

APPLYING LEAN PRODUCTION PRINCIPLES TO THE CONSTRUCTION INDUSTRY

**John Strickland
Bob Kirkendall**

“Planning is great as long as you get someone else to do it .”

Of course this is true, and plans are better when the right people are involved. This article will describe an approach for distributing responsibility for short term planning to those best able to accomplish it. This approach has resulted in significant cost and schedule savings (up to 30%) while making work at the jobsite a lot more tolerable. It’s an approach called Lean Construction.

The construction industry has developed a number of specialized tools; Critical Path Method (CPM) schedules, Gantt charts, earned value analysis, and various budget-tracking methods to plan and control projects. However, construction projects today are undeniably more fast-paced and change-prone compared to the relative predictability that characterized projects of the past. The more dynamic tempo of contemporary construction requires more dynamic means of management. Despite the best efforts to refine the means of construction management over the years, the construction industry continues to suffer through cost overruns, missed schedules and unmet expectations. Fortunately, there are tools that can help us take our planning and control capabilities to the next level.

A growing number of people are beginning to use “Lean Construction” techniques in response to the complexities of modern construction. Lean Construction gets its name from its close ties to Lean manufacturing approaches pioneered by Toyota and adopted by other leading manufacturers. The Lean Construction Institute (LCI), led by Greg Howell and Glenn Ballard, was formed in 1997 to improve the way production is managed on projects. IDC was a founding member of LCI and many of the ideas presented in this paper are borrowed from LCI. Lean Construction techniques do not replace the planning tools noted above, but they do provide a common sense approach to improve our ability to plan. The Lean planning tools are also easily understood by craft employees, and utilize their talents in planning and controlling the project.

IDC has seen some very promising results, including a fast track project for a leading high technology company that realized 25% savings compared to the company’s previous projects after the owner, the designers and the contractor teamed at the beginning to implement the program. This client is now convinced that the Lean approach is a key to successful projects, and we recently won repeat business largely because of our commitment to using a Lean process. The Lean program tends to create a much better environment, with far better cooperation and far less conflict than commonly found on complex projects. That may be the biggest benefit, unless, of course, you are in the litigation business.

So What Is Lean Construction?

Lean Construction is a planning and control system designed to improve project performance by improving the short term planning process. The Lean concept is based on

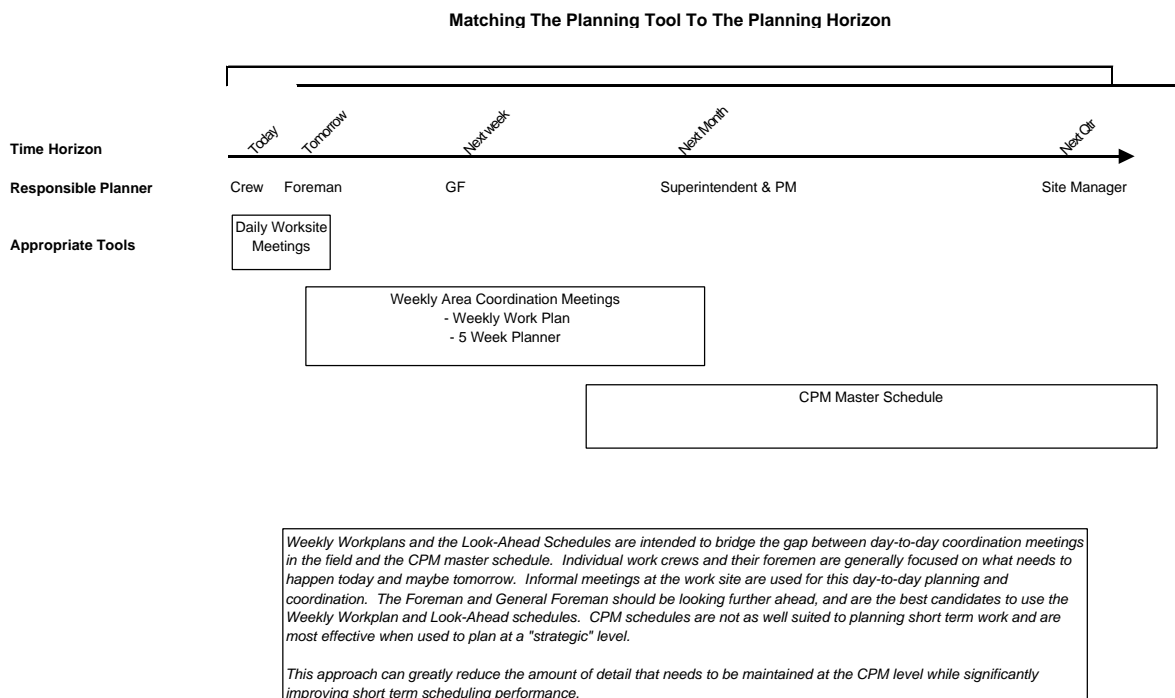
deceivingly simple ideas. Few would argue that a construction crew could accomplish more work with less effort if:

- Everyone on a project team understood what they needed to do and how their work needed to be coordinated with other crews.
- Everybody could rely on the schedules provided by the other participants.
- They had what they needed to complete their task before they tried to start it.
- Work was scheduled so that it flowed between crews smoothly.

Making these things happen is the goal of Lean Construction.

Go With The Flow

Conventional planning tools break the project into discrete tasks that can be individually managed. This assumes that minimizing the time or money required for each individual task will minimize the time or money required for the entire project. While this approach seems to make sense, it doesn't work in real life on even moderately complex projects. Even the most carefully crafted CPM schedule cannot adequately account for the complex inter-relationships between tasks. Toyota and other leading manufacturers learned that focusing on the *flow* of work through the factory is more important than the cost or speed at any particular work station. They also proved that centralized planning could not control work flow; planning should be distributed to the production force.



These lessons have great application in the construction business. Seasoned construction professionals can tell you that it's a pleasure to work on jobs that are "in synch" while one

of the most common observations on a troubled job is “we could never get a good rhythm going.” Well-prepared CPMs (which are quite rare) are one tool for encouraging flow over the course of the project. They provide the strategic view that assures there is a path through the project and identify key milestones and requirements for long lead items. The Lean planning process described below assures work flow in the upcoming 4 or 5 weeks, or the tactical view.

Reliability First, Then Speed.

So how can we coordinate our tasks to achieve the smooth flow of work that seems to be so important? Most large projects have some sort of weekly planning and scheduling meeting. Unfortunately, these meetings don't tend to be very effective at planning the next week's work, let alone what will happen several weeks in the future. LCI research found that on major projects with conventional planning systems, only about 30% of a week's tasks assigned at the beginning of the week were actually accomplished during the week. Often, there was never really any chance that they could be done because some key element was not available when needed. Often this is prerequisite work from another crew or supplier. And since the completion of one crew's work almost always triggers the start of the next crew's work, this lack of reliability prevents smooth flow and leads to tremendous efficiency losses. Contractors, especially smaller specialty firms, are acutely aware of this problem. They need to know when the job is *really* ready for them to do their job, not when it's *supposed* to be ready. Their profitability also depends on mobilizing once and completing their work in one relatively continuous operation. If schedules were more reliable, each crew could do a better job of planning, and the overall flow and efficiency of the project would improve. This is essentially the same lesson that Toyota taught the manufacturing world: The key to performance is flow, and the key to flow is removing variability.

Typical project management tools are focused on what *should* be done. Unfortunately, inadequate consideration is given to what *can* be done. (This is especially true if the job is being scheduled from a single CPM schedule that is only a rough model of how the work will be done, or if the project is behind schedule). Scheduling tasks that can't be done is a surefire way to miss scheduled dates. The Lean approach requires that the resources are in control, the work in the right sequence and within the capacity of the crew before it is assigned. Only then will the crew *commit* to accomplishing the task. It's important that an assignment meets these criteria because other people are depending on your plan in order to efficiently plan their work. This is distinctly different than common practice on construction sites, where the logic is “let's put it on the schedule and see if we can hit it.” Note that it is the crew leader, not somebody several layers away in the organization, that assures the criteria are met. A key concept of a Lean project is that nothing should be placed on the plan for next week unless everything needed to successfully complete the task is on hand at the beginning of the week.

If making short term schedules reliable is necessary, it only makes sense that we systematically learn from our failures to meet schedules. Prompt feedback is another key element of Lean Construction made possible by applying criteria to assignments. Conventional systems provide no systematic way of learning from the expensive lessons that the project gives us when we fail to meet our weekly work plans. They tell you *whether* you've missed the mark, and maybe *who* missed it, but not *why* the date was missed. Using

the Lean approach, actual results are compared to the list of tasks that were committed to. Tasks were either done, or they were not done – there is no partial credit. If a task was not done, the reason for the miss is identified and traced back to root causes. Management can then take action to prevent them from recurring and can use the feedback to improve the planning process. Few companies could name the top three reasons for their schedule misses. It's pretty difficult to take corrective action if you don't know the cause of your problems. This is important because misses result from management failures. Some readers will note a striking similarity to Total Quality Management, and this is correct. In this case the planning process is the object of the improvement effort.

This feedback mechanism highlights a subtle, but critical, element that is not provided by conventional project management tools. The control function in traditional systems is designed to tell you *whether* the plan was accomplished while the control system in a Lean approach is designed to *assure* that the plan is accomplished.

The Lean Construction process uses a four- or five-week look-ahead process to assure that everything needed for a task will be ready when the task is scheduled to begin. Many projects use a look-ahead planning system to warn people when they are supposed to start work. In Lean Construction this period is used to identify constraints and remove them. The look-ahead plan organizes this effort. Most project leaders have had the unpleasant experience of sitting through a “post mortem” meeting after a key date was missed in order to assign blame and responsibility. The idea of the look-ahead process is basically to have the “post mortem” meeting 4 or 5 weeks in advance so that the painful and embarrassing session can be avoided. Too often, the response to missed schedules is to invoke tough contractual penalties on the party least successful at avoiding blame. Advocates of Lean Construction have decided that tough contract language and administration is a lousy substitute for good planning. This attitude goes a long way towards making the construction process a less stressful and risky adventure.

Workable Backlog & Starting Each Task As Early As Possible

Workable backlog is a key tool for providing efficient workflow. Workable backlog is defined as work that *could* be done now (i.e., we have everything that we need to do the job) but does not *need* to be done now. Construction crews commonly refer to this as “fill in” work. Maintaining some workable backlog is a good thing. Your crews can efficiently use their time even when they cannot accomplish one of the tasks on their weekly workplan, and keep working if they are more efficient than expected. A good rule of thumb is that you should commit only 75% of the crew's capacity for the week to work on the weekly workplan that must be done to assure work for the next crew. You can supplement that work with about 50% of the crew's capacity in workable backlog to assure that they both release work as planned and are kept fully utilized. This concept is quite contrary to conventional practice, which is to put a more on the crew's schedule (some of which they could not possibly perform) in order to make them “stretch.” The problem with the “stretch” approach is that it leads to schedules that aren't met and the corresponding loss of reliability and smooth workflow. Besides, crews figure out the game pretty quickly and it is rarely effective for long. Committing the crew to 75% of their capability and putting plenty of workable backlog in front of them will improve schedule reliability and still keep the crew busy for the whole week.

Creating workable backlog has important implications for how we interpret our CPM schedules and enforce schedule compliance. The common “push” approach calls for us to start each task as soon as possible in the effort to avoid the chance of missing the project completion date. If we do that we will never, by definition, have any workable backlog. If we don’t have workable backlog, we severely compromise smooth flow or reliable schedules. Besides, starting a non-critical task early does nothing to improve the over-all completion date. This is another area where the Lean Construction approach parallels Lean manufacturing. Basically, performing work before it’s needed is creating inventory. Lean manufacturing has taught us that inventory is one of the worst forms of waste.

Trust Me, Buddy

If you’ve read this far, you will recognize that the Lean Construction approach requires the major project participants to establish a culture of trust and cooperation – just like a successful Total Quality Management program. This may represent the most significant variance between Lean and other commonly used approaches. Subcontractors have been almost unanimously supportive when we have introduced Lean Construction. Responses along the lines of “Hallelujah!” or “It’s about time!” are common. Accordingly, Lean Construction is probably not a suitable choice for projects that are driven by “bid ‘em and bust ‘em” construction managers that prefer intimidation to integration. For a lot of people, however, the Lean approach is an exciting, refreshing and profitable way to bring construction management into line with techniques that have clearly improved productivity in other industries.

For more information regarding Lean Construction, I suggest that you contact the Lean Construction Institute @ (208) 726-9989 or www.Leanconstruction.org.