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Status of Green Supply Chain Management Adoption in Midwest Manufacturing: an Empirical Study

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ABSTRACT

Companies today are facing increasing regulatory, community, and competitive pressures to consider environmental issues in their quest to pursue profits. They have started looking at Green Supply Chain Management (GSCM) as the new paradigm to reduce the environmental impact of their activities and to produce more environmentally sustainable products and services. The purpose of this study is to understand the extent to which GSCM practices have been implemented in Midwestern manufacturing firms, the driving factors for the implementation and the perceived benefits of GSCM.

KEYWORDS: Green supply chain management, Environmental sustainability, Midwest manufacturing, GSCM adoption

INTRODUCTION

Consumers and regulators are becoming increasingly aware of the impact of industrial activities on the natural environment and the ecosystems that support life. To address pressing environmental concerns, manufacturing and logistics firms are turning to more environmentally friendly supply chain management processes, a practice referred to earlier as GSCM. According to Srivastava (2007), GSCM is defined as “integrating environmental thinking into supply-chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers as well as end-of-life management of the product after its useful life.”

GSCM is an umbrella term for various supply chain management practices, both, within and between firms. Collaboration with external partners is a key supply chain management process. External collaboration can be directed upstream toward suppliers or downstream toward customers. GSCM encourages companies to work with suppliers and customers to address environmental concerns. This approach specially focuses on inter-organizational interactions, where supply chain members share common goals, plan together and collaborate to reduce environmental impacts.

Regarding practices internal to the manufacturer, Srivastava (2007) organizes GSCM practices into four broad categories: (i) Eco-design; (ii) Green manufacturing; (iii) Reverse logistics and

network design; and (iv) Waste management. In addition to these four categories, we view environmental management as a key, and often overlooked, dimension of GSCM. We briefly review each of these five categories of practices.

Eco-design

Because much of the environmental impact of a product is determined at the design stage, eco-design consists of designing products and services in such a way as to minimize their environmental footprint over the entire product lifecycle, i.e., from raw materials to production to consumption to disposal at the end of life.

Green Manufacturing

This category includes (i) green purchasing, (ii) reducing material and energy consumption during production, and (iii) recycling and remanufacturing. Green purchasing is the practice of purchasing a product that has a lesser or reduced negative effect or increased positive effect on human health and the environment, when compared with competing products that serve the same purpose (NASPO Green Purchasing 2016). A good practice would be to purchase materials that are either recyclable or reusable, or have already been recycled (Sarkis 2003). Green purchasing affects various dimensions of GSCM, such as, materials used in product design, product design process, supplier process improvement, supplier evaluation and inbound logistic processes (Zhu, Sarkis and Lai 2008). Recycling and remanufacturing allow firms to recover some value from returned or end-of-life products that would otherwise be thrown away.

Reverse Logistics and Network Design

Generally, manufacturing a new product will generate more carbon emissions than reusing an existing asset while recycling can help reduce landfills. In order to recycle or remanufacture products, manufacturers would have to bring their products back to a manufacturing facility which can be achieved through reverse logistics. Reverse logistics can be defined as “the process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal” (Rogers and Tibben-Lembke 1998). The network design of a reverse logistics network should enable the transfer of products from a former user to the manufacturer and back to the market again.

Waste Management

A good waste management system should be able to account for all forms of wastes generated across the supply chain. The system should be able to deal with waste minimization, reusing and recycling unavoidable waste, and providing ways to safely dispose of unusable waste and residues. Installing pollution control and prevention technologies can help cut down pollution, which is a wasteful by-product of production. In many cases, manufacturers are required to do so by law. Investing in end-of-pipe pollution control technologies can aid in treating the emissions and waste produced at various stages in the supply chain.

Environmental Management

Environmental Management Systems are strategic management approaches that define how an organization will address its impacts on the natural environment (Darnall et. al, 2008). It is a management system that is implemented from within the organization. According to Lamprecht 1997 Environmental Management Systems consist of an environmental policy, as well as a set of evaluation processes that require the organization to assess its environmental impacts, establish goals, design and implement processes for environmental control, monitor goal attainment, and undergo management review. Popular methodologies include ISO 14000 and Total Quality Environmental Management which reach outside the firm to include both suppliers and customers.

The Midwest region has a long tradition of manufacturing and accounts for 30% of U.S. manufacturing (Midwestern Governors Association 2010). For example, more than 60% of all automobiles and 40% of machinery and primary metals manufactured in the U.S. are built in the Midwest (Midwestern Governors Association 2010). There is a dearth of empirical studies in literature which have examined the degree to which U.S. manufacturers have implemented various GSCM practices and their impact on company performance. The few studies that exist are based on very small sample size and narrowly focused on a particular industry group such as electronics or semi-conductor. In this paper, our purpose is to survey Midwestern manufacturing firms about their level of adoption of GSCM. We survey manufacturing companies in the Midwest to answer the following questions:

1. To what extent do Midwestern manufacturing companies use GSCM practices?
2. What drives the use of GSCM practices by the Midwest manufacturing companies?
3. What are the financial, operational and environmental benefits of GSCM as perceived by the Midwest manufacturing companies?

LITERATURE REVIEW

The first objective of our study is to understand the extent of GSCM adoption by manufacturers in the Midwestern United States. To the best of our knowledge, this research is the first to survey GSCM adoption by U.S. manufacturers especially in the Midwest region, the hot bed of traditional manufacturing in U.S. Studies in other regions and contexts include among others: Zhu, Sarkis and Geng (2005) in China; Holt and Ghobadian (2009) in UK; Zhu et al (2010) in Japan; Zailani et al (2012) in Malaysia; Mitra, and Datta (2014) in India; Böttcher and Müller (2015) in Germany; rekova et al (2014) in Netherlands; de Sousa Jabbour et al (2011) in Brazil; Wu, Ding and Chen (2012) in Taiwan; Lin and Ho (2011) in China; and Large and Thomsen (2011) in Germany.

Our second goal is to understand what motivates or hinders firms to adopt GSCM. Consistent with Corbett and Klassen (2006), we propose that firms adopt GSCM in response to two main forces: (i) Economic forces and (ii) Social forces. We begin our discussion of the literature by considering economic forces.

Economic forces tap into managers' sensitivity to financial rewards and punishments. Naturally, if GSCM practices are good for the business, manufacturers are likely to adopt them, and there are many instances where it is the case. Investment recovery is a good example. It allows the manufacturer to recover through recycling or remanufacturing some value from end-of-life products that would have otherwise been sent to landfills. Network optimization, a GSCM

practice falling in the reverse logistics and network design category, is another example. Simchi-Levi (2010) shows that optimization of the supply chain network can reduce transportation costs while lowering the firm's carbon emissions. Redesigning the production process to improve material use can generate large cost savings. GM saved \$12 million by implementing reusable containers with its suppliers (McDaniel and Fiksel 2000). Lastly, Porter and van der Linde (1996) discuss several instances in which efforts to reduce pollution have forced the firms to find new ways to produce. Interestingly, the innovations they discuss have generated benefits that more than offset the costs of reducing pollution.

In addition to direct financial gains, GSCM practices can also benefit the firm by improving brand reputation and market value, both of which are important outcomes for managers. In a global survey of 378 senior executives, KPMG found that 41% of respondents cited the desire to enhance brand reputation as a key reason for their involvement in sustainable practices (KPMG 2011). Furthermore, Klassen and McLaughlin (1996) found that financial markets reward firms for environmental excellence and penalize them for environmental mismanagement. Their study illustrates that receiving environmental performance awards was positively associated with financial market valuation while environmental crises negatively impacted market valuation.

In the literature, the relationship between environmental and firm performance has been framed in terms of the resource-based view (RBV) theory. According to RBV, firms that hold valuable and rare resources which are difficult to imitate or for which there is no substitute in the market will enjoy a sustained competitive advantage. Firms rely on natural resources for their operation and survival. Using arguments grounded in RBV theory, Hart (1995) and Hart and Dowell (2010) assert that firms which excel at managing natural resources will outperform competitors. Thus, managers should develop strategies to acquire such capabilities.

Next we turn to social forces and the related framework of institutional theory. Institutional theory describes an "inexorable push toward homogenization" among organizations (DiMaggio and Powell 1983, p. 148), a statement based on the observation that, in stable industries, organizational forms are remarkably similar. Institutional theory advocates that organizations tend to align (or become isomorphic) with their environment. According to DiMaggio and Powell (1983) this happens via the interplay of three mechanisms: coercive, mimetic and normative isomorphism.

Coercive isomorphism denotes the formal and informal pressures exerted on a firm to conform with expectations stemming from the cultural, political and legal environment, for example, the adoption of pollution control equipment in response to government mandates. In the environmental arena, regulation may often be the only way to force firms to curb their pollution (Sterner 2003). Participation in certain markets (e.g., the financial markets) comes with reporting and other stringent requirements. Furthermore, local communities, sometimes with the help of non-government organizations, lobby to keep polluting industries away from them or seek redress from polluters in the aftermath of environmental disasters. Such pressures can be quite immense. For example, settlement of the Deepwater Horizon oil spill in 2010 cost BP \$18.7 billion (U.S. Department of Commerce 2015). Henriques and Sardosky (1996) found that a firm's drafting of an environmental plan is positively associated with neighborhood and community pressures. Informal pressures also arise from employees whose morale is positively impacted by the firm's good reputation and practices (Chinander 2001).

Mimetic isomorphism, the second mechanism of homogenization, occurs in response to uncertainty. When managers are unsure about what to do because of technological uncertainty

or goal ambiguity, they tend to imitate successful companies. Such a mechanism may be at play in US where companies are investing to reduce their greenhouse gas emissions in spite of considerable uncertainty regarding EPA's ability to implement binding climate change regulations.

Lastly, normative isomorphism as the third mechanism is an outcome of professionalization. It, is the process by which managers in an industry organize themselves to define the conditions and work methods in their industry. The development of industry-sponsored codes of practices, the emergence of industry-wide training programs and the practice of recruiting from the same accredited schools encourage the adoption of homogenous work practices within an industry. The Responsible Care program from the North American chemicals industry is the largest environmental self-regulation program in the world (Iannuzzi 2002). Our GSCM survey instrument addresses all three of these mechanisms.

METHODOLOGY

This empirical study consists of developing a questionnaire and collecting responses from middle to senior level managers in the Midwest manufacturing companies. The questionnaire was divided into three main sections: (1) pressures/drivers for implementing GSCM practices; (2) GSCM practices implemented; (3) performance outcomes. Section 1 on pressures/drivers utilized 18 items which were answered by respondents using a five-point Likert scale. Section 2 on GSCM practices involved items which asked how often companies used 28 different GSCM practices. These items were answered using the five-point Likert scale. Section 3 on performance outcomes used 20 items which asked what happened to the performance in environmental, financial, and operational areas as perceived by each respondent's company. These items again were answered by respondents by using a five-point Likert scale. This survey borrowed many of the question items from Zhu et. al (2007) which focused on studying GSCM adoption within Chinese automotive industry. Additional question items were developed after reviewing relevant research literature (Min & Galle, 1997; Carter & Carter, 1998; Walton, Handfield, & Melnyk, 1998; Carter, Kale, & Grimm, 2000).

The survey was made available to middle to senior level managers at 112 manufacturing companies in the Midwest region. The survey was made available online using www.monkeysurvey.com web site which hosted the survey and the link to complete it was sent to each of the respondent company.

RESULTS AND DISCUSSION

Table 1 shows the four driver factors along as aggregates of pressure items faced by the Midwest manufacturing companies. Surprisingly, we find that pressures related to internal impetus, and not regulatory, are most significant to be faced by Midwest manufacturing companies for implementing GSCM practices. It may be due to the fact that Midwest economy is deeply rooted in manufacturing and the environmental regulations in this region are still evolving and being slowly phased in.

Pressures/Drivers		Mean	Standard Deviation
DR1	<i>Regulation</i>	3.86	1.08
DR2	<i>Market</i>	3.77	1.12
DR3	<i>Suppliers</i>	3.49	1.19
DR4	<i>Internal Impetus</i>	4.06	0.99

The internal impetus factor has the highest mean of 4.06 (4=important; 5=extremely important) among all the four pressure factors. A smaller standard deviation value of 0.99 suggests broader consensus (little variation) among all respondents regarding the importance of this factor as a significant driver for green supply chain initiatives. All the corresponding items within this factor have mean scores above 4.00 with the exception of cost of eco-design/disposal of hazardous material which has a mean of 3.84. It implies that most Midwest manufacturing companies are serious about managing the environmental impact of their manufacturing operations by including environmental concerns in their company's mission statement.

Regulatory pressures with a mean of 3.86 constitute the second most important driver for implementing GSCM practices. Midwest manufacturing companies are facing strong pressures from national, state, and local level environmental regulations with means that are close to 4.00. We also find that the pressure from export countries' environmental regulations is less important than that from domestic environmental regulations. It may be due to environmental regulations within export countries that are not as strict as within United States.

Market related pressure with a mean of 3.77 is the third most important driver for environmental practices among Midwest companies. Pressure coming from environmental requirements of domestic customers as compared to foreign customers is more significant in shaping Midwest manufacturing company's environmental practices. These companies are also feeling significant pressure for establishing a "green" image or footprint. Midwest manufacturing companies do not seem to be facing much direct pressure from their suppliers for green practices. The means for items within this pressure factor ranges from 3.39 to 3.54. It seems that Midwest manufacturing companies are leveraging on their suppliers' capability to deliver environmentally friendly parts/packaging in pursuit of their environmental goals.

Table 2 shows the type and degree to which each of the GSCM practices have been implemented by the Midwest manufacturing companies in response to various underlying pressures identified earlier. The means for all the five practice factors range from 2.82 to 3.73.

Practices		Mean	Standard deviation
PR1	<i>Green Purchasing</i>	2.82	1.45
PR2	<i>Cooperation with customers for environmental requirements</i>	2.99	1.42
PR3	<i>Investment Recovery</i>	3.59	1.28
PR4	<i>Eco Design</i>	3.48	1.43
PR5	<i>Internal management</i>	3.73	1.29

In general, practice factor means are found to be considerably lower than pressure factor means implying that adoption of GSCM practices has lagged the underlying pressures for environmentally friendly manufacturing. We also find the standard deviation values for GSCM practice items to be higher than those for GSCM pressure items. It suggests that there exists a considerable amount of variance among respondents on the degree to which each company has implemented the GSCM practices.

It seems that the Midwest manufacturing companies have been able to implement GSCM practices related to internal management with a higher degree of success (mean=3.73). Practices such as engaging in environmental compliance and auditing programs, pollution prevention programs, ISO 14000 certification, and environmental management systems all have means reflecting higher levels of implementation. Other internal management practice items such as senior and mid-level management commitment, cross functional cooperation, total quality environmental management, eco-labeling of products, and special training of workers on environmental issues have mean values which imply their adoption to be at the early stages.

Table 2 further shows that GSCM practices related to investment recovery with a mean of 3.59 have the second highest degree of adoption. Mean scores on GSCM practices such as sale of scrap and used materials, recycling of used or defective products, and sale of excess capital equipment are used quite often by the manufacturing companies. GSCM practices related to eco-design are the next most adopted practices with a mean of 3.48. It is noteworthy that the GSCM practice design of process for waste minimization has a very high level of implementation compared to others within the eco-design practice factor. It seems manufacturing companies find it challenging to implement the practice of designing products for reuse, recycle, recovery of material, and component parts (mean=2.96) i.e. products that form a closed loop system. These companies have seen some success in designing products that consume less material and energy as well use less or no hazards component parts.

GSCM practice factors such as green purchasing and cooperation with customers for environmental requirements with means of 2.82 and 2.98 respectively are infrequently implemented by the Midwest manufacturing companies. Table 2 shows that adoption of GSCM practice cooperation with customers in the supply chain for eco-design in terms of seeking their input or inviting them for joint development efforts is the least (mean=2.80). There seems to be at least some cooperation with customers for cleaner production (mean=3.18) and green packaging (mean=3.00). The Midwest manufacturing companies seriously lack implementation of practices related to green purchasing. Barring two GSCM practices within this factor, cooperation with suppliers for environmental objectives and dealing with ISO 14000 certified suppliers, rest of them have mean scores below 3.0. Midwest manufacturing companies need to work closely with suppliers in developing design specifications for environmentally friendly purchase items.

Table 3 relates to the perceived performance outcomes in environmental, financial, and operational areas as a result of GSCM practices implemented by the Midwest manufacturing companies. It is to be noted that the financial performance is examined by considering two distinct dimensions - gains due to cost savings and burden due to increase in costs affiliated with implementing GSCM practices. The study finds environmental performance with a mean of 4.14 (4=slightly improved; 5=greatly improved) to be highest as compared to either operational or financial performance.

Performance		Mean	Standard deviation
PF1	<i>Environmental Performance</i>	4.14	0.86
PF2	<i>Financial Gain</i>	3.68	0.91
PF3	<i>Financial Burden</i>	3.21	0.87
PF4	<i>Operational Performance</i>	3.67	0.85

It is not surprising that all of the environmental performance items have mean scores above 4.0. GSCM practices at Midwest manufacturing companies have led to significant improvements in reducing waste water and consumption of hazardous or toxic materials, each with a mean of 4.24. Companies have also seen adequate reductions in solid waste and air emissions.

The Midwest manufacturing companies found the financial gain (mean=3.68) to significantly outweigh the financial burden (mean=3.21) that implementation of GSCM practices entailed. Cost savings due to decrease in energy consumption and fines for environmental accidents were most significant. Financial gains also resulted from fee reductions for waste discharge and waste treatment. Gains in operational costs saw least amount of improvement. Further, as a result of implementing GSCM practices, the manufacturing companies experienced significant increase in investment costs (mean=3.49) when compared to other cost areas. The companies did not see much impact in the cost associated with purchasing environmentally friendly materials or environmental training costs.

On the operational performance dimension, the Midwest manufacturing companies saw large improvements in the areas of increased scrap rate and promotion of product quality as a result of GSCM adoption. Companies also felt that GSCM practices have improved capacity utilization, product flexibility (ability to offer product variety), and inventory levels to some extent. Impact of GSCM practices on timely delivery of goods was found to be positive (mean=3.44), but least significant compared to improvements in other operational areas.

CONCLUSION

Our results show some evidence that economic and social forces are pushing the Midwestern manufacturing firms in our sample to adopt GSCM. Both market and regulatory pressures scored high in our survey results. As expected, coercive forces are playing an important role. Interestingly, the source of the strongest pressures comes from within the company. More precisely, it is the commitment to environmental excellence from top management or from headquarters that has the largest impact. Senior managers in the companies we surveyed appear committed to improving the environmental performance of their companies, which suggests that the adoption of GSCM practices may not be a passing fad but rather a transformation of manufacturing and supply chain management practices. The high adoption of ISO 14000 certification suggests the influence of normative forces as well. In the current exploratory study, we have considered regulatory, market and internal forces independently of each other.

Our results also indicate that managers perceive some financial and operational benefits from deploying GSCM. This is also good news for the future of GSCM. For sustainability to be realized, one needs production methods that provide benefits to the firms while preserving scarce environmental resources.

This paper is one of the few research focused on studying the types and degrees of pressures, practices, and performance outcomes faced by Midwest manufacturing companies. Its findings, even though exploratory in nature, add to the continued understanding of environmental issues in the GSCM literature. Future work may include studying environmental responses in other geographic regions by companies within specific manufacturing or service industry.

REFERENCES

References available upon request.