Lean Measures Don't Always Mean Lean Thinking

Leaders need to understand why a process focus is equal in importance to focusing on results.

David Mann

Lean measures can drive lean transformations, but sometimes in the wrong direction. That is, when leaders focus only on results, they can miss the purpose of lean measures — to bring sharp focus on process. The results-only mentality can corrupt "lean" measures, turning them into just another batch measure of performance. It doesn't have to be that way, but until leaders learn to think differently, they can misuse lean measures. The opposite can also be true; metrics not traditionally associated with lean can be used to promote lean thinking. Visits to two plants illustrate both of these lessons.

I was in the two plants not long ago. Both were on the journey to lean. Both had come to similar crossroads, the point at which they could take their lean implementations to the next level. Yet they were heading in opposite directions. The difference was reflected in their decisions about how they measure lean progress. Their leaders' approaches to measurement showed very different understandings — or misunderstandings — of what it means to be lean, and to be a lean thinking leader.

Pitch Attainment Focus

The first plant produces metal cabinets for various applications. Its lean focus involves setting aggressive goals for pitch attainment in each of its value streams. Pitch in this instance is not measured by pack-out quantity, as described in *Learning to See*. Instead, pitch is a defined time interval of production. For this plant's value streams it is 30 minutes. The goal for units

In Brief

Leaders need to develop their understanding of why a process focus is equal in importance to focusing on results. Their organization will also benefit from effective problem evaluation. Good performance reports may not reflect needed progress, as shown in two cases. It also shows the importance of not only what you measure, but how you use measures.

produced per pitch is the expected number of takt cycles to be completed in the pitch interval. Takt time is determined as usual, available time (here, in seconds) divided by demand in units. (This is a neat way of establishing the basis for frequent assessment of actual versus expected production in make-to-order environments where order, pack, and ship quantities vary widely with customer requirements.)

The production processes in the cabinet plant consist of several fabrication steps starting with flat sheet steel blanks from a supplier. The process begins with forming the blanks, then welding components and subassemblies, painting the subassemblies and components in a powder paint operation; and assembly into finished units ready to ship. Takt time is 60 seconds for the products in this plant's value streams. Actual production in units completed is recorded every 30 minutes on a production tracking board at final assembly, the end of the value stream. At a 60-second takt time, hitting — or attaining — pitch produces 30 completed units per 30-minute pitch. The production numbers for pitches are written on a pitch-by-pitch production tracking board at the end of the assembly line. A pitch's numbers are written in red if actual production is short of the expected goal of 30 units (with allowances for pitches that included planned breaks) or in green for pitches where actual production met the expected 30 units.

I got to the plant early, in time to attend the morning production meeting (one of two held each day in this closely-managed operation). The regular agenda seemed routine: safety, quality, delivery, and cost. But as the value stream leaders reviewed the previous day's results, I was surprised to hear each one reporting on pitch attainment. I had never heard that measurement used in this context before. The plant's goal for pitch attainment is high: 95 percent for each value stream. So, actual production must meet the expected number of units in at least 95 percent of the 16 pitches in an eight-hour shift, or 15 of 16 pitches. Ninety-five percent shows as a green bar on the pitch attainment spreadsheet projected on the screen in the production meeting; missed pitches would have shown as a red segment in the bar. All value streams were green on pitch attainment; in fact, all were at 100 percent.

Production Plans Hits and Misses

The second plant produces automotive fuel system components. Its operations are based on high-volume, automated machining processes quite different from the cabinet plant. The fuel systems plant had recently shifted from recording machine downtime as an indicator of performance in its predominantly machining-focused production environment. The new measures are based on Overall Equipment Effectiveness (OEE) for each critical piece of machinery based on hourly documentation of OEE's standard six losses. Each production cell or area has OEE tracking boards on the floor right in the production area. Operators or team leaders in each area record performance every hour. For hours that miss expected production, they also record each instance of time or pieces lost and the immediate reason for it in one or more of the standard six losses in OEE. The six categories for losses in OEE are: waiting for material, waiting for an operator, minor stoppages, major stoppages, defective output, and equipment operating at less than the planned rate or speed. (See Figure 1.)

OEE is a coefficient produced by multiplying three percentages. One is the percentage of machine availability versus planned availability, or the percent of the time a machine was supposed to be available for production that it was actually available. The second is the percentage of actual production speed versus planned production speed, or was the equipment running at its designed rate, or slower, or faster. The third factor is yield, or what percentage of parts produced met specs and were suitable for use. An OEE of .85 is considered very good. Consider that if each percentage (% availability, % speed, % yield) were 85, or .85, OEE would be .85 x .85 x .85, or an OEE of 0.61.

Week 17, 2009 5/3/09			OEE Tracking				Workcenter B731 Team Leader: RJB
Period	Material Min	Operator Min	Minor stop Min	Major stop Min	Yield Pieces	Speed Rate	Reasons
7-8am	3						fork lift start up ran late
8-9am							
9-10am			5				feed adjustment
10-11am							
11-12am					7 scrap		broken punch
12-1pm							
1-2pm							
etc							

Figure 1. By tracking the occurrence each hour of each of the OEE losses and the immediately-observable reason for each loss, the fuel systems plant was using OEE to focus on the health of its processes — it was using OEE as a lean measure.

Production plans assume an OEE of .85. When a department misses this OEE goal, it misses its planned output. When the misses are enough to require overtime hours, (on the weekend for this three-shift, 5 x 24 operation), the number of overtime hours required is displayed on a vertical "thermometer" chart for the value stream. Zero marks the center of the vertical thermometer bar, which is calibrated in one-hour increments above and below zero. One hour of overtime shows as one red increment on the bar below zero. Two hours would show as two red increments, and so on.

If a department's OEE exceeds the standard planning basis of .85, output exceeded the planned rate of production. In these cases, if the department had been behind, it could catch up. When that happens, red increments are deleted for each hour made up. Or, if production runs ahead of the planned weekly rate, increments above zero would be colored in, in green. Once the weekly production plan is met, the workweek is complete and the production workforce can go home. The number of green segments at any point in the week represents a snapshot of the cumulative hours early on Friday the department could go home, subject to further gains and losses as the week progressed. (In this plant, going home early is valued far more than overtime.) Conversely, the number of red segments represents the weekend hours the department would have to work.

Takt Time, Pitch Attainment, or What?

I was puzzled by these two plants' approaches to measurement. Why were they so different? I kept returning to questions about the two plants.

First, something seemed wrong about the cabinet plant's goal of 95 percent for pitch attainment, but what was the problem? Wasn't this a case where for green pitches, more was better? Or was it?

Second, I couldn't understand why the fuel system plant didn't use takt time (available time divided by customer demand) as a basis for measuring performance. At a minimum, releases from its OEM customers established customer demand by the week, and usually a month in advance. Variation in demand, when it occurred during the month, was usually to adjust an upcoming weekly schedule. So, weekly demand was stable over 15 shifts. Yet the plant didn't use takt time as its basis for measurement. Why not? It would have easily been the basis for directly measuring actual versus expected production. From takt, the plant would know the expected number of units produced per day, or shift, or hour. Or, as I had seen in other automotive suppliers, the plant could have used takt as a basis for measuring expected versus produced pack-out quantity, or pitch.

Red ... or Green?

Back in the cabinet plant, later in the day, I was out on the production floor gemba walking with an engineer who had been involved in designing the assembly processes. We came to the production tracking board for a mixed-model value stream which, I had learned in the production meeting, was experiencing parts shortages for one of the two models it produced. Takt time for this value stream was 60 seconds for each type of unit. The line alternated units every other pitch. That meant building upper cabinets every 30 minutes, then lower units for 30 minutes, then upper units, and so on.

What we saw on the production tracking board had the engineer and me literally scratching our heads. Every pitch's actual production was recorded in green. Production for the first four pitches of the day was right on goal — 30 units per 30 minutes, with the "30" recorded in green. In the pitches after that, every other pitch was recorded as a green "30," but the alternating pitches, also in green, showed "28" even though the goal for each pitch was the same — 30. Nothing was recorded in the "reasons for missed pitch" column on the tracking board for the 28-unit pitches, and clearly there wouldn't have been planned downtime, say for a break or safety meeting lasting only two minutes. (See Figure 2.)

As we stood at the board with puzzled expressions on our faces, the team leader for the area walked up, greeted us, and asked if we had any questions. We expressed our confusion over the green "28s" on what seemed to us to be missed pitches. He told us they had been experiencing parts shortages on upper units that day, but that "the full team is here today, and the line's running good, right on takt." As to the missing units, he went on to say, "If we'd had the parts, we would have built 'em at takt, so I colored those pitches green." We thanked him and moved on.

The meaning of what I had seen gradually became clear to me. I knew the manufacturing executive responsible for this business unit was a classic results-oriented manager. He set the goals, the plants submitted their plans, he approved them usually after some pointed negotiations around doing more with less, and then it was up to the plants to perform. Walking through the plants occasionally, this executive saw entries on production tracking boards in red, indicating missed pitches, equipment or material problems in fabrication or paint areas, and the like. Red meant problems. Problems threatened results. Problems, therefore, were not good, and attracted the attention of the executive. When all measures were green, this executive shifted his attention elsewhere.

In the case of measures showing red, the ensuing conversation between the executive and the plant manager might well have gone something like this: "You gave me your plan, I provided you the resources we agreed on; do you need my help meeting your goals?" There was only one acceptable answer to this kind of question: "No, sir!"

I knew the plant manager and his staff well enough to know that nobody had been told to cheat on their performance measures. Yet I also knew that in the hierarchical organ-

Misusing Lean Measures

Pitch	Goal	Actual	Reasons for Misses
1	30	**30**	
2	30	**28**	
3	30	**30**	
4	30	**28**	
5	30	**30**	
6	30	**28**	
7	30	**30**	
8	30	**28**	
etc.	etc.	etc.	

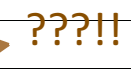

Figure 2. This chart makes no sense from a lean perspective. By not documenting the reason for — or even acknowledging — missed pitches (circled), the cabinet plant is failing to assess the health of its processes. It is using a lean measure incorrectly — as just another summary, or batch, performance measure.

izations in which most of us work, people know it is important to deliver what the boss asks for. In this case, the boss was asking for green pitches 95 percent of the time. The style of this executive is direct, blunt, and demanding. Altogether, the message was clear enough throughout the plant down to the level of production team leader. Fudge, "tweak," or "refine" the measures if you must, but make them hit the target. Unfortunately, this practice is not uncommon; perhaps you have experienced it as well.

Kermit the Frog famously said, "It's good to be green!" Perhaps more to the point, in this environment, it was good not to be red.

Of course, achieving results is not a bad thing; it's what our organizations are supposed to do. How those results are produced is one of the subtle, but crucial differences that separate lean from conventional organizations, and lean thinking leaders from conventional ones.

What is Lean?

Lean most fundamentally is an improvement process. Shigeo Shingo, the Japanese industrial engineering professor who documented the development of the Toyota Production System (TPS), said that lean thinkers seek out problems where none are thought to exist, and then work to eliminate their root causes. Why? Because lean is about improvement, and when a process routinely operates without missing a beat, it provides no clue as to where it might be improved. The lean saying, "Lower the water to expose the rocks," addresses just this situation. When all is green, find a way to stress the system; increase changeovers, link previously separate operations, reduce inventory, reduce lot sizes, increase the frequency of observation (that is, reduce the pitch interval), reduce internal delivery leadtimes, and so on. Do these things not to break the process, but to stress it. The stressed system reveals weaker points that show up as process misses, hiccups, and interruptions in flow of various kinds. These all signal points where the process might be improved so that when it returns to a stable state, it will be operating at an improved level.

Missed Opportunities for Improvement

The production tracking chart, whether hour-by-hour, or more or less frequently, is the classic lean tool for close focus on process. The purpose of these visual controls is precisely to record and preserve the immediate circumstances for each missed takt cycle or missed pitch. Lean characterizes these misses — these problems — as gold nuggets to be mined rather than garbage to be covered up, buried, or hidden. Because the parts shortage in the cabinet plant wasn't flagged on the production tracking chart as the immediate reason for the 28-unit pitches (which, after all, were coded green), no missed pitches were recorded and no reasons for misses were documented.

Maybe the parts supply chain would improve by itself. Improvement certainly wasn't going to be stimulated by having to explain red pitches in the production meeting. And so, the opportunity to ask why the shortage occurred was missed, and the opportunity to improve the process was hidden.

What the cabinet plant was doing by its emphasis on 95 percent green pitch attainment, and therefore getting what it asked for, was based on a fundamental misconception of what lean is all about. If you strive for improvement, you should record output or other process parameters at frequent intervals. By doing so, you enable the process itself to identify opportunities for improvement by the misses and interruptions documented on the production visual control charts.

I've never seen an operation that doesn't have lots of ways of measuring its results, and I bet you haven't either. Much more rare is the operation that focuses attention on measuring the health — good or ill — of its processes, and therefore pays attention to the instances where the process operates abnormally. Hour-by-hour production tracking charts reflect this close attention to process and drive for improvement. They bring problems to light and stimulate root cause corrective action. But the charts

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can't do their job when the objective is for them to be all green all the time. That's why recording and reviewing misses pitch by pitch is process-focused measurement, but setting aggressive goals for daily pitch attainment is not. For a rule of thumb, when tracking charts consistently show green 75 percent of the time, a best practice is to take action to stress the system and use what you learn, documented on the tracking charts, to drive improvement.

The cabinet plant prided itself on its lean designs and methods. Yet it had bastardized its primary lean measurement system. It had turned the basis for the classic lean measure of process — takt time — into one more summary — or batch — measure of results at the end of the day. As with so many measures of results, people in the plant knew how to give management, and ultimately the manufacturing executive, the numbers they were asking for. At the time, there was little focus in the plant on the kind of continuous improvement based on process focus that is a hallmark of a lean operation. Instead of mining the nuggets that might have shown on the production tracking visual controls, the unspoken but nonetheless clear message was to bury them.

A Puzzlement: Why OEE?

So, takt time, or in other contexts, clearly-defined expectations for pace, seemed to me a key to lean thinking, lean measurement, and further improving lean process designs. A time-based measure of expected production is straightforward and readily interpreted, equally in manufacturing or in office processes. That's why I was so puzzled by the OEE-based measurement system in the fuel systems plant. The basis for pace, that is, for calculating takt time was literally handed to the plant in advance by the week. What could be simpler than measuring their production based on takt time? This approach would provide a powerful focus on process, process health, and the process misses that point to opportunities for improvement. I didn't get it; what was I missing?

Most of my lean experience up to that point had been in discrete manufacturing mostly in a metalworking environment with processing steps of form, weld, paint, and assembly processes in a make-to-order business model. A large order might be a few thousand units produced over several days. Some legacy automated processes were still in use, but it was by no means a high-automation operation.

OEE Can Be a Lean Measure

The fuel systems plant is a discrete producer, as opposed to a continuous process operation like a refinery, steel mill, or some chemical or plastics operations. What I finally came to see was that even though the components are produced as discrete units, the volumes are so high, tens of thousands per day, that the plant shares important characteristics of a continuous process. That is, with stable incoming material quality, the sources of variation in the production process would nearly always be attributable to the production equipment, or the support processes that served it — availability of people to operate it and the required raw or WIP inputs. That, I finally understood, was why the plant moved from measuring unplanned downtime to using OEE to assess the health of its processes, rather than basing its measures on takt time.

Knowing actual versus expected production per pitch, and missed pitches, in this equipment-intensive operation would have immediately led to the question: Why did we miss pitch? The answer would almost always be that we experienced unplanned downtime. In turn, that would lead to the question: What caused the downtime? The answer could almost always be characterized as one of the OEE six big losses.

By tracking the occurrence each hour of each of these losses and the immediately-observable reason for it, the fuel systems plant was indeed focusing on the health of its processes. When I walked myself through the logical chain from takt-based measurement to equipment downtime, and then to OEE's categories of downtime, I reached the

same conclusion as the lean thinkers at the fuel systems plant: OEE was just the right tool to bring close focus on process in this automated machining environment. OEE was process focus in this operation. What sealed the process focus deal for me was that the plant Pareto-charts the reasons for OEE losses, and uses the information in root cause analysis and corrective action to drive process improvements.

It's important to note that the fuel systems plant could have simply used OEE as a summary measure of results. Green would have been OEE of .85 because that's what management wanted to see. That might well have given rise to the mystery at the end of the week: If our OEE is green all the time, why do we need to work weekends to meet customer demand? Instead of that, the plant's lean thinking leaders understood that the purpose of their OEE measurement was process focus and the opportunities OEE tracking revealed for process improvement. By concentrating on their process measures and keeping them separate from their already established measures of results, they were able to drive improvement in results, and to this tangible extent: The plant's parent company had decided to reduce its North American capacity in fuel systems by closing two of its four domestic plants in that division. The OEE-focused plant that so puzzled me is one of the two in North America still operating.

Changing How Leaders Think About Performance

These two cases provide a good illustration of the subtleties involved in lean transformations. Putting lean tools in place is by far the easier part of the change to lean. Changing what managers look for, ask about, and measure — that is, how leaders think about performance — is where most of the difficulties arise in sustaining lean transformations.

Even when you put lean measurements in place to support a newly-converted lean production process — too often an afterthought if done at all — there's more to be done. Leaders need to develop their understanding of why a process focus is equal in importance to focusing on results. They also need to recognize the value of problems to the degree they become nervous when none are apparent, and so go looking for them as valuable clues to the best next places to work for improvement.

Finally, measurement is important for the reason we all know: What gets measured gets done. So, consider measuring things that reflect process and improvement focus, like the number of flow interrupters in your process that have been eliminated through root cause corrective action. Or, create a rogues' gallery of the problems that have been eliminated from your process. Look for summaries in your production areas that show last week's top three reasons for process misses, and then look for evidence, such as A3 project plans or accountability board task assignments, for root cause investigation or projects to implement root cause corrective action. And, look for evidence of improved process health, such current and future state value stream maps with kaizens identified on them as the plan to improve cycle time, reduce rework, or scrap, or errors, or reduce process time, or redesign handoff points to reduce errors, and so on.

If you're a frog, it may be good to be green, but some red here and there helps drive improvement. That's a lesson you need to learn and remember on the way to transforming yourself into a lean thinking leader.

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