

**Understanding the Business Rationale Behind the Trend Towards
Environmentally Friendly Manufacturing Practices**

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EXECUTIVE SUMMARY

In the past few decades, businesses around the world have begun implementing environmentally friendly business and production practices, popularly known as “going green.” This trend will steadily increase as input costs rise, resources become scarcer, and global competition intensifies. The intention of this study is to review existing organizations that have adopted green manufacturing practices in order to examine the business rationale to go green.

The literature on the business rationale behind green technologies centers around three main categories: cost savings, attracting investors, and avenues toward enhanced competition through good publicity and product improvement. All three components reiterate the same point: when environmentally friendly practices complement the goal of achieving fiscal soundness and greater profits, companies are more than willing to go green.

To assess the business rationale behind the trend toward environmentally friendly manufacturing, we have identified seven suppliers and buyers in the automotive industry that work with large automotive corporations, including General Motors (GM), and conducted interviews with these suppliers to assess the degree to which environmentally friendly manufacturing techniques affect company profitability. We also conducted an interview with a contact at GM to learn more about this rationale from the buyer perspective. The intent is to determine whether or not the incorporation of green manufacturing practices is a factor in a company’s competitiveness and the extent to which decisions to go green are influenced through the automotive supply chain.

Overall, the companies we interviewed agreed that lean/green technologies serve as a complement to company profitability and competitiveness. The main reason environmentally friendly techniques are undertaken is because of the associated cost savings. Companies do not initially implement green technologies due to any sense of ethical obligation to protect the environment. The influence of OEM decision making to implement lean/green strategies is also felt throughout the automotive supply chain to varying degrees. For example, most companies incorporate lean because of pressure from OEMs to improve efficiency and cut costs.

Based on the findings obtained from these interviews, we propose several recommendations for NACFAM and its members:

- Conduct a survey of 50-100 suppliers who supply a variety of products to OEMs throughout the country. The purpose of the survey would be to examine, in greater detail, the breadth of the industry trend toward environmentally friendly manufacturing in order to generate substantive data for qualitative analysis and policy recommendations.
- Educate companies about environmental practices and lean manufacturing techniques that complement profitability rather than serve as a financial burden. It is imperative that members implement these techniques earlier rather than later in order to remain competitive in the future.
- Understand how government programs, designed to encourage business incorporation of green practices, interface to best support the trend toward environmentally friendly manufacturing techniques.
- Support legislation that benefits manufacturers by encouraging the development and implementation of lean and green technologies.

LITERATURE REVIEW

I. Introduction

In the past few decades, businesses around the world have begun implementing environmentally friendly business and production practices, popularly known as “going green.” This trend will steadily increase as input costs rise, resources become scarcer, and global competition becomes fiercer. The intention of this literature review is to complete a comprehensive survey of existing literature, private organizations, non-governmental organizations (NGOs), and government organizations that address the business rationale behind the current trend toward going green. While this literature review identifies three main motivations for adopting environmentally friendly initiatives, it is important to note that companies go green to achieve multiple objectives.

II. Business Rationale Behind Environmentally Friendly Manufacturing Practices

The literature on the business rationale behind green technologies centers around three main categories. Cost savings, discussed in Part A, is by far the most influential benefit of going green. Part B highlights green manufacturing as a way to attract investors. Finally, Part C captures a third motivation to go green—enhanced competition through good publicity and product improvement. All three components reiterate the same point: when environmentally friendly practices complement the goal of achieving fiscal soundness and greater profits, companies are more than willing to go green.

A. Cost Savings

Manufacturers and other businesses will need to adopt green technologies to combat rising energy, water, and input costs. The National Association of Manufacturers (NAM) promotes greater industrial efficiency as a way for American manufacturers to remain competitive with international competitors who may be able to use cheaper labor and comparatively inexpensive inputs.¹ Rising energy costs provide much opportunity for manufacturers to reduce operating expenses by adopting energy efficient measures and applying greener techniques. A NAM study shows that 22% of the non-labor cost disadvantage faced by American manufacturers is due to the rise in natural gas prices. The article further states that more research and development, as well as scientists, are needed to further develop clean technologies.²

With regards to waste minimization, estimates suggest that British companies can save over \$5 billion by reducing waste disposal costs. Businesses have the potential to achieve significant cost savings due to the incorporation of measures as simple as reusing or selling waste products that were once simply discarded. These reductions include the costs of buying raw material

¹ Engler, John. “Speech at Energy Efficiency Forum on 15 June 2005 in Washington, DC.” 15 June 2005. Online transcript. 06 October 2005. <http://www.nam.org/s_nam/doc1.asp?CID=69&DID=234540>.

² Jasinowski, Jerry. “Our Energy Future: Efficiency and Innovation.” 9 August 2005. *Atlanta Journal-Constitution*. 06 October 2005. <http://www.nam.org/s_nam/doc1.asp?TrackID=&SID=1&DID=234880&CID=201416&VID=2&RTID=0&CIDQS=&Taxonomy=False&specialSearch=False>.

waste and the reuse or sale of recovered waste products. Savings can potentially be even greater because this figure does not include savings from reduced energy costs.³

Government agencies, like the Environmental Protection Agency, also offer numerous voluntary programs to encourage company use of environmentally friendly practices. (Please refer to the Appendix for a brief summary of voluntary programs currently offered by federal agencies.) “Lean Manufacturing,” a program at the forefront of green manufacturing techniques, is a prominent example of how companies can implement environmentally friendly manufacturing practices to benefit their bottom line. The federal government, taking note of the beneficial uses of lean manufacturing, incorporates Lean into several of its voluntary programs.

One important aspect of Lean is that it is becoming a prominent strategy for small and medium-size firms to meet economic and competitiveness needs in the global market. Economic downturn in recent years and pressure from the global market have prompted increasing numbers of smaller businesses to seek out advanced manufacturing techniques to increase their competitive edge and ease supply chain pressures. Lean methods decrease time, material, and capital intensities. Resulting benefits include: reduced inventory levels, decreased material usage, optimized equipment, reduced need for factory facilities, increased production velocity, enhanced production flexibility, and reduced complexity. Lean experts indicate that “between 30 and 40 percent of all U.S. manufacturers report to have begun implementing lean methods, with approximately 5 percent well down the road of implementing multiple advanced manufacturing tools.” These numbers are indeed impressive given that transitioning to lean manufacturing usually takes 5-10 years and is a long-term strategy.⁴

Improved environmental performance is one outcome of Lean’s systematic elimination of non-value added activity and waste from the production process. Environmental performance, however, is not the primary incentive for organizations to engage in lean manufacturing. The EPA finds that companies generally engage in lean for three reasons: “to reduce production resource requirements and costs; to increase customer responsiveness; and to improve product quality, all of which combine to boost company profits and competitiveness”. Environmental improvements “basically ride the coattails of lean production” because lean methods do not explicitly incorporate environmental considerations. In summary, “lean is fundamentally about competitiveness, not environmental improvement.”⁵

NGOs also provide programs to increase the efficiency and “greenness” of corporations. The World Resources Institute, for example, has implemented Climate Northeast, a program where member corporations develop greenhouse gas inventories and share energy management practices to reduce costs and environmental impact.⁶ Forums like these serve to increase awareness of green technologies and their benefits. NAM, mentioned earlier, is another organization that conducts research to benefit their member base of manufacturers. The importance of environmental issues and cost saving strategies is evident by the attention these

³ Reeve, Paul. “Best Practice could boost profit” *The Safety & Health Practitioner* 21.8 (August 2003): 18(1).

⁴ U.S. Environmental Protection Agency. “Lean Manufacturing and the Environment: Research on Advanced Manufacturing Systems and the Environment and Recommendations for Leveraging Better Environmental Performance.” October 2003. Online Report. 06 October 2005. <<http://www.epa.gov/lean/leanreport.pdf>>.

⁵ Ibid.

⁶ Assadourian, Erik. “The Role of Stakeholders.” *World Watch*. 18.5: September/October 2005: 25.

issues receive from NAM in the form of cost-saving strategies, news reports, and policy analysis.⁷

Corporate leaders are recognizing that green industry changes will be in the best interest of their cost-saving strategies: “The motive for these corporate crusaders is less save-the-planet than protect-the-bottom-line.” General Electric, Ford Motor Company, Duke Energy, Exelon, and JP Morgan Chase are among the increasing number of Fortune 500 companies pressuring the federal government to mandate reductions in carbon dioxide emissions. With the launch of its multimillion dollar ad campaign, “Ecomagination,” GE has committed to developing clean energy technology and improving its overall production efficiency. The CEO of GE stated that this decision was taken, “not because it is trendy or moral, but because it will accelerate our growth and make us more competitive.”⁸

Not all companies have the same desire to go green. Reasons range from a lack of awareness of benefits to uneasiness due to the risk of high investment costs for structural changes. The decision for a company to go green is often hindered by issues of internal organizational factors and resources. Larger companies, compared to smaller companies with fewer resources, are able to invest in environmental management. The EPA and other organizations that help smaller businesses bridge this resource gap are important to the spread of lean and green technology. It is important to note, however, that some industries cannot go green without using more energy. *Energy Conservation News* cites the plastic industry as one industry where it may be more expensive to go green than to stay at status quo.⁹ These instances, however, are drastically outnumbered by support for green business models and technologies.

B. Attracting Investors

Environmental impact and efficient manufacturing are important to investors who have the access and the control to discuss business practices with management. Consequently, they have the ability to persuade businesses to adopt green practices.¹⁰ Investors have begun to collaborate to leverage their efforts. One such milestone occurred when investors recently met at the United Nations in May and formed the “Investor Network on Climate Risk.” This network pledged to invest \$1 billion in clean energy and vowed to pressure companies to disclose their environmental impacts.¹¹

According to Carbon Fund, a non-profit that promotes the reduction of carbon emissions, businesses reduce CO₂ in order to please shareholders who increasingly inquire about environmental practices.¹² As a result of the Sarbanes-Oxley Act of 2002, major U.S. companies are already incorporating greater transparency efforts into their business plans. This, along with corporate citizenship, attracts environmentally conscious investors. BP, UPS, and Proctor &

⁷ “Resources and the Environment.” NAM website. 07 November 2005. <http://www.nam.org/s_nam/sec.asp?CID=43&DID=41>

⁸ Little, Amanda Griscom. “CEOs Against CO₂.” *Sierra*, September/October 2005.

⁹ “Where’s the Savings in Green Manufacturing?” *Energy Conservation News*. 22.2: September 1999.

¹⁰ Assadourian, 23.

¹¹ *Ibid*, 24.

¹² The Carbon Fund website. 06 October 2005. <www.carbonfund.org>.

Gamble have successfully integrated new environmental policies that reduce energy consumption and environmental impacts.¹³

Investing in green and charitable corporations is popularly dubbed “Socially Responsible Investing,” (SRI). SRI is taking off in Western Europe where pension funds must disclose the environmental and social actions of their investments. This move gives shareholders much more influence over corporate behavior. For this trend to have a significant impact in the U.S., however, major investors and pension funds, will need to choose investments along SRI guidelines.¹⁴

C. Competitiveness

The average investor and consumer are not likely to knowingly, or actively, invest in a company that blatantly violates environmental standards or human rights. Environmental responsibility, which includes adopting green manufacturing practices, can raise long-run profits, especially if it creates extra benefits such as a better business environment that penetrates all levels of the operation. Consumers and investors have much more access to this information now than they did in the past. This knowledge and increased competition forces companies to be more responsible for their practices.¹⁵ Many firms must choose to be proactive and adopt green strategies or be reactive and change once they are prodded by consumers and investors.¹⁶

Ford’s recovery and redevelopment of its famous Rouge plant is one example of a company using green and lean technology to redefine its image and, in the process, become more competitive. The plant will focus on constructing a green building with a plant-layered roof, special ventilations, and other features. Eventually, Ford would like to transform all of its plants along this same model to promote green building and also to set itself apart from other car manufacturers. These new plants will include buying, selling, and leasing options, as well as the dissemination of a wide range of information about automotive world. This will serve as a way to inform Ford customers about recent company activities, as well as advertise its green image.¹⁷ Ford is not stopping there. The company is also pushing its tier-one suppliers to meet the green challenge by mandating that each tier-one supplier become registered ISO 14001 in order to make their business practices green as well. As a result, Ford not only implements green practices, it only associates with suppliers who are also willing to do so.¹⁸

Peter Asmus, writing for *California Journal*, discusses how the public perspective can be crucial for the success of companies.¹⁹ For example, ARCO, a gasoline company, started manufacturing gasoline with the component MTBE. MTBE was initially perceived to contribute to better air quality but actually infects ground water. Bad publicity, consequently, forced ARCO to reassess its manufacturing processes. As more corporations become environmentally sensitive, or face

¹³ “Corporate Citizenship Reporting Playing Larger Role in Global Companies’ Strategies.” 1 September 2005. Online article. 06 October 2005. <http://www.greenbiz.com/news/news_third.cfm?NewsID=28700>.

¹⁴ Assadourian, 24.

¹⁵ Schueth, Steve. “Caring Capitalism,” Responsible Investment Forum with Steve Schueth. 06 October 2005. <http://www.greenbiz.com/news/reviews_third.cfm?NewsID=28739>.

¹⁶ Assadourian, 25.

¹⁷ “Revolution at the Rouge.” *PR Newswire*. 01 November 1 2004: 8141.

¹⁸ Domico, Michelle and Jean Marie Saidler. “Clean and Green.” *Ceramic Industry*. 52.2 (Feb 2002): 54(3).

¹⁹ Asmus, Peter. “The Greening of Corporate California,” *California Journal*. 01 September 1998.

consumer boycotts over their lack of sensitivity, some environmental consultants are urging businesses, big and small, to incorporate environmentally friendly practices and techniques.²⁰

Evidence shows that small manufacturers are behind in acknowledging and addressing environmental concerns of governments and consumers. This information is not surprising given that smaller manufacturers have fewer resources. Small and medium-size businesses often lack the awareness or expertise to transition to green and lean manufacturing. Government programs, like Lean, have increasingly stepped in to fill this gap so that American manufacturers remain competitive with forward-looking foreign companies that exceed US environmental standards, such as Honda and Toyota.²¹

Green technologies will play a critical role for the survival of U.S. companies in the global market. Firms are looking to find a niche in the market and green manufacturing techniques are becoming a beneficial venue. Recently, China has expressed interest in becoming a world leader in producing hydrogen-fuel-cell powered cars. Leading car manufacturers have an incentive to develop vehicles for the massive Chinese consumer market. The Chinese government has taken the initiative by sponsoring R&D centers to promote green technologies. The Chinese market is so large that the price of fuel cells will decrease to more affordable levels and the infrastructure for hydrogen fueling stations will be sustainable. These emerging markets could potentially play host to a leading, innovative industry that is virtually non-existent elsewhere.²²

Like foreign competitors, foreign governments also influence the way American companies behave. “Keeping the future manufacturing enterprise secure is critical and should be a high priority for all manufacturers, although it is not currently at the top of the list for most companies. In the future, environmental pressures will increase in importance. This increase in importance will not be driven by EPA alone, but will be driven by regulations being implemented by our trading partners.”²³ Concentrating efforts on more efficient technology and setting standards in environmental management may force the rest of the world to emulate Europe and enable the U.S. market to remain competitive.²⁴

U.S. companies will have to abide by European Union standards if they wish to do business there. Recent history suggests that when new standards make their debut in the EU, they are eventually implemented by the U.S. and the rest of the world. For these reasons, many American firms who do global business find it in their best interest to adopt the new standards sooner rather than after being prodded by the EPA.²⁵ The EU directives, Waste Electrical and Electronic Equipment (WEEE) and Restriction on Hazardous Substances (RoHS), for example, will have

²⁰ Delmas, Magali A. and Ann K. Terlaak. “A Framework for Analyzing Environmental Voluntary Agreements.” *California Management Review*. 43.3 (Spring 2001).

²¹ “Green Manufacturing is A Strategic Priority” *Manufacturing News*. 7.6: 15 September 2000: 1.

²² Simmons, Craig. “The High Road.” *Newsweek International*. 29 August 2004.

²³ National Research Council of the National Academies. “New Directions in Manufacturing: Report of a Workshop. Washington, DC, 2004.” The National Academies Press. 05 October 2005. <<http://www.nap.edu/catalog/11024.html>>.

²⁴ “Europe’s Steelmakers Get Lean and Green.” *Business Week*. 19 February 2001: 00077135: 3720.

²⁵ Elkington, John and Mark Lee. “WEEE Are the World: New EU environmental standards are changing the global marketplace.” 20 September 2005. *Grist Magazine*. 06 October 2005. <www.Grist.org>.

significant implications for European manufacturers and consequently for American manufacturers competing in the same market.²⁶

III. Conclusion

Competitive companies today are turning to lean and green manufacturing techniques to improve their financial state, not necessarily to improve the environment. The EPA and Department of Energy programs that help companies transition to lean and green practices note this motive. Lean Manufacturing workshops, for example, are marketed as ways to save time and money, not ways to save the environment. Government experts surmise that efforts to “paint lean green” are not likely to make headway with most lean practitioners and promoters.²⁷ This is because many companies are not aware of the benefits of going lean and green.

Where once environmental responsiveness was viewed as involving expense and trade-offs with other corporate goals, it is increasingly being portrayed as an opportunity. Decreased operating expenses, increased sales, improved customer feedback, enhanced competition, and improved corporate image constitute significant benefits. The effective development of new, environmentally improved products will clearly be crucial in creating successful environmental strategies and in moving companies and economies towards environmental sustainability. Development and innovation remain critical elements in the creation of new products. This follows in the greening of manufacturing especially. Environmental concerns are leading to new customer requirements. In transitioning to these new requirements, however, companies need good managers and increased supplier involvement.²⁸

In order to move toward green manufacturing, businesses need to focus on entrepreneurship, long-term cost-saving strategies, corporate social responsibility, and commitment to the natural environment. Businesses should adopt a long-term perspective and understand that sound environmental practices can be profitable.²⁹ The companies that will succeed are the ones that envision the challenges of the future and start preparing for them now.

²⁶ Lee, Cash. “Green concept vital for local producers.” *China Daily-Hong Kong Edition*. 11 August 2005.

²⁷EPA. “Lean Manufacturing and the Environment.”

²⁸ Pujari, Devashish, Gillian Wright, and Ken Peattie. “Green and Competitive: Influences on Environmental New Product Development Performance.” *Journal of Business Research*, 56 (2003).

²⁹ Menguc, Bulent and Lucie K. Ozanne. “Challenges of the ‘Green Imperative’: a Natural Resource-Based Approach to the Environmental Orientation-Business Performance Relationship.” *Journal of Business Research*. 58 (2005): 430-438.

METHODOLOGY

To assess the business rationale behind the trend toward environmentally friendly manufacturing, we have identified seven suppliers in the automotive industry that work with large automotive corporations, and conducted interviews with these suppliers to assess the degree to which environmentally friendly manufacturing techniques affect company profitability. We also conducted an interview with GM to learn more about this rationale from the buyer perspective. The intent is to determine whether or not the incorporation of green manufacturing practices is a factor in a company's competitiveness and the extent to which decisions to go green are influenced through the automotive supply chain.

The interviews serve as case studies in this analysis and provide qualitative/anecdotal evidence as opposed to quantitative data. Each interview was carried out over the phone. We were unable to interview additional companies due to the time constraints of this project. The information we obtained from these interviews serves as the basis of our findings and policy recommendations to NACFAM.

Please refer to the Appendix for the list of interview questions used, the list of companies interviewed, and their corresponding contact information.

FINDINGS

Organization/Company	Findings: Company Perspectives on Green Manufacturing
Green Suppliers Network-EPA	<ul style="list-style-type: none"> • Goal for GSN is to attract members by selling the cost savings approach of the program, not the environmentally friendly approach (environmental aspect not part of big picture for these companies). • Lean is primary component of GSN because reduces waste, energy inefficiency, time (increases profitability). • GSN believes energy is the biggest area in which to save money.
Solvents and Solutions, Inc.	<ul style="list-style-type: none"> • Green is more expensive in the short term but benefits outweigh costs in long run. • Companies are hesitant to go green because of initial costs. • Important to educate companies about the benefits of green/lean. • Emphasize that implementing green techniques complements cost savings.
BAE Industries	<ul style="list-style-type: none"> • Trickle down effect to implement environmentally friendly techniques evident through supply chain often driven by OEMs. • Major reasons for going green: public image, regulatory requirements, reducing costs, and improving the efficiency of the facility. • Biggest obstacles: time, resources (involves many people to make change), and costs (long-term cost savings to make up for short-term loss).
FlexForm Technologies	<ul style="list-style-type: none"> • Government and the automotive industry need to be talking about LCMs (Life Cycle Management) and incorporating this into policy decisions. • Automotive suppliers and OEMs must start incorporating green/lean/LCM into their competitive strategy or they will face a credible threat of going out of business. • It is very important to switch to environmentally friendly manufacturing techniques earlier rather than later. FlexForm believes green techniques will be the primary method of manufacturing in the future because the resulting reduction of costs increases competitiveness.
General Motors	<ul style="list-style-type: none"> • Biggest Obstacle: Smaller companies do not go green because they do not have money, knowledge, or understanding, so GM mentors smaller companies to go green. • For GM, hard to implement environmental changes because company is so big.
Autoliv Electronics	<ul style="list-style-type: none"> • The Toyota lean manufacturing process is superior. • US companies will continue to lose their competitive edge if they do not innovate and become lean and green because of scarcer resources, rising energy costs and stiffer competition from the European Union. • Biggest Obstacles: lack of responsibility, knowledge, effort from senior management
UFP Technologies	<ul style="list-style-type: none"> • US companies are going to lose their competitiveness if they do not adopt EU standards soon. • Moved to an entirely automated assembly line that is totally green (were using people in the assembly line but was more expensive and had more waste). • In order to be competitive, companies need to have waste reduction across their entire production process.
Lear Corporation	<ul style="list-style-type: none"> • The incorporation of lean manufacturing is critical because it saves time, money, and reduces waste. It can therefore also be construed as environmentally friendly. • Cost savings is the only reason companies will adopt lean/green strategies. • Need to spend time with smaller suppliers to help them become lean and green because they do not have the resources to do so on their own. • Biggest Obstacle: small companies do not have the resources to go green on their own.

The findings and recommendations found in this report were compiled from interviews with manufacturers in the automotive industry. When developing our methodology, we initially intended to speak with representatives at GM and Toyota and their suppliers. Due to various resource constraints, our team realigned the methodology to sample automotive suppliers who work with several OEMs and collect qualitative data about their company experiences and perceptions with regards to going green. This broader approach remained true to our original goal to assess the business rationale behind the trend toward environmentally friendly manufacturing practices in the automotive industry.

The interviews typically lasted 30-60 minutes and centered on a list of talking points that can be found in the appendix. In total, we spoke with six automotive suppliers, one original equipment manufacturer (OEM), and a representative from the Environmental Protection Agency (EPA). Please refer to the Appendix for company contact information.

We found that many of the suppliers are required by their customers to meet various management and environmental standards. The most common standard is ISO 14001, which is implemented by 760,900 organizations in 154 countries. The ISO 14000 series of standards is primarily concerned with environmental management. To hold an ISO 14001 certification, organizations must minimize their harmful effects on the environment and achieve continual improvement of their environmental performance. ISO 14001 is designed to be flexible enough to apply to all organizations in both the private and public sectors. ISO 14001 Certification potentially improves environmental management and enables equal access to a going “green” in the market place.³⁰

A. Green Suppliers Network, EPA

On September 23, 2005, Project Green spoke with Laura Nazef, Environmental Protection Specialist in the Pollution Prevention Division of the Green Suppliers Network (GSN) at the EPA. GSN is a program initiated by the EPA in partnership with the Department of Commerce’s National Standards and Technology, Manufacturing Extension Partnership (MEP). The purpose of the program is to provide small and medium-sized manufacturing companies with technical assistance on lean and clean (a combination of lean and green) manufacturing techniques. GSN technical reviews assist manufacturers in implementing lean and clean manufacturing processes that increase energy efficiency, reduce resources, and eliminate waste. GSN also provides guidance to manufacturers on ways to enhance company resource efficiency and pollution prevention programs.³¹

GSN and MEP promote lean manufacturing to small businesses as a way to help the companies remain competitive. Lean focuses on eliminating wasted energy and time from the production process. Small and medium-sized manufacturers alike face considerable pressure from their purchasers to continually lower prices. The goal of GSN is to help these manufacturers meet this pressure through cost saving measures that also benefit the environment.

³⁰International Organization for Standardization. 17 November 2005 <<http://www.iso.org/iso/en/prods-services/otherpubs/iso14000/index.html>>.

³¹ Environmental Protection Agency. Green Suppliers Network, Basic Information. November 12, 2005. <<http://www.epa.gov/opptintr/p2home/gsn/network.htm>>.

Ms. Nazef noted that companies become members of GSN because they are looking for a holistic approach to profitability and sustainability; environmental performance is just one factor in this approach. GSN attracts potential members with the cost savings benefits of the program. The additional benefit of reducing a company's environmental impact through lean application is only a minor component. Furthermore, garnering good publicity for their environmental efforts is not a motivating force for GSN members. Members do not incorporate environmentally friendly manufacturing techniques to boost their public image, but rather because they realize the true benefit of green practices is cost minimization.

B. Solvents and Solutions, Inc.

On October 27, 2005, Project Green spoke with Bart Bergsbaken from Solvents and Solutions, Incorporated (SSI). SSI was founded over 20 years ago as a parts washer company. They have recently embraced a new technology, developed by Bob Westcott, called StillClean. President Bob Westcott, in trying to meet the needs of his customers in an industry with new regulations, developed and patented a small distillation unit in 1988 to be used in conjunction with their other parts cleaners. In 2002, Drawform, the larger sister company, decided to integrate its proven technology into an even smaller unit and, after two years of research and design, developed the StillClean. The StillClean is a solvent recycling System that is portable, easy to use, and affordable. SSI is a master distributor for StillClean.

SSI has worked with many companies in the automotive and other manufacturing sectors. At Rolls Royce, the StillClean recycles 900 gallons of hazardous waste and replaces it with 900 gallons of clean solvent, virtually eliminating any hazardous waste leaving the facility. Prior to the development of StillClean, solvents were recycled, but not with the same degree of efficiency and cost savings. The Rolls Royce Company reduced solvent purchases from \$300,000 a year to \$21,000 a year from recycling. The motivation to recycle the solvent was mainly for costs savings purposes, not necessarily because of ethical or environmental considerations.

Mr. Bergsbaken shared one anecdote about a manufacturer operating adjacent to a lake. That company used to drain solvent into the lake and then refill their tanks with new, clean solvent. SSI worked with them to install the StillClean, which has stopped the dumping of hazardous waste into the lake and reduced the purchase of solvent. Such companies are not aware of the affordability of recycling and other green technologies.

SSI mostly works with small businesses with limited resources. These businesses are more concerned about cost savings than about their environmental impact, so SSI primarily highlights the cost-effectiveness of the StillClean; the environmental advantages are secondary and not the major selling point. Mr. Bergsbaken's approach to selling a product differs greatly depending on the size of the company and the audience. While he stresses cost savings to companies like GM, he may greater emphasize the environmental aspects when speaking with a corporate environmental specialist.

Most often, however, companies view green technology as an expense. SSI overcomes this misconception with the fact that a relatively high-cost initial investment in green and lean technology will lead to long-term cost savings. The upfront cost to purchasing a StillClean

machine can be up to \$2,000. This is a difficult sell when dealing with small companies that are experiencing cash flow problems. SSI explains to such companies that by spending \$2000 now, they will save money at the end of the year and the following years to come through reduced solvent and dumping costs.

Sales are also difficult to OEMs and other large automotive companies with sufficient budgets. According to Mr. Bergsbaken, it takes more time to educate larger companies on the cost and environmental advantages of certain products because the decision makers are insulated by layers of corporate bureaucracy. These large companies state they are interested in environmental technologies and techniques but unfortunately are often merely paying lip-service to the concept of eliminating waste. New vendors often are not able to establish a relationship with OEMs, and therefore fail to make the leap from sales pitch to sale.

Mr. Bergsbaken stresses the need for education of the benefits of green and lean technologies. Some companies erroneously switch to water based solvents thinking it is better for the environment, but water-based solvents are harder to clean. This misinformation about products prevents many companies from going truly green. Many companies are hesitant to apply lean/green standards because they are reluctant to be the first to try something new. Others have soured to the concept of green technology because they primarily view green technology as an expense rather than a measure to complement profitability. Suppliers like SSI are able to bridge this information gap with cost-effective strategies.

C. BAE Industries

On October 31, 2005, we spoke with Chris Mieczkowski, the Quality Administrator at BAE Industries. BAE Industries began operations in the early 1970s as a Tier 1 supplier to General Motors. BAE offers metal manufacturing services ranging from prototype development to full manufacturing, production, assembly and delivery of engineered products. They work on the full range of development from concept, to design, to manufacturing and assembly, to delivery. Their specialty is making mechanisms for automotive seats (hinges, latches, floor mounting brackets). BAE now also operates as a Tier II supplier to Lear. This movement has allowed BAE to expand its customer base and product line.

According to Mr. Mieczkowski, most automotive suppliers make environmental improvements to maintain their ISO 14001 certification, often a requirement for contracts with OEMs. The automotive industry is one of the only industries where being ISO 14001 is a requirement to do business. Where once only Tier I suppliers were required to be ISO 14001, Tier II suppliers are now required to be ISO 14001 as well. Foreign OEMs sometimes have requirements that extend beyond ISO 14001. For example, Toyota suppliers must meet Toyota's own environmental standards. Asian and European standards, however, have not been as successful in permeating domestic OEMs and their supply chains. The OEMs' influence down the supply chain wanes beyond the Tier II level; it is not as common to see suppliers in Tier III and Tier IV certified, but many are trying to get there. GM, for example, is too far removed from its Tier III and Tier IV suppliers to influence them to become ISO 14001 certified.

BAE's environmental efforts place them on par with the majority of suppliers, if not ahead of them. In order to push environmentally friendly manufacturing even farther, BAE mentors its

suppliers. BAE sends a quality engineer to visit suppliers' facilities and to develop objective targets to improve suppliers' environmental practices. While BAE does not require their suppliers to be ISO 14001 certified, most are certified or close to it.

BAE also incorporates environmentally conscious decision making into its internal managerial structure. Managers work with one another to keep things clean and green, such as looking into ways to reduce natural gas and electricity use. Manufacturing engineers, when developing new projects, also look at ways to include lean concepts in order to make operations as efficient and economical as possible.

Mr. Mieczkowski noted some major factors in transitioning green manufacturing: public image, regulatory requirements, reducing costs, and improving the efficiency of the facility. The biggest obstacles in implementing environmentally friendly techniques are high-cost investments and the scarcity of time, resources and costs. Not all small suppliers have the capabilities that large suppliers have including resources, because of this, it is harder for smaller suppliers to innovate.

D. FlexForm Technologies

On October 27, 2005, we spoke with Garry Balthes from FlexForm Technologies. Founded in 1999, FlexForm Technologies began manufacturing non-woven natural fiber composite mats and panel products that are strong, lightweight, moldable, and completely recyclable. Natural fibers are derived from bast fibers, most commonly kenaf, jute, and hemp. FlexForm's composite materials serve the needs of several industries, including the automotive, recreational vehicles, truck, modular housing, office furniture, and packaging products. FlexForm Technologies engineers design and develop its products, serving as a full-service manufacturer.

FlexForm's production employs the latest manufacturing technology that provides high quality with the lowest man-hour industry standards cost. It manufactures green products made from 50% sustainable resource fiber with the remaining 50% from hydrocarbon-based polymers, an unsustainable resource. FlexForm dominates 90% of the automotive market in bast fiber reinforcement in North America, a new and growing market. Older technology is being replaced, moving to reduction in weight to reduce tail pipe emission costs while improving quality and impact safety. Lighter materials are also able to be fully recycled and reused without adding virgin materials—for example, door panels can be stripped from old cars, removing any foreign product such as ferrous and non ferrous materials, ground to correct particle size and then remolded into a composite sheet that can be remolded into another new door panel or other component. Nominally, natural fiber materials can be recycled up to two times before any significant degradation to material strength occurs, after which a percentage of virgin material can be blended in to bring the recycled composite material back to original specifications. These features are increasingly important as the cost of hydrocarbons rise and their availability diminishes.

FlexForm is considered a Tier I, Tier II and Tier III supplier because they supply to both OEMs and lower level suppliers. As a Tier I, FlexForm supplies to Absorb Tech with finished product. As a Tier II, FlexForm supplies to Johnson Controls, who molds FlexForm products as finished goods. Another client, Simco Automotive, is a Tier II supplier who molds FlexForm product in an interim process, then supplies to a Tier I who applies the finished surfaces. In all cases,

FlexForm provides customers from all Tier levels with research and development support, including design support during pre- and post-beta development. The Tier II aspect of FlexForm naturally gravitates toward green manufacturing due to constant pressure to improve technology, strength-to-weight ratios, price points, and technical advantage. Tier I firms see green as important avenue for cost reduction. FlexForm products, however, are not marketed to OEMs as supporting green, but instead as promoting cost reduction and increased efficiency in processing finished parts, and in improvements to safety and structure.

OEMs in general value green and lean technology for its cost-saving attributes, not for its low environmental impact. Mr. Balthes was quick to note that Toyota, however, is one exception because they promote significant cooperation with Tier I companies and their suppliers. Daimler-Chrysler, similar to Toyota, highly promotes the use of newer composite technologies with strong consideration to improved part performance and cost reduction of finished goods. The efforts put forth by these companies is substantially more involved and effective than the efforts of Ford and GM.

American companies will need to turn to green practices to counter global competition and diminishing natural resources. Unlike their Asian counterparts, American manufacturers have always had access to a ready supply of resources and raw materials. With rarely a resource scarcity, American firms often use the cheapest resource available without much regard to resource sustainability. These companies focus on primarily cost reduction and not the development or use of alternative technologies. This is perhaps one explanation why so many Tier I companies and OEMs currently face fiscal difficulties. Alternatively, companies like Toyota have never had unlimited access to natural resources and were consequently forced to innovate and practice lean and green manufacturing to reduce resource dependency. Green is the wave of the future and companies not keeping up with green technologies will inevitably be left behind. Large, domestic companies simply do not fully consider the need for resource conservation. Hydrocarbons are limited in supply, and dependent automakers will be in financial difficulty in the future as those resources become even scarcer. Executives at Vision, Delphi, and Ford may talk green, but they have not implemented a truly green approach at the engineering level. This complacency results in little product innovation and discourages the use of alternative materials.

Manufacturers must maintain price advantages through a variety of methods, and price points are the number one consideration for adopting green technologies. Other issues that influence the decision to go green are cost reduction through production efficiencies, design capabilities, and product longevity. For example, using lighter materials will reduce vehicle weight by two pounds, thus lowering the cost of the car and increase its gas mileage. While newer materials such as FlexForm's mats and paneling might be more expensive than their competitors', OEMs will be able to purchase less of FlexForm's products to fulfill their needs. This can save the OEM money, and conserve resources because the products are recyclable. When marketing green products, FlexForm must demonstrate cost savings because management often plays the role of decision maker when companies consider going green. Large companies, despite their budget resources, may be slower to turn green due to corporate bureaucracies that inhibit the transition.

Many of FlexForm's motivations for going green are due to European Union regulations. The EU Life Cycle Management (LCM) program aims to reduce the dependence on virgin materials, thus reducing landfill basis and extending the life cycle of vehicles by reusing valves. LCM states that all vehicle components must be recycled, with the supplier responsible for the parts recycling. LCM guides manufactures on the implementation of the regulations but does not dictate which materials to use. The vehicle price includes the recycle recovery price. There is a similar, albeit with looser guidelines, movement gaining momentum in North America. The goal of LCM in North America is to implement LCM voluntarily before it becomes government mandate. Some in the auto industry fear the US Government will follow the EU's lead by enacting LCM prior to consultation with the automobile industry. This type of regulation has yet to become a priority in the US political sphere partly because the public has not demanded it.

E. General Motors

On November 2, 2005 we spoke with John Bradburn from General Motors. Founded in 1908, GM is the world's largest automaker with 325,000 employees in 32 countries to support vehicle sales in 200 countries.

An example of some marketing tools GM uses to emphasize their green practices is an idea they call "environmental features." GM highlights special features on several vehicle models, such as splash shields composed of recycled materials that were manufactured keeping the environment in mind. GM also surpasses other OEMs by operating numerous plants, such as the Lordstown and Spring Hill facilities, that minimize environmental impact. Many other GM plants incorporate green facility products into their designs such as landscaping and architectural products produced from recycled materials. GM chooses to incorporate green practices because cost savings can be realized and consumers are also interested in knowing that their vehicle was manufactured in an environmentally conscious way. While GM views itself as a green company, it is important to note that going green is a budding industry-wide trend.

GM focuses on projects that are economically and environmentally efficient. Due to the high level of global competition, management decisions are mostly influenced by cost. GM, like other manufacturers, finds that waste reduction is one area where costs are reduced through lean and green technology.

Mr. Bradburn describes GM's relationship with suppliers as a formal process of sourcing. The involved process consists of the following steps: vehicle development, requests for quotes based on vehicle specifications, technical detail performed by engineers, evaluation by management. GM constantly searches for cost savings, increasingly via environmental metrics, goals and deliverables. In order to understand total costs, GM is working toward utilizing total life cycle business case development. This method factors in environmental, health and safety business case impacts which may result in initial costs in order to reap higher long-term sustainable savings.

GM uses its resources to spread the effects of green and lean manufacturing to its suppliers. GM mentors smaller organizations that lack resources, technical expertise or knowledge of the benefits of green. For example, GM has presented at the State of Michigan at its annual conference on waste reduction and efficiency. GM also visits universities and speaks to

suppliers to create environmentally friendly products. The corporation is also involved with the Suppliers Partnership for the Environment. This program offers cost reduction opportunities for companies that are too small to conduct their own research and development.

GM's size and resource availability is one asset that helps it transition to green. Because of GM's size, historically, change has been slow. However, today, processes are in place such as the Global Manufacturing System (GMS) and "Go Fast" systems to enable moving forward quickly. When a large company can move quickly, changes become significant and the impacts are greater. In the end GM needs to protect its products, market share and the environment.

F. Autoliv Electronics

On November 10, 2005, Project Green spoke with Ray Pekar, facility director from Autoliv Electronics. Autoliv Inc. was founded in 1997 as a result of a merger between Autoliv AB of Sweden, the leading automotive safety company in Europe, and Morton ASP, the leading airbag manufacturer in North America and Asia. Autoliv is now the global leader in the automobile occupant restraint market.

Recycling is a central component of the Autoliv manufacturing process. At one point in time, airbags contained heavily polluting substances that were harmful to the environment. Today, these substances have been removed and the non-pollutant components of old airbags are being reused. Autoliv has also reduced the amount of material used to make airbags thus creating a more efficient product with less waste. Autoliv transformed this process from an internal company-specific development to an industry-wide practice. This transformation was highly cost-effective in the long run.

Autoliv has been using the Toyota lean manufacturing production system since the 1990s. The company transitioned to lean manufacturing because it was a requisite in order to do business with Toyota. Mr. Pekar commented that Toyota heavily pressures its suppliers into incorporating the Toyota production scheme across all aspects of the manufacturing process to promote quality products and encourage cost savings. Mr. Pekar firmly believes that the assimilation of Toyota's lean manufacturing techniques within Autoliv has resulted in improved manufacturing effectiveness throughout the entire organization because it provides for a continuous strategy of improvement, efficiency, and profitability.

In order to assist suppliers in incorporating lean manufacturing, Toyota arranges onsite mentoring programs. In this situation, a Toyota mentor resides with a supplier company for one to two years, advising the supplier on ways to improve its production systems and company culture. Companies such as Ford and GM, on the other hand, have made efforts to emulate the Toyota scheme but to a lesser degree. These efforts have taken more of a "SWAT" team approach. Ford and GM will send mentors to supplier companies in order to educate the suppliers about efficient manufacturing techniques but the process is usually conducted over the course of one to two weeks and is not focused on long-term change and assistance. It is important to note that becoming lean is a 20-25 year process. Reports which state that the initial implementation of lean manufacturing can be completed within 3-5 years are incorrect. Lean is a long-term process because the central concept is constant improvement and innovation to reduce excess waste and energy.

Mr. Pekar noted many obstacles exist within the manufacturing industry, which prevent companies from adopting green manufacturing processes. Some of these obstacles include a company's lack of knowledge about green manufacturing techniques, a lack of corporate responsibility, and a lack of commitment from senior management. Companies which are unwilling to invest in lean/green manufacturing practices face a credible threat to competitiveness and profitability in the future. Mr. Pekar commented that the only time he believed suppliers would be negative about lean and green initiatives would be when customers have set unrealistic production deadlines and requirements (for example, the requirement within the automotive industry to include special coating on seatbelts which forced companies to incur high costs under a short timeframe). For the most part, companies want to be lean and green, assuming they can afford it and meet realistic demands.

Suppliers experience relentless price pressure from customers. Through the use of lean manufacturing techniques, Autoliv is able to stay ahead of the price curve and remain efficient and competitive in the world market. Mr. Pekar stated that lean/green technologies constitute the direction of growth for the automotive industry. These technologies are here to stay and will become one of the primary methods by which business is conducted. In order to remain competitive in the future, companies must shift to lean/green practices.

G. UFP Technologies

On November 9, 2005, Project Green spoke with Greg Curfman, program manager from UFP Technologies. Founded in 1963, UFP Technologies is a designer and custom converter of foam, plastics and natural fiber products. The company operates in North America with ten factories and three satellite facilities.

UFP functions as a Tier I as well as a Tier III supplier. For example, UFP is a Tier I supplier to GM but a Tier III supplier in the Mercedes supply chain. Seventy percent of UFP's market share comes from the sale of door panels, made out of fully-formed natural fibers, to Mercedes. An important feature within Mercedes production is the implementation of recycling practices at all levels of the supply chain. Mercedes promotes the continual research and incorporation of recycled materials and new technologies as ways to reduce costs and inefficiencies. Mercedes' products were initially designed and built in Europe where stricter manufacturing regulations and environmental considerations impose a heavy emphasis on recycled materials and waste reduction. Mercedes has continued this production system into business relations with American suppliers. Mr. Curfman highlighted that in doing business with Mercedes, roughly 1.5 million tons of material waste that was previously discarded at landfills, is now recycled back into the production chain. Mr. Curfman noted that when working with GM, on the other hand, the company solely focuses on cost savings. This can, at times, translate into the use of lower quality materials. A clear distinction exists between American car companies and foreign car companies with regards to their efforts to implement environmentally friendly manufacturing techniques.

Mr. Curfman shared some examples illustrating instances in which UFP Technologies adopted green practices in order to save costs. For example, UFP transitioned to an entirely automated assembly line that includes aspects of lean manufacturing, consequently eliminating excess waste

and time. UFP also invested in a high efficiency classifier system in which the heat released during the cooling process of product production was reduced, allowing for greater energy efficiency. Most manufacturers still employ the old system that generates a substantial amount of excess heat and contributes to higher production costs.

Naturally, there are several impediments to transitioning to new manufacturing practices, chiefly the incursion of large capital costs. On the whole, companies will incur short term losses due to the time needed to cover the costs of initial capital investments. These losses, however, will be offset by long-term cost savings due to increased efficiency and waste minimization. In order to remain competitive, companies must incorporate waste reduction processes, increased energy efficiency and a recycling mindset across their entire production line. Furthermore, it is important for companies to invest in manufacturing processes that reduce company dependence on oil and other nonrenewable resources. This should be the standard in the industry, not the exception.

H. Lear Corporation

On November 10, 2005, Project Green spoke with Rebecca Spearot, Director of Environmental Management, Lear Corporation. Lear Corporation is a Fortune 500 company and ranks as one of the world's leading automotive interior systems suppliers. Headquartered in Southfield, Michigan, Lear's production focuses on the integration of complete automotive interiors, including seat systems, interior trim and electrical systems.³²

Lear's manufacturing processes include seating assembly, headliner production, wire harnesses, cut and sew, carpet, and injection molding. Injection molding is one of the most energy intensive processes at Lear. Lear seeks out ways in which to incorporate increased energy efficiency in all their processes in order to mitigate the effects of high energy costs. Lear's investment in technological innovation and implementation of environmentally friendly manufacturing techniques is driven by long-term cost efficiency. Lear decided to implement Lean Manufacturing because of the associated cost savings. Lear's purchasing group also works with suppliers regarding lean manufacturing.

Dr. Spearot also noted that all Lear facilities are ISO 14001 third party certified in name and in practice. While some companies may tout their ISO 14001 certification, they refrain from fully benefiting from implementing related EMS management strategies. Lear, on the other hand, uses ISO 14001 as it was originally intended—as a management tool. Lear encourages its suppliers to become certified to the ISO 14001 standard and works with companies in mentoring programs to help them implement ISO 14001.

Lear invests in this approach because there is tremendous pressure from the market to reduce costs and by enacting these techniques, suppliers are better able to meet this challenge. Dr. Spearot acknowledged that it can often be difficult to engage smaller companies in these mentoring programs because of limited resources such as time and personnel availability.

³²Lear Corporation. 17 November 2005. <http://www.lear.com/jsp/common.jsp?page=al_aboutlear>.

On the whole, companies adopt green manufacturing techniques because of the associated cost savings benefits, and nothing else. Cost savings is the primary selling point for companies to implement lean practices. Environmental concerns and the positive public image that result from environmentally friendly manufacturing processes are only side considerations. Companies may choose to capitalize on these additional benefits or not. Cost savings is a natural consequence of lean manufacturing because of its inherent emphasis on “waste” reduction and it is this aspect that appeals to companies. Green, however, is invariably a component of lean because reducing waste and inefficiencies results in positive benefits for the environment. Collecting the associated “green” metrics is difficult, just because the definitions are not precise. Most all lean workshops can be related to “green” savings.

As a side story, Lear also partners with a company in Mexico, whereby Lear provides the company with excess materials, such as leather, that were “by-products” of the initial production process. The company is then able to reuse the leather to create bags, wallets, shoes and other consumer items. For example, Lear reduces the amount of money spent on costly transactions associated with dumping excess waste in landfills by implementing these manufacturing and recycling techniques and consequently minimizing physical waste.

By incorporating techniques such as ISO 14001 and Lean Manufacturing, Lear is simply keeping up with the market competition. In large part, the green culture of a company depends upon managerial leadership and initiatives.

Summary

Overall, the companies we interviewed agreed that lean/green technologies serve as a complement to company profitability and competitiveness. The main reason environmentally friendly techniques are undertaken is because of the associated cost savings. Companies do not initially implement green technologies due to any sense of ethical obligation to protect the environment. The influence of OEM decision making to implement lean/green strategies is also felt throughout the automotive supply chain to varying degrees. Most companies incorporate lean, for example, because of pressure from OEMs to improve efficiency and cut costs.

RECOMMENDATIONS

Based on the findings obtained from our interviews, we propose several recommendations for NACFAM and its members with respect to the current trend toward environmentally friendly manufacturing techniques.

1. Conduct a survey.

We recommend NACFAM conduct a survey in order to expand upon the findings of this report and obtain greater insight into the business rationale behind the trend to go green. Due to time constraints, this project focused on a small, case studies approach to obtain our findings and recommendations. This consequently limited the scope of our analysis. The next logical step for NACFAM would be to conduct a survey of 50-100 suppliers who supply a variety of products to OEMs throughout the country. The survey should be sent to suppliers via email to be filled out online. Hard copies of the survey should be mailed out if problems with email addresses arise. The purpose of the survey would be to examine, in greater detail, the breadth of the industry trend toward environmentally friendly manufacturing in order to generate substantive data for qualitative analysis and policy recommendations. The list of questions we used in our phone interviews, found in the Appendix, could serve as a basis for the survey questions. The structure of the survey should include open-ended questions with space to allow contacts to write in additional information, anecdotal evidence, etc. The initial obstacle to conducting this survey, which we also experienced in conducting our case studies, is to obtain the appropriate contact information.

Recurrent themes from project findings that NACFAM should expand upon in the survey:

- The decisions to implement lean/green technologies are driven by cost savings. Environmental benefits that result are a positive extension of these practices. This area offers noteworthy opportunities for growth and profitability.
- The European Union manufacturing regulations and standards, including the use of LCMs, are important areas that warrant further attention and research due to the increasing competitiveness of the world market. Suggested areas to develop upon would be EU regulations on LCM versus North American policies and the eventual politics that will likely play into the final LCM outcome in the United States.

(Mr. Garry Balthes of FlexForm Technologies and Mr. Ray Pekar of Autoliv are very knowledgeable on this subject. Contact information is included in the Appendix).

- The trend toward environmentally friendly manufacturing techniques is on the rise due to scarcer resources, tighter regulation, and increased competition. These techniques will be an integral component to profitability in the future.

2. Increase efforts to educate suppliers about the complementary relationship between lean/green techniques and cost savings.

Small and medium-sized businesses may not be aware of the cost savings associated with implementing environmentally friendly manufacturing techniques because of limited resources, time, and personnel. It is important to educate companies about environmental practices and lean manufacturing techniques that complement profitability rather than serve as a financial burden. Informational campaigns and long-term mentoring programs are examples of educational tools that OEMs can implement. To remain competitive, the manufacturing industry must invest in understanding this relationship.

In addition to educating suppliers about green manufacturing techniques, OEMs should actively advocate the incorporation of these techniques into company manufacturing processes. It is imperative that members invest in these techniques earlier rather than later in order to remain competitive in the future.

3. Understand how government programs, designed to encourage business incorporation of green practices, interface to best support the trend toward environmentally friendly manufacturing techniques.

It is in the best interest of OEMs to better understand how these programs work, what incentives they offer, and how effective they are in producing beneficial results. By learning more about these programs, OEMs have the opportunity to work with government agencies to improve upon these programs, create new programs, and/or direct agency attention to areas that may need further assistance.

Programs such as the Manufacturing Extension Partnership (MEP) and Green Suppliers Network (GSN) provide technical and financial assistance to manufacturing companies to enable the transition to green manufacturing techniques. OEMs that are knowledgeable of these programs can work with the Department of Commerce and Environmental Protection Agency to improve upon these programs and increase their effectiveness. Suggested improvements include: increased corporate involvement and education at the executive and management levels; greater data collection and analysis of potential and actual cost savings from green and lean technology; and increased public awareness of the benefits of lean and green technology.

These government enterprises and incentives will significantly benefit the American manufacturing industry because they promote enhanced competition utilizing efficient use of scarce resources, such as raw materials and energy; greater environmental stewardship; and heightened corporate social responsibility.

4. Support legislative action that benefits manufacturers by promoting the development of and transition to green technologies.

To encourage companies to invest in green technologies, OEMs would also profit from lobbying for legislative action that will assist manufacturing companies in defraying the up front costs of these investments. Such assistance comes in the form of tax credits or government subsidies that

would provide financial incentives to overcome these initial high costs. Senator Barack Obama (D-IL) and Representative John Inslee (D-WA) have also recently introduced legislation that would reduce the burden of healthcare costs for automotive makers who use a portion of those savings to develop fuel-efficient vehicles.³³ Legislation such as this provides creative avenues—outside the regulatory framework—through which the government can encourage research and development, and implementation of green technology.

³³ Little, Amanda Griscom. "The School of Barack." 22 November 2005. *Grist Magazine*. 30 November 2005 <<http://www.grist.org/news/muck/2005/11/22/obama/>>.

APPENDIX

A. Talking Points

1. What size market share does your organization possess? What factors contribute to your competitive structure and in which ways do you reduce costs?
2. Does your organization use lean manufacturing techniques? If so, what was the motivation to use lean? (E.g. cost savings, environmental considerations?)
3. Do your organization's manufacturing methods involve environmentally friendly manufacturing techniques? (E.g. pollution prevention, energy efficiency, recycling, waste minimization).
4. Are environmental considerations a component of your organization's profitability strategy? Do environmentally friendly manufacturing techniques complement profitability or hinder it?

If your organization does not use environmentally friendly manufacturing techniques, please proceed to #10.

5. Was the decision to use environmentally friendly techniques motivated by cost savings?
6. Are there other reasons, aside from cost savings, that informed your organization's decision to use environmentally friendly manufacturing techniques? (E.g. investor relations, attract new investors, public perception, etc).
7. Does your organization have data/anecdotal evidence relating to environmentally friendly cost savings or the percent of overall cost savings that can be attributed to environmentally friendly manufacturing techniques? (e.g. 0%, 0-5%, 5-8%)
8. By incorporating environmental considerations into its business practices, is your organization incurring short term losses in exchange for predicted long term profitability?
9. Were environmentally friendly manufacturing techniques incorporated into your organization's manufacturing process in order to remain competitive with other suppliers? When dealing with your buyers and/or suppliers, is the fact that your organization uses environmentally friendly techniques a selling point that improves your competitiveness when securing contracts?
10. As a supplier, what is your perception of environmentally friendly manufacturing techniques? Is "green" a dirty word in the automotive industry?
11. If your organization does not incorporate environmentally friendly manufacturing techniques, why not? What are the perceived obstacles to incorporating environmentally friendly practices?

B. Brief Overview of Existing Government Programs to Encourage Environmentally Friendly Manufacturing

Intense pressures exist for manufacturers to cut costs, raise quality, and speed up product development. These pressures are compounded by the requirement that companies work within the framework of environmental regulations promulgated by the Environmental Protection Agency (EPA). The high cost of compliance with regulations and protection against litigation can, at times, work to undercut business competitiveness. Manufacturers can be especially hard hit by these burdens: “The cost of regulatory compliance alone adds up to \$8,000 per manufacturing employee, 67% higher than average cost per employee of businesses overall.”³⁴ To address this issue, federal agencies have established an array of voluntary programs to help companies remain competitive, while also complying with environmental regulations. As opposed to the command and control strategies employed in previous decades, the federal government is now promoting the use of voluntary programs to achieve business and environmental objectives. While regulations certainly play an important part, voluntary programs have the potential to support superior environmental results.

The following is a brief overview of existing, voluntary programs created by federal agencies (Environmental Protection Agency, Department of Energy, and the Department of Commerce) to promote and encourage the use of environmentally friendly manufacturing practices.

(All information contained in the following summary was taken from agency websites).

Environmental Protection Agency

Green Suppliers Network (GSN), Office of Pollution Prevention and Toxics (OPPT)

The Green Suppliers Network (GSN) is a collaborative project between industry, the U.S. Environmental Protection Agency (EPA), and the U.S. Department of Commerce’s Manufacturing Extension Partnership (MEP). GSN works with small and medium-sized manufacturers and their suppliers in providing low-cost technical reviews that focus on process improvement and waste minimization. 360vu, the national accounts arm of MEP, administers the technical reviews. GSN teaches suppliers Lean and Clean manufacturing techniques which help to increase energy efficiency, identify cost-saving opportunities, and optimize resources to eliminate waste. Lean and Clean Manufacturing focus on incorporating process, energy, and material efficiencies into supply chains that can lead to substantial environmental benefits and reductions in labor and capitol costs. Clean manufacturing consists of integrating environmental considerations into the lean manufacturing framework. By combining lean and clean manufacturing methods, technical reviews optimize resources such as labor and materials, identify opportunities to maximize return on investment, and eliminate waste. As a result, companies establish processes that are more effective and products, higher profits, and fewer environmental impacts. GSN reviewers work with suppliers to identify significant cost savings to improve the organization’s bottom line. Organizations also retain all cost savings from

³⁴ National Research Council of the National Academies. 2004. “New Directions in Manufacturing: Report of a Workshop.” Washington, DC: The National Academies Press. 06 October 2005. <<http://www.nap.edu/catalog/11024.html>>.

implementing GSN recommendations. The EPA provides program support and financial assistance to help cover initial start-up costs.

Website: <http://www.epa.gov/greensuppliers/>

Contact: Laura Nazef
Office of Pollution Prevention and Toxics
Tel: (202) 564-7523
Email: nazef.laura@epa.gov

Lean Manufacturing, Office of Policy, Economics, and Innovation (OPEI)

Lean Manufacturing is a business model that emphasizes eliminating waste while delivering quality products at the least cost to manufacturers and customers. Waste is characterized as the use of loss of resources that do not lead directly to creating a product or service a customer wants. Lean has three objectives:

1. Reduce production resource requirements by minimizing inventory, equipment, storage, and production space and materials;
2. Increase manufacturing velocity and flexibility;
3. Improve quality and eliminate defects.

The overall objective of lean is therefore, the rapid, continual improvement in cost, quality, service, and delivery. Significant environmental benefits typically result as a consequence of this process. Lean methods do not intentionally incorporate environmental considerations into its manufacturing processes, thereby providing an opportunity for the EPA to work with industry to further enhance an organization's environmental performance. Multiple companies of various sizes, nationwide, in multiple industry sectors (primarily in manufacturing and the service industry) are implementing lean production. Companies generally choose to engage in lean manufacturing to boost company profits and competitiveness. Lean Manufacturing represents a fundamental paradigm shift from conventional "batch and queue" mass production to product-aligned "one-piece flow" pull production. Numerous methods exist by which organizations can implement lean production. Lean methods include 5S, Standard Work & Visual Controls, Cellular Manufacturing, Just in Time (JIT)/Kanban, Total Productive Maintenance (TPM), and Six Sigma.

Website: <http://www.epa.gov/lean/>

Contact: Mitch Kidwell
Office of Policy, Economics, and Innovation
Tel: (202) 566-2214
Email: kidwell.mitch@epa.gov

Green Supplier Network and Lean Manufacturing are the two most prominent voluntary programs that serve the needs of manufacturers. There are additional voluntary programs offered by the EPA that provide beneficial uses to manufacturers and promote environmentally friendly techniques. Green Suppliers Network and Lean Manufacturing can also incorporate the following programs and practices into their implementation plans. The following is a summary of these programs:

Environmental Management System (EMS)

Environmental Management Systems (EMSs) are important vehicles for improving environmental performance by providing organizations with tools to manage successfully their environmental activities in a cost-effective manner. EMSs maintain standard processes and practices for addressing environmental impact and assist organizations in managing regulatory responsibilities and unregulated environmental impacts such as resource conservation and energy efficiency. The implementation of EMSs encourages organizations to incorporate environmental issues into everyday operations. EMSs provide the following benefits to organization: assistance for compliance with regulatory responsibilities and non-regulatory responsibilities such as energy efficiency and resource conservation, facilitation of risk and liability assessments, increased operating efficiency, creation of standard operating procedures, increased employee environmental awareness, and improved public relations. Current research regarding EMSs suggests organizations believe they are beneficial in improving performance and compliance issues.

Website: <http://www.epa.gov/ems/index.htm>

Sector Strategies Program, National Center for Environmental Innovation (NCEI)

The Sector Strategies Program customizes strategies that hone in on special circumstances within specific industries. The program works with these specific industry sectors to improve environmental performance by reducing the impact of selected manufacturing and service sector processes. Priorities of the program include, addressing regulatory barriers that can stand in way of better performance, promoting widespread use of EMSs developed with sector-specific operations, and developing measures to track environmental performance. Sector Strategies expanded its clientele in 2003 and currently partners 12 sectors: Agribusiness, cement manufacturing, colleges and universities, construction, forest products, iron and steel manufacturing, metal casting, metal finishing, paint and coating, ports, ship building and ship repair, and specialty-batch chemicals.

Website: <http://www.epa.gov/sectors/program.html>

Sustainable Futures Initiative, Office of Pollution Prevention and Toxics (OPPT)

Sustainable Future Initiatives is a program directed toward chemical manufacturers and manufacturing industries that use chemicals. The program combines the Pollution Prevention (P2) Framework (a tool which combines numerous computer-based methods that screen for hazardous exposure concerns and allows for faster review of pre-manufacture notices) with training, technical assistance, and special support for small businesses. This strategy promotes the design, development, and application of safer products and processes throughout the chemical industry.

Website: <http://www.epa.gov/opptintr/newchems/sustainablefutures.htm>

Design for the Environment (DfE), (OPPT)

Design for the Environment (DfE) helps companies to find more environmentally sound alternatives to existing processes or technologies. DfE works with individual sectors to compare

and improve performance, human health and the environmental risks and costs of existing and alternative products, processes, and practices. The program promotes integrating cleaner, cheaper, and smarter solutions into everyday business practices. It also incorporates the idea of green chemistry discussed below.

Website: <http://www.epa.gov/opptintr/dfe/about/index.htm>

Green Chemistry Program, (OPPT)

The Green Chemistry Program promotes the research, development, and implementation of innovative chemical technologies that prevent pollution in scientific and cost-effective manners. Green Chemistry involves the creation of chemical products and processes that reduce or eliminate the use and generation of hazardous substances during the design, manufacture, and use of chemical products and processes. This model supports the use of chemistry for pollution prevention. The program works in collaborations with industry, academia, and government agencies. Partners in industry included: BF Goodrich Company, Dow Chemical Company, Dow Corning Corporation, E.I DuPont de Nemours, Eastman Kodak Company, Polaroid Corporation)

Website: <http://www.epa.gov/greenchemistry/index.html>

Energy Star, (OPPT)

Energy Star promotes energy efficient products and practices and remains a valuable market for manufacturers. EPA offers strategies for superior energy management with tools and resources to help in the efforts to save energy. Such tools and resources include technical guidance, procurement policies, demonstrated best practices, and communications resources. Energy management is an important aspect of environmental management that provides favorable dividends for business. Research suggests energy management allows businesses to achieve superior financial performance and cost saving results. The Department of Energy also promotes Energy Star.

Website: <http://www.energystar.gov/>

WasteWise Program, Office of Solid Waste and Emergency Response (OSWER)

The WasteWise program helps organizations eliminate costly municipal solid waste and select industrial wastes, which ultimately benefits the bottom line and the environment. The flexibility of the program allows partners to design their own waste reduction plan. The program also provides free technical assistance to help organizations develop, implement, and measure waste reduction activities. There is no membership fee. Organizations have the opportunity to set goals that are most feasible and cost-effective for their own interests. Waste reduction, however, makes good business sense by saving organizations money through reduced purchasing and waste disposal costs. Large and small businesses from all industry sectors can participate.

Website: <http://www.epa.gov/epaoswer/non-hw/reduce/wstewise/about/index.htm>

OSWER also created, The Guide for Industrial Waste Management, which offers tools and recommendations for reducing waste specific to the manufacturing process.

“Guide for Industrial Waste Management” <http://www.epa.gov/epaoswer/non-hw/industd/guide.htm>

Department of Energy

Manufacturing processes are amongst more energy-intensive processes. Energy costs are therefore a major financial concern for many manufacturers in the United States. Companies achieve substantial energy and cost savings through efficiency enhancements to technology adopted by industries.³⁵ The Department of Energy promotes and provides access to these technologies.

Office of Industrial Technologies (OIT):

The Office of Industrial Technologies (OIT) is part of the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy. OIT develops and provides advanced energy efficiency, renewable energy, and pollution prevention technologies for industrial applications through partnerships with industry, government and NGOs.

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Industrial Technologies Program (ITP)

Industrial Technologies Program (ITP), a division within the Office of Industrial Technologies (OIT), helps companies reduce energy requirements of manufacturers while stimulating growth. ITP supports technology partnerships aimed at improving industrial energy efficiency. According to the National Research Council of the National Academies, the commercialization of emerging technologies that result from this partnership included: saving energy and materials; facilitating cost-effective compliance with environmental regulations; increasing productivity and reducing waste; enhancing product quality; reducing production costs; and boosting competitiveness in global marketplace.

Website: <http://www.eere.energy.gov/industry/>

ITP sponsors the following programs which promote environmentally-friendly manufacturing practices/tools:

- **Industries of the Future**

Industries of the Future is a strategy the OIT uses to promote industry-wide efforts to improve resource productivity. ITP possesses portfolios of over 500 Research and Development projects addressing the priority needs of energy-intensive industries. Industrial projects have been conducted in the following nine energy and resource intensive fields: aluminum, chemicals, forest products, glass, metal casting, mining, petroleum refining, and steel.

³⁵ National Research Council of the National Academies. 2004. New Directions in Manufacturing: Report of a Workshop. Washington, DC: The National Academies Press. 06 October 2005. <<http://www.nap.edu/catalog/11024.html>>.

Website: <http://www.eere.energy.gov/industry/technologies/industries.html>

- **Industries of the Future: BestPractices**

BestPractices serve to help the country's most energy-intensive industries to improve their competitiveness by bringing together the best available and emerging technologies and practices. Implementation of these technologies come together to assist companies in improving energy efficiency, environmental performance and overall productivity. OIT tools help manufacturing plants to improve reliability, reduce downtime, save money, increase productivity and competitiveness, and reduce emissions. The website includes case studies that document the success of best practices and lessons learned for companies to look into. The website also provides access to software and databases designed to help manufacturers save money through efficient, energy management systems. To request copies of BestPractices or learn more about products and tools, call the OIT Clearinghouse: (800) 862-2086 or download the information at:

www.oit.doc.gov/bestpractices

Website: <http://www.eere.energy.gov/industry/bestpractices/>

- **Industrial Assessment Centers (IACs)**

Industrial Assessment Centers provide comprehensive, industrial energy evaluations to small and medium-sized manufacturers. The centers consist of teams of engineering faculty and students located at 26 universities around the country. These teams conduct in-depth energy audits or industrial assessments, at no cost to manufacturers, and provide recommendations to manufacturers to help them identify opportunities to improve productivity, eliminate waste, and save energy. Recommendations average about \$55,000 in potential annual savings for each manufacturer.

Website: <http://www.eere.energy.gov/industry/bestpractices/iacs.html>

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Department of Commerce

National Institute of Standards and Technology (NIST):

NIST is a non-regulatory federal agency within the U.S. Department of Commerce's Technology Administration. The mission of the organization is to develop and promote measurement, standards, and technology to enhance productivity, facilitate trade, and improve the quality of life. NIST has four programs to carry out this mission: NIST Laboratories, Baldrige National Quality Program, Advanced Technology Program, and the Manufacturing Extension Partnership. Of interest for this literature review is the Manufacturing Extension Partnership (MEP): a nationwide network of local centers offering technical and business assistance to small and medium-sized manufacturers.

Website: <http://www.nist.gov/>

Manufacturing Extension Partnership (MEP):

MEP is a nationwide network of nearly 350 nonprofit centers. The purpose of these centers is to provide small and medium manufacturers with the help they need to succeed in a global market. MEP advises manufacturers on energy efficiency, introduces links to local resources and expertise, supports greater supply chain integration, and provides access to technology for improved productivity. All centers, serving all States and Puerto Rico, link through the Department of Commerce's National Institute of Standards and Technology. The centers receive funding from local, state, federal and private sources. Each center works directly with manufacturers to provide expertise and services tailored to the organization's needs. This can range from process improvements, and worker training, to business practices, and applications of information technology.

Website: <http://www.mep.nist.gov/>

MEP offers the following products and services: Lean Manufacturing; Strategic Management; Quality; Growth Planning; Environment, Health, and Safety; Human Resources/Organizational Development. Of interest for this literature review are Lean Manufacturing and Environment, Health, and Safety.

- **Lean Manufacturing:**

U.S. manufacturers are facing increased global competition. To this end, many organizations have begun to implement lean manufacturing techniques. The goal of Lean Enterprise is to eliminate overproduction caused by traditional scheduling systems and to produce only what customer's want, when they want it. Lean Enterprise focuses on producing more with existing resources by eliminating non-value added activities. MEP helps organizations to develop and implement long-term plans to streamline operations. The resulting benefits of lean include: reduced cycle time, reduced inventory, reduced work-in-progress (WIP), reduced costs, increased capacity, improved lead times, increased productivity, improved quality, and increased profits.

Website: <http://www.mep.nist.gov/lean/lean.html>

- **Environment, Health and Safety:**

MEP consultants help companies avoid wasting materials and energy. This program provides the following services: Environmental Management Systems (EMS), energy efficiency, waste reduction, material selection, recycling, and worker safety. These services are provided through the Clean Manufacturing methodology. Clean Manufacturing seeks to continuously improve processes and products in order to increase companies' productivity and lessen their impact on the environment. MEP consultants identify causes of waste and proceed to develop an action plan to improve the organization's performance that leads to greater profits and cost savings.

Website: <http://www.mep.nist.gov/environment/environment.htm>

NIST Workshop to Address New Global Environmental Regulations (October 5-7, 2005)

NIST will be conducting this workshop to assist U.S. manufacturers and their supply chains in meeting new environmental regulations implemented by the European Union (EU). These regulations restrict the use of hazardous substances in electronics and a wide range of other consumer products. The workshop will focus on addressing the challenge U.S. industry faces in coming into compliance with the EU directive on the Restriction of Hazardous Substances (RoHS) in Waste Electrical and Electronic Equipment (WEEE), which comes into effect in July 2006. RoHS restricts lead, mercury, cadmium, hexavalent chromium, and PBBs and PBDE flame-retardants.

Website: <http://www.mep.nist.gov/RoHSconference/RoHSconference.htm>

This will be a good session to follow up on since the workshop will also touch upon environmentally friendly manufacturing to be enacted in accordance to RoHS Directives.

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