Reducing Waste, Making Money:
Measuring the Impact of "Lean & Clean" Workshops
At Suppliers Partnership for the Environment (SP) Member Sites

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This paper details the manufacturing, energy and environmental performance improvements achieved by suppliers taking part in Lean & Clean Workshops as members of the Suppliers Partnership for the Environment (SP). It shows the "wiring" between manufacturing improvement – higher asset utilization, faster changeovers, reduced inventory stocks and lower scrap rates – and society-wide energy and environmental savings. The performance of SP members completing Lean & Clean workshops will be compared against the Performance Benchmarking database maintained by the MMTC, Michigan's affiliate of the NIST Manufacturing Extension Partnership.

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Taking Out Waste, Taking Out Cost

The U.S. Environmental Protection Agency (EPA) and General Motors Corporation (GM), along with a number of major Tier I, II, and III automotive suppliers, have created an environmental management model that enables large manufacturers to engage their suppliers in business-centered approaches to reducing environmental impacts. The Suppliers Partnership for the Environment (SP) has been created to develop a process through which all automakers, also referred to as automotive Original Equipment Manufacturers (OEMs), will be able to minimize the environmental impact of their manufactured products up and down the supply chain. While that has long been the goal of the OEMs, most suppliers are focused on reducing cost to sustain and improve margins. While these suppliers' resolve to improve environmental performance may be great, their actions are tempered by the need to save money. Traditionally, many of them have equated stronger environmental performance with *increased* cost. To address this, SP has strived to link "clean" manufacturing with the savings associated with "lean" manufacturing approaches.

SP has been designed in part to leverage the automotive industry's influence with federal agency resources in order to push environmental improvement through the manufacturing supply chain. Large companies need top-performing suppliers, yet no one corporation has the resources to work directly with its entire supply chain. Through this innovative partnership with EPA and the National Institute of Standards and Technology's Manufacturing Extension Partnership (NIST MEP) program, manufacturers leverage federal resources to reach their multi-tiered supply chains. SP thus meets a need industry cannot meet for itself.

SP is an innovative partnership between automotive OEMs, their suppliers and the EPA. SP addresses the goals of the membership to improve environmental performance, while providing value throughout the automotive supply chain. SP provides a forum for small, mid-sized and large automotive and vehicle suppliers to work together, learn from each other, and share environmental best practices. The organization provides value to its members by:

- Providing a forum for companies to work together to share "best practices" through task forces and work groups to address specific issues
- Providing facility-specific technical assistance on energy and materials use optimization
- Identifying and addressing externally driven environmental impacts
- Retaining the costs savings realized through SP activities

SP provides its members with the opportunity to work with a NIST MEP technical assistance center to conduct facility-specific "Lean & Clean" workshops. All cost savings identified during the workshops are retained by the participating supplier. This is significant because, traditionally, most supplier cost savings have had to be passed on to customers in the form of price reductions.

SP has expanded the boundaries of environmental management beyond the manufacturers' walls. Solutions are developed through a collaborative process involving the supplier, the manufacturer

and other members of the supply chain. This unified approach applies systems thinking to environmental performance, rather than simply optimizing a supplier's own operations and/or transferring environmental burdens from one company to another through outsourcing. For example, where supplier environmental improvements are determined to be constrained by their customer's product or process specifications, the customer works with the supplier to minimize or eliminate the constraint.

The GM - Saturn Workshops

GM and EPA conducted a "Greening the Supply Chain" pilot project with GM's Saturn division, in which real opportunities to improve both the environment and the competitiveness of companies of the supply chain were identified. Specifically, the pilot project identified problems with packaging, use of chemicals, water and energy consumption, air and water emissions, solid waste, transportation efficiency and product design, and explored how to improve in these areas. The Suppliers Partnership for the Environment (SP) grew out of this experience.

During GM's pilot project with EPA, four facility-specific workshops were conducted with GM Saturn VUE suppliers. These resulted in the identification of multiple opportunities for improving both environmental and financial performance. The impacts identified aggregated to nearly half a million dollars. The pilot project proved that companies can improve business practices and environmental performance, and *save* money doing so. This demonstration was not lost on General Motors, which is taking steps to replicate the Saturn experience throughout its supply chain.

A final Phase 1 report, *Greening the Supply Chain Pilot Project (August 2002)*, documents critical issues and key findings of the initial phase of the program. It was prepared by Battelle Memorial Institute and the University of Tennessee Center for Clean Products and Clean Technologies. According to the Report, the four pilot workshops identified sixteen potentially valuable environmental improvement opportunities and solutions. Eleven were opportunities for product or process design improvements and increased financial value. All sixteen reduced supplier operating costs, and five provided direct cost savings to GM as well. Eleven of the opportunities were judged to have been caused by a GM-Saturn product or process specification.

The environmental benefits of the workshops included a reduction in electricity consumption of about 1.9 million kilowatt hours, CO_2 emissions reduction of about 80,000 pounds, transportation fuel use reduction of about 3,600 gallons, and solid waste disposal reductions of about 300,000 pounds. Across the four workshops, projected savings included annualized operating cost savings of about $360,000, and a capital cost avoidance of about $426,000. Based on a 13.85% weighted average cost of capital, the annualized economic benefit of the four workshops totaled about $419,000, or about $105,000 each.

Applying this $105,000 just to GM's 3,000 *direct* suppliers would predict a potential economic benefit of about *$315 million a year* across the GM supply chain.

Non-quantifiable business benefits of the program include better regulatory compliance, materials management, product quality, corporate image, and opportunities for strategic partnerships.

The Michigan MEP Workshops

SP's primary beneficiaries, arguably, can be the thousands of small and medium-sized US manufacturing suppliers, most with slim profit margins. The program allows them to make environmental improvements and address financial pressures without sacrificing profitability. By providing hands-on, facility-specific technical assistance, the NIST MEP team helps small suppliers meet the demands of their large manufacturer customers.

Following the successful GM-Saturn example, NIST MEP looked for additional opportunities to offer SP Lean & Clean workshops in the industry, even beyond a particular customer-supplier link. The Michigan Manufacturing Technology Center (MMTC), Michigan's affiliate of the NIST MEP program, conducted week-long workshops for two SP members, both of which are relatively small suppliers. (Additional workshops are in process at two additional Michigan locations, but results were not available in time to be included in this paper.) As with the Saturn suppliers, both Michigan MEP-facilitated SP workshops included a full assessment of operational and environmental performance. Each used a consistent, validated process for estimating the impact of process improvements on both environmental and economic outcomes.

These estimated outcomes, which have been agreed to by the two companies, are summarized in the table on the next page. On-going "lean" savings identified totaled about $430,000, plus a one-time inventory reduction of almost $447,000. Total "clean" savings totaled nearly $49,000. Scrap and rework cost reductions, which relate to both "lean" and "clean," totaled $17,000.

BAE Industries identified large "lean" savings available to it by slashing stamping press downtime through quicker changeovers, better steel stocking, and chutes for shunting offal. By implementing a pull system between assembly and shipping, both inventory and schedule bumping could be reduced radically. In the "clean" arena, BAE determined that it could make four changes at a one-time cost of $8,100, but with a recurring annual benefit of more than $25,000, while also reducing scrap and rework by $17,000 and other expenses by almost $8,000:

- Change from E-coat to black oxide and save both money and the environment
- Recycle its die lubricants
- Reduce its generation of waste oil
- Compact and recycle its cardboard

Renosol Corporation also realized large "lean"savings by redesigning its process to pre-heat molds, commonizing Velcro fastener strips and relocating proximity switches. In the "clean" field, Renosol estimated that it could, at a one-time cost of less than $37,000, but with a recurring annual benefit of more than $48,000:

- Reduce fumes and improve safety
- Redesign its racks to eliminate the need for shrink-wrapping

- Replace its use of cardboard by shipping parts in dunnage with returnable dividers

Applying the same accounting framework as in the GM–Saturn calculation results in a total, two-workshop economic benefit of $565,000. Adding the four Saturn workshops to the two completed Michigan MEP workshops, the total six-supplier impact exceeds $980,000.

		BAE		Renosol		Across Both MI MEP Workshops		
Category	Improvement	One-Time Cost to Implement	Anticipated Benefit	One-Time Cost to Implement	Anticipated Benefit	Total Anticipated Annual Benefit	Anticipated Annual Benefit, by Category	
Lean	Higher Run Hours per Production Machine		$ 170,776			$ 200,576	$ 429,642	Lean
	Reduced Downtime by Pre-Heating Molds			$ 1,200	$ 31,000			
	Reduced Inventory Stocks Relative to COGS: *One-Time Cash Freed Up by Inventory Drawdown* *Recurring Savings in Carrying Costs, Floorspace, & Obsolescence*		$ 446,880 $ 67,024			$ 67,024		
	Reduced Premium Freight Expense		$ 4,300			$ 4,300		
	Reduced Need to Bump Scheduled Jobs		$ 31,262			$ 31,262		
	Standardize on a Single Velcro Type			$ 5,200	$ 64,000	$ 58,800		
	Relocate Proximity Switches to Back of Cannon Line			$ 1,800	$ 69,480	$ 67,680		
Both	Lower Scrap & Rework Expense Relative to COGS		$ 17,034			$ 17,034	$ 17,034	Both
Clean	Reduced Utility Expense Relative to Sales						$ 48,685	Clean
	Reduced Die Lube Expense Reduced Waste Oil Disposal Expense	$ 2,400	$ 21,840 $ 324			$ 19,764		
	Reduced Cardboard Expense via Compacting & Recycling	$ 5,700	$ 3,096			$ (2,604)		
	Reduced Fumes via Extending Exhaust Hoods Improved Safety via Improved Forklift Training			$ 19,700 $ 245	not quantified			
	Redesign Racks to Eliminate Shrink Wrap			$ 16,675	$ 18,000	$ 1,325		
	Replace Cardboard with Returnable Dividers			under investigation	$ 30,200	$ 30,200		
Other	Other Changes		$ 7,831			$ 7,831	$ 7,831	Other
Total	***Total Savings, incl. One-Time Cash Free-Up***		***$ 770,367***				***$ 950,072***	Total
	Total, Recurring Annual Savings		***$ 323,487***		***$ 212,680***	***$ 503,192***	***$ 503,192***	

SP is seeking additional suppliers as members, and looks forward to many more companies – particularly in the metal finishing field in which your companies participate – working with the NIST MEP part of the SP team to undertake many more SP Lean & Clean workshops.

Metrics to Document and Track Improvements Across Suppliers

BAE and Renosol's environmental performance improvement potentials can be compared against MMTC's proprietary database of small and medium-sized suppliers, which each year collects detailed information from more than 500 manufacturing plants. Specifically:

- BAE's $25,000 anticipated reduction in material cost (0.25% of sales) would move it a predicted 1.8 percentile-points up in the distribution on material cost as a percent of sales, while its scrap and rework expense reduction of $17,000 would move it nearly ten percentile-points on scrap and rework expense as a percent of cost of goods sold.
- Renosol's $48,000 material cost savings on shrink-wrap and cardboard packaging would move it up about 3.7 percentile-points in the distribution on material cost as a percent of sales.

One of SP's five work groups, the Environmental Performance Metrics Work Group, is focusing on the issue of metrics and their consistent application across SP members' improvement activities, including but not limited to "Lean & Clean" workshops. A critical question in this area is normalization, i.e., determining relevant denominators for metrics expressed as *x per y*. For material use reduction, the preferred denominator was determined to be sales; thus reduced packaging might be measured as a drop in lbs corrugated / sales. For energy and water use, and for total and toxic waste generation, the preferred denominator was value-added (i.e., sales less the value of outside purchases). Thus improvements in these areas can be represented as reduced resource requirements relative to value-added. We also found that resource productivity could be measured by making value-added (VA) a *numerator* as well, as is shown in the table below.

	Addressing Opportunity Results in a Change in:	
Resource	Resource Consumption	Resource Productivity
Energy	btu / VA	VA per btu
Material	lbs of ... / sales	sales per lb of …
Water	gals / VA	VA / gal
Waste, Toxics	lbs of ... / VA	VA / lb of …

Beyond Automotive: Extending Opportunities for Collaboration

Recently, EPA has initiated efforts to take the SP approach into additional industry sectors. Consortia of aerospace and healthcare companies are piloting the model in their respective industry sectors. International response has been positive as well. In fact, South Korea approached EPA about replicating the program for their manufacturing sector. Training of Korean technical assistance providers on the model and methodology has begun.

The successes of these partnerships are opening up many opportunities for collaboration. As a delivery system for technical assistance, SP is adding new tools and resources through partnerships with other federal (including DOE) and state (including in MI, CT, OH) agencies as well as with non-profit entities (e.g., the Chemical Strategies Partnership).

SP is a trade association and information and material for the general public, including the association's charter and bylaws, is available on its website, www.supplierspartnership.org. In addition, the EPA website provides a link to SP's site at www.epa.gov/oppt/suppliers