Lean construction and data centers: Benefitting quality, safety and cost

Anyone who has assembled a bicycle understands the frustration of misplacing a nut, stripping a screw or discovering he is missing a bolt for a kickstand. The whole project may be delayed while he searches for a misplaced piece, replaces a defective component or orders a new part by phone, only to discover subsequently that he has misread the directions and needs go back several steps.

Magnify these annoyances by a factor of 10^6 and you are looking at the typical data center construction site. During construction, the collective touch points for workers—the number of times they touch a tool, a screw, a locknut, a fitting, a clamp, a conduit, a wire, a cable tray component—total in the millions, and so do the moments of opportunity for wasted time, materials and productivity.

Waste may become evident in:

- Transportation of materials or product from one place to another without adding value.
- Dormant inventory of materials, products or information waiting to be processed.
- Excess movement and/or poor ergonomics.
- Delays caused by shortages, pending approvals or downtime.
- Over-production that results in more products than are required.

– Over-processing that adds more value than the customer is paying for.
– Defects and rework.
– Misusing or failing to tap the talents of workers.

Factories once experienced similar types of waste, an expense that drove many industries to reinvent the way they fabricated products. They began employing lean manufacturing, with just the right preassembled parts and subsystems delivered to the assembly line at just the right time as a way to reduce waste throughout the entire production chain, from suppliers to assembly to warehousing and delivery.

Today, the lean techniques that proved so effective for manufacturers are being adopted by contractors in a movement toward "lean construction." Contractors are working to reduce waste in all forms—anything other than the minimum amount of materials, parts, space and workers' time that are absolutely essential to add value to a project. In this way, lean construction seeks to minimize costs and maximize value on every project.

Furthermore, lean construction can improve safety on jobsites. Rather than exposing workers to increased risks of accidents by rushing to make up lost time or to meet deadlines, crews following lean construction principles can work in a more organized and purposeful fashion in which productivity equates not to haste but rather to planning and continuous improvement.

An end to chaos

Traditionally, job sites are chaotic. The mechanical, electrical and plumbing contractors and utilities all work independently on their own parts of the project. One contractor needs to wait for another to complete a portion of the work before proceeding, yet both are on the same schedule. If a hitch develops, the schedule can collapse in a domino effect.

Lean construction seeks to resolve such issues by bringing all the workers together to agree on a plan and to share in the project's rewards. Instead of relying on the general contractor to sub out work to all the other contractors, everyone involved works together in a contractual agreement to follow a certain plan together, an approach that grants them profit sharing. Their objective is continuous improvement from the very start of project design all the way through delivery to the customer.

This technique is the foundation of integrated product delivery (IPD), a lean construction tool that seeks to promote collaboration on the jobsite through shared risk and rewards.

The principles of this philosophy are being advanced by the Lean Construction Institute (LCI), a United States-based organization with chapters in Europe and Asia. Every year, LCI trains contractors in cities around the world, focusing on making workflow more predictable by employing a holistic view of projects and encouraging everyone involved to discuss progress and potential issues. The institute reported that, when this type of cooperative, lean-oriented attitude was adopted, jobsites became more productive:

> "As workflow became more predictable, sites became better organized, meetings were shorter, disputes fewer, and bottlenecks and interruptions to workflow became more obvious. Specialty contractors began to change the structure of their work more by applying principles from production management; they brought larger assemblies to site. Work structuring determines who does what, when, and where. More possibilities for improvement became apparent as the focus of improvement and structure of work shifted from local productivity to the performance of larger systems."

Lean tools

Contractors have relied on some aspects of lean construction for many years, in the form of pre-fabricated and modular systems. Pre-fab is a tool of lean construction that eliminates waste and increases work efficiency by bringing pre-assembled walls and other structures to the job site. These pre-fab segments are built in a controlled, easily measurable manufacturing environment that reduces onsite labor hours during installation.

Modularization carries pre-fab to new heights by constructing flatbed-size building modules at offsite manufacturing plants. Each module may be completely equipped with windows, lighting, wiring, computer connections, plumbing and HVAC. The modules are transported to the jobsite and are simply stacked, like LEGO blocks. Modularization improves speed of construction and quality control, resulting in up to 90 percent less waste with far less labor.

Another critical lean tool is building information modeling (BIM), which involves the generation of a 3D computerized model of the building under construction, with all the details of its functional systems and components. It serves as a highly detailed and accurate bill of materials for the entire project and as a project management tool. BIM offers a visual environment accessible to the architect, engineer, general contractor, electrical, mechanical and plumbing to see specifications and locations for every component to help them work together. The results are greater efficiency and reduced conflict on the site.

Lean construction techniques for data centers

Data center contractors now are beginning to implement some elements of lean construction, especially when addressing infrastructure in walls and ceilings. For example, a data center may contain hundreds of thousands of feet of cable baskets and trays. The conventional method of building trays is to buy 20-foot straight sections of steel or aluminum in bulk and then cut and bend them to form the trays on site. In a BIM environment, however, contractors know at the very start of the project exactly what the building and trays will look like. They therefore can design a system with the trays already cut and bent and just connect them on site. Each tray's carton tells the workers where it goes, and efficiencies increase immensely.

The Thomas & Betts unit of ABB plans to offer this type of pre-assembly services in the future for such data center structures as trays, trapeze systems and remote power panels. Another candidate for this technique is a prewired whip—conduit assembled with wires running through it and fittings attached at the end. Rather than pulling wires through conduit on the job site, stripping the wire ends and attaching fittings, workers simply make a few quick connections.

As owners demand more efficiency in data center construction, designers and contractors increasingly will rely on lean construction techniques as new tools of their trade.

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