Beyond Lean Toward Green

Australian manufacturers show how a lean approach to environmental sustainability yields big benefits to the triple bottom line.

Ian Young

Australia is a thirsty country. Following months and years of below average rainfall, and an increase in consumption by a growing population, locals can now walk across Victoria's Lake Wendouree, a once natural body of water that hosted the 1956 Melbourne Olympics rowing regatta.

With severe water restrictions in place, leaders and decision makers face heated debate over who has priority over the use of water — the residents, the food producers, or other local manufacturing industries — and what is the best way to secure future supply if the current trends continue. In Victoria, manufacturers find themselves under increasing pressure to reduce their level of consumption of this precious resource. While they use less than 2.5 percent of all water consumed (in 2005), the cost of this water is predicted to have doubled by 2013.

While water is the most urgent issue in drought-plagued Australia, similar debates are underway throughout the world about other sustainability issues, including consumption of energy, raw materials, packaging, and consumables. Still other debates rage over contentious issues such as climate change or reducing global warming, the use of toxic chemicals and heavy metals, and the effect of manufacturing on ozone depletion, biodiversity, and air pollution. But many companies have moved beyond the debates and are now taking action; they are beginning to see business opportunities in addressing these environmental challenges. (See Figure 1.)

Such is the approach of the companies in a program called *Lean to Green,* devel-

In Brief

Two groups of Australian manufacturers have embarked on an effort to extend their thinking beyond their current excellence "lean" programs by overlaying environmental "green" themes to their organization's improvement efforts.

Using the *Lean to Green* methodology, developed by the Manufacturing Best Practice Program in Melbourne, they show how organizations can take an operational approach to integrating their triple bottom line with manufacturing best practice.

Natural Drivers of the Green Wave

"Smart companies use environmental strategy to innovate, create value, and build competitive advantage."

The top ten environmental issues for organizations to understand and consider the impact of are:

- Climate change
- Energy
- Water
- Biodiversity and land use
- Chemicals, toxics, and heavy metals
- Air pollution
- Waste management
- Ozone layer depletion
- Oceans and fisheries
- Deforestation.

Green to Gold, Daniel C. Esty and Andrew S. Winston (Yale University).

Figure 1. Leading companies, such as those participating in the *Lean to Green* consortia, understand that "green" isn't as much about becoming more "socially responsible" or environmentally friendly; it's about running a better business.

oped by the Manufacturing Best Practice Program in Melbourne, Australia which brings together leaders of manufacturing companies to learn how to lead excellence within their operations. In the past two years, the program has brought together two groups of companies, 14 in total, as a consortium to pilot an approach to addressing environmental issues by using lean tools.

Operations managers and process improvement leaders of the participating companies — ranging from component assembly, plastic extrusion, and vehicle building to food, pharmaceutical, and packaging — all found through this experience that it's not just about conservation and the environment; it's about how to make a business more competitive and profitable, primarily by understanding and reducing consumption in the value stream.

"Sustainability for me, is about better business and about being more in touch with the environment and the community," said Ros Huggins of Amcor (Flexible packaging division), echoing the idea of a triple bottom line (TBL) — a focus not just on the bottom line profits, but also on the planet, or environmental issues, and people.

With an understanding of the triple bottom line, these organizations are extending their thinking beyond their current excellence or lean programs, and overlaying environmental green themes to their improvement initiatives.

The initial results are impressive. In less than 12 months, Davey Water Products, a manufacturer of pumps and rainwater harvesting systems, reduced landfill by 80 percent and reduced energy consumption and carbon footprint per unit by 35 percent. Olex Australia, a Nexans company who manufactures cables, reduced water consumption by over 50 percent for five consecutive months and reduced landfill waste from 120 cubic meters to 90 cubic meters per month.

These organizations are also better able to see the environmental benefits of their lean implementations, and are using this insight to forge stronger relationships with both their customers and the people within the business. The St. Regis Bates facility of Amcor changed the shape of a package that is shipped throughout the world, resulting in a drop of sea freight costs between ten percent and 18 percent. Kraft, maker of Vegemite — a national food icon — now understands that a change in their labeling process has also resulted in a significant increase in glass recovery, saving tons of carbon per year in the downstream glass recycling process.

Others have reduced consumption of materials and toxic chemicals and solvents by 25 percent. According to Mark Doneddu, ITW Buildex, Australia's leading manufacturer and supplier of self-drilling screws, "Our biggest issue from a lean, environmental, and waste perspective was our effluent treatment of water and the waste from our alloy plating processes — it uses 90 percent of the water at our factory. A quick fix has halved the use of chemicals, and the long-term solution will enable us to reuse the rinse water many, many times."

Water use, of course, was of particular concern, and each company approached it differently. Some companies focused on improving the quality of the used water so it could be re-used prior to discharge. By recycling trade waste water, Buildex will potentially save more than three megaliters of fresh water per year; and others, including Olex, focused on reducing leaks and improving current practices to halve their consumption.

Davey Water Products saved 1.6 megaliters of water in one year using its own technology to harvest the rainwater off their roof for use in its powder coating processes, while Amcor, which uses little water in its flexible packaging processes, now captures the water from its large roofs and donates it to the local community to water their playgrounds and sport fields.

Lean and Green: The "How-to"

While many organizations have embraced lean manufacturing and the concepts of the Toyota Production System as the foundation of a successful business model, many of these businesses continue to operate on the assumption that current levels of material consumption will be sustainable forever — what *Lean to Green* calls the "Take-Make-Waste" model. Yet the increasing cost and reducing availability of materials, combined with the increasing waste disposal and treatment costs, suggests such an approach is not only unsustainable, but bad for business.

By examining the "why" behind these trends and considering the people and planet along with the profit dimensions of the triple bottom line, the consortia of companies found that it is possible to reprioritize and in some cases reverse previous supply or outsourcing decisions.

"Due to a combination of efficiency gains from our lean programs, and a better understanding of the total cost of supply from a triple bottom line perspective, we have brought back into our plant products that we had been importing," said Buildex Process Engineer Mark Doneddu.

The program also helped the organizations to understand the total lifecycle and all costs, and has led to a change in the paradigm that "Sustainability is an added cost." Paul Cauchi, Amcor operations manager, said: "Regardless of whether an improvement project was people-focused or planet-focused, it always had a significant impact on reducing costs as well."

The similarities between reducing wasted time and effort and reducing waste of resources are a natural fit. Peter Puts, of Davey Water Products, reflected, "We have been doing lean for some time, and it has been very easy to transform into green."

The Top Ten "How-to" Guidelines

From their initial experience translating their lean programs to encompass green initiatives, the teams participating in the pilot program, sponsored by Sustainability Victoria, developed a list of guidelines to share with other organizations who want to expand their lean programs.

The list could easily be mistaken for a generic "lean" approach, however words have been changed to shift the emphasis from "flow and time" to "mass and enviro-wastes" (see Figure 2). It is important to note that this is not a sequential list and guidelines are not shown in any order of priority; different organizations have

Isn't Environmental Waste an 8th waste?

Many organizations in an effort to link their lean programs with green initiatives have added environmental waste to the list of lean wastes as an 8th (or 9th) waste.

The companies in the *Lean to Green* pilot agree this over-simplifies and masks the root cause of over-consumption in the value-adding processes of an operation.

They say that an important element of linking the lean and green philosophy is for an organization to understand how the seven lean wastes link with the environmental (or consumption) wastes. Process leaders need to understand how each of the traditional lean wastes translates into the enviro-waste categories: energy, water, and raw materials, including packaging.

For example, overproduction and defects may result in over-consumption of all waste categories. Inventory of finished goods can result in large warehouses that require heating and lighting, longer travel distances (energy), and additional outer packaging and wrapping materials than if the products made today were delivered to the customer tomorrow.

The Ten "How-to" Guidelines

In an effort to share what they learned, the *Lean to Green* consortium members came up with a list of guidelines for companies who want to use lean principles to achieve environmentally sustainability.

1. Understand the current state
2. Use a mass balance to understand process flow and capability
3. Define the Key Consumption Ratios
4. Develop a TBL plan that links projects with goals
5. Set targets, milestones, and resources
6. Get the lean teams involved
7. Use the 5Rs to identify consumption reduction opportunities
8. Understand the downstream processes
9. Redesign the product and packaging
10. Seek support of leaders and decision makers.

Figure 2. While the guidelines may at first look like a set of generic lean guidelines, they have a green overlay. For example, "value-adding ratio" in lean is "key consumption ratio" in green, while 5S becomes 5R.

approached the implementation in different ways, but all agree these guidelines have given some structure to their thinking and understanding.

1. Understand the Current State

The first stage of leading improvement is to "learn to see" and understand the current state. The consortium of companies each conducted this evaluation at two levels within their organizations.

In the first instance they focused on the overall organization. Participants completed a self-assessment of the organization by rating themselves against a series of questions. A score was calculated for each of eight categories, including Best Practice Outcomes, Leaders and Management, Finance and Reporting, Human Resources, Sales and Marketing, Design and Development, Supply and Purchasing, and Value-Adding Operations.

Then they conducted a more detailed "Waste Walk" of the value-adding operations to link the enviro-wastes with the lean wastes, to complete the initial step of understanding the current state.

2. Use a Mass Balance to Understand Process Flow and Capability

"One of the tools that were introduced was the mass-balance cycle, looking at inputs and outputs and resource usage," Amcor's Ros Huggins said. "That has helped us to focus strategically on where our real issues are in terms of waste-to-landfill which is co-mingled plastics and energy use, which relates to our extrusion processes."

A thermodynamic systems view and a mass balance approach to understanding consumption in the value stream was the subject of a previous *Target* article (See "From Lean to Green: Interface, Inc.," Fifth Issue 2008).

A block flow analysis of the entire product life cycle helped the companies demonstrate the potential of optimizing consumption. (See Figure 3.)

Rarely does an operation summarize on one page all of the inputs to all of its processes. "It is making us ask better questions as a team so that we can not only find the areas of waste, but the solutions as well," says Buildex's Doneddu. Often, different people are responsible for purchase of raw materials, energy, and other utilities, while still others are responsible for overseeing waste disposal or meeting environmental regulations on, say, emissions of $C0_2$.

3. Define the Key Consumption Ratios

Having developed an overall picture of consumption of all inputs including purchased raw materials, energy, water, etc., the companies identified their Key Consumption Ratios (KCRs). Most often, KCRs are ratios of grouped inputs per unit of manufactured output, as consumption is closely related to output. For example, it is better to monitor electricity and water usage per unit produced, than kilowatts or megaliters on their own.

However better improvement KCRs combine inputs and outputs from non-production ratios such as virgin material verses recycled material, or water into finished goods versus water discharged. The final step in defining the KCRs is to develop monthly trend charts.

Using a Mass Balance Approach

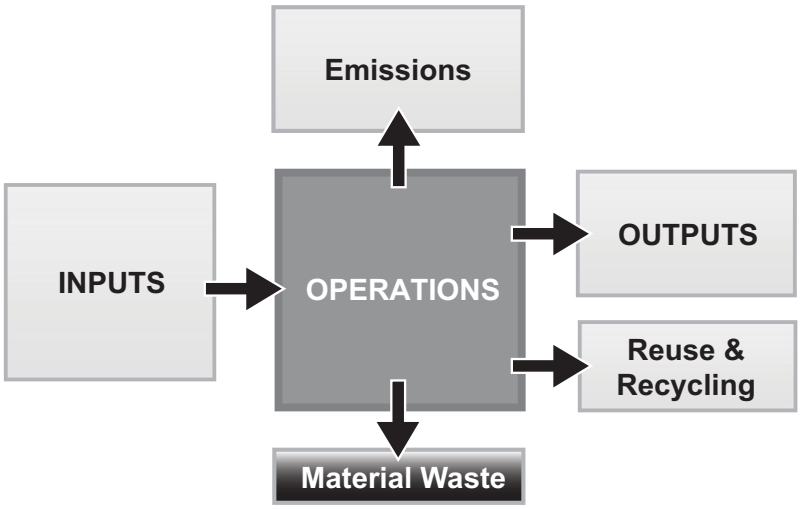


Figure 3. The mass-balance approach summarizes all inputs and outputs of a process, which helps identify opportunities for improvement.

4. Develop a Plan that Links Projects with Goals

A key step in moving forward is to develop a TBL plan that links strategic organizational goals with specific process improvement initiatives using a hoshin-kanri type approach.

A key element of the *Lean to Green* approach is that participants refer to master lists of possible goals and initiatives and, based on the initial diagnostic stages, use a process of elimination and prioritization to develop the plan. The "top" of the plan (see Figure 4A) is completed first by selecting the strategic goals that combine Profit, People, and Planet attributes.

The column on the left side of the plan (see Figure 4B) is shortlisted from over 100 potential generic improvement initiatives. These actions are prioritized based on impact, cost, and ease of implementation.

5. Set Targets, Milestones, and Resources

The TBL plan also incorporates measures and expected outcomes. It is listed as a separate guideline as it is the most critical planning step, and most frequently overlooked.

"To implement a sustainability program, you need a plan that links to your overall business' objectives," said Ros Huggins. Olex Continuous Improvement Manager Arch Fragale added: "What's most important about sustainability is creating the measures and setting the targets."

Targets and milestones are set based on priority and availability of resources to lead and coordinate all improvement activities.

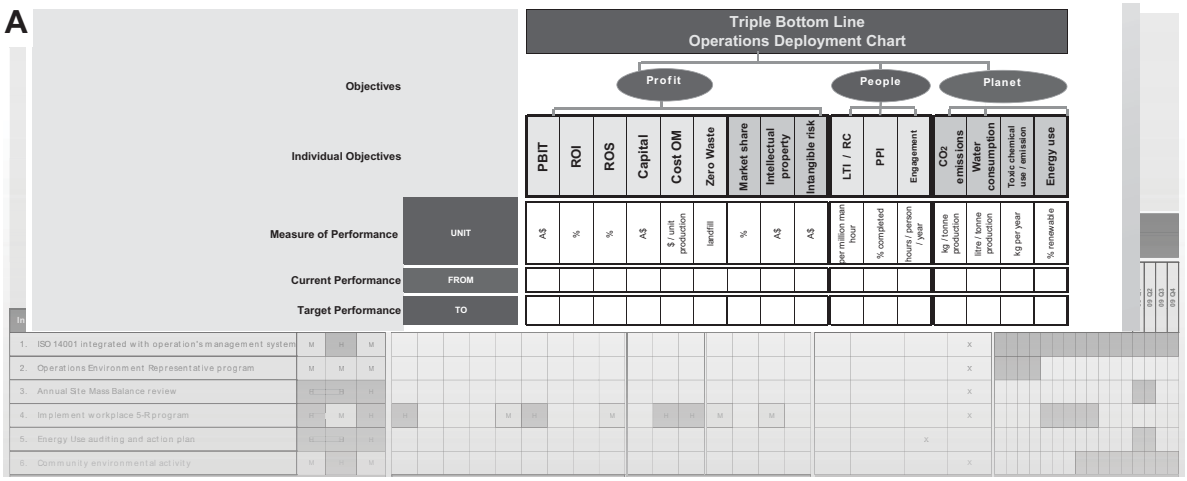
6. Get the Lean Teams Involved

Most organizations that have embraced lean have an effective 5S program in place. However, many of these organizations also find it difficult to keep the workforce engaged and actively involved in improvement initiatives. Many of the people active in lean teams are also concerned about the environment and are actively engaged in reducing consumption at home: saving water, reducing power and gas bills, and converting to more fuel-efficient vehicles. At companies with mature lean practices, such as Davey Water Products, recruiting lean practitioners to a green initiative will be easy. "On announcing our *Lean to Green* program, 30 of our 100 employees volunteered to be on a team to reduce waste to landfill, reduce electricity, and implement a recycling program," said Davey's Peter Puts.

An initial step is to expand lean teams to include separation and collection of wasted materials, and consumption of all utilities (water, electricity, and gas). According to Larry Challis, innovation manager at Amcor St. Regis Bates, "A reduction in landfill is a key to see as it indicates a change in culture."

Have a Triple Bottom Line Plan

A



B

Initiatives - All operations	Impact	Ease of implementation	Return
1. ISO 14001 integrated with operation's management system	M	H	M
2. Operations Environment Representative program	M	M	M
3. Annual Site Mass Balance review	H	H	H
4. Implement workplace 5-R program	H	M	H
5. Energy Use auditing and action plan	H	H	H
6. Community environmental activity	M	H	M
Initiatives - Operation specific			
7. Reduction of Waste to Landfill	H	H	H
8. Implement rainwater harvesting system	M	H	M
9. Recovery of waste ink	M	X	H
10. Develop a Used (Product) recovery plan	H	M	H
11. Develop a Low Carbon product portfolio	H	X	H
12. Optimise Fuel use in distribution	H	X	M

Figure 4. A key step in moving lean toward green is to develop a triple bottom line (TBL) plan that links strategic organizational goals with specific process improvement initiatives using a hoshin kanri-type approach.

7. Use the 5Rs to Identify Consumption Reduction Opportunities

The 5Rs are Recycle, Repair, Reuse, Reduce, and Refuse. The waste hierarchy implies that while Recycling is good, Repair, Reuse and Reduce is better, and Refusing is best of all. (See Figure 5.)

The pilot companies found that this approach is best applied to the packaging and ancillary items that are consumed in the process. Like 5S, the 5Rs is a relatively simple concept, but delivers step-jump results in reducing recycling quantities by avoiding over-consumption.

For example, Davey Water Products received components from a Chinese supplier. The packaging materials, made of styrene, couldn't be reused or recycled and were going straight to a landfill. When Davey refused to accept styrene, the supplier changed to a fiberboard end cap, which Davey could recycle. With further changes to the specification, the end cap can now be reused to package the assembled pump and motor. This project, initiated by a shopfloor team, demonstrates three of the 5Rs in action.

8. Understand the Downstream Processes

While lean encourages the understanding of what happens in the customer's downstream processes, there is often little understanding about what happens at the downstream processes of waste collectors.

As already mentioned, Kraft found that the way it adhered labels to jars of product affected the eventual level of glass that could be reused as clear cullet. By walking the value stream to its end, they found that jars that had labels that were difficult to remove were not being recycled. Instead, they were downgraded and stockpiled at the glass recovery and recycling facility.

Further, the effectiveness and much of the cost of recycling comes down to sorting and segregation, rather than collection. These activities can easily be integrated with a 5S program. Segregation also facilitates better measurement of waste (by weight) and aids in identifying the source of the waste. This is an example of lean initiatives having a significant (positive) impact on reducing enviro-waste without a conscious effort.

The 5Rs

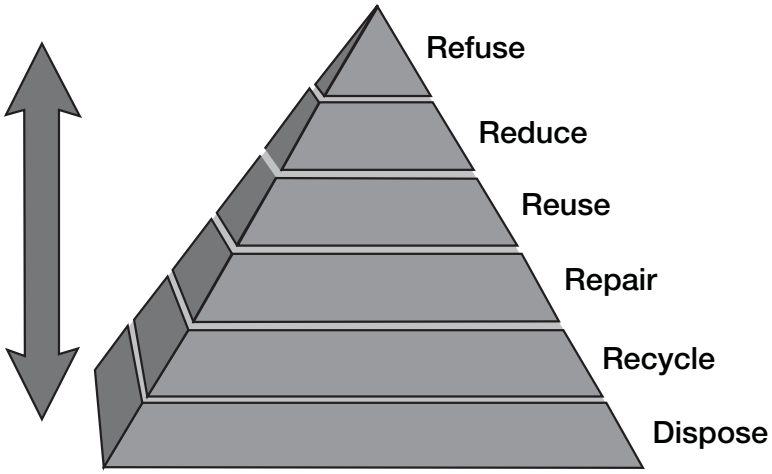


Figure 5. The waste hierarchy shows that while Recycling is good, Repair, Reuse, and Reduce is better, and Refusing is best of all.

9. Redesign the Product and Packaging

Much of the consumption is locked in at the design stages. A "dumpster dive" to audit the waste removal bins frequently finds that the hard waste removed from the operation is either scrap and off-cuts of purchased raw materials, or packaging and other dunnage required for transport of raw materials to the operation.

Sustainability requires a "whole of life" perspective. The product's footprint on the environment is most often largest during the in-use stages of its lifecycle. For example, Davey redesigned a spa bath pump to reduce power consumption by almost 60 percent over the life of the pump. This has had a much greater reduction on overall CO_2 emissions than the emissions from the plant (due to energy consumption).

10. Seek Support of Leaders and Decision Makers

Many sustainability initiatives have grown from the "shop-floor-up." To ensure adequate resources are allocated, and that improvement initiatives are supported, it is imperative that the process improvement champions seek the support of leaders and decision makers, by making them aware of plans and sharing the early outcomes. "We now understand that sustainability is everyone's role — it's not just the role of our environmental manager," said Olex's Fragale.

The Business Imperative

Every indication is that the increasing cost and decreasing availability of all inputs to the value-adding process — raw materials, energy, water — as well as the increasing cost of waste disposal and environmental regulations will dictate many, if not most, future management decisions. Increasingly leading companies understand that becoming green is — or increasingly will be — the source of their competitive advantage. Becoming "green" in this environment isn't as much about becoming more "socially responsible" or environmentally friendly; it's about running a better business.

They also recognize that being lean in the traditional sense does not provide the competitive advantage it once did; it's become a given, a basic requirement for survival. However, by extending lean thinking to include this broader view, companies can maximize the impact of their enterprise

Lean to Green Success

The outcomes achieved in less than 12 months at one or more of the participating *Lean to Green* operations include the following:

- Reduction in waste to landfill by up to 80 percent
- Reduction in energy and carbon footprint per unit by up to 35 percent
- Savings (and donations) of millions of liters of water
- Reduction in transport costs of up to 15 percent
- Reduction in consumption of materials, off-cuts, and toxic chemicals by up to 25 percent.

improvement efforts. Many of the lean tools easily serve as a way to understand and reduce an operation's consumption and waste output — which means reducing costs. Furthermore, just as lean enables green initiatives, green can re-energize lean. "By doing green, we are becoming lean," said Matt Nettleton, continuous improvement manager of Corex Plastics. "There is much more traction with our people."

Embedding lean and green practices within the culture of an operation also keeps the focus on the business, rather than on scrambling to meet whatever happens to be the environmental or financial concern of the day. While emphasis on reducing water consumption waxes and wanes with the level of local rainfall, the urgency of reducing fuel or raw material rises and falls with inevitable price fluctuations, or the attention given to environmental regulation shifts with the political winds, an organization focused on lean and green practices steers a steady course.

The same can even be said for global warming which appears to have taken a back seat on the agendas of many companies and indeed countries, as they wrestle with the more immediate global financial crisis. Until recently, many organizations were being "pushed" to focus on reducing their carbon footprint. Ironically, the area to focus all improvement efforts needs to be on reducing consumption and costs.

With lean as a foundation, and by overlaying an understanding of how each of the seven wastes translates into consumption wastes, an organization's consumption of key resources will significantly decrease, and ultimately so too will their carbon footprint, providing a consistent competitive advantage. This approach not only helps guide the business through the short- to mid-term financial crisis, but places the organization in a strong position for when the global warming issue returns to the top of the agenda.

Ian Young is program director of the Manufacturing Best Practice Program and facilitates a Lean to Green consortium of manufacturing organizations in Melbourne, Australia. A case study of the four pilot companies was presented at the 2008 AME Toronto conference. *The pilot Lean to Green programs were supported by Sustainability Victoria and South East Business Networks.*