JBIM

Journal of Building Information Modeling

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BIM in Structural Engineering:

A Current View of the Profession From one of the First National Surveys in 2008 of SE's by a Non-Profit SE organization

By Will F. Ikerd II, P.E., C.W.I,

THE IMPORTANCE OF THE ADOPTION OF BUILDING INFORMATION Modeling (BIM) by the structural engineering profession cannot be emphasized enough because the structure is the key component of buildings and all other disciplines are built on and scheduled around it. The BIM enabled process for structural elements maximizes the potential for construction schedule optimization which can result in significant savings on projects. Trades related to architectural finishes, plumbing, electrical, HVAC, fire protection, curtain wall, stone, masonry, and other facade systems must all follow the critical path delivery of the structural frame.

However, for the building industry to experience the value of BIM to its fullest, the structural engineering profession must first assess where it is with BIM so that it can then choose the best path for the profession to transform into a BIM delivery process. This first step began last year with one of the first national surveys of the structural engineering profession and BIM. The BIM and Structural Engineering survey was a collaborative effort of the Structural Engineering Institute's Committee on BIM (now the Joint SEI-CASE committee on BIM) and the Structural Engineers Association of Texas (SEAoT).

The survey first provides demographic information of the structural engineering profession as it relates to the topic of building information modeling (BIM). The survey was sent to over fifteen thousand SEI members via email and over seven hundred responses were received. The typical structural engineering office would be considered a small to medium sized office of 2 to 10 people with the majority of offices being less than 20 people. Most respondents were in their thirties, in upper management and had obtained a masters degree.

The computer analysis software tools that structural engineers use varied greatly over the 20 applications surveyed. None of the 3D structural analysis software applications had more than a 50 percent market usage which underscores the need for open interoperability among the analysis packages with BIM programs. The respondents represented a broad cross-section of building types with commercial buildings being the most common. Over half of those surveyed identified building information modeling as being a relational database. A third recognized a current need to use BIM and almost another third expected to need it within two years. A very high interest in BIM was recorded for a third of the company leaders and an even greater percent of personal interest.

Half of those responding have BIM software with Revit Structure being the significantly dominate platform of over 8 percent of the respondents. Although a combination of training methods could be used, the self paced training with software provided tutorials was the predominant method. The majority of responses reported that their firm's training program was "horrible, non-existent" to "moderately effective". In addition to training drafters in BIM, most firms are also training their recent graduate engineers-in-training (EIT) and project managers with professional engineering (PE) licenses. Of those expressing an opinion, the plurality of responses reported an estimated four to six weeks of lost billable time due to training per person in the first year of implementation.

The structural engineering profession can be seen in three phases when considering its transformation process as it relates to the structural profession as it relates to building information modeling. Useful in understanding this process is the technology adoption lifecycle model which describes the adoption of a new innovation, according to the demographic and psychological characteristics of defined adopter groups. The process of adoption over time is typically illustrated as a classical normal distribution or "bell curve" (see **FIGURE 1**). The model indicates that the first group of people to use a new product is called "innovators," followed by "early adopters" and then the "early" and "late" majority, and the last group to eventually adopt a product are called "resistance" or "laggards".

Traditionally our profession in modern times has consisted of engineers and technical drafters with some of the latter who become engineers as well. Before computers, this process required a considerable amount of time and structural design progress on projects with a high degree of deliberation and thought. Changes from the architect came in the form of issued paper document sets that were couriered or delivered. Engineers progressed their designs and communicated to their technical drafters their intent via paper sketches and notes. When we moved our drafting technicians from the drawing board to CAD, we did not fundamentally change the traditional office relationship with the structural engineers.

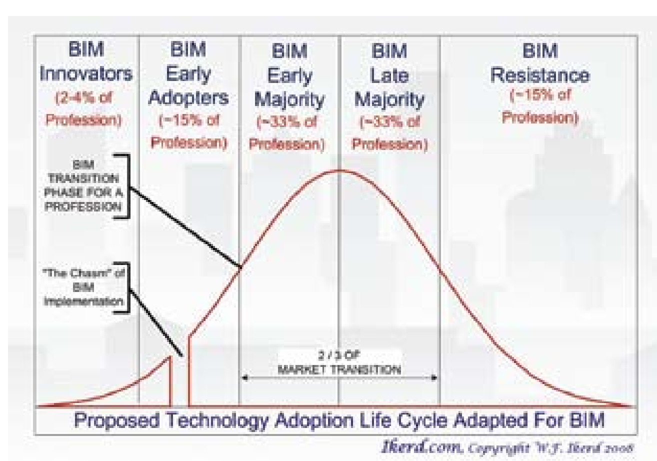

Figure 1. Author's application of BIM with classic adoption life cycle model of new technology. In light of the national suvey of structural engineers, the profession is poised for the early majoity and some of the late majoity to transition to BIM in the next two years.

Based on the survey results, the profession is a few years into the second phase of transition to BIM now. For this second phase to take hold, the A\E\C\O\FM industry required three essential elements to begin using parametric modeling in a reasonable price range: computer power, common software platforms and bandwidth to transmit the models. We began to see this at the turn of the century. In this phase we are challenging traditional office work flows as engineers take a more active role in the production of the drawing by working in the same models alongside their technicians. Structural engineers are starting to see benefits of linking their structural engineering analysis applications to one central BIM; however, these benefits are very limited in this BIM transition phase due to interoperability challenges with the software. Most of the success structural engineers are seeing in this phase is with mentoring younger structural engineers by visualizing constructability in 3D models, communicating the structural aspects of buildings with their clients and in early quantity take offs to facility value engineering. Some noted success has also been reported of structural engineering models being utilized in construction to facilitate the fabrication process in areas such as structural steel. The challenges of this phase are marked by firm resistance to change, uncertainties in liability issues, and aversion to the significant investment firms must make to transition to BIM.

The third phase of BIM in structural engineering will be signified by a majority (see **FIGURE 1**, BIM Late Majority) of structural firms who have trained their engineering staff to fully utilize the BIM and leverage the structural analysis links that will have matured into dependable tools. While open to debate, the results from the survey question asking when firms will need to use BIM to meet their clients' needs indicate that this phase would be well underway before 2015 (see **FIGURE 2**). This phase of BIM transition will also begin with a number of project successes achieved by early adopters to the BIM process.

Interoperability will also move beyond linking in the office with the structural engineer's analysis model to greater use of their model downstream in the construction and fabrication process. The early success of interoperability in the steel industry even with some challenges that took place during the transition phase will be followed in this phase with other materials and systems that are influenced by the coordination of a building structure such as pre-cast concrete, concrete reinforcing steel, concrete formwork modeling, and engineered products such as bar joists, wood products and building envelope systems. The theme of the early part of this phase in structural engineering will be lean design with just-in-time delivery of the engineered building components that is coordinated in the BIM. Some firms may significantly struggle with the challenges of changing roles as A\E\C\O\FM teams move towards tighter Integrated Project Delivery that is facilitated by BIM as a process and tool. Other firms will enjoy the rewards of adding value to the process through their investment in BIM. ■

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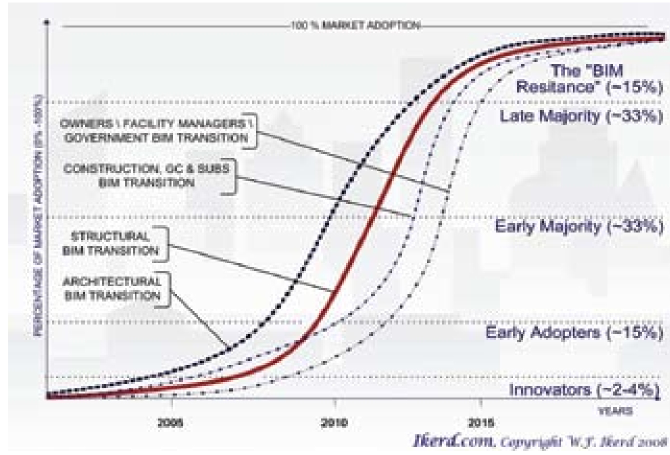

Figure 2. Author's projections of the technology adoption of BIM for the stakeholder in the project delivery process. Projections are based on the national survey refrenced in this article, author's experience, and history of other technolgy transition.

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