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BIM: A Comprehensive Collaboration Tool

by Dana K. "Deke" Smith, FAIA

I am sure many of you have been hearing from your associates in the industry that managing successful facilities and infrastructure projects is getting harder. Costly change orders are the rule, not the exception, and contingencies are under-budgeted. Projects are taking longer and longer to deliver, in part because of the amount of time it takes to get the necessary permits and inspections in a tight economic environment in which jurisdictions are increasingly being asked to do more with less. Then once the certificate of occupancy has been issued, precious little of the information generated during design and construction can be turned over in a usable form to those who will be maintaining the facility.

The reality is that the entire process from project inception to demolition is fraught with significant waste in both materials and human capital. It permeates every business process, but is most commonly rooted in the continuous re-collection of information. We have not been able to link our disciplines and activities to create an interoperable flow of information. We do not have confidence in the accuracy of information that has been collected and provided to us, so we re-gather it.

However, there is an approach available today that provides the foundation for much more efficient project delivery and better quality. This approach provides for a coordinated and contiguous business-based process that is evenly applied across and accessible to all in the building industry throughout the life cycle of a facility.

Engineering Collaboration

Although there is no magic solution that is going to fix all of the problems overnight, there are several promising approaches to business transformation. The most notable among these is based on Building Information Modeling (BIM) and is pulling together other ongoing process reengineering efforts such as Six Sigma and Lean Design and Construction under a new effort at the National Institute of Building Sciences (NIBS) called the buildingSMART alliance.

Thanks to technical improvements on all fronts, it is now possible to change the way we approach projects so that we can truly simulate the finished product, "experience the facility" and use that information to predict the full impact of the facility over its life cycle, which in turn facilitates managing fabrication, assembly and occupancy. Although still in its relative infancy, BIM can provide the continuity of information needed for better long-term-focused business decisions from the boardroom to the facility occupant.

A basic premise of BIM is collaboration by different stakeholders at different phases of the life cycle of a facility to insert, extract, update or modify information to support and reflect the roles of the stakeholder. A comprehensive approach that requires an underlying life-cycle-oriented culture change in order for its full potential to be realized, the goal is twofold. First is to create a facility virtually, completely analyze it prior to construction to work out problems, use it as a basis for building regulatory review and approval, and predict how it will operate. Second is to use the resulting model as a repository for information about the facility that can be used throughout its life to help sustain it and ensure that it remains functioning as it was designed in addition to being a data resource for fire, EMT and police.

The three-dimensional model generated during the process is a shared digital representation founded on open standards for interoperability. It contains much of the same information as the blueprints, specification sheets, test reports, spreadsheets, etc. currently generated for building projects. The difference is that all the data are in a common digital format that can be readily shared across a multitude of applications by all who have, create or need it. However, the model is only the repository for the information: business processes must be developed or reengineered to take advantage of the opportunity it provides as a collaborative information resource. These processes need to begin with project inception and carry through even past demolition.

The most significant savings created by the model come from modifying business processes so that they feed information into the model as automatically as possible. For example, invoices can be received electronically and information about a component such as its model number, serial number and supplier can be captured automatically and directly loaded into the database. In addition, warranty, preventive maintenance and installation information can be pulled directly from the manufacturer's website. The identity of the subcontractor who installs the component can also be input. This information is then passed on to the operator and sustainer of the facility, and work orders to maintain the item are tied to it and updated as work is completed. A properly designed work order management system will indicate what preventive maintenance may need to be done at the same time that repairs are being conducted on something else, and work orders should not be allowed to be closed until the information is updated.

Much of the waste that will be eliminated through the use of BIM is buried in business processes that require the collection of information that should already be

available. In many cases, for example, potential problems can be identified or predicted ahead of time, whereas if there is no model or the model has not been maintained, a considerable number of unforeseeable conditions may have to be addressed.

Scope of Collaboration

The scope of collaboration includes the following entities and operations, as each is in the position of having or having to collect information.

- Owners (high-level summary information about the facility)
- Planners (existing information about the physical site and corporate program needs)
- Realtors (information about the site or facility to support purchase or sale)
- Appraisers (information about the facility to support valuation)
- Mortgage Bankers (information about demographics, corporations and viability)
- Designers (planning and site information and program information from owners)
- Engineers (an electronic model to import into design and analysis software)
- Cost and Quantity Estimators (an electronic model from which to obtain accurate quantities)
- Specifiers (intelligent objects from which to specify and link to later phases)
- Attorneys (more accurate legal descriptions as well as more accurate information to defend or on which to base litigation)
- Construction Contractors (intelligent objects for bidding and ordering and a place to store gained information)
- Subcontractors (clearer communication and an accurate model from which to build to ensure that conflicts have been eliminated)
- Manufacturers (accurate modeling information for analysis and assembly of the facility)
- Fabricators (can use intelligent model for numerical controls for fabrication)
- Code Officials (code compliance checking software can quickly identify code compliance issues)
- Facility Managers (need product, warranty and maintenance information)
- Maintenance (need to easily identify products for repair parts or replacement)
- Renovation and Restoration (use information to minimize unforeseen conditions and resulting costs)
- Disposal and Recycling (better knowledge of what is recyclable and what is not)
- Scoping, Testing and Simulation (electronically build facility, eliminate conflicts and understand how facility will function prior to having a physical product)
- Safety and Occupational Health (knowledge of what materials are in use and electronic Material Safety Data Sheets, reduction of trades and excess materials on site)
- Environmental (improved information for environmental impact analysis)
- Plant Operations (three-dimensional visualization of processes)
- Energy (optimized energy analysis)
- Space and Security (intelligent objects in three-dimensions provide better understanding of vulnerabilities and how to overcome them)
- Network Managers (three-dimensional physical network plan is invaluable for troubleshooting and managing connectivity and network security)
- CIOs, CFOs and CEOs (basis for better business decisions and information about existing infrastructure)
- Risk Management (better understanding of potential risks and how to avoid or minimize them)
- Occupant Support (visualization of spaces, phones, equipment and furnishings)
- First Responders (minimize loss of life and property

with timely and accurate information about what is in the facility and where, including hazardous materials and areas of refuge)

The common pool of information provided and maintained by BIM makes collaboration not only possible but readily accomplished. Compare this to the current way of doing business in which many, if not all, of these entities and operations must collect a great deal of information independently because it is not readily available or current.

Building Smarter

With the buildingSMART alliance as the rallying point, we are beginning to see some strong collaborative teams in design and construction, and especially in design-build scenarios, but this needs to carry over into facility operations and sustainment and beyond. Although a lot of work still needs to be done to optimize the use of BIM, returns are already being realized, and these will grow exponentially as more facets of the industry link to these successes.

Individuals and associations that want to be part of the solution should consider joining the buildingSMART alliance. Organized by the nonprofit NIBS, its mission is to "improve all aspects of the facility and infrastructure life cycle process by promoting collaboration, technology and open information standards." Significant resources are needed, but the returns will be all the greater for your contributions.

For more information about the buildingSMART alliance, visit its website at *www.buildingSMART alliance.org.* ◆

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