

Lean n' mean

Lean teams deliver automotive assembly plants through innovative use of BIM, as this case study notes.

In the new \$1.5-billion General Motors (GM) automotive assembly plant located just outside Lansing, Mich., U.S., people work under bright task lights while robots assemble vehicles in the dark. A 1.5-million-square-foot white polymer roof deflects the sun's heat and rainwater is collected in cisterns to be used instead of potable water for flushing toilets. These and other environmental innovations make this the greenest auto plant in the world. The facility not only saves \$1-million in annual energy costs, but it also cost 20 percent less to build than traditional auto plants.

Completed in 2006, the Lansing Delta Township Assembly Complex employs 3,000 people to produce GM's new crossover models: the Saturn Outlook, GMC Acadia, and Buick Enclave. The US Green Building Council's Leadership in Energy and Environmental Design (LEED) program awarded the plant the prestigious Gold Certification in recognition of the relatively small ecological footprint made by this 2.4-million-square-foot facility. When in full production, the plant is expected to save three million kilowatts of electricity and four million gallons of water each and every year. As just one of 550 LEED-certified buildings worldwide and the only automotive plant, the Lansing Delta Township complex also exemplifies sustainable construction practices. More than 25 percent of the construction material has recycled content, 60 percent of materials were sourced from within 500 miles, and 80 percent of the construction waste was diverted from landfills. Today, half the construction site remains undeveloped.

Before construction ever began on this landmark facility, records were already being set for efficiency. The design-build team responsible delivered the project approximately 12 percent faster than scheduled and 20 percent faster than comparable projects. The team pioneered the use of 3D-enabled building information modeling (BIM) technology on a collaborative design platform, all the while improving construction quality and job site safety. The Lansing Delta Township complex demonstrated that 3D design and construction techniques can be successfully applied to building and process integration as well as automated collision detection to minimize field interferences during construction.

Ghafari Associates, LLC, a leader in BIM deployment for the automotive industry, served as the architect/engineer and 3D integrator for the Lansing Delta Township complex. The project team's successful collaboration with

GM and its partners led to the award of five additional projects using 3D design and construction.

"These schedule-driven projects used lean methodologies enabled by the innovative use of 3D BIM to eliminate waste," said Samir Emdanat, director of virtual design and construction for Ghafari. "The design-build team saved money and time, and accomplished the projects with off-site fabrication and just-in-time delivery techniques of lean construction."

Document-sharing efficiencies

GM projects are highly collaborative, with participation from GM engineers, design contractors, general contractors, primary subcontractors, fabricators, and detailing teams. Working within the constraints of GM's compressed design-build schedule, Ghafari achieved significant efficiencies by using ProjectWise to manage and distribute hundreds of 3D models and thousands of drawing files and submittals in real time across multiple locations in the United States and Mexico.

As the projects neared completion, the team shared more than 80,000 documents and 2D and 3D model files – representing upward of 85 gigabytes of data updated and maintained by hundreds of architects, engineers, detailers, fabricators, and installers. The ProjectWise collaboration system enabled multiple team members to access the right information at the right time throughout each project. The system was comprised of a centralized database and a series of remote file-storage servers for teams at different geographic locations. Remote file storage and automatic file synchronization between local and remote servers minimized download times for those working in various locations while maintaining version control and ownership, access, and security privileges.

In contrast to a conventional portal, where users have to remember to download the most current versions of files, the ProjectWise system automatically updated files when changes were made by other team members. Reference files affected by changes were also automatically updated, resulting in additional time savings. Once documents were issued electronically, a searchable "electronic stick set" reduced the resources needed to track the latest versions of the issued documents.

A range of Bentley's BIM solutions were implemented to meet the challenge of designing and detailing the facilities' integrated systems. Bentley's support of open standards and interoperability allowed the team to reuse

rather than recreate data to be incorporated at all stages from design to fabrication and assembly. Using BIM, the team assembled coordinated models for all architectural, structural, mechanical, electrical, and plumbing systems prior to construction.

Production of 3D installation and shop drawings significantly reduced the number of conventional 2D construction documents required. With these models as a guide to coordinating facility and process systems during construction, the team reduced errors and omissions by three to five percent of the construction budget. "This was achieved through a commitment to build from comprehensive 3D models defined by facility geometry and refined by the team with fully incorporated structural, mechanical, and electrical details," said Emdanat.

The LEED-certified Lansing plant was just the first of the six GM projects using 3D technology to design and construct sustainable manufacturing facilities. Thanks to the project team's collaborative efforts, the second project, the 442,000-square-foot expansion of the Flint Engine South plant, was built 27 percent faster than target.

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