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On the cover: Alexander Calder (1898 - 1976) Mobile created for the National Gallery of Art’s East Building of the National Gallery of Art. This magnificent mobile was the artist’s final major work of art. It is 76-feet long and weighs 920 pounds. Cover photography by Andrew M. Eschen. With permission, National Gallery of Art, Washington, DC.
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OVER THE PAST FEW years I have watched with pride as the buildingSMART alliance™ has grown from concept to reality. Its contributions to the positive growth of and improvements in the building industry are truly amazing, and it is most gratifying to see our industry’s associations, government and talented individuals work together to achieve advances none could have achieved individually.

This will be my last opportunity to address you, the readers of the JBIM, as NIBS president as I am retiring later this year. I am delighted to turn the reins over to my good friend and colleague Henry L. Green, Hon. AIA, who has been selected by the Institute’s Board of Directors as the next President and CEO of the National Institute of Building Sciences. I could not be more pleased with his selection and am confident that Henry will lead NIBS to the next level where it will help to achieve a new array of improvements to the building process and dramatic improvements in the performance of tomorrow’s buildings. I have known and worked with Henry for many years on NIBS’ programs and initiatives of BOCA, International and the International Code Council. He is well known to and highly respected by leaders of the building community and by the NIBS staff. He is an innovative and thoughtful leader with the background, talent and knowledge to reach out to and work with all sectors to help improve our vast industry. As a past NIBS Board chairman and chairman of NIBS’ Building Seismic Safety Council he well understands NIBS’ and its programs.

Since 1989, Henry has been the executive director of the Michigan Bureau of Construction Codes. In that position, he has provided executive management and oversight for construction codes programs in the State of Michigan including the development and implementation of construction codes and standards, building inspection programs, and public education programs. As a volunteer, Henry has served as the president of the International Code Council (ICC) and president of one of ICC’s legacy organizations, the Building Officials and Code Administrators, International. His contributions and accomplishments have been widely recognized by numerous awards and honors from a host of building industry organizations.

Ron Skaggs, FAIA, chairman emeritus of HKS Architects and the chairman of the NIBS Board noted, “I am delighted that our search for the new president and CEO of NIBS has concluded so successfully. Under the long-term leadership of David Harris, FAIA, the Institute has flourished in numerous areas of design and construction and he has been a strong advocate for integrating the rational use of information technology into the building industry. I am confident our incoming president and CEO, Henry Green will build on this solid foundation. Through his longstanding background in the building industry, his in-depth knowledge of NIBS and his previous participation in the buildingSMART alliance™ Task Force and other NIBS programs, Henry brings the ideal combination of skills to take us to the next level. We all offer David our best wishes in his well deserved retirement and we welcome Henry in his new role as a key part of an organization that he knows so well.

In this critical time for the facilities industry I urge each of you to join in the effort to transform our 100 year-old linear and repetitive paper-based building process into one that wisely and efficiently utilizes information and data to virtually design, construct, operate and maintain new and existing buildings with less waste and more efficient use of human and other resources. You can help to achieve this transformation by getting involved. You are critical to the success of these essential advances for the future of our industry. So, if you have not done so already join with your US and international colleagues today by becoming a member of the buildingSMART alliance™. You will be in very good company!

David A. Harris, FAIA
President
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The third edition of the Journal of Building Information Modeling (JBIM) marks the beginning of our second year as the buildingSMART alliance™. The Alliance is presented with many new and intriguing opportunities to help the facilities industry transform to an improved way of doing business. For example, we had over 30 abstract submissions for this edition of the magazine, which would be enough material to take us at least into 2010. Since a lot of the material is time sensitive, we are developing new ways to get this information out to you our reader faster by integrating the magazine with the buildingSMART alliance™ web site. Watch for a new section under the News and Events section on the web site coming soon.

This issue covers a wide range of subjects not well covered elsewhere in the media. Starting with the Coast Guards approach of linking facilities to mission. Almost everyone has a mission, but rarely do we demonstrate a direct link to the facilities needed to support it. Another article includes more about the SMART Codes effort of the International Code Council. In our effort to expose, the later parts of the life cycle to the opportunities available we have an article about Emergency Operations Centers use of BIM. We are continuing our approach of a broad range of levels, in each edition of JBIM we will have articles from each of the following departments: Cover Story, Expanding thought. Critical need or New capability; BIM Case Studies / Best Business Practices; Economics / ROI; Lifecycle/Technology Spotlight; Training and Education; and Local Interest Groups.

I can also report that the strength of the Alliance continues to build. Our membership continues to expand rapidly and we are providing more opportunities for people to get involved with projects.

Interoperability continues to be in the forefront of recognized issues to help reduce some of the waste in our industry; however, all agree we still have a long ways to go on this important subject. We continue to believe that IFCs will play a significant role in the long-term solution to the issue although each step to make the practitioners life easier is appreciated.

Probably the best example of demonstrated ifc based interoperability as well as the overall breadth of scope of what the buildingSMART alliance™ focused on is BIMStorm™. There have been several examples of worldwide mass collaboration to date with several more planned. Each one has a different focus with some large citywide master planning efforts and others focused on just one structure. The basic concept is a “charette on steroids” and uses many open standard products.

Construction Operations Building Information Continued on page 12.
Exchange (COBIE) which provides a view of the depth of scope of our efforts had a very positive showing before some 200 participants at the prestigious National Academy of Sciences auditorium in late July. The presentations involved many of the major vendors demonstrating how they implement the COBIE format. This demonstration helped move its acceptance as an emerging standard just that much further along the path. COBIE is important, as it is also one of the few projects that demonstrate information flowing through the facility lifecycle. Information is initiated during design, collects additional information during construction, with the intent on delivering it to the operator and sustainer of the facility.

We are looking forward to the buildingSMART alliance™ National Conference running from December 8-11, 2008 at the Washington Convention Center, Washington, DC. The first day will be set aside for meetings, the second day to seminars, and the third and fourth days for education sessions and exhibits. One of the highlights on Thursday will be the buildingSMART alliance™ keynote address by Ambassador Richard Swett, FAIA the only architect to be a congressional representative in the 20th century. His insight on issues facing our industry and its transformation must not be missed. I hope to have a chance to talk with many of our members and readers at the conference.

Education continues to be one of the primary focus areas of the Alliance because it is fundamental to our future. A baseline survey was launched in the early summer to identify where various architecture, engineering, building construction and facility management colleges and universities stand at this point in relationship to their programs teaching BIM courses. The results will be analyzed in mid fall and presented at the buildingSMART alliance™ National Conference in December. In fact, we have initiated an entire thread of the conference related to education. We will highlight some of the best examples to date in schools challenged to educate our future practitioners. This is proving to turn out to be a significant challenge for already strained curriculums. The conference will give many of educators a chance to interact with other and with practitioners to exchange ideas and approaches.

There will be an additional thread oriented toward those who are just getting started with BIM, another towards those currently implementing BIM while yet another is focused on the technical details of ifc’s, IDM, MVD and the IFD Library. Many decisions are based on cost, and Building Information Models are very well suited to help improve our understanding of the cost of a facility because of the integrated nature of the model. Several cost-engineering organizations have begun focusing on integrating cost into BIM this year and we will report on their findings as they become available. We are now beginning to look well past the initial QTO efforts. We want to also implement the feedback loops so necessary for process improvement for all analysis tools.

Involving our members in projects at multiple levels is critical to the long-term success of the Alliance and the projects area on the web site is beginning to expand to identify all the various organizations involved in BIM efforts. A goal of this effort is to help people understand all the efforts that are underway so that coordination will occur prior to decisions being made instead of having to harmonize efforts after the fact, which is always, more difficult. We hope to take many of these on to be included in future versions of the National BIM Standard.

It is my hope that these efforts plus the magazine and web site will help you understand our role in the industry and that you will want to become involved to the greatest extent possible. We need your help as a sponsor so that we can accelerate our efforts, but even your involvement as an individual member will help demonstrate that you and collectively we are serious about transformation. I hope you enjoy the magazine.

Dana K. Smith, FAIA
Executive Director
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**Building Explorer**
A very big step has been in the works since early this Spring as the NBIMS Committee moves from being an organizational committee into one capable of managing the process of receiving, processing, publishing, maintaining and governing a consensus standard for the building industry.

TWO STEPS FORWARD AND one step back; isn’t that how progress works? In the case of the NBIMS Committee over the last few months it is more like three or four steps forward and one, well, ‘paused’ while some groundwork is being laid.

For some time now we have planned on offering a capability, in the form of an interactive web-based tool so that the community of interest could search for and/or define new information exchange requirements. It turns out that, in order to offer this tool, additional detail is needed—which brings us to both the only pause and the first step forward. Several working groups have been formed and are actively working to research and revise the OmniClass™ tables so that a consistent and sufficiently large vocabulary is available to describe the people, places, things and processes that are fundamental to information exchange requirements. Updating these tables will be immediately useful to the building industry and will also give NBIM Standard specifications an enhanced foundation.

Another big step forward is that, perhaps by the time you read this, the National BIM Standard Committee, the National CAD Standards Committee and the buildingSMARTalliance™, have been operating under parallel but separate governance within the National Institute of Building Sciences (NIBS) will be merged under the buildingSMARTalliance™ organization. The history is interesting but the important point to most in the industry is that this managerial change will consolidate the Outreach and Community Adoption, Standards Specification and Consensus, and the Interoperability Projects activities already in full swing and growing monthly. The result will be a well-defined ‘front door’ and a consolidated core for industry transformation information, interoperability projects, and consensus standards activities.

How will it work? In general, the Alliance Board of Direction will govern the overall operations while the NCS management and operations will continue to function as before and the NBIM Standard organization will transform into its planned operational structure. (More about that in a moment.) Perhaps the most obvious challenge is that membership requirements, including dues and availability of products, have been handled differently in each of these organizations. The opportunity going forward is to adopt business and funding models that continue to provide coordination, promotion, information and access to finished products through open publication models for no or lowest possible cost while linking paid membership, sponsorship and sales of publications to direct services and enhanced member activities.

A very big step has been in the works since early this Spring as the NBIMS Committee moves from being an organizational committee into one capable of managing the process of receiving, processing, publishing, maintaining and governing a consensus standard for the building industry. In February the Executive Committee, following the principles and goals published in NBIMS Version 1 – Part 1, initiated a remodeling that will be consistent with NIBS and ASTM recommendations for implementing and managing consensus standards and with operating consensus standards organizations such as the OmniClass™ Development Committee and the Open Geospatial Consortium.

NBIMS Version 1 – Part 2 is anticipated to contain the operational and policy details of the NBIMS Specification Program including, for example, how projects (several of which are already in progress) will be asked to submit work products for consensus standardization, the management and operational staffing and committee structures, policy and procedures associated with review and consensus balloting, relationships to international Standards organizations whose normative standards are use by NBIMS and to which NBIMS expects to contribute, and many other governance and operational issues. NBIMS also anticipates that the Part 2 document, a draft of which is targeted for December 2008, will include some information on the first candidates to be submitted to the consensus process.

JBIIM this month is full of exciting project case studies illustrating that beneficial industry transformation is well underway and will likely never return to its former ways. But the final character of the industry remains malleable and, as consumers, we must continue to encourage and then reward owners who fund projects and adopt and require use of open and interoperable exchange standards as well as vendors who dedicate increasing portions of their R&D budgets to advance the development and implementation of open and interoperable solutions.

As always I am gratified by the steady stream of new Committee members each month. For those of you that haven’t joined the buildingSMARTalliance™ as well as the NBIMS and/or NCS Committees I strongly encourage you to do so as individuals—and then lobby your company to join as well. In the next few months, we will be pushing more information on the NBIMS transition to operations out to the Community via the websites, listserv, JBIIM and conference presentations. On behalf of the Executive Committee I thank you for your continued participation.

Thank you.

Alan Edgar, Assoc. AIA
Chair,
National BIM Standard Executive Committee
ALEXANDER CALDER’S MOBILES ARE useful symbols for balancing the elements of an organization as fundamental changes within the industry and missions/business structures impact an organization.

As a trained engineer Calder had the understanding of balance and equilibrium needed to experiment, fail and succeed in his work. His work is a physical metaphor for maintaining equilibrium when the winds of change blow. As with Calder’s mobile an organization implementing BIM must maintain a balanced relationship between:
1. Business process improvements;
2. Enabling technology; and
3. Organization/cultural.

A BIM storm is blowing. BIM technology will impact the equilibrium of your organization no matter what role it plays in the building industry. The size of your organization does not matter—it will experience transformation, disruption, and rebellion. For instance, it is not uncommon for technology initiatives to fail because of user resistance related to culture. “That’s not how we do things around here” is not an uncommon phrase for JBIM readers.

Unanticipated change and unintended consequences will occur over time within any organization. Touch one organizational element and the others begin to spin in multiple directions. It is nearly impossible to introduce change in one element without impact on the others. Over time and unattended the response to change can become points of failure and disruption (out of balance) or opportunities to innovate and transform.

Since 1997 the U.S. Coast Guard has faced many challenges. The organization has experienced national crisis and disruptive change while implementing BIM pilots. Understanding the three key elements of organizational change and finding solutions to inevitable problems experienced by the Coast Guard did not happen immediately. As a result not all pilots have become universally accepted. Some innovations have been accepted by early adopters and enlightened local leadership; while other innovations have been resisted by local users and status quo leadership. Thus a seamless workflow and a truly integrated system has yet to be realized. More will need to be accomplished in order to streamline these components into an enterprise BIM system implemented across the organization.

The experiences of the US Coast Guard as an owner organization implementing BIM and the changes that were turned to opportunities can help anyone manage an implementation of BIM. It starts with a balanced design supporting the overall goals of the organization and uses technology enablers, information, and flexibility to maintain organizational equilibrium.

VISION, REVISION, VISION AGAIN

When preparing to implement a dramatically transformative technology such as BIM, it is important to have full support from executive leadership who convey a clear vision, yet develop a flexible and dynamic strategy to enable that vision.

Coast Guard Commandant Admiral Thad Allen commissioned a strategic facility management study as a Rear Admiral in charge of Coast Guard resources in 1997. The resulting Shore Facility Capital Asset Management (SFCAM) Study, initiated the direct link between facilities and strategic Coast Guard mission success. This was the business driver that eventually blew BIM into the Coast Guard. It was the baseline to the follow-on SFCAM Strategic Initiative, that then lead to the SFCAM Roadmap. The initiative described “what” and the roadmap described both “how”, “when” and “why” BIM and other technologies and collaborative processes needed to be implemented.

The study pointed out how professional engineers needed to transform shore facility support from a decentralized, locally controlled traditional facility engineering organization, to a single chain of command operation. This allowed comprehensive coordination of a capital asset management organization with a $7.5 billion portfolio supporting agency-wide strategic outcomes. The transformational need then resulted in a new vision that has guided our shore support organizational change efforts.

At the same time and prior to 9/11, Rear Admiral Allen had a larger Coast Guard-wide vision he called “Systems-of-Systems.” It included systems engineering approaches to mission execution. The result was better integration of mission, operations, and logistics with interoperable C4ISR (Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance) systems. SFCAM became a separate, but integrated, “mini mobile” suspended from part of the larger Coast Guard mobile.

While few people understood what it would take to achieve the goals stated in the study, Admiral Allen said, “David, don’t worry, it will take 10 years to achieve these initiatives.”

This year Admiral Allen presented to Congress a plan that reorganizes the Coast Guard’s major components to consolidate operations, unify operational command and control, and places new emphasis on readiness and doctrine that has direct impact on facilities management. “I’m trying to change the culture and structure of the Coast Guard to make it a change-centric organization that’s more capable of sensing the external environment and very subtle changes in demand
signals from our constituencies,” Admiral Allen said in an interview published in Proceedings, U.S. Naval Institute, Aug 2008. The resulting Coast Guard restructuring request currently before Congress is considered one of the most comprehensive change management plans under federal review.

FLEXIBLE FRAMEWORK, FLEXIBLE PEOPLE

In 2000, the strategic initiative resulted in an overarching facilities plan called “The Framework for Integrated Decision-Making” or “the Framework”.

The Framework established the principle that business processes come before technology and must be well-defined. Then information technology systems and core competencies can improve to enable mission support and determine the most important missions. BIM and related technologies supplied visual decision support, aggregated and related data, metrics and simulation that would support the Framework for integrated decisions. At a project level this use of BIM was collaborative.

The most effective level of support is given when 1) facilities are directly linked to mission outcomes, 2) daily tactical activities are directly linked to overall Coast Guard strategic outcomes, and 3) integrated horizontally managed workflows cut across vertical organization stove pipes.

These three flexible goals are supported by 1) interoperable and open systems, 2) normalized enterprise data bases with detailed metadata, and 3) incorporation of national and international industry standards and taxonomic classification schema. The Framework is fact-based; repeatable; verifiable; and auditable. Business cases are risk adjusted and reflect a total mission cost of ownership, across the full life cycle.

The Framework is composed of five components:

1. National, Departmental and Agency strategic plans;
2. A Strengths, Weaknesses, Opportunities, and Threats (SWOT) Assessment;
3. A Gap Analysis to compare the operational requirements (demand) to logistical capabilities (supply);
4. A Business Case Analysis; and
5. Tactical Execution and Performance Based Management.

The first and last steps are bridges to traditional strategic assessments and funding execution efforts, respectively. The three middle steps represent the body of the integrated decision-making efforts. The SWOT Assessment is applied to four separate, yet integrated assessments to include: Public Demand/Mission Assessments; and Operational/Logistical Assessments. The framework allowed a level of integration and decision support that some felt unnecessary, but the Framework helped the Coast Guard proof of concept pilots dramatically shift mission and vision after the events of 9/11. Understanding the real outcome of an activity is central to understanding BIM implementation.

The SFCA vision and mission incorporated flexibility, therefore the changing post 9/11 requirements were accommodated through process integration, systems interoperability, and a focus on executing a changing mission quickly.

PROOF OF CONCEPT PILOTS

The Charleston Regional Strategic Plan (RSP) served as the first Framework prototype starting in 2002. The project was divided into 86 sub-component tasks addressed by internal post-graduate level change agents and forward thinking private consultants that included Change Management professionals BK Simerson and Michael Venn of Tradewinds Consulting, LLC. BIM, new business processes, and flexibility were the culture of the team. How activities were accomplished and what was possible with information allowed the team to collaborate early and integrate expertise and information through the Framework.

The Charleston RSP Framework prototype project was a near total success. The entire prototype objectives were accomplished including for the first time: Research on 15 key industry trends and metric data about them at the international, national, and regional levels; comparison of industry trend data with 11 Coast Guard mission areas (legal authorities) and local operational data to produce the first ever estimate of current an future demand for Coast Guard services in the Group Charleston area of responsibility. Development of The Charleston RSP Framework prototype pilot project was a near total success. It demonstrated that the Framework could be used to link facilities to strategic outcomes using the fact-based SWOT process; develop viable business case alternatives from the CONOP and CONLOG developed in the SWOT process; and gain local command buy-in for the process and the solutions generated. The effort also produced a complete web-based RSP planning document.

Along the way the prototype process generated the need for and described 13 facility assessments. Four of these assessments (MDI, FCI, SUI, and operating expenses) have been integrated into the Federal Real Property Council and the Office of Management and Budget directives in association with Executive Order 13327.

However, this prototype pilot was not completely successful: The regional engineering service unit did not act on the finished plan and therefore the Charleston RSP has not been formally adopted. This failure can be traced to cultural and senior leadership resistance within the servicing unit to new methodologies; associated workflow changes; and technological innovation.

FLEXIBILITY AND ACCESS TO INFORMATION = INNOVATION

During the Charleston prototype pilot project, port security operations associated with the 2003 Operation Iraqi Freedom blocked access of the planning team to Coast Guard installations. Continued on page 20.

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GSA BIM Guide

For all major projects (prospectus-level) receiving design funding in Fiscal Year 2007 and beyond, GSA requires spatial program BIMs be the minimum requirements for submission to OCA for Final Concept approvals by the PBS Commissioner and the Chief Architect. This initial phase worked with major BIM vendors to help test that the BIM software is in alignment with the BIM standards defined by GSA.


AEC Industry

*US Coast Guard mentioned

US Coast Guard
Continued from page 20.

However, because Building Information Models of all the facilities had already been created by Dianne Davis and her team from AEC Infosystems, Inc; a security assessment and analysis of Anti-Terrorist and Force Protection (AT/FP) was conducted without having to access the installations.

Ian Thompson of Standing Stone Consulting, Inc. was able to use BIMs that included operational and organizational data as well as architectural and geospatial data to complete 80 percent of required CPTED-RED security analysis of the facilities and the overall installation without ever entering the Charleston base. Enough security analysis was conducted virtually to move forward on critical parts of the security pilot project in ways that would not have been possible without BIM and the new approach to facilities.

The BIM models were used for line of sight, measuring set-backs, and developing architectural solutions in real time for some issues. The time to insight and decision was significantly reduced and the quality of information supporting complex issues was improved.

The security analysis exercise is also an excellent example of collecting data once and repurposing it for many intended and unintended uses. “Collect once, use often,” is a data strategy that increases productivity in surprisingly positive and measurable ways. Readiness capabilities in Charleston after 9/11 were tested and verified in ways that had no comparative example with other government projects.

By April 2005 Paul Harold and his team at the Coast Guard Civil Engineering Technology Center had integrated Google Earth™ imagery with existing Coast Guard shore infrastructure databases using KML and API software coding to place Coast Guard information on the 3D maps of the world. This was also integrated into the enterprise-wide Capital Asset Management Portal (CAMP).

For the first time, shore infrastructure data, images, drawings, and documents could be related to a 3D-geographic point on the earth and shared by users without any special GIS software or skills. In fact, Coast Guard pilots began using the site imagery to plan their flights to Coast Guard units. This led air station personnel using the site to mine data about their own specific facilities and relate it to their operational requirements and performance. BIM models of piers were e-mailed to cutters in preparation to docking.

Another example of unintended use of existing data occurred during and immediately after hurricane Katrina in September 2005. While Vice Admiral Allen stepped in to lead the overall recovery efforts, Coast Guard engineering personnel used the site to view almost real-time updates of damage reports and recovery efforts related to Coast Guard installations that were caught in harm’s way. Investigation of commercial market products revealed the importance of object technology and geographic information systems. Following 9/11, the importance of having building objects communicate with geospatial systems increased significantly in importance to mission execution success.

**35 SECTOR COMMAND DESIGN PILOTS**

Unforeseen re-uses of BIM information requires not only imagination and the understanding of business cases, but how cultural changes can be immediate when impacted by unforeseen changes in situation. This combination of environmental change, operational needs, accessibility to trusted and re-usable BIM data and flexible and imaginative teams produce true innovation.

Another direct result from 9/11 was a requirement to create 35 Coast Guard Sector Commands by combining marine safety and operations units at our ports across the country. Each port required a new Sector Command Center for which no requirements existed. In Feb 2005 the first version of the Sector Command Center Parametric Planning Tool software was delivered to the Coast Guard by Kimon Onuma and his team of ONUMA, Inc. The innovative visual
relational database software was used to rapidly define the project parameters, originate the project program requirements, and create design development options.

In less than 45 days, a team of internal staff and expert consultants developed and tested new BIM tools and processes. The team then implemented the tools and processes to create schematic designs of all 35 Sector Command Centers in 4 months.

It would have required a combined 350 months if previous methods were used. This award-winning Sector Command Center project featured use of first-of-a-kind, web-based BIM relational database software planning tools from ONUMA, Inc. with collaboration from AEC Infosystems, Inc.

Immediately following the Sector Command Center project was the Off Cycle Crew Support Unit (OCCSU) Planning Project that was greatly assisted with a customized version of the Sector Command Center Parametric Planning Tool. This version of the parametric planning tool proved as successful as the Sector Command Center Parametric Planning Tool. Both tools are still up and running as enterprise systems run over the CAMP portal.

FINDING PARTNERS—SHARING KNOWLEDGE

SFCAM Roadmap pilots were driven by operational need. The Coast Guard is an owner-operator responsible for the entire life cycle of facility assets. At least 85 percent of the total life cycle costs of the shore plant accrue during the operation and maintenance phases. Planning, design, and construction only account for 10-15 percent of total life cycle costs. BIM-Based Facility Assessments at several locations mapped the processes for efficient data collection and level of BIM detail. The right BIM information resulted in the Coast Guard’s portfolio of more than 8,000 buildings totaling 33 million square feet to be modeled at a low level of geometric detail but with a high level of information; and 15 percent of the portfolio modeled at a high level of detail. The assessments pilot combined the creation of data rich BIM models as part of an overall facility inventory and assessment process led by CDR Jack Dempsey and his team at Civil Engineering Unit Oakland.

Initial research into improving centrally managed enterprise facilities processes with advanced technology revealed the need for extensive taxonomic classification systems; adherence to national and international open standards; data/metadata normalization/harmonization; open data sharing, and the abandonment of proprietary systems - all issues familiar to readers of JBIM.

Early investigations for existing information about advanced technology applied to facilities management led to involvement with National Institute of Building Sciences; the Construction Specification Institute; the Open Geospatial Consortium; the American Institute of Architects; The Open Standards Consortium for Real Estate; and membership in the Federal Facilities Council, the buildingSMART alliance; and buildingSMART International where the Coast Guard remains an active member.

BALANCING ACT II, III…

In a short period of time great challenges impacting the industry, nation and the US Coast Guard forced new business processes and mission requirements. Continuous planning became necessary and possible because of BIM implementation. Why BIM was developed was facility management related, how the models became useful and will be dependent upon the flexibility and cultural changes in the organization.

9/11, sustainability, environmental and security needs required change. BIM technology and processes enable a positive response to change. The complex balancing act the Coast Guard shore support is conducting within the larger Coast Guard framework has produced much innovation, much resistance, and much insight. SFCAM is a “mini mobile” in balance with the larger change management “mobile” created by Admiral Allen.

As you read these words the Coast Guard is poised to implement its most dramatic restructuring since World War II. Change is naturally resisted unless there is a motivating circumstance or cultural change that helps overcome the resistance. These examples provide a simple overview of the complex balancing act the Coast Guard shore infrastructure professionals have managed over time and the enabling role that BIM technology will play in the Coast Guard of tomorrow. This balancing act will take a strong vision expanded by the successes and failures we have experienced; full support from enlightened leadership; and a flexible strategy rather than a rigid strategic plan. These are essential for any organization or business facing change today.

David M. Hammond, RLA, ASLA, APA is a Senior Program Manager for the Coast Guard’s Office of Civil Engineering. He is an internationally recognized expert and thought-leader within the AECOO industry with regard to organizational change management; process reengineering; integrated decision-making; and performance-based asset management.

James Watson and William Faesenmeier of MACTEC also contributed to the BIM-Based Assessment pilots.
ABSTRACT

The International Code Council’s SMARTcodes project team is building a platform to support automated code checking of building plans for compliance with the International Code Council’s model codes. To date, the Code Council debuted an auto code checking demonstration of the 2006 International Energy Conservation Code (IECC) SMARTcode, and is working on the egress and accessibility provisions of the International Building Code.

INTRODUCTION

Building regulations have existed for centuries. In recent years, new and existing structures have had to respond to population growth; address issues such as energy, the environment and enhanced public safety; and foster application of new technology. In parallel, building regulations (codes, standards, rules and other criteria) that guide their design, construction, commissioning, operation and use, as well as the processes to apply and verify compliance with those criteria, have also needed to respond. The evolution of information technology, which has been comparatively rapid in a short period of time, is helping to provide a solution to such challenges. The availability of building information modeling, e-permitting and other new information technology (IT) makes it possible to complete existing processes in less time and affords the opportunity to develop and apply new processes, such as software-generated, automated code checking.

PURPOSE

The purpose of this article is to provide an overview of building regulations and new IT that is relevant to their application.

EXPECTED OUTCOME

The expected outcome is to show how the building regulatory process can change in the future, based on the availability of new IT and a building information model (BIM).

OVERVIEW OF THE BUILDING REGULATORY PROCESS

Once adopted, there are varying processes employed to implement and administer the building regulations. In most cases, this involves a design firm preparing plans and specifications, which are then submitted with a permit application to the applicable agency or agencies by the owner/developer or their representative. Once approved, the agency issues a permit and construction begins up to the point covered by the permit. If subsequent submissions of and modifications to the plans and specifications are made, the applicable agency or agencies would provide further review and approval of the new information. This process is enjoying significant application of IT for communications and information transmission.

CODE CHECKING TODAY

Currently, the majority of building departments conduct plan reviews manually because building designs are submitted by hand on paper or electronically in 2D. Similarly, designers and builders rely on hard or “plastic” versions of the building regulations to ensure projects comply with applicable requirements. All of the effort to verify compliance is based on human intervention, with the exception of some specialty programs that can process hand-entered data and provide an assessment of compliance for certain aspects of the building that must be read and interpreted by hand. In most cases, the process established by the applicable agency may vary based on a number of factors, most notably the size and complexity of the project. In some cases, owners or their agents will hire expediter to channel a project through the process and agencies may offer an expedited process as an option. In many such cases, additional manpower and expense are involved, something an owner/developer may count as cost effective when they consider the return on investment (ROI) on the project if the timeframe from inception to occupancy can be shortened.

IDENTIFICATION OF INFORMATION EXCHANGES

Throughout this process there are a number of information exchanges. The required information is obtained from the building regulations which, in the past, was
Where the building regulatory requirements are available in a format that software can understand and apply as a limiting rule set, then software can undertake the task of evaluating the BIM for conformance with building regulations. Automated code checking by software using SMARTcodes is one approach to putting building regulations and related content in a format that software can understand and apply to identify “clashes” between the information in the BIM and regulations. In simple terms, data are provided once, software acts on those data, and, in terms of a final outcome on regulatory compliance, if the results are positively reviewed, the plans can be approved.

**BENEFITS FROM AUTO CODE CHECKING**

In creating BIMs, designers can begin to automate a process of determining if the plans and specifications (building data) are complete and conform to building regulations. The personnel who currently handle that task can augment their efforts with software and be confident their submittal is complete and complies, and if the submittal is changed at any time, can be quickly rechecked. Imagine then submitting a BIM to the applicable building regulatory agency with a software-verified auto code check report that one is certain complies with the codes, who then applies the same software in conducting plan review and/or uses the report. Instead of waiting weeks or months for plan approval it is feasible to secure approval in a matter of days.

This expediting, which normally would require additional manpower and consequent expense is all handled by software. Think of the time, money and resources that could be saved by designers, contractors and code officials. More significantly, consider the economic value provided to owners and developers, who can go from plan submittal to a certificate of occupancy sooner, as well as more timely tax revenue received by local government.

Most importantly, the likelihood is that such plan reviews would be more thorough and save building departments manpower resources in plan review. Those gains could be applied to field inspections and ensuring that buildings constructed and occupied comply with the adopted criteria, with the end result being enhanced public safety. An added benefit is the resulting as-built BIM that would be accessible to fire, EMT, police and other officials in addressing natural and man-made disasters.

**E-PERMITTING**

As part of e-government initiatives, e-permitting has the potential to streamline and speed up the current permitting process. Dovetailing with automated code checking efforts, e-permitting would also allow for easier information sharing across agencies and departments, and more convenient access to permit status updates for the permit seeker. Upload the BIM to a server, let software do the checking and use the e-government portal for a virtual review session with the regulators prior to and during construction.

**THE FUTURE**

Instead of the potentially frustrating, time-consuming, paper-based process currently in place, BIM and IT hold the promise for change. The day of creating a BIM, getting instant feedback on regulatory compliance, e-submitting the BIM and receiving a plan approval and permit without ever leaving the office is coming. What can each one of us do over the next few years to help make this vision a reality?

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*Image 1: [AEC3 XABIO: Automatic code compliance checking](https://example.com)*

*Image 2: [Building Correction Notice: Upon inspection, a violation of Code section ICC_2006_705_A20 was observed:](https://example.com)*
WHAT THE INDUSTRY THINKS
BUILDING INFORMATION MODEL
(BIM) IS

The industry (software vendors, architects, builders) tends to think of a BIM as the 3D representation created from 2D Computer Assisted Drawings (CADD) files or by a specialized BIM application. Facility owners and operators, however, are beginning to realize a BIM only begins with that 3D representation; it reaches far beyond that to incorporate all of the facility-associated data including but certainly not limited to: as-builts, equipment specifications and operations manuals, parts lists, data from the building automation and control systems, and fire response plans. Those owners and operators realize that having all of this information in electronic format that can be integrated and correlated would provide the basis for their lifecycle BIM and provide the basis for real time data for a decision support system that can be used for a wide variety of scenarios and applications.

The industry is concentrating on representation because today's BIM products solve problems that have long existed in the construction industry. They allow for early clash detection and analysis of the building, and these mean fewer changes in the field leading to more efficient and cost effective construction. The new BIM products are also a starting point for interoperability. As a result, Industry Foundation Classes (IFCs) are primarily concerned with ensuring the ability to share data between the different disciplines of construction. A longer term view is being able to share in real time between systems without any manual processes for exporting or importing data. This allows for the creation of a lifecycle BIM. The creation of an integrated BIM that could be used to enhance survivability of facilities and improve the health, safety and welfare of building occupants by securely integrating certain building design, automation and control systems and select force protection systems, thereby creating an integrated campus.

In taking this approach the project demonstrated that the BIM must go beyond conventional BIM definitions and into a model that integrated a wide range of data sources into a single operational awareness tool that could be used to facilitate the implementation of the National Incident Management System (NIMS) to include local incident command, giving an unprecedented ability to access building data, security data, and emergency information for an incident commander.

This new way of looking at what the BIM could do for a facility resulted in a much more robust and comprehensive BIM than currently defined. The diverse nature of where all the data resided dictated the BIM needed to be something that could access this information without having to purchase new software. Each software system currently being used has a specific purpose and was chosen because it met that purpose. The cost of developing and implementing a single software system containing all of the functionality currently residing in this diverse group of software applications was cost prohibitive. Such a monolithic system also creates an inherent vulnerability by creating a single point of failure. By using the current COTs applications, not only was this vulnerability eliminated through distributed control, the cost associated with development and implementation was avoided.

It is critical that access issues to the BIM be addressed early. These concerns include the need to ensure the information contained within the BIM is secure and available to those who need it, while denying access to others. Since 9/11 the need to secure critical and sensitive facility information has become a driven in the development of BIM information for the Federal Government. This enterprise-centric decision support system solution demonstrated an integrated BIM capable of supporting building operations and maintenance activities as well as incident command operations is the type of model building owners and operators will need in the future.

CREATING A VIRTUAL DATA BIM

While most operations and command centers have video walls with CCTV and other systems displayed, those systems are not integrated in any way. To create a decision support system for the integrated command center, the Pentagon’s Washington Headquarters Services and Pentagon Force Protection Agency worked together to incorporate data from normally disparate systems into a BIM that was the foundation for real-time information for emergency response.

The integrated system was based on building automation and control and fire protection systems to provide real time information about the state of the building. This dynamic information was augmented with data from the Computerized Maintenance Management Systems (CMMS), Computerized Facility Asset Management (CAFM) systems, as well as the commissioning database and displayed for the incident commander in a heads up display. Additional emergency-oriented static data sets—like evacuation routes, standpipe locations and sprinkler zones, and hazardous material locations—could be layered on this foundation of dynamic building data. The data mined from these combined sources could provide an incident commander with a single comprehensive view of the facility.

The resulting system gave the incident commander access to a large set of building data to respond to any threat with a complete picture of the situation. Integrating the various databases made it possible for immediate answers to questions by using a query tool to drill down from the comprehensive view into the BIM data. With a single click, the incident commander could overlay a dataset and answer the questions “What organizations will be affected by this emergency?” or “Are
there any hazardous materials near the fire?” Integrating the databases also meant that the answers to the questions could be quickly located on floorplans or related to other datasets. In the event of a fire, the incident commander would be able to search mechanical drawings of the fire’s location to find and display the gas cut-off valve.

This integrated emergency system was based on what could best be thought of as a virtual data BIM. It contained a visual representation of the building with all of the CADD files associated with the facility and a 3D representation. It was not, however, based on one of the current BIM tools because integrating the data would not have been as easy. Instead, it was an interface to the facility data that allowed easy access to any particular slice of the data and continued to use the best of breed CMMS and building automation applications that were already in use.

THE BENEFITS OF A LIFECYCLE BIM

Though this integrated system was only a proof of concept application, it demonstrated the possibility of creating a single, comprehensive view of a facility based on automation and control data that could be used for emergency response. It also demonstrated that it is possible to use existing data and Commercial off the Shelf (COTS) software to create single-click access to disparate data and allow for the creation of information from various datasets by feeding or pulling data into a common interface. This would provide emergency responders with a more directed and timely approach to response and recovery actions.

Moreover, the integrated system created for emergency management can be the foundation for operational efficiency. During routine operations, building operators and force protection personnel can address daily tasks in a more efficient manner because they have ready access to a more complete picture of the facility’s condition and the status of the various systems that monitor and control facility assets and occupants. The integration of data also makes it possible to mine data from the building automation and control systems for trending, predictive maintenance, and to better manage energy in a large facility.

CONCLUSIONS

Current BIM approaches tend to focus on the initial planning, design and construction. Capturing the data generated in these phases of life cycle are important, but they ultimate serve a more important master, operation and maintenance. The BIM of the future must integrate all aspects of a facility’s life, to include security, emergency response, operation, maintenance, and focus on optimization of not only the planning, design and construction, but all aspects of the building’s operation.

Anything less than this will not meet the owners needs. If the BIM is not useful after project delivery, the owner will not be willing to pay for the BIM, even if BIM becomes the standard practice for project deliverables. The BIM becomes useful only if we understand the owners’ needs for operating, maintenance and security.

The industry is struggling to decide the appropriate method to create the interoperability necessary to achieve a viable BIM. National Institute of Building Sciences (NIBS) has attempted to address the issue through the use of a National BIM standard and the use of IFCs. Industry software vendors are also attempting to make their products more interoperable as well. Both of these solutions and others must be considered as we move to a day in which we can duplicate the IT industry’s “plug and play” approach.

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INTRODUCTION

Owners have sometimes appeared to be “silent partners” in current BIM implementations, a legacy of their traditionally limited role in the creation and use of project documentation. While owners have a vested stake in the content of this information—and the underlying processes of project design and execution—their relationship to this information have historically focussed on managing oversight, approval and, of course, financial responsibility. Until recently, developers of BIM technologies have concentrated primarily on parties that develop project documentation (architects, engineers, and consultants), and to some degree on contractors and subcontractors who process the documents for construction. Where owners have been considered in the development of BIM tools, it has largely been towards its use in facilities management applications.

Many (but by no means all) owners have so far taken a hands-off approach to the development of the BIM data and supporting process changes. There remains the perception, and potentially the reality, of shifts in risk associated with owners taking a strong leadership role in the working methods of the building team. There is the sense that some efficiencies and increased control may be enjoyed by the project participants in leveraging shared BIM data, resulting in a better overall building. However, there is also the perception that these benefits are unlikely to translate measurably into lower project costs for the project team – relative to the additional risks and responsibilities brought about by the owner imposing process change.

Owners have the most to gain from the benefits of BIM, as the ultimate beneficiaries of improved building performance and project delivery efficiencies. As project stakeholders, the owners are also best placed to impose the necessary enabling structure of information development, distribution and organizational processes.

Providing owners with direct added value from the BIM dataset is an important advancement that is required to drive adoption. However, this owner-driven approach to BIM implicitly requires new practices by owners that drive a need for improved access to the project information. Benefits are now beginning to occur through providing owners direct visibility and control of the project BIM, and by integrating BIM further into financial aspects of building ownership.

Gehry Technologies has participated in a number of projects that point to methodologies that can bring owners into the BIM conversation as more active participants, by identifying and providing new values to owners beyond those traditionally associated with project information.

A. Case Study: Swire Properties’ One Island East

Swire Properties Limited is a substantial developer of commercial, retail and residential properties throughout the world, who has made a significant investment to develop owner-driven BIM methodologies for many of its new projects.

The One Island East project in Hong Kong, a 70 storey, 1.4 million square foot office tower, was the first Swire Properties BIM driven project to be completed. The owner retained Gehry Technologies (GT) as the BIM Consultant for the project, to assist in the implementation of BIM practices and supporting technologies. The owner’s objective was to achieve a higher quality design while saving money and improving construction time by using collaborative, collocated work methods and integrated 3D modeling tools. The initial objective was to save 10 percent on the cost and reduce construction time.

B. Team setup and implementation

GT was brought in during Design Development, after preliminary 2D drawings had been completed. GT produced the initial BIM model from the 2D Design drawings, and then transferred the BIM to the project team. Formal management of the model was then adopted by the owner, with the BIM Consultant providing the Model Manager for this role.

During the design phase, the owner provided a co-location office space for the project BIM team near the building site. Each of the key consultants provided a project team of BIM staff, who were responsible for developing and coordinating their components of the design and associated modeling. The owner provided a server, a web portal and associated IT infrastructure for the team. Workstations and software were also acquired by the owner, who sponsored the BIM training and technical support for the design phase team. The owner provided an active, senior project management team that managed the process. The BIM Consultant worked as a member of the project team to develop and implement the BIM methodology, providing database architecture, information development and control processes, BIM trainers, technical support and supplementary BIM modeling staff. A model manager led the coordination and management of BIM information developed by the team for the duration of the pre-tender phase. The team developed virtually all of the project 3D data on a common software platform, Digital Project. Internet-based vaulting, and versioning database technology was used to coordinate the parallel collaborative working processes of the 30 person team.

MEP modeling has proven to be one of the most significant contributing factors to the success of the integrated BIM value...
delivery. The OIE model included all major MEP elements. Clash detection was used extensively and continuously both to identify interferences associated with these items and to manage the construction of correct openings in structure and architecture. This process enabled the design team to identify and resolve over 2000 conflicts before tendering. Later, during construction, the contractor used the same technology and working methods to identify and manage hundreds of clashes and coordination issues. All shop drawings—including all MEP shop drawings—were reviewed against the design intent as indicated in the BIM model and then incorporated into it. Any requirements for revisions that were identified in this shop drawing process were returned to the relevant sub-contractor for incorporation into revised shop drawings. The construction BIM model became the main visualization tool for coordinating the many elements of the project prior to construction.

4D simulation was employed extensively to help to optimize the construction sequence and manage risk. In addition to “conventional” 4D modeling, construction process simulations were produced for Gammon by the Virtual Prototyping Laboratory at the Hong Kong Polytechnic University, in cooperation with the BIM Consultant, and using process simulation tools developed in the manufacturing industry for assembly line simulation and control. These simulations were produced using the actual BIM elements aggregated by the project team. The contractor’s team conducted detailed construction sequence optimization exercises before the actual construction. A number of sequencing problems and clashes were identified—particularly in critical risk areas such as the 4 day floor construction cycle and the erection of the outrigger floors. Job safety aspects were also vetted and communicated to construction personnel through the construction simulation process.

C. Results and lessons learned

Gammon Construction has reported that Construction Process Modeling saved the project at least 20 days. Across the construction industry, it is thought that geometric coordination of the design prior to construction yields at least a 10 percent overall cost saving, and that construction process modeling can contribute an additional 20 percent cost saving. Order of magnitude reductions of contractor Requests For Information (RFIs), and significant reductions of claims on site resulting from incomplete design coordination were experienced on this project. The project was pre-tender 3D BIM model helped them to evaluate the level of risk and resulted in lower tender returns than in a traditional 2D-based tender. After completion, the contractor adopted Digital Project and 3D BIM and created a permanent inhouse construction BIM team.

Throughout the design and construction phase, the BIM was used to monitor cost in real time. The technology can produce vast, detailed and appropriately formatted quantity take off information in real time. This helps the entire project team to manage cost more effectively throughout the project. Ongoing 4D analysis and Construction Process Simulation were used extensively to optimize the construction process.

On One Island East, the owner’s leadership of the BIM process was fundamental to the success of the project. This direct, top down approach provided a coordinated vision for the project goals and provided an effective structure for delivering the results.

Since beginning owner driven BIM practices on One Island East, Swire has subsequently deployed these practices on a number of large new developments in Hong Kong and China. The owner has continued to retain Gehry Technologies for assistance in transitioning the methods initially developed on One Island East to other projects in his portfolio.

The One Island East team was honored to receive the 2008 AIA TAP BIM Award for Process Innovation on this project.

Owners have the most to gain from the benefits of BIM, as the ultimate beneficiaries of improved building performance and project delivery efficiencies.
LIKE ALL STATES, WISCONSIN government is faced with challenges of limited resources, aging workforce and increasing demands for environmentally responsive facilities.

Unlike all States, the Wisconsin Department of Administration has engaged in systematic implementation of Building Information Model (BIM) software tools and development of new processes that enable us to meet our capital development challenges. The lessons we have learned about large-scale BIM deployment can lead other public and private entities to successful resolution of the significant challenges facing all of us in the building industry.

As in the private sector, no major tool set and business process change can be successful without support from the highest level of the organization.

In fact, our journey to BIM was launched on April 11, 2006 when Governor Jim Doyle signed Executive Order 145 requiring all state buildings to conform to high environmental and energy efficiency standards. When signing the act, Governor Doyle stated, "...I want the state to lead by example. This Executive Order will make sure that our state buildings are a model for the rest of the state in energy conservation, and save us millions in the process."

The order requires the Department of Administration to set goals, establish programs, create guidelines and use integrated processes to conserve energy and improve sustainability on capital projects.

It quickly became clear that BIM was necessary to meet requirements of the Executive Order on our $1.2 billion of annual construction projects involving more than 300 construction firms and more than 200 design firms serving 16 state agencies and the 13-campus University of Wisconsin System. The state-wide building portfolio includes more than 6,200 facilities with a replacement cost estimated at 9.5 billion dollars.

To meet the goals of the Executive Order for such a large enterprise, we began moving from a project-centric management approach to a portfolio management approach.

Combining the demands of portfolio management and energy conservation would greatly improve Total Cost of Occupancy and Ownership but require guidance from the construction industry, state agencies, the University of Wisconsin System and others.

It became clear that BIM could help us achieve the high performance standards and energy conservation the Governor required for State facilities and operations.

To take advantage of BIM, process changes were needed. On March 13, 2008, David Helbach, the Division Administrator and Secretary to the Building Commission said, “The State Building Commission has directed DSF (Division of State Facilities) to work with interested parties to clarify the conditions under which state interests are best served by employing alternative delivery methods and to recommend statutory language changes.” Recommendations are scheduled to be presented in November to the Building Commission.

BIM IMPLEMENTATION

The Department of Administration Division of State Facilities is working with state agencies, the university system, and private companies in the building industry to develop guidelines and standards for formal implementation of BIM rollout strategies officially beginning in July 2009.

BIM seminars have been held and are being scheduled in conjunction with the University of Wisconsin, 13 pilot projects are in progress for state agencies, surveys of public and private entities are being conducted, business cases are being developed, education plans are in place with professional organizations, such as the buildingSMART alliance™ (editors note: the author is the current Education Contact of the Alliance), the DOA took a leading role in the AIA BIM Award winning BIMstorm LAX in January 2008 and other initiatives are in place.

The Department has provided education and discussion at the past two Annual DSF Consultants Conferences sponsored by the American Council of Engineering Companies. The presentation topics have included: “Looking to the Future: Building Information Modeling”; “Building Information Modeling: Present & Future - Discover the Power of BIM in Design Coordination”; “Design Solutions – Integrating MEP Building Information Models” and “Legal & Operational Aspects of BIM.”

PILOT PROJECTS

The 13 BIM pilot projects have a combined construction value of more than $300 million and are being delivered using traditional design-bid-construct methods. The initial uses of BIM focused on architectural and structural design. Some MEP consultants had the capability to utilize BIM software and processes.

A recent survey of pilot project participants found that the initial benefits included...
improved communication and understanding of the project due to the visualization capability of the technology. The design teams report that this improves their understanding of the project complexities and allows the client agency to react early in identifying adjustments to program space needs. The ability to visualize and apply automated clash detection in the design process has improved coordination between disciplines. Continued monitoring of these projects as they move into construction will allow all state client agencies and building industry professionals to learn from our activities. We expect the projects will have reduced user agency generated change orders and less coordination-related errors and omissions.

This year, DSF will provide an update on developing guidelines and standards for using BIM on state projects.

LEADERSHIP

It is not a matter of whether or not the building industry in Wisconsin will retool with BIM; it is only a matter of how. How to implement this technology to leverage the improvements BIM allows is the challenge that is being met by our leadership and staff. The DSF is developing business cases that benefit both the public and private interests to accelerate the adoption of BIM for capital projects. Under the leadership of David Helbach, Wisconsin is showing a holistic approach as inspired and encouraged by the highest level in the State Capital of Madison, Wisconsin.

The July 13, 2008 National Governors Association Issue Brief included a piece titled, “Greening State Government: “Lead by Example” Initiatives.” It included the following text, “The [Wisconsin] Department of Administration is currently working with business partners and other state agencies to develop a set of guidelines and standards for architects, engineers, and contractors to follow in carrying out design and construction Building Information Model (BIM) deliverables on certain projects. BIM is a digital representation of all aspects of a facility and can assist state agencies in assessing energy use within a particular facility.”

WHAT DOA IS DOING

The Wisconsin DOA has a comprehensive approach to state-wide building industry adoption of BIM that can be clearly traced and emulated by other States and large building owners, designers and developers. Key to the initial success and buy-in of all parties is the connection of the “green building” executive order to an administrative action plan focused on Building Information Models.

As a members of FIATECH, the Wisconsin Department of Administration and Department of Commerce (responsible for regulatory administration of the adopted state wide building code) have joined together to accelerate implementation of BIM for both design and regulatory compliance using model checking being developed by the ICC smartCODE initiative. As the rules-based model checking software is refined, the state will have higher levels of certainty of outcomes for project goals and will encourage greater levels of BIM adoption by the entire State building industry.

Key to statewide implementation of BIM is support of open standards for BIM software interoperability as championed by the buildingSMART alliance®. Open standards will assure that project data can be used for many diverse applications including energy modeling, sustainability analysis, cost tracking and schedule management. The principle objective of supporting open standards is to maintain one set of data for multiple uses without re-entry of existing data into new applications. Open standards are key to successful BIM implementation and the Wisconsin DOA is proud to join other government agencies, such as the General Services Administration and the United States Coast Guard in supporting the Alliances efforts to maintain and develop this interoperable data exchange format.

In February, the Department participated in the BIMstorm LAX demonstration planning process organized by Onuma, Inc. The state provided program data and assembled a planning team that included Connolly Architects of Milwaukee, and Paul Adams, AIA, Denver Colorado. The value of open standards for digital exchange, and experiencing new ways of working with the applications was invaluable to those that participated and observed.

The most significant benefit of the education sessions and one-day BIM design exercise was understanding that the key issue is not the use of new software tools but the new way people work together in real time because of those tools. Throughout the day of the BIMstorm, it became apparent that the main transformation BIM enables is the way we work and interact with each other. The event showed that the project owner and A/E relationship will be more transparent and collaborative in sharing the development of solutions and decision making for effective results.

The Department continues to meet with state agencies and university facilities to determine short term objectives and long term goals of BIM implementation. We are now working on the CAD / BIM / GIS standards for electronic plan distribution and for record documents for archival integrity.

With governmental leadership, early adopter architectural leadership, education support and business process leadership clearly pointing the way to success, Wisconsin’s BIM initiatives clearly demonstrate the state motto – “FORWARD.” The State is clearly pointing its building industry to an almost unprecedented opportunity to address environmental concerns and economic development at the same time.

Bill Napier is a Project Manager at Wisconsin Department of Administration. He is a specialist for Building Information Modeling (BIM) and Integrated Project Delivery (IPD) developing standards and guidelines for the Division of State Facilities.

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Building Information Models and Model Views – Part 2

By Richard See, Managing Director – Digital Alchemy

PART 1 OF THIS article (published in the Fall, 2007 issue of JBIM), provided some history about Building Modeling and Building Information Modeling (BIM), and ended by introducing Information Delivery Manuals (IDMs) and Model View Definitions (MVDs) as parts of a process for realizing software interoperability in targeted building industry processes. This part will provide more detail about a standard process and toolset for developing BIM based solutions for the building industry.

CHALLENGES ON THE ROAD TO INTEROPERABILITY

Interoperability across all disciplines, phases, and software tools used in a building industry project is a lofty goal. The International Alliance for Interoperability (IAI) began pursuit of this goal in 1994 and developed the Industry Foundation Classes (IFC) as the information model schema for sharing BIM information across these boundaries. In only a few releases, the IFC model schema was very large and quite complex. Software companies looking to support the standard needed a strategy for phasing their implementations and for ensuring they delivered something useful and valuable to their customers at each milestone in building support for IFC.

To address this need, in 2000, the BLIS Consortium introduced a process and toolset to bring focus to software support for IFC data exchange based on end user use cases. The process involved identifying building industry processes in which sharing BIM data would deliver maximum value to the project. The goal was to reduce complexity for software vendors by giving them specifications for the subset of IFC that would fully support the targeted end user exchange scenario (e.g. early design stage architectural design to HVAC design). Nearly 60 software products by 35 organizations developed support for one or more of the BLIS Views of IFC in the 2000 to 2003 timeframe. About half of these were certified through certification testing that included data validation similar to what is discussed below.

In 2005 timeframe, two processes were initiated which extended these ideas: Information Delivery Manuals and Model View definitions.

Frustrated by a lack of reliability in IFC data exchange in products at the time, the Norwegian chapter of IAI (later renamed to buildingSMART) funded development of a process and documentation formats for Information Delivery Manuals (IDMs). Their goal was to enable “contracted data exchange.” That is: to enable sufficient specificity in the requirements for data exchange in building industry projects that these requirements could be included in project contracts. The approach taken extended and enhanced the process for capture of such requirements that had been used by IAI since 1994. End user domain experts (the architect and the HVAC engineer in our example above), facilitated by an information modeling expert, documented an existing industry process (in the form of one or more process diagrams) and the information exchanges that occur in that process (in a spreadsheet).

In parallel, the Finnish chapter of the IAI set out to update the model view definition process and tools used by BLIS in the context of their Virtual Building Laboratory at Tampere University of Technology. As with IDM, the proposed standard for MVDs involved both a process and standard documentation formats. In addition, a software toolset to was developed to support Model View diagramming and a web site was established to support coordination across MVD definition projects. The MVD process and format was proposed as a standard for use by the IAI/buildingSMART in late 2005 and was adopted as the standard in early 2006.

Both the IDM and MVD processes and templates have been used in several projects over the past few years, but generally separately.
There was a need to see these two complimentary systems integrated into a single process and toolset for defining and developing BIM solutions for interoperability.

**THE IFC SOLUTIONS FACTORY**

In the summer and fall of 2007, an integrated process for defining end user BIM data exchange requirements, IFC based technical solutions for those exchanges, software certification, and end user BIM data exchange validation was proposed to the US National BIM Standard (NBIMS) committee, IAI/buildingSMART international, and several organizations using IFC based BIM data exchange. The name of the integrated system is the IFC Solutions Factory. It includes 4 sub-processes, toolsets, and templates (see Image 1).

The IFC model schema and International Framework for Dictionaries (IFD) are used as resources in the design of IFC based solution, certification testing, and BIM Data Validation.

**IFC SOLUTIONS FACTORY TOOLS, TEMPLATES, AND WEB SITES**

This section will provide a very brief introduction to the subcomponents for each of the 4 phases of the IFC Solutions factory. More detail and examples will be provided in a 3rd installment to this series.

**REQUIREMENTS DEFINITION**

- **Process Map** – Documents the end user process(es) using Business Process Mapping Notation (BPMN).
- **Exchange Requirements** – Documents the data (objects, properties, and relationships) that must be exchanged at a point in the end user process.
- **Generic BIM Guide** – Provides instruction to end users for the subject process and exchange(s). This can range from what must be included in the BIM, to exchange tips, to reference standards that must be used (e.g. a classification system).
- **Exchange Requirements Model (ERM)** – Entity/relationship diagrams for each exchange. These are generic and not yet related to IFC or any other information schema.
- **Coordination Web Site** – IDM page(s) – A web site will be established for coordination across all phases of the Solutions Factory. This will foster coordination, sharing, and re-use of common concepts all four phases of the factory. The basic building block for these solutions is called a Concept (e.g. the concept of assigning classification to a product or assembly).
SOLUTION DESIGN

- **Model View Definition** – Documents the purpose and scope of a Model View, including the project participants, the applications types (from/to) and the end user processes/exchanges supported. Note: a Model View integrates requirements for one or more ERM (typically more than one).

- **Concept Definitions** – Documents a data concept included in the Model View. Typically these correspond to end user concepts defined in supported exchanges, but often an end user concept will translate into more than one concept in software data exchange.

- **Generic Model View Diagrams & Software** – Entity/relationship diagrams for the single model that satisfies all exchange requirements for the target end user processes. These diagrams are still independent of any particular information model schema. These diagrams are created using a software toolset that supports diagramming in Microsoft Visio and re-use of existing concepts on the coordination web site (through web services).

- **IFC Model Binding View Diagrams & Software** – Entity/relationship diagrams for an implementation of the Model View using a specific version of the IFC model schema. This is the ‘solution’ for exchange of BIM data in the target end user processes using IFC. Together with the Implementation Guidance, these specify software implementation requirements for both export and import of the model view. These diagrams are created using the same software toolset and coordinating web site as for the Generic Model Views.

- **Implementation Guidance** – These document software implementation requirements at the concept level. They include data instance diagrams, implementer agreements, and any reference data sets (e.g. reference standards, look-up tables, or industry enumeration data). They are intended to address any and all ambiguities as to how a software product will support the Model View.

- **Coordination Web Site – MVD pages** – The same web site described above will include all the concepts used in existing MVDs. The software toolsets described allow the MVD developer to use pre-existing concepts in their MVD and to upload new concepts for use in future MVDs. The goal is to avoid re-inventing any wheels (i.e. one good way to support assignment of classification, not many similar ways).

SOFTWARE IMPLEMENTATION AND CERTIFICATION

- **Certification Test Cases and Test Suites** – Historically, test cases using in IAI certification testing have been very geometry centered. This will change over the next few years, so that testing is expanded to other important data relationships in IFC model Views. In general, test cases should be developed to independently test each concept included in the Model View. For leaf node concepts (leaf nodes in the MVD diagrams), these can be thought of as Unit Tests. Testing for higher level concepts can be thought of as Integration Tests.

- **Product Specific Certification Testing Reports** – Certification test reporting will be improved using the Model View diagrams. Concepts that are correctly supported will be shown with solid lines and no notes. Concepts that are not correctly supported will be shown with solid lines and no notes. Concepts that are not correctly supported will be shown with solid lines and no notes.

---

**Table I**

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Lead Organization</th>
<th>Project Objective</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMARTcodes</td>
<td>International Code Council</td>
<td>Automated building code compliance checking</td>
<td>Q3-07 through Q2-09</td>
</tr>
<tr>
<td>Qty Takeoff for Building Services</td>
<td>buildingSMART Norway</td>
<td>BIM driven takeoff and cost estimating for building service (MEP) systems</td>
<td>Q2-08 through Q1-09</td>
</tr>
<tr>
<td>Concept Design BIM 2009</td>
<td>US GSA, Statsbygg (Norway)</td>
<td>Spatial Program Validation Energy Performance Analysis Circulation &amp; Security Analysis</td>
<td>Q4-07 through Q4-09</td>
</tr>
<tr>
<td>COBIE</td>
<td>US Army Corps of Engineers</td>
<td>Handover of information from Construction to Building Operations</td>
<td>Q2-08 through Q2-09 (est.)</td>
</tr>
<tr>
<td>NBIMS</td>
<td>buildingSMART Alliance</td>
<td>National BIM Standard</td>
<td>Q4-08 through Q4-09</td>
</tr>
</tbody>
</table>

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supported will be shown with dotted lines and include keynotes to an exceptions section in the report. This will make it easy for end users to review test results, product by product. A data representation of these results can also be used to compare the results from two products (e.g., one exporting and the other importing the IFC BIM) so that the end user knows exactly what concepts will be correctly exchanged.

• Coordination Web Site – Implementation & Product Certification page(s) – As for Requirements (IDM) and IFC based Solution (MVD), there will be a section of the coordinating web site dedicated to documenting the tests that were run for software product certification and the results for each product tested. This will give end users unprecedented access to both the scope and results for these tests.

BIM DATA VALIDATION
• Product Specific BIM Guides – These will be product specific adaptations of the generic BIM Guide (above) which show the user how each requirement is completed for a particular application (i.e., screenshots and application specific guidance).
• IDM/ERM Specific Validation Rules – Business rules in the original requirements definition (i.e., use of UniFormat classification in one exchange and MasterFormat classification in another) are mapped to the constraints branch of the IFC schema in the same way as exchange concepts are mapped to the product and resource branches. The result is a constraint (or requirements) model that can be used to check data in a BIM claiming to meet all exchange requirements. Such BIM Data Validation can be done by any end user or by a consultant using a data validation software application. Examples include the Solibri Model Checker and Xabio—each using an exchange specific plug-in.
• Coordination Web Site – BIM Data Validation page(s) – Finally, the coordinating web site will include one or more pages dedicated to providing end users with ERM specific constraint models and instructions for BIM validation in their projects.

PILOT PROJECTS USING THE IFC SOLUTIONS FACTORY
While IDM and MVD have been in use for awhile, the IFC Solutions Factory has integrated them with improvements to certification testing and reporting and with the addition of BIM data validation, which is probably the most important aspect of the Solutions Factory for end users. It is this ability to confirm BIM data as being fully conformant to requirements for an exchange that allows project team members to require use of such exchanges in their project agreements. This is an important and necessary milestone.

Because of these changes, the IFC Solutions Factory is being tested in several projects. The projects outlined on Table 1 will be using and providing feedback for improvement of the IFC Solutions Factory processes, tools, templates, and web sites over the next 18 months.

Part 3 of this article series will walk through examples for each of the IFC Solutions Factory phases and deliverables.

Richard See is Managing Director of Digital Alchemy, Chairman of the BLIS Consortium, Leader of the Models and Implementation Guidance committee in the NBIMS initiative, member of the Technical Advisory Committee for buildingSMART International, and member of the Technical Committee for the buildingSMART Alliance (North America).
Towards Interoperable Building Product Content

By Stephen A. Jones, Senior Director, McGraw-Hill Construction, and John K. Lien, Director, Content Management, Business Information Group, The McGraw-Hill Companies

THE VISION OF BIM as the future global standard for all design, construction and operations critically relies on an ability to electronically extract relevant information from one or more core design models (architectural, structural, MEP, etc) to perform useful analyses and other lifecycle workflow activities. In order to realize that vision the objects with which the core design models have been created need to provide sufficient data about their attributes to power these activities. Currently, there isn’t enough readily available BIM-enabled building products content to meet this need. And as the universe of BIM-related tools continues to increase in number and sophistication, the need for intelligent objects of building products will grow exponentially.

Recent McGraw-Hill Construction research with architects that are highly experienced using BIM indicates a preference to initially construct a BIM using generic components as placeholders for the building products. BIM software vendors are trying to address this need by providing object libraries of generic building components and products in their software.

These generics typically carry enough information to serve as a graphical placeholder in a building model, but not enough data to represent specific products available from particular building product manufacturers (BPMs). In fact some generics analyzed by McGraw-Hill Construction don’t represent any product commercially available. Also, they don’t easily convert to represent actual products that meet the need of the project. So there is still a gap in the ideally seamless process from design, through the marketplace and into installation and operation. There is a growing need for proprietary (product-specific) BIM content for building products.

Of the approximately 60,000 BPMs in the US, only a small number have created proprietary BIM objects, which are typically distributed through their web sites and a few public, free building product content distribution sites. One challenge these manufacturers face is anticipating the pace of BIM adoption; they can’t justify reducing their spending on traditional content in order to pay for creation of new kinds of content. So BIM content is a completely incremental cost for them. As a result many BPMs are expressing reluctance to invest until adoption increases.


But we strongly believe that is a temporary obstacle. The Smart Market Report on Interoperability also forecasted a tipping point for BIM adoption in 2008. A few innovative BPMs are investing now to be industry leaders, and as adoption inevitably and quickly spreads, more BPMs will be willing to invest, if for no other reason than to match their competitors’ BIM offerings.

To fill the void in the interim, some subscription sites featuring privately-built content and a variety of peer-sharing sources are becoming available online with both generic and proprietary objects, but the reported quality varies widely. In McGraw-Hill Construction’s research, a majority of the respondents expressed a
preference to build their own content, many having experienced serious problems created by content from un-vetted external sources.

But importantly, McGraw-Hill Construction research also indicates that if a reliable and comprehensive source of building product objects was available, a large number of respondents would be comfortable accessing them through such a source.

Many BPMs are also concerned about the apparent lack of a globally accepted standard for creating BIM content; they don’t want to have to make multiple investments. This is certainly a more complex challenge.

But the manufacturing sector has successfully met this challenge with initiatives starting in the mid-late 1980s. According to a veteran of the manufacturing content space, David Bandi, currently Director of Business Development for Content Search Solutions at Autodesk, “While manufacturers refer to this change as Design-for-Manufacture, and the AEC sector references Integrated Project Delivery and BIM, the concepts are similar; how to leverage modeling technology to improve ‘buildability’ earlier in the design phase and bring efficiency to the full design, source, build and service continuum. This can only be realized with a depth of data that is specific to each product (non-generic), accurate and multi-faceted. Much of that was achieved through data and performance standards which eventually were globally adopted. It certainly wasn’t done overnight.”

### APPROACH TO A SOLUTION

In the two previous issues of JBIM, BIM is often referred to as a container for data or an information repository—that is, emphasis is placed on the content of the model. Historically, in content management systems, the content was not often stored for delivery to multiple channels. The content was aggregated and stored with a single purpose in mind—perhaps a catalog, installation instructions or warranty information.

Information in a BIM needs to be more agile than that. By examining the exchanges already defined we can predict some uses such as automated code checking. To support exchanges the content, or BPM products, must be defined in common terms. OmniClass and IFD provide a framework for doing so.

The Construction Specifications Institute (CSI) is leading the way by bringing together public and private entities on its OmniClass Development Committee. CSI states that OmniClass is “a standard for organizing all construction information”. Some OmniClass tables are mature and well known since they are adoptions of existing standards such as MasterFormat and UniFormat. But other tables key to defining BPM products, namely table 23 (Products) and table 49 (Properties), are new to the industry, and are still in “Draft” status, requiring broad participation in their development.

How do we participate? We can drive standards from both ends. That is by definition and by implementation. Definition comes early in the process where requirements and perspectives are shared and harmonized. But only through implementation do we learn whether or not the standards we are creating are on target. Feedback from implementations into the standards is critical for our success.

### EXAMPLE OF THIS APPROACH

Autodesk, McGraw-Hill and others recently participated in the launch of Autodesk Seek, a web service that allows designers to search and find generic or manufacturer-specific building products and associated design content. Content delivered via this web service is organized according to OmniClass table 23, Products. McGraw-Hill has integrated its entire Sweets database of building products content (2D, 3D and BIM) with Autodesk Seek and developed a set of design selection attributes for each of the products. These attributes were developed by McGraw-Hill in conjunction with OmniClass Table 49, Properties.

Although McGraw-Hill has a long history with MasterFormat, this was its initial effort with OmniClass Products, which is in “Draft” status. MasterFormat organizes products by work results and consequently a product may legitimately be categorized many ways. With OmniClass Products, a product must belong to a single category. As McGraw-Hill applied OmniClass Products to its Sweets content, errors were identified within the table that broke this rule. This new standard is still in development and McGraw-Hill actively participates on its development committee. But simultaneously, McGraw-Hill is trying to drive its adoption by using it with its partners in its services. In fact, this initiative leveraging OmniClass Tables 23 and 49 was one of the first attempts to commercially apply what has heretofore been a largely academic exercise. McGraw-Hill is feeding its work to the CSI to apply to the IFD (International Framework Dictionary) an important element of global taxonomy for the building industry.

### CONCLUSION

On May 10th, 1869 two locomotives faced each other at Promontory Summit, Utah, celebrating the first transcontinental railroad. Different companies, with different teams and techniques, had successfully worked the same problem from different angles. (Never mind they were celebrating an incomplete solution. It would be 3 years before a railroad bridge was built over the Missouri River, truly completing the effort.)

We in the BIM community, perhaps not by design, are taking a similar approach. On one side we are moving forward with what we know today. Applications and tools already in the marketplace are being extended and modified with BIM in mind. Companies are forming alliances around common goals, improving interoperability between their products and improving the productivity of their customers. Simultaneously, via the buildingSMART Alliance, we are coordinating our efforts and driving standards. We are improving and continuing to define those standards by using them right now and providing feedback.

BIM is big, has many players and will be evolving for years, probably forever. Companies are laying rails by placing solutions in the marketplace today. But only through participation and communication around standards can we insure that the rails will line up when we’re done.

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IN JANUARY OF THIS year, a group of structural engineers from the Advanced Building Design division at Intertech Design set out to accomplish a large task. They were to take a department of their parent company, Curtainwall Design Consulting™, and completely change the way they did business. CDC has a long history of providing proven solutions for the curtain wall and façade industry. They are well known around the globe with over 19 offices worldwide, allowing them to be a part of some amazing projects. Its principals are dedicated to delivering state-of-the-art solutions to their clients. Many of their divisions, including Intertech, have done so by implementing new technologies like Building Information Modeling (BIM).

It is Intertech’s history and expertise with BIM that will allow them to assist their fellow workers in making the transition to a new way of working.

ADOPTION OF A NEW PARADIGM

CDC’s Production department provides many services including fabrication drawings for façade system components. Previously all of this work was done using traditional 2D CAD.

As building designs continued to get more geometrically complex, this job became more challenging and the need for designing in 3D increased.

This need was met by a select group of individuals that were able to digitally visualize tricky situations with basic 3D modeling. However, utilizing the model to produce fabrication documents was not possible. It was clear that a digital prototyping solution specific to the manufacturing industry was needed.

Getting various people to “buy in” to digital prototyping was not easy.

Clients were uneasy that it would not produce standard compliant results. Upper management was concerned about the costs of implementation and the delayed return on investment. Middle management struggled to find the best way to implement the technology into the flow of work, and no one wanted a losing horse on their team. The staff was overwhelmed with having to learn a new system, especially when some have been recognized as the best in the business at what they do. Each of these concerns had to be addressed continually throughout the initial stages.

One strong reason some in the building products industry have not been able to embrace digital prototyping is that most products currently available are best suited for industrial designers. Designing the types of façades CDC encounters each day does not follow the typical product development cycle. A majority of CDC’s work is custom designed for each customer. Vendors, having realized the growth potential in the AEC market and that most software available lends itself to items that are mass produced, have added features like rapid profile builders and custom content libraries that have greatly increase the software’s flexibility.

STARTING SMALL

Work began small to develop a method
demonstrate that digital prototyping software could produce similar results to 2D CAD.

Eventually work on a pilot project began. A small test region of an actual building referred to as a performance mock-up was chosen. Its small size and simple geometry ensured a limited staff would be able to complete it successfully. A project manager from the production department at CDC oversaw the work of the engineers from Intertech. They were able to produce tangible results while the more experienced managers from CDC provided knowledge of the complex systems. Thankfully the CDC management had the foresight to see how this blend of people proficient with technology and those familiar with the end product would be a key contribution to the success of the pilot.

The company had originally tried unsuccessfully to implement this new technology by simply training a number of its staff. The knowledge of how the software worked was not enough. A process for how to integrate digital prototyping had to be engineered. Outsiders, those not involved in the day-to-day operations of the production, offered a fresh perspective and were less impeded by the desire to do things the way they used to be done. The BIM process involves changing your mindset. It incorporates dimensions of data non-existent in 2D CAD. A model has the potential to generate a Bill of Materials, or it may be passed on to an

**A slide from an internal training presentation outlining one of the developed workflows.**
engineer for use in analysis, or to a fabricator to drive production equipment. Gone are the days of overriding dimensions in CAD so something “looks” right.

Some of the benefits are captured before the model gets downstream. Digital prototyping afforded CDC’s management with the ability to validate and dissect designs in 3D with inexpensive review software before fabrication documents were produced. In addition, a number of transitional conditions were worked out in real time thanks to the ease of modeling and availability of custom created sections that could be interchanged. This approach of having a designer see the results of his ideas modeled instantly had never been done before at CDC.

TRANSITIONING TO A FULL-SIZE PROJECT

Generally the consensus for moving into the next phase of implementation is to gradually increase the size and scope of projects. CDC increased the size of the next project by 450 percent from the pilot phase. This should come with a disclaimer: “attempt at your own risk.” For CDC this was justified because the actual building chosen was based on the mockup from the pilot project. This kept the engineers, who were less familiar with façade design, from having to learn a new system. This decision was not without fault.

The first challenge would be training additional staff to make up for the increase in work. Rather than hire outside educators, internal staff was used to develop an accelerated training program that focused on aspects of the software specific to the job. As progress was made and as workers gained confidence, additional skills could be learned. Once again, the engineers from Intertech combined with staff at CDC that had a strong knowledge of the project. Some aspects of the workflow remained unchanged. A decision and compromise had to be made as to how much to model. In the
A screen capture showing the load on the CPU from simply zooming on a complex model.

end, minor elements like gaskets were left out in favor or fasteners which were shown to provide valuable feedback.

The next challenge was computer hardware. The new software required strong processors, video cards, and fast, reliable network connectivity.

The typical 2D CAD workstation was not up to the task. This demand for resources was driven by a huge increase from the pilot phase in the number of models and their complexity. Certain aspects of the project had to be handled by specially designated computers capable of processing difficult tasks. These tasks included assembling units to form a completed wall, or modifying many members in a single step.

CLOSING THOUGHTS
This article had originally been intended to highlight the use of a digital model to drive fabrication machinery. This is one of the many downstream benefits of digital prototyping. The final file can be read into a machine and produce an accurate working part saving up to 30 percent of production time. This benefit however is just one of the many available when using a digital prototype. More important is the steps required to implement such technology and the mindset that must accompany the new software. In the end, the simple action of building something digitally gives you a profound new understanding of your design. Many of the designers would later remark how actually seeing the system modeled was much like having their light bulb turned on during their first site visit.

Integrating digital prototyping into a business is not without difficulty, but there are many resources that can make the transition a smoother one. Software resellers offer support and guidance that no book or forum could replace. Industry events like seminars or user groups are great places to share ideas or get advice. The atmosphere at such events are surprisingly open and the opportunity for learning is great. If you have any questions or comments about the article or the projects mentioned, please contact the author at jwilliams@idise.com.

Joe Williams, EIT is a structural engineer and digital solutions specialist for the Advanced Building Design department at Intertech Design, Inc., which is a charter member of NBIMS. He is a member of SEAOE’s State IT Committee on BIM in Structural Engineering. He has assisted in developing presentations on BIM & sustainable design technology for SEAOE’s Structures Congress, and AGC’s national BIM Forum. Additionally, he has assisted at Autodesk’s national conference on the topic of integrated structural engineering and BIM. Mr. Williams has a Master of Science, Architecture from Mississippi State University, with a focus in digital design and design visualization. His Bachelor of Science was in Civil Engineering from the University of Memphis, with a focus in Structural Engineering.

Our design team and partners work literally elbow-to-elbow every day, adding a new dimension to the definition of Building Information Modeling. The exciting new Interdisciplinary Science & Technology Building IV at Arizona State University, now in design, is just one fresh HDR project using this approach.

We are committed to quality integrated project delivery through current BIM technologies. Come collaborate with us.
MODELS ARE EXTERNAL TOOLS that we have used to represent reality, to try to understand the impact of a projected object or of a sequence of events with the purpose of forming or perfecting what may really happen in the world we live in, the impact or the consequences of our human projects. This peculiar function antedates the origin of the human race as related figuratively in Genesis when God “molded” or “modeled” the first human in clay “to His own image” and then infused the spirit or as in the Mayan Bible, the “Popol Vuh”, that starts with a fantastic modeling session of the pagan gods in which they vainly try to create the first humans with clay “but they didn’t move” and then wood “that could speak but not feel” until they discover maize, the perfect material, and so “the arms and legs of the four men were made of corn meal”.

When R. Buckminster (Bucky) Fuller visited us in the mid 50s at the College of Architecture and Design at the University of Michigan he would spend with us a few days defining the project, the resin impregnated cardboard geodesic dome to serve as a possible mass produced house or the Dymaxion dome. Then he would leave and return a month later when we had built the full scale models. Thousands of hours were spent by some 10 or 12 students, sacrificing evenings and weekends so that when Bucky returned the full mock-up was built.

At the juncture we are today with BIM we can look at it as the fantastic and powerful product of 3D digital technology to produce accurate models at a very low cost, something that the profession could not achieve efficiently until the mid 1990s.

The time had arrived in the mid 90s when computers were jumping significantly in the power of their processors, virtual memories and hard drives, connected to the enormous informational resources of the Internet. Facing such huge power the leaders in the industry, starting perhaps with the software vendors, realized that the technology to design, construct and manage buildings would undergo a fundamental transformation. It was not necessary to flatten out the desired object in the real world. It was possible now to start with the 3D representation that embodied the architect’s vision of what the clients’ and projects’ needed and the 3D image on the computer screen could be equally perceived by all from all angles. A metaphysical transformation of the representation of reality had happened; an event that most scientists now agree was equivalent to the invention of the printing press by Guttenberg in the 15th century.

The most far reaching step taken in these encounters with this powerful technology was to establish the goal of interoperability to make sure that the avalanche of 3D information going into the production of the building modeling process was open and interchangeable.

Let’s take an overview of this history of building modeling throughout the ages.

The Egyptians used models for two main purposes. First to try out and display the overall form of their vast constructions and the effect on their surroundings. The great stepped pyramid of Zoser, that is believed to be almost a full scale model of the later pyramids at Giza, all funeral monuments, was actually used also a tomb. Second the Egyptian’s belief in the after life moved them to build thousand of small scale models of rooms, kitchens, granaries, bakeries, parks and stables that were to accompany the deceased to their resting places. The
Greeks, that learned from the Egyptians, developed intellectual models with a whole set of rules on proportion, shape, regulating curvatures, number and position of columns, capitals, architraves and pedestals. No actual drawings or models of Greek temples and monuments have been found but the rules of their mental models appear in many of their writings. The Romans, that learned from the Greeks, used extensive models, full scale and small scaled models, required by their more complex forms, their arches and their domes. Vitruvius explains the different use of models contrasting the Greek mental constructions with the experimental innovations of the Roman architects. The Pantheon with its 142’ dome was considered to be “a model of Heaven”.

The great architects (or master-builders) of the Gothic Period and the Renaissance made extensive use of models, especially of scale models, to design and build their churches and palaces. One of its greatest, Leone Battista Alberti (1404-1472) wrote extensively on the subject. His treatise On the Art of Building in Ten Books addresses the importance of the scale model for the patrons to understand and evaluate the works proposed by the architects. “These (small scale models) will enable us to weigh up repeatedly and examine, with the advice of the experts, the work as a whole ad individual dimensions of all the parts, and, before continuing any farther, to estimate the likely trouble and expense”.

Two of the most important consequenc-es derived directly from the powers of BIM technology are interoperability and defragmentation, two enormous achievements of our age. Interoperability happened when the enormous power of the new technology sprung up in the mid 1990’s, almost simultaneously in different countries and the need to establish a common language became essential to further the benefits of 3D modeling. It was not only the fear of chaos but the huge powers that became available that made it mandatory to set up standards of language and communication. The ability to electronically transfer accurately huge amounts of data required a set of rules. For these rules to be effective they must be based on open standards that were available to all.

Defragmentation resulted from the ability to work around a single model or set of models, to bring all the specialists and specialties to work and share the same model, to sit around the table to share and contribute to the design, construction and operation of the subject building or process to achieve a unified whole.

The fragmentation of the building process, from its inception to its demise, has been correctly blamed for a huge portion of the current waste of the Construction Industry estimated to be about 30 to 40 percent of total construction cost. For the U.S. alone this is in excess of three hundred billion dollars per year. The losses are even greater if the operating costs of existing facilities are considered.

At this time BIM is in full swing and multiple variations of uses are springing up every day. Architecture, Engineering, Construction and Property Management are in a direct path to a wholesome approach that will bring enormous benefits. The power of visualization through modeling, something that has existed since Antiquity is in our hands.

Jose F. Teran, AIA, is a member of the Board of Directors for the National Institute of Building Sciences (NIBS). He resides in Key Biscayne, Florida.
Synergy in the Sandbox

By Adam Lega, BIM Coordinator, KAI Design & BUILD

AN ARCHITECT, AN ENGINEER, a contractor and an owner walk into a bar... sounds like the beginning of a joke, right? Nope. This has become reality in the world of local user groups!

A local user group (LUG) is "a group of individuals, usually in a specific city or other geographical area, who are interested in common topics, and who meet regularly to discuss them." The term apparently got a start from the Linux Users Group but has since broadened to encompass the term "Local." Typical LUG activities include: encouraging and assisting new users, listening to presentations on specific topics, exchanging job information, developing projects, socializing and discussing means and methodologies about the topic around which the user group has formed. So basically, a LUG is like a neighborhood sandbox—it brings people together from all different walks of life to play and learn.

As BIM has become the new buzzword in the industry (and yes, it is official that BIM is unofficially a word), LUGs have begun to pop up everywhere to promote the concept of BIM and the supporting software products that make BIM possible. Some of the user groups are grass-roots efforts, some are corporate-sponsored. Our purpose is to explore several LUGs in particular and find out how they get the community more involved.

LUGs in four different markets (St. Louis, Kansas City, Denver and New York) were explored and—like neighborhood sandboxes—while their sponsorships are different, it was refreshing to discover that there are a number of similarities.

Each group handles meetings and topics in a similar fashion.

Typically, the LUG gets together informally, usually for dinner and drinks while they listen to a presenter for anywhere between thirty minutes to one hour. Dinner is generally provided free of charge for the attendees, either paid for by the group sponsor, donated or by minimal membership fees. The topics presented are relevant to the group meeting. After the presentation, there is a discussion that carries on until the last person decides to leave.

How often each group meets is a different story, however. According to Patrick Davis of the Kansas City Revit Users Group (K.C.R.U.G.), "We try to do something quarterly. Everyone is extremely busy and if we do a meeting or session, we want to make sure that it is meaningful." The Revit Roundtable (R.R.U.G.) and Ground Breakers [i.e. Civil] (G.B.U.G.) Users Groups in St. Louis meet six times a year—once every quarter and then twice for special sessions. "This allows people flexibility and keeps the group focused on the issues of BIM..." says Tracy Fisher of Hagerman and Company, Inc. On the other hand, the NYC Metro BIM Users Group was founded in April 2008 and to date they have had four meetings. That is at least once a month. The Denver Revit Users Group (D.R.U.G.—anyone noticing a theme here with these "UG" names?) also meets once a month, for twelve meetings per year. "We strive to keep the topics of our presentations varied in both discipline and skill level...from beginning a new project to advanced techniques..." according to Christopher Lynch, Vice President of D.R.U.G. This brings us to the next set of similarities:

Each group has a variety of members—from different market segments to varying skill levels—people are always willing to attend.

According to Davis, "We have people, from those that have not even purchased the tools, to experts." In St. Louis, the R.R.U.G. "gets attendance from everyone—architects, engineers, owners, professors, some students—the exception being contractors, though that is also changing as BIM becomes more prevalent," says Fisher. Lynch supports this assessment as well saying that the members come from "all areas—we have college students, architects, structural and MEP engineers and General Contractors." Another interesting bit of information—each group has managed to grow their user base despite their different means of supporting themselves. The common consensus: word of mouth is the most effective means of expanding each group. For example, in Denver the group has grown to 196 members. They have a minimal membership fee to support the cost of meetings and enjoy the support of some of the local resellers to provide resources. In Kansas City, they "no longer track membership...but at last count had 250 plus members." There are no membership fees in KC and the group itself has no sponsors. It is just an informal get-together with people who want to share information about BIM. R.R.U.G. in St. Louis is sponsored by Hagerman and Company, Inc. They have about 70 members to date and are continuing to grow. Because R.R.U.G. has a corporate sponsor, there is no membership fee associated with being part of their group. The newest member of the LUGs studied, NYC Metro BIM has 168 BIMologists at the time this article was written—and that is four months into their groups founding. Even more interesting is that anyone can join their group. Despite catering to their strong local presence, NYC Metro also has a growing national membership, due to their use of technology. New members just sign up on their website. This leads to another observation:

Each of the groups has a web presence of some kind.

R.R.U.G. uses email and the web to register people for meetings. Additionally, a PDF newsletter, The Revit Review, is sent out to all registered members in order to communicate what happens in each of the meetings that take place. For D.R.U.G., the internet, "...has been very key to our organization. Almost the entire organization is run through the website...providing one central location for members to access...past presentation downloads, allowing people to join or just being able to contact someone to get more information." Lynch also says that their blog "provides volunteers a quick and easy method of updating the website and keeping members informed." K.C.R.U.G. has a website and blog that is not much used at all. Davis links to other sites that have the resources already available, rather than repeating what has been done well elsewhere. NYC Metro has one of the most interesting web uses. As stated previously, they draw members from a national audience. This happens through their use of the web to broadcast their local meetings via webinar technology. It enables people nationally to participate locally, to view the presentation being given. For NYC Metro, the internet is instrumental in organizing the meetings and registering the members who attend.

So what does each group gain from forming? With some differences, the motivation is the same: Hagerman and Company, Inc. has invested their own resources—marketing, profit, time and effort—into sponsoring a synergistic
atmosphere at R.R.U.G. and G.B.U.G., where locals from different companies can get together and share knowledge. What motivates Hagerman to do this is not profit but instead “to be perceived as the industry experts and service leaders,” according to Fisher. Though profit is not motivation, it makes sense that Hagerman will have a better reputation across the AEC industry as a direct result of fostering a collaborative environment. Contrast that to K.C.R.U.G. who “has attended some of the AUGI meetings at AU about growing your User Group, creating an organization structure and that is not what this group is about. We are just trying to share information, if that means 100 people attend a meeting or 10, that’s ok,” says Davis. For D.R.U.G., “the members show up because of the content that is provided.” Lynch goes on to say that, “… I also receive the benefit of networking with a wide variety of professionals in the design/construction field, and they recognize me as one of the area’s most advanced users.” NYC Metro is “dedicated to supporting the networking for all organizations involved in BIM, gaining the support and involvement of owners, architects, engineers, construction firms and practitioners, educational institutions, property and facility managers and other professionals.”

Each group was formed as an outlet to share information and network with like-minded individuals.

Each of the Local User Groups covers BIM in one way or another.

Take a look at the names of each User Group studied. G.B.U.G., R.R.U.G., D.R.U.G., K.C.R.U.G., NYC Metro BIM—it is evident that their focus is to understand the tools used in the BIM process. They each go about it differently, however. BIM encompasses much more than just a single piece of software. BIM is a process, a methodology—a noun, a verb and a gerund all rolled into one acronym if you want to get technical (in fact, the only gerund not ending in “-ing”). This is where each group stands alone. G.B.U.G. studies civil aspects of BIM, R.R.U.G. studies architectural, structural and MEP. D.R.U.G. and K.C.R.U.G. have discussions that focus on process and tools that will work with Revit exclusively. And NYC Metro approaches BIM as a whole, studying what it does to benefit business and society alike—how it is used currently, how it will be used and how we can achieve true collaboration in an interoperable environment.

How do we get into the sandbox?

This question has a simple answer—go to a meeting of your local user group. An intriguing phenomena evolving with BIM has been the buildingSMART Alliance Interest Groups or “BIM Breakfast” groups as they have been called. Like the LUGs, they meet once a month in a local venue for breakfast and BIM, in a session that lasts about ninety minutes. It is very informal and has drawn users from all over. In fact, the NYC Metro BIM users group is an Alliance affiliate. Unlike the LUGs, they have no specific software focus. These groups are local grass roots organizations that have been established to get AEC practitioners and stakeholders alike to interact with each other in an effort to understand BIM and help make it better.

Or better yet, start a user group—build your own local BIM sandbox! The buildingSMART Alliance website has a list of currently active interest groups and who to contact to get involved. There is also an excellent PDF guide outlining how to start a BIM interest group in your neck of the woods. The challenge is getting that local sandbox synergy to coalesce.

Whether at a home or in a park, a sandbox is a place where neighborhood kids get together to create and play. And if someone does not play nicely, they are evicted. So the synergy remains undisturbed and is left to foster a culture of sharing and collaboration. These local
user groups are akin to that sandbox—locals gathering to learn, share and grow in their chosen topic. What ultimately creates this synergy in the sandbox? Remarkably, across all these groups it is the members who are the most important factor in their success. Different people from different market segments are all coming together to network, to chat, to share knowledge and to help each other understand BIM. Some meetings are formal, while some are informal; but they all promise an environment where people can collaborate and disseminate information about a topic that everyone desires to understand—it is all about BIM.

Special thanks to the following for their contributions to the research in this article: Tracy Fisher and Amy Ameling from Hagerman and Company, Inc in St. Louis, Missouri, Patrick Davis from HNTB in Kansas City, Missouri, Christopher Lynch from Fentress Architects in Denver, Colorado.

Adam Lega is the Building Information Modeling Coordinator for KAI Design & BUILD.
Project Updates

By E. William East

MEMBERS OF THE ALLIANCE are working very hard on many projects that are beginning to transform our industry. Below is a list of some of these projects and information about the most recent achievements. More information on many of these projects is available through the Alliance website or by contacting the listed point of contact.

AECOO Testbed

The Testbed is an international, hands-on, and collaborative rapid prototyping program designed to develop and deliver working commercial software that can frame candidate standards for OGC’s, the National Building Information Modeling Standard’s (NBIMS,) and buildingSMART International’s specification and other standards programs where they may be formalized for release as open standards. The current phase of the Testbed is focusing on developing information interoperability using Industry Foundation Classes (IFC) in two primary areas: quantity take-off and energy analysis. AECOO-1-Testbed is a joint buildingSMART alliance / Open Geospatial Consortium’s (OGC) Interoperability Initiative. It provides a global, industry wide effort to move our building industry forward in meeting a number of challenges. (POC Louis Hect, lhecht@opengeospatial.org)

Construction-Operations Building Information Exchange (COBIE)

COBIE eliminates duplicative data entry, eliminates paper reproduction costs, and improves the quality construction handover information. A number of federal agencies are requiring the delivery of COBIE data during design and also during construction. These agencies include: Department of State, Corps of Engineers, and General Services Agency. A live demonstration and automated testing of designer-side COBIE deliverables was conducted in July 2008. The following vendors were successful in providing COBIE design data directly from their applications: Autodesk (Revit), Bentley (Architect), Netscheck (Vectorworks), Onuma (Onuma Planning System), Project Work Bench (Room-Data). (POC Bill East, bill.east@us.army.mil)

Inter-agency Federal Asset Classification

The IFACT project is designed to create a database to improve equipment asset identification and tracking, and asset information management.

While this work is sponsored by several federal agencies the holder of the classifications developed through this work will be the Construction Specification Institute. To that end, this effort has participated in a review of the OmniClass Table 23, “Products.” The team is also working to compile a new set of abbreviations in the National CAD Standard. (POC Greg Ceton, gceton@csinet.org)

Quantity Take-Off

The quantity take-off project aims to eliminate the time wasted in “counting door knobs and light bulbs.” The Association for the Advancement of Cost Engineering (AAACE) and the American Society of Professional Estimators (ASPE) are leading this effort to identify design and estimating information exchanges required, not only to eliminate the “counting” activities, but also mapping of discipline oriented design views to system oriented construction processes. (POC Peter Bredheoef, pete.bredheoef@ch2m.com)

SMARTCodesTM

The objective of the SMARTCodesTM project is to support rapid completion of code complying design and more timely permitting reviews using BIM-based submissions. Demonstrations of automated code checking of BIM designs against the envelope and lighting provisions of the 2006 ICC International Energy Conservation Code have been completed. Current work is focused on egress and accessibility provisions of the 2006 ICC International Building Code. Development of formal BIM-based information exchange standards supporting these automated checks is underway. The team is currently working with BIM vendors to support their demonstrations of automated code checking. (POC Dave Connonover, dconnonover@icc.org)

Spatial Compliance Information Exchange (SCIIE)

Ensuring compliance with spatial programming requirements is an important aspect of the overall project management goals of any project. SCIIE enables the accounting of space by function and zoning using the recently harmonized IFMA/BOMA space measurements standards. One of the key ideas behind the development process of Information Exchange formats is the re-use of previously created “model views” or extracted data sets. SCIIE data is also needed for facility asset management and is already delivered through the COBIE format, described above. As a result, if one changes space measurement and zoning requirements in the COBIE specification to be required data items, then the SCIIE is delivered as a by-product of the COBIE deliverable. SCIIE is a generic specification that fully reflects the requirements of the GSA BIM Guide for architectural programming, only using non-agency specific information classifications. (POC Bill East, bill.east@us.army.mil)

Specifiers’ Properties Information Exchange (SPIE)

The Specifiers of Construction in Independent Practice (SCIP) is an industry-wide initiative that includes CSI, product manufacturers, manufacturer’s association, specification software companies, product publisher organizations, and federal government agencies to prepare a minimum set of attributes that can be specified to be included on all manufactured products in a BIM model. A complete set of properties across all UNIFORMAT and MATERFORMAT sections have been completed. Templates for these property sets and sample data from participating manufacturers should be presented late 2008. Demonstrations of software support for these property sets and associated draft federal government specifications to require these properties may be completed as early as Fall 2009.

Structural Information Exchange

This project has brought together several structural engineering software manufacturers to develop an information exchange standard for structural member geometry. This was required since current BIM and structural engineering software do not provide common interchange formats for structural geometry. This project is sponsored by the Pankow Foundation and has been underway since September 2007. (POC Thomas McLane tmclane@atcouncil.org)

UNIFORMAT Consolidation

The team working to consolidate UNIFORMAT has held five workshops starting in 2006. Each workshop had over 20 participants providing broad stakeholders representation. In April 2008 the proposed UNIFORMAT updates were published for public comment. The team is currently evaluating these updates and will present the final recommendation for UNIFORMAT revisions in late 2008. (POC: Robert Johnson rjohnson01@covad.net)
If you believe in what we are attempting to do then we need your support. Please go to the website (www.buildingsmartalliance.org) and join the Alliance and invest in your future. We encourage you to join as an organization as the switch to BIM is organizational and this would send a strong message not only to your organization, but to the industry. However, if you are not able to do that then please join as an individual.

Joining as a sponsor will have the biggest impact on the industry and will provide you the opportunity to help guide the Alliance by being included on the Board of Direction. Sponsorships over $25k provide access to all chapters worldwide. Therefore, if you are multinational or considering being so in the future, this might be your best investment.

Our approach is to make the vast majority of our products available at no charge to the end user. This is because it is our goal to be as inclusive as possible to achieve a faster market penetration of all phases of the industry. However, we cannot do that without resources and that is where you come in. Since you understand what we are trying to accomplish your support will help others learn.

It is estimated that there are upwards of 10 million people involved in the facilities industry. There is no telling how many we need to fully engage in order to succeed, but the number is quite large. We plan to do this with the support of industry associations, government agencies, as well as individuals.

The various products that we are currently providing after just one year in operation include the following. We need your support to first simply sustain these products:

- Journal of Building Information Modeling magazine;
- Support to buildingSMART International ($25K Sponsors are International members);
- Sponsorship of Alliance projects and project promotion (e.g. Smart Market Report and BIM Storm);
- Presentations, workshops and seminars to nearly 100 organizations a year;
- Coordination of Speakers Bureau;
- Coordination with all organizations involved in BIM;
- National BIM Standard Development;
- International standards development (ifc, IDM, MVD & IFD Library);
- buildingSMART alliance™ web site;
- Two conferences per year (Spring and Fall);
- Organizational support for Local buildingSMART alliance™ Interest Groups; and
- Central staff support for the Alliance.

Our goal is to expand these products by adding additional products. These will only be made possible through a significant increase in membership:
• JBIM Live—an on-line version of JBIM allowing longer articles and more timely posting of articles than twice a year.

• Project sponsorship is based on the funding you provide. Many projects are critical to our common good, but are not funded to include any level of collaboration and coordination with others. The Alliance will help support those projects and ensure that multiple organizations can work together.

• New projects that are not funded that need funding will also come directly from you. A list of projects will be created to identify these opportunities. Sponsorship also lets you fund specific additional projects of interest to your organization.

• The National BIM Standard needs substantial expansion. Projects must be completed then go through the consensus process so that they can be incorporated into the standard. This takes staff time and resources to accomplish.

It should be noted that our goal currently is to develop a plan and demonstrate practitioner interest in transforming the industry. However, we do not think that we are going to solve a $400B problem on the backs of the practitioners. It will take significant involvement from those who are spending the $400B, in order to accomplish this. We first have to identify where the funds are being wasted, then provide a plan to fix the problem areas. Once we reach that point then the funding for overall success will be made available. This will not be a quick fix, but will occur through an overall transformation throughout the industry. We have never had a better opportunity to succeed than we do now. But it will only come if you support the early phases now.

Please seriously consider joining the Alliance now.

For more information on the alliance and membership fees, please contact:

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