

Use lean methods to speed drawing

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A top priority for drafting groups is to produce drawings more quickly. This is driven by customer schedules and demands from production. This article discusses how lean methods are used to significantly speed the drawing process. Timelier drawings offer substantial benefits:

- competitive advantage by offering a shorter schedule to customers
- substantially lower production costs (earlier drawing availability allows more scheduling time to optimize plant productivity, resulting in fewer form changes and other changes)
- reduction of costly missed concrete placements because of unavailable drawings

The opportunity to reduce drafting-cycle times by weeks can be identified using process analysis and lean cycle-time-reduction methods. An analysis of projects smaller or larger than the example given in this article will result in similar conclusions about cycle-time reduction but in proportion to the size of the project.

The process map with a timeline analysis will identify substantial cycle-time-reduction targets. Steps to achieve reduced cycle times include improving

- drafting planning, coordination, and accountability
- drafting quality
- drafter and checker productivity
- information flow to drafting.

Timeline analysis to improve cycle time

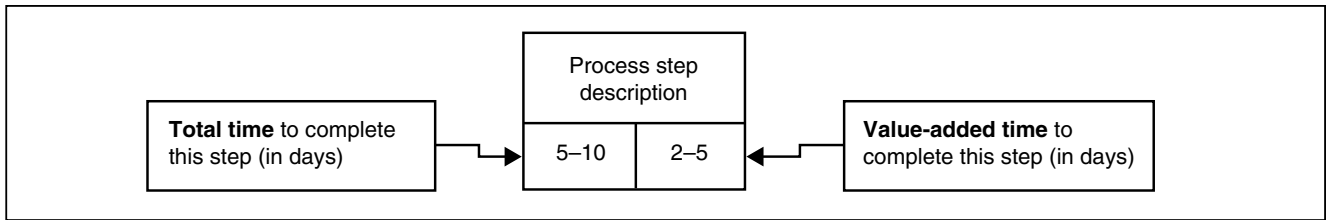
A value-stream process map, timeline analysis, and the concept of value-added activity (as opposed to non-value-added activity) are tools to identify the pathway to a leaner drafting process.

The timeline for each process step in our example project is divided into two categories:

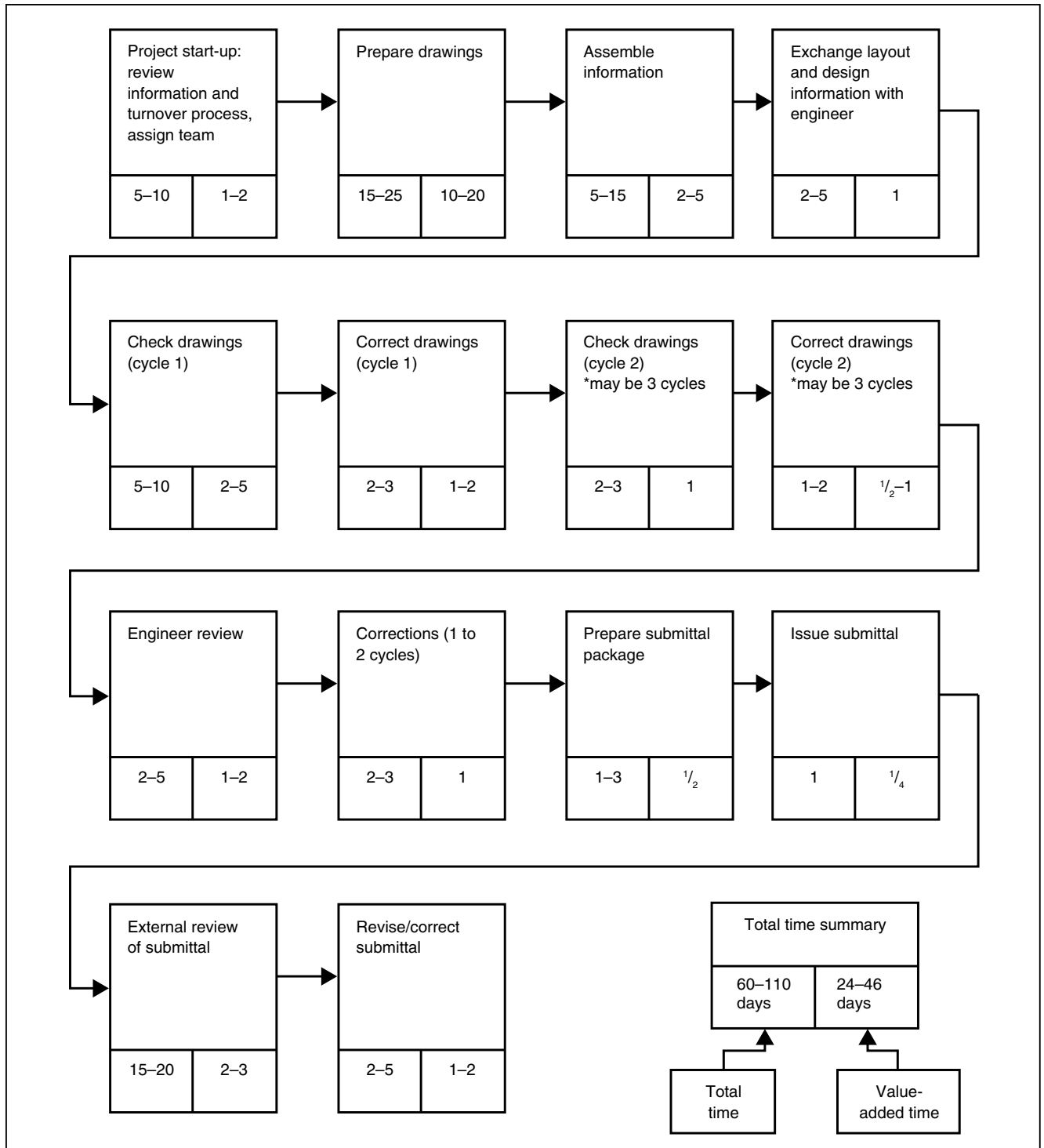
- total time in days required for the task to be completed
- value-added time required for the task (in this example, value-added time is the time needed to complete the task if the work could be completed with no interruptions or delays)

The first process step is activity related to the project's start-up, where

- the drafting manager reviews the construction drawings, proposal, specifications, and other documentation and assigns a project team; and
- the drafting project team reviews drawings and other information and may participate in the project turnover process.



This figure summarizes the steps and timelines from a project's start to submittal for a typical midsized structural project.



This simplified drafting value-stream map highlights cycle time and queues from the project's start to submittal.

Comparison of total time with value-added time

	Start to submittal approval time		Start to submittal issue time	
	Low range	High range	Low range	High range
Total time	60 days 12 weeks	110 days 22 weeks	45 days 9 weeks	90 days 18 weeks
Value-added time	24 days 5 weeks	46 days 9 weeks	22 days 4 weeks	43 days 9 weeks
Difference	36 days 7 weeks	64 days 13 weeks	23 days 5 weeks	47 days 9 weeks

Note: The high range columns show the potential time saved from project start to submittal approval. The low range columns show the differences between total time and value-added time but exclude the time required for submittal approval because the submittal-approval time frame is usually outside of the precaster's control. Error-correcting time is included in the value-added category. In a totally lean enterprise, error correcting would not be viewed as a value-added activity.

Due to commitments to other projects, the start-up activity might take from five to ten total days to complete, but the actual project-related activity or value-added time—primarily the review of drawings and other information—is only from one to two days.

Another example that highlights the difference between total time and value-added time is the fifth step, in which the drafter submits the drawings to a checker. The checking process may only consume from two to five days, but isn't completed for five to ten days because the checker is busy. These differences exist at each stage in the process.

In the example, the total time from project start to submittal completion ranges from 60 to 110 days, or 12 to 22 weeks, depending on the project size. However, the value-added time ranges from 24 to 46 days, or 5 to 9 weeks. The value-added time is much less than the total time because of the many periods in which no work is performed to advance the drawings to a complete state. In other words, the drawings sit idle while waiting for missing information or for unavailable resources, such as the drafter, checker, or engineer.

As these wait queues are reduced or eliminated, the time to produce erection drawings and shop tickets can be substantially reduced, at least by one or two weeks and often by much more. In the example, this means that a project that currently requires from twelve to twenty-two weeks to progress from start-up to submittal could be completed in as little as six to ten weeks.

As noted previously, the difference between total time and value-added time is explained by the many instances where the project is idle, either while information is

sought or while human resources are unavailable to complete a task. Some reasons include the following:

- There is a wait for information:
 - The drafter waits for information.
 - The drafter waits for design input from engineering, or the engineering department waits for the layout and other details from drafting.
- There is a wait for resources:
 - The drafting manager doesn't begin the review and team assignment until other work is completed.
 - The drafter doesn't begin the initial review until other work is completed.
 - The drafter waits for the kick-off process.
 - The drafter starts the project.
 - The drafter completes the drawings, likely while working on other projects simultaneously.
 - The drawings wait until the checker has time to check them.
 - The corrections wait until the drafter has time to make corrections.
 - The checked drawings wait until the engineer has time to review them.
 - The corrections from engineering wait until the drafter has time to correct them.
 - The wait is extensive (perhaps from three to four weeks) while the submittal is approved.
 - The shop tickets and material lists wait until they are checked.

Current state



From 9 to 17 weeks to submittal issue milestone

Future state of phase 1: reduced queue time and defect cycles, improved information flow and productivity

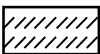


From 8 to 13 weeks to submittal issue milestone

Future state of phase 2: further reduced queue time and defects cycles, further improved information flow and productivity



From 6 to 10 weeks to submittal issue milestone

 = value-added time
  = queue, waiting time

This visual representation shows cycle-time reduction as drafting processes are improved.

- The checked shop tickets and material lists wait until the drafter is available to correct them.

The goal, through an improved process, is to complete the project much more quickly by eliminating the queues. Examples of leaner drafting-process targets include the following:

- The drafting department is provided with advance notice of impending and newly awarded projects so that department planning is improved.
- Plans, specifications, contract drawings, proposals, and other start-up information are provided to drafting without delay.
- Drafting of initial project reviews and team assignments are completed without delay.
- Drafting team begins work without delay.
- Improvements to information processes allow drafting to receive information more quickly.
- Through improved planning, the checker is scheduled to check erection drawings without delay. For example, drawings will be available for checking at a specific time on a specific day. They will be checked at that time and returned to the drafter within several hours.
- With greater first-time drafting quality, checking is completed more quickly and fewer corrections are required.
- Through improved planning, the engineer is scheduled to review erection drawings without delay. With greater first-time quality, the

Drafting-project-evaluation example

Evaluation factor	Rating
Completeness of information (poor, average, good)	Average
Complexity (low, medium, high)	Low
Schedule (reasonable, tight, problem)	Reasonable
Personnel (high experience, experienced, low experience)	Experienced
Overall project risk rating (low, medium, high)	Medium

engineering review is completed more quickly and fewer corrections are required.

- Through improved planning and coordination with the general contractor, the submittal review is completed more quickly. Although this sounds challenging, on certain fast-track projects general contractors and precasters have demonstrated that they can work cooperatively in order to achieve quick submittal turnaround.

The cycle time will be further reduced through gains in drafting quality, productivity, and information flow.

Steps to reduce drawing-cycle time

Improve project planning and coordination to reduce wait queues

Improved project planning and coordination will reduce the many instances in which work sits idle. With a credible plan, resources are available to respond quickly during all phases of work on a project, including project start-up, turnover, drafter start, and checking. Sound project planning will reduce queues and improve coordination between drafting and engineering so that the drafter is not waiting for engineering and vice versa.

In a perfect world, wait queues would be completely eliminated. In that case, the total time and the value-added time would be almost identical. This perfect target is unlikely to be achieved, but many weeks can be eliminated from schedules.

Drafting project plan example

A realistic project plan is a necessary tool to ensure that resources assigned to the project are adequate to complete the work by the target date. Drafting groups try their best to meet deadlines, but in many cases project-planning tools are not used.

Without a project plan, information and processes aren't available to determine whether a schedule is realistic. A drafting project plan, created at the beginning of each project, will provide a clear answer to the question: Do we have a realistic plan to meet this schedule?

In some instances, the initial project plan will indicate that a schedule cannot be met. Early detection of such situations leaves time to devise an alternative approach to ensure that key deadlines can be met.

A basic drafting project plan identifies major milestones, target dates, and the required effort, in days or hours, for each task. Project plans should be developed by the drafter for each of the projects and then reviewed with a supervisor. This creates a higher level of ownership to meet targets for time standards and completion dates.

Credible project planning assumes that basic time standards are in place so that the effort required can be reasonably estimated. In addition, a realistic project plan begins with an accurate initial evaluation of the project. Following are some key evaluation factors:

- information quality and completeness
- project complexity
- schedule
- personnel capability

Project plans should be kept simple and should only include a small number of critical milestones so that they are easy to update to accommodate changes. For larger, complex, or critical projects, more in-depth project plans are appropriate but require more effort to create and maintain.

Simplified drafting-project-plan example

Milestone	Time needed, days	Target date to complete
Kickoff and drafting-project plan complete	1	Day 2
Complete exchange of layout and design information with engineer	2	Day 7–15
Erection drawings ready for drafting check	20	Day 30
Drafting check and engineering review complete	2	Day 32
Submittal package issued for approval	1	Day 34

Drafting progress review example

With a drafting project plan in place, progress can be evaluated regularly. Actual progress should be compared with the schedule at least weekly but as frequently as real time or daily when a key project-status metric changes.

In general, the drafter assigned to the project should prepare or participate in preparing the project plan. The drafter should also be responsible for monitoring progress because this will help to reinforce ownership and accountability. In addition, the drafter should proactively communicate any variances from the schedule.

A color-coded, visual management tool may be used by the drafter to monitor and communicate project status.

The color-coded status report is a visual management tool that quickly communicates project condition highlights to others. Often, the project status will be located at the drafter's work area or on a bulletin board in the drafting office. In that way, the project status summary is visible to the drafting manager, project manager, production personnel, and other interested parties.

Picture, for example, the drafting manager or a project manager walking past a drafter's cubicle and noting that a project status code that had previously been green is now red. That will lead, without delay, to a discussion about what has changed, whether help is needed, and whether other options need to be considered to keep the project on track.

Adopt pull scheduling

The lean "pull" concept of scheduling can be helpful in improving drafting-schedule performance. Pull scheduling means that drafting output is produced in the order determined by the needs of the customer. In the case of drafting, the customers are production and field.

"Push" scheduling means that drafting output is created in the order that suits drafting, independent of the needs of production and field. In other words, drawings are pushed to the customer rather than pulled by the customer.

Drafter project status summary example

	Start to submittal issue time		
	Schedule	Information	Defects
Project 1	Green	Green	Green
Project 2	Red	Red	Yellow
Project 3	Green	Yellow	Green

Note: green = good; yellow = minor issues; red = major issues.

Because of the numerous changes to project schedules, keeping up with the needs of production and field can be a time-intensive activity. Lean organizations use simple tools to tackle schedule coordination and communication. A helpful concept is to have the customer directly signal to the supplier what is needed. This avoids the need for complex, organization-wide planning tools.

The equivalent in a drafting environment is for the project drafter to be fully aware of the production/erection schedule and to manage output to meet those schedules. Through the project status summary, the drafter will be able to communicate quickly if a schedule cannot be met. Then corrective actions, such as assigning additional resources, can be assessed and the best option selected. The key is early detection of the problem.

Improve drafting quality

First-pass drafting-quality rates are typically low, so drawings pass through two or three cycles of drawing, checking, and corrections. This consumes a number of days of schedule time.

The following scenario is common for most drafting departments:

1. The drafter finishes the erection drawings and provides them to the checker.
2. The checker finishes other work and then checks the erection drawings.
3. The checker returns the marked erection drawings to the drafter.
4. The drafter completes other work and then corrects the erection drawings.
5. The drafter provides the erection drawings to the checker.
6. The checker finishes other work and then rechecks the erection drawings.

Typical checking milestones are the drafter check of the erection drawing, the engineer review of the erection drawing, the submittal review, the drafter check of the material list, and the drafter check of the shop tickets. At each of these checkpoints, two to three passes may be needed before drawings move to the next phase. During each pass, the drawings sit in an idle queue waiting for a drafter, checker, or engineer.

Progressing from three check/correct cycles to one can potentially reduce the drafting schedule by five to twenty days.

Improve information flow

Improvements in the flow of information to drafting will reduce the time spent waiting for information.

Improve drafter and checker productivity

Productivity gains are crucial to producing drawings more quickly. Fortunately, a number of steps can be taken to improve drafter and checker productivity, including training, best practices, standards, technology, and defect reduction.

Summary

Drafting-cycle times can be reduced significantly through

- reduced waiting queues through improved drafting planning, coordination, and accountability;
- reducing the number of draw, check, and correct cycles with improved drafting quality;
- improved drafter and checker productivity; and
- improved information flow to drafting.

A drafting-process map with associated timelines will identify the source and duration of the waiting queues and other non-value-added activity. Corrective actions can then be implemented to reduce queue (idle) time through improved scheduling and coordination of work flow.

A typical target for drawing-cycle-time reduction is to reduce the project's start to submittal milestone by at least one to two weeks. A more aggressive target is to reduce the time by half. Similar gains can be achieved in shop-ticket-cycle time.

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Reader comments

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