

Lean Manufacturing and the Environment

Ignoring the 8th Deadly Waste¹ leaves money on the table.

Mitch Kidwell

Taking a break from a *kaizen* event, I had the rare opportunity to pick the brain of the *sensei*, a Japanese consultant who had been involved with lean manufacturing since before its arrival to the United States. Since I work for the Environmental Protection Agency (EPA), I asked him about the status of lean manufacturing in Japan, and in particular whether the focus of lean and efficient production had begun addressing environmental concerns. Through a few more questions and responses, his answer became clear. Environmental concerns *are* a part of the lean concept. Emissions to air and water, as well as the generation of solid/hazardous waste, represent a waste of production (that is, no value to the customer), just as surely as the need for protective equipment (such as gloves and ear plugs) is, and that *eventually* lean would address them.

Lean usually helps the environment without really intending to. A Shingo Prize-winning study that EPA commissioned found that through Lean, many companies were saving money by taking steps that also benefited the environment, *even when they were not consciously trying to do so*. “Environmental” wastes, such as excess energy or water use, hazardous waste, or solid waste, present largely untapped opportunities to the lean practitioner. This is obvious if one steps back to consider the

overall goals of lean manufacturing continually improving production efficiency. More efficient production means less energy used per unit produced. It means less material resources are used per unit produced, and materials (and energy, for that matter) are used or reused more efficiently. Aside from the obvious savings on production costs, this more efficient use means not only less energy and raw materials consumed, but also less material emitted to air and water, and less solid/hazardous waste generated. See the box for examples.

Therefore, EPA has begun to look very closely at lean as an area in which environmental and business practitioners can work together. On the one hand, lean practitioners save money finding undiscovered opportunities to eliminate the same wastes that concern environmental agencies. On the other hand, much expertise in environmental waste-minimizing opportunities already exists. It is readily available by tap-

In Brief

Lean strategies coincidentally benefit the environment, without the need for special “environmental” toolkits or a separate focus on environmental considerations, as explained by author Mitch Kidwell of the EPA.

Examples of Environmental Gain from Production Process Kaizen

General Motors: An assembly plant evaluated paint booth cleaning operations; cleaning took place every other day. They discovered that the automated section of the painting operations only needed to be cleaned once a week, as long as the cleaning was thorough and bigger holes were cut in the floor grating to accommodate thicker paint accumulations. More efficient cleaning techniques and solvent recycling were also implemented.

Production gain:

Reduction in cleaning frequency reduced downtime and improved production flow.

Environmental gain:

Use of purge solvents was reduced by 3/8 gallons per vehicle.

VOC emissions from purge solvents were reduced 369 tons in the first year these modifications were implemented.

Goodrich Aerostructures: A facility shifted to lean point-of-use chemical management systems. Goodrich personnel worked with suppliers to get just-in-time delivery of chemicals in smaller, right-sized containers.

Production gain:

Delivery of right-sized containers to the point-of-use (either in work kits or by designated water spiders who courier materials to the point-of-use) reduced wasted worker movement and downtime.

Shifting to right-sized containers of chemicals reduced inventory and minimized the chance of chemicals expiring on the shelf.

Eliminated the need for four 5000 gallon tanks containing methyl ethyl ketone, sulfuric acid, nitric acid, and trichloroethane, thus eliminating the need to address risk management planning and other chemical management requirements for the tanks.

Environmental gain:

Right-sized chemical containers reduced chemical use and hazardous waste generation. Minimized the waste generated through chemicals expiring in inventory.

Eliminating the four 5000 gallon tanks eliminated the potential for large-scale spills.

The Gehl Company, West Bend, WI: The modification of a paint stripping process demonstrated the connection between lean manufacturing and pollution prevention — and demonstrated that pollution prevention saves money. (Or in environmental lingo, “P2 Pays.”) The company replaced chemical paint strippers with a blasting cabinet that uses small plastic particles to strip paint off parts.

Production Gain:

This directly resulted in savings of \$32,000 a year in waste disposal costs.

Environmental Gain:

Employees had a safer and healthier work environment. The long-term expense or liability that this eliminated cannot be quantified, but it is “significant.”

Please note that this type of process improvement and money-saving exercise was an EHS-oriented kaizen event, with the methodology being wholly consistent with lean manufacturing.

ping into the many years of knowledge that environmental experts and in-house Environment, Health and Safety (EHS) personnel have in finding and eliminating wastes in ways that can significantly boost the economic bottom line.

Environmental Waste: An Overlooked Savings Opportunity

Lean manufacturing first came to EPA's attention through case studies that demonstrated that very significant reductions in so-

called “environmental wastes” (that is, the 8th Deadly Waste) resulted from Lean activities solely focused on increasing production efficiency.² In 2003, EPA published this report, a collection of case studies of lean manufacturing activities and the environmental benefits that resulted. We are proud that this report won a Shingo Prize for research.

Companies usually do not consciously target “environmental” issues such as energy or water use, solid or hazardous waste, or chemical hazards, in their lean initiatives. Typically, environmental costs and impacts are considered overhead. Thus they tend to be hidden from the cost evaluation of a specific production process. But with the recent rise in energy (and transportation) costs, an increasing number of companies have begun specifically targeting energy consumption for kaizen. Energy consumption has a very definite, measurable impact on a company’s bottom line as well as a facility’s environmental footprint.

To understand lean better, EPA began participating in actual kaizen events. That’s how I met the sensei. When I suggested to him that the lack of environmental considerations during lean events was leaving opportunities for reducing costs on the table, he responded by saying that such a situation simply indicated a flaw in how lean was being implemented. He believed environmental considerations and the costs involved are an inherent component of lean. If cost-reduction opportunities concerning environmental wastes are being overlooked, then the true costs of production are not really being accounted for. He also went further by saying that if the true costs of production are not being overlooked, then it is likely a simple question of priorities.

He pointed out that many ideas for improving production efficiency reduce or eliminate all manner of wastes. Even if environmental wastes do not get first priority, it is likely that eventually lean will get around to addressing them. In some cases, this will happen through lean activities not intentionally focusing on environmental wastes, as was shown in EPA’s 2003 report. However, companies may consciously

choose to focus kaizen on particular “environmental” wastes.

Lean manufacturing confers very real benefits by reducing the costs of production and more efficiently using capital. If lean manufacturing also incorporates environmental considerations, it can help a company achieve many other long-term goals, such as environmental sustainability and maintaining a good relationship with the public.

Environmental Expertise Can Help Achieve Lean Goals

Lean manufacturing provides the opportunity for businesses to collaborate with EPA and other environmental agencies — either by working together directly to address a specific concern or by using environmental experts as a source of information and tools that lean practitioners can find helpful. For many years, EPA has promoted the concept of “pollution prevention,” — eliminating pollution from the production process rather than installing costly “end of pipe” controls. Pollution prevention assistance providers have acquired years of expertise in finding ways to eliminate waste. They do audits with manufacturers, suggesting ways to save energy and reconfigure production processes to minimize the wastes generated, while at the same time, making the kinds of efficiency improvements that lean manufacturing also seeks out.

Most pollution prevention strategies actually save money. Few pollution prevention ideas would be voluntarily implemented if they only increased the cost of production. While the goal of pollution prevention is not to increase production efficiency per se, and the goal of lean manufacturing is not to minimize environmental wastes per se, both disciplines tend to arrive at the same, or at least consistent, end results.

From EPA’s perspective, leveraging lean to achieve environmental goals is a no-brainer. Lean manufacturing represents the Rosetta stone for translating pollution prevention ideas into a language that makes sense to the operations side of a business. Likewise, focusing on environmental wastes can help companies achieve their lean goals.

EPA's "Lean and Environment" Initiative

To help bridge the gap, EPA has begun to observe how lean works in action, and to work with lean experts on strategies for targeting environmental wastes. EPA has partnered with several companies, Manufacturing Extension Partnerships (MEPs), and Federal facilities that have already begun making the connections between lean and the environment. We have been delighted to find that lean companies tend to be very free about sharing information, experience, expertise, and the actual tools they've developed in furthering the goal of efficient production. We set about acquiring lean experience through attendance at lean conferences, workshops, visiting facilities to see firsthand the changes resulting from lean implementation, and by actively participating in *kaizen* events and other lean activities at various partner facilities. EPA participated in a special session at AME's 2005 conference in Boston and 2006 conference in Dallas, where EPA also had a booth.

Based on our experience and that of our partners, in January 2006, EPA developed and published "The Lean and Environment Toolkit" (see box copy). The Toolkit incorporates tools already developed and used by our partners, as well as new ideas that arose during our collaboration. Lean practitioners will find these tools to be

very familiar; for the most part, they're traditional lean tools with slight adaptations to account for a slightly different perspective.

For example, the Toolkit includes a Value Stream Mapping (VSM) tool, which is basically the same as the traditional VSM, but adding a "starburst" to identify environmentally sensitive processes. These would be processes that involve the need for a permit, the use of hazardous materials, or where an opportunity for achieving environmental gains consistent with production efficiency is identified during the VSM exercise. Should such a process be addressed by a future lean event, the team working on the event would know to involve environmental, health, and safety (EHS) staff. More significantly, the Toolkit demonstrates how the VSM can also be adapted to track the use of raw materials, energy, or other utilities, such as water. Without adaptation, many lean techniques can also specifically address environmental concerns. They can be used in a *kaizen* event focused on a specific environmental problem, or in *kaizen* dealing with process waste in general.

Another fairly common example is a "6S Checklist" where "Safety" is the sixth "S." This checklist includes items for tagging potentially hazardous materials, and organizing them to minimize the risk of spills or unsafe exposure.

EPA has designated this Toolkit as "Version 1.0." In keeping with the continuous improvement philosophy, EPA expects to publish additional versions. We seek input on suggested changes, both in substance and presentation, to enhance the Toolkit's usefulness to lean practitioners. EPA welcomes suggestions for other lean concepts that EPA should pursue to enhance the environmental benefits of lean manufacturing. We seek information or data from you that EPA can provide to other companies to assist them in drawing their own links between Lean and the environment.

EPA's lean website provides a link to make such suggestions. We really want to hear from you. *Please contact us at www.epa.gov/lean.*

The Lean and Environment Toolkit

How can EPA help save you money? "The Lean and Environment Toolkit," published in January 2006, presents slightly modified standard lean tools, such as VSM and 5S, to include environmental considerations. The Toolkit also provides checklists and other standardized forms used during *kaizen* events that provide a framework for environmental considerations.

The Toolkit is available for download at www.epa.gov/lean. There is also a link on this site to provide comments, suggestions, and especially if you would like to share success stories involving lean manufacturing and its impact on the environment, or seek further information.

Bringing EHS into the Lean World

A key recommendation in the Toolkit is to involve EHS staff more fully in Lean activities, and to draw on their environmental expertise. Currently, when EHS personnel are involved, their role is geared heavily toward health and safety, as well as ensuring compliance with OSHA requirements.

Environmental concerns are often downplayed, or even absent from kaizen activities. This seems to be a natural outgrowth of regarding environmental issues as a “monument” during kaizen, being cautious making changes to a production cell that may make perfect sense, but that would require a permit modification to maintain compliance, for example. But such environmental monuments are little different from other monuments that kaizen teams feel compelled to “lean around.” Sooner or later they need to be addressed.

While compliance issues are rightfully a major concern, and people acknowledge that it's better to get such issues out in the open early in a kaizen event, there's still a natural inclination to downplay or even exclude environmental monuments from improvement considerations. As a result, EHS personnel participating in a kaizen event may leave their “environmental hat” behind, or be reluctant to offer their “environmental” ideas, believing that they will not receive full consideration because they come from “the nay-sayer.”

However, more and more experienced lean companies are finding that it pays to encourage EHS personnel to wear their environmental hat. With that hat come insights into costs that are otherwise hidden from the operations side, and from the accounting system, but that's another issue. These insights can help evaluate the true costs associated with a particular production process, and find opportunities otherwise unseen.

For example, EHS staff are more likely to realize that a more expensive, but less toxic solvent may actually be more cost-effective if it results in less hazardous waste (or even none) being generated. The costs to

treat and dispose of wastes often exceed the added expense of less toxic solvent.

Another all too common example is that it seems more efficient from a production perspective to combine wastewater streams and treat all the wastewater together. However, if one stream results in a hazardous waste, combining it with other wastewater streams can generate a much larger volume of hazardous waste. How could that happen? Suppose electroplating rinse water is one of the wastewater streams. Under the hazardous waste regulations, the sludge from the treatment of electroplating rinsewater is a hazardous waste. Combining the electroplating rinsewater with other wastewater streams does not change the regulatory status of the rinsewater (that is, it remains electroplating rinsewater). So the sludge resulting from the treatment of the combined waste stream continues to be considered the sludge from the treatment of electroplating rinsewater, and so continues to be a hazardous waste, only now with a much larger volume because of the precipitants contributed by all the other wastewater streams. In such a situation, the added cost of treatment and disposal of the larger volume of hazardous waste could easily exceed the operational savings of combining all the facility's wastewaters, something an EHS person would know.

Combining waste streams can also adversely impact the recyclability of all resulting waste, impacting the cost of a facility's overall waste management program. For example, scrap metal and used oil are both recyclable, but combining the two could render both unrecyclable unless they are again separated. Even then, they are less attractive to a recycler. Too often, such environmental costs are hidden in overhead, and the insights that would have brought them to light during a kaizen event never arise if environment expertise is omitted or discouraged during the event.³

We strongly encourage companies to involve EHS staff in kaizen events on production processes, and encourage them to wear their “environmental hat.” Certainly, many kaizen events do not require environmental insights. But with a little time and

experience, managers soon learn when to involve EHS staff, just as they sense when to involve people from marketing, purchasing, or IT when a process kaizen is apt to cross boundaries. Unless they do, they'll never know what insights they missed.

Working Together Toward Sustainability

EPA has recognized that "lean strategies" coincidentally benefit the environment. As noted earlier, EPA also recognizes that lean is first and foremost a business model. Trying to hijack it to redirect to other goals will not be successful either for EPA or our business partners. Thus, we encourage targeting environmental wastes not for altruistic reasons, but because it serves the same goals as targeting wasted time, wasted motion, and other traditional "deadly wastes."

Nevertheless, the environmental benefits that result from kaizen activities can be quite significant. They can lead a company towards sustainability and a reputation as a good corporate citizen. Increasingly, companies concerned with their public image have adopted, directly or indirectly, the goal of reducing their environmental footprint in their mission statements. For a variety of reasons, they are taking steps well beyond what is required by law and looking at the "triple bottom line" of economic, environmental, and social concerns. (Interested readers may want to review Gary Langenwalter's article, "'Life' is Our Ultimate Customer: From Lean to Sustainability" in *Target's* first 2006 issue.⁴)

While not every company is ready for this step, EPA encourages companies to consider it, and views the lean journey as an excellent way to start the environmental journey. EPA's goal is to maximize the environmental benefits of lean by raising the awareness of the linkage between lean and the environment. We are developing pollution prevention and other relevant expertise. We will develop informational materials, such as the Toolkit, when appropriate. To do this, EPA needs the input of lean companies.

We need you to tell us what we can do to help your company continue the lean path. We trust that environmental considerations can become incorporated as an inherent part of lean, without the need for special "environmental" Toolkits or a separate focus on environmental considerations. We need not wait for lean to *eventually* address environmental considerations — they are worth considering now as part of efficient production.

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Footnotes:

1. The 8th Deadly Waste is a term coined by lean manufacturing companies and assistance providers that have partnered with EPA in pursuing the goal of enhancing the environmental benefits inherent in lean manufacturing. "Environmental waste" is a term used to distinguish between those emissions and solid/hazardous wastes that EPA typically considers waste from the 7 Deadly Wastes associated with lean manufacturing.

2. "Lean Manufacturing and the Environment: Research on Advanced Manufacturing Systems and the Environment and Recommendations for Leveraging Better Environmental Performance," EPA100-R-03-005, October 2003. This EPA publication is available for downloading at <http://www.epa.gov/lean/leanreport.pdf>.

3. For smaller companies that do not have such compartmentalization of key functions, insights into environmental costs and alternative processes and materials can often be gained through pollution prevention assistance providers, Manufacturing Extension Partnerships (MEPs), state regulatory agencies, or private consultants that specialize in such issues.

4. "'Life' is Our Ultimate Customer: From Lean to Sustainability," by Gary Langenwalter, *Target*, Volume 22, Number 1, p. 5.

