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The USC School of Cinematic Arts:
The Arrival of Spring in the Facilities Industry

Building Information Models and Model Views – Part 3

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 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. Part 2 of this article (published in Fall 2008) provided more detail about a standard process and toolset for developing BIM based solutions called the IFC Solutions Factory. In this third installment of the series, we will look at the Solution Factory artifacts for a project organized, funded, and managed by the US Government Services Administration (GSA), the buildingSMART alliance™ (bSa) and the Open Geospatial Consortium (OGC).

The project began July 2007, when GSA began formulating requirements to enable energy analysis of buildings in early stages of design. During the past 18 plus months, an IDM and MVD have been developed and widely reviewed, prototype software implementations have been developed, and software testing has begun. By the time this article is published, the first public demonstration of software supporting this interoperability use case will have shown at the national building museum in Washington, DC. It will show models created in ArchiCAD and Vectorworks exported as IFC BIMs. These IFC BIMs are then preprocessed by the Geometry Simplification Tool (GST) (developed at the Lawrence Berkeley National Laboratory (LBNL) and submitted for energy analysis by EnergyPlus (also developed at LBNL). EnergyPlus is the premier full building energy simulation engine. The resulting energy performance assessment will then be compared to energy targets and provide feedback to designers early in the design process—when there is still time and flexibility to make design changes.

The following IDM, MVD, and software testing examples were developed by the original GSA teams (there were two) and by the team for the Building Performance Energy Analysis (BPEA) thread of the bSa/OGC Testbed project. The March 26 demonstration in Washington, DC and subsequent Engineering Report will culminate that Testbed. However, work to evolve these prototypes into commercially available products will continue in the "Concept Design BIM 2009" project, funded by GSA, Statsbygg (equivalent of GSA for Norway), and Senate (equivalent of GSA for Finland).

IDM FOR "ARCHITECTURAL DESIGN TO ENERGY ANALYSIS"

As the name implies, this interoperability use case involves development of building model in an architectural BIM authoring application and then submitting that BIM to an energy analysis application in order to give energy performance feedback to the designer, throughout the design process. Other use cases are being developed in parallel. These include cost feedback, and checking that spatial programs and security requirements are met. As described in the previous article, there are three primary deliverables in an IDM: a process map (the end user process), exchange requirements (the information to be exchanged), and a BIM guide (instructions to the end user). Examples and web addresses for download and review are also included.

PROCESS MAP

A process map is a series of process diagrams that chart the tasks and information flow in an industry process using Business Process Mapping Notation(BPMN), and standard managed by the Object Management Group (OMG) (www.omg.org).

Each task, decision gateway, reference data type, and exchange requirement is documented in the IDM document, as shown in www.blis-project.org/IAI-MVD/IDM/BSA-002/PM_BSA-002.pdf.

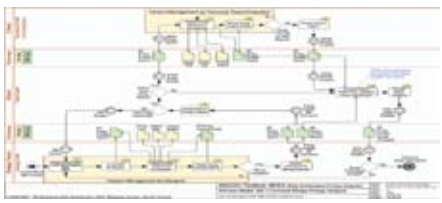
EXCHANGE REQUIREMENTS

An exchange requirements document defines the data to be exchanged between two applications being used in the process map. This includes data element names, descriptions, data types and units. www.blis-project.org/IAI-MVD/IDM/BSA-002/ER_BSA-002.pdf.

BIM GUIDE

The BIM guide provides guidance to end users that will participate in the industry process and BIM data exchange documented in the process map and exchange requirements. In particular, it captures the business rules that the end user must follow to be successful in creating the BIM to be exchanged and/or using the BIM in the receiving application. www.gsa.gov/gsa/cm_attachments/GSA_DOCUMENT/GSA_BIM_Guide_Series_05_Version_1_R2C-a3-l_0Z5RDZ-i34K-pR.pdf.

The full article with high resolution photos can be downloaded at www.buildingsmartalliance.org

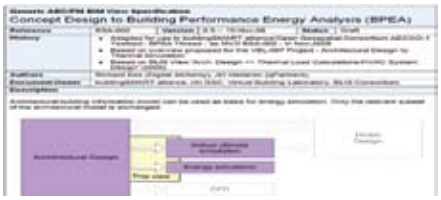


MVD FOR "ARCHITECTURAL DESIGN TO ENERGY ANALYSIS"

As described in the previous article, the MVD provides guidance to software companies looking to support the IFC BIM exchange in their applications. This is done through a web of interconnected pages on the MVD Coordination web site at www.mvd.buildingsmart.com (which forwards to www.blis-project.org/IAI-MVD/). These pages include an MVD overview, a generic MVD (independent of any information model), one or more MVD bindings (to the IFC BIM schema), and implementer guidance for each MVD Concept in each binding. Examples and web addresses for download follow.

MVD OVERVIEW

This document provides a high level overview of the purpose of an MVD, the IDM that defines requirements, and the application types expected to support the IFC BIM exchange. www.blis-project.org/IAI-MVD/MVDs/BSA-002/Overview.pdf.



GENERIC MVD

The generic MVD is a series of entity-relationship diagrams that define the software data concepts (MVD concepts) to be exchanged. Each diagram is focused on a configuration of static MVD concepts (concepts that can be reused in many MVD Diagrams, and do not change, -e.g. name, description and 3D placement) to be included in the exchange for a single variable concept (concepts that can be configured to include different information in different MVDs, -e.g. wall, door or window). www.blis-project.org/IAI-MVD/reporting/browseMVD.php?MVD=BSA-002&BND=Generic&LAYOUT=H.

MVD BINDING TO THE IFC BIM SCHEMA

An MVD binding defines how each MVD concept will be represented in a data exchange, using an information model schema. In this example, the binding is to the IFC 2x3 schema, developed by buildingSMART International. Other bindings could be developed for future versions of the IFC standard, of for other information model schemata, including XML schema definitions. www.blis-project.org/IAI-MVD/reporting/browseMVD.php?MVD=BSA-002&BND=IFC2x3&LAYOUT=H.

SOFTWARE IMPLEMENTATION GUIDANCE FOR MVD CONCEPTS

One of the significant issues with software support for IFC in the past has been inconsistent interpretation of implementation requirements. This is generally attributed to insufficient documentation of requirements for the Coordination View (the model most implemented to date). The current MVD system addresses this by requiring documentation for each MVD concept that includes an instantiation diagram (exactly which IFC entities and relationships must be included) and all implementer agreements. The intended result is an implementation spec that is unambiguous and will be implemented consistently by any number of software vendors. www.blis-project.org/IAI-MVD/reporting/showConcept.php?CREF=BSA-267 (where BSA-267 is the Concept ID).

SOFTWARE TESTING FOR "ARCHITECTURAL DESIGN TO ENERGY ANALYSIS"

In order to have confidence in any data exchange, the candidate software implementations must be tested. The third process/toolset in the IFC Solutions Factory is focused on development of thorough and repeatable testing of software applications for correct support of export or import of an MVD.

The structure of an MVD, as a collection of concepts, lends itself very well to software unit testing. Unit tests are software tests that test for compliance to a single requirement. The test package for a single MVD concept includes one unit test for each requirement defined in the implementation guidance for that concept. These unit test packages are run by the software development or test engineer using the NUnit Test Framework (www.NUnit.org).The image below shows an example of the results for testing all ElementQuantities in a test file generated by a BIM authoring application. As you can see, some failures are because the test file did not include all the required object types. Test packages will be downloadable from the MVD Coordination web site by mid-2009.

END USER VALIDATION OF BIM DATA EXCHANGE

The fourth process and toolset in the IFC Solutions Factory, as described in the last segment of this series, is focused on enabling end users to validate a BIM they have received as correctly supporting all requirements in the agreed BIM data exchange (i.e. the agreed IDM exchange requirements and BIM guide requirements). Development of this process and tools is ongoing, so I don't have an example here. What can be shared is that this development is based on technology developed for automated building code compliance checking in the SMARTcodes project (www.iccsafe.org/SMARTcodes). Examples should be available for review and comment in late 2009. ■

Part 4 of this article series will walk through a series of MVD concepts that are common to a wide array of buildingSMART industry use cases. Review of these key concepts will give the reader a much better understanding and appreciation for how BIMs are structured and why the relationships between objects in a BIM are just as important as the objects themselves.

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).