

# Deployment of Green Best Practices in Supply Chain Processes

Howard Sodano, Jr.

<sup>1</sup>Christian J. Grandzol, Ph.D., CPIM  
Department of Management  
Bloomsburg University, Bloomsburg, PA 17815

## ABSTRACT

Developing practices, processes, and products that have minimal impact on the ecosystem has become a key driver for supply chain management professionals. “Going green” can both lower costs and provide a competitive advantage, yet a majority of firms remain underprepared. This study identified green “best practices” in the supply chain field and investigated the extent to which selected businesses in the Northeastern Pennsylvania (NEPA) region are instituting them. We found that the selected companies are pursuing several green best practices and are especially strong in manufacturing activities. However, most practices are, at best, only in the infancy or isolated stages. Opportunities for businesses to more fully integrate their green programs and expand their green projects are discussed.

**Keywords:** environmental impact; green sustainability; Supply Chain Management

An MIT Sloan Management Review study found that 92% of executives believed that environmental sustainability impacts their business (2009), and Becker (2008) reported that green (reducing impacts on the environment) requires a long-term strategy. Yet, firms have taken on green initiatives with limited vision and questionable commitment. For example, the MIT study found that 70% of executives reported having no case for green, and over 50% said their efforts to date were to meet regulatory requirements. The result: a majority of companies are underprepared to see the environmental and economic benefits they could achieve (Aberdeen Group, 2008).

Green efforts were traditionally viewed as distractions or resulted from the need to comply with regulations (Aberdeen Group, 2008), but that perspective has been changing due to a variety of reasons including the realization that green can bring positive financial outcomes. For example, when companies comply with mandates to replace hazardous materials or reduce wastes going into landfills, they often discover they can save money, reduce risks, increase revenues, and improve image (Chorley, 2009; Crandall, 2008). Organ-

izations committed to green have been rewarded with demonstrable results in areas such as cost savings and share price growth. For example, an A.T. Kearney study (2009) found that sustainability-focused companies’ stock price outperformed their peers in 16 of 18 industries during the recent recession by an average differential of 15%.

It is likely that the greatest green impact will come in the supply chain field (Galvao, 2010; Becker, 2008), because the supply chain has a disproportionate impact on the environment and the direct activities of one company are generally a small portion of the overall chain’s impact (Wilkerson, 2008). When a customer buys a product, they also inherit the practices and processes that made and delivered that product. This chain is where the majority of environmental impacts tend to be created and consequently is where the largest opportunities reside (Carbon Disclosure Project, 2010a). True improvement is only possible when companies work to green their supply chains. Therefore, our purpose was to identify:

1. Supply chain practices that are known to reduce environmental impacts.
2. The extent to which select businesses in NEPA use these practices.

---

<sup>1</sup>Faculty mentor and correspondent [cgrandzo@bloomu.edu](mailto:cgrandzo@bloomu.edu)

## LITERATURE REVIEW

A supply chain is a network of organizations that engineers the flow of information, products, services, and funds (Blackstone & Cox, 2008). Supply Chain Management (SCM) is the activity that manages these processes, but perhaps uniquely from other fields, does so in a cross-functional and cross-organizational fashion (Lambert, 2008). The scope of SCM is large, spanning activities such as design, procurement, manufacturing, distribution, and reverse logistics. Most organizations can be considered supply chain companies. For example, manufacturers are part of a supply chain as are transporters, service providers, distributors, retailers, etc. Regardless of their place in the chain, companies pursue various practices to execute their supply chain processes.

Green SCM (GrSCM) refers to improving the environmental performance of companies, their suppliers and customers, and the links between them (Lu *et al.*, 2007). GrSCM attempts to integrate environmental thinking into all aspects of SCM, including product design, material sourcing, manufacturing, packaging and labeling, transportation, and end-of-life management (Srivastava, 2007). Previously, organizations employed separate units for environmental management, but “the best practices call for integration” (Srivastava, 2007, pg. 53).

SCM is a central focus for green efforts because of the scope of the activities it encompasses and the need for continued viability of supply (Srivastava, 2007). As Penfield (2008) noted, today’s SCM issues will become much more severe in the next decades. Creating sustainable supply chains requires new practices where the impact on air, water, land, and life are known, managed, and mitigated (Malcolm, 2010). Conducting supply chain assessments, improving production processes in collaboration with partners, designing products for better environmental compatibility, redesigning logistics networks, and using green sourcing strategies are essential tasks for today’s SCM managers (Becker, 2008; Malcolm, 2010).

Despite these realizations, it appears difficult to implement GrSCM. Over a decade ago, Narasimhan and Carter (1998) found that few organizations determined the economic risks that come from environmental impact, and that even if high level managers emphasized environmental issues, they were short on the talent and budgets to address them. These same issues are present today. Bangalore (2009) reported that many companies undertake *ad hoc* green projects without well-defined frameworks, unclear payback timeframes, and lack of clear objectives. Capgemini Consulting (2010) found that 56% of companies believe that sustainability is a key driver in their supply chain agenda, but only 34% reported a sustainability program as one of their Top 10 projects. Another study found fragmented GrSCM efforts at a majority of companies and little use of endorsed standards (Conference Board, 2010).

These fragmented efforts and variable commitment levels lead to underperforming organizations that do not realize the operational efficiencies they might otherwise achieve. Aberdeen (2008) reported that companies with the strongest green programs realized annual cost decreases in supply, facilities, energy, and transportation, while companies with the weakest programs saw those same costs increase. What makes for a “strong” green program? A variety of individual practices have been identified including, but not limited to: calculating the return on investment for green projects (Conference Board, 2010), tracking material and energy flows during a product’s life (Lu *et al.*, 2007), establishing systems that capture and convert post-consumer waste (Field & Sroufe, 2007), speeding the velocity of returns management flows (Aberdeen, 2010), and expanding procurement decisions to include environmental considerations (Malcolm, 2010).

Complete frameworks have also emerged that specifically address GrSCM issues. One involves infusing green into existing SCM improvement methodologies such as Lean Six Sigma (Chapman & Green, 2010). Lean Six Sigma is a hybrid improvement methodology that incorporates Lean Manufacturing’s elimination of non-value adding activities and rapid improvement focus with Six Sigma’s systematic approaches to variation reduction and employee training. Expanding the focus of Lean Six Sigma to include environmental wastes ensures green is not relegated to an isolated status, but is instead integrated into existing programs. This can result in decreased costs, liability, and risk of compliance violations (EPA, 2007). For example, standard Lean Six Sigma practices can be used for a variety of environmental impacts without having to create redundant programs. For instance, a company can use standard Lean Six Sigma practices to eradicate energy consumed in excess of necessity. This will help the organization lower costs.

Another framework adds green considerations to the Supply Chain Operations Reference Model (SCOR), a widely-used, process-focused SCM framework. GreenSCOR integrates environmental considerations throughout SCM activities to green the actions that drive the entire chain, not just individual pieces. It synchronizes efforts among suppliers and customers, uses standardized metrics to measure total supply chain footprint, and provides green best practices for a variety of processes (Supply Chain Council, 2008).

It is clear that GrSCM is a core consideration for today’s businesses and can reduce environmental impact and supply chain costs (Aberdeen, 2009a). Attention has turned away from “why” GrSCM is needed, to “how” it should be done (Bangalore, 2009). Our review indicated that guidance already exists, but there is a disparity between what this guidance directs organizations to do and what they are actually doing. There is a gap between intent and action at most companies, and actions to date have been largely defensive, disconnected, and incremental (MIT, 2010).

## METHODS

### Participants

Five organizations from the NEPA Chapter of the Association for Operations Management (APICS) participated in the study by completing a questionnaire that examined the supply chain activities at their facilities. These organizations were primarily units of larger companies. The participants represented the industrial supplies, industrial goods, metal fabrication, and pharmaceuticals industries and varied in size from \$20 million in annual revenues and 70 employees at the facility to \$130 million in annual revenues and 400 people at the facility. These companies were members of supply chains (as manufacturers or distributors), and the study examined these organizations' practices.

### Procedures

In fall 2010, we asked 6 manufacturing and distribution organizations to participate since they were active members (defined as holding a leadership position) in the NEPA APICS Chapter. They were informed that participation involved completing a detailed questionnaire of various GrSCM practices. The questionnaire was distributed electronically to the organizations' representatives and was returned via e-mail. Five of the 6 selected companies returned their questionnaires. The study was not designed to yield a representative sample; it was intended to yield in-depth analyses of select companies.

### Instrumentation

We researched existing instruments and found there were none that assessed the comprehensive green practices that occur under the supply chain umbrella. Therefore, we developed a detailed survey after reviewing credible sources such as the Supply Chain Council, APICS, MIT Sloan Management, and Aberdeen Group. The questions related to best practices identified by one or more of these sources. The survey was lengthy (see Appendix A) and was designed so that organizations can use it to evaluate their standing relative to the identified industry best practices.

In addition to the faculty mentor, the survey was examined by another expert at a PASSHE institution. The expert has a background in survey design and a Ph.D. in operations research. He teaches/publishes extensively in the supply chain field and is familiar with the best practices for green supply chain as published by the leading professional societies. The expert suggested changes to some of the scales, suggested clarifying some of the terminology, helped with the demographics questions, and suggested deleting questions that were not critical. The design of the study and the scaling of the questions prohibited additional psychometric analyses.

### Data Analysis

The survey captured nominal data due to the categorical scales of yes/no or no efforts, little is being done, etc. (see

Appendix A). Descriptive statistics were calculated for each question and the results were summarized using tables. These analyses helped categorize the extent to which the selected businesses were pursuing the various practices.

## DISCUSSION OF RESULTS

The responses from the 5 selected companies are summarized in Tables 1 through 7. Each table contains best practices grouped into categories that were chosen to align with common supply chain processes or activities. For example, practices that specifically deal with manufacturing or facility management are grouped together; practices that focus on transportation are grouped together. A company occasionally answered "not applicable" on an individual question; these data were excluded from the tables. We present responses on 40 of the 55 survey questions. Seven questions were classification questions and the others we did not report were deemed non-essential for this paper.

### Strategic Emphasis

Table 1 displays the strategic emphasis the selected companies place on GrSCM. There was a disparity between the espoused importance of green as a driver in the supply chain agenda (60% said it was "somewhat important") and the priority placed on green in budgeting considerations (only 20% said it was "somewhat important"). The reverse supply chain (bringing back returned or used products) was also not particularly important to the selected companies. Aberdeen Group (2008) reported that the top performing GrSCM com-

Table 1. Strategic Emphasis on GrSCM (n=5)

	Not Important	Somewhat Unimportant	Somewhat Important	Very Important
Green as a driver in the SC agenda	20%	20%	60%	0%
The reverse supply chain on operational and financial performance	0%	60%	40%	0%
Priority of GrSCM in budgeting considerations	40%	40%	20%	0%

panies are differentiated by clear emphasis on GrSCM as a driver, strongly integrated programs and coordinated vision. Given the relative lack of commitment from the sample companies, it is doubtful that GrSCM will be a driving source of advantage unless definitive commitments are made.

### Commitment to Green

Table 2 displays basic foundational practices of GrSCM such as having an executive for GrSCM and including green in the mission statement. The majority of companies are publishing GrSCM information annually and using cross-functional teams. An area of concern was that 60% of the businesses do

Table 2. Organizational Commitment to Green (n=5)

	No	Yes
Clearly articulates commitment to green in mission statement	60%	40%
Has an executive leader responsible for GrSCM initiatives	40%	60%
Publishes GrSCM information at least annually	40%	60%
Pursues GrSCM via cross-functional teams	40%	60%
Uses endorsed standards	60%	40%

not use endorsed standards. In terms of supply chain partnering, it is difficult to benchmark and facilitate sharing among partners if definitions and standards do not align. It was also concerning that 60% did not include a commitment to green in their mission. Including green in the mission and using endorsed standards have been identified as necessary commitments to fully realize the environmental and financial benefits of green (Conference Board, 2010).

### Fundamental Enablers

Table 3 displays basic enablers of GrSCM programs such as employing clear performance standards, quantifying the benefits of green efforts in real dollars, and training employees on green. On the whole, these practices were not being pursued or were in the infancy stages at the selected companies. This signals a need to improve on these dimensions.

For example, training employees on green and integrating green with existing improvement methodologies (such as Total Quality Management, Six Sigma, or Lean Manufactur-

Table 3. Fundamental Enablers of GrSCM Programs (n=5)

	No Efforts	Little Efforts	Infancy Stage	Fully Integrated
Have clear GrSCM performance standards	40%	0%	40%	20%
Determine the economic risks posed by GrSCM	40%	0%	60%	0%
Quantify the costs and benefits of green efforts in real dollars	40%	20%	40%	0%
Use lifecycle analysis tools to investigate total SC environmental impact	50%	25%	25%	0%
Managers have visibility into GrSCM metrics	40%	20%	20%	20%
Benchmark GrSCM best practices	40%	20%	40%	0%
Train employees on green	20%	40%	40%	0%
Integrate green with existing improvement methodology	40%	20%	40%	0%

ing) leverage existing frameworks and ensure employees can contribute to green improvements (Chapman & Green, 2010). The businesses also need to quantify the benefits and costs of their green projects and link them to financial outcomes. Otherwise, little serious attention will be devoted to them

(Aberdeen, 2009b). Additionally, there is a need to provide more visibility into GrSCM metrics. Aberdeen (2009b) reported that a majority of top performing companies provide real-time visibility into green metrics; a majority of their peers do not even define green metrics. With one exception, the companies in our sample have not fully established visibility to date.

### Green Manufacturing and Facilities

Table 4 displays the manufacturing and facilities related practices such as using pull-based replenishment methods, reducing waste generated at the facility, and mistake-proofing in environmentally hazardous areas. Due to the energy intensiveness of running a plant, it is logical that the sample organizations would choose to focus on internal operations at their facilities. As Aberdeen (2008) reported, pursuing savings associated with things such as energy consumption often lead to significant improvement opportunities.

The companies were strong in using pull-based replenishment methods and have taken initial steps to offer product take back programs. With one exception, the companies had fully integrated programs for tracking emissions and energy

Table 4. Green Manufacturing and Facilities Practices (n=5)

	No Efforts	Little Efforts	Infancy Stage	Fully Integrated
Have a product take back program	0%	33%	67%	0%
Mistake proof where hazardous materials are used	20%	0%	20%	60%
Using more pull-based replenishment methods	0%	0%	20%	80%
Have a workplace recycling program	0%	0%	20%	80%
Track energy consumption	0%	20%	0%	80%
Track emissions	20%	0%	0%	80%
Have a plan to minimize energy use and emissions	25%	0%	0%	75%
Have a plan to minimize water use	20%	0%	0%	80%
Have a plan to reduce waste generated	0%	20%	0%	80%

consumption, and have plans to reduce water use, waste, and emissions. We did not break down the emissions into the various scopes, but they are likely tracking Scope 1 emissions which is carbon (a greenhouse gas) generated at the facility. Of perhaps more importance are Scope 3 emissions (carbon produced due to logistics, travel, use of products, and supply chain) which are tracked by few companies, but are usually the biggest sources of emissions (Carbon Disclosure Project, 2010a). Starting in 2011, the GHG protocol (de facto standard for carbon reporting) will include specific guidelines for Scope 3 emissions, making supply chain a central part of greenhouse gas reporting (GHGprotocol.org, 2011). Unfor-

tunately, we did not assess the organizations' capabilities to capture Scope 3 emissions.

### Supply Management

Table 5 displays practices commonly associated with supplier management such as preferring to use recycled supplies. The companies reported engaging in some positive activities along their supply chains. As discussed previously, there are limits to what a company can do in isolation and unless the total supply chain's environmental impact is considered, it is disingenuous to claim "green" (Corporate Executive Board, 2007).

The companies reported increasing collaboration with their partners, using recycled supplies, and considering green in their procurement strategies. An area of concern was that most were not monitoring their suppliers' compliance, even though they may specify criteria for their suppliers' green performance. Perhaps the companies are not willing to dedicate resources or do not have the resources to perform ongoing monitoring. The organizations may also be benefitting from their increased collaboration with their suppliers (Table 5). Increased collaboration usually builds trusting relationships, which reduce the need for monitoring.

### Logistics and Transportation

Table 5. Green Considerations in Supplier Management (n=5)

	No Efforts	Little Efforts	Infancy Stage	Fully Integrated
Collaborate with supply chain partners to improve green performance	20%	20%	40%	20%
Procurement strategy includes green considerations	20%	20%	40%	20%
Have criteria for suppliers' environmental performance	20%	20%	40%	20%
Monitor suppliers' environmental compliance	75%	0%	25%	0%
Prefer previously used, recycled, or remanufactured supplies	0%	25%	75%	0%

Table 6 displays practices related to transportation management such as switching to greener transportation modes and reducing total miles traveled. The companies were taking steps to minimize frequent shipments, reduce total miles, and maximize load fills. These activities are important because transportation has a large environmental impact and it is growing. Overseas manufacturing and the demand for fast deliveries has increased the types of shipping that create the most emissions - jets and trucks (Golobic, Boerstler, & Ellram, 2009.). Currently, U.S. freight movement accounts for 25% of GHG emissions and by 2020 there will be a 70% increase in the amount of freight moved in the U.S. per day

(Crowley and Goldberg, 2010). Companies will need to think not just about ways to reduce the undesirable effects of their transportation needs (*i.e.* using alternative fuels), but also how to eliminate the necessity to travel so many miles.

Table 6. Green Considerations in Logistics and Transportation (n=5)

	No Efforts	Little Efforts	Infancy Stage	Fully Integrated
Minimizing frequent shipments	0%	0%	80%	20%
Bundling deliveries	0%	0%	75%	25%
Considering emissions in decisions	0%	50%	25%	25%
Reducing total miles	0%	50%	0%	50%
Redesigning networks to accommodate greater returns	25%	25%	25%	25%
De-speeding our supply chain	0%	67%	33%	0%
Switching to more green modes	67%	33%	0%	0%
Increasing load fill	0%	0%	50%	50%

Opportunities were found for switching to modes such as trains and ships (can be intermodal if spurs/ports are not available). These two modes contribute little to global emissions (Carbon Disclosure Project, 2010b) and can reduce the use of high-emissions vehicles such as trucks. The companies were also doing little to slow down their supply chain. This practice means using less expedited shipping and literally reducing the speed at which vehicles travel. The reason for this practice is that a linear decrease in speed brings a squared decrease in emissions (World Economic Forum, 2009). However, reducing the speed of trucks might result in higher inventory levels, more trucks on the road, and less pay for drivers if they are paid by the mile. These tradeoffs must be examined on a case-by-case basis.

### Packaging

Table 7 displays practices associated with product packaging such as minimizing the use of materials in packaging and using recyclable materials. With the exception of one company, the participating companies are lacking in these areas. The companies may generate positive financial returns by emphasizing packaging projects as part of their GrSCM program.

Packaging is a critical consideration when it comes to loading vehicles to their maximum weight and reducing the amount of material waste that is generated. For example, vehicles typically run out of space before they meet their maximum weight (Lu *et al.*, 2007). While packaging accounts for only about 5% of total weight in a vehicle's load, it consumes a higher percentage of space (World Economic Forum,

Table 7. Green Considerations in Packaging (n=5)

	No Efforts	Little Efforts	Infancy Stage	Fully Integrated
Redesigning containers/packaging to minimize materials	0%	40%	40%	20%
Using multi-purpose, reusable, or recyclable packaging/dunnage	0%	75%	0%	25%

2009). The more space that is taken up with packaging, the fewer goods can be shipped at once. Fewer goods at once results in more trucks on the road and overall higher energy consumption. Top performing companies are finding ways to increase product-to-package ratios while ensuring the product will arrive without damage (World Economic Forum, 2009).

### Limitations and Future Research

A weakness of our study was the small number of businesses that participated. This design allowed us to perform an in-depth analysis but it stifled our ability to make generalizations. Future researchers should study a larger sample of businesses and use a more targeted population such as a certain industry or business sector. Another avenue would be an in-depth cost/benefit analysis of the various GrSCM practices across a spectrum of businesses and industries. For example, the costs associated with a GrSCM practice may outweigh the benefits in some applications or some practices may have undesirable consequences on some other environmental impact. These studies would help businesses make well-advised and prioritized decisions without considerable assessment expenses.

### Summary

We found the selected companies were engaging in several practices that should help them reduce their environmental impact, position them to be competitive in the future, and prepare them to serve increasingly green conscious customers. We also identified areas for improvement such as switching to greener modes of transportation, monitoring suppliers' performance, and using endorsed standards, but those suggestions come with a caution. Each practice is not necessarily correct for every industry or business. Some contradict with existing business paradigms and some add costs while having a negligible reduction in environmental impact. The innovations that can come from GrSCM projects are desirable, but businesses should pursue GrSCM in an informed and disciplined way that minimizes the impact on the ecosystem and generates a positive return on investment.

### LITERATURE CITED

Aberdeen Group. 2010. Reverse Logistics: Driving Improved Returns Directly to the Bottom Line. Retrieved June 23, 2010, from <http://www.aberdeen.com/Aberdeen-Library/6323/RA-reverse-logistics-return-refurbishment.aspx>

- Aberdeen Group. 2009a. A Leaner and Greener Service Fleet. Retrieved February 1, 2010, from <http://www.aberdeen.com/Aberdeen-Library/6138/AI-green-service-fleet.aspx>
- Aberdeen Group. 2009b. Sustainable Production: Good for the Plant, Good for the Planet. Retrieved March 14, 2010, from <http://www.aberdeen.com/aberdeen-library/6007/RA-sustainable-production-manufacturing.aspx>
- Aberdeen Group. 2008. Building a Green Supply Chain: Social Responsibility for Fun and Profit. Retrieved February 1, 2010, from <http://www.aberdeen.com/summary/report/benchmark/4836-RA-green-supply-chain.asp>
- A.T. Kearney. 2009. Green Winners- The Performance of Sustainability-Focused Companies During the Financial Crisis. Retrieved January 6, 2010 from <http://www.atkearney.com/index.php/Publications/green-winners.html>
- Bangalore, S. 2009. A Framework for Executing Green Supply Chain Projects. Retrieved April 13, 2010, from <http://supply-chain.org/civCRM/event/info?id=114&reset=1>
- Becker, T. 2008. The business behind green. *APICS Magazine* 18(2): 20-21.
- Blackstone, J.H., and J.F. Cox. 2008. *Apics Dictionary* (12th ed). Apics, Chicago.
- Capgemini Consulting. 2010. Customer Back on Top of the Supply Chain Agenda in 2010. Retrieved June 19, 2010, from <http://www.capgemini.com/services-and-solutions/challenges/supply-chain-management/publications/supply-chain-agenda-2010/>
- Carbon Disclosure Project. 2010a. Supply Chain Report 2010. Retrieved November 1, 2010 from [https://www.cdproject.net/CDPResults/CDP-Supply-Chain-Report\\_2010.pdf](https://www.cdproject.net/CDPResults/CDP-Supply-Chain-Report_2010.pdf)
- Carbon Disclosure Project. 2010b. Transport Report. Retrieved August 20, 2010, from <https://www.cdproject.net/CDPResults/CDP-Transport-Report.pdf>
- Chapman, C.D., and N.B. Green. 2010. Leading toward green: Manufacturer uses method to cut wastes, save money. *Quality Progress* 43(3): 18-24.
- Chorley, J. 2009. Supporting sustainable business. *APICS Magazine* 19(2): 1-43.
- Conference Board. 2010. Sustainability in the Boardroom. Retrieved June 19, 2010, from [http://www.conference-board.org/knowledge/describe\\_ea.cfm?id=1812&program=Governance&nav=cg](http://www.conference-board.org/knowledge/describe_ea.cfm?id=1812&program=Governance&nav=cg)
- Corporate Executive Board. 2007. The Case for Sustainability. Retrieved July 2, 2010, from [http://sustainability.executiveboard.com/abstract/forumResearch\\_qeboi.html](http://sustainability.executiveboard.com/abstract/forumResearch_qeboi.html)
- Crandall, R. 2009. Riding the green wave. *APICS Magazine* January/February: 24-27.
- Crowley, S. and D. Goldberg. 2010. Federal Transportation

- Bill Should Clean Up Dirtiest, Fastest Growing Transportation Sector: Freight. Retrieved March 17, 2010, from <http://www.edf.org/pressrelease.cfm?contentID=10890>
- Environmental Protection Agency. 2007. The Lean and Environment Toolkit. Retrieved June 29, 2010 from <http://www.epa.gov/lean/toolkit/LeanEnviroToolkit.pdf>
- Field, J.M., and R.P. Sroufe. 2007. The use of recycled materials in manufacturing: Implications for supply chain management and operations strategy. *International Journal of Production Research* 45(18-19): 4439-4463.
- Galvao, A. 2010. From buzzword to business model. *APICS Magazine* 19(1): 24-25.
- Golicic, S., C. Boerstler, and L. Ellram. 2009. Greener, cheaper. MIT Sloan Management Review. Retrieved March 20, 2010, from <http://sloanreview.mit.edu/business-insight/articles/2009/4/5143/greener-cheaper/>
- GHGprotocol.org. 2011. Product and Supply Chain Standards. Retrieved February 9, 2011 from <http://www.ghgprotocol.org/standards/product-and-supply-chain-standard>
- Lambert, D.M. 2008. *Supply Chain Management: Processes, Partnerships, Performance* (3rd ed.). Supply Chain Management Institute, Sarasota FL.
- Lu, L. Y.Y., C.H. Wu, and T.C. Kuo. 2007. Environmental principles applicable to green supplier evaluation by using multi-objective decision analysis. *International Journal of Production Research* 45(18-19): 4317-4331.
- Malcolm, J. 2010. Keeping orangutans out of the supply chain. *Inside Supply Management* 21(5): 22.
- MIT Sloan Management Review. 2009. The Business of Sustainability: Findings and Insights from the First Annual Business of Sustainability Survey. Retrieved March 15, 2010, from <http://www.mitsmr-ezine.com./busofsustainability/2009#pg1>
- Narasimhan, R., and J.C. Carter. 1998. *Environmental Supply Chain Management, Research Monograph*, Center for Advanced Purchasing Studies, Tempe, AZ.
- Srivastava, S.K. 2007. Green supply-chain management: A state-of-the-art literature review. *International Journal of Management Reviews* 9(1): 53-80.
- Supply Chain Council. 2008. Supply Chain Operations Reference Model, Version 9.0. Retrieved May 27, 2010, from <http://supply-chain.org/>
- Wilkerson, T. 2008. Introduction to GreenSCOR: Introducing Environmental Considerations to the SCOR Model. Retrieved on July 3, 2010, from <http://supply-chain.org/f/SCWNA08%20-%20%20WilkersonC.pdf>
- World Economic Forum. 2009. Supply Chain Decarbonization: The Role of Logistics and Transport in Reducing Supply Chain Carbon Emissions. Retrieved July 12, 2010, from <http://www.weforum.org/pdf/ip/SupplyChainDecarbonization.pdf>

Appendix A

**Green Supply Chain Management Survey**

GrSCM is a growing and broad field that does not yet have standardized definitions. However your organization defines it – green, sustainability, environmental management, etc. – we are interested in practices that minimize the environmental impact of your supply chain. We consider the supply chain to include design, sourcing, production, packaging, order fulfillment, distribution, logistics/transportation, sales, returns management, and disposal.

**Please select the category that best describes your organization:**

- |  |                          |                          |                          |                          |                          |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|  | We don't<br>have one     | <1 year                  | 1-2 years                | 3-4 years                | ≥5 years                 |
| 1. How long have you had a defined GrSCM initiative? | <input type="checkbox"/> |

**How would you classify the following for your business?**

	Not important at all	Somewhat unimportant	Somewhat important	Extremely important
--	-------------------------	-------------------------	-----------------------	------------------------

- |   |                          |                          |                          |                          |
|---|--------------------------|--------------------------|--------------------------|--------------------------|
| 2. Green as a driver in the supply chain agenda.                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. The reverse supply chain on operational and financial performance. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. The priority of GrSCM in budgeting considerations.                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

**Our organization ...**

	Yes	No
5. Clearly articulates commitment to green in its mission.	<input type="checkbox"/>	<input type="checkbox"/>
6. Employs endorsed GrSCM standards/definitions (an example is GreenSCOR).	<input type="checkbox"/>	<input type="checkbox"/>
7. Has an executive leader responsible for GrSCM initiatives.	<input type="checkbox"/>	<input type="checkbox"/>
8. Publishes GrSCM information at least annually.	<input type="checkbox"/>	<input type="checkbox"/>
9. Pursues GrSCM via cross-functional teams.	<input type="checkbox"/>	<input type="checkbox"/>

**How would you classify the following?**

	No efforts are currently in place	Efforts in place according to top management and/or corporate, but little is actually being done	Started pursuing in the last few years; still in infancy or isolated stages	We have a robust, coordinated, and fully integrated program	Not applicable to our business
10. We have developed clear GrSCM performance standards.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. We determine the economic risks posed by green issues on our supply chain.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. We quantify the costs and benefits of green efforts in real dollars.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. We use life cycle analysis tools to investigate the environmental impact of our supply chain.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. We use defined GrSCM metrics.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Our managers have visibility into GrSCM metrics.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	No efforts	Little actually being done	Infancy or isolated	Robust/fully integrated	N/A
16. We benchmark other firms' GrSCM best practices.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. We collaborate with supply chain partners to improve green performance.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. Our procurement strategy includes green considerations.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. We have criteria for our suppliers' environmental performance.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. We monitor our suppliers' environmental compliance.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. We prefer previously used, recycled, or remanufactured supplies where we can.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. Environmental compatibility is included in product design decisions.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. We are designing products that appeal to green-conscious consumers.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. We use 3 <sup>rd</sup> party endorsements if "green" labels are used.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25. We have an Environmental Management System to track our performance/compliance.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26. We have a pollution prevention program.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27. Green is integrated with our existing improvement methodology (ex. Lean; Six Sigma)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28. We train our employees on green issues.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
29. We are using more pull-based replenishment methods.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30. We have a workplace recycling program.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	No efforts	Little actually being done	Infancy or isolated	Robust/fully integrated	N/A
31. We track our energy consumption.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
32. We track our emissions.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
33. We have a plan to minimize energy use and emissions.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
34. We have a plan to reduce water use.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
35. We have a plan to reduce the waste we generate.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
36. We have a product take-back program.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
37. We employ mistake-proofing in areas where hazardous materials/wastes are used/generated.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
38. We redesigned our logistics networks to accommodate greater returns for remanufacture, reuse, or recycle.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39. We aggregate/bundle requirements/deliveries to minimize transportation.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
40. We consider emissions in transportation decisions.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
41. We route to minimize fuel consumption.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
42. We have an initiative to reduce our total transportation miles.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
43. We are de-speeding our supply chain (decreasing ship/truck speed, using less expedited shipping, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
44. We have a plan to increase our load fill.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
45. We are using more clean-vehicle technologies.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	No efforts	Little actually being done	Infancy or isolated	Robust/fully integrated	N/A
46. We are switching to more green modes such as rail and waterways.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
47. We are minimizing the use of frequent shipments.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
48. We are redesigning containers/packaging to minimize materials.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
49. We are using multi-purpose, reusable, or recyclable packaging/dunnage.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**The following questions are for classification purposes (double-click to enter text):**

50. What is your job title? [Click here to enter text.](#)
51. What is your department? [Click here to enter text.](#)
52. What is your function in your department? [Click here to enter text.](#)
53. What industry do you operate in (Please include the NAICS Code)? [Click here to enter text.](#)
54. What are the typical annual revenues generated at **your facility**? [Click here to enter text.](#)
55. How many people are employed at **your facility**? [Click here to enter text.](#)