JBIM
Journal of Building Information Modeling
An official publication of the National Institute of Building Sciences
buildingSMART alliance™
National Institute of Building Sciences: An Authoritative Source of Innovative Solutions for the Built Environment
Fall 2009

BIM Enables Success on WTC Mega Project

Performance Specifications for Building Information Exchange

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DISCUSSIONS OF BUILDING INFORMATION MODELING OFTEN center on building geometry. The most widely described uses of building information to date have been for collision detection and progress visualizations. *Engineering News-Record* reported recently that one hour spent in design coordination activities results in ten hours of saved field re-work. Attaching geometry to Critical Path Method schedules creates "4D" models, useful in reducing on-site conflicts due to trade scheduling and material handling.

The majority of information needed by the owner, construction agents, and ultimately, the facility manager, does not directly concern the geometry of the building. Equipment lists, for example, provide the list of equipment and equipment types listed with their room number and some limited sets of properties. Other equipment properties may be found in the specifications, a decidedly non-geometric representation of building information.

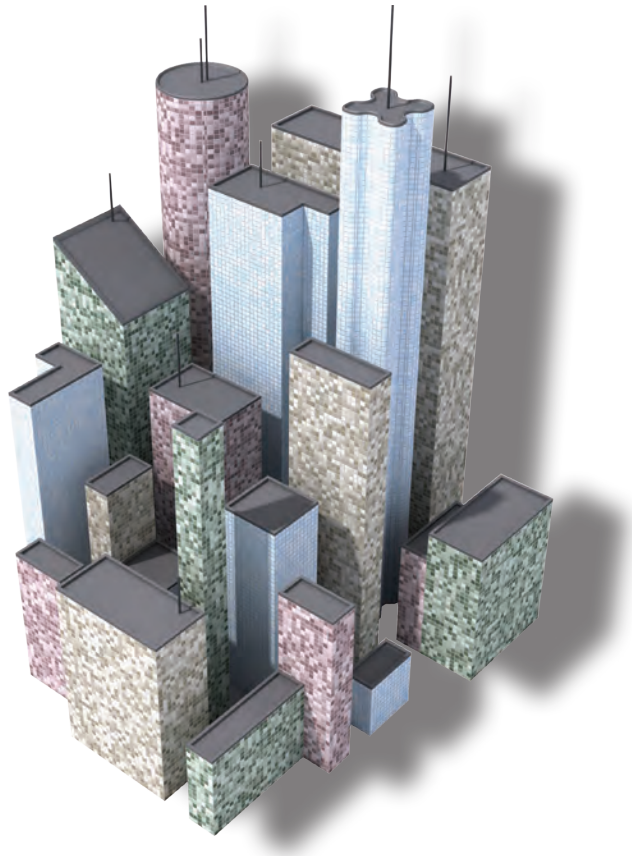
The worker installing a pump, for example, does not need to know a detailed geometric representation of that device. They do, however, need to have the installation instructions from the manufacturer and information about the inflow and outflow piping and the status of the powering electrical system.

A brief list of information currently exchanged in a variety of different documents and messages in many proprietary formats, follows:

Commissioning Plans	Cost Estimates
Daily Reports	Equipment Lists
Floor Plans and Drawings	Fabrication Drawings
Insurance	Invoices
Manufacturer Product Data	Operations & Maintenance Manuals
Photographs	Progress Schedules
Quality Control Documentation	Requests for Information
Room Data Sheets	Safety Inspections
Spare Parts Providers	Specifications
Tests and Certifications	Warranties

Table 1. Typical contract deliverables.

None of the public building information modeling specifications reviewed by me distinguish between the requirements for building information deliverables and the technology that is required to deliver such information. One example of the lack of separation is the requirement that as-built models be accurate below the tolerance of the completed construction. Finished walls may, for example, be ¼ inch out of vertical alignment across the face of a long wall, therefore requiring the as-built deliverable to be accurate within ¼ inch is an untestable requirement.



For the purposes of operations and maintenance activities, in another example, the geometric location of water values within a building needs only to be within the listed room number and within two feet of the as-installed location.

The separate specification of information requirements and accuracy from means and methods is the essential characteristic of open competitive bidding. By defining requirements, vendors specializing in specific means and methods can compete in the marketplace to deliver the best value product at the least cost to the owner. While the use of performance specifications related to physical components of the building is well understood, examples of performance specifications for the delivery of electronic information is not found in current contracts.

The most basic performance specification for the delivery of electronic information is the ASCII file format. This format, now embedded in every software system in the world, defines the computer coding required for representation of alphabets, numbers and commonly used symbols. The ASCII requirement is so well embedded within computer software that contracts no longer specify that text information be represented in ASCII format.

An electronic format more closely tied to the construction industry is the Standard Data Exchange Format (SDEF).

SDEF is a Critical Path Method scheduling data exchange format used for over 15 years by the Corps of Engineers and others (http://140.194.76.129/publications/eng-regs/er1-1-11/entire.pdf). SDEF cost-loaded CPM schedules are submitted, in a non-proprietary format, to assist in determining contractor payments.

DRAFTED SPECIFICATIONS

The first demonstration of performance specifications for building information deliverables was conducted in July 2008 at the National Academy of Sciences (www.buildingsmartalliance.org/news/20080723.php). Three new specifications were presented, and several widely used commercial software systems demonstrated their ability to comply with these requirements.

The first of the performance specifications required project planners to provide space programming, and blocking and stacking diagrams in a neutral file format to allow the information to be used by designers and others downstream in the process. This specification was based on the requirement of the *GSA BIM Guide*, but removed the agency-specific requirements to allow the format to be used across the entire industry. The open standard format for this information exchange is called the Spatial Compliance information exchange (www.buildingsmartalliance.org/projects/scie).

The second of these specifications extends design quality-control deliverables to allow designers to demonstrate that they have met their contractual obligation to coordinate the designs provided by various consultants. This specification requires designers to provide a hard- and soft-collision report and identify any significant collisions not addressed in the subject deliverable. While BIM software may be used by the designer to perform this collision detection report, CAD vendors may also collate the results of "light-table reviews" to arrive at a similar set of collision information. The objective here is the result of the action, and not that a specific set of software was or was not used. The open standard format for this information exchange is called the coordination view information exchange (www.buildingsmartalliance.org/projects/cvie).

The third performance specification required contractors to provide equipment lists, warranties, spare parts suppliers, submittals and maintenance plans in a format that would not end up in building's boiler room. The Construction Operations Building information exchange (COBie) is currently gaining both national and international attention due to demand to eliminate the waste associated with creating, reproducing, processing and archiving paper documents (http://wbdg.org/resources/COBIE.php).

Public agencies currently have COBie requirements listed in the BIM sections of their specifications that are incorrect. The COBie specification presented in July 2008 clearly states that the COBie specification replaces those sections of current Operations and Maintenance Manual specs that require delivery of paper handover documentation. Since COBie is a performance-based specification for information delivery, it does not matter if COBie data has been produced manually in a spreadsheet form or automatically via export from BIM software. Demonstrations of software certified against an internationally accepted update to COBie will be conducted at the National Institute of Building Sciences Annual Meeting, in conjunction with Ecobuild America, December 7-10 in Washington, D.C.

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IN PREPARATION

I am leading a team to extend the initial COBie data set to begin to capture additional facility management information in a format that can be re-used. The Equipment Layout information exchange (ELie) project has a goal of providing a common layout for piping schematics. ELie takes into account work already accomplished by the process plant industry, as well as information to describe building blocking and stacking diagrams contained in COBie. A demonstration of work on ELie will be held at the Institute's Annual Meeting.

The second project to extend COBie is the Specifiers' Properties information exchange (SPie) (http://wbdg.org/references/pg_spt.php). SPie is currently working with specifications software firms, manufacturers and trade associations to begin to develop open standard property sets for materials, products and equipment. The initial set of these properties, created by the Specifications Consultants in Independent Practice in conjunction with the Construction Specification Institute, is currently available on the Whole Building Design Guide's Product Guide. A demonstration of work on SPie will be held at the Institute's Annual Meeting.

Given the Department of Defense's interest in reducing its energy footprint, my team is also working on a longer term project to transform the exchange of energy-related building information exchanges into a full energy management control cycle. The current phase of this effort, the energy information exchange (ENERGie) format, will extend early design energyanalysis efforts funded by the General Services Administration into the design stage. A demonstration of work on ENERGie will also be held at the Institute's Annual Meeting.

As with previous efforts, each of these new exchange specifications are aligned with the buildingSMART Industry Foundation Class schema and that portion of the IFC model represented in COBie. Reports that automatically identify deviations between submissions and these formats are also fully interoperable between IFC and ifcXML.

FUTURE SPECIFICATIONS

With many of the contractual deliverables identified in **Table 1**, it is possible to identify a significant amount of wasted effort required by all parties to produce the contracted information and also by those who would use the information once delivered to the owner. The current way cost estimates are exchanged, for example, requires repeated counting of "door knobs, light bulbs and carpet areas" throughout the average 67 year life of an army building. Exchanges of site photos and construction punch lists would be greatly enhanced by identifying the context of the files and transactional information.

The AGCxml project (http://buildingsmartalliance.org/index.php/projects/agcxml) has begun to develop message wrappers within which project information may be supplied and consumed across the World Wide Web. AGCxml is a good start and will continue as the performance requirements for the information contained within these wrappers is specified. The content will include both specific information to be transferred and references to other building information that allow the transaction to be placed within the larger project context. Use of AGCxml will depend on the development of an ecosystem of web service-oriented software tools.

CONCLUSIONS

One of the primary drivers of waste in the design and construction industry is the lack of reliable methods for contracted information exchange. The development of performance specifications for the delivery of consistent, computable building information is the only approach that will allow market forces to drive the innovations needed to eliminate such waste. These innovations will come both in the software we use to perform and transmit our work, and in the types of services that will be needed to coordinate and manage such transactions.

We are at the early stage of completing a variety of different information exchange formats. While the work to develop these formats does not proceed as quickly as one would like, once it is completed, the specifications can be directly applied without reliance on proprietary means and methods.

To accomplish this hard work, your help is needed. Please sign up with the buildingSMART alliance™ to contribute to these existing projects and to start new projects to develop performance-based specifications for the delivery of building information in your subject matter area or customer domain. ■

Acknowledgements: The views expressed in this article are those of the author and not the policy of the U.S. Army Corps of Engineers or the Engineer Research and Development Center.

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