Developing a Lean Performance Score

Here's a way to track the progress of your lean journey.

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"It sure would be nice if I had one number [like ROI] to tell me if my company's lean efforts were successful." That statement came from a manager of a company beginning its lean journey, and this manager is certainly not alone. During my site visits to investigate how to assess lean performance, manager after manager from other companies echoed the sentiment, and it's understandable. After all, single measures like return on investment (ROI) and earnings per share (EPS) are universally known and widely used. Perhaps a single-composite measure would assist management in better evaluating their company's lean implementation.

In the September 1956 issue of *Administrative Science Quarterly*, V.F. Ridgeway states, "Without a single overall composite measure of performance, the individual is forced to rely upon his judgment as to whether increased effort on one criterion improves overall performance, or whether there may be a reduction in performance on some other criterion which will outweigh the increase in the first. This is quite possible, for in any improvement situation many of these objectives may be contradictory to each other."

Ridgeway's comments especially ring true in evaluating the success of a lean implementation. It has been well documented that financial results lag behind operational improvements in lean implementations.

To measure the success of a lean effort, companies may want to develop a lean performance score (LPS) by using the Analytic Hierarchy Process (AHP). This article highlights input from managers at six companies implementing lean manufacturing, examples of how to use the LPS, and the necessary steps to build an organization-specific LPS.

Measuring Lean Performance

A successful lean implementation will result in various operational and financial improvements. Operational improvements include higher quality and productivity as well as lower nonproductive capacity and lead times. Some financial improvements realized from a successful lean implementation include increased cash flows, lower inventory levels, and lower costs.

As a company begins its lean journey, the questions about what to measure and how to measure it become paramount. Brian H. Maskell and Bruce Baggaley address these issues in *Practical Lean Accounting* by presenting a starter set of lean metrics. Maskell and Baggaley's list of metrics and the lean metrics proposed by other lean consultants all have a similar goal—measuring the success of a lean effort. As a company begins developing its lean performance system, two questions bear answering:

1. Which metrics are more important than other metrics in measuring lean performance?

ILLUSTRATION: IMAGEZOO

2. How can we reconcile that some metrics may pull in opposite directions?

The Analytic Hierarchy Process can assist management in addressing both questions.

The Analytic Hierarchy Process

Thomas L. Saaty developed the AHP to facilitate decision making for multicriteria problems. For example, when buying a car, many people look at several criteria (or elements) in selecting one car over another car (e.g., cost, safety, style, gas consumption). The AHP uses paired comparisons of elements with respect to a common goal or criteria. Elements deemed important to a goal are paired so that individuals or groups can judge the relative importance of one element over another (e.g., cost over style) with respect to a goal (e.g., selecting the best car). The end result of the AHP is a set of weights derived from the pairwise comparisons. (An excellent review and list of additional resources related to the AHP can be found at http://en.wikipedia.org/wiki/Analytic_Hierarchy_Process).

The beauty of the AHP is that it produces a ranking of the elements. A variety of institutions (e.g., governmental, military, educational) have used AHP across a broad spectrum of decision making (e.g., supplier selection, resource allocation, hiring). The Summer 2004 and Spring 2002 issues of *Management Accounting Quarterly* demonstrate how companies can use the AHP to develop a balanced scorecard.

Using the AHP to Rank Elements

Management can use the AHP to develop a score to measure and monitor a company's lean performance. To demonstrate, six companies ranked five common lean performance elements. Table 1 provides a brief description of each company, and Figure 1 displays the lean performance elements used to build an LPS. Managers completed 10 pair-wise comparisons ranking each element against all other elements in terms of relative

importance. For example, a manager would rank the importance of quality as compared to costs when considering the goal of measuring lean performance.

Table 2 presents how the managers ranked the elements. Across all six companies, increased quality and capacity are more heavily weighted than the other three performance elements, with decreased manufacturing costs having the lowest weight. If managers weighted each element equally, then each element would have a final weight of 0.20. Table 2 shows that managers don't believe the five performance elements should be weighted equally. AHP captures and accounts for this fact. The final AHP weights appear consistent with lean manufacturing being more an operational improvement initiative and not solely a cost-reduction exercise.

Table 3 shows the magnitude of the differences in AHP weights between the performance elements. Each AHP weight is compared to the lowest AHP weight (decreased manufacturing costs). Take SnuggleUP, a home appliance manufacturer, for example. Increased quality (0.277) is weighted two times higher than decreased manufacturing costs (0.136). Companies should explicitly consider these differences when developing a lean performance-measurement system, but, unfortunately, they usually don't. The AHP-developed LPS, however, specifically considers the ranking of performance elements in measuring lean performance.

Developing a Lean Performance Score

The LPS serves two purposes. First, it allows each performance measure to be weighted differently depending on the company's objectives. Second, it creates a single-composite measure that monitors the overall success of an organization's lean efforts. Once managers complete the AHP, identifying the specific performance measures used to monitor each element is the next step in developing an LPS. Before looking at the specifics of an LPS, consider Table 4, which displays some typical performance measures a company tracks during a lean implementation. It shows improvements in three performance measures, while one, average unit cost, increases.

The question management constantly asks is whether the lean efforts are succeeding. The response is usually something like, "Well, the operational measures are heading in the right direction, but our costs are not. I believe the unit cost will turn around and show improvements as the operational improvements continue." In other words, "I think so." In evaluating the lean efforts, Table 4 doesn't explicitly consider a ranking of the performance measures, yet the responses from the six companies indicate a ranking may exist. Table 5 uses the performance measures and numbers from Table 4 and shows how each is used in building an LPS.

Table 5 presents the LPS using "the percent improvements toward the future state" as the primary inputs. As Maskell and Baggaley discuss in *Practical Lean Accounting*, a lean performance system should have both a current and a future state. In other words, management should devote time to set performance targets and explicitly display those targets so coworkers can monitor the success of the lean implementation. The targeted improvement column represents the change needed to achieve the organization's future state. The actual change column is simply the difference between the current results and the baseline. The LPS computation in Table 5 is simply the sum of the AHP weights corresponding to each performance area multiplied by the performance result for a given time period.

The baseline LPS is zero because there has obviously been no improvement from the baseline. (Since it contains no information, a company usually wouldn't publish this column.) Likewise, the future-state LPS is 100% since the results are based on improvement toward the future state. If the organization achieves its future state, the actual change would equal the targeted improvement. The current-state section contains the LPS that management would monitor and publish. To compute the results, divide the actual change column by the targeted improvement column. Each performance measure result is multiplied by its AHP weights, and the sum of each performance measure score equals the current-state LPS.

In the example in Table 5, the company's LPS is 4.7%. The score represents improvements in three of the five performance measures: a two-percentage-point improvement in first-time through, a four-percentage-point drop in nonproductive time, and a reduction of one and a half days in dock-to-dock days. Those improvements are offset by the $2.48 increase in the average unit cost. Since the improvements are weighted more heavily than the cost increase, the overall LPS is positive. With the target of 100%, the LPS is easy to understand. The current LPS indicates that the organization has achieved 4.7% of its future-state goals. If performance deteriorates, the LPS will be less than zero, indicating that the organization has dropped below the baseline. In Table 6, the current-state LPS is a negative 17.5%. The negative sign readily reinforces the point that results have deteriorated.

Figure 1: Lean Performance Elements

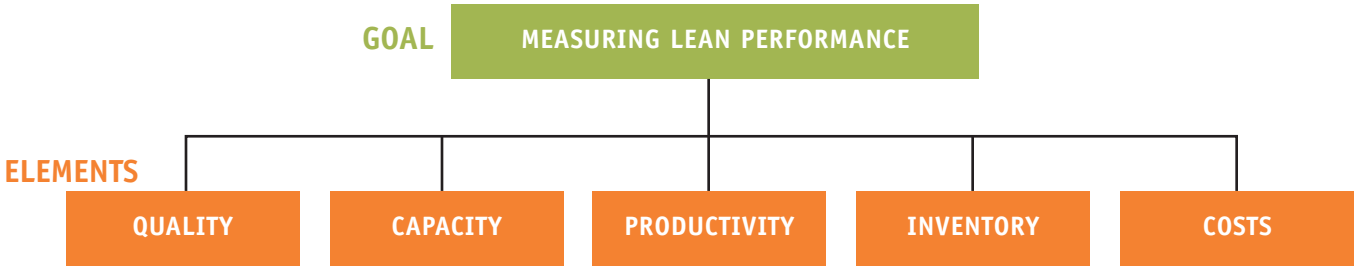

Table 1: Participating Companies

COMPANY NAME	INDUSTRY	LEAN MATURITY
SnuggleUP	Home appliance manufacturer	Just beginning journey
Healthy-U	Health and nutritional products manufacturer	Just beginning journey
BombsAway	Aerospace contractor	Just beginning journey
LaserTouch	Aerospace component manufacturer	Lean is way of life
GloveIT	Sporting goods manufacturer	Just beginning journey
FillitUP	Industrial parts manufacturer	Walking down the lean path

Table 2: Lean Benefit Weights

	INCREASED QUALITY	INCREASED CAPACITY	INCREASED LABOR PRODUCTIVITY	INVENTORY REDUCTION	DECREASED MANUFACTURING COSTS	TOTAL
SnuggleUP	0.277	0.265	0.180	0.142	0.136	1.000
Healthy-U	0.211	0.272	0.188	0.184	0.145	1.000
BombsAway	0.287	0.266	0.166	0.144	0.138	1.000
LaserTouch	0.277	0.265	0.180	0.142	0.136	1.000
GloveIT	0.226	0.256	0.193	0.168	0.157	1.000
FillitUP	0.203	0.252	0.192	0.190	0.163	1.000
Average	**0.247**	**0.263**	**0.183**	**0.162**	**0.146**	

Table 3: AHP Weight Comparison

	INCREASED QUALITY	INCREASED CAPACITY	INCREASED LABOR PRODUCTIVITY	INVENTORY REDUCTION	DECREASED MANUFACTURING COSTS
SnuggleUP	2.0	2.0	1.3	1.0	1.0
Healthy-U	1.5	1.9	1.3	1.3	1.0
BombsAway	2.1	1.9	1.2	1.0	1.0
LaserTouch	2.0	2.0	1.3	1.0	1.0
GloveIT	1.4	1.6	1.2	1.1	1.0
FillitUP	1.2	1.5	1.2	1.2	1.0
Average	**1.7**	**1.8**	**1.3**	**1.1**	**1.0**

Table 4: Lean Performance Measures

MEASURES	BASELINE	FUTURE STATE	TARGETED IMPROVEMENT	CURRENT RESULTS	ACTUAL CHANGE
First-time through	48.0%	96.0%	48.0%	50.0%	2.0%
Nonproductive capacity	62.0%	36.0%	-26.0%	58.0%	-4.0%
Sales per employee	$25,230.00	$26,380.00	$1,150.00	$25,230.00	$ –
Dock-to-dock days	20.5	4.5	(16.0)	19.0	(1.5)
Average cost per unit	$328.27	$308.61	$(19.66)	$330.75	$2.48

First-time through: percent of total units that pass through the value stream on the first pass without being repaired, reworked, or scrapped.
Nonproductive capacity: percent of capacity that is not productive or that is available but not used.
Sales per employee: revenue shipped divided by the average number of full-time equivalent employees in the value stream.
Dock-to-dock days: total inventory within a value stream divided by the average rate of products shipped.
Average cost per unit: total value stream costs divided by units shipped.
(See Maskell and Baggaley's *Practical Lean Accounting* for more definitions.)

Table 5: LPS Example (Use Tables 4 and 5 together to determine the lean peformance score.)

		BASELINE		CURRENT STATE		FUTURE STATE	
MEASURES	AHP WEIGHTS	RESULTS	SCORE	RESULTS	SCORE	RESULTS	SCORE
Percent improvement toward future state:							
First-time through	24.7%	0.0%	0.0%	4.2%	1.0%	100.0%	24.7%
Nonproductive capacity	26.3%	0.0%	0.0%	15.4%	4.0%	100.0%	26.3%
Sales per employee	18.3%	0.0%	0.0%	0.0%	0.0%	100.0%	18.3%
Dock-to-dock days	16.2%	0.0%	0.0%	9.4%	1.5%	100.0%	16.2%
Average unit cost	14.6%	0.0%	0.0%	-12.6%	-1.8%	100.0%	14.6%
Overall score	**100.0%**		**0.0%**		**4.7%**		**100.0%**

Table 6: LPS Deterioration Example

MEASURES	BASELINE	FUTURE STATE	TARGETED IMPROVEMENT	CURRENT RESULTS	ACTUAL CHANGE
First-time through	48.0%	96.0%	48.0%	42.0%	-6.0%
Nonproductive capacity	62.0%	36.0%	-26.0%	65.0%	3.0%
Sales per employee	$25,230.00	$26,380.00	$1,150.00	$24,750.00	$ (480.00)
Dock-to-dock days	20.5	4.5	(16.0)	22.0	1.5
Average cost per unit	$328.27	$308.61	$(19.66)	$331.25	$2.98

		BASELINE		CURRENT STATE		FUTURE STATE	
MEASURES	AHP WEIGHTS	RESULTS	SCORE	RESULTS	SCORE	RESULTS	SCORE
Percent improvement toward future state:							
First-time through	24.7%	0.0%	0.0%	-12.5%	-3.1%	100.0%	24.7%
Nonproductive capacity	26.3%	0.0%	0.0%	-11.5%	-3.0%	100.0%	26.3%
Sales per employee	18.3%	0.0%	0.0%	-41.7%	-7.6%	100.0%	18.3%
Dock-to-dock days	16.2%	0.0%	0.0%	-9.4%	-1.5%	100.0%	16.2%
Average unit cost	14.6%	0.0%	0.0%	-15.2%	-2.2%	100.0%	14.6%
Overall score	**100.0%**		**0.0%**		**-17.5%**		**100.0%**

Like most performance systems, a lean performance-management system should be tailored to the organization. The specific performance measures, the weight of each performance measure, and the aggregation method all depend on management's goals and objectives. The sidebar "Developing an LPS" presents a five-step process to help your company assess its performance.

Pros and Cons of an LPS

A properly constructed LPS addresses two problems using multiple measures to assess performance. First, an LPS provides a single metric to gauge the level of lean implementation success so it's easy to understand. For example, an LPS score of 54% means the company has achieved 54% of its future-state goals. Since employees are able to grasp its meaning, companies can use the score to motivate and compensate. Second, an LPS clarifies the improvement priorities via the weights used in building the score. An LPS with quality ranked twice as high as costs directs everyone to focus on improving quality. While companies can't ignore costs, the significance of costs is muffled when compared to quality issues. As companies mature in the lean journey, the rankings can and will change over time. The revised rankings shift everyone's priorities to what management believes is most important.

As with most performance metrics, there are some concerns with using a single-composite system like the LPS, which companies shouldn't use exclusively. In other words, management should communicate the individual metrics to build the LPS. As you decompose ROI into its individual components (i.e., margin and turnover) to gain an understanding as to why ROI changed, the LPS should be decomposed as to why it changes over time. Those details provide management with information to continuously improve. Table 5 provides a template that could be used to communicate those specifics.

Another concern is the time lag between operational improvements and improved financial results. Not considering that time lag while developing an LPS could result in a less-than-useful metric. For example, consider a company early on its lean journey that assigns a cost element (e.g., total manufacturing costs) very high as compared to other operational elements. Because of the time lag between early operational improvements and delayed financial results, the LPS could be negative or flat at best. Those results could be misinterpreted that the lean implementation isn't working when, in fact, the results reflect the overemphasis on costs early in a lean implementation and the disregard of the time lag inherent in the financial results. The time lag issue should be addressed when determining future-state goals.

DEVELOPING AN LPS

To help you move along the lean journey path, follow these five steps.

Step one: Determine the lean performance elements to use. The key is selecting the few measures that best evaluate the success of the lean program.

Step two: Have knowledgeable individuals rank the elements selected in step one using the AHP.

Step three: Determine the future-state goals for each measure used in the LPS. Determining the future-state time period is crucial. Is the future state six months? One year? Five years? Once the future-state time period is determined, a targeted objective for each performance measure is required. The targets should be attainable yet not easily reached.

Step four: Compute the LPS using the results of the previous steps. You can use Table 4 as a guide.

Step five: Publish the LPS. Developing an LPS is an academic exercise if it isn't published and updated on a regular basis. The LPS provides the feedback needed to continuously improve.

A Powerful Signal

Organizations can begin measuring and monitoring lean transformations. If you don't measure your organization's lean transformation, you won't monitor it, and if you don't monitor your organization's lean transformation, you can't manage it. If you don't manage your organization's lean transformation, it will fail.

The LPS provides companies with another lean accounting tool to help measure the overall success of their lean journey. It simplifies the communication of how well companies are implementing lean and provides a mechanism to embed management priorities within the performance system. Although a lean performance score isn't a substitute for the various operational and financial results companies track, it can be a powerful signal as to whether companies are staying on the lean journey path. **SF**

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