There’s Lean, and Then There’s Green!

Using Lean Manufacturing Principles to Deliver Green Results

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While there’s no doubt that Lean Manufacturing will result in lower material and labor costs and greater production revenues, there is less discussion about the benefits of Lean in relation to Green Manufacturing.

Here are a few examples cited in the U.S. Environmental Protection Agency’s “The Lean and Energy Toolkit” (www.epa.gov):

- From 2005 – 2007, General Electric reduced greenhouse gas emissions by 250,000 metric tons and saved $70 million in energy costs
- A Baxter International facility combined Six Sigma and energy efficiency efforts to save $300,000 in energy costs in one year
- Toyota Motor Manufacturing North America has reduced average facility energy consumption per vehicle by 30% since 2000

It’s interesting that these three companies, very familiar to Lean Six Sigma communities, are bridging the continuous improvement gap between operational performance and environmental performance. This article explores the linkages between Lean manufacturing principles and the benefits of Green manufacturing.

Foundational Green Reliability

When implementing Lean within our organizations, equipment reliability is the predominant foundational element that enables Lean operational performance. Embracing Green Manufacturing requires giving more focus to environmental and energy concerns during the implementation of reliability improvement projects.

Improvements geared towards improving equipment reliability have distinct linkages to environmental performance, such as reducing the amount of product and raw material waste through: 1) the elimination of catastrophic breakdowns through formalized root-cause analysis; 2) providing routine monitoring of system parameters through predictive technologies; and 3) preventing interruptions to production cycles with a focus on Overall Equipment Effectiveness (OEE). Sustainable Green Reliability Excellence (Rx) requires a focus in three holistic areas:

1. Green-Centered Maintenance – This approach evaluates the impact of functional failures on environmental performance and administers the appropriate condition monitoring and preventive maintenance actions. This will adequately predict when energy consumption becomes excessive, or material degradation has the ability to threaten the environment, effectively mitigating these risks before accruing operational costs. The result of these enviro-friendly strategies is two-fold: 1) optimized environmental performance, such as energy consumption; and 2) operational costs are reduced or sustained.
2. Designing for Green Reliability – Whether your organization is considering upgrading existing assets or purchasing new assets, environmental performance impact must be quantified and considered in the decision-making process. In a model organization like GE, life cycle cost analysis is performed during conceptual design to evaluate engineered solutions for implementations based on the total life cycle cost. This helps identify the financial gains or losses resulting from predetermined operational and maintenance practices designed to ensure ideal levels of reliability, availability, and maintainability.

When bridging the environmental gap, organizations like GE have begun to evaluate the energy consumption of each engineered alternative as a sustaining cost category. Those solutions or alternatives that effectively utilize higher efficiency motors, alternative fuels, or inherent energy sources (e.g. passing exhaust gases or condensing fluids through heat exchangers in order to heat the workspace as an alternative to a stand-alone HVAC system) will cost less over the life cycle period, be that five, ten, or thirty years. The additional benefit of a Green-focused life cycle cost analysis is that it will be easier to identify oversized equipment which could be replaced by smaller, more energy-efficient alternatives. In many cases we tend to over-engineer our plant assets and therefore spend more than we should to operate and maintain the system or asset over the life cycle period.

3. Sustainable Life Cycle Management – From conceptual design of new assets to the disposal of depleted assets, all functions of your business must be integrated to efficiently manage plant assets over the entire life cycle period. Life cycle asset management, with regards to environmental performance, requires that your organization be capable of determining the environmental impact associated with components and materials installed in the manufacturing system, be that energy consumption or the generation of harmful byproducts and waste.

Sustaining businesses have demonstrated an ability to control cost and curb environmental impact through life cycle thinking and therefore have created additional value within their products which can be recognized by their customers. Efficient asset management is implemented via systems and structures to capture data for the purpose of decision-making in eight aspects of the asset life cycle:

a) Design – conceptual design of new assets or modification of existing assets
b) Procurement – purchasing new assets or re-engineered components in order to support configuration changes in the manufacturing process
c) Storage – holding new assets or components in order to support configuration changes in the manufacturing process
d) Installation – installing new assets or components in the manufacturing process
e) Commission – initial startup of new assets or components
f) Operate – daily operational standards of practice
g) Maintain – routine maintenance standards of practice and maintenance strategies
h) Decommission – shutdown and disposal of manufacturing assets, or shutdown and handling of components which are uninstalled for reconditioning

From Lean to Green Manufacturing

The leading similarity between the benefits of Lean and the benefits of Green is waste, and so it makes perfect sense that in order to achieve higher levels of environmental performance your organization must first adopt the principles and practices of Lean manufacturing. Two examples from the EPA’s research on Lean and the environment, Eastman Kodak and Baxter International Healthcare Corporation, illustrate this point.

Eastman Kodak Company has been focused on Reliability Centered Maintenance since the early 1990’s and built a Lean business model upon their already excellent reliability foundation. From 1999 through 2006, Eastman Kodak conducted numerous kaizen events focused on energy reductions within their manufacturing processes by defining the problem statement as “what do we use energy to do?” They
found that there were two main areas where energy reductions would produce significant savings: 1) steps within the manufacturing process used to generate heat; and 2) the magnitude of energy used to turn motors and mechanical drive systems. Over the seven year period, Eastman Kodak energy reductions resulted in savings of nearly $15 million.

Baxter International Healthcare Corporation, a worldwide leader in global healthcare products, found environmental performance improvements through the Lean practice of value stream mapping (VSM). In one specific plant, VSM was used to walk through the manufacturing process in order to identify major water usage steps. Overall, 96 opportunities for environmental impact improvement were identified, prioritized, and implemented, with an estimated energy reduction value of 170,000 gallons of water per day.

Other Lean concepts such as operator care, Kanban and SMED can potentially improve the environmental performance of your organization as well.

Operator Care programs focused on developing standards of practice within the operating units decrease variation in the manufacturing process which reduces the amount of product and raw materials waste. For example, a world-wide leader in alumina refining and the manufacturing of aluminum products, successfully reduced energy consumption as a result of training Operators in better standards of loading, starting, and operating manufacturing equipment. Operator Care programs have also helped this manufacturer improve workplace safety and reduce lost workdays.

Kanban, or pull-systems established within the manufacturing process, have greatly contributed to material and waste reductions. Kanban practices are designed to provide the right materials at the right time to support manufacturing needs. This concept focuses on reducing excess inventories of raw or work-in-process materials which cannot be consumed immediately by the production cycle. Cell-based manufacturing processes that signal a pull for materials based on the demand for product can significantly reduce raw material consumption, decreasing the amount of waste material delivered to landfills, as well as reducing the demand on raw material resources.

SMED, or Single Minute Exchange of Die, a practice that helps your organization reduce changeover durations in order to adjust the manufacturing process based on product demand, has the potential to reduce the amount of waste generated from raw and unprocessed materials leftover in the manufacturing processes. For example, an aluminum door and window manufacturing facility conducted SMED events to reduce the amount of paint wasted per changeover from 50 gallons per day to less than 10 gallons. Paint disposal costs dropped by as much as $280,000 annually, and paint and solvent disposal were reduced by more than 40%. Using a cross-functional team, they identified waste elimination opportunities that included:

- Redesigning paint piping systems
- Moving low-volume part painting closer to the paint booth to eliminate lengthy piping systems
- Changing out hoses
- Standardizing processes
- Using alternative methods to clean the lines

**Incentives to “Go Green”**

As we’ve seen thus far, applying Lean manufacturing principles towards environmental performance improvement has the ability to dramatically reduce the overall impact of manufacturing on the environment, but there might be other incentives for your business to focus efforts on going Green. Besides federal government programs, such as the EPA’s “Lean Manufacturing and the Environment”, there are several state and local government incentives designed to encourage manufacturers to further help conserve national resources through Renewable Energy Certificates (REC). In most states RECs can be applied towards investments in alternative energy sources, utility loans and rate discounts,
environmental grants, and even tax credits and exemptions, all of which help to further reduce the operational costs associated with manufacturing, as well as improve the image of your business. To learn more about government programs in your state, search the national Database of State Incentives for Renewables and Efficiencies at www.dsireusa.org, hosted by North Carolina State University.

To learn more about how **Reliability Excellence (Rx)** and Lean methodologies have helped organizations eliminate waste and reduce their environmental impact, please email info@LCE.com.

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