

FOR LEAN TO BE GREEN

THE PERFORMANCE MEASUREMENTS MUST CHANGE

Brian H Maskell, President, BMA Inc

with assistance from

Robert B. Pojasek, Ph.D, First Environment Inc.

All companies must comply with environmental regulations. But the people entrusted with the overall responsibility for meeting these legal requirements are rarely involved in lean activities. Few company's lean activities systematically address environmental issues. To make matters worse, lean changes by people not familiar with these environmental requirements can create risky and expensive issues for the facility. For a company to become truly "lean and green" it is vital that the environmental issues are thoroughly integrated with lean improvement processes and that the people responsible for environmental compliance are actively involved.

To avoid noncompliance altogether, companies seek to avoid the very need for compliance by changing processes to avoid the "trigger" that sets the expensive compliance system into action. The emphasis must go beyond compliance to daily process improvement. Companies with environmental management systems, such as ISO 14001, have specific projects to lower the environmental footprint. Under the lean principle of "pursuit of perfection" the longer term goal is to eliminate all hazardous substances and other environmental risks.

In this short article we will show how a company can become "lean and green" by integrating the environmental issues into the organization's accounting, control, measurement, and improvement processes. The starting point is to develop lean performance measurements that reflect the company's strategies, environmental requirements, and lean transformation process.

Performance Measurement Linkage Chart

Readers who are familiar with Lean Accounting will know that lean performance measurements are

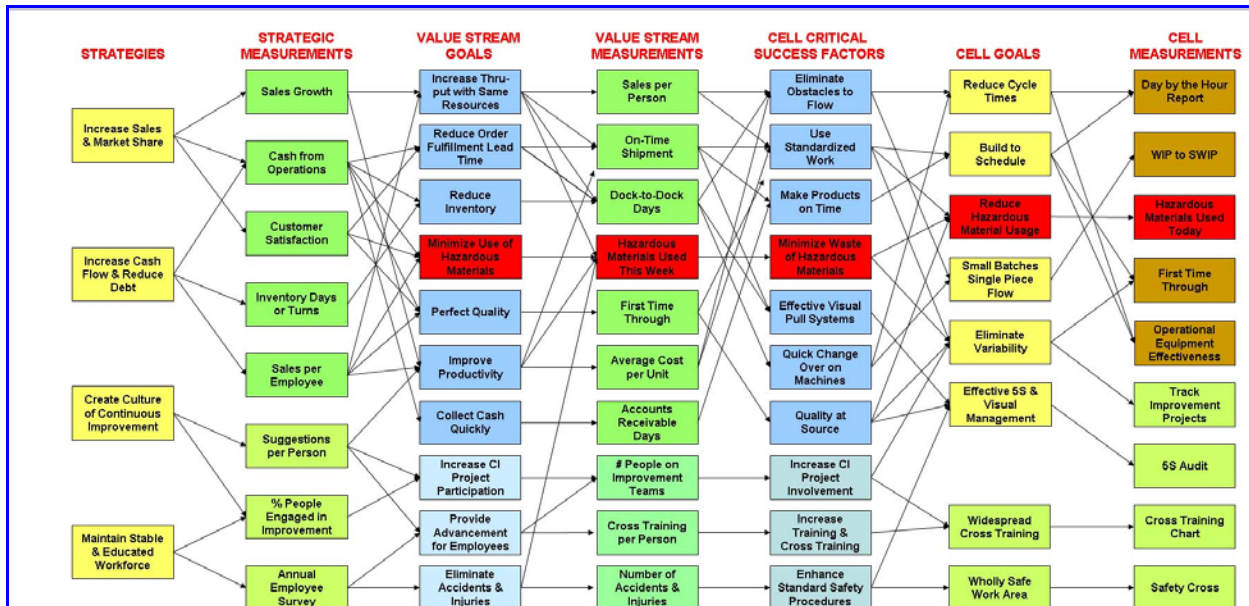


Figure 1: Example of Lean Performance Measurement Linkage Chart. "Green" issues shown in the red boxes.

BMA Inc.

100 Springdale Road #110, Cherry Hill NJ 08003

Tel: +1 609 239 1080 Email: bmaskell@maskell.com Web: www.maskell.com

developed using the "lean performance measurement linkage chart". The purpose of this linkage chart is to enable us to develop measurements that link the company's strategy with measurements at the plant level, the value stream level, and the cell or process level. Plant level measurements are usually produced monthly and show the outcome of the company's operation. The value stream measurements are usually reported weekly and are used primarily to drive lean continuous improvement. The cell and process measurements are measured very frequently - often every hour - and are used to control the process and identify problems that need to be solved. When environmental issues are important, it is essential that "green thinking" is incorporated into the performance measurement process.

The example below comes from a company that uses solvent-based adhesives as a large part of their process. The linkage chart incorporates measurements related to the company's strategy - including the environmental issues raised by the adhesives. At the cell level there is a daily measurement of the amount of adhesive used within the production cell in comparison to the amount shown in the standardized work. This gives us an understanding of amount of wastage and lossage of the solvent. This can be measured using a control chart or a ratio (input vs output), and is reported by the cell operators on the visual control board within the cell. The purpose of this measurement is the same as for the other measurements, to:

- a. Control the process
- b. Correct the process when it goes wrong
- c. Improve the process

The *cell/process measurements* are discussed briefly each day at the cell team's "10 minute meeting" at the beginning of the shift, and one day each week the "10 minute meeting" is focused on environmental issues. The cell team-members develop small improvement projects to better control the usage of the adhesive and to reduce losses of solvent. These projects deal with such issues as the right methods for applying the adhesives, the storage of the materials, and other practical problems with materials and methods.

Other cells within this company have environmental compliance and improvement issues relating to waste water, heat, solid waste, spills/leaks, air emissions, and so forth. The cell/process measurements reflect the local needs and issues.

At the *value stream level* the total solvent usage is recorded each week. Again the information is collected by the people within the value stream and shows how much solvent is being used and a pareto chart shows the causes of excessive usage. This information is used by the value stream manager and the value stream continuous improvement team to develop larger improvement projects designed to make significant reduction in the usage of the adhesives and the solvent losses. These improvement projects address the value stream as a whole and deal with issues that are not restricted to individual cells. They address the end-to-end value-stream and include such issues as how the materials are ordered and received from the suppliers, how the materials are stored, how they are moved to the cells, the equipment used to apply the adhesives, the standardized work, training of the people, and so forth.

These weekly value stream measurements include each of the environmental issues that relate to the operation of the value stream. There are usually some environmental measurements that are not related to individual value streams but are general across the company's operations. These would be included as "support operations" and are reported in a similar way to those of the various value streams. These support operations have clear accountability and improvement activities.

There are no specifically "green" measurements at the *plant or company level*. The company does not have an environmental strategy as such; environmental issues are embedded into the company other strategies. As can be seen from the linkage chart, the environmental issues emerge from the strategies as the company goals and critical success factors are developed. The "green" issues are a regular component of the company's lean measurement and improvement process along with such familiar issues as quality, productivity, costs, etc..

2. Value Stream Costs

If you are familiar with Lean Accounting, you will remember that cost information is reported by value stream rather than by product or production work order. The financial information is generally reported every week to the value stream and is shown on "plain English" statements that are readily understandable to everyone. It is possible to make the costs of environmental compliance and improvement clear on the financial statements. This enables the value stream manager to easily see the financial impact of environmental improvement efforts. The example below shows the costs of the lost solvent, the costs of the equipment required to capture the solvent, and the cost of recycling the solvents.

REVENUES		
Gross Sales	\$32,332,000	
Less Adjustments	(\$162,000)	
Net Sales	\$32,170,000	
VARIABLE COSTS		
External Sales Force (7.5% of ns)	\$2,412,750	7.5%
Material Purchases	\$7,853,000	24%
Contribution after Variable Costs	\$21,904,250	68%
CONVERSION COSTS		
Wages	\$7,920,000	
Fringes	\$3,011,000	
Supplies & Tooling	\$1,122,000	
Depreciation	\$465,000	
Utilities	\$247,000	
Outside Services	\$572,000	
Scrap & Warranty	\$468,000	
Environmental Compliance	\$196,000	
Travel & Entertainment	\$158,000	
Professional Services	\$69,000	
Rentals	\$118,000	
Advertising & Exhibits	\$27,000	
Employee Recruitment	\$28,000	
Other Conversion Costs	\$828,000	
TOTAL CONVERSION COST	\$15,229,000	47%
TOTAL VARIABLE & CONVERSION	\$25,494,750	79%
OPERATING PROFITS	\$6,675,250	21%

Figure 2: Plain English Financial Statement showing value stream costs including environmental costs.

3. Box Score

The "box score" is widely used in Lean Accounting for reporting value stream performance, for decision-making, and showing the true impact of lean improvement. The example below shows a box score being used to make decisions for improving the value stream. The left hand column shows the value stream performance based on the current state value stream map. The columns show the impact of the planned changes on the value stream performance; operational, financial, and capacity usage.

The improvement plan developed by the value stream team includes considerable work to reduce the use of hazardous waste. This is one of the primary value stream performance measurements and these measurements drive the continuous improvement processes. If the environmental measurements are included in the value stream measurements then "lean and green" work together.

As you can see, there will good operational improvement as a result of each of the planned improvement events. You can also see that the usage of the value stream resources are also improving. In the current state there is only 5% available capacity within the value stream and this limited capacity results in considerable overtime and late deliveries. As the improvements are made the available capacity is freed up leading to reduced overtime costs and improved profitability. The operational improvement, however, are more marked than the financial improvements, and the improvements in the use of hazardous waste is quite significant. It is often the case that the financial improvement from lean transformation lags operational improvement. There are three primary reasons for this:

- Most of the costs are fixed and can not be changed in the short term.
- There are methods within traditional standard costing that give misleading results. They show that bad things are happening when in fact there is good lean improvement. For example, reducing inventory will artificially lead to reduced profits on the income statement.
- The elimination of waste often does not directly lead to cost reduction, it leads to opening up newly available capacity.

		CURRENT STATE	Kaizen #1	Kaizen #2	Kaizen #3	New Extractor	Kaizen #4	FUTURE STATE
OPERATIONAL	Sales per Person	\$160,850	\$165,000	\$165,000	\$165,000	\$165,000	\$165,000	\$189,750
	On-Time Shipment	87%	87%	94%	94%	96%	96%	96%
	Dock to Dock Days	24	24	17	8	8	8	8
	Hazardous Gms/Case	12.2	12.2	12.2	6.0	2.0	2.0	2.0
	First Time Through	43%	55%	67%	67%	69%	74%	74%
	Average Cost	\$159.34	\$158.11	\$155.05	\$152.64	\$149.03	\$148.16	\$155.63
CAPACITY	Productive	43%	43%	47%	52%	49%	41%	47%
	Non-Productive	52%	49%	37%	35%	31%	27%	31%
	Available	5%	8%	16%	13%	20%	32%	22%
FINANCIAL	Revenue	\$32,170	\$33,000	\$33,000	\$33,000	\$33,000	\$33,000	\$37,950
	Material Purchases	\$7,853	\$7,656	\$7,350	\$7,056	\$6,985	\$6,846	\$7,872
	Labor	\$10,931	\$10,931	\$10,931	\$10,931	\$10,603	\$10,603	\$10,603
	Outside Services	\$572	\$572	\$572	\$480	\$480	\$480	\$553
	Other Conversion	\$6,139	\$6,139	\$5,955	\$5,955	\$5,776	\$5,776	\$5,873
	Value Stream Profit	\$6,675	\$7,702	\$8,192	\$8,578	\$9,155	\$9,295	\$13,049
	Return	21%	23%	25%	26%	28%	28%	34%

Figure 3: Box Score showing lean improvement plan

While it is important to ask about the cost savings coming from lean improvement, there is a more significant question. "How can we use the newly available capacity to our best advantage?" Every time you create a future state value stream it is important to calculate the box score information related to the planned future state. This will often show that one of the primary improvements in the opening up of available capacity. This enables the value stream team to determine how to use this newly available capacity. There are many choices, of course, but in this simple example the value stream team works with sales & marketing to increase demand for the value stream's products. The results are shown in the right hand column of the box score under the heading "Future State".

4. Continuous Improvement

The methods of "lean and green" fit naturally into a lean continuous improvement approach. There are three levels of improvement efforts at work simultaneously within a mature lean organization:

- Break-through improvement using current and future state value stream maps.

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- b. Continuous improvement completed by the value stream team-members and driven by the (carefully chosen) value stream weekly performance measurements.
- c. Many small "just do it" improvements that are completed within the value stream's cells and other processes and are driven by daily problems and the employees knowledge of their processes.

In order to improve the hazardous waste measurements the value stream team included two kaizen events; kaizen #3 and the introduction of a new style of extractor equipment for the solvents. These break-through improvements were conducted jointly with the supplier of the adhesives. These were major events that are closely linked to the company's strategy deployment and broader lean objectives. Over the longer term the company is striving to bring hazardous wastes down to zero through product redesign, new technologies, eliminating the need for adhesives, etc..

Break-through improvement events are also initiated to achieve specific compliance goals contained within the ISO 14001 (or other) environmental management system. These compliance goals often affect more than value stream and the companies other support operations. These broader changes must be integrated into the value streams' lean continuous improvement plans and be completed using cross-functional teams.

In addition to the large break-through events, the value stream continuous improvement team initiated several smaller projects that were driven directly from the need to improve the value stream performance measurements. These are on-going projects that are completed by the value stream team-members who are empowered - and required - to work continuously to improve the performance of the value stream flow. Some of these projects would be designed to improve the hazardous waste measurement. The environmental compliance manager should be either be a member of the value stream CI team or be readily available to the team-members for advice and guidance.

The third level of improvements comes from the 1000's small changes made by everybody throughout the organization. These come from identifying process failures and eliminating them. Observing waste in the local processes and removing it. Studying the processes and changing the standardized work to create a better process. Some of these "just do it" improvement would reduce the impact of the hazardous waste.

It is important that these frequent small changes made throughout the operation are completed with a knowledge of their impact on the company's environmental compliance needs. This is achieved by:

- a. Conducting regular training on relevant environmental issues. This is often achieved through the teams' daily meetings having a "green" emphasis one day per week. The environmental compliance manager attends these meetings and provide short, simple, and practical training sessions.
- b. When these "just do it" improvements are discussed and approved at the cell/process team meetings, the environmental issues must be included. It may be necessary of the environmental compliance manager take part in these discussions.
- c. When value stream maps and process maps are drawn they should clearly show the places where environmental risks occur within the operation. These are color-coded and the risk issues documented. Similar color-coding is common for ISO 9000 risk and Sarbanes Oxley risks.

5. *Supplier Relationships*

The relationship between a lean company and its suppliers is very different from that of traditional companies. Lean organizations seek to create long term and mutually beneficial partnerships with their suppliers. This aspect of lean thinking is particularly beneficial with regard to environmental issues. In most cases the suppliers have a great deal of knowledge and experience with the environmental issues related to their products. Major breakthrough improvement and reduction of environmental risk is often best achieved through joint improvement events between the company and the supplier - and also the suppliers suppliers. These events not only provide great improvement but further create the close relationships and partnerships that are so key to the lean supply chain.

6. *Sales Implications*

In a similar way the "lean and green" approach to measurement and improvement can reap great benefits for increased sales and growth. Lean is primarily a medium-term growth strategy. We eliminate waste and create newly available capacity. This capacity is then used to make and sell more products and services without increasing our costs. Over the longer term this leads to the lowest cost of products and services.

The focus on environmental improvement that comes from including these issues in the company's regular lean performance measurements will - in turn - create products and services that reduce the customers' costs and their cost of compliance to environmental regulations. This aspect can greatly increase the value for your customers, increase the prices of your products and services, and create mutually beneficial long-term relationships with your customers. A true win-win.

7. *Conclusion*

For the "lean and green" approach to business to be successful, the environmental issues must not be the responsibility of a technical specialist outside of the company's primary operations. Additionally the focus must not be on merely complying with environmental regulation. For a company to be successful, the "lean and green" measurements must be tightly integrated into the organizations regular, visual performance measurement system at every level of the organization. This will - in turn - bring the environmental issues into the company's on-going continuous improvement processes where knowledgeable and empowered people will work every week and every day to improve the company's "green" performance. When this is coupled with close relationships with customers and suppliers, then the company is beginning to become "lean and green".