In 50 Words Or Less

- Organizations can often overlook wastes related to material and energy sources.
- Traditional lean tools can be used to cut energy use, curtail overproduction and improve the bottom line.
- One military supplier used lean to uncover ways to reduce its energy use and environment-related waste, building a more-efficient production cycle.

Leaning toward Green

by Christopher D. Chapman and Newton B. Green II

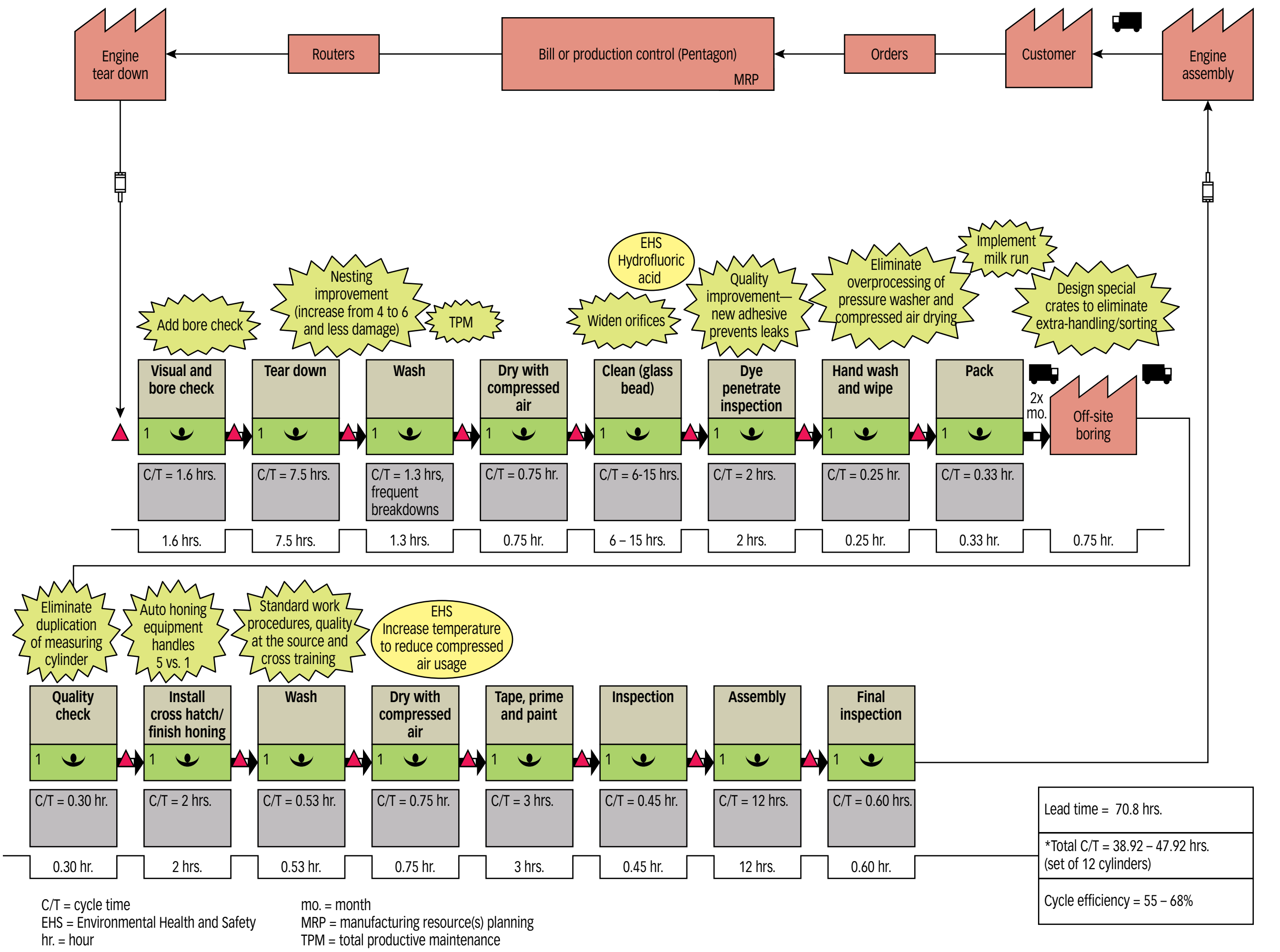
Manufacturer uses method to **cut wastes, save money**

LEAN PRACTITIONERS HAVE long challenged employees to question why a process is performed a particular way and whether it is necessary, and to shift their paradigm to implement a more efficient way to provide customer value.

To do so, seasoned lean implementers have developed a keen eye for identifying wastes—at least the conventional types. Often referred to as the seven deadly wastes, these conventional wastes include:

1. Overproduction ahead of customer demand.
2. Waiting for the next processing step.
3. Unnecessary transport of materials.
4. Overprocessing due to poor tool and product design.
5. Inventories that are more than the absolute minimum.
6. Unnecessary movement by employees during the course of their work.
7. Production of defective parts.[1]

Cylinder value stream map / FIGURE 1



These wastes are often exposed by looking at a process or activity and asking the fundamental lean question: "Is this really necessary to create the product or service for the customer?"

Until recently, many people seemed to restrict the use of this probing question and looked only at the actions undertaken to transform the raw material into a finished product. If lean practitioners don their "green spectacles" to view this from a broader perspective, probe further and begin to ask the same fundamental lean question about material and energy sources used to create the product, then, more waste and cost savings will be uncovered.

For instance, ask whether the chemicals, materials, water and electricity are necessary and whether there is an opportunity to reduce the amount used. Ask whether you can reduce or eliminate the amount released to the air, water or land. By doing so, lean practitioners will essentially begin to develop their "green eyes" and identify previously overlooked energy and environmental wastes.

Tecmotiv (USA) Inc., a remanufacturer in upstate New York, chose to see through green lenses and successfully integrated lean and energy and environment (LE2) initiatives.

Uncovering opportunity

With rising energy costs, expanding environmental footprints and global warming concerns, energy and environmental wastes are becoming increasingly scru-

INDIVIDUAL CYLINDERS placed in the staging area for a remanufacturing process at Tecmotiv.

tinized, because these types of wastes can be just as costly and erosive as the seven deadly wastes. Furthermore, from a process improvement standpoint, these wastes have largely been overlooked, proving the old adage, "The greatest waste is the waste that you do not see." Many lean practitioners have been looking but have largely failed to see the whole opportunity.

As the lean practitioner begins to venture into this new target area, the fundamental question remains the same: "Is this activity or resource necessary to provide customers what they want?" The answer requires lean practitioners to broaden their focus of productivity and efficiency to include energy and environmental resource streams.

In addition to recruiting frontline operators, managers and engineers to implement preventive measures for the seven deadly wastes, lean practitioners will need assistance from their environmental health and safety (EHS) personnel to improve this aspect of the business. This piggybacks on a well-established lean practice of assembling a cross-functional team of individuals with different perspectives to examine business processes to identify opportunities for improvement (such as *kaizens*).

So it's no surprise when an EHS specialist is added to a lean team, more opportunities become apparent. Through this expansion of lean focus, these environmental and energy (E2) wastes (such as unnecessary or excess use of energy and resources or the release of substances into air, water or land that could harm human health or the environment) are prominently highlighted on the continuous improvement road map.

Furthermore, many common lean targets have energy and environmental implications. For example, when overprocessing and transportation wastes are reduced, the energy (lighting, heating and cooling) needed to power the affected equipment also can be reduced. The good news is that traditional lean tools—such as waste identification, value stream mapping with minor modifications, 5S (sort, set-in-order, shine, standardize and sustain) with an increased emphasis on safety (6S), and *kaizen* along with problem solving with an E2 focus, can successfully uncover previously overlooked opportunities.

Recognizing the importance of E2 and the desire of most businesses wanting to do the right thing, more managers are making E2 management a critical part of their business plans, along with lean. In addition to satisfying their social and environmental responsibilities, this also helps companies save money and improve their bottom lines.

EPA assistance

Recently, the U.S. Environmental Protection Agency (EPA)—in partnership with various manufacturers and organizations—developed separate toolkits for lean and the environment, and for lean and energy. These toolkits offer practical strategies and techniques that enable lean practitioners to seamlessly identify environmental and energy wastes alongside other improvement opportunities uncovered by value stream mapping analysis.

Value stream mapping is "a simple process of directly observing the flows of information and materials as they now occur, summarizing them visually and highlighting sources of wastes, and then envisioning a future state with much better performance."[2] This results in the discovery of often-overlooked and hidden problems.

The New York State Pollution Prevention Institute (NYSP2I) at the Rochester Institute of Technology has integrated lean and environment, and lean and energy toolkits into its LE2 program. Tecmotiv partnered with NYSP2I to use this approach to reduce energy use and its environmental footprint while increasing profitability and productivity.

Improvement and savings / TABLE 1

Wastes	Improvements	Annual results
Overprocessing	Widened orifices in glass bead blast cabinets, reducing cleaning time per cylinder by 50%, overall energy use and material (glass bead) and nonhazardous waste.	Reduced labor hours
Defects	In-process inspection moved to the beginning of process, thereby identifying bad parts at the start of the process instead of passing defects to downstream processes, thus reducing rework. Implemented quality at the source (for example, transferred responsibility for quality from inspectors to assemblers). This required cross-training and visual standard work procedures.	Less detergent used: 41 gallons Less water used: 1,480 gallons
Overprocessing	Boring, honing and cross-hatching now performed on an automatic honing machine instead of doing one cylinder at a time manually.	Less nonhazardous wastewater: 259 gallons
Unnecessary motion	Parts repackaged in special crates to minimize handling.	Less glass bead: 3,631 pounds
Overprocessing	Eliminated one process-cleaning step, reducing electricity use (less use of high-pressure spray washer).	Less nonhazardous solid waste: 5,791 pounds
Waiting and scrap	Reused (clean and plate) formerly discarded hardware, resulting in less work stoppage due to unavailable parts.	$64,335 in total cost savings

Taking action

Tecmotiv is a qualified supplier of tracked combat vehicle suspension components and tactical wheel vehicle components for the U.S. Army, Tank Automotive and Armaments Command. Tecmotiv is also the only private contractor approved by the U.S. government to build CD-850 transmissions and to rebuild AVDS-1790 engines. These 800 and 1,000-horsepower engines are used in tanks and other large military vehicles, and they must be maintained regularly.

Engines processed by Tecmotiv must be cleaned before being remanufactured, and the surface-cleaning process was a costly production bottleneck that caused delays in meeting customer demand. A particularly problematic part was the cylinder, and each engine contains 12 cylinders.

Consistent with the LE2 approach, Tecmotiv and NYSP2I added an EHS expert (from NYSP2I staff) to their *kaizen* improvement team. First, this cross-functional team prepared a value stream map (VSM) of the cylinder remanufacturing process from cylinder detachment through disassembly and cleaning to reassembly and reattachment. This VMS is shown in Figure 1 (p. 20).

Although value stream mapping revealed that Tecmotiv's cylinder remanufacturing process was already performing at an excellent cycle efficiency range of 55 to 68%, it presented more opportunities to reduce waste and cost. Cycle efficiency is calculated by dividing the value-added time (work a customer would recognize as necessary to create the product) by the total lead time (how long the process actually takes from start to end). In other words, cycle efficiency is the total hands-on time divided by customer wait time.

ONE OF THE 12-cylinder engines that Tecmotiv workers disassemble and clean before the remanufacturing process begins.

According to author Michael L. George, cycle efficiency of 35% or more is world class.[3] Cycle efficiency is used to gauge the amount of waste, potential for improvement and cost-reduction opportunities. This metric is improved by eliminating wastes. The LE2 team focused on cycle-efficiency improvements (highlighted with the yellow *kaizen* bursts in Figure 1) and looked for processes with:

- High energy, water and material use.
- Significant solid or hazardous waste generation requiring environmental permits or reporting to environmental agencies.
- Pollution control equipment.
- Use of toxic chemicals requiring personal protective equipment (PPE).
- Lean opportunities with E2 implications.

In short, the team was asking, "Is this necessary?" throughout the entire process flow.

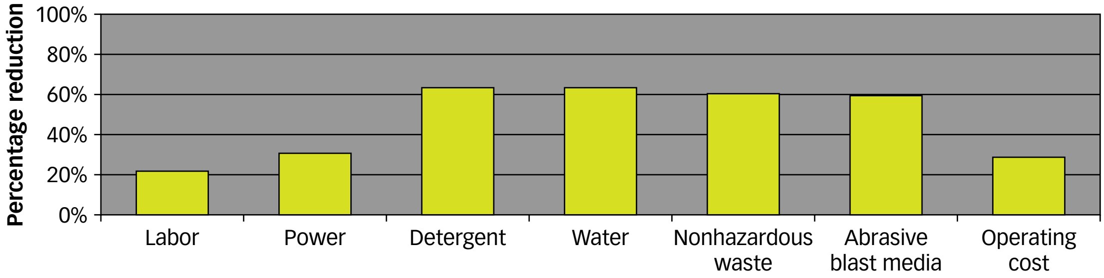
Table 1 includes improvements and savings uncovered through the preliminary LE2 value stream analysis. Look for the yellow *kaizen* bursts and EHS icons in Figure 1 for more examples.

The EHS professional helped the team see that many of the waste reductions also had E2 implications. For example, many plant operators thought energy could be conserved by reducing the temperature of spray washers used to clean parts. But that was untrue for cases in which subsequent operations, such as drying with compressed air and additional cleaning with abrasive blasting, were also required to meet customer specifications.

Use of compressed air is notoriously inefficient. If the temperature of the spray washer is raised so parts flash dry after using the spray washer, drying operations with compressed air can be reduced or eliminated. Cleaning efficiency also improves with increased temperature, thereby reducing cycle times in subsequent cleaning operations that also use power and compressed air, such as abrasive blasting.

The process of evaluating a single process step in a vacuum, also known as suboptimization, fails to consider the interdependency of a specific process step with downstream process steps. Conversely, the broader perspective of collective evaluation—also known as value stream analysis—avoids the unfortunate result of realizing minor savings on one process

Reductions in key metrics / FIGURE 2



step while incurring larger, additional costs on subsequent steps, more simply stated as being "penny-wise and pound-foolish." This is, perhaps, the most powerful aspect of the LE2 process.

Strategies that worked

Implementation of specific strategies—such as increased spray-washer temperature, increased batch sizes and widening of orifices in abrasive blast equipment—reduced the use of electricity, compressed air, water and detergent, decreased the consumption of glass beads and cut down on the creation of nonhazardous waste water and solid waste.

If the team had used only traditional lean manufacturing measures, these savings would not have been captured. The EHS *kaizen* member also facilitated a 6S audit. The 6S audit requires an assessment of not only the quantity, usefulness and frequency with which items are used in a work area, but also the risk and toxicity of the items. The 6S audit highlighted the use of toxic chemicals and evaluated alternative formulations for line personnel to consider.

This audit helped the LE2 team enhance the existing PPE program and encouraged the team to brainstorm comprehensive corrective actions and alternative methods to avoid injuries and to ensure ongoing compliance with environmental and occupational health and safety regulations.

Other improvements included posting visual work instructions, eliminating duplicate work steps, initiating cross training and reusing formerly discarded hardware. Figure 2 (p. 23) shows the percentage reductions in several key environmental metrics.

Thoroughly convinced of the value of LE2, Tecmotiv assigned more internal lean practitioners to transform its entire remanufacturing process. This involved enrolling some employees in lean Six Sigma Green Belt programs. One employee was later certified as a Master Black Belt.

This initiative has set the stage for establishing a more prominent lean and green continuous improvement culture. With these initial savings and waste reductions, Tecmotiv is seeing green in more ways than one. QP

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