Architecture, Engineering, and Construction: On the Verge of Convergence

CIMdata Commentary

Key takeaways:

- *The past several years have seen growing adoption of Building Information Modeling (BIM) within the Architecture, Engineering, and Construction (AEC) industry, but construction productivity growth has continued to lag manufacturing*
- *A convergence is beginning to take place between AEC and manufacturing—AEC customers are increasingly interested in adopting processes and technologies from the manufacturing industry to find ways to realize the productivity potential of their technology investments*
- *The need for process improvement is driving interest in new fabrication and assembly techniques, virtual design and construction (VDC), and other innovations, as well as new technology platforms such as product lifecycle management (PLM) related cloud services*

Introduction

The overriding trend and enabler for change in the Architecture, Engineering, and Construction market has been the adoption of Building Information Modeling processes and associated enabling technologies. Although estimates vary across studies, the rate of BIM adoption exceeds 50% in most developed markets.[1] One primary economic driver for BIM has been the need to improve construction efficiency. A 2007 study documented 25 to 50 percent waste in coordinating labor and in managing, moving, and installing materials.[2] Unfortunately, the investment in BIM has not yet resulted in sufficient productivity gains—recent statistics from the United States Bureau of Labor Statistics and National Bureau of Economic Analysis demonstrate that labor productivity growth in construction continues to lag manufacturing.

Three high level trends in the industry are now promising to deliver on the potential of BIM. The first is wider demand and support for interoperability among applications. The development of new standards and stronger interoperability capabilities among applications are beginning to erase the boundaries among disciplines that have historically operated in siloes. The second trend is the adoption of production techniques from manufacturing. Organizations are discovering that configured and prefabricated modules can be produced more efficiently in factories, and can be assembled on site faster, at lower cost, and higher quality. The final trend is the increasing availability of technology solutions that leverage and extend BIM models. These solutions include VDC, digital fabrication from parametric models, project collaboration, reality capture, augmented reality, among others. The wider availability of cloud services and high-speed network connections is accelerating the adoption of these solutions and enabling their pervasive use on construction sites.

All three of these trends closely parallel earlier developments in the manufacturing industry. The adoption of PLM in manufacturing has been a key enabler of productivity growth in the industry, and many of the innovative technologies and processes now being adopted in AEC

[1] Jones, Stephen, and Harvey Bernstein. "The Business Value of BIM for Construction in Major Global Markets." *SmartMarket Report*. McGraw Hill Construction. 2014.

[2] Tulacz, Gary, and Tom Armistead. "Large corporations are attempting to meet the industry halfway on issues of staff shortages and risk." *Engineering News Record*. November 26, 2007.

were pioneered in manufacturing. PLM is also a key factor in the ability of manufacturers to efficiently design and produce modular, configured, and customized products for AEC applications. Within AEC, there is a growing recognition of the need to adopt a holistic approach encompassing project lifecycles from concept through operations and maintenance. In CIMdata's view, this convergence between AEC and manufacturing promises to benefit both industries. Ultimately, we believe that as the AEC market embraces a lifecycle approach, BIM will increasingly be recognized by the industry as a subset of PLM.

Solution Provider Innovations

Solution providers have introduced innovative new products and business models to address needs in the AEC Market. These innovations fall into two broad categories—technology innovation and business model innovation. Taken together, these two categories of innovation are lowering barriers to entry and enabling new levels of productivity.

On the technology front, solution providers have been especially active in focusing on internal development and acquisition in the following areas:

- Cloud services, especially as applied to project collaboration and construction management
- Mobile solutions, often to support in-field work processes and usually in conjunction with cloud services
- Extending VDC from 3D clash detection to include scheduling and costing
- Production and fabrication solutions that help take advantage of the trend toward modular design with off-site fabrication and on-site assembly
- Integration, a broad term including interoperability and standards compliance, as well as software solutions to better connect structured information between manufacturing and construction, and between construction and operations
- Reality capture (laser scanning and photogrammetry) and the processing of data from these sources
- Simulation, especially the integration of simulation into existing use cases and better support for up-front simulation

Innovative new business models are equally important to extending adoption of AEC solutions to all stakeholders across the lifecycle of designing, engineering, constructing, operating, and maintaining facilities. Smaller companies, in particular, can find it difficult to justify upfront investments in software from different providers across multiple projects. In response, most startup companies and many established solution providers have introduced term subscription licensing models. The net result is a completely new value proposition for AEC customers ranging in size from the smallest subcontractor to the largest multinational firm. Although term software delivery models are being introduced in multiple markets, they are an especially good fit for AEC customers given the project-based nature of their work and the need for companies of various sizes to collaborate on any given project.

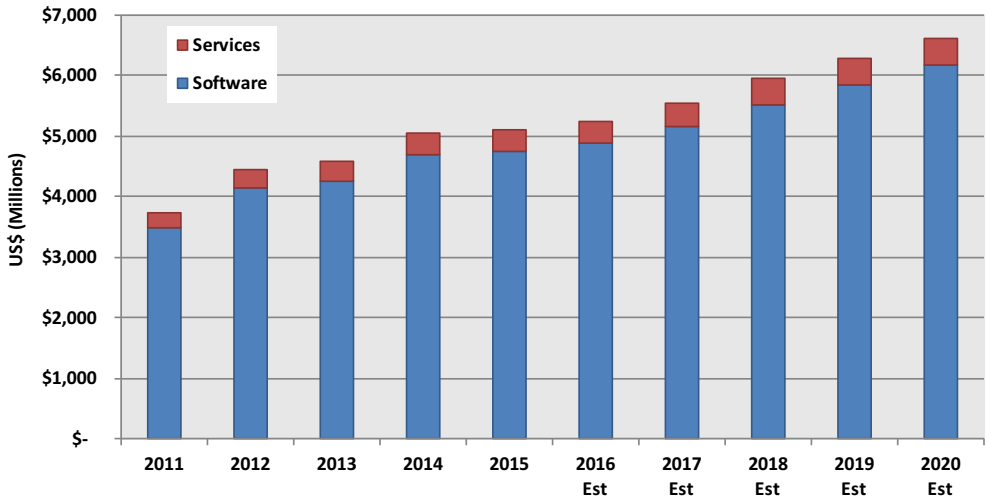
Market Overview Report

The changes taking place in the AEC market have created a need for deeper analysis and market intelligence to inform decision making at solution providers, manufacturers, AEC firms, and organizations that commission AEC projects. CIMdata assessed the information available in the market and determined that a significant gap existed between these needs and the information available. To fill that gap, CIMdata has extended its existing PLM Market

Analysis Report (MAR) Series by creating the AEC Market Overview Report. This report contains information valuable for any organization that is interested in better understanding the overall market for AEC solutions, key trends, and both major and emerging market players. The AEC Market Overview Report is valuable to a range of audiences. Solution providers and their partners can use the report to support strategic planning, sales planning, and marketing. Industrial companies including building products manufacturers, AEC, and EPC firms seeking to make investments can use this information as part of their decision making process. Owners and operators can use the report to inform their technology strategies. Industry and financial analysts often acquire MAR data to support mergers and acquisitions (M&A).

The CIMdata 2016 AEC Market Overview Report provides an in-depth analysis of trends, technologies, and individual solution providers, in addition to revenue details for major providers, geographies, and sub-segments, historical data, and a market forecast. The report is available for purchase at http://www.cimdata.com/en/online-store/market-analysis-reports. The report is the inaugural issue of the publication. It expands upon the methodology and data from CIMdata's global PLM MAR series, and leverages the expertise and research from CIMdata's AEC & Manufacturing Convergence consulting practice.

The market for AEC as measured in U.S. dollars grew more slowly in 2015 compared to prior years, and growth in 2016 is likewise expected to be muted. This is a result of a combination of currency exchange rate fluctuations and changes in subscription models by certain AEC solution providers. CIMdata expects growth to rebound strongly starting in 2017, with particular growth in solutions for construction applications. This historical and forecast solution provider revenues is one of more than 20 charts and tables included in the report:



The report profiles each of the top 16 AEC solution providers as measured by revenue, and briefly profiles a number of smaller companies that are introducing notable innovations to the market. It also discusses the top five trends in the industry and highlights key advantages, concerns, and considerations for each.

Summary

The AEC market is undergoing rapid change. Now that the majority of customers have adopted BIM, the next challenge for the industry is to achieve the productivity and efficiency benefits promised by BIM. To meet this challenge, industry participants, ranging from building

products manufacturers to AEC firms and solution providers, are looking to lifecycle strategies pioneered in the manufacturing industry. By combining technology innovations, new business models, and new work processes, the industry has the opportunity to close the productivity gap with manufacturing and generate greater efficiencies throughout the lifecycle from initial concept through facility operations.

About CIMdata

CIMdata, an independent worldwide firm, provides strategic management consulting to maximize an enterprise's ability to design and deliver innovative products and services through the application of Product Lifecycle Management (PLM). CIMdata provides world-class knowledge, expertise, and best-practice methods on PLM. CIMdata also offers research, subscription services, publications, and education through international conferences. To learn more about CIMdata's services, visit our website at http://www.CIMdata.com or contact CIMdata at: 3909 Research Park Drive, Ann Arbor, MI 48108, USA. Tel: +1 734.668.9922. Fax: +1 734.668.1957; or at Oogststraat 20, 6004 CV Weert, The Netherlands. Tel: +31 (0) 495.533.666.