

Chapter 11 Key 6: Integrating Project Delivery

In Sutter's brave new world of lean construction, the traditional "command and control" mentality of project management is gone. Gone are most lump sum, low-bid contracts. Gone are guaranteed maximum prices. Gone are inflated bids to cover risk. Gone are the adversaries. Gone are most requests for information. And, so far, gone are costly claims.

—Nadine Post, *Engineering News*

The headline in the local paper forced Jim's hand: "New City Hall Uncertainty Threatens New Commercial Development." As city manager, Jim could no longer avoid facing the council. Rumors were now front-page news, and delays on the project would soon back the city into a corner. A large developer planned to buy the old building site, tear it down, and build a mixed-use town center that combined retail, business, and townhouses. Continued delays with no end in sight caused the developer to send a letter to the mayor, each city council member, and the local paper with a clear message: "If the city is not capable or willing to keep its promised hand-over date of the old City Hall for demolition, we will have no choice but to select an alternate site in the neighboring town."

Stan, the construction manager, spent a blurry weekend reworking the critical path for the project and running scenarios to see if and where they could make up time. He needed to brief Jim before the city council meeting. The polite veneer of this small town had cracked. This would be a tough meeting with one question on the table: “What’s the recovery plan?”

“How in the world did this thing get so off track?” Stan was weary and frustrated. He had helped to sell their firm to Jim and the city council. “Our size and expertise will make the difference for a project of this importance to the community,” he’d said. They were selected over two local firms who had a long history with the city.

His firm tapped Stan because he was one of their best. A former Marine and expert in logistics, he was allowed to handpick his subs. A project of this stature would open a new and growing market for the contractor—or so it had seemed. Now it looked like the firm would likely take a big loss and have to contend with several lawsuits as well.

Stan had begun the project four months earlier with a thorough analysis of the design, schedule, trades, and constraints. He broke the job down into its individual elements and knew every aspect inside and out. He crafted a strategy for deploying resources and was ready to map out a clear plan, which took shape in an elaborate critical path. The master schedule listed more than 6,000 activities defined and linked, each with its predecessor and successor. He worked closely with the point person for every firm after the contracts were awarded to make sure that everyone bought in to their schedule. Stan had built-in buffers at potential pinch points in the schedule. He felt that the project contingency of 5 percent for the architect and 7 percent for their portion would be more than adequate.

Jim and several members of his department were impressed with Stan’s forethought and planning at the kickoff meeting. He knew this was the right team to bring in, even though he caught heat for not selecting one of the local contractors.

But then a particularly hard winter delayed breaking ground. Stan thought that if he could gain some time getting the structure up and expedite the curtain wall, he might be able to double up crews on the interior and align back with the schedule—maybe. The structural fabricator promised to rush their order, but the engineer missed his hand-off and they lost their production slot by a day. That cost Stan’s team a critical two weeks in the schedule. When the structure was finally erected, the curtain wall was ready to go. But then a problem in

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coordination showed up. The curtain wall contractor called out for a 1/8-inch tolerance to attach to the frame, but the structural contractor left 1/4 inch. Stan pressed for the recovery date. The best guess was a three- to four-week delay to fabricate new attachment brackets.

At this point, the schedule was broken. There was no way to keep up with the day-to-day problems and update the master schedule to provide some kind of order to the project. Stan had to improvise daily and assign whatever subs he had where he could. He lost coordination of the schedule, and the owner lost confidence that Stan and his team could keep their promises.

TRADITIONAL PROJECT MANAGEMENT

Stan's approach followed a textbook project management process: reduce everything to its elements and reconstitute those elements back to the whole. From there, Stan identified the logical phases, determined individual tasks for each phase, sequenced them, allocated the time required, and then linked dependent tasks to prior ones. Stan was using the latest software, which allowed quick adjustments in case a task finishes faster or is delayed and shifts all the successive tasks linked. Stan's approach was rational, orderly, and makes sense, which was certainly confirmed during the kickoff meeting as he went through the intricate details of how he arrived at a plan. When Stan opened it up for questions or concerns, there were only a few; most simply wanted to clarify their part in the puzzle. During the entire meeting, whenever Stan looked up, he saw everyone nodding in agreement. Stan would look back to the master schedule and point to the blueprint, and after another phase was explained, he looked up and everyone still nodded.

What went wrong in Stan's airtight plan? The same thing that goes wrong with the 70 percent of projects that exceed their budget and bust the schedule. Traditional project management just *doesn't work* in today's world. This approach to planning and project management consistently produces unreliable outcomes. According to the Lean Construction Institute, "Normally only 50 percent of the tasks on weekly work plans are completed by the end of the plan week."¹ That figure is well documented.²

We can trace the problem to assembly-line thinking adapted for management by pioneers like Fredrick Taylor.³ Assembly-line thinking does not reflect what really takes place when constructing a building. Yet its attraction is hard to deny; it's part of our Western,

rational, Cartesian DNA. Within that paradigm, we have come to believe that the world is divided by knowers and doers. The knowers figure out what, how, and who; the doers perform the specific task assigned. If everyone does his or her job, then everything goes according to plan; at least, that is the theory. KlingStubbins's Scott Simpson sums up the situation: "Conventional execution, even if flawlessly carried out, can only achieve conventional results."

So how can the construction industry keep its schedule and price promises? As we'll see, the answer lays in another major mind shift and, yes, another revolution. It's called Lean Construction.

LEAN CONSTRUCTION

Like most of us, when Stan approaches a project, he sees a collection of elements (material and labor) assembled to produce building. His job is to bring order to all of these moving parts.

Stan knows that getting the most out of his effort will require him to make each specific element as productive as possible. That typically means completing each activity in the shortest amount of time for the least cost. He can see the linear cause and effect along a stream of tasks, but it begins to break down when multiple sequences run into obstacles or collide. There's just no way to play through all of these different possibilities and then reconstruct a master schedule.

Stan has to lock down on one or possibly two schedules and then do his best to realign the work and force the crews to line up with the new plan. But at this point in the project, the activity seems to have taken on a life of its own, and reining it back in will be no easy feat.

A NETWORK OF COMMITMENTS

Some of Stan's buddies in Michigan have told him about a process they follow called Lean Construction. When he heard them say, "We focus on the relational interactions between the trades," he had to laugh. That just seemed like chaos; they were asking for trouble. One friend described a project as a "network of commitments."

"What does that mean, a network of commitments?" Stan laughed. "That's no different than what I do. It just sounds cool and New Age-y."

This fluffy phrase, "a network of commitments," was like a needle in Stan's mind. It would not go away. He went home that evening and crashed in his recliner, looking for some good music to listen to. Music

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was his refuge. It was like another language and world that he loved to explore.

“Now there’s a familiar sound.” He stopped on a channel, “An Evening at the Kennedy Center with the Marine Corp Band.” The band stirred up memories of his days as a Marine—the precision, the dedication, and the loyalty to one another. He loved to watch the conductor, standing tall like a stick and waving his arms toward one group and then another. “Perfect coordination and harmony, I love it!” While listening to the music with its clarity and harmony, his thoughts drifted back to the project. Stan didn’t wear his Marine pride on his sleeve, but he *did* bring that pride to the work he did. If the crews with whom he was working could show just an ounce of that kind of discipline and pride in their work, things would be better.

He clicked through a few more channels and ran across another show, “The Legends of Jazz” with Ramsey Lewis as host. He watched bass guitar player Marcus Miller begin with a few quiet and simple chords and then shift to an up-tempo syncopated rhythm. Within seconds, the drums, guitar and piano entered at the same time. Stan brought his recliner forward and now sat at the edge with elbows on knees and staring directly into his television. Stan was having what he called “a music moment.”

Stan watched the way the musicians looked at each other for cues, the way they leaned toward one another during transitions. He noticed the way in which the lead switched from player to player. Suddenly, the idea of a project as a “network of commitments” took on a whole new meaning. Stan realized that he was trying to run projects like that Marine drill sergeant; there *was* no network of commitments. The only commitment was to learn your part and follow the leader. Jazz, on the other hand, now that was all about commitments to one another—from tight interaction to listening, *really* listening. Music wouldn’t work at all if one guy tried to take charge, but it sounds fantastic when everyone is working to synchronize with the other musicians.

Could this really be what his buddies in Michigan meant? Can a project really flow like a jazz session? Stan promised himself that if he managed to survive this project, he was going to call his buddies to find out more.

DESCRIBING THE ELEPHANT

Hal Macomber, a principal for Lean Project Consulting, Inc., uses the parable of the three blind men describing an elephant to explain why,

when it comes to large, complex projects, we are unable to grasp the big picture: because people see only the part of the project they are touching directly.

Breaking projects into knowers and doers, therefore, is inherently flawed. Central planning fails. The revolution turns the entire situation upside down, to one where the traditional doers provide the collective intelligence to tackle large and complex tasks. The rub, however, is that distributed collective intelligence does not behave according to Cartesian logic.

Lean Construction provides a framework with tools to capture the big picture, tools that are proving highly effective. The hurdle is giving up the illusion that a clearly laid out plan, with assigned tasks and milestones, represents anything more than one blind man's take on the elephant. Once over this attachment, the rest becomes amazingly simple and, in retrospect, common sense.

Co-author of *Swarm Intelligence* Eric Bonabeau reinforces the nature of the shift and the challenge making it in an interview for O'Reilly Media. He explains that, "Human beings suffer from a 'centralized mindset'; they would like to assign the coordination of activities to a central command. With self-organization, the behavior of the group is often unpredictable, emerging from the collective interactions of all the individuals. The simple rules by which individuals interact can generate complex group behavior.

"My experience trying to 'sell' the concepts of swarm intelligence to the commercial world is that managers would rather live with a problem they can't solve than with a solution they don't fully understand or control. So the mindset is a big barrier to adoption."⁴

Bonabeau describes several features of self-organization: flexibility to adapt to changing environments; a group's ability to perform a given task, even if one element of it fails, and the absence of need for external source or force of control. The hardest feature to embrace is the notion that various paths may emerge along the path to the solution, instead of following a predetermined (critical) path.

IF IT CAN WORK WITH GM . . .

In 1984, General Motors and Toyota entered into a joint venture, New United Motor Manufacturing, Inc. (NUMMI). By all accounts, the original GM plant had been a failure, while NUMMI was a success.

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Toyota used its unique management approach—Lean—to transform the same workers using the same equipment into an award-winning factory.

NUMMI has become a famous case study that is often cited to highlight the contrasting mindsets. That contrast is perhaps best captured by this quote from a worker in Matthew May's *The Elegant Solution*:

“Never in a million years would I tell you this work is creative. Then Toyota took over twenty years ago. They teach us their system and say to us, ‘We want you to tell us how to make it better.’ We went from ‘just do your job’ with GM to ‘no one knows the job better than you’ with Toyota.”

GM was so impressed with the results that they created a Global Lean department. Yet several Lean experts to whom we spoke note that GM's results still lag far behind that of Toyota. They offered the explanation that, “Toyota has no department for Lean, no central program. Toyota develops their ‘masters,’ called Sensei's, through a non-directed mentoring process and new masters seek to develop others. It's simply a part of their culture, not a department.”

The lesson for commercial real estate? In the absence of a new paradigm, Lean might as well be just another bag of tools. Leadership's biggest challenge is to transform its legacy management system and culture.

IS IT WORTH THE EFFORT?

Keeping promises requires more than good intentions. It requires rewiring 500 years of Western rational breeding and a lifetime of habit. And this rewiring calls for transformational leadership. However, being an expert within a bad system seems to trump the discomfort of being clueless in a good system. The payoff to let go may be enough to cross over, or the cost for not changing may one day force your hand.

Here are some numbers that may make it easier to decide to cross over:

- McGraw-Hill's Steve Jones says that they typically estimate labor for a construction project at 50 percent—10 percent for overhead and 40 percent for materials.
- Glenn Ballard and Greg Howell, who run the Lean Construction Institute, have tracked numbers that indicate only 50 percent of promises made for the week ahead are delivered.

- Clive Thomas Cain, in *Profitable Partnering for Lean Construction*, reports that “Overall, the ineffective utilisation of labour and the wastage of materials put total unnecessary costs at around 42 percent.”

Cain goes on to explain the improvement that he found by employing techniques similar to the ones that Toyota developed: “[The] Improving M&E Site productivity study and other similar studies . . . puts labour efficiency at the industry average of 40 percent . . . and materials wastage at 30 percent . . .” In another report, the effective utilization of labor ran between 30 to 40 percent. On top of all this, there is a large disconnect among the knowers, those who plan and manage these projects, who overoptimistically estimated labor efficiency at 85 percent.

To go back to an earlier point, Cain argues that instead of looking for project cost reductions by decreasing profit margins through competitive bidding there is more to gain by changing to a system that uses collective intelligence to reduce waste and inefficiency.

Projects that adopted the Lean mindset and techniques were able to raise their “labour efficiency levels to around 70 percent and reduce material waste to around 4 percent. This gives a saving of around 30 percent which is then available for increasing profits and wages, reducing prices, improving research and development and developing training.” On a \$10 million project, that savings equals \$3 million. What could you save on *your* next project?

WHAT DO YOU TRACK?

Keeping promises assumes keeping track of the things that routinely interfere with delivering on those promises. However, Cain found that “virtually no firms within the industry have an improvement program based on measurement and elimination of unnecessary cost.” He provides owners with a series of questions for their teams to better uncover which hidden areas drain efficiency.

- Do they know how often materials arrive late?
- Do they know how much rework regularly occurs (including design)?
- Do they know how much regular disruption occurs on site?
- Do they know how often cluttered or unorganized work areas cause delay and disruption?

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- Do they know how much of the raw materials are wasted?
- If the answers to any of these questions are no, Cain then asks: “How can they know their performance is improving?”

GETTING USED TO NEW THINKING

Moving into a world where trust is the governing principle supported by a system to enable keeping promises will demand a new understanding of the nature of a project within this different context. DPR’s Dean Reed defines projects as “networks of commitments.” The role of leaders is to “bring coherence to these networks of relationships in the face of uncertain paths.” They identify the work clusters, bring the right people together, set the stage to work collectively, and help each team choose the right tools to understand and rehearse the work before them. Leaders invest more effort developing healthy team dynamics and have to exercise restraint from stepping in and directing efforts. This is a paradigm shift away from managing activities and toward improving the relational interactions.

A paper issued by the AIA describing *Target-Value Design* defines design as a social activity: “The notion that one person sits alone and is inspired to design misses both the nature of design and the countless contributions of others.” Value in this world is not determined up front; it evolves as the client’s understanding of the project grows. They are brought to make decisions that trade one value for another. Dean Reed explains that value surfaces in his group’s projects as they work against the constraints of time and money. For example, “Our client desires a marble floor, but [after] exploring that option, [finds that] it is more expensive than she had planned. Now there is a choice to be made. Choices [raise the issue of] priorities, and allow the project team to gain deeper insight into the client’s unscripted values.” In this context, you will never hear these words from a client: “You gave us what we asked for, just not what we wanted.”

The client must take an active role as part of the team, one that is vital to the collective mind. The role that traditional third parties have played—as a buffer to and agent for the owner—must also be redefined. They can take a more significant part by bringing key partners to the table. They may be able to wear the leadership mantel that provides cohesion to the team if they can adapt to the new mindset and acquire new skills. They can no longer justify their value through

adversarial bidding practices that only reduce profit margins and create a context that needs a sheriff to maintain order.

This is a world that searches for fundamental causes, and realizes that those causes lie hidden beneath layers of consequences. Removing those layers requires a different mindset toward problem solving. Trust is the only context for those closest to the root problem to come forward and share what they see. Candor is the barometer of trust. Now, is the only time to see the problem within its context, and the collective mind is the only way to see the elephant in its entirety.

Simply put:

- Trust aligns relationships.
- Early collaboration aligns the team with the business case.
- Sustainability aligns vision.
- Transformational leadership realigns paradigms.
- BIM aligns design.
- Lean thinking aligns process.

These are all facets to a prism, and each contains the light of the other components. For example, Lean practices seek to define value through the client and assume trust, and it is collaborative. These descriptions, however, help to call out a particular strength as we attempt to understand the elephant.

THE ESSENTIALS

We now find Stan doing some homework on the Internet and finding information on The Lean Construction Institute. The institute had a considerable amount of material on its website, and it was a bit overwhelming to Stan. So he called his friend and asked, “Where do I start?”

His friend said, “Let me step back a bit and explain some of the changes taking place in the industry.

“There are two primary frameworks that provide a guide for this new paradigm and process: the Lean Construction Institute, led by Glenn Ballard and Gregory Howell, adapting Toyota’s production process for construction; and the American Institute of Architects guidelines for Integrated Project Delivery.

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“Lean Construction embodies a paradigm shift from conventional project management expressed as a philosophy for delivering value, a theory of project management, specific techniques, tools, workshops, and resources. The LCI website is www.leanconstruction.org. The site offers links to research, audio and PowerPoint presentations, and useful books.”

Stan was scribbling notes madly as his friend continued.

“The American Institute of Architects issued their guidelines for *Integrated Project Delivery (IPD)* in April 2006, which they followed up with a practical guide collaborating with CURT and the Associated General Contractors in July 2007.⁵ The AIA provides a broader conceptual framework supported by contracting practices. It does not provide strategy or tools, and it’s not a philosophy. Markku Alison is the AIA’s resource architect supporting their IPD initiative.

“The two models complement each other. If your firm is interested in the framework and thinking behind keeping promises through trust and integration, but you want to develop your own approach toward projects, the AIA resources will best serve those needs. If you’re looking for a system to support that shift, I recommend exploring what the Lean Construction Institute offers.”

“It looks like I’ve got my work cut out for me, then,” said Stan. “Thanks for your help.”

“No problem,” said his friend. “Enjoy the journey!”

Throughout our own journey, Mindshift attended workshops, conducted research, and tapped into the experience and knowledge of several experts, like Dean Reed (DPR), George Zettel (Turner Construction’s Lean champion), Gary Hamor (president of Lean Practices, Inc.), to help us get our arms around Lean and its potential to transform project management.

We liked the idea of breaking a project into its component systems so that we could wrap our minds around it. Matthew May notes in his book describing Toyota’s management, “A given system is broken down into its component systems and designed in a modular fashion, enabling individual parts to develop before being integrated into a single system.”⁶ This scales the project down to a doer level of understanding. Sutter Health divides projects into systems of eight clusters, each of which is led by a cluster manager: structure, site improvements, landscapes, material handling, vertical transportation, interior finishes, building envelope, and mechanical, electrical and plumbing.

We also found that Lean becomes a continuous process for the elimination of waste, because it trains people to identify the common forms and causes for waste. And more important it identifies these signs of waste as symptoms for deeper systemic issues. If workers were waiting, that would lead to an immediate inquiry to trace the roots: Do they not have the tools or materials? Are they unclear of their task? George Zettel pointed out that their studies showed that 50 percent of a construction worker's time is waiting. Taking too much material or more-than-needed components to the site "just in case" is waste. Staging and restaging materials is waste, and it's commonly done. Rework is a major source of waste, and can account for up to 10 percent of the cost for a conventional project.

Here's an example:

Would we rather have a master plumber doing actual plumbing work or walking across the site to get more materials? The idea behind eliminating waste is to keep this plumber busy 90 percent of the time or better. Retrieving parts or tools is not plumbing work; it is not adding value and therefore is waste. Keeping the plumber plumbing is Lean's objective.

Some will ask, "Who is going to retrieve the materials. They have to be moved." The first goal is to stage the materials to minimize the movement and then secondly assign the task to a lower paid laborer so the plumber can focus on where he adds his value. This example deals with three of the seven sources of waste: waiting (for materials), unnecessary movement, and an inefficient process.

Lean thinking allows a team to develop a deeper understanding of value, rather than simply focusing on delivering a project on time and within budget. Values are those benefits that the client and different project stakeholders desire and gain on the project. The understanding of these facets grows and clarifies as the project evolves.

The goal of the Lean journey is to achieve minimal waste and maximum value. Meeting that goal requires the ability to build quality by not allowing variations on the front-end and during implementation. This is yet another shift in thinking. Under the old model, the work is completed, inspected, and then corrected. This system treats a component of work as if it were unrelated to the rest of the project. Lean thinking doesn't just build in quality because it sounds good or it's a principle. It is a principle because any deviation from this practice hinders relationships—either by waiting or taking additional time to fix or work around the problem. It also hides the root of the source of that problem.

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Lean thinking is built on mutual respect. It embraces the practice that everyone brings value, has a stake in the outcome, and has an equal voice in deciding direction. Respect enables self-organization and candor. One of the most appealing elements of Lean thinking is its search for simplicity. This is manifested in the drive to root causes, establishing value as defined by the client, communicating visually, and breaking complex things down to the doer level of understanding.

Gary Hamor says that up to 30 percent of Lean thinking and processes deal with communication. He claims that we all know where assumptions lead, and Lean's strength makes the invisible visible (processes) and the intangible tangible (value). Traditional project management tends to be highly abstract: timelines, tasks, checklists, RFIs and change orders. Lean goes in the opposite direction.

Behind each of those abstractions are people. If the process is designed around people improving their interactions, then much of these abstractions shrink or disappear entirely.

GETTING STARTED

Stan did his homework for almost a year before he was finally ready to get started. Lean was still a bit of a mystery to him, but he kept hearing about the incredible results—projects routinely completed ahead of schedule and frequently 10 percent under budget. Two things stood out even more than cost savings: Many of these projects had just a handful of change orders, and there were no claims at the end of the job! In fact, each of the people to whom his buddy had introduced him spoke about Lean with the same kind of enthusiasm they might have for their favorite car. One project manager that he talked to on a hospital site in Tennessee even said, “I’m having fun again, and the results are awesome.”

Still, Stan was frustrated. There seemed to be some code, some fraternity that all these people were in on, the meaning of which had not yet come together for Stan. He could see that simply overlaying some of the tricks he had read about, like value-stream mapping, might improve some of his project, but not to the degree he was seeing take place on the Lean projects.

So when Stan heard about a training seminar that the Lean Construction Institute was holding at Texas A&M, he immediately signed

up. He read a little more and learned that Texas A&M was developing a center of excellence around Lean, Green, and BIM. “This ought to be interesting” he thought to himself.

At the seminar, Stan met many Lean veterans, people from DPR, Turner Construction, Linbeck, and Swinerton, and he heard about others, like Boldt and Herrero. There were a few architectural and engineering firms along with some of the sub-trades. The session facilitators spent a little time covering theory and a few case studies, but they then quickly divided the room into tables of six people for an exercise called the Airplane Game.

THE AIRPLANE GAME

Stan sat down at the table and introduced himself to the other five players. The goal was for each team to build as many Lego airplanes as possible in six minutes. Stan frowned; he remembered playing Legos with his son when he was a kid. But he didn't say anything. By now, he'd learned that his preconceptions didn't really get him anywhere. The group's job was to simulate three different scenarios. The first was a fairly conventional process. Each person would take part in adding a few blocks to the plane, and pass their work down to the next station. That seemed easy.

The policy for the first exercise seemed straightforward. Just do your job without talking back and forth. You can't pass along work until you complete your batch of five. If there are any mistakes, they get passed along and caught by the inspector at the end. For the logistics, they were allowed to look at a highlighted picture of their part of the plane. The scale was small and all the lines were the same color. It was a bit confusing, but Stan figured he could do it. Each person from the team went to the material bins and selected the number of pieces they thought they might need. Each person was rewarded by the number of pieces they completed.

When the timer went off, Stan's adrenaline started pumping. He was second in line and had four pieces to attach. The first station only had two, the main fuselage and the beam of the wing. Stan could feel his fingers fumble a bit, especially when he was just more than halfway through and there was a new batch of five sitting in the queue. At about two minutes into the exercise, their first plane—and batch—was completed. The last guy raised his hand and the facilitator noted the time. Stan looked up from time to time and saw some of the others fumbling and attaching a Lego block just off of its mark, remarking to himself, “Nothing I can do about it.”

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When the timer sounded the end, everyone looked up, tense from the competition. Stan glanced around the table. He had passed along all the work he could, but the station before him had three batches of five that could not get passed forward because it took Stan longer to add his four pieces.

It was time to measure everyone's performance. Stan's team overestimated the number of planes they could finish by three times. About 25 percent of the finished planes had defects. The most eye-opening count were the number of incomplete subassemblies at the different stations.

"Wow," Stan thought. "That's a lot of wasted work. We didn't even come close to our target."

The facilitator debriefed the group, and there was a lot of active chatter. Several examples were thrown out comparing the problems to a live job; drywall and the MEP portions came up a few times. He then laid out the changes for the second exercise. This time, instead of building batches of five, one plane was to remain in the queue. The team was allowed to point out problems, but it was not permitted to fix them once they passed the station that created them. "*Now* how many planes do you think your team will build, and how fast will you put that first plane together?"

At the end of this phase, the first plane was completed in under a minute. The number of completed planes doubled, and the number of mistakes dropped as well. And while the estimates were still off, they were a lot closer.

"What are some of the lessons we can learn from this change?" the facilitator asked. The answers came at him rapid-fire:

"Reducing the size of each batch streamlines things."

"We could communicate a little more, and we caught some mistakes as soon as they happened."

"We were much more realistic in what we said we would do, and almost dead on in our projections of when we would finish that first plane."

"Excellent," encouraged the facilitator. "Our final exercise will modify the process even more drastically. This time, each team member will have his own diagram with color-coding of the blocks that you are responsible for assembling. We are also going to give each person an even number of pieces to attach. The biggest change, however, is communication and the ability to help one another."

When the timer buzzed, the room was buzzing too, because just about everyone had the same epiphany.

“So what happened this time?” asked the facilitator.

“Our first plane was completed in less than 20 seconds!”

“That’s a big improvement over your two-minute plane in round one.”

“We doubled our output again.”

“We had no defects.”

“We had a lot of talk going back and forth and a little help if one of the members was getting bogged down.”

“We were one plane off our estimate. Not bad!”

The facilitator instructed, “Okay, now each of you look at your tables. How many subassemblies are sitting in each station?”

Stan looked and laughed with disbelief; not a single piece remained at their table and only a few were at some of the others.

MAKING CONNECTIONS

“No waste, no defects, and more than tripling your output! That’s what we call optimizing the whole.”

Stan sat back in his chair and thought, “If I could go into each section of a job and restructure how we attack an area, I can see how we would turn this thing upside down! But for me to get all the trades to sit down and even look at a section—let alone work out this kind of give and take—a lot would have to change.”

While some of what Stan had learned began to make sense to him, it also elicited deeper questions about how to achieve the cooperation. He felt that he had turned a corner; but he was not yet solidly heading down this Lean path.

Stan played a few more games at the seminar that illustrated ideas and spurred deeper discussions that clarified what distinguishes Lean from traditional project management.⁷ Stan finally got the point that Lean was as much a mindset as it was a set of tools. Once he began to see that a project was a network of commitments, the other pieces began to fall into place.

PIECES TO THE PUZZLE

Stan heard a lot about those other pieces at the seminar, and his interest was now definitely piqued. Two of these tools—value stream mapping (a technique used to analyze the flow of work and

“Let me give you an example. We were having trouble getting paid in a timely way, and it was creating friction between our billing group and the client’s accounts receivable group. We brought them together for a lunch and then went back to the project room to meet. The first thing we did is break the ice and get each group to talk to one another.

“Our facilitator asked the client’s team to map each step they take in order to pay a bill: who receives it, where it goes next if there are no questions, what happens if there are, and so on. And we followed each trail through until it gets paid.

“The facilitator then asked our team to go up and do the same with our process: to map out each step that it takes to generate an invoice. Once both were up on the board, we ran through both processes while each team explained their own. The facilitator then asked both groups to go up to the map on the wall and begin looking for gaps, overlaps, or places that create delays or problems. Within 30 or 40 minutes, the buzz, light debates, and problem solving allow a new map to emerge.

“The facilitator has the group stand by the map and walk through the process as a whole. As they discuss the procedure, a few more steps are removed, linked, or renamed. But like the airplane game we played this afternoon, we restructured the work and gave everyone a say in the process—with a very clear understanding from everyone on how to make it as smooth as possible.”

“So what happened?” asked Stan.

“Our turnaround for payment went from well past 60 days to under 20,” his buddy said, smiling. “We also kept the group together as a social network, had a few lunches, and revisited the map to improve it further.”

LAST PLANNER SYSTEM

Stan and his friend had time for one more round of beers before they called it a night. “How do you deal with so much flux from week to week?” asked Stan. “It’s a killer trying to keep up with the changes and hold the master schedule together. When I get promises from each of the crews at the beginning of the week, I’m lucky if half of the work is completed.”

“Stan, here’s what we found using the old system. Our crews never had a real say in the schedule. So we started off without any buy-in. Sometimes a crew knew upfront that it would be a stretch to make, but nobody wants to admit that in a public forum. We also had the

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superintendents in the room and no one from the crews doing the work. So we got many heads nodding but no one really looking up or speaking up. The superintendents were also coming in with their agenda—how to make money and get in and out as quickly as possible. There was no interest in coordination. The site too often became a competition, with people getting in each other's way and making a general mess.”

“Yep, that's it,” Stan agreed.

“So we adopted a tool that really pulls this together; it's called Last Planner. I don't set the schedules anymore the way I used to building my master schedule. We pull the doers together and set the plan collectively. It's called Last Planner because the last ones who plan out the work are also the ones doing the work.”

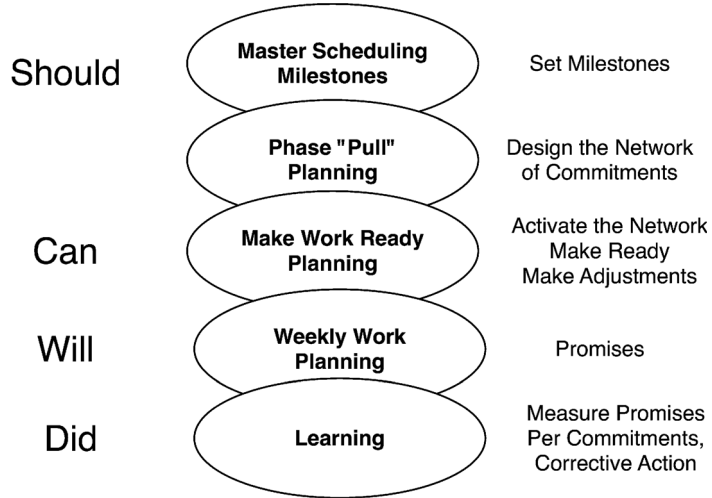
“Good idea,” said Stan.

“Yeah, it's really simple when you think about it. We take the crews that have work that week; we know the goal, and we begin walking backwards. If, for example, our drywall crew is going to complete their work, they need a full set of plans and a 3D model posted to see what the product will look like when finished. In order for them to have the plans, the architect has to get the owner to sign off. To get the sign-off, the architect has to have the full specs and pricing completed. To have the full specs and pricing, they need to have reviewed the options. And so we just keep going backwards until each step is covered and handoffs are made clear.

“This works on a larger scale too. We set our milestones with the master schedule, work through the phases, and discuss the handoffs. These set our targets. Then we look out six weeks at what we think we can do, figure out what work has to be prepped, and look for any constraints that need to be removed. Once we get down to the week's plan, we're tackling work that we are confident can get done with the teams that have to directly coordinate with one another. They begin committing to the work, and then making promises to one another regarding handoffs.

“We make the handoffs clear, measure results at the end of each day, and post those results in each area. We keep track of the amount of commitments that were made, and divide that by the number that we completed. Any promise not kept is identified in one of the many categories we track. Just like the airplane game, our accuracy projecting work starts out a bit shaky but quickly improves. After a few weeks, we'll start seeing some patterns show up. There are usually one or two reasons that we find more often than others that the work hasn't been completed as promised. We can then attack that category with some of the other tools that we have with Lean.”

Figure 11.2 Planning Windows for the Last Planner System
The Last Planner System of Production Control
5 - Connected Conversations



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Adapted from a presentation by the Lean Construction Institute

Figure 11.3 Metrics for Unmet Promises

Reason	ocurrence
Unclear information	xxxxxxxxxxxx
Too few operative(s)	xxxxxxxxxxxx
No promise to deliver	xxxxxxxxxx
Client/Design change	xxxxxxx
Overated capacity	xxxxxxx
Late request	xxxxxx
Unclear requirement/CoS	xxxxx
Prerequisite work	xxxx
Failure to request	xx
COS not made clear	xx
Rework	xx
Other	xx
Absent operative(s)	x
Unplanned work	x
No customer	
No performer	
No due date	

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Figure 11.4 The Big Room



NO MORE SILOS

Stan felt like the two big mysteries that had been holding him back were on the verge of being revealed. He asked his friend, “How do you get away from the silos when planning a project? And how do you schedule work with any degree of confidence?”

His friend said, “Well, Lean has several tools built on the essentials we were talking about today. Target value costing and visual management are two really good ones.”

We agree with Stan’s friend. Target Value Costing provides a collaborative tool for arriving at the target cost on projects that usually involve an open-book approach by each of the stakeholders. Once costs are determined, managers create incentives meant to reward the outcome of the project- and not the individual stakeholders. Dean Reed gave an example where his team placed all of their profit for a recent job at risk and would only make a profit if they met the target number. They met that number, and the project achieved additional incentives.

Visual management recognizes that a picture is worth a thousand words. Whenever possible, Lean projects attempt to use visual tools to map processes, providing 3D images for the way the work is to look when completed. Turner’s George Zettle says that they use BIM to

create a sequence of steps for how an area will come together. They will either have a laptop on site to play the animation or take screen shots several steps along the animation and show the crew. Tocci Construction sets up a poster-size 3D model on an easel for crews to see a greater level of detail. Part of visual management, however, is building the awareness that visual cues on the site have an underlying story. A pile of material sitting out is a symptom of a problem that needs to be explored, as is a messy work area.

Lean has a wide range of other tools with resources to walk you through the big idea or principle and explain how to use them.

STAN GETS A FIRST-HAND TASTE

Stan's buddy called to invite him to spend a day with one of their teams involved in a Target Value Design exercise for a university physics lab. Stan arrives at the "Big Room" with 40 people or so. He didn't see his friend, so Stan sat in the back and kept quiet. When the day was over he could hardly believe what he saw and the positive energy he left with. His friend called and asked how the day went. Stan was eager to replay the day.

"The team broke the project down into each cluster (sitework, structure, interiors, etc.) and took an in-depth look at each member's pricing. At one point in the meeting, the mechanical design engineer spoke up: "The cost of my work is above the target." So far, he is the only one out of line.

"How did it play out?"

"Certainly not what I expected. The engineer presents in front of all 40 or so people and described the status of his work and the measures he is taking to get within the budget. At the end of the presentation one of the members begins to question him, with some tough questions. He was asked what kind of new ideas he was bringing to the job and whether or not he was pulling out all the stops to get his work in line. I just assumed it was the GC, the architect, or maybe the owner. When the session was over and each cluster team broke off to meet, I went up to one of the guys who I knew was with the contractor and asked, 'Who was the guy putting some solid pressure on the mechanical engineer?' When he told me it was the concrete frame subcontractor, I was blown away, but then it clicked. When everyone has a shared interest in the outcome of the project, anyone can step up."

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“Stan, I think you’ve put it together. Our common incentive pool creates genuine transparency, and Lean provides a way to handle what in the old days would have turned into finger pointing, or worse never brought up in the first place. When everyone has skin in the game then everyone looks after one another in a positive way.”

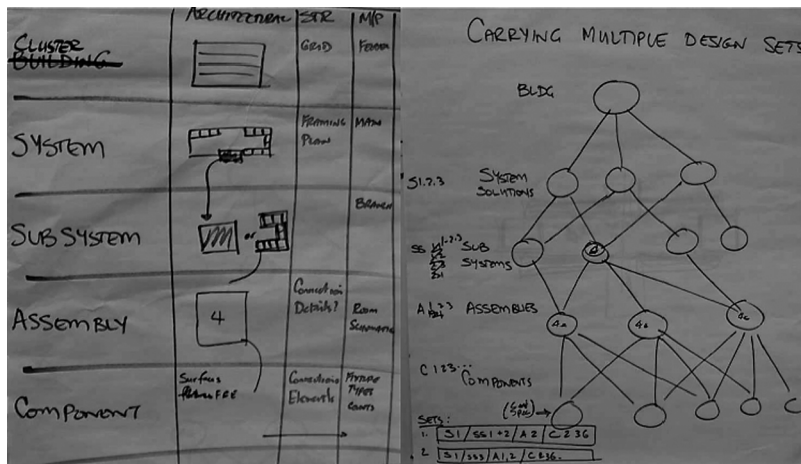
This meeting actually took place, and one of our Mindshift members was there to observe. The specific technique of Target Value Design was useful, but the process and the behavior that was witnessed made a bigger impression.

LEAN ARCHITECTS

Lean is slowly working its way into the offices of architects. They too have their internal processes, silos, and handoffs that can benefit from the same disciplines. Set Based Design is one tool firms like HGA Architects and Engineers on the Sutter Health projects are currently using. George Zettle describes how this works.

“The architect will create a set of design solutions early in the project and carry those solutions forward until there is a clear ‘winner.’ For example, we may consider two or three structural framing systems, and as we get further into the design, the architect will better define the interior space and the floor circulation. This may change the bay sizes and favor one solution over the other. It sounds counterintuitive, but it really does

Figure 11.5 Set Based Design



save time and cost. If we lock in too early on a particular solution, and we find out it's not the optimal one, then the client either has to live with a less-than-desired outcome or pay for a major rework of the design. This way, we haven't exhausted one solution all the way through."

LEAN: TALKING POINTS

Stan went back to the office filled with plans. "Janet," he said to his assistant, "call a meeting for Monday. I think we're ready to get this thing going for real."

It had been a long journey for Stan—more than a year, in fact. During that time, he had to accept that the old way of doing things really wasn't working, and then he had to learn a whole new way of seeing—a completely different world view. But once he got it, he *got* it. And he was ready to run with the ball and show others exactly how to work within this new paradigm.

Stan's story is a common among other Lean advocates. Here's why:

- Lean aims for predictability of workflow and not for optimizing productivity of each component.
- Lean works to improve relational interaction and to reach outcomes; it does not focus on outcomes as a means to drive activity.
- The customer determines value, and that value clarifies through the project. Value is not fixed at the outset. Lowest upfront price does not equate to lowest final cost or best value.
- Doers determine how and when work is done, instead of centralized planning pushed through a critical path.
- Quality is built-in at the front end instead of inspected and repaired at the back end.
- Lean focuses on variability throughout the process. Traditional project management is only concerned about it at key milestones.
- Lean creates an environment of transparency, whereas conventional projects don't ask, or worse issues are ignored and/or covered up.
- Incentive is based on the outcome of the project and not on individual completion of tasks.
- Lean projects are networks of relationships built within an environment of people who feel committed to one another; and these commitments are not abstractions, like timelines and task lists.
- Because incentives are shared, money can be shifted to changing priorities without penalizing anyone.

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- The client plays an active role in the project and does not delegate their role to a third party.
- Sub-trades are recast as flexible players to the overall project, which leverages talent and skills where they can make the best effect.
- Design is an iterative process and requires options; it is not a predetermined path.
- Design is a social activity that includes key stakeholders, and is not the exclusive activity of “experts.”
- Lean teams co-locate and interact regularly, not just when meetings are scheduled.
- Work is a group endeavor, not a collection of independent efforts.
- Lean uses systems theory to understand the nature and dynamics of a project instead of breaking a project into its individual parts.

THE FUTURE FOR LEAN

Lean is still in its early adopter phase. There are strong regional areas that are using Lean practices and several individual firms. Similar to the adoption of BIM, some of the larger firms’ field offices are practicing Lean, but have not migrated to Lean as a culture. That migration takes time.

Healthcare was one of the first industries to adopt Lean Construction, and Sutter Health is perhaps still the best example. This number is growing rapidly. The future of Lean, however, may already be unfolding. At the time of writing this book, we identified 49 hospitals or healthcare systems adopting Lean to improve their internal operations. Several of the firms we interviewed are developing a consulting side to their business, as they recognize the broader applications for Lean thinking and large demand within organizations for improving efficiency and removing waste.

In Lean, Stan discovered a life-changing world built on trust, participation, and a new kind of common sense. We heard the same sentiment expressed over and over when we talked to construction managers using Lean and the owners whose projects have been transformed.

In the next chapter, we describe the Integrated Form of Agreement and AIA’s Integrated Project Delivery Guidelines. The chapter will provide the rationale behind these radical departures from traditional contract structures and provide examples of how they are being used.