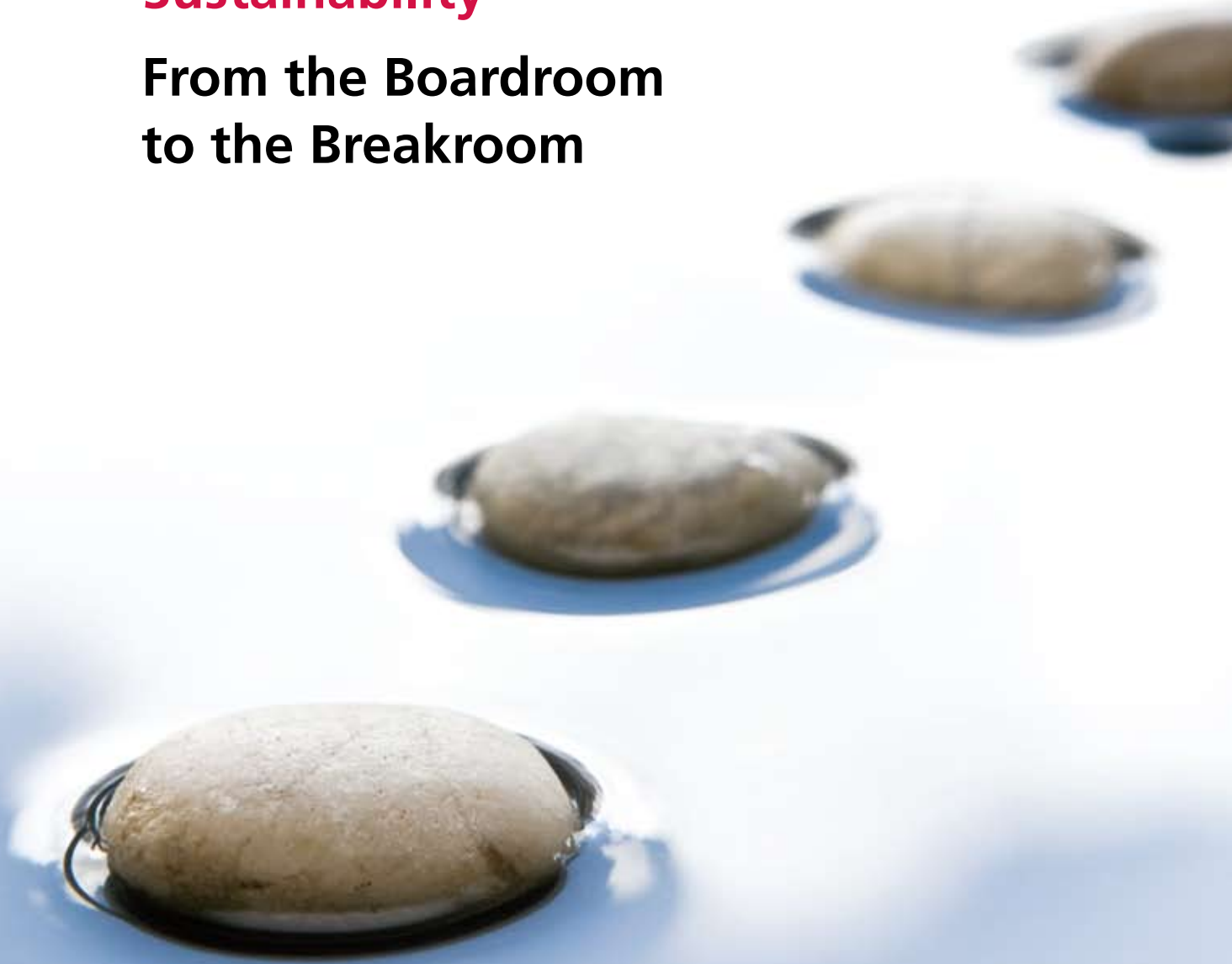


# Sustainability

## From the Boardroom to the Breakroom





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# Executive Summary

Many consumer products companies have now started evolving beyond the initial surge of packaging and varied disjointed low-hanging-fruit projects. With a CEO-led vision of becoming more environmentally responsible, many consumer products companies have also started to realize that manufacturing and distribution operations represent a major opportunity to achieve substantial gains in sustainability.

Moreover, improving sustainability in manufacturing and distribution via process changes represents a major opportunity to also deliver improved financial performance.

The opportunity is truly vast. Among all industries, the consumer products sector is among the greatest users of water, energy, chemicals, physical space and people, and it is one of the largest contributors to solid waste. Not surprisingly, consumer products remains one of the biggest opportunities for gains in sustainability.

## Process Pitfalls in Packaging and Pallets

To date, much of the focus on sustainability has involved changing to lighter-weight containers, such as thinner-wall bottles and lower-gauge secondary packaging. Some packaging initiatives have delivered excellent results, which have been widely lauded. However, few have heard about the many seemingly simple sustainability efforts that have delivered “unintended consequences” – consequences that end up hurting both profitability and sustainability. For example, difficulties running lighter-weight materials on existing manufacturing lines have also yielded rising damage and unsaleable losses that add to waste and energy inefficiency. This paper addresses solutions to such obstacles to achieve fully effective sustainability.

Another major sustainability opportunity involves order fulfillment. As customers (retailers and wholesalers) press ever harder to receive frequent deliveries of mixed pallets that exactly meet their needs, distribution processes become stressed. In such cases, old palletizing and transportation management approaches have become inadequate. This paper addresses additional opportunities to meet changing customer needs in a manner both more sustainable and more cost-effective.

## Manufacturing that’s Lean – and Clean

As companies seek better ways to achieve sustainability gains beyond packaging, many find that manufacturing and supply chain operations offer a “target-rich environment.” This paper offers some practical ways to achieve cost-effective sustainability goals in the short and long term. Many of the actions require little, or no, capital expenditure. Many actions have very practical, proven approaches.

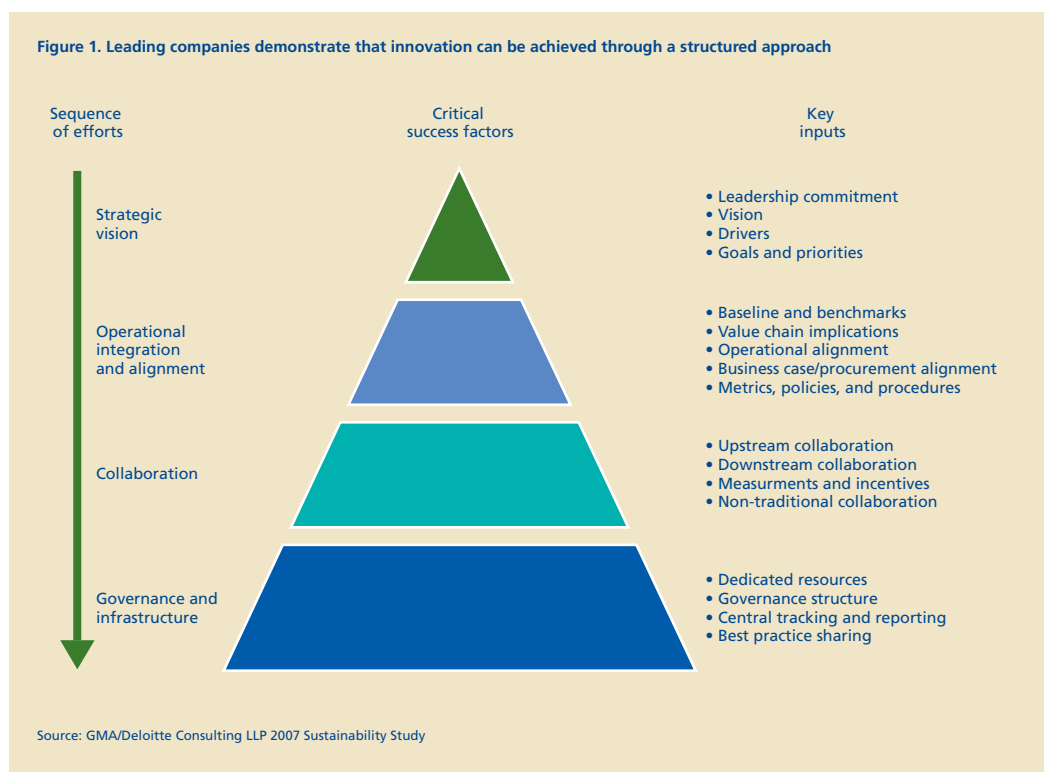
In the short term, companies need to evolve their lean manufacturing programs into lean-and-clean manufacturing programs, which add a sustainability focus. Although lean manufacturing advances typically enhance sustainability, they typically miss key areas of sustainability. So lean-and-clean becomes important and typically results in better performance improvements than Lean alone.

In the longer term, enhancements in processes, including facility layout, control and equipment, greatly improve the sustainability – and overall efficiency – of an operation. They reduce use of energy, water, chemicals, people and floor space. Recent advances in palletizing and supply chain planning have also enabled companies to satisfy their customers in a much more sustainable way.

## Aligning Sustainability Vision with Planning Policies

While many sustainability gains require little or no capital expenditure, new or retrofitted lines do. Unfortunately, the alignment between sustainability vision and daily practices at many companies has not become effective in all functions. Some companies encounter a pitfall with existing policies for development of business cases and purchasing that do not consider long-term costs and benefits of sustainability. These must be changed to avoid costly mistakes. Total cost of ownership and hard-to-isolate benefits have become key elements of decision making that must become aligned with senior leadership's vision.

Many companies have passed beyond the stage of Strategic Vision (see figure 1 below) and started implementing a varied range of "low-hanging-fruit" projects that are usually disconnected. Now companies face the need to bring operational integration into alignment with the vision. The greatest gains over the next few years will come when companies extend sustainability from the boardroom to the breakroom.



By learning from recent pitfalls, consumer products companies can achieve lasting gains in sustainability. With a little extra effort, helping the planet can also help shareholder value.

# Introduction:

## Trends in Sustainability Point to Operations

In June of 2007, Deloitte Consulting LLP, in partnership with the Grocery Manufacturers Association (GMA), published a pioneering study on Sustainability within the consumer products and retail industries. The findings indicated that companies were aggressively undertaking sustainability initiatives. While there were many motivators, most companies were undertaking sustainability for their own efficiency and risk management.

In the intervening year, five high-level trends continue to shape sustainability in consumer products. They are:

1. **Consumer demands** – that insist upon sensitivity to environmental concerns in visible ways. However, a majority of consumers still insist upon price and convenience, which can detract from sustainability goals
2. **Customer demands (e.g., Retailers)** – that press for greater packaging innovation and packaging reduction that also maintain goals for reduced total costs. However, customers are also demanding more customized shipments, special sizes, and improved service levels, which again, can detract from sustainability goals
3. **Network complexity** – which is caused by brand acquisitions, evolving distribution channels, direct store deliveries (DSD), re-packing, SKU proliferation and changing merchandising at the retailers, inhibits sustainability goals
4. **Economic uncertainty** – that puts a higher premium on cost reduction without incremental capital investment, which can inhibit sustainability gains from plant improvements – and that places a priority on inventory reduction without a decrease in service levels, which leads to more frequent, smaller and less-emissions-efficient deliveries
5. **Undefined metrics** – that inhibit sustainability efforts since there are neither standards nor common methodologies for measuring and tracking the progress of sustainability initiatives

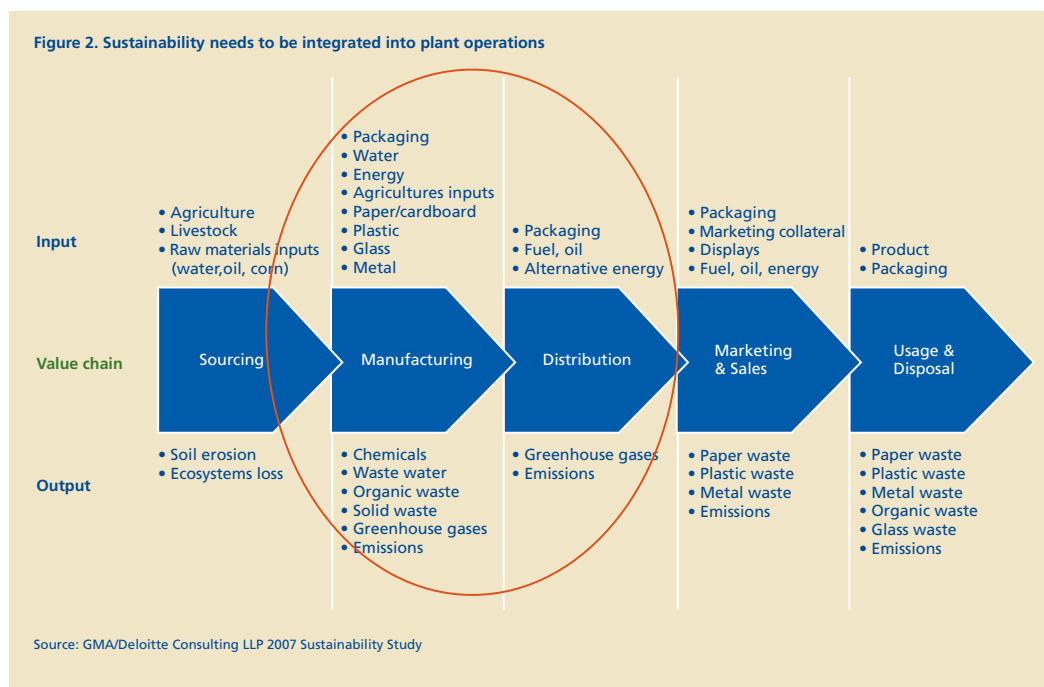
The original GMA/Deloitte Consulting study highlighted that significant progress had been made on sustainability, but that the majority of the effort was expended on articulating high-level goals and undertaking specific (usually disconnected) initiatives. Very few companies had undertaken the work of integrating sustainability across functions. On numerous occasions, we heard that while CEOs had articulated a vision, little had been done to determine the true viability, opportunities and potential risks associated with sustainability. On a large number of occasions, we heard that “unintended consequences” occurred, especially:

- Sustainability actions that adversely impacted the broader operational value chain
- Alternative packaging initiatives that caused production and damaged product losses

Unfortunately, Plant Operations has been largely ignored in sustainability initiatives.

To help companies address these operational implications, the GMA partnered with Deloitte Consulting, the Packaging Machinery Manufacturers Institute (PMMI) and Hartness International to create: "Sustainability: From Boardroom to Breakroom." This report is intended to start addressing open questions and provide a "roadmap" to help avoid "unintended consequences" associated with Plant Operations.

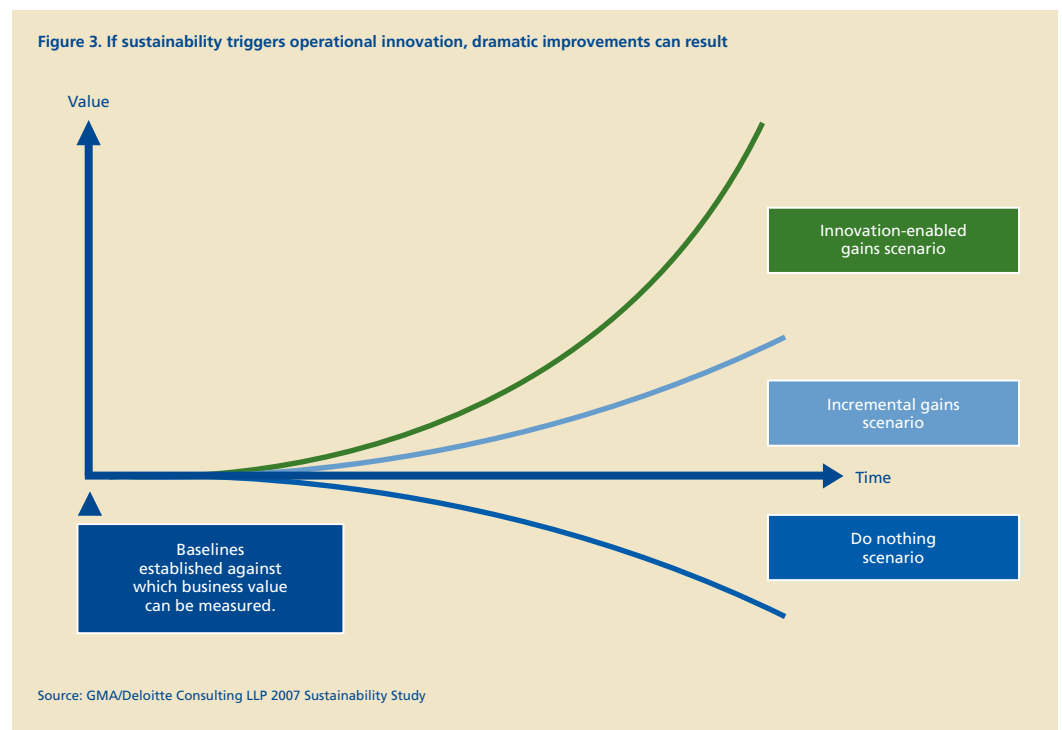
The authors would like to thank Grocery Manufacturers Association (GMA) for their vision and commitment in providing this information to their members.



# The Change Imperative

Sustainability is here to stay. Consumers and retail customers insist upon it. We owe it to our children. It makes sense to take action – and most companies have.

To date most sustainability actions have been focused on quick wins and packaging, but for many of those past initiatives to succeed, action in Plant and Distribution Operations is required. In the future, most sustainability initiatives need to be related to Plant and Distribution Operations. That's where the majority of consumer products resources (e.g., materials, water, packaging, energy) are expended; that's where the majority of sustainability efforts will have the greatest impact.



Moreover, even though much sustainability effort needs to be directed toward operations, the entire company will benefit.

Not surprisingly, a growing number of consumer products companies have started focusing sustainability initiatives on operations. They realize that manufacturing and distribution processes have a far greater impact on the company's economic, social and environmental performance than stand-alone finished product or packaging initiatives.

Operations process improvements can impact every part of the enterprise. Unfortunately, many managers neglect to evaluate all the benefits of these initiatives, including:

- **Enhancing eco-efficiency** – Reducing inputs of limited raw materials or fuel consumption, reducing waste production and utilizing by-products from other industries, all of which allow companies to cut costs
- **Improving product added value** – With a sustainability approach, companies can often expand some products' value propositions
- **Creating new market opportunities** – Sustainability successes facilitate expansion into new countries, regions or market segments (e.g., the 38 percent of consumers who buy pro-environmental, healthier foods and beverages)
- **Strengthening management reputation** – Socially responsible management strengthens corporate culture, improving employee loyalty and attracting high-potential new employees
- **Improving brand reputation** – A proactive sustainability strategy helps companies keep their “license to operate”, and improve their corporate image and brand value

Some leading managers are now discovering that major sustainability gains comprise equal parts efficiency gains and enabling innovation. For example, much larger gains in sustainability – and gross margin – occur when:

- Efforts to reduce resource consumption yields sustainable line designs that also cut downtime and labor
- Efforts to meet customer requests for custom pallets yield reduced transportation and compliance costs
- Efforts to offer lighter and more sustainable packaging yield more efficient manufacturing lines

While this broad range of company-wide benefit stems from sustainability efforts, many managers associate sustainability only with “eco-efficiency” and link it with on-going Lean or Six Sigma initiatives. While cost and efficiency is certainly an important aspect of the change imperative, it is not the only one, and part of integrating operations with the sustainability vision will entail educating managers about the breadth of sustainability benefits.

There are undoubtedly many sustainability improvements that require little or no capital expenditures; however, the largest benefits will occur when managers think not just about another way to save, say energy, but about process innovation.

# Sustainable Packaging Impacts Operations

Pressures from both consumers and retail customers have challenged consumer products companies to demonstrate their commitment to sustainability in the most visible way – through their product packaging. Moreover, the challenge continues to grow. While consumers want reduced environmental impacts, they also buy more ready-to-eat and single-serving packages, which increase the volume of packaging – and the sustainability challenge.

Retailers and consumer products companies have responded with more sustainable packaging designs, materials and formats. These initiatives represent the visible, relatively easy gains (or “low-hanging fruit”) of the sustainability movement. Companies seek packaging that reduces the volume of material that should be recycled – and also that allows shipping more products per truckload, which yields savings in cost and emissions.

However, these changes in packaging have led to increased complexity that has often offset sustainability gains with inefficiencies in production, greater unsaleables and higher energy consumption. In some cases, the net effect from improved packaging may be negative.

#### Figure 4. Eight Criteria for Sustainable Packaging:

1. Is beneficial, safe and healthy for individuals and communities throughout its lifecycle
2. Meets market criteria for performance and cost
3. Is sourced, manufactured, transported and recycled using renewable energy
4. Maximizes the use of renewable or recycled source materials
5. Is manufactured using clean production technologies and best practices
6. Is made from materials healthy in all probable end-of-life scenarios
7. Is physically designed to optimize materials and energy
8. Is effectively recovered and utilized in biological and/or industrial cradle-to-cradle cycles.

\*Source: SPC ([www.sustainablepackaging.org](http://www.sustainablepackaging.org)), a non-profit industry working group and a project of GreenBlue.

Companies can ensure that their sustainability gains in packaging are increased by manufacturing improvements, rather than diminished by them. In addition, consumer products executives will find that their manufacturing operations can yield even greater improvements in sustainability than packaging – while also yielding cost savings.

At many companies, key areas of additional gains will come from advances in packaging materials and adhesive application processes.

## Lightweight Containers Deliver Heavyweight Hassles

Numerous consumer products manufacturers have reduced the weight of packaging (e.g., lighter plastic bottles) to use less material and reduce transportation costs. However, the traditional marketing and new product development teams that design packaging are challenged by consumer, customer and regulatory requirements, and may not necessarily work with the Production Department and Plant operations to test and measure the net impact of new packaging to the product lifecycle.

Unfortunately, lightweight containers often require different handling. Some traditional operations can damage the lightweight containers, increasing unsaleables, waste and energy wasted producing damaged product.

Manufacturers and retailers seek sustainability improvements in customer-facing packaging and, secondary and tertiary packaging materials. Clearly, substantial opportunities lie in improved outer packaging – as long as companies simultaneously adjust manufacturing/distribution processes to maintain high standards for low unsaleables, pilferage and handling efficiencies.

## Reducing Harmful Materials

A key sustainability goal involves decreasing the use of harmful materials (e.g., glues, resins), and more sustainable alternatives to traditional adhesives and paperboard are emerging quickly.

Some companies are evaluating a new paperboard for sustainable packaging. Instead of using wax or clay-coated paperboard, new paperboard has a coating made of recycled PET bottles, which provides the barrier protection desired. These new packaging materials also can increase the performance of adhesives because bonding can be achieved at lower temperatures and with less adhesive material.

Additionally, changing from virgin paperboard to recycled paperboard dramatically reduces the amount of water needed in the production process. By taking an existing packaging design, changing base materials and using reduced quantities of adhesives, sustainability gains can be achieved with only modest investment.

Some companies are investigating starch-based adhesives to replace the petroleum-based resins currently in use. Among these so-called “bio-polymers,” polylactic acid (PLA), or polylactides derived from corn are being investigated as alternative, renewable feedstocks for the production of a range of packaging formats. These polylactides (PLAs) may save money by replacing oil with less expensive and more widely available and eco-friendly raw materials, such as corn and sugar cane.

Foaming adhesives can lower adhesive density and requires less adhesive. However, the proper adhesive must be selected to avoid pop-opens later in the distribution chain. In addition, more advanced adhesive equipment can reduce energy consumption and conserve the amount of adhesive laid down by dispensing glue in a pattern of dashes - - - - - rather than in a solid line -----.

While these changes can lower emissions of greenhouse gases, improve composting and reduce energy consumption, the changes, if not monitored carefully, can have some unintended consequences: increases in energy and material resource consumption. To ensure that their sustainability programs’ gains are sustained, leading companies are involving their Operations functions in implementing sustainable packaging process initiatives.

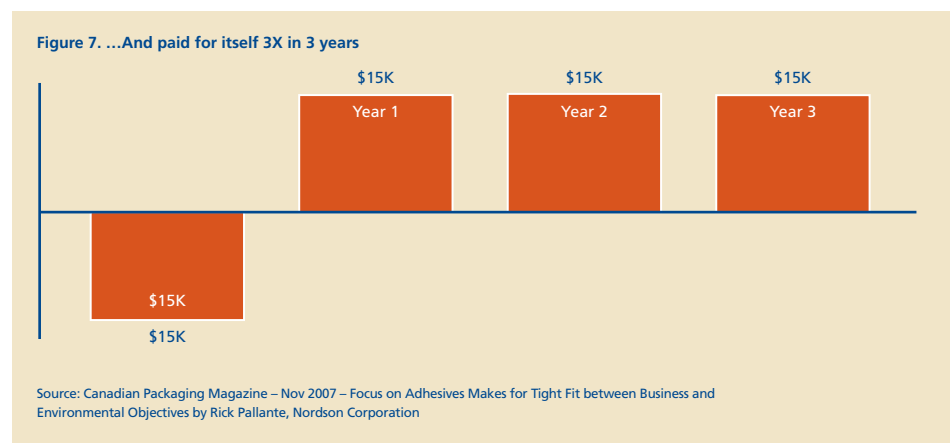
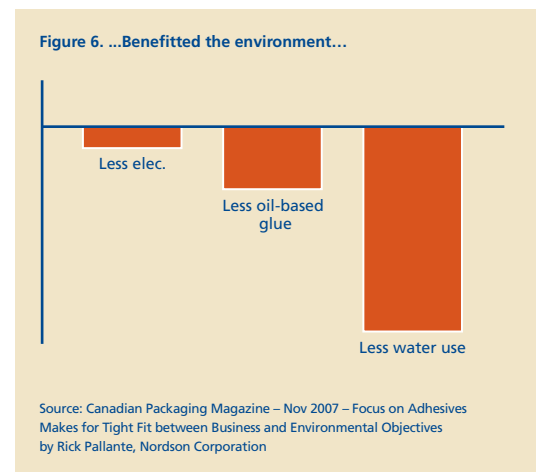
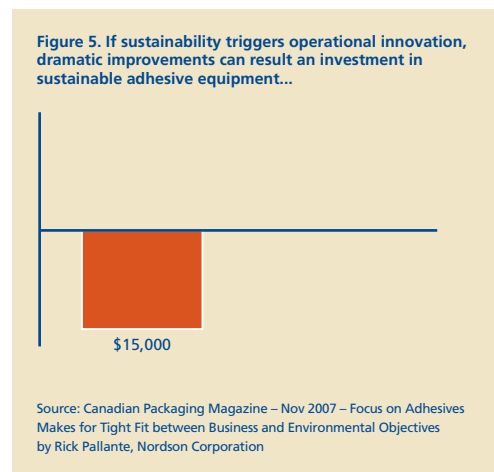
## Case Study – Reducing Adhesives in Packaging

When a leading producer of quality biscuits, cookies and crackers launched an initiative to improve sustainability, it improved its manufacturing process – delivering sustainability savings and cost savings.

The bakery company dramatically reduced the amount of adhesive needed to seal packages for multiple lines of cookies and biscuits. Rather than using a long, continuous bead of adhesive, the company applied “stitching,” which uses shorter, intermittent beads that produce the same tight seal. This reduced adhesive consumption by 70 percent. The savings paid for the new packaging process in the first year.

Using less adhesive saved 35 barrels of oil, a significant amount of energy for heating and running the line, plus over 260,000 gallons of water previously used for traditional package gluing. This is in addition to the savings in packaging material and recycling delivered by changing its package design.

The bakery experienced how changes to package designs – and the package production process – creates fully “intended savings” and avoided the “unintended consequences that might have occurred by focusing simply on materials consumption and not considering the process implications of the change.



# Long-Term Sustainability Gains in Plant Operations

Many short-term opportunities help achieve sustainability goals while providing good returns in manufacturing performance, but the largest gains can be achieved when an opportunity arises to design new lines or retrofit older ones. New innovations can be incorporated to achieve substantial gains in sustainability. Often, innovative line design and improvements in process equipment require significantly fewer resources to operate while still producing the same amount of product at the same (or higher) efficiency.

The prime success factor in new line design involves a more holistic approach that anticipates future changes as well as current requirements. A lean line design process that considers current advances in changeovers, line lubrication and remote line monitoring can deliver long-term gains in sustainability.

New and redesigned plants allow starting from a blank sheet, but retrofitted lines provide another excellent source of cost-effective major gains in sustainability and efficiency. Not surprisingly, some of the world's leading consumer products companies are conducting plant efficiency and sustainability studies that identify opportunities. These studies analyze line performance, control and resource utilization. They use simulation models to identify areas for improving sustainability and cost effectiveness – and also to test for unintended consequences, such effects of new, lightweight containers or the elimination of line lube.

## Lean Line Design

Sustainable manufacturing line design requires a different approach. The traditional design approach starts with conveyor requirements and then fits operations into the conveyor layout. Sustainable line design reverses that order. Sustainable design steps are:

1. Determine the major equipment requirements based on internal customers' (i.e., product/brand manager, marketing) and external customers' (i.e., retailers, consumers) needs, including current and probable range of future production levels, and product and packaging sizes and formats
2. Lay out the equipment, minimizing floor space to reduce the number of people and resources needed to run the line
3. After establishing the equipment layout, design conveyor systems to minimize the number and size of conveyors and cut energy use. Using the new accumulating conveyor systems eliminates inefficient mass flow conveyors while buffering critical operations to protect them from line stoppages
4. Consider breaking the traditional paradigms of, for example, a bottling line's flow of make, fill, cap, label, pack and palletize. Alternatives might reduce the energy and resource use. For example, in cold-filled bottling, labeling bottles immediately after the bottle maker might eliminate pre-labeling drying, reducing energy for hot drying air and air conditioning. Also, consider advances in change parts, line lubrication and remote monitoring
5. In an iterative process, return to step two to improve the equipment layout, then back to the conveyor layout to optimize the total design

## Change Parts

When considering possible sustainability savings, most managers think of where they see resources being used the most. However, perhaps the greatest waste of resources is operating an entire, staffed line that is not producing any product. Minimizing downtime helps maximize sustainability. It also helps increase shareholder value.

Change parts (i.e., machine parts or components needed to run a different product or package than the one currently on line) accommodate periodic changes in product sizes and types on a production line. Each time a different product is introduced to the line, many of the major equipment items have to be reconfigured to handle that change, resulting in lost production and wasted plant resources during the downtime.

Some companies are now designing lines that require little or no downtime to accommodate changes. The re-configurations occur automatically. For equipment where change parts cannot be eliminated completely, advances in design allow a reduction in changeover time and a faster return to full production after a changeover. This reduces or eliminates wasted energy, product and other resources during changeovers – a clear sustainability gain with an economic ROI as well.

## Line Lubrication

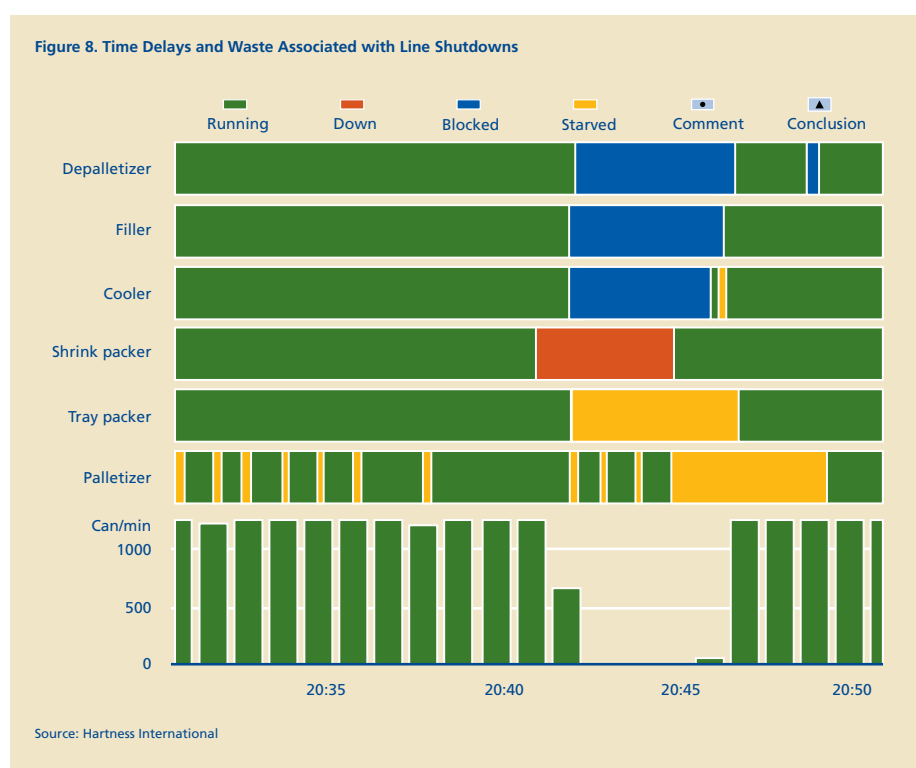
A major opportunity to conserve resources involves line lubrication. Traditional bottle, jar and can lines require line lubrication, usually a water and soap mixture, to allow containers to be conveyed flow smoothly through the line. This technique uses large quantities of water and soap, which become effluent. One three-shift soft drink bottling plant can easily generate 20 million gallons of line lubrication wastewater per year. Advances in dry lube and line design and control now enable substantial gains in sustainability by reducing water for lubrication from hundreds of gallons per shift down to mere ounces.

Dry lubrication products are biodegradable and provide the same lubrication as water/soap mixture in an environmentally friendly way.

Another solution eliminates the need for containers to slide over the surfaces of the conveyors. New line accumulation methods and advances in line control (that start and stop conveyors in synch with the operations of filling, capping, labeling, etc. stations) help prevent containers from jamming, thus eliminating the need for lubrication. This approach reduces energy and wastewater use simultaneously.

## Remote Monitoring

Another cause of wasted environmental and productive resources is line shutdown. When equipment or systems fail, the outages often cause days of waste, not just minutes or hours. Some leading consumer products companies are using new remote monitoring tools to scrutinize and troubleshoot line operations continuously – minimizing downtime and improving sustainability. By sensing impending trouble and troubleshooting problems much more quickly than before, remote monitoring avoids some shutdowns and reduces the downtime on others. It also reduces the delay and cost of travel to the plant by external vendor experts who diagnose and repair the problems.



Remote monitoring interfaces line monitoring and control systems to plant networks and the Internet so distant experts can diagnose or even predict emerging problems. The system automatically alerts staff to stoppages as they occur or when equipment is about to run out of material. By tracking problems historically, the systems enable improvement teams to identify and solve persistent problems for continuous improvement.

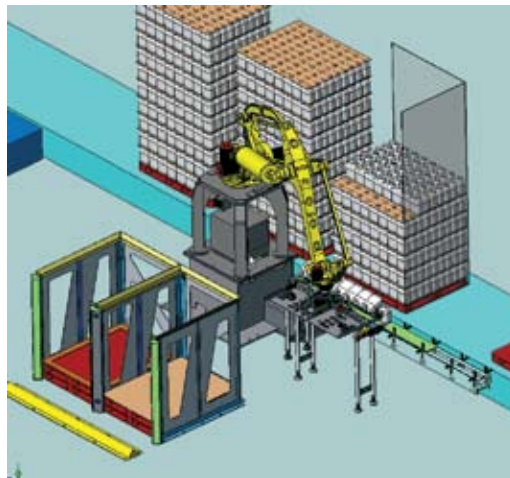
Video recording recreates critical events to help understand what happened leading up to and causing a downtime event, accelerating diagnosis and solution of costly problems.

By anticipating and accelerating solutions to downtime and persistent problems, remote monitoring greatly contributes to both sustainability and cost-effective operational efficiency.

## Robotic Depalletizing

For difficult-to-handle and unstable materials (e.g., tall, lightweight containers) a robotic depalletizer provides a cost-effectively sustainable solution. Even when it is not as fast as a conventional depalletizing approach, the robot's savings in damaged product, manpower, compact footprint and flexibility to depalletize any shape container with zero changeover time produces a more sustainable solution.

Figure 9. Sample Robotic depalletizer



Source: Hartness International

## Pet Food Container Depalletizing Equipment

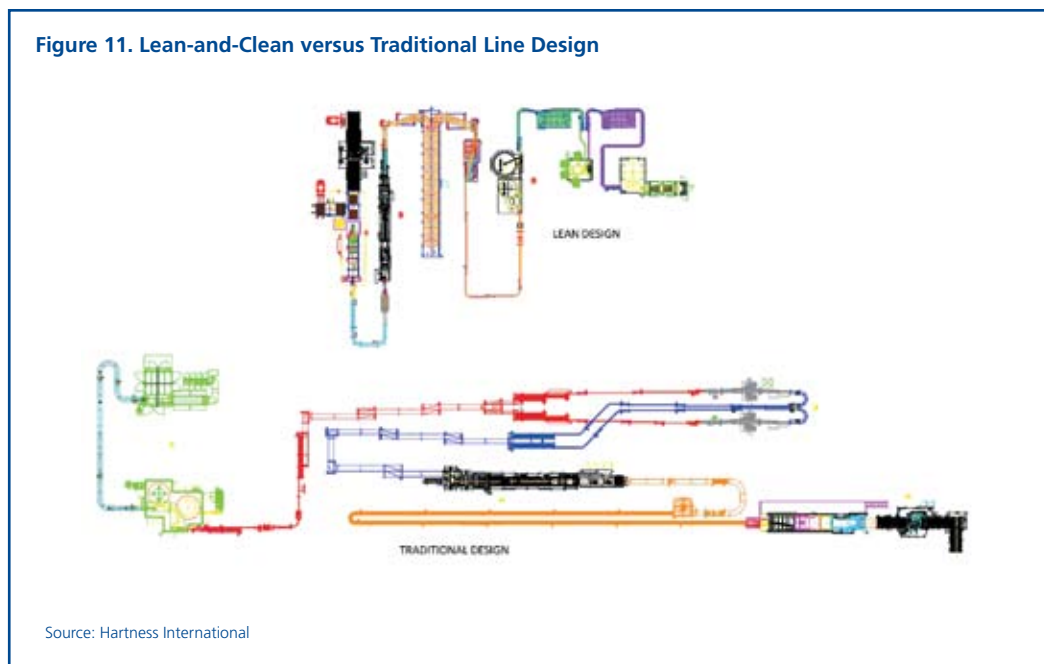
Figure 10. Sample Pet Food Container Depalletizing Equipment



Source: Hartness International

## Case History – Traditional Vs. Lean-and-Clean Line layouts

The differences between Lean-and-Clean and traditional lines become apparent when contrasting a recent traditional design for a cold-fill juice line with a recent Lean-and-Clean design. Both have the same product throughput using PET bottles.



**Figure 12. Comparison of traditional to lean-and-clean design**

Description	Conventional line		Redesigned line		Savings
	Value	Cost	Value	Cost	
Floor space	32,346 ft <sup>2</sup>	\$9.7MM	19,232 ft <sup>2</sup>	\$5.8MM	41%
Hvac costs	808,650 ft <sup>3</sup>	\$58,000	480,800 ft <sup>3</sup>	\$34,600	41%
Labeling room A/C	4,500 ft <sup>3</sup>	\$324	0 ft <sup>3</sup>	0	100%
Motor electrical load	115 KWH	\$51,485	59 KWH	\$26,600	48%
Operator costs	4 operators	\$240,000	3 operators	\$180,000	25%
Soap vs. Dry lube for conveyors	4500 gal.	\$24,750	100 gal.	\$15,000	39%
Cleaning solution	11,700 gal.	\$175,500	2,500 gal.	\$37,500	79%
Water for conveyor lube	399,300 gal.	\$2,196	12,000 gal.	\$66	97%
Water for cleaning	50,000 gal.	\$275	25,000 gal.	\$138	50%
Water treatment load	465560 gal.	\$9,311	39,500 gal.	\$790	92%

Source: Hartness International

Advantages of the more-sustainable Lean-and-Clean design include:

- Dramatic reductions in consumption of water, energy and plant space
- Minimal conveyor transports product between operations, reducing use of motor and electricity
- Compact design requires only three operators versus four for traditional
- Line handles lightweight bottles better via layout and robot
- Labeling upstream of the filler eliminates gas driers and extra air-conditioning since already-dry bottles are easier to label
- Robotic palletizing at floor level improves reliability without a dedicated operator
- Greatly reduced floor space requires reduced plant resource consumption
- Improved production efficiencies for improved sustainability and shareholder value

# Short-Term “Lean & Clean” Gains in Plant Operations

Today, leading consumer products managers are re-thinking lean operations to include sustainability – and thus inventing “Lean-and-Clean.” Varied individual innovations at diverse consumer products companies can be aggregated into a new philosophy of lean-and-clean, which is where we believe consumer products operations will be evolving over the next several years. By using Lean techniques – plus Clean ones – consumer products companies can achieve greater sustainability goals simultaneously with improving operating performance.

Among the innovations that comprise the new Lean-and-Clean operations are:

- Lean’s “7 Deadly Wastes” have become “8 Deadly Wastes” by adding environmental waste
- Environmental waste assessments are being included in value stream mapping
- Lean’s traditional 5S system has become 6S (5S + sustainability)

Moreover, while some lean-and-clean initiatives entail upgrading manufacturing lines and equipment, companies have many other ways to improve sustainability that do not require long-term capital expenditures. Uncovering these short-term lean-and-clean gains starts with recognition of the “8th Deadly Waste” and continues through a four-step process.

## Lean-and-Clean’s 8th Deadly Waste

For years, most manufacturing companies have implemented lean manufacturing techniques, which have also provided some sustainability gains. By its focus on eliminating waste, Lean helps achieve sustainability goals. However, traditional lean manufacturing’s focus on cost reduction and elimination of waste does not investigate all sustainability opportunities. Some tend to be left out. That’s why lean manufacturing techniques need to be updated to become “Lean and Clean” by adding to Lean’s “7 deadly wastes.” Environmental waste becomes the 8th deadly waste.

Figure 13. Sustainability impact of lean manufacturing's seven – now eight deadly wastes

Waste Type	Sustainability Impact
Overproduction	<ul style="list-style-type: none"> <li>• More raw materials consumed in making the unnecessary production</li> <li>• Extra products may spoil or become obsolete requiring disposal</li> <li>• Extra hazardous materials used result in extra emissions, waste disposal, worker exposure etc.</li> <li>• More energy is consumed in operating equipment to make unnecessary products</li> </ul>
Inventory	<ul style="list-style-type: none"> <li>• More packaging to store work-in-process (WIP)</li> <li>• Waste from deterioration or damage to stored WIP</li> <li>• More materials needed to replace damaged WIP</li> <li>• More energy used to heat, cool and light inventory storage and warehouse space</li> </ul>
Transportation and Motion	<ul style="list-style-type: none"> <li>• Emissions from transport</li> <li>• More energy used for transport</li> <li>• More space required for WIP movement, increasing lighting, heating, and cooling demand and energy consumption</li> <li>• More packaging required to protect components during movement</li> <li>• Damage and spills during transport</li> <li>• Transportation of hazardous materials requires special shipping and packaging to prevent risk during accidents</li> </ul>
Defects	<ul style="list-style-type: none"> <li>• Raw materials consumed in making defective products</li> <li>• Energy consumed in making defective products</li> <li>• Defective products may require recycling or disposal</li> <li>• More space required for rework and repair, increasing energy use for heating, cooling and lighting</li> </ul>
Over Processing	<ul style="list-style-type: none"> <li>• More energy consumed in operating equipment related to unnecessary processing</li> <li>• More parts and raw materials consumer per unit of production</li> <li>• Unnecessary processing increases wastes and emissions</li> <li>• Use of right-sized equipment often results in significant reductions in energy use per unit of production</li> </ul>
Waiting	<ul style="list-style-type: none"> <li>• Potential material spoilage or component damage causing waste</li> <li>• Wasted energy from heating, cooling and lighting during production downtime</li> </ul>
Environmental Waste: Lean-and-Clean's 8th Deadly Waste	<ul style="list-style-type: none"> <li>• Excess materials and resource wastes</li> <li>• Energy use</li> <li>• Pollution/emissions output</li> <li>• Scrap and non-product output</li> <li>• Hazardous materials use and wastes</li> </ul>

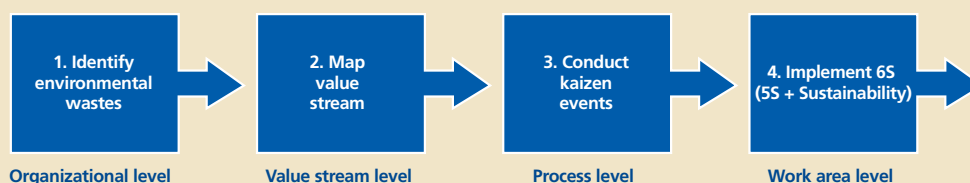
Source: Lean and Environmental Toolkit – <http://www.epa.gov/lean>

Adding sustainability considerations to lean efforts can increase value, accelerate lean implementation, decrease material costs and reduce the risk of compliance violations.

### Become Lean + Clean in Four Stages

To incorporate environmental performance into a lean manufacturing program, focused at each level of the organization, some leading consumer products companies are engaging in four implementation stages.

Figure 14. Title Four Implementation Stages for Lean and Clean Manufacturing



Source: Lean and Environmental Toolkit – <http://www.epa.gov/lean>

## 1. Identify Environmental Wastes

Consumer products managers have long measured product process/recipe inputs and outputs. Now more have started measuring environmental inputs and outputs as well. They have:

- Added metrics to understand the sustainability performance of production areas
- Demonstrated management commitment for expanding lean to encompass environmental performance
- Integrated environmental waste into lean training programs
- Made environmental wastes visible and simple to eliminate using visual controls
- Recognized and rewarded sustainability success

Typical sustainability metrics that enhance lean-and-clean efforts involve:

- Scrap/non-product output
- Materials use
- Hazardous materials use
- Energy use
- Water use
- Air emissions
- Solid waste
- Hazardous waste
- Wastewater

The US Green Building Council and its LEED (Leadership in Energy and Environmental Design) Rating/Certification System provides another resource for identifying environmental wastes and achieving excellence in environmental facility design. Some leading consumer products and retail companies have started using LEED ratings in their sustainability efforts. For facilities that achieve environmental design excellence, it also provides a highly credible independent source for publicizing accomplishments in sustainability.

## 2. Map the Value Stream

Many companies implementing lean use value stream mapping to understand the sequence of activities and information flows used to produce a product. However, conventional value stream mapping can overlook three types of environmental considerations:

1. Raw materials used in products and processes
2. Pollution and other environmental wastes in the value stream
3. Flows of information to environmental regulatory agencies

By expanding the traditional value stream map to include natural resource flows (such as energy and water use) for each manufacturing step, the mapping process can:

- Collect environmental performance data for processes in the value stream
- Identify processes with opportunities for gains in sustainability
- Ensure that changes to those processes are managed effectively

### 3. Conduct Kaizen (Improvement) Events

Kaizen events are team-based activities designed to eliminate waste and make rapid changes. Kaizen teams dive deeply into value stream mapping to identify opportunities for improvement. To accomplish this, leaders/facilitators at events should ask targeted questions such as:

**Figure 15. Key questions for identifying lean-and clean opportunities**

#### **Water Use**

- How much water is used in the process, and how is it used?
- How can you reuse the water and/or reduce overall water use?
- Can you reduce contaminants in wastewater and discharges?

#### **Chemicals and Material Use**

- What types and quantities of chemicals/materials are used in the process?
- How can you reduce the overall quantity and chemicals and materials used?
- Can you switch to less harmful chemicals?
- Can you eliminate any non-value added use of chemicals or materials (excess packaging, unneeded painting, etc)?

#### **Solid Waste**

- What types and quantities of solid waste are generated by the process?
- How can you reduce the overall amount of solid waste generated?
- How can you reuse or recycle solid wastes?
- Is there a local composting facility to which waste can be taken?

#### **Hazardous Waste**

- What types and quantities of hazardous waste are generated?
- How can you reduce the amount and toxicity of hazardous waste generated?
- Can you separate hazardous wastes from other wastes better?

#### **Air Emissions**

- What types and amounts of air emissions are generated by the process?
- How can you reduce the overall amount or toxicity of air emissions?
- How far did vehicles travel to deliver parts and supplies?

#### **Energy Use**

- How much energy is used in the process and how is it used?
- How can you reduce overall energy use?
- Is equipment running or are lights on when not being used?
- Are you using efficient light bulbs?
- Can you save energy by consolidating operations and/or storage space?
- Can you shift to a cleaner source of energy?

#### **Energy – Motors and Machines**

- Are machines left running when not in operation? If so, why?
- Are energy-efficient motors, pumps and equipment used?
- Are motors, pumps and equipment sized according to their loads? Do motor systems use variable speed controls?

#### **Energy – Compressed Air**

- If compressed air is used, are there any leaks in the compressed air system?
- Do compressed air systems use the minimum pressure needed to operate equipment?

#### **Energy – Lighting**

- Is lighting focused where workers need it?
- Is lighting controlled by motion sensors in warehouses, storage areas and other areas that are intermittently used?
- Are energy-efficient fluorescent light bulbs used?

#### **Energy – Process Heating**

- Are ovens and process heating temperatures maintained at higher levels than necessary?

#### **Energy – Facility Heating and Cooling**

- Are work areas heated or cooled more than necessary?
- Do employees have control over heating and cooling in their work area?
- Are exterior windows or doors opened to adjust heating and cooling?

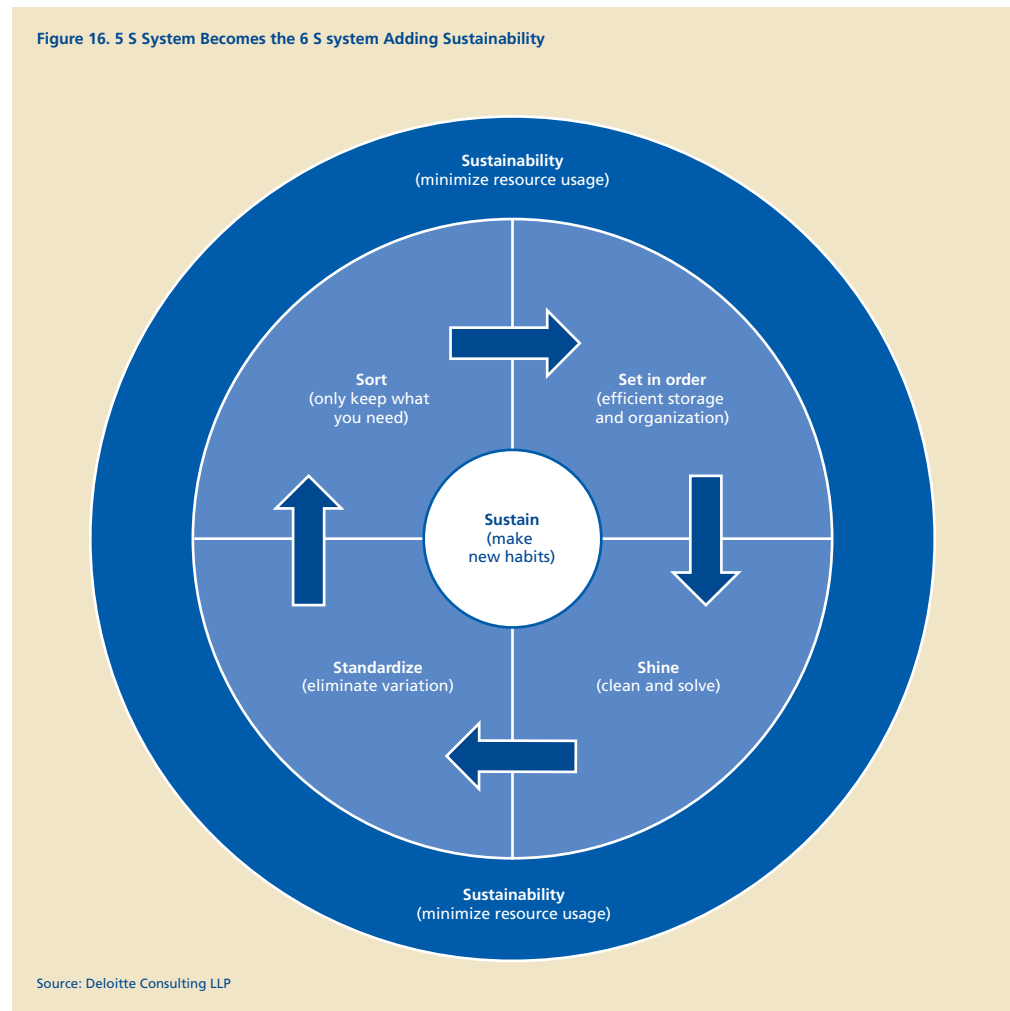
Source: Lean and Environmental Toolkit – and Lean and Energy Toolkit – <http://www.epa.gov/lean>

Traditional Kaizen events may need to be updated to achieve Lean-and-Clean goals, particularly regarding energy wastes. Effective new Kaizen events include:

- Energy Treasure Hunts – plant-wide assessments of energy savings opportunities using a cross-functional team
- Value-and-Energy-Stream Mapping – integration of energy use analysis into the value stream mapping process
- Root-Cause Problem Solving – problem solving tools to find and address root causes of energy wastes and variation
- Energy Kaizen Events – process improvement events that identify and implement employee ideas for saving energy and reducing environmental wastes

#### 4. Implement 6S (5S + Sustainability)

The well-known 5S system was designed to reduce waste and optimize productivity by maintaining a clean, orderly workplace and using visual cues to achieve more consistent results. Just as “Lean” can become “Lean-and-Clean,” the famed 5S system can become the 6S system. The 6th S stands for sustainability.



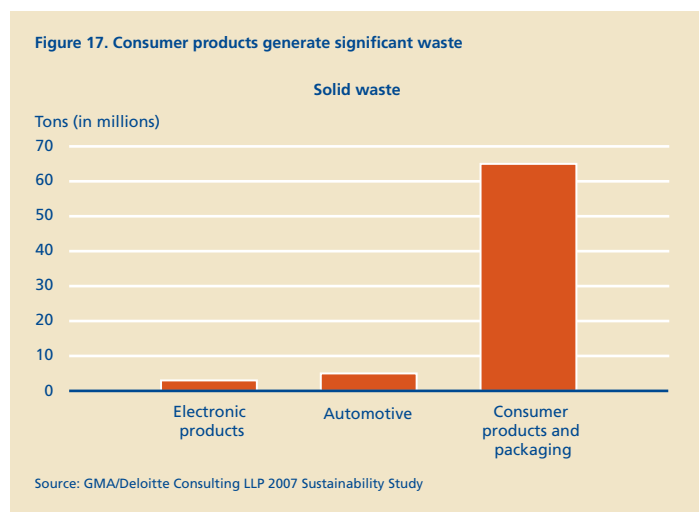
## Food & beverage company builds on all 6 pillars for sustainable savings

By incorporating environmental and sustainability issues into its 5S program – making it a 6S initiative – a food and beverage manufacturer eliminated substantially more waste than would have otherwise even been considered. For example, by asking the right questions, managers at the food and beverage manufacturer significantly reduced the amount of water used during clean-in-place operations. Previously, water had been left running during set-up. In addition to saving water, the project reduced overall set-up time and delivered ongoing savings in labor, asset utilization and energy.

A reference that illustrates lean-and-clean techniques for reducing energy usage and maximizing value delivered to the customer is the EPA's "Lean and Energy Toolkit".

## Consumer Products Manufacturing Has a Major Sustainability Opportunity

Consumer product businesses have a large environmental footprint. Consumer products companies use more natural resources than most industries, and they use large amounts of energy and chemicals as well. Moreover, consumer products and packaging industries stand among the largest contributors to solid waste.



The evolution of traditional consumer products manufacturing indicates there are substantial opportunities for sustainability gains.

Traditional consumer product manufacturing lines occupy large amounts of floor space, and have large buffers between operations to protect each operation from downtime upstream or downstream. Historically, consumer products lines were not designed with sustainability in mind. They were designed for reduced initial capital cost and usually have been retrofitted many times for new products, containers equipment upgrades, etc. Typically, changeovers to run the next product entail significant, costly downtime.

Moreover, since the people responsible for purchasing capital equipment are generally not those responsible for operating it or accounting for the operational costs of commodities, consumer products manufacturing lines can be heavy users of energy, water, people and other commodities. Consequently, consumer products manufacturing encompasses a broad range of sustainability opportunities.

# Sustainability

## Impacts Distribution/ Fulfillment Operations

The two greatest consumer products expenditures of environmentally sensitive resources are for manufacturing product and transporting it. Consumer products businesses operate one of the world's largest sources of fuel consumption: distribution of product from harvest to plants and then to distribution centers (DCs) or stores. Consumer products distribution/fulfillment constitutes one of the world's largest opportunities for gains in sustainability.

To the degree consumer products businesses can ship precisely what customers need to where it's needed when it's needed, they advance sustainability. To the degree that unnecessary handling, storage and re-handling of product can be avoided, they advance sustainability. To the degree consumer products businesses can avoid unnecessary truck miles, they advance sustainability.

Three emerging initiatives enable consumer products businesses to manage distribution and fulfillment to achieve major sustainability gains while reducing transportation and handling costs across the entire supply/demand chain:

1. Shipping the exact inventory that retail customers need while eliminating extra handling, storage, and re-handling of product from the entire supply/demand chain – producing “rainbow” (mixed product) pallets in a cost-effectively sustainable manner (robotic palletization)
2. Eliminating one entire leg of truck transportation that wastes immense amounts of fuel, generates added emissions and runs up costs – the return of empty trucks after they make a delivery (empty miles reduction)
3. Eliminating another entire leg of truck transportation that wastes large amounts of fuel, emissions and costs – the travel from port of entry to the manufacturer's distribution center for globally sourced products (DC By-Pass)

A select number of visionary consumer products executives see beyond their own company's perspective to the bigger objective of getting product to consumers at the best possible balance of sustainability and cost. They see not just the consumer products company's costs, but across the total supply/demand chain from plant to store. They foresee a supply/demand chain in which all tasks are completed at the location where they can be performed most cost effectively and in which unnecessary tasks are eliminated. They see beyond the age-old struggle between a manufacturing perspective that wants to produce and ship in the cheapest way for them and a retail perspective that wants to lower inventories by ordering only what will be needed to serve consumer demand until the next shipment. These visionary executives realize that shifting a traditionally retail task to the manufacturer's DC makes sense if the manufacturer can perform that task more efficiently.

## Robotic Palletization

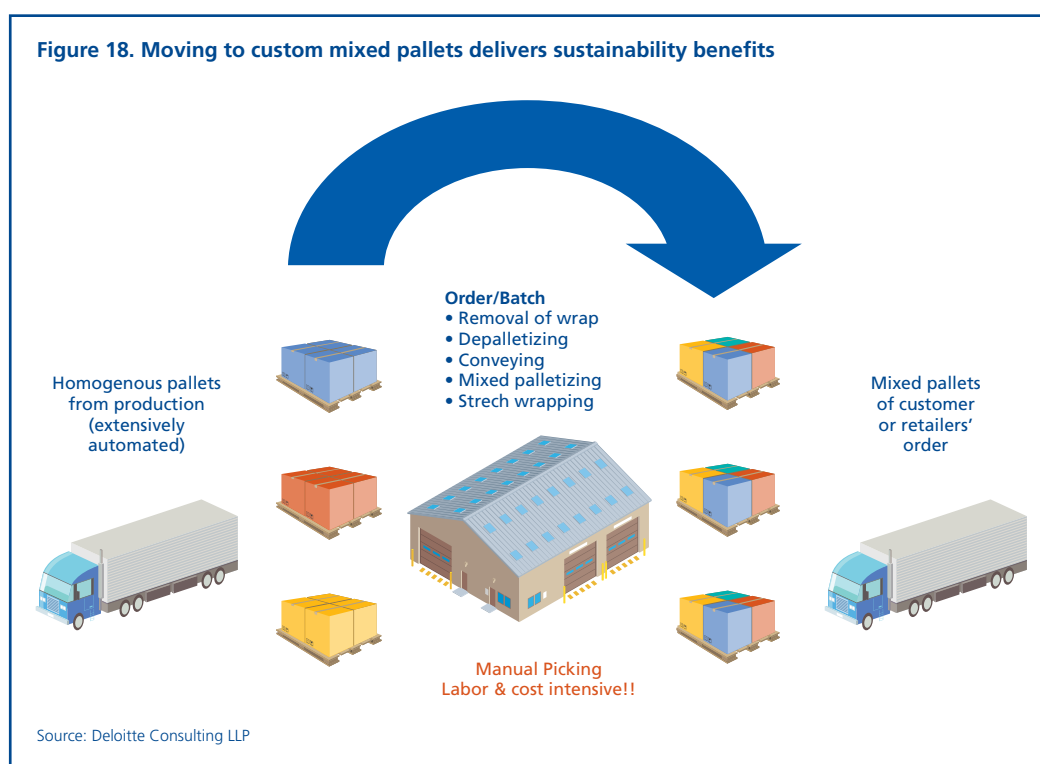
Retailers place orders for custom, built-to-order, mixed pallets matched to the individual patterns of consumer demand and promotional display at their stores. Such orders minimize retail inventories and handling costs. Retailers also want smaller case sizes, reduced secondary packaging and more frequent shipments.

When retailers receive full pallets of one SKU for anything other than the fastest moving SKUs, they often have to receive, break down, store, re-pick, re-palletize and re-ship to stores. If the products had been palletized correctly for the store the first time, much of the intermediate handlings and re-work could be eliminated – delivering sustainability and cost savings from the perspective of the total supply chain leading to the consumer. Therefore, retailers demand custom-mixed pallets. Retailers are demanding.

When excess inventory arrives at stores, it often means the stores' back rooms get clogged. Studies show that such excess inventory results in *higher* stockouts at the shelf because store associates cannot find items easily enough. This hurts manufacturers as much as retailers.

The end result of mixed pallet orders is stress placed on many consumer products manufacturers' order fulfillment processes. Manufacturers have traditionally shipped single-SKU pallets, preferably in full truck loads. Most consumer products companies are neither organized nor equipped for efficiently building custom-mixed pallets.

Some consumer products companies have adapted to customers' needs for built-to-order pallets by shipping to intermediate consolidation centers and using manual labor to repack the pallets. This is very expensive and leads to increased emissions, product damage and packing errors. It's not a sustainable solution.

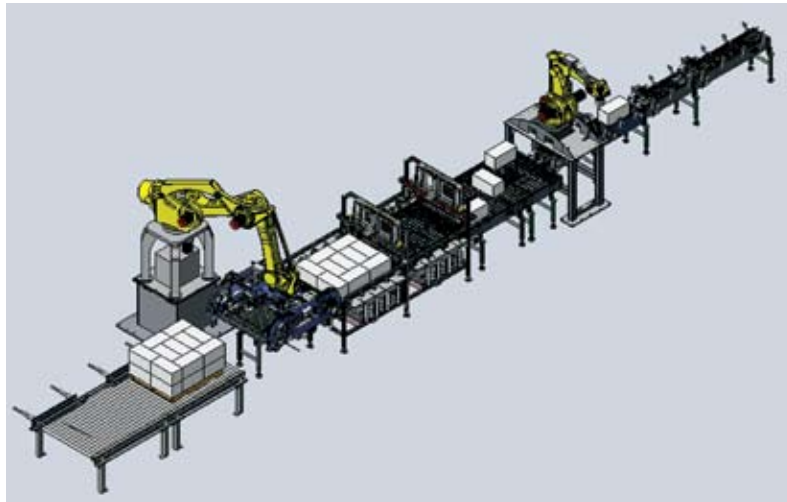


Some manufacturers have used some automation that builds partially customized pallets in layers, e.g. “rainbow” pallets. Although this is closer to what customers want, it is still not fully responsive. Designed for high volume single-configuration operations, traditional palletizing equipment has difficulty handling rainbow and mixed-case pallets. It also can have problems handling the newer lightweight packaging that can be easily damaged from rough handling or being squeezed in the palletizer. Some automated rainbow pallet approaches work, but suffer from extensive conveyor lengths and inflexibility for changing product configurations.

Savings would also be gained from transportation/emissions plus increases in efficiency, labor reductions and reductions in floor space for order fulfillment. Consumer products companies need new techniques to handle custom-build mixed pallets efficiently.

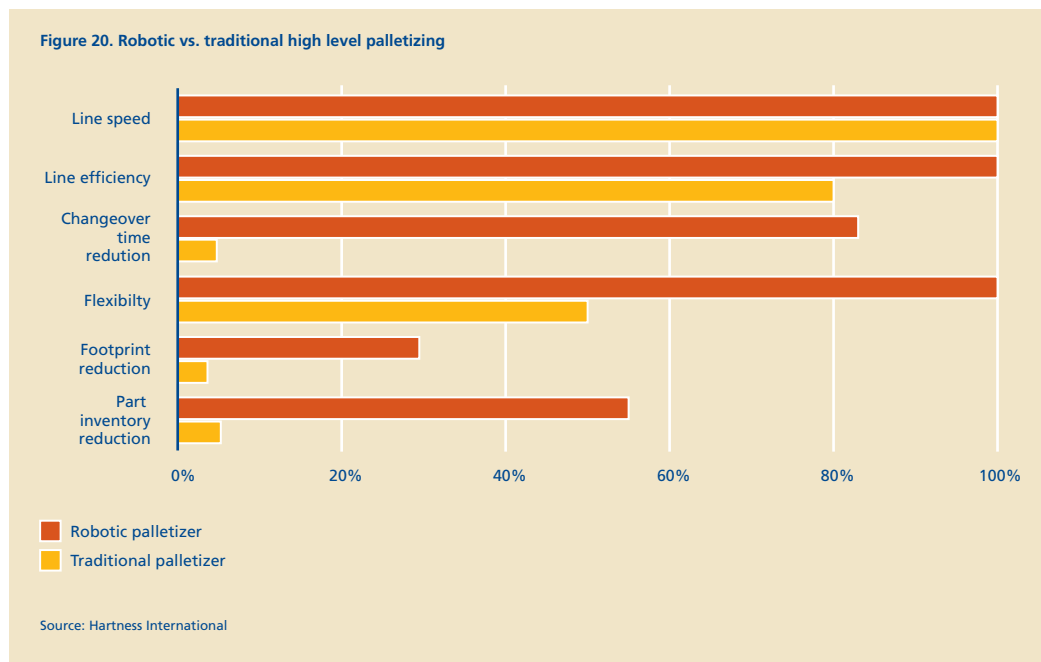
Robots offer a solution. They already dominate traditional, lower-speed palletizing processes, as one robot can handle multiple low-speed lines. Their flexibility and reliability are proven and more companies are starting to use robotic palletizing for rainbow and mixed-case pallets. Current models now allow greater speeds and heavier loads, up to 700kg.

**Figure 19. Robotics offer a solution to minimize waste**



Source: Hartness International

One additional advantage is that robots handle changes in package size, weight and pallet configuration on the fly with little or no intervention. Another is the ability to create column-stacked cases/bundles/etc. (used for display pallets) within stretch-wrapping machines. Traditionally, these are risky due to the loss of stack quality or possible collapse.



## Empty Miles/Deadhead Reduction

Every day, thousands of trucks travel the nation's highways – empty. A vast number of them are returning from a delivery of consumer products, burning millions of gallons of fuel and exhausting untold tons of emissions. Consumer products businesses have a very large opportunity – and some would say a responsibility – to minimize those empty miles on deadhead routes.

While collaborative transportation systems have helped match some backhauling trucks with some potential loads intended for locations aimed toward empty trucks' home yards, they have only touched the potential benefits. Working through VICS (Voluntary Interindustry Commerce Solutions) and GS 1 (the non-profit industry organizations that have brought us advances such as bar codes, EDI and Collaborative Planning), some visionary consumer products businesses are creating a web portal that matches suppliers' shipment needs with available empty backhaul truck capacity in North America.

While this is only entering a proof-of-concept stage at this time, the potential size of the benefits in sustainability and cost competitiveness have excited the imagination of many consumer products transportation managers.

## DC By-Pass Transportation Reduction

DC By-Pass is a simple concept: Move shipments arriving at North American ports directly to retail distribution centers (DCs). Today, most shipments of globally sourced consumer goods get shipped to the manufacturer's/brand owner's DC, and the goods then get re-shipped to various retailers' DCs. DC By-Pass consolidates shipments from multiple manufacturers/brand owners at or near the ports to then travel in truckloads directly to retail DCs. It eliminates an entire leg of transportation and an entire handling of product, with dramatic savings in both emissions and costs.

Also being developed by VICS, DC By-pass is only entering a pre-pilot development stage at this time. However, the volume of potential gains in sustainability and cost savings has captured the attention of numerous consumer products supply chain leaders.

# Alignment with Business Case Development & Procurement

Most consumer products companies have established a vision for sustainability and a commitment to it. Now the industry is entering the next stage of evolution: integration and alignment of the vision across functional areas. In addition to manufacturing and distribution operations, two of the most common areas of misalignment among consumer products companies involve policies in business case development and procurement.

Unfortunately, business case development and procurement, if misaligned with corporate vision, can place unnecessary hurdles against cost-effective sustainability gains for the rest of the organization. In particular, they are worthy of a quick senior management review to ensure that any disconnects get redirected toward the vision. That step will also help avoid unintended consequences.

Common root causes of unintended consequences involve:

- Inclusion of sustainability factors in business cases and procurement
- Broadening the range of costs – and the time horizon of total costs – considered
- Broadening the range of benefits considered

## Include Sustainability in Supplier Agreements, Business Cases & Procurement Decisions

Larger consumer products companies typically have procurement agreements that govern the relationship between brand owners and suppliers. Most of these agreements contain painstaking detail around everything from discount schedules to penalty clauses. However, very few mention sustainability. As such, the disconnect between sustainability vision and procurement practices remains wide.

Companies aligning policies with the corporate vision will be adding sustainability metrics, policies and goals to supplier agreements. They will also apply sustainability to their policies for preparing and evaluating business cases and their criteria for making procurement decisions. The most common and largest pitfalls in business cases and procurement decision making involve failure to consider the full range of costs and benefits included. By requiring inclusion of sustainability factors in business cases and procurement evaluations, consumer products companies will substantially improve their decision making and avoid unintended consequences.

## Broaden the Range of Costs Considered

While CEO vision spotlights ongoing sustainability, daily practices far down in the enterprise linger in the dark. When planning a sustainability initiative, many managers tend to focus on initial capital costs. However, since sustainability is all about ongoing, year-to-year resource consumption and emission, responsible management that considers sustainability must evaluate ongoing, year-to-year resource consumption and emissions. With its long-term horizon considering total costs, sustainability not only helps the environment, but also helps managers make fully informed decisions that result in more efficient business processes operating with fewer resources.

Familiar with return on invested capital, many managers remain uncertain about total cost of ownership (TCO). Unfortunately, few companies use TCO when developing business cases or making capital expenditure purchasing decisions.

TCO calculations help companies assess both initial and long-term operating costs and benefits related to an investment. TCO analysis calculates the total life-long, fully burdened costs for any investment, such as a business process change or an equipment purchase. The TCO gets compared to the total benefits of ownership (TBO) to determine a total ROI.

Lowering TCO typically aids sustainability goals. Lowering TCO also often results in higher up-front costs for superior equipment, systems and training.

To further a vision of sustainability, companies can require adding sustainability factors and a TCO calculation for business cases and procurement decision making. (See TCO with Sustainability Worksheet.) That way, managers will compare long-term returns and consider both long-term costs and sustainability factors when evaluating alternatives. That way, companies will make business decisions that are truly cost-effective as well as pro-sustainability. That way unintended consequences become transformed into intended performance gains.

### Case History: When Less Expensive Was Very Costly

A pharmaceutical company needed to purchase an ink jet coder for labeling product containers with FDA-required dates and lot numbers in the production process. Two printers met the specifications. Printer A had almost half the capital cost of Printer B. There was no policy for inclusion of sustainability or total lifecycle costs, so Printer A was purchased.

However, once Printer A was installed, operations discovered that its ongoing operating cost exceeded \$33,000 per week, mostly for ink refills. Printer B had guaranteed a weekly operating cost of just over \$3,200. In two months, Printer B's operating costs would have made up the difference in initial cost – and improved sustainability with its less-expensive, eco-friendly ink.

Over the course of one year, Printer A will cost the pharmaceutical company over \$1.5 million in excess costs, plus the environmental cost for using more toxic ink. Over the printer's 5-year expected lifetime, the total excess cost to operate Printer A would soar to \$7.5 million.

The procurement agent was lauded for his strong negotiation skills, saving \$60,000 in capital expenditure. In reality, he besmirched the company's sustainability policy, and lost the company over \$7 million.

That costly unintended consequence would have been avoided by a requirement to compare TCO and sustainability factors.

**Figure 21. Total Cost of Ownership**

	<b>Printer A</b>	<b>Printer B</b>
Capital cost	\$65,678	\$125,678
Ink cost	\$1,850	\$42
Eco-friendly ink	No	Yes
Rework cost	\$120	\$15
Minor stops	\$4,667	\$583
Preventative cost	\$2,400/yr	\$600/yr
Cost per week – 5 days	\$33,335/wk	\$3,200/wk

Source: Hartness International

## Broaden the Range of Benefits Considered

If policy requires consideration of sustainability factors and goals, the vision will be realized more effectively and faster. When developing business cases or evaluating process alternatives, many consumer products managers consider the hard-dollar “eco-efficiency” savings from reduced raw materials and fuel consumption. Few consider other, softer-dollar benefits derived from improved sustainability. A broader range of sustainability benefits includes:

- **Enhancing eco-efficiency** – Reducing inputs of limited raw materials or fuel consumption, reducing waste production and utilizing by-products from other industries, all of which allow companies to cut costs
- **Improving product added value** – With a sustainability approach, companies can often expand some products’ value propositions
- **Creating new market opportunities** – Sustainability successes facilitate expansion into new countries, regions or market segments (e.g., the 38 percent of consumers who buy pro-environmental, healthier foods and beverages)
- **Strengthening management reputation** – Socially responsible management strengthens corporate culture, improving employee loyalty and attracting high-potential new employees
- **Improving brand reputation** – A proactive sustainability strategy helps companies keep their “license to operate”, and improve their corporate image and brand value

Figure 22. TCO with sustainability worksheet

#	Description	Amount
	<b>Initial Investment</b>	
1	Equipment Base Price	\$ _____
2	Equipment Options	\$ _____
3	Factory Acceptance Test (FAT) – Static Inspection	\$ _____
4	Factory Acceptance Test (FAT) – Dynamic Pre-Testing	\$ _____
5	Factory Acceptance Test (FAT) – Induced Failure Testing	\$ _____
6	Platforms	\$ _____
7	Spare Parts	\$ _____
8	Installation Costs	\$ _____
9	Training Costs	\$ _____
10	Training Documentation	\$ _____
11	Start-Up Costs – Technician On-Site	\$ _____
12	Commissioning costs	\$ _____
13	On-Site Qualification & Verification Support	\$ _____
14	Service Contract	\$ _____
15	Warranty (beyond standard period)	\$ _____
16	Taxes	\$ _____
17	Freight Charges	\$ _____
Up to 5-Year Ongoing Operating and Maintenance Costs		
	(Fewer years if item's expected lifecycle is shorter than 5 years)	
18	Maintenance Costs (Spare Parts – Electrical & Mechanical, Tech Service labor costs) <ul style="list-style-type: none"> <li>• Year 1</li> <li>• Year 2</li> <li>• Year 3</li> <li>• Year 4</li> <li>• Year 5</li> </ul>	\$ _____
19	Changeover & Downtime Costs (downtime for change parts, expected service downtime, uptime reliability factor) <ul style="list-style-type: none"> <li>• Year 1</li> <li>• Year 2</li> <li>• Year 3</li> <li>• Year 4</li> <li>• Year 5</li> </ul>	\$ _____
20	Utility Consumption & Waste Disposal (Water, Electricity, Line Lube, Air, Chemicals, Wastewater/Sewer, Solid Waste Disposal etc.) <ul style="list-style-type: none"> <li>• Year 1</li> <li>• Year 2</li> <li>• Year 3</li> <li>• Year 4</li> <li>• Year 5</li> </ul>	\$ _____
	Salvage value at end of life	(\$ _____)
<b>Total Cost of Ownership aggregated over a period as long as 5 years</b>		<b>\$ _____</b>

Source: Deloitte Consulting LLP and Hartness International

# Conclusion: Extend Sustainability from the Boardroom to the Breakroom

Sustainability is good business.

Rising commodity prices have impacted consumer products companies substantially. As prices for fuel, agricultural commodities such as wheat, corn and sugar and oil-based plastics – all major purchase items for consumer products companies – continue to climb, conserving those commodities through sustainability measures becomes essential.

In addition, some 17 percent of consumers are “green buyers” using the sustainability reputation of brands to make purchase decisions. An additional 21 percent of consumers have strong preferences for food and beverages that are both environmentally friendly and healthy. Moreover, some of the world’s largest retail customers have begun measuring consumer products suppliers’ carbon footprints and other sustainability performance metrics.

Furthermore, acting in a sustainable way makes companies more competitive. Achieving sustainability improvements makes a company more nimble in a fast-changing world, its brands more attractive to consumers and retailers, and its management more respected by employees, regulators and the financial markets. In short, the drivers for improved sustainability also leverage improved business performance.

Sustainability is also a matter of personal values. Most consumer products executives want to leave a legacy of having improved the planet in a significant way.

It’s no surprise that most consumer products company CEOs have stated their sustainability visions. It’s no surprise that Boards of Directors have made long-term commitments to it. The vision for sustainability gains starts in the Boardroom.

## Implementing the Vision from Boardroom to Breakroom

In implementing these sustainability visions so far, many consumer products companies have addressed retail partners’ pressures for innovative, more sustainable packaging changes. Many have also identified additional quick-win, low-hanging-fruit sustainability projects. However, few have evolved to the next stage of implementation: aligning the entire organization with sustainability and related long-term operational improvement.

This alignment and integration across company functions will be where the next major advances in cost-effective sustainability will occur. The real gains come when the vision from the boardroom becomes understood throughout the organization – all the way to the breakroom.

The greatest sustainability opportunities at most consumer products companies will involve manufacturing and distribution operations. Some of the recent packaging reductions touted for their sustainability gains have actually yielded unintended consequences: Lighter packaging led to production inefficiencies and damaged product losses. Transforming those unintended consequences into full successes will require changes in operations. In addition, most of the future's sustainability gains will involve operations. Since Operations consume most of the environmental resources (e.g., water, energy, chemicals), Operations will be where the greatest sustainability gains occur.

Moreover, improving sustainability in manufacturing and distribution via process innovations produces long-term operating efficiencies. Thus, applying sustainability to operational decisions typically delivers improved financial performance.

### A Vast Opportunity Awaits

The opportunity is truly vast. Among all industries, consumer products is among the greatest users of environmental resources, and it is one of the largest contributors to solid waste (e.g., packaging) and greenhouse gas emissions (e.g., order delivery via trucks). Not surprisingly, consumer products remains one of the biggest opportunities for gains in sustainability.

In the short term, perhaps the best way to incorporate sustainability into manufacturing operations companies with little or no capital expenditures involves adapting lean manufacturing programs to become lean-and-clean manufacturing programs. Lean-and-clean adds sustainability to Lean, and typically results in better performance improvements than Lean alone. It also creates more flexibly responsive operations, which are a strategic advantage.

For example, advances in robotic palletizing are enabling companies to satisfy their customers' needs for customized mixed-pallet orders in a much more sustainable – and cost-effective – manner. In the midterm, emerging advances in fulfillment and transportation planning promise major opportunities to reduce trucking emissions – and costs. These include Empty Miles reduction to minimize the volume of trucks returning empty and DC By-Pass to replace trucking globally sourced goods to manufacturer DCs with direct delivery to retail DCs.

Longer term, the best way to implement a sustainability vision requires improving manufacturing processes, including facility layout, control, equipment, labor and floor space. Advances in lean line design, change parts, line lubrication, and remote monitoring are creating substantial opportunities for more sustainable – and cost-efficient – operations.

### Avoid Common Misalignments for Success

As companies enter sustainability's next evolutionary stage of integration and alignment, two common misalignments will become particularly important to address. They involve company practices for business case development and procurement. Since sustainability improvements require a long-term, total-lifecycle-cost-of-ownership perspective, business case development and procurement decision making will need to start disciplined consideration of ongoing costs and benefits. Currently, few companies consider total cost of ownership and the full range of sustainability benefits. Senior managers who ensure that business cases and procurement practices reflect the long-term vision for sustainability will also set their organizations up for long-term cost effectiveness and fewer unintended consequences. They will set their organizations up for higher ROIs.

By adopting these changes, consumer products companies will achieve lasting gains in sustainability. By adopting them, senior managers will find that helping the planet also helps shareholder value. Sustainability is good business – when it is taken all the way from the boardroom to the breakroom.

# Appendix

## Appendix A

### Sustainability Metrics

#### Measuring Sustainability

Measuring sustainability performance is not standardized, resulting in the inability to effectively analyze trends or perform peer comparisons. Currently, corporate sustainability performance is compared within indices, such as the Dow Jones Sustainability Index or the FTSE4Good Index. The financial indices provide a way to compare overall corporate performance and assess the relative financial attractiveness of companies. However, these indices do not use a common set of metrics to measure sustainability; rather, the criteria for sustainable performance vary from index to index, and are not always transparent. Additionally, these indices rely on self reporting of performance metrics which are inconsistently measured and are not validated by the indices.

**Calculation methods vary.** Even if the same metric were used, there is a significant variation in the type of unit used to measure output. For instance, energy could be measured by kilowatt hours, mega joules, or giga joules. This tends to vary by geographic locations, which have different metrics systems. How a particular metric is calculated, and which factors are included in the formula, also tend to vary.

At this stage, there are no commonly accepted or ideal metrics framework for measuring sustainability performance among consumer-focused businesses. In our survey, we collected commonly used metrics, which we have listed below. To the extent that the industry can collectively agree on select metrics, it would help the industry advance its performance measurement and benchmarking efforts. Once the metrics are selected, however, measurement systems and calculation methodologies must also be aligned. Additionally, where collaboration is required, the metrics should be shared among firms via scorecards or other tools.

**Figure 23. Common sustainability indices**

Sustainability Index	Description
Dow Jones Sustainability Index	An index that tracks the financial performance of the leading sustainability-driven companies worldwide, providing asset managers with reliable and objective benchmarks to manage sustainability portfolios. DJSI provides a financial quantification of company sustainability strategy and their management of sustainability opportunities, risks, and costs.
FTSE4Good (Financial Times Stock Exchange)	An index designed to measure the performance of companies that meet globally recognized corporate responsibility standards, and to facilitate investment in those companies. For inclusion, eligible companies must meet criteria requirements in five areas: 1) working towards environmental sustainability; 2) developing positive relationships with stakeholders; 3) up-holding and supporting universal human rights; 4) ensuring good supply chain labor standards; 5) countering bribery.
LOHAS (Lifestyles of Health & Sustainability) Index	Developed by the Natural Marketing Institute (NMI), the LOHAS Index is a ranking of the fifty most environmentally and socially responsible companies based on both a consumer perspective and investment analyst ratings of corporate sustainability and responsibility. The LOHAS Index is selected from companies in the Russell 3000 Index.

Source: GMA/Deloitte Consulting LLP 2007 Sustainability Study

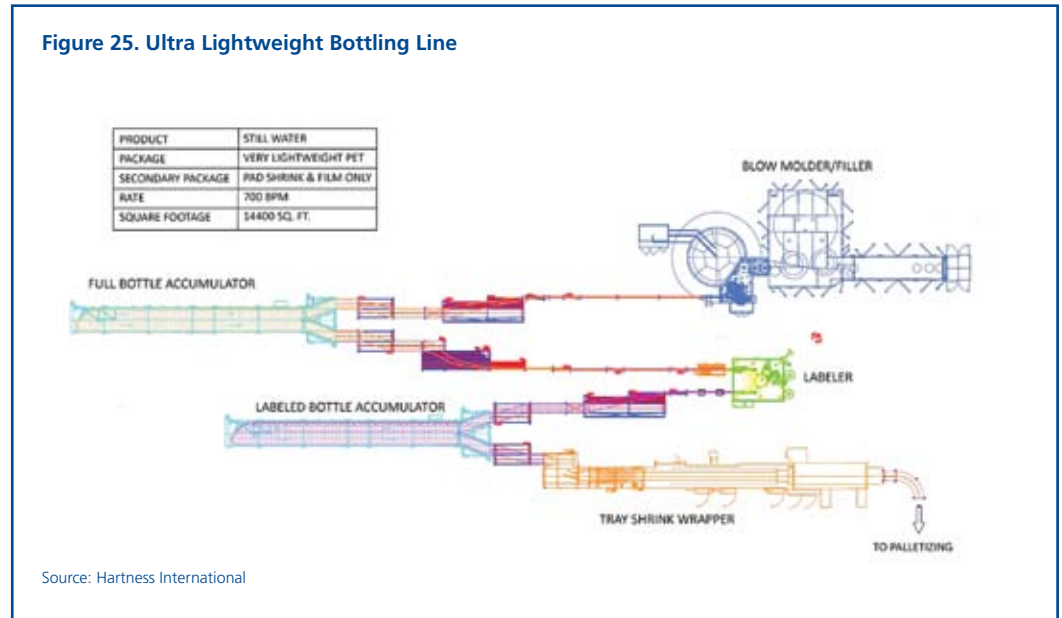
**Figure 24. Sustainability metrics**

Program	Representative Metrics
Energy Conservation/ Use of Environmentally Friendly Energy Sources	Total energy consumed per year
	Percent reduction in energy consumed per year
	Energy consumed per unit
	Energy consumed per truck of delivered products
	Percent energy use from alternative sources
	Percent energy use offset by alternative energy credits
Reduction of Harmful Air Emissions	Total emissions generated per year, including direct or indirect GHG emissions, and ozone depleting substances
	Emissions generated per unit
	Percent reduction in use of harmful refrigerants
Water Conservation or Processing	Total water consumed per year
	Water consumption per unit
	Wastewater generated per unit
	Percent savings in water usage
Waste Reduction	Total waste generated per year (e.g. hazardous, non-hazardous, solid)
	Total waste generated per unit (in per square foot or other measure)
	Percent reduction in waste volume going to landfills per year
	Percent reduction in waste produced during operational processes
	Total waste composted per year
Product and Packaging Recycling	Total waste recycled per year
	Recycling Rate
	Percent of waste sold for reuse per year
Ecosystem and Land or Ocean Biodiversity Preservation/ Natural Resource Conservation	Number of new locations that are 'brownfield' developments
	Area of land disturbed
	Area of land protected
	Area of land restored
	Percent of products sourced responsibly from non-endangered ecosystems (e.g. Forest Stewardship Council, Marine Stewardship Council)
Sustainable Agriculture/ Livestock Care	Number of suppliers providing organic or sustainable products
	Percent or Number of products offered that are organic/sustainable (including private label)
	Percent market share in organic products
	Amount of store space dedicated to sale of organic products
	Dollars spent on promoting organic products from sustainable agriculture
	Number of farmers helped or supported
Reduced Packaging/ Increased Use of Bio-degradable Packaging	Amount of packaging materials used by weight or volume
	Percent of suppliers meeting scorecard or other formal sustainable packaging requirement
	Percent reduction in packaging as a result of retailer or retailer-supplier efforts
	Product/package ratio
	Percent recycled content of distribution or product packaging (e.g. pallets, crates)
	Number of products with sustainable packaging (e.g. biodegradable packaging)

Source: GMA/Deloitte Consulting LLP 2007 Sustainability Study

## Appendix B

### Additional Case Histories



When packaging such as the new ultra-lightweight PET bottles became part of a bottled water brand's strategic vision, success involved changing the manufacturing and distribution process. Ultra-lightweight bottles are difficult to handle due to their low crush and damage resistance.

### Ultra-Lightweight Water Bottling Line

The manufacturer developed this 700-bottles-per-minute design, which also saved labor by using a single operator. In addition to reducing product packaging, the new process reduces secondary packaging: Instead of the traditional corrugated secondary packaging uses only a cardboard pad with shrink wrap.

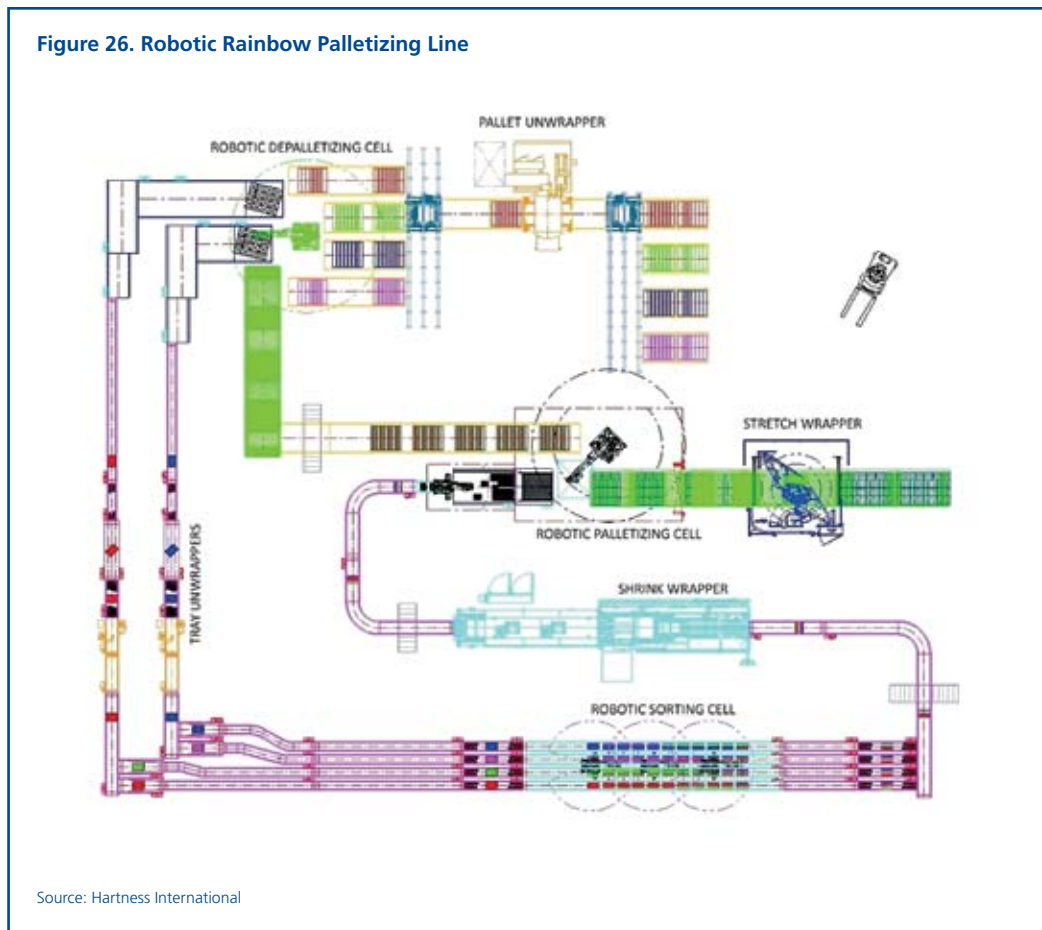
The new design produced sustainability and total cost savings by:

- Shrinking the footprint, enabling labor savings using only one operator
- Reducing conveyors and associated motors and power requirements
- Cutting damaged goods and unsaleables – a huge source of environmental and financial waste
- Reducing corrugated packaging

### Case History: Robotic Rainbow Cases & Pallets

To get closer to meeting customer demands precisely, a soft drink bottler automated the process of creating rainbow pallets – and cases. The approach depalletizes and unwraps cases from four separate products, sorts them to produce mixed cases (e.g., 4 cola, 4 diet, 4 orange and 4 lemonade cans in a case) and shrink-wraps and re-palletizes them.

Figure 26. Robotic Rainbow Palletizing Line



The new design produced sustainability and total cost savings by:

- Helping to meet customer demand for semi-custom-packed cases and pallets
- Shrinking the labor content, enabling use of only one operator
- Shrinking the footprint compared to manual custom-case-and-palletizing space
- Reducing packing errors, getting closer to perfect orders
- Reducing damaged product losses, which is a major sustainability gain because it avoids wasting all the water, commodities and energy that went into making them

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## Reference Guide

An example of a simulation tool that can be used for performance studies would be Flexsim from Flexsim Software Products, Inc, (<http://www.flexsim.com>)

Dry lubrication products are available from Ecolab (<http://www.ecolab.com>), JohnsonDiversey (<http://www.johnsondiversey.com>) and Hartness International (<http://www.hartness.com/#>)

Fanuc Robotics (<http://www.fanurobotics.com>)

For more information on robotic depalletizers, contact Hartness International (<http://www.hartnessvisy.com>)

Hartness International Dynac Accumulation Systems at <http://www.hartness.com/dynac.asp>

Hartness International (<http://www.hartnessvisy.com>); ABB Robotics (<http://www.abb.com>); KUKA Robotics Corporation (<http://www.kuka.com>)

Information on issues and metrics related to packaging sustainability is available from the Sustainable Packaging Coalition at <http://www.sustainablepackaging.org>

Lean and Environmental Toolkit (Version 1.0) at <http://www.epa.gov/lean/toolkit>

Lean and Energy Toolkit at <http://www.epa.gov/lean/LeanEnergyToolkit>

Line control and conveyor systems that eliminate the need for line lubrication can be found at Hartness International (<http://www.hartnessintegration.com>)

Links to information on sustainable packaging technology is available from PMMI at <http://www.pmmi.org> and <http://www.packexpo.com>

Nordson Corporation – Packaging Adhesive Systems (<http://www.nordson.com>)

Remote monitoring tools are available from Hartness International (<http://www.hartness.com>) and Zarpac Inc. (<http://www.zarpac.com>)

Sustainability: Balancing Opportunity and Risk in the Consumer Products Industry, A 2007 GMA and Deloitte Consulting LLP Research Project

Video monitoring technology is available from Hartness International Performance Solutions using their HERO system (<http://www.hartnessperformancesolutions.com/hero.html>)

#### **Grocery Manufacturers Association**

The Grocery Manufacturers Association (GMA) represents the world's leading food, beverage and consumer products companies. The association promotes sound public policy, champions initiatives that increase productivity and growth and helps to protect the safety and security of the food supply through scientific excellence. The GMA board of directors is comprised of chief executive officers from the association's member companies. The \$2.1 trillion food, beverage and consumer packaged goods industry employs 14 million workers, and contributes over \$1 trillion in added value to the nation's economy.

The GMA Associate Member Council consists of senior-level executives from leading service providers and suppliers to the consumer packaged good industry. Its primary mission is to assist in creating and facilitating an open dialogue between all members of the GMA around issues germane to the CPG industry. Working in collaboration with the GMA leadership and staff, the Council's goal is to provide keen and unbiased insight, knowledge and counsel about emerging industry issues with the aim of improving the business capabilities and results of GMA member companies.

#### **About PMMI**

PMMI is a trade association with more than 550 member companies that manufacture packaging and packaging-related converting machinery, commercially-available packaging machinery components, containers and materials in the United States and Canada. PMMI's vision is to be the leading global resource for packaging, and its mission is to improve and promote members' abilities to succeed in a global marketplace. PMMI organizes the PACK EXPO trade shows: PACK EXPO International, PACK EXPO Las Vegas and EXPO PACK México. Learn more about PMMI at [pmmi.org](http://pmmi.org)

PACK EXPO International will be held November 9-13, 2008 at McCormick Place in Chicago, Illinois. The show will be co-located with PROCESS EXPO and Converting & Package Printing EXPO. PMMI also produces EXPO PACK México, the premier packaging show in Mexico serving the Latin American region. This show will be held June 24-27, 2008 at Centro Banamex, Mexico City, Mexico. PACK EXPO Las Vegas will be held October 5-7, 2009 at the Las Vegas Convention Center in Las Vegas, Nevada. Visit [www.packexpo.com](http://www.packexpo.com) for more information.

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The Association of Food, Beverage  
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