



TOWN+GOWN

BIMapalooza

A Town+Gown Symposia Event with
The General Society of Mechanics and Tradesmen
of the City of New York
20 West 44th Street
November 12, 2013 (8:30 a.m. to 11:30 a.m.)

BIM-fest Synopsis. The January 23, 2013 symposium event used several items as departure points for the conversation. A Ph.D. dissertation entitled *What Is the State of Building Information Modeling and Integrated Project Delivery in Public Sector Construction?* and a 2011 fall semester NYU/Poly Department of Civil Engineering class, Information Systems in Project Management Course (CE8303), served as the academic contribution.¹ *The BIM Guidelines*, issued by the New York City Department of Design and Construction (DDC), served as the practitioner contribution.² *The BIM Guidelines* document is the first expression of the City's effort to bring building information modeling (BIM) to bear on public project design and construction

Q: What is BIM?

A: An acronym representing three separate but linked functions:

- *Building Information **Modeling**: a business process*
- *Building Information **Model**: a digital representation*
- *Building Information **Management**: the organization and control of the process utilizing information in the digital prototype*

See

<http://www.buildingsmart.org/organization/OPEN%20BIM%20ExCom%20Agreed%20Description%2020120131.pdf>

processes, with the ultimate goal of expanding BIM use across the portfolio of projects as well as expanding its use from design through construction to post-completion occupancy activities.

The brief presentations led to a wide-ranging conversation that illuminated the potential for research projects in Town+Gown. In view of the potential for avoided costs from BIM implementation, there was a discussion about the types of project cost data that would be necessary to evaluate the impact of BIM, including measuring avoided costs. DDC's linkage of BIM to post-completion occupancy activities led to the suggestion that applying BIM, via "Laser Interferometry Detection and Ranging" technologies (LIDAR), to existing structures of all kinds, public and private, could be useful in accelerating the adoption of BIM in the built environment, as well as leveraging BIM technology for first responders during emergencies, such as fires. The last issue raised was that of interoperability—"the need to pass data between applications, and for multiple applications to jointly contribute to the work at hand."³ Since design "and construction are collaborative activities, so too are the tools that support them."⁴

Précis Document as Homework. The Town+Gown symposium event provides space for reflection on completed projects where members of Town+Gown

can discuss completed projects in an open-ended manner to identify appropriate action, including future research, within Town+Gown. Conversations with academics about completed projects, which practitioners have sponsored and participated in, can advance ongoing conversations among practitioners. For this symposium event, there is no crisis—this is simply a research-based conversation. There is no particular agenda other than what is suggested by the completed projects and prior symposium events. But for the conversation to be productive, this précis document is the “homework assignment”. It will provide background contextual information as a foundation for raising questions and discussing them.

BIM and existing built artifacts—first responders and infrastructure projects. While discussions about BIM have tended to focus on the design and construction of new projects, the discussion at BIM-fest focused squarely on the application of BIM to existing buildings for public safety purposes. Under current city law, owners of certain commercial buildings taller than six stories must submit architectural floor plans in a 2-dimensional computer-assisted design (CAD) format to the New York City Fire Department (FDNY). This data, which is part of the covered buildings’ comprehensive (combined) fire safety and evacuation and emergency action plan, provides building information for the occupants as well as the first responders. Currently, FDNY staff is able to access the 2-dimensional CAD building data at an emergency site to communicate critical data to firefighters in these buildings during an emergency. Participants at BIM-fest raised, as a topic for conversation, the potential for BIM technology, which can represent the same floor plan data in a three-dimensional format, in conjunction with global positional systems capacity, to increase first responder safety on the job.

Since release of *The BIM Guidelines*, which currently applies to vertical structures, not horizontal infrastructure, DDC has begun to pilot the use of BIM during the public review and participation process.⁵ While two-dimensional blueprints for planned projects comply with the legal requirements for public project review—and until BIM entered the field, it was the most cost effective way to provide such information—they sometimes are unable to communicate important information to those not trained to read them. BIM’s three-dimensional capacity can make technical data more readily observable and understandable to the members of the general public charged with public project review, permitting a comparison between a pre-construction—or existing—site condition and the desired post-construction condition.

What do these two case study descriptions of BIM applications with respect to existing—or “as built”—conditions suggest? What other “as built” conditions would be amenable to BIM use, enabled by LIDAR? What research would be helpful to consider going forward?

Evaluating the impact of BIM on projects—a data and budget discussion. The completed dissertation and the engineering class simulation suggest that application of BIM on a public construction project, even in the context of the segmented design-bid-build delivery methodology, can permit project participants to avoid costs due to minimizing gaps in information transfer that lead to rework during the construction phase, with attendant increases in costs effected *via* change orders. Several DDC projects underway have utilized BIM during the design and construction phases, providing additional potential for BIM-enabled operation and maintenance during the life of the buildings.

DDC has applied other design- and construction-management tools and techniques to its projects in

queue, such as “design metrics” and “lean construction” principles.⁶ Design metrics enables a project team to articulate design goals early and communicate them to ensure their realization through the construction process. Critical elements of this methodology are establishing consensus around design priorities, tracking them through the process, evaluating their effectiveness at project completion and feeding back evaluations to inform subsequent projects. Lean construction aims to eliminate waste and provide value in construction by applying total quality management strategies adapted to the construction setting.⁷ DDC has also taken advantage of the city-wide Capital Project Scope Development program (CSPD), operated and funded by the City’s Office of Management and Budget, for some of its projects. CSPD provides expense funds to agencies contemplating capital projects for design scoping services before capital budget adoption in order to increase the chances that the estimated cost at adoption is realistic.

Additionally, BIM, whether at the end of new construction/major renovation or in conjunction with LIDAR to document existing conditions, is a tool for public owners to use for operations and maintenance during an asset’s life cycle—also referred to as “state of good repair”. The City’s state of good repair process and requirements can be found in Section 1110-a of the City Charter and are managed by the Mayor’s Office of Management and Budget via the Asset Information Management Systems (AIMS) program.⁸ BIM’s functionality from design to asset life cycle closely dovetails with the City’s environmental sustainability focus on building performance and its financial sustainability focus on life cycle operations and maintenance.

The City’s centralized financial management system, which contains budget planning data and contract payment audit data, and construction agencies’ internal project management data systems contain

a wealth of data that is potentially useful in evaluating the impact of BIM and the interventions on projects. But first, it is necessary to explore the theories linking management tools to effects, generate appropriate hypotheses and models, evaluate the usefulness of existing data sources in conducting impact analyses, and suggest the generation or collection of additional data to the extent the data cataloguing reveals gaps.

In theory, a management intervention that increases communication among project participants at various points of the process can be expected to avoid certain types of changes during construction that arise from information asymmetries and their associated costs. Three earlier Town+Gown projects—*NYC Capital Budgeting: The Impact on the Operating/Expense Budget; Increasing Project Planning and Scheduling Certainty for Critical Construction Projects; and, Balancing Cost and Quality for New York City Infrastructure Projects*—document aspects of the City’s capital planning-to budgeting-to construction process continuum and look at the processes through different, but related, lenses.⁹

How might we use the completed and related projects in Town+Gown to provide the foundation for the City and its agencies to establish methodologies and data sets necessary to measure the impact of these interventions when a sufficient number of projects have reached completion to permit quantitative evaluation?

Interoperability Issues. As noted above, BIM is a computer-based tool to manipulate, manage, utilize and communicate physical artifact data for a variety of functions related to the physical artifact, fixed in place from its design and construction to its operation and management during its lifecycle, all of which, in the public construction sphere, is financed with a combination of public debt and

expense funds from a variety of sources such as property and sales taxes as well as utility fees. BIM is a tool that also facilitates a collaborative process among project participants along the planning-to-design-to-construction continuum.

All of this requires interoperability across the lifecycle of a built artifact and interoperability across a range of project participants contributing different skill sets and enabled by different BIM tools and programs. At the precipice of widespread public- and private- owner integrated utilization of BIM, which will likely follow the path of adoption of CAD from paper-based blueprints, the question is not “if”, but “when” and “in what manner”. At this point it is possible to explore a series of public policy questions emanating from the question of “in what manner”. Government, as public owner, as regulator and as economic development actor, can act in various ways to minimize negative externalities, for itself and for the jurisdiction it controls, that will occur from the imperfect workings of private market mechanisms.

Thus, now is a good time to ask some public policy questions, such as “what is the appropriate role for government in the area of BIM interoperability?” and “what are the appropriate respective roles for the three levels of government, all of which are large public owners and thus consumers of BIM, and all of which regulate aspects of built environment participants, built environment processes and built environment artifacts?”

ENDNOTES

¹ For an abstract of the class, see http://www.nyc.gov/html/ddc/downloads/pdf/town_and_gov_n/TG_building_ideas_V2.pdf.

² See <http://www.nyc.gov/html/ddc/html/pubs/publications.shtml>.

³ Chuck Eastman, Paul Teicholz, Rafael Sacks and Kathleen Liston, *BIM Handbook: A Guide to Building Information Modeling* (Hoboken: 2008), p. 66.

⁴ *Idem*

⁵ See Chapters 6, 9, 10 and 70 of the New York City Charter

⁶ It was also suggested at BIM-fest that data recorded at the contractor level, including the sub-contractor level, would be useful to assess the impact of BIM during construction and to link to construction management analytical tools such as earned value management. While, there is a link between enterprise-wide project evaluation analyses and micro-project evaluation/management analyses, for a large public owner it seems more effective to articulate the evaluation methodology and required data at the enterprise level first and then proceed to the micro-project level. Once public owners get a handle on their enterprise-wide issues, next steps would include focusing on data generated at the contractor and sub-contractor level to support both macro-level and micro-level analyses.

⁷ E.g., the last planner system for phase “pull” planning, make work ready planning, weekly work planning and learning by percent plan complete.

⁸ For a description of the AIMS program and its nexus to financial sustainability, see http://nycbonds.org/NYC/html/nyc_disclaimer.html to obtain an official statement for a recent City bond issue. The description of the AIMS program can be found under Section VII FINANCIAL PLAN—Long-Term Capital Program. For a description of recent management initiatives related to the AIMS program, see p. 56 at http://www.nyc.gov/html/omb/downloads/pdf/mm5_13.pdf; cf., pp. 70-71 at

http://www.nyc.gov/html/omb/downloads/pdf/mm5_08.pdf.

⁹ For abstracts of these projects, see http://www.nyc.gov/html/ddc/downloads/pdf/town_and_gov_n/TG_building_ideas_V1.pdf; http://www.nyc.gov/html/ddc/downloads/pdf/town_and_gov_n/TG_building_ideas_V2.pdf; http://www.nyc.gov/html/ddc/downloads/pdf/town_and_gov_n/1.%20CURRENT_PROGRAM/BuildingIdeas3_web.pdf.