

A Study on Green Supply Chain Management Practices among Large Global Corporations

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The purpose of this research is to understand the status of sustainable supply chain management practices among the world's largest corporations. Reacting to increasingly stringent government regulations and rising consumer demands for more sustainable products, and trying to create competitive advantages, many companies have begun implementing sustainability practices in their strategy and everyday management. Although there are surveys and anecdotes about how companies are adopting "green" concepts and practices, few studies have been done on what large companies do and how they do it. This research addresses such issues using content analysis of sustainability reports published by Fortune Global 500 companies. Because these large global corporations have enormous economic and environmental impact on society with their extensive networks of suppliers and customers, understanding their sustainability practices, especially in the light of global supply chain, will help us spot the trends in corporate sustainability management and fill the gap between what has been done and what needs to be done.

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I. INTRODUCTION

The purpose of this research is to report the status of sustainable supply chain management practices among the world's largest corporations. Many Fortune Global 500 companies document their sustainability practices in their annual reports or stand-alone sustainability reports. This study examines such reports from the 2009 Fortune Global 500 list and reports on what these large companies are doing in the sustainability movement and how much of their sustainability efforts are in the area of supply chain management. We aim to establish a baseline measure of what the current sustainability practices are and hope to develop practical performance reports in the future for organizations to use. We use content analysis to

search in their reports for a list of relevant sustainability keywords commonly found in literature to assess their evolving practices of sustainability.

II. LITERATURE REVIEW AND RESEARCH METHODOLOGY

Green or sustainable supply chain management is defined as the strategic, transparent, integration and achievement of an organization's social, environmental, and economic objectives in the systemic coordination of key inter-organizational business processes for improving the long-term performance of the firm and its supply chain partners (Ageron, Gunasekaran, and Spalanzani, 2011). This implies that specific criteria have to be applied

by all supply chain partners. At the same time, responsible environmental and social behavior must be promoted as well for the good of the entire chain (Testa and Iraldo, 2010). Helping other players understand the importance of resolving environmental and social problems, and supporting them in their improvement initiatives is a major issue for each member of the supply chain. Environmental and social benefits decrease if downstream and upstream partners are not integrated into sustainable practices (Ageron, Gunasekaran, and Spalanzani, 2011). We will discuss relevant literature in this section, and how we develop the research methodology to help understand the status of green supply chain management practices among large global companies.

2.1 Literature Review

Organizations have been paying attention to environmental preservation since the negative impacts of industrialization were made public by reports and books such as the famous “Silent Spring” in 1962 (Carson, 1962). In the 1990s, management scholars researched organizational environmental practices and advocated more holistic and responsible practices in the supply chain (Wu and Dunn 1995). The now popular concept of “triple bottom line” was cornered by John Elkington (1997) and soon adopted by many organizations in their corporate strategy and management practices. Most people are now familiar with the importance of measuring performance in three critical pillars of people, planet, and profit. Since then, many more scholars have studied and documented the impact of corporate activities on the environment.

Organizations have also been more open about their environmental practices thus providing scholars opportunities to conduct research. The tradition of keeping companies’ environmental, health, and safety information to themselves and to regulatory agencies has changed within the last few years. Stakeholder attention or the risk of negative media attention

motivates company representatives to provide information about their practices (Nawrocka, Brorson, and Lindhqvist, 2009). Since supply chain is the one management function that connects the inside of an organization to the outside, be it suppliers or customers, and oftentimes represents the most visible corporate activities, various forms of sustainable supply chain management practices have been adopted as organizations strive to be green. Examining their own operational processes and monitoring supplier activities have become important sustainability tasks for many managers. Studying sustainable supply chain management at leading companies, therefore, will help shed light on the current state of sustainability practices and point out the future opportunities for improvement.

Green or sustainable supply chain management has been recognized as a way to create economic value (Mefford 2011, Winkler 2011). It is particularly insightful to learn about supply chain management, a collaborative process involving many interdisciplinary entities, both internal and external and at multiple levels of organizational structure (Cavinato, Flynn, and Kauffman, 2006). In their exhaustive study, Carter and Easton (2011) specifically identify several trends in implementing sustainable supply chain management strategies. Hu and Hsu (2010) also provide a framework for understanding the important factors necessary for developing and implementing sustainable supply chains. Looking at a supply chain, especially a global one often seen in today’s intertwined economy, may reveal the many areas that sustainable practices can be applied.

From materials used in manufacturing to locations of vendors along the supply chain to transportation carriers used to the final consumption of the product, supply chain management decisions interact with sustainability in many ways. Previous research focused on the purchasing function in both the private sector (Pagell, Zhaohui, and Wasserman, 2010) as well as the public sector (Walker, Di Sisto, and McBain, 2008) shows the importance

of material choices and vendor certification. Sustainable transportation (Varma and Clayton, 2010) and warehousing (Tan, Daud, and Sundaram, 2010) can also help lessen the negative impact on the environment. Each seemingly independent supply chain decision carries the risk of potentially harming the environment when it's magnified multiple times through the global supply chain. On the other hand, a more sustainable supply chain in the global context may help improve the overall performance of the supply chain thus creating a competitive advantage for the members along the supply chain.

Organizations that operate in multiple countries face a daunting challenge because the laws and regulations in different countries can vary widely. The challenge for companies when it comes to supply chain management is the widely variable regulatory environment from region to region and from country to country. For organizations with facilities in more than one state or country, compliance assurance can be very difficult if not impossible (Cahill and Kane, 2011). Firms need to understand that government involvement can actually facilitate their efforts (Sheu 2011). In order to avoid penalties, management must understand the impact of their daily activities. The task of businesses then is to pay attention and to assure minimal vulnerability in compliance-related matters, and to do so in the most efficient and cost effective way (Cahill and Kane, 2011).

Similar research has been done to understand what large companies are doing in terms of sustainable transportation. Golicic, Boerstler, and Ellram (2010) surveyed a small sample of 44 Fortune 500 companies to understand their sustainable transportation strategies. However, their work is limited to only American companies who were engaged in one of the three pre-determined green activities. Expanding on their work, we look at how large global corporations (Fortune Global 500) are leveraging sustainability in their publications to position themselves in the minds of their

stakeholders as "good citizens." We include specific supply chain practices in the keyword search and also report those identified in previous studies (for example, Walton, Handfield, and Melnyk, 1998; Walker, Di Sisto, and McBain, 2008).

2.2 Research Framework

Large global corporations account for a large portion of the world economy and generate significant environmental impact. Their involvement in sustainability, therefore, will have similar impact up and down the supply chain. Because sustainability and the business interpretation (e.g. the triple bottom line) is a complex and evolving field, with fragmented approaches the rule (Erol, Sencer, and Sari, 2011), it would be helpful if we start looking into large organizations' activities from what they discuss in their annual reports. Assuming companies report what they do, if not more on the positive side, we can assess the current status of green supply chain activities by systematically documenting claims made in their annual reports. Using tools such as content analysis, we should be able to achieve a quantitative measure of what sustainable activities large multinational organizations embrace. We should also be able to get a sense of what directions these green supply chain management practices are headed by reading reports produced by more sustainability-minded leading companies. With a combination of quantitative and qualitative assessment, we should be able to provide a good snapshot of what sustainable supply chain management practices are among large global corporations.

2.3 Research Methodology

We use the 2009 Fortune Global 500, the latest available data, as the base year for our analysis. This list compiled by Fortune magazine is a credible and authoritative compilation of the largest corporations in the world based on their revenues. Other lists such as Financial Times

Global 100 exist but Fortune has a longer history of ranking corporations (Fortune 2009). We searched each of the Global 500 companies' websites for published reports that may contain corporate sustainability practices, including social responsibility reports, corporate citizenship

reports, and sustainability reports. Because of the differences among companies in their fiscal year and when they release their reports, we looked for 2009 reports first then 2010 reports. Search criteria included specific sections of their websites such as About Us, Shareholder

TABLE 1: Sustainable Supply Chain Keywords from Literature

No.	Keyword	Supply chain specific?	Rationale
1	Alternative fuels		Fuels may be used to power machinery, not just vehicles
2	Carbon footprint		General sustainability practice
3	Certified suppliers	Yes	Part of supply chain
4	Clean engine	Yes	Specific to trucks/fleet management
5	Clean truck	Yes	Specific to trucks/fleet management
6	Corporate social responsibility		General sustainability practice
7	Design for disassembly	Yes	Part of supply chain
8	Design for environment	Yes	Part of supply chain
9	Energy efficiency		General sustainability practice
10	Environmental stewardship		General sustainability practice
11	Fuel efficient	Yes	Specific to trucks/fleet management
12	Fuel saving	Yes	Specific to trucks/fleet management
13	Green logistics	Yes	Part of supply chain
14	Green manufacturing	Yes	Part of supply chain
15	Green procurement	Yes	Procurement is part of supply chain
16	Green supply chain	Yes	Supply Chain
17	Greenhouse gas emission		General sustainability practice
18	ISO 14000		General sustainability practice
19	Product life cycle analysis		General sustainability practice
20	Recycling materials		General sustainability practice
21	Reduced packaging	Yes	Packaging affects supply chain performance
22	Smart way	Yes	Federal EPA program
23	Supplier audits	Yes	Part of supply chain
24	Supplier certification	Yes	Part of supply chain
25	Supply chain	Yes	Supply chain
26	Sustainability scorecard		General sustainability practice
27	Sustainable supply chain	Yes	Supply chain
28	Sustainable transportation	Yes	Transportation is part of supply chain
29	Triple bottom line		General sustainability practice
30	Vehicle routing	Yes	Fleet management

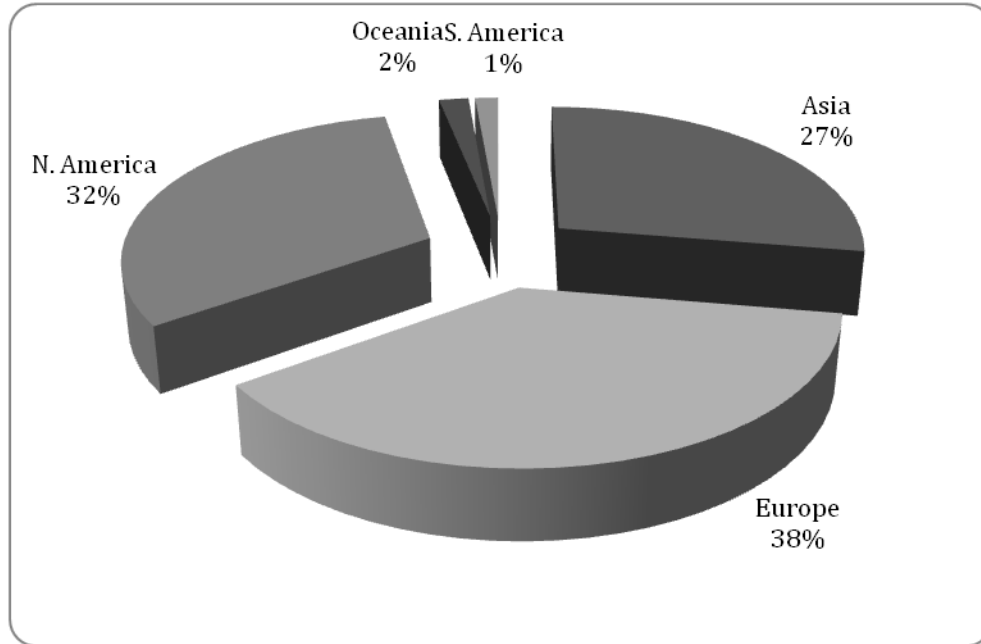


FIGURE 1. Geographical Location of Global 500 Companies

Relations, or other similarly titled tabs. We also searched the entire site by the keywords sustainability, citizenship, and social responsibility to ensure inclusion of any such reports with different titles. The self-reported documents are used, instead of the more standard and required 10K reports, because these are the only places where sustainability practices can be found. Once we obtained the reports (mostly through instant download and few through mail inquiries), we converted them to digital format in MS Word or Adobe PDF.

We compiled a list of keywords from the literature. Some keywords are mostly related to supply chain management (manufacturing, transportation, logistics, distribution, etc.) or applicable to supply chain members and they are identified as such. This classification allows us to study companies that are engaged in sustainability along the supply chain. The keywords are listed in Table 1 with brief explanations.

We then developed a content analysis algorithm to search for the keywords. We tested and validated the program with the first 10 reports to ensure search accuracy. Finally, we

used the robust search algorithm to run content analysis for all the reports. The purpose of this content analysis is to identify leading companies in sustainable supply chain activities. Once they were identified, we read their entire sustainability reports to find and report the common threads of these activities. Their sustainable supply chain management initiatives and accomplishments help us paint a picture of the status quo in current sustainable supply chain management practices.

III. RESULTS AND DISCUSSIONS

3.1 Sample Demographics

Figures one to three highlight the extent of sustainability reporting in the Fortune Global 500 companies. Figure 1 shows the geographical locations of headquarters. This is important when discussing sustainability as certain regions (Europe) and countries (Japan) may have been leaders in the movement. It is also important to help point out any geographical differences in reporting sustainability activities.

Figure 2 shows the percentage breakdown of sustainability reporting. About 2/3 of the

largest companies produced a sustainability report of some kind. A small portion of the reports, 23 or 5%, cannot be used for our content analysis either because it was printed in hard

copy and scanning did not yield satisfactory results or it was published in web format where compilation into a usable pdf or Word format failed.

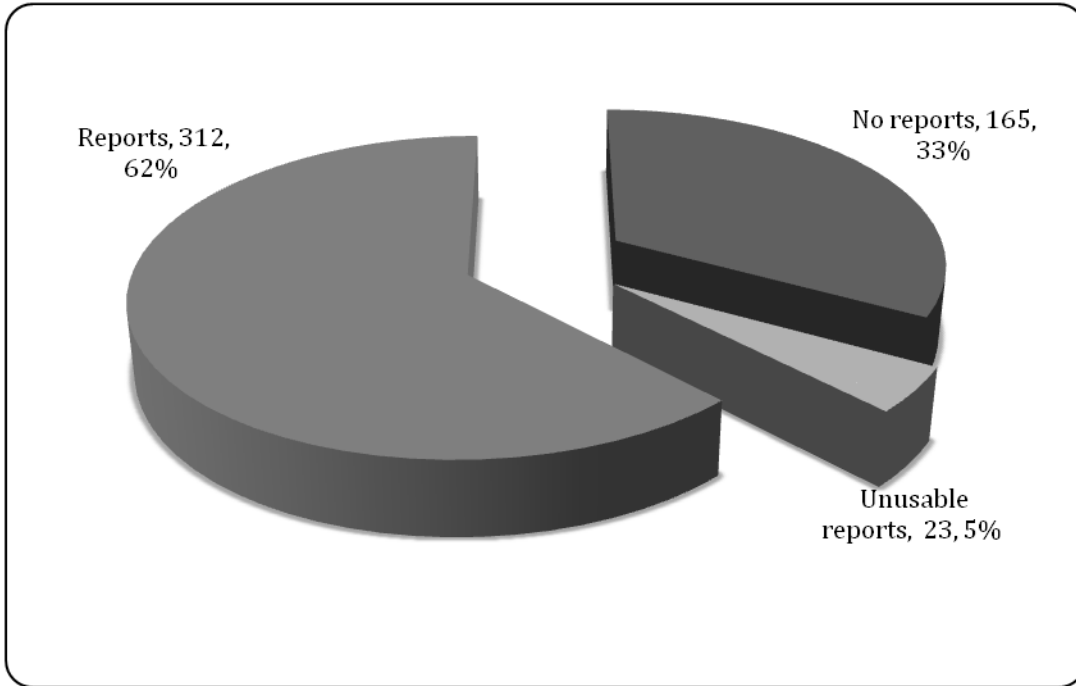


FIGURE 2. Sustainability Reporting Among Global 500 Companies

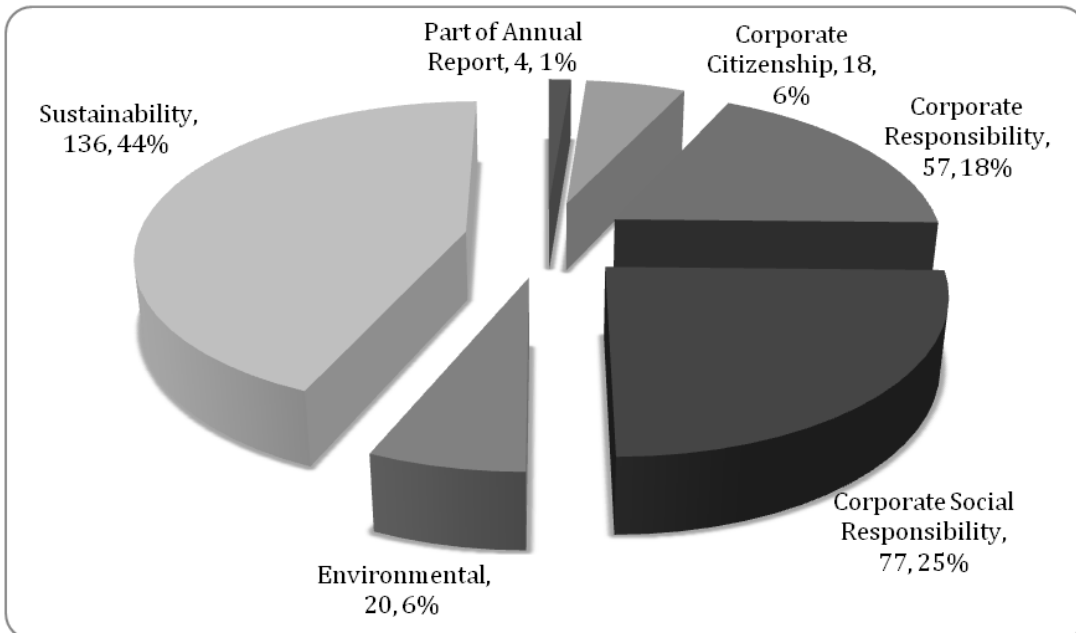


FIGURE 3. Types of Sustainability Reports Analyzed

During the study, we identified several varieties of reports that fall under the rubric of sustainability report. Only a very small percentage of companies (1%) incorporate sustainability reporting in the organization’s annual report. Others choose various names to separate from annual reports: Sustainability Report (44%), Corporate Social Responsibility Report (25%), Corporate Responsibility Report (18%), Corporate Citizenship Report (6%) and Environmental Report (6%) as shown in Figure 3.

Quantitative Discussions

Content analysis yields some interesting results in Tables two through four on the total of 312 reports analyzed. Among the top 10 keywords found in the search as shown in Table 2, one can conclude that environmental concerns are still on top of companies’ sustainability priorities. Cost and energy efficiency related measures, including fuel saving, fuel efficiency, greenhouse gas emission, and carbon footprint are among the most mentioned keywords. Supply chain, on the other hand, is gaining more attention as companies look into opportunities from procurement, suppliers, and other supply chain members.

TABLE 2. Top 10 Keywords Discussed in Reports

Ranking	Keyword	Mentioned in % of reports analyzed
1	energy efficiency	78.8%
2	greenhouse gas emission	76.6%
3	supply chain	71.8%
4	carbon footprint	50.3%
5	fuel efficient	18.9%
6	environmental stewardship	16.3%
7	green procurement	13.1%
8	fuel saving	11.9%
9	supplier audits	8.7%
10	sustainable supply chain	6.7%

Table 3 highlights the companies with the highest percent of our 30 select keywords in their documents. The top companies mentioned only 6-10 of the 30 keywords, which is a concern because these 4% of the Fortune Global 500 companies have only up to one third of the commonly utilized supply chain sustainability keywords present in any of their reports. The implication is that supply chain is not yet at the same level as the rest of the environmental measures that companies have undertaken. The geographical spread by region is largely North America and Europe and the industry types are mostly manufacturing and retailing.

The findings in Table 4 continue the earlier findings in that very few companies even discuss the concept of sustainability in conjunction with the supply chain. Hewlett Packard, the highest scoring firm in both Table 2 and Table 3 mentioned only 26% of the 19 supply chain keywords and 33% of the overall sustainability keywords. Most companies that mentioned sustainable supply chain keywords are in manufacturing, transportation, and retailing.

3.3 Qualitative Discussions

With quantitative analysis done, we then studied the sustainability reports produced by the top companies in Table 4 to learn about their sustainable management practices, including the ones in green supply chain. The following are our findings.

Reported Major Activities:

- Education, training, and awareness programs: Consistent with Lueneburger and Goleman (2010), many companies have sustainability training programs for employees and suppliers. FIAT, for example, reports the amount of time spent on employee training in bringing up the sustainability awareness. Quanta and Hon Hai also report on their supplier education initiatives to ensuresustainability in their supply chain members.

TABLE 3. Top Companies with Most Keywords Discussed

Ranking	Global Ranking	% of keywords mentioned	Company	Sales, Million USD	Region	Business Type
1	32	33.3%	Hewlett-Packard	118,364	North America	Computers, Office Equipment
2	151	30.0%	Deutsche Bahn	48,963	Europe	Railroads
3	106	26.7%	A.P. Møller-Mærsk	62,637	Europe	Shipping
4	167	26.7%	Best Buy	45,015	North America	Specialty Retailers
5	468	26.7%	Bombardier	19,721	North America	Aerospace and Defense
6	191	26.7%	Cisco	39,540	North America	Network and Communications Equipment
7	64	26.7%	Fiat	86,914	Europe	Motor Vehicles and Parts
8	352	26.7%	Mazda	25,242	Asia	Motor Vehicles and Parts
9	50	26.7%	Metro	101,217	Europe	Food and Drug Stores
10	376	26.7%	Michelin	24,016	Europe	Motor Vehicles and Parts
11	143	26.7%	UPS	51,486	North America	Mail, Package and Freight Delivery
12	144	23.3%	Caterpillar	51,324	North America	Construction and Farm Machinery
13	61	23.3%	Deutsche Telekom	90,260	Europe	Telecommunications
14	161	23.3%	Fujitsu	46,714	Asia	Computers, Office Equipment
15	52	23.3%	Hitachi	99,544	Asia	Electronics, Electrical Equipment
16	109	23.3%	Hon Hai Precision Industry	61,861	Asia	Electronics, Electrical Equipment
17	208	23.3%	Iberdrola	36,879	Europe	Utilities
18	244	23.3%	Idemitsu	33,522	Asia	Petroleum Refining
19	495	23.3%	Samsung C&T	18,635	Asia	Trading
20	3	23.3%	Walmart	405,607	North America	General Merchandisers

TABLE 4: TOP COMPANIES WITH MOST SUPPLY CHAIN KEYWORDS DISCUSSED

Ranking	Global Ranking	% of supply chain keywords mentioned	Company	Sales, Million USD	Region	Business Type
1	32	26.3%	Hewlett-Packard	118,364	North America	Computers, Office Equipment
2	151	26.3%	Deutsche Bahn	48,963	Europe	Railroads
3	64	21.1%	Fiat	86,914	Europe	Motor Vehicles and Parts
4	106	21.1%	A.P. Møller-Mærsk	62,637	Europe	Shipping
5	167	21.1%	Best Buy	45,015	North America	Specialty Retailers
6	468	21.1%	Bombardier	19,721	North America	Aerospace and Defense
7	191	21.1%	Cisco	39,540	North America	Network and Other Communications Equipment
8	352	21.1%	Mazda	25,242	Asia	Motor Vehicles and Parts
9	52	21.1%	Hitachi	99,544	Asia	Electronics, Electrical Equipment
10	342	15.8%	Quanta	25,967	Asia	Computers, Office Equipment
11	50	15.8%	Metro	101,217	Europe	Food and Drug Stores
12	376	15.8%	Michelin	24,016	Europe	Motor Vehicles and Parts
13	143	15.8%	UPS	51,486	North America	Mail, Package and Freight Delivery
14	144	15.8%	Caterpillar	51,324	North America	Construction and Farm Machinery
15	61	15.8%	Deutsche Telekom	90,260	Europe	Telecommunications
16	161	15.8%	Fujitsu	46,714	Asia	Computers, Office Equipment
17	109	15.8%	Hon Hai Precision Industry	61,861	Asia	Electronics, Electrical Equipment
18	495	15.8%	Samsung C&T	18,635	Asia	Trading
19	387	15.8%	Anheuser-Busch InBev	23,568	Europe	Beverages
20	115	15.8%	Dell	61,101	North America	Computers, Office Equipment

- Supplier risks assessment, auditing, certification: Sustainability certification requirements are becoming increasingly more important for sustainable conscience organizations. Examples can be found among

Fortune 500 companies and also in the biofuels/bioenergy (Scarlat, Dallemand, 2011), coffee (Raynolds, Murray, and Heller, 2007), and wine (Berghoef and Dodds, 2011) industries.

- Sustainability KPIs for logistical activities/projects: One of the popular areas for sustainability development is to develop a series of key performance indicators or KPIs. KPIs need to be consistent with organizational goals and objectives (Bai, Sarkis, and Wei, 2010). The results of the present study suggest that many managers believe what is measured gets done. Thus, measuring activities geared to meeting objectives will carry significant weight. Results of our study bear this out where companies have developed auditing and certification tools to assess supply chain risks. For example, in the computer industry, HP and Dell audit their suppliers periodically then certify them for their sustainability levels. Retailers like Wal-mart also have stringent requirements and processes for their suppliers.
- Environmental Management System: In the past, organizations have been developing methodologies to measure the environmental impact of company activities (Veleva, et al, 2004; Bjorklund, 2010). Companies are developing even more comprehensive systems to manage Environment-related matters the same way they manage production or logistics resources. Deutsche-Bahn, for example, has a system that monitors all of its maintenance activities for environmental issues.
- Membership in NGOs and professional organizations: Increasingly, social movements' scrutiny is focused on multinational companies. As these movements continue to gain global recognition, it becomes more important that they are considered as part organizations' strategic environmental calculus (Perez-Aleman, and Sandilands, 2008). The study results show most companies belong to one or more non-profit organizations dedicated to

sustainability or environmental preservation. It seems that joining such organizations helps keep companies up to date in sustainability front. Some industry leaders, such as HP, are partnering up with professional associations to develop industry standards.

Supply chain coverage:

Most companies report a series of activities along the global supply chain. They report having initiatives in the areas of purchasing/procurement, transportation & logistics, product development, production/processes, sales and service, packaging, and even end of life recycling. Manufacturers seem to lead the way in supply chain activities as many of them report monitoring such activities in their own supply chain and for their supply chain partners including carriers and first and second-tier suppliers.

Non-supply chain coverage:

Companies report activities that reflect the organization's commitment to sustainability, including corporate governance, customer relations and customer education, community relations, and human (workers) rights issues. Many are regulatory and compliance activities but more are marketing and PR-related measures. Specific Initiatives:

All companies in Table 4 report specific initiatives as examples that support their sustainability claims. Reducing energy consumption tops the list of such initiatives. It is good for the environment and also good from the cost perspective. Companies also report efforts to cut GHG emission, including the selection of shipping modes and the use of cleaner fuels or alternative energy sources. Some companies, such as Mazda and Michelin report developing newer and cleaner products that help reduce negative environmental impacts. Most companies

also report how they reduce, reuse, and recycle packaging materials and production wastes.

IV. CONCLUSIONS

4.1 Conclusions

Our research provides some insights as to what extent do large companies engage in sustainable supply chain practices and what specific activities they are doing. As customers expect a firm to assure socially and ecologically sound production, more companies are likely to initiate more sustainability efforts. While current green supply chain management practices still focus on cost reduction and pollution prevention, we see positive changes in organizations evolving and incorporating more proactive sustainable measures into their strategy and everyday practice.

Our study shows over two-thirds of the firms are producing some type of sustainability report. This is an indication of the level of importance and commitment from large companies. While many are reporting their mostly positive sustainability involvement, few discuss in depth about their green supply chain practices. It appears that companies are slowly and gradually turning their attention to potential environmental benefits in the global supply chain.

Energy efficiency, fuel efficient, and fuel saving are among the most mentioned keywords in our study. This means that companies are paying attention to the low hanging fruits of both environmentally responsible and cost saving measures. Greenhouse gas emission, carbon footprint, and environmental stewardship were also mentioned in a large majority of the reports. This may indicate a compliance issue or media-generated hot topic among managers. We are pleased to find out that a few supply chain-related keywords such as green procurement, sustainable supply chain, and supplier audit are mentioned by some companies. Even though the number of companies mentioning these keywords

is small, it's a beginning. This is probably a reflection of the interest in uncovering the potential sustainability benefits along the stretched global supply chain.

Among the more supply chain minded organizations, many are building a management system where sustainability performance can be measured. Developing an environmental management system, installing a few sustainability KPIs, requiring suppliers to meet specific sustainability requirements, and joining NGOs or professional organizations all help companies quantify their efforts and begin to actively manage sustainability activities in a more systematic way. Education and training, for both employees and suppliers, helps disseminate the information and knowledge about the company's sustainability determination. The coalition around a standard set of measurements, combined with a thorough commitment to third party audit procedures will do much to legitimize company claims. Along with supply chain specific initiatives, these broad-based sustainability efforts will form the foundation of more sustainable supply chain management practices.

4.2 Limitations and Future Research

The present research represents the first attempt to summarize how some of the largest global companies are approaching sustainability and leveraging it as part of an overall business strategy. Using content analysis of corporate reports, we understand that the research is limited to companies' self-reported activities that have no priorities or quantitative measures. Unlike financial reports that have standard format and are mandated by regulatory agencies, sustainability reports range widely and include many different activities. It would be useful to develop a validation mechanism or a quantitative measure that can be used to ensure what the reports say is consistent with what actually happens. This research also represents a static, positive perspective of what is happening now. To develop a better understanding of

sustainability trends, one would want to engage in a longer term longitudinal study. There is also need for a comparative study between geographical areas, over long period of time, to truly understand what the changes and gaps have been and why they exist. Finally, it would be interesting to see if there are differences between industry sectors (i.e. manufacturing vs. service-based industries) in their green supply chain activities.

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