Lean Construction Basics from The Construction Leading Edge

Lean is a holistic, value-based approach to creating the built environment. Where almost all current approaches to managing design and construction assume that the process from conception to operation is a linear sequence of events, Lean has been developed to organize and reshape what those familiar with the Architecture/Engineering/Construction (A/E/C) world realize is more like a non-linear labyrinth. Lean seeks to restructure the project's operating system to focus on what adds value and to smooth out the workflow.

A different future state?

When Lean practitioners speak to groups about this new system concept, invariably many people in the audience listen for a while and then raise their hand and say that they have been regularly practicing most of the principles, behaviors and tools used in Lean. They may go on to cite collaboration, partnering, bringing stakeholders early into the process, and maybe even working in teams.

They will also state that they have been involved in very successful projects when they worked with the right players and used these tools. When questioned further, however, they usually admit that they have been on jobs with virtually the same set of players using the same tools where the results were less than wonderful. And that is a fundamental issue in today's environment –the inability to reliably predict future success even with a great cast of characters and a desire by all parties to succeed.

So, what is new and different with Lean Construction and can it make project delivery more reliable and likely to meet or exceed customer expectations? The initial findings are promising and the following tries to convey why this is occurring.

Given that it is a relatively new "operating system," Lean Construction is not easily defined in a sound-bite or elevator speech. It has seen multiple definitions in its evolution.

Because it is hypothesis—and research-based, founded on the scientific method (Plan –Do –Check –Adjust), some concepts, principles and tools are developed and then found to not produce the value expected and are reshaped or discarded. These sub-definitional elements then change and combine, leading to further refinement of the definition.

One definition that seems well suited from a PM/CM perspective was developed by the Lean Construction Institute and is excerpted as follows:

Lean Construction is a production management-based approach to project delivery –a new way to design and build capital facilities. . . . Lean changes the way work is done throughout the delivery process. Lean Construction extends from the objectives of a lean production system – maximize value and minimize waste –to specific techniques and applies them in a new project delivery process. As a result:

- The facility and its delivery process are designed together to better reveal and support customer purposes. Positive iteration within the process is supported and negative iteration reduced.
- Work is structured throughout the process to maximize value and to reduce waste at the project delivery level.
- Efforts to manage and improve performance are aimed at improving total project performance because it is more important than reducing the cost of increasing the speed of any activity.
- Control is redefined from "monitoring results" to "making things happen". The performance of the planning and control systems are measured and improved.
- The reliable release of work between specialists in design, supply and assembly assure value is delivered to the customer and waste is reduced.

Lean construction is specifically formulated to arrive at all project and program goals without conceding that trade-offs of time, cost, quality, participant satisfaction, or safety are inevitable.

Lean project delivery: New thinking, new tools and new behaviors

Lean is a philosophy, culture and discipline with a set of preferred behaviors and a continually increasing repertoire of tools. Learning Lean is hard, disciplined work and requires participants to unlearn many behaviors that worked well in a traditional setting but are antithetical to the Lean experience.

The leader as "the loudest voice" or the "I wind up doing it myself because I can't trust anyone else to do it right" hero personality do not work well in theLean environment. So, when many of the behaviors that worked in a non-Lean world are stripped away, a new repertoire of tools is needed to replace the dysfunctional ones.

At first, it may seem to some new Lean initiates that they are back attending grammar school. But for most learners, the light turns on quickly and they realize that there really are better ways to contribute, learn and add value. And they find they are having fun too.

The following sections provide a glimpse of some of the most common tools and behaviors used in a Lean environment. This list just scratches the surface of the toolbox that is evolving and developing rapidly in IPD/Lean settings.

Lean tools

Lean tools should only be used when they drive value into, or eliminate waste from, the project. The wrong tool or a tool improperly used creates waste, not value. And as with most useful tools, they require training in order to be used properly and without damaging the project.

Plan-do-check-adjust (PDCA)

At the heart of Lean thinking isthe scientific method and the Shewart cycle, also known as the *"Plan – Do – Check - Adjust" (PDCA)*

PDCA consists of four stages, including:

1. Plan –Investigate the cause of a troublesome condition and create a proposal for its modification or resolution.

2. Do –Perform a test implementation of the plan.

3. Check –Assess the results of the test for effectiveness.

4. Adjust –If the results are satisfactory, modify the original condition ordefine a new standard procedure. If the results are not satisfactory, refine the plan and repeat the cycle until satisfactory results are achieved. The new improvement becomes the standard, when the process may begin again to attain the next improvement.

While this sounds simple, developing the discipline to deeply engage in this process is counterintuitive to many in the construction industry who always want immediate action. How many times have you heard team members say, "Wedon't have time for that, we are already behind!" Learning how to better plan to create the capacity for the discipline of PDCA is a major function of the Last Planner System, discussed below.

A3 Reports

An A3 report is a way of organizing and analyzing issues that require the composer to fully engage with PDCA thinking. A typical A3 states the background, the problem, the current state; the future desired state and the proposed counter!measures to get to the future state all on a single, 11" by 17" piece of paper. John Shook, the "A3" guru, has explained the process as follow: ". . . an A3 document structures effective and efficient dialogue that fosters understanding followed by the opportunity for deep agreement. It's a tool that engenders communication and dialogue in a manner that leads to good decisions, where the proposed countermeasures have a better chance of being effective because they are based on facts and data gathered at the place where the work is performed, from the people who perform it."

While a properly prepared A3 appears very simplistic, it is anything but. A3s are the by-product of a disciplined, collaborative approach to problem solving, with significant work and distillation both by the author and the collaborators. A3s are invaluable for providing a durable record that

reflects the knowledge, thought process, and decision recommendation in an exceptionally accessible format. A3s are proof of the old adage, "I wrote a long report because I did not have the time to prepare a short report."

Value Stream Mapping

Value stream mapping is an important tool that enables a team to analyze business processes step by step to discover how value is produced, and to identify hidden waste. It allows a team to explore, develop a shared understanding and document both the "current state" of how an operation is performed and the "future state" once that process has been optimized. Simply stated the steps are:

- Identify the target product (deliverable), product family or service.
- Draw a current state value stream map, which shows the current steps, delays and information flows required to deliver the target product or service. This may be a production flow (raw materials to consumer) or a design flow (concept to launch).
- Assess the current state value stream map in terms of creating flowby eliminating waste.
- Draw a future state value stream map.
- Implement the future state.
- Assess and adjust the new process as needed.

Target Value Design

Target Value Design (TVD) is a design strategy and process that offers designers an opportunity to engage in the design conversation concurrently with those people who will procure services and execute the design. It focuses on designing based on the articulated project values, which become design criteria rather than mere aspirations. Major aspects of the TVD process include the following:

- Rather than estimate based on a detailed design, design based on a detailed estimate. The initial detailed estimate is a by-product of the team's initial "validation study," a joint effort of the designers and trade contractors to develop a mutually understood and agreed basisof design, and a trade estimate tied to the basis of design. While the validation study produces the project's "expected cost" –what current best practice would support –the team then sets a target cost as a "stretch" goal to drive innovation. No longer should an owner, seeing a leap in the estimated price as design progresses, hear the common refrain from a contractor, "Well, now that there are more drawings, I have a better idea what the designer had in mind!" TVD is calibrated to eliminate this waste.
- Rather than evaluate the constructability of a developed design, develop the design based on input on what is constructible.
- Rather than evaluate the constructability of a developed design, develop the design based on input on what is constructible. Don't "draw" without first confirming with the

builder that if it is drawn that way it will still be within the estimate and will be safe and productive to execute.

- Rather than design alone and then gather for group reviews and decisions, designers, constructors and users work together to define the issues and produce decisions used by the designers to realize the design.
- Rather than quickly choosing a single solution based upon one person's past experience, use set-based, concurrent engineering concepts to carry multiple solutions far into the design process and narrow choices only at the last responsible moment. Fully research the range of possible solutions, document the developed knowledge, and engage in a decision-making process that disciplines the team to make a decision that is anchored in the facts, rather than the one favored by the dominant personality.
- Rather than have designers and makers working alone in separate rooms, work side-by-side in physical proximity or virtual settings.
- Rather than have designers and makers working alone in separate rooms, work in pairs or a larger group face-to-face. If the project can't afford full-time co-location, develop a virtual alternative, with routine sessions where people are in the same virtual room.

Last Planner System ™ / Commitment-Based Planning

Lean project delivery presupposes that project workflow is based upon individuals making and keeping commitments. It seems obvious that each project participant is dependent on others in the project's "network of commitments" to start and finish their work as promised in order to promote the reliable flow of work on the project. When preceding work is not done when promised, it creates problems for the team that is to follow.

Projects are often chaotic, schedules are rarely accurate and many projects are treated as "a commitment-free zone."

On typical construction projects, where only about 55% of items promised to be completed actually are done when promised, this lack of reliability often results in lack of trust and escalating games of "chicken." Because trade contractors want to assure they have plenty of work available when they send crews to site, they delay mobilizing; having been burned historically with false promises that preceding work would be complete on a certain date. General contractors, believing based on prior experience that the trades won't show up on the date they require, start asking the trades to be present sooner. When the trade reviews the site before mobilizing and sees that the work is not ready, they increase their buffer to protect against the unreliability of the GC to predict when the work will be done. Given this, why are we surprised that projects are often chaotic, that schedules are rarely accurate, and that projects are referred to as "a commitment-free zone"?

The Last Planner System™ (LPS) was developed to provide a systematic process of production planning and control that is focused on improving work flow reliability. Its ultimate goal is to allow the "Last Planners" (trade foreman and design captains) to be in position each week to make reliable commitments and keep them. When they are able to do this, workflow becomes

more reliable. With more predictable workflow, companies are able to make better decisions about resource allocation, scheduling and coordination. The system, as with other planning systems used on Lean projects, mandates that every participant has a voice with the responsibility to speak up, make and keep promises and say no when it is required.

LPS is founded on the reality that advance planning never accurately predicts the future, that conditions on projects change, and that plans will need to be changed. It also recognizes that the further removed the planning process is from the date when the work will be performed, the less accurate it will likely be. Finally, it acknowledges that the greater the detail included in the forecast, the more likely it will be wrong. In order to address these issues, LPS performs planning in increasing levels of detail as the time for performance gets closer. It also assumes that teams can learn from planning failures and develop strategies to improve their ability to plan reliably.10

LPS is a production/workflow control system designed to:

- Empower front-line personnel to make decisions about what work to commit to delivering within a given timeframe.
- Improve workflow by ensuring that future work is READY when needed by the next performer.
- Track Percent Plan Complete (PPC) as a measure of variability in commitment-keeping.
- Produce reliable results task by task throughout the project from conception to completion.

As noted above, LPS has multiple layers of planning. **Milestone planning** is done as a strategic exercise to confirm at the highest level whether the project can be completed within the overall time allotted. Milestone schedules are prepared based on the key owner schedule requirements and other major project milestones. While this task is often driven by the construction manager or the general contractor, it should involve as many team members as possible to either validate or challenge the assumptions underlying the schedule.

The next level of planning occurs in **"pull-plan sessions"** where the relevant project performers come together to discuss work in a particular phase or needed to meet a particular milestone. A "**phase schedule**" is prepared to address how a milestone is achieved, pulling back from the milestone through necessary major activities that allow one trade or discipline to complete its work in that phase.

The focus is on what each trade or discipline needs from others in order to properly start and finish its work. The phase schedule defines the hand-offs from one discipline or trade to another, assuring that the performer and the customer for each portion of the work agree on the criteria for determining that the work being delivered is fully ready—that is, there are no constraints to the next performer on the project. Each performer must identify their needs and constraints and negotiate with those from whom they need something to accomplish their work. The by-product of the phase planning is a graphic plan showing not just the sequence of work,

but detailing the agreement between each "performer" and its "customer" describing what exactly will be provided (sometimes called the "hand-off criteria") and by when.

The next level of planning is referred to as **"Look-Ahead Planning."** The look-ahead window will depend on the project, but is usually a minimum of six weeks. The window should be set to assure that any constraints identified in the look-ahead process can be resolved at least the week before the work is planned to be performed.

The look ahead process is also called the "make-ready process" –the focus here is to identify any constraints (obstacles) that would prevent the work from being started and completed as planned. These constraints, which might be submittals, material deliveries, pending Requests For Information (RFI's) or similar items, must be resolved in order to allow the work to be promised and completed. As part of the look ahead process, LPS looks for a reliable promise from a project participant to remove the constraint, reflecting an agreement with the individual identifying the constraint about how and by when it will be resolved.

The final planning level in the LPS is the weekly work planning session. This is sometimes referred to as weekly foreman planning. Weekly work plans are used to obtain commitments from the Last Planners of what work will be completed each day during the coming week and to assure coordination between the Last Planners. The weekly work planning process will also identify any "workable backlog" –constraint-free work that is not required to be done this week according to the plan, but which the entire team agrees can be pursued if the team has excess capacity.

Identifying and agreeing on workable backlog assure that pursuing that work will not injure or detract from one of the other team member's ability to pursue its work. As part of the weekly work planning meeting, the team will also review the scorecard from the preceding week of "planned percent complete" –what percentage of the items promised last week were actually completed as promised – as well as the reasons for variance. With the goal of improving planning system reliability, the purpose of this review is to identify the root causes of plan failure and to explore what the team might do differently in the future to improve their ability to produce reliability.

A simplified view of LPS is based on the "Should, Can, Will, Did" convention:

SHOULD work is derived from the master and phase schedule.

CAN work is derived from the Look-Ahead Plan and represents what the team thinks can be done.

WILL work is derived from weekly work plans and is work that a performer agrees will be done.

DID work is completed work.

The PPC (Percent Plan Complete) metric is derived by dividing the DIDs by the WILLs.

This information is an excerpt from Managing Integrated Project Delivery from The Construction Management Association of America. The entire document is available at https://cmaanet.org/files/shared/Managing_Integrated_Project_Delivery_1.pdf

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