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Time Fence Secrets

Uncovering the bridge between planning and lean execution

By **STEVE BELL, CFPIM**

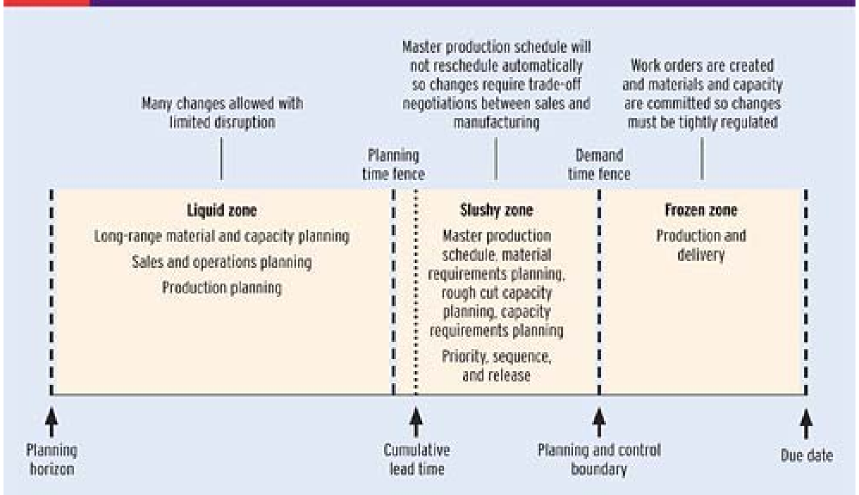
Experienced lean practitioners recognize that they must make effective use of all available tools, while ensuring that each tool does not propagate non-value-added activities into the value stream—particularly on the shop floor. This precaution is especially important when the tool is an enterprise resources planning (ERP) system. To maximize lean performance (and avoid introducing unnecessary complexity and wasteful activity) we must establish a "demilitarized zone" between ERP and lean. This points to often misunderstood planning resources called time fences, which are guidelines that regulate change to the master schedule as the time for execution approaches.

Careful planning clearly is required in a lean environment, especially when inventories are low and materials are delivered Just-in-Time (JIT) to the shop floor. Planning time fence rules bridge the gap between manufacturing resource planning (MRP II) and lean execution. Therefore, we must look at them in a new way.

Time fences

In the traditional planning world, time fence rules demarcate boundaries within which the master schedule may be changed based on certain conditions. Time fences not only indicate when changes may be made and where tradeoffs must occur, but who (the system, the planner, or the upper manager) is authorized to make them. These decision rules become more rigorous as we approach the time for release of work to the shop floor. Traditional time fences are described as liquid, slushy, and frozen zones, and are illustrated in Figure 1.

Figure 1 Traditional time fences



When in the liquid zone, distant events are fluid and dynamic, and most actions taken in this region do not affect the immediate production schedule. In the liquid zone, the planning software may be permitted to automatically schedule and reschedule planned purchase and production orders because execution is far off.

The slushy zone also is called the tradeoff zone. This region is bounded by cumulative lead time, which is the longest lead time required to purchase or produce all materials and subcomponents required for the finished part. Within the slushy zone, jobs of similar routing may be swapped by the master scheduler with little impact on capacity, while jobs with similar components may be swapped with little impact on material requirements. However, if a tradeoff creates a material or capacity constraint, the decision may require management intervention.

The frozen zone also is called the point of no return. In this zone, materials and capacity are committed and work is issued to the shop floor. Even minor changes in the frozen zone are potentially disruptive and must be tightly controlled, often requiring management approval. Without well- defined rules, executing changes within the frozen zone becomes the chaotic world of the expeditor, and throughput is permanently lost when the smooth flow of production is violated.

Rapid change
In a traditional planning and scheduling environment, where work is performed in large batches over long periods of time, the frozen zone is often measured in days or even weeks. However, when an enterprise transforms itself to lean, batch sizes and lead times shrink, creating an environment that promotes rapid change. Still, planning time fence rules must apply, even as the duration of the frozen zone approaches the time it takes to produce a single unit.

Long-range planning (the liquid zone) clearly is necessary in a lean environment, for example, when procuring long lead time parts from overseas. But as we enter into the slushy zone, with short production lead times, limited material variation, and a level production schedule driven by short-term demand, forecast uncertainty is reduced and short-range planning becomes less art and more mechanism. To the degree that a lean shop is repetitive (making the same item or variations in a mixed-model flow according to a level schedule), the need for materials becomes more stable. In such a situation (an automotive assembly, for example), a lean manufacturer may establish the JIT delivery of parts on a schedule that is established days or weeks in advance. This requires careful planning and communication with suppliers.

That's not to say that all lean operations are strictly repetitive. In fact, many have focused factories or lines to handle less repetitive products. This is a runner, repeater, and stranger approach—where runners (highly repetitive products) are assigned to dedicated lines, repeaters (high volume but more variability) may share lines with runners, and separate operations are designed for the often highly profitable but infrequent stranger products.

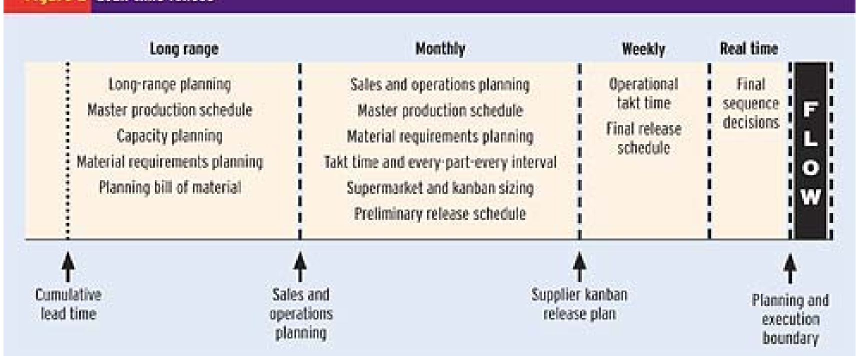
In a mixed model environment, a level schedule predefines a mix of products to be produced on a repetitive basis: 20 red, 10 green, and 5 blue, followed by another 20 red, and so on. Paradoxically, within a carefully planned repetitive operation such as this, last-minute changes may not cause disruption. In Jeffrey K. Liker's *The Toyota Way*, Alan Cabito, group vice president of Toyota motor sales, states:

"The Toyota system's not a build-to-order system. It is a 'change-to-order' system. We pick a car on the line, any car, and change it. There's a lot of complexity to changing color—you have to change virtually all the accessories. And the way that gets managed is on the allowance of how much change can take place … Every week we can modify anything that's unbuilt, except for the basic body type."

Lean enables this sort of flexibility as long as we follow the material tradeoff rule prescribed in the slushy zone. In the case of a mixed-model operation, if the pitch interval (takt time multiplied by batch size) is 10 minutes, then the planner/scheduler has a recurring window of 10-minute increments in which to change the next job to be inserted into production. A heijunka box features slots arranged according to takt and pitch time. Authorization kanban cards specifying a particular product may be inserted into each slot. These boxes can be helpful at this level. Of course, once that card is taken out of the slot and delivered to the shop floor, the order should not be changed.

How lean time fences work
Though timing in a lean environment is fluid, even the terms liquid, slushy, and frozen are too restrictive. A more effective way is to divide lean time fence zones into long range, monthly, weekly, daily, and real time, shown in Figure 2.

Figure 2 Lean time fences



Products with a cumulative lead time greater than 30 days (beyond the monthly zone) belong in the long-range "advance planning" zone. As many organizations adopt a postponement strategy, they may depend on a long lead time supply of low cost, repetitively manufactured core products from global suppliers, which are subsequently pulled from a semifinished goods supermarket through final assembly on demand. These long-range purchase requirements may be calculated by MRP II using a planning bill of material. If a lean enterprise has reduced all supplier lead times to within one month, then long-range requirements planning may be necessary only for marketing strategy, supplier negotiation, long-range capacity, and facilities investment planning purposes.

Forecast and actual orders come together in the monthly zone to represent a short-term demand pattern. The sales and operations planning process develops the monthly production plan based on the appropriate combination of forecast and existing demand. The production plan is management's authorization for an acceptable volume and rate of production at the product family level for the month.

The master scheduler translates demand into the master production schedule, which states the monthly production target in terms of specific quantities per finished item, grouped by their respective value streams. Takt time is calculated and compared to the longest cycle time in the flow path to determine schedule viability—the lean equivalent of rough cut capacity planning. When level scheduling is used, the appropriate batch size and interval must be determined. The preliminary release schedule of quantity, mix, and sequence is then communicated to suppliers.

The variability of demand and product mix, the accuracy of the near-term forecast, and the frequency and lead time of customer orders all influence decisions on kanban and supermarket sizing in the same manner as a traditional reorder point safety stock calculation. The monthly zone is equivalent to the traditional slushy zone, where equal and opposite changes in the production plan are allowed as long as they do not affect material and capacity availability of other jobs.

At the end of each week, the shop's current production rate should be assessed, calculating a new available production time for the following week—the weekly zone. The total demand by product for the following week also may be determined using new forecast and actual order information. Operational takt time for the next week then may be calculated by dividing total production time available by the total demand and comparing it to the current cycle time to determine schedule viability. Schedule viability is the lean equivalent of capacity requirements planning.

If the operational takt time is not significantly different than the monthly takt time—or if small weekly changes to takt time are impractical— then the monthly takt time is used and variations are buffered by kanbans and supermarkets.

Tradeoffs must be managed carefully in the weekly zone. The equal and opposite change rule of the traditional slushy zone applies here. Because we now are within critical purchase and production lead times, if the shop is near peak capacity or there are critical material constraints, then each change in the schedule must be carefully counterbalanced by another change. A final release schedule of quantity, mix, and sequence is developed and communicated to suppliers.

The real time zone is equivalent to the traditional frozen zone. In a lean operation the duration can be extremely short and is ideally governed by takt and pitch times. Until the very moment the next job is released to a pull signal, the scheduler may change the item or configuration to be produced as long as this can be communicated to production (for example, using manual or electronic kanban) and there is no tradeoff cost, such as a materials constraint. There can be no expediting once a job has been released because it flows smoothly to completion.

Why should you care?

Lean performance cannot be sustained without effective planning. However, while many practitioners are given extensive lean education, they may receive only a limited foundation in traditional planning methods—perhaps because some in the lean community may believe these methods are somehow obsolete or unnecessary. Furthermore, some may feel that information systems themselves are only sources of waste, rather than tools for improvement. There are many important interrelationships between lean activities, traditional methods, and the information systems that support them. Time fences are a good place to begin closing these understanding gaps.

Each enterprise may employ time fences differently. Some will use them as parameters within their planning software to actively guide planning, procurement, and scheduling recommendations made by the system. Others simply may view time fences as policy guidelines to govern the perpetual promise-date negotiations between sales and manufacturing. In a lean operation, long- and medium-range planning rules are essential, but the need for rigorous frozen zone controls are largely eliminated by demand pull mechanisms, such as kanban and heijunka.

Why invest time in explaining new lean techniques in terms of old planning time fence logic? Put simply, to bridge the gulf between the two worlds and to clearly explain how the traditional planning logic applies in a lean environment. Consider this: Few organizations have reached the maturity level where they can declare themselves completely lean. Even those that have progressed far in their lean journey still—by fate or by choice—may have in their mix a few stranger products and processes with large batch sizes and long lead times. This means the relative duration of time fences for each value stream may vary widely within a single enterprise; while, at the same time, there is likely to be a single planning system that must manage them all.

As we continue to strive toward lean, thoughtful use of tools, both old and new, is essential. Established methodologies and information systems can and should be continuously improved alongside the processes they support.

Steve Bell, CFPIM, is the author of Lean Enterprise Systems: Using IT for Continuous Improvement. He is president and co-founder of Steady Improvement, a management consulting firm. He may be contacted at (503) 789-8627 or steveb@steadyimprovement.com.