detail and properties.

Chuck Eastman, Manu Venugopal and Shiva Aram are with the Georgia Institute of Technology. Rafael Sacks is with Technion – Israel Institute of Technology.

The authors would like to thank the presenters for their strong support and help: Robert Anderson (Nemetschek Vectorworks), Mark Flamer (Nemetschek Scia), Mark Potter (StructureWorks), Alistair Wells (Tekla) and Dan Monaghan (Nemetschek Precast). Visit http://dcom.arch.gatech.edu/pcibim for more information about this ongoing project.
The UK Government’s BIM Strategy: COBie and Beyond

By Nicholas Nisbet

WE GAVE YOU TEA AND STRANGE spelling and now the United Kingdom (UK) is taking back the Construction Operations Building information exchange (COBie)! There was a long period where it seemed that the UK was unable to embrace BIM with the enthusiasm and success of our American cousins to the West and our Scandinavian cousins to our East. Suddenly, though, we are back in the game.

Of course we never left the pitch. Under different names, building information modeling (BIM) has had a distinguished history in the UK. In the late 1970s, the idea was pioneered that facilities might be better designed using computers. In those days, computers were too expensive to draft on, so instead we made them hold detailed 2D and 3D building representations, and let the drawings and schedules roll off over night.

But in the 1980s, cheap personal computers with graphical user interfaces turned our heads and management was let off the innovation hook. The main driver was that desks take less space than drawing boards.

We had an early wake-up call when BAA (formerly British Airport Authority) planned London Heathrow’s Terminal 5. The challenge came from several reviews of the construction industry including the Egan Report: Rethinking Construction, written by a past chairman of Jaguar Cars, Ltd. The industry pitched BIM to BAA. Instead, a hybrid system was built around a one-vendor format. The project did, however, introduce new levels of 2D and 3D discipline to the design and subcontractor supply chains. A small amount of government funding was put into an Avanti research initiative. This allowed the hard-won and hard-fought protocols to be disseminated and tested on other projects, including St. Helens Hospital, near Liverpool. That protocol is now enshrined in British Standard BS 1192:2007.

Meanwhile, buildingSMART UK and Ireland (buildingSMART UKI) continued to pitch to government that the next change would require more standards for interoperability. It was Central Government (Whitehall\textsuperscript{1}) thinking as an asset owner that suggested that there were gross inefficiencies in its procurement process. Reviews of both the construction policies and the green agenda pointed to the need for BIM. The industry was challenged to report back on the proposal that the “Government as a client can derive significant improvements in cost, value and carbon performance through the use of open sharable asset information.” The acronym BIM was deliberately excluded: the challenge was to show results, not to endorse a method.

Another government initiative ensured that all buildings and infrastructure, whether new or refurbished, should be captured and managed together to improve efficiency. The first pilot projects started in March 2012. These include a new prison and courthouses, building refurbishment and a major road construction. An earlier prison project reaching completion in 2012 is also being handed over using COBie.

In July 2011 the HMG Treasury accepted the industry’s proposals. Paul Morrell, the Government’s Chief Construction Advisor, has led an effective campaign to challenge the industry and, in the space of a few months, the editorial tone changed from “never” to “how”. The strategy requires the adoption of COBie as the universal language for all participants, both on the design/supply side and on the asset management side.

A number of ground-clearing initiatives were launched, covering education, training and the further development of BS 1192. Mark Bew, chairman of buildingSMART UKI, leads the industry response and is helping coordinate the work packages. One early success is that all the professional organizations working under the Construction Industry Council are agreeing on a common plan of works. This allows us to discuss the timing of the COBie data drops in clear terms. In January 2012, at the Queen’s New Year’s Honours, Bew was awarded the title of Member of the Most Excellent Order of the British Empire (MBE)—a clear sign of official endorsement.

In activities that parallel the National Institute of Building Sciences and the Specifiers’ Properties information exchange (SPIe) initiative, the UK National Building Specification is leading the industry by committing to sharing its property sets and offering a UK National BIM Library. This is creating a platform for manufacturers and designers to explore open standards-based product information, using both COBie and Industry Foundation Classes (IFC).

Of course, COBie is not the last word. By specifying the contractually required information deliverables, all the participants are free to “stick” to COBie or “double” and go for increasing levels of integrated BIM. Most lead designers and lead contractors in the UK are now redoubling their efforts to use BIM, knowing that having taken the step up to COBie, the rest may even be relatively straightforward. By 2016, the expectation is that these leaders will be collaborating to achieve federated BIM through non-proprietary formats such as IFC.

The collaboration between the United States and the United Kingdom is being cemented by a memorandum of understanding between the buildingSMART alliance™ and buildingSMART UKI. Judging by how much the sharing of ideas has already achieved, this should be very beneficial.

\begin{footnote}
\textsuperscript{1} “Whitehall” is frequently used as a figure of speech for overall British governmental administration.
\end{footnote}
data-integrated with all critical FM information systems. There will exist standards and processes (both industry wide and tailored for our facility), which will allow for seamless delivery of services and deliverables during the design and construction phases (the university adopted COBie in its latest BIM guidelines). This should be done for the goal of allowing our organization to completely monitor and operate a new (or recently remodeled) building, from the first day that it is turned over.”

THE FEDERAL AVIATION ADMINISTRATION

Another example comes from the Federal Aviation Administration (FAA), which is going through a significant transformation over the next decade; a switch from ground-based radar control to a global positioning system (GPS). As part of the “NextGen” transformation, FAA is evaluating a transition to BIM while continuing to support traditional 2D workflows. The FAA team is working on an agency-wide life-cycle BIM implementation plan and would like to take advantage of the many benefits BIM offers.

To address this business challenge, Lockheed Martin awarded a contract to EcoDomus to develop a proof-of-concept project that includes laser scanning an existing facility, conversion of PDF drawings and point clouds to BIM, and integrating BIM datasets with FM packages, GIS and the building automation system.

Demonstrating these systems working together, providing better analysis of building performance and helping improve efficiency of FM personnel will help the FAA in its upcoming transition to the new ways of doing business.

THE GSA

This magazine has an article about GSA’s objectives for BIM and facility management. My company is involved in several pilots for GSA and the most interesting is about comparing a BIM-based energy model (IFC to EnergyPlus) with actual data collected by the building management system to identify energy-related issues, while enabling engineers to utilize BIM for maintenance tasks, including access to BIM and all documents on Tablet PCs.

CONCLUSION

I’ll briefly state the obvious: government directives (for example, related to energy efficiency) or other regulatory requirements (for example, the Joint Commission on Accreditation of Healthcare Organizations for the healthcare industry) force organizations to adopt innovative techniques, including a transition to life-cycle BIM.

The examples we just reviewed have different approaches to proving the benefits or ROI for the life-cycle BIM: 1) a champion (a visionary) among the top facility management; 2) business necessity due to upcoming changes; and 3) regulatory requirements.

How you massage the “soft data” to prove your point is secondary. Picking one of those three (or coming up with more benefits), depends on a particular situation. But there is no doubt—life-cycle BIM is here to stay and sooner or later all building owners will adopt it.

Igor Starkov, Co-founder of EcoDomus, Inc., has 18 years of international business management experience, of which 10 years were dedicated to the construction software industry. EcoDomus solutions integrate BIM with FM software, with Building Automation Systems (BAS) and Geographic Information Systems (GIS) for the most complete analysis of building performance and maintenance.

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Figure 2. This image shows a model for one of the buildings on the USC campus.
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