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GREEN AND SUSTAINABLE SUPPLY CHAIN PRACTICES: ADAPTING GLOBAL SUPPLY CHAIN PROCESS

Rachel M. Bonnell

Under the Supervision of Professor Mary Bartling

Abstract

Statement of the Problem

Climate change is a serious issue affecting the world and has been largely attributed to the carbon emissions and pollutions of industry and their related supply chains. Due to the impending issue of climate change, companies and their subsidiaries must recognize their corporate social responsibility and evolve their global practices and strategies to include green supply chain practices in order to mitigate their negative environmental effects. Green supply chain management is an emerging and growing field that presents numerous opportunities for organizations to adjust their strategic vision and goals and engage with green and sustainable technology and processes.

Methods and Procedures

The information utilized in this project is comprised mainly of secondary data analyses relevant to the topic presented. This data includes statistics related to both pollution emissions and green supply chain mitigation tactics. Additional data was obtained from various agencies including the United States Environmental Protection Agency (EPA) and the International Organization for Standardization (ISO). Additional sources published via scholarly and peer-reviewed academic journals, theorists, and educators were also cited in order to illustrate and support the arguments of this paper.

Summary of Results

The supply chain industry and its related functions contribute significantly to climate change that corporations and their subsidiaries must recognize the social responsibility to combat

its effects and mitigate future damage to the environment. However, this paper outlines green supply chain practices and technology that can be utilized to reduce the carbon footprint of organizations and their supply chains while creating opportunities to reduce costs, increase revenue and long-term financial performance, develop innovated processes, and grow a stronger consumer base.

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Green and Sustainable Supply Chain Practices: Adapting Global Supply Chain Processes

Introduction

Statement of the Problem

Climate change is a serious issue affecting the world and has been largely attributed to the carbon emissions and pollutions of industry and their related supply chains. In fact, the largest U.S. contributor to carbon emissions is transportation – a key sector within the supply chain field – accounting for about 28% of total U.S. greenhouse gas emissions (*Fast, 2020*). Companies and their subsidiaries must recognize their corporate social responsibility in reducing their negative environmental impact and implementing green supply chain practices.

Due to the impending issue of climate change, companies and their supply chains must recognize their corporate social responsibility and evolve their global practices and strategies to include green supply chain practices in order to mitigate their negative environmental effects. According to a 2018 study (*Fast, 2020*) conducted by the U.S. Environmental Protection Agency (EPA), industry's greenhouse gas contribution has risen to a share of 22% of the total U.S. greenhouse gas emissions. This statistic does not include other pollutants released into the environment by industry activities including waste, scrap, contaminated materials, and other byproducts (*Fast, 2020*).

Green supply chain management is an emerging and growing field that presents numerous opportunities for organizations to adjust their strategic vision and goals and engage with green and sustainable technology and processes. Barriers to implementing green supply chain practices may be significant in the short term when considering time and financial resources. However, the benefits of these practices extend beyond eliminating carbon emissions and pollution to long-term financial performance, production efficiencies, and positive brand

recognition (Sharma, & Gandhi, 2016). In order to achieve these benefits, firms should utilize many of the growing trends in green supply chain practices including:

- Global Outsourcing;
- Strategic Orientations;
- Reverse Logistics;
- Green Information Technology Systems (GITS);
- Company and Employee Buy-In;
- Visibility and Collaboration; and
- Green Human Resource Management

Organizations must realize they have a moral obligation to help combat climate change and utilize the tools and technology available to prevent an even worse environmental outlook. When engaged successfully, green supply chain practices can reduce companies' environmental impact while also increasing production efficiency, improving financial outlooks, and growing a positive brand image and tapping into a new generational consumer base (Wang & Gunasekaran, 2017).

Purpose of the Study

The purpose of this study is to demonstrate the negative environmental impact many supply chain activities have and consider how this impact can be mitigated or reduced through the utilization of green supply chain practices. This research should provide an in-depth and comprehensive look at the problem of global climate change, attributing supply chain factors, and green supply chain strategies, technologies, and practices. Origins of green supply chain practices, current activities and certifications, differences among industries and regions,

corporate responsibility, and future trends will all be discussed in the hopes of developing a wide-ranging view over the problem as well as potential solutions.

Significance and Implications of the Study

The significance of this study is demonstrated by providing an overarching view of the contributions to global climate change caused by current supply chain practices. This study will note the importance of corporate responsibility towards the global environment, emphasizing companies' roles in environmental efforts. This study will also highlight those existing issues, as well as mitigating green supply chain strategies, technologies, and practices that can be implemented to reduce the global supply chain environmental footprint and overall negative impact on climate change. It may stand as a comprehensive overview and exist as a resource, providing an all-encompassing view of green supply chain practices.

Assumptions and Limitations

The following are items under assumption in this paper:

1. Climate change is negatively impacting the global environment;
2. Supply chain activities, especially those related to industry and transportation, contribute negatively to climate change, specifically regarding carbon emissions and pollution;
3. The information and procedures utilized in the creation of the cited scholarly articles, academic journals, statistical data, and safety regulations was gathered with sincere interest of accurate and scientific data and without additional motives.
4. The gathering and secondary analysis of cited scholarly articles, academic journals, statistical data, and safety regulations was complete with sincere interest of the problem presented in this paper.

The main limitation of this research is the use the of secondary analysis of existing sources where there may exist unknown conditions or factors impacting the data presented.

Delimitation of the Study

The scope of this paper delimitates the selected research utilized to supply chain activities and strategies, specifically those surrounding industry and transportation, that impact climate change, as opposed to any activity or strategy that may impact climate change such as methane production by livestock.

Methodology

The primary method of approach for this project will consist of a secondary data analysis of research and statistics relevant to the topic presented. This data may include statistics related to pollution emissions from current supply chain activities, as well as those related to mitigation tactics by green supply chain practices. Further research information and statistics will be obtained from various agencies including the United States Environmental Protection Agency (EPA) and the International Organization for Standardization (ISO). Other literature and research will be attained from scholarly and peer-reviewed academic journals, theorists, and educators that have published credible work that can be used to illustrate and support the arguments of this paper.

Review of Literature

This paper addresses the serious issue of climate change and the contribution supply chain activities have towards the problem. In order to better understand the issue, impactful trends, and possible mitigation tactics, various works of research were consulted in order to clearly define and support each segment stated previously. The bulk of the literature reviewed for this paper included twenty-three scholarly articles retrieved from the Karmann Library's online

database. Additional online sources were consulted for supplementary information. Because of the significant impact corporations around the globe have on global climate change, it is imperative that they meet their social and environmental responsibility to reduce their own individual impacts.

A study was completed by Tuni, Rentizelas and Duffy (2018), to identify quantitative methods to measure the environmental performance of supply chains and their key features. A systematic literature review was conducted as research for this study, encompassing 78 peer-reviewed publications, considering aspects including environment, measurement, model types, and the scope of the supply chain. The study concluded that there is little standardization regarding metrics surrounding supply chains, green supply chain activities, and the environmental impact of supply chains. While there was a significant focus on the use of natural resources, energy, and pollution emissions, there are few functions of traceability of supply chain activities and their less immediate or direct effect on the global environment.

Innocent Senyo, Agyabeng-Mensah, & Afum (2020) considered the increasing concern for environmental protection through pollution prevention and conservation as a driver for organizations to implement both green supply chain practices as well green human resource management. This study explored the influence that both green supply chain practices and green human resource management may have on several metric categories, including operational, market, financial, social, and environmental. Data for this study was gathered via structured questionnaires completed by supply chain and human resource managers and suggested that the individual practices are complimentary both to each other and the overall strategic goals of an organization.

Longoni, Luzzini, and Guerci, (2018) recognized that balancing environmental, social, and economic performance is a critical task for consumer-facing businesses. This study investigated the deployment of environmental management through human resource activities, i.e. green human resource management, as well as green supply chain management to explore the impact on financial performance. A multiple-respondent survey from multiple industries in Italy suggested that both strategies positively impact both environmental and financial performance.

The online article, *Fast Facts on Transportation Greenhouse Gas Emissions* (2020), provides summaries of 2018 research, discussing the breakdown of greenhouse gas emissions in the United States. The study found that 28% of the greenhouse gas emissions in the United States were attributed by transportation methods, a key component of supply chain activities.

Kumar, Teichman, and Timpernagel (2012) also supported the concept that green supply chain practices can provide financial incentives when implemented efficiently. This study followed Coca-Cola, a leader in global sustainability, and Apple, an emerging presence in global sustainability, to evaluate the efforts of green supply chain practices and their relation to cost savings.

Dam and Petkova (2014) considered potential financial impacts of a public company's stock price before, during and after implementing green supply chain strategies. This was an event study using a sample of 66 multinational firms that committed to the Carbon Disclosure Project (CDP). In contrast to other articles reviewed for this paper, the study found that following company announcement of participation in the CDP, stock prices declined in marginally significant fashion.

Ortas, Moneva, and Álvarez (2014) also investigated the link between sustainable supply chains and companies' financial performance. This study used multivariate measures of

sustainable supply chain performance, as well as causality tests, on a diverse sample of 3,900 companies over an 8-year time period. The main conclusions of the article indicated a bidirectional causality between sustainable supply chain performance and overall financial performance, supporting the link between sustainable supply chain performance and financial performance.

Wang and Gunasekaran (2017) suggests that environmental impacts exist at each stage of a supply chain. Taking a nonlinear dynamic system approach, this study described the dynamics of the expected reduced impact of sustainable supply chains on the environment. The study supported the environmental impact of supply chains, concluding that the impact justifies both environmental and economic significance related to supply chain sustainability.

Lee, Jin, Choi, and Noh (2013) discussed the relationship between the forces of pressure impacting green supply chain management and the performance of the supply chain. Standard metrics were discussed, specifically considering resources, output, and flexibility and how those metrics can demonstrate and contribute to a supply chain's overall success. Data was gathered using a survey questionnaire, due to a lack of archived data at the time of the study. The overall findings of this article concluded that implementing green supply chain practices is instrumental in the long-term performance and competitive advantage within an organization.

Lu, Zhao, Xu, and Shen (2018) researched the potential institutional pressure of maintaining sustainable supply chains and its relationship with economic, social, and environmental performance, specifically addressing whether sustainable supply chain practices can positively impact overall performance. The study followed Chinese manufacturers and concluded that sustainable supply chain practices do impact the economic, social, and environmental performance of the companies that implement them.

Roehrich, Hoejmose, and Overland (2017) explored how green supplier selection drives green supply chain performance and how the level of performance is also dependent on mechanisms of autonomy, competence, and relatedness within the supply chain. This study utilized 18 interviews as well as secondary data to highlight the importance of green supplier selection, specifically highlighting the impact supplier motivation can have on green supply chain management.

Other articles were reviewed to specifically consider specific green supply chain practices and their initial drivers. For instance, Molina-Besch, Wikström, and Williams (2019) explored packaging recommendations within life cycle assessment studies of food and to determine the level of direct and indirect impact food packaging has on the environment. The study found that food packaging is trending towards more sustainable practices like an increase in recyclable packaging or a decrease in overall packaging, though the overall environmental impact of food packaging is still significant.

Androvicsova (2018), an article released by the United Nations Climate Change website, discussed several mitigating strategies to cut carbon emissions created by supply chains. Beyond reducing their carbon footprint, companies that were successful in these strategies also saw reduced costs related to transportation and production, creating an additional incentive to implement and maintain efficient green supply chain practices.

The purpose of Islam, Karia, Fauzi, and Soliman (2017) was to create a comprehensive list of green supply chain practices. The data surrounding these practices was gathered through a structured review process and critically examined data pulled from peer-reviewed articles and other works. The study compiled a final list of 15 features of green supply chain practices

including reverse logistics, industrial symbiosis, green information technology, green design, and carbon management.

Okongwu, Morimoto, and Lauras (2013) discussed green supply chain initiatives from the perspective of a continuous improvement philosophy as well as investigates the level of green supply chain reporting across business sectors. This paper utilized content analysis and principle component analysis of selected companies from ten different industries to gather data. In the course of the study, it was determined that consumer facing industries demonstrated much higher levels of green supply chain initiative reporting than business-to-business industries, supporting the growing trend of the “conscious consumer.”

Kaur, Sidhu, Awasthi, Chauhan, and Goyal (2018) explored the barriers companies face to implement green supply chain management strategies, focusing on seven Canadian electronics manufacturing firms. The three main categories of barriers include knowledge-related, or the lack of awareness of environmental impacts, lack of training, lack of technical expertise, etc., commitment-related, or the lack of corporate social responsibility, and product design-related, or the complexity and feasibility to reuse or recycle used products.

Rauer and Kaufmann (2015) also considered key barriers to green supply chain initiatives and investigated possible mitigations to the many barriers of implementing green chain management. This study analyzed data gathered from ten green-tech companies involved in the sourcing of rare earth metals. The findings of this study suggested that there are two categories of external barriers to green supply chain management: structure-related and environmental standards-related.

Tachizawa, Gimenez, and Sierra (2015) analyzed the complex interrelationships among green supply chain drivers, as well as green supply chain management and performance. Data

was gathered via survey, completed by a sample of purchasing and supply chain managers, and analyzed to relate the various drivers, approaches, and performance presented. The study found that coercive and non-coercive drivers impact green supply chain management approaches differently while true performance improvements require the integration of suppliers into collaborative practices.

Additional resources were reviewed to consider standards in sustainability strategies. *Carbon Trust Standard: Certification: Carbon Trust* (2019) discussed the Carbon Trust which is an organization that helps companies develop and communicate strategies related to carbon, water, and waste management. The group uses third-party assessments to provide expertise and knowledge, assisting companies towards an overall goal of net zero emissions and achieving the Carbon Trust Standard and ISO 14000.

What Is EMAS? (2019) explored European Union's Eco-Management and Audit Scheme (EMAS) as a management instrument for European companies to evaluate, report, and improve environmental performance. Though created by the European Commission, these standards are applicable worldwide, providing applicable information and strategies for companies of all economic scales and sectors.

Niehaus, Feiboth, and Goedhals-Gerber (2018) reviewed the existing sustainability reporting practices present in South African organizations as well as the expected impact of a pending carbon tax. Data for this study was gathered from annual sustainability reports and analyzed using non-parametric statistical testing. The results demonstrated the insufficient reporting practices present in certain sectors.

There are many sustainable supply chain strategies that companies may choose to implement to mitigate their environmental impact. Several studies researched also explored the

relationship between these strategies when implemented in parallel. Yang, Sun, Zhang, and Wang (2018) discussed green supply chain management and green information systems as sustainable supply chain strategies, identifying common features of two IT-related sustainability functions. The study found that, provided a successful operational fit following functional deployment, the implementation of green supply chain management and green information systems should provide positive long-term impacts on environmental, social, and financial performance.

Yang, Sun, Zhang, and Wang (2020) built upon the research of Yang, Sun, Zhang, and Wang (2018), discussed above, presenting both green supply chain management and green information system as two pillars of sustainability and green innovation. This study specifically considers the alignment of the two pillars in terms of corporate synergy, exploring the interdependency of the two. The study found that the alignment and synergy present was informal but effective at enhancing the economic, operational, environmental, and social performance of the other system.

Yu, Zhang, and Huo (2019) developed a model to research the relationships between supply chain quality integration, green supply chain management, and environmental performance. The study collected data from 308 manufacturing companies in China and was empirically tested. The study found that supplier and customer quality integration had a positive impact on green purchasing and customer green cooperation, in turn improving environmental performance.

Green, Inman, Sower, and Zelbst (2019) assessed the potential complementary impact of just-in-time (JIT), total quality management (TQM), and green supply chain practices on environmental performance. Data was taken from a sample of 225 U.S. manufacturing managers

and analyzed using a PLS-SEM methodology. The study found that JIT and TQM were directly and positively associated with green supply chain practices and that all three strategies positively impact environmental performance.

Sharma and Gandhi (2016) explored various sources of peer-reviewed literature in order to identify future sustainability strategies and trends, identifying “green supply chain practices” and “green supply chain performance” as constructs for the co-relational study. The study concluded that there is still additional need for detailed studies on the components of green supply chain practices that have strong associations with components of green supply chain performance.

Chin-Chun, Tan, and Zailani (2016) discussed green supply chain practices like reverse logistics, eco-reputation, and eco-innovation orientation strategies, specifically addressing these tactics when applied in manufacturing operations in emerging countries. The authors utilized empirical testing via structural equation modeling during the study and concluded that implementing sustainable supply chain practices can improve reverse logistics outcomes, providing additional insight into eco-reputation and eco-innovation strategic orientations.

Missing from this genre are any significant studies pulling together the critical issues, trends, and mitigation tactics relating to climate change into one comprehensive resource. This paper aims to consolidate much of the previous research to provide a wide-ranging source on climate change as related to supply chain activities.

Methodology

There are many green supply chain management strategies that organizations can implement in order to mitigate their environmental impact, as well as trending movements to support the efforts. However, there may also be significant barriers to entry. As green supply

chain management is a relatively new field, the available research is lacking comprehensive sources compiling the research and data related to facts on the global environmental impacts of supply chains, barriers to entry, green supply chain strategies and technology, growing trends in the field, etc. This seminar paper aims to compile the information gathered from numerous scholarly articles and experiments in order to provide a single, cohesive and comprehensive source.

In order to complete this paper, both qualitative and quantitative secondary data sources were referenced. All scholarly articles utilized in this paper were peer-reviewed, published in academic journals, and sourced from the Karrmann Library's online database. All online sources were published on a U.S. or European Union official government agency website. This approach was deemed the most suitable approach as it allowed for the gathering of expert research in all topics to be addressed in this paper. All scholarly articles were published within the last nine years (2012-2020) while all online resources were published in the last two (2019-2020).

Data was analyzed categorically, with similar articles being reviewed and analyzed together in order to develop trends and highlight similarities and differences within the research. Because the approach of this seminar paper is to provide a comprehensive resource surrounding the issue of environmental impact by supply chains, green supply chain management strategies, barriers to implementing, trends, etc., secondary data provided the best opportunity for developing a thoroughly researched seminar paper, utilizing the expertise of many scholarly-reviewed and professionally published sources.

Analysis

Supply Chain Performance Metrics

There are several components when determining the performance of a supply chain including resources, output, and flexibility. Resource levels can demonstrate the supply chain's forecasting abilities and transportation efficiencies. Adequate resource levels also significantly impact the financial perspective through total cost, distribution cost, manufacturing cost, inventory cost, and return on investment (Lee, Jin, Choi, & Noh, 2013).

Output can be measured in a variety of ways including the level of customer service, customer response time and customer complaints, sales numbers, profit margins, timeliness of deliveries and stockout scenarios, manufacturing lead time, and shipping errors (Lee et al, 2013). Flexibility is the ability of the supply chain to respond to uncertainty including variations in volume, distribution, responsiveness, product, etc. Flexibility can lead to reductions in inventory, and therefore associated costs, the mitigation of market variations, the quick adjustment to changing customer demands, and further integration with suppliers and customers (Lee et al, 2013).

Flexible Supply Chains to Implement Green Supply Chain Practices

The necessity of implementing green supply chain practices is growing significantly as downstream buyers and consumers become increasingly more aware of the environmental effects supply chains have on local, regional, national, and global communities and demand that organizations take social and environmental responsibility for their negative environmental contributions (Roehrich, Hoejmoose, & Overland, 2017). Consumers are demanding more accountability from the brands they frequent while government agencies are also expanding

green legislation in an attempt to combat global climate change and mitigate the already-present impacts.

Green supply chains must be robust. In order to fully design, implement, and engage with green supply chain practices, a firm must first evaluate their supply chain, identifying strengths and potential areas of improvement. Evaluating their resources and outputs provide great opportunities to innovate current processes (Wang & Gunasekaran, 2017). However, from a long-term perspective, firms that are able to increase their supply chain's flexibility will be able to fully engage green supply chain practices by increasing their ability to react to consumer demands and government regulations with little to no penalty in terms of time, effort, cost, or overall performance. Increased flexibility will also allow firms to convert products and practices to more green-friendly alternatives by reducing the cost and time required to make the change, as well as improve operational outputs by decreasing inventory and the overall cost of the innovations (Lee et al, 2013).

History of Green Supply Chain Practices

The effects of industrialization on the global environment are significant. It is estimated that in 2009, 80% of carbon emissions were contributed by supply chains (Islam, Karia, Fauzi, & Soliman, 2017) and according to Androvicsova (2018), "Carbon emissions in supply chains are on average four times those of company's direct operations." In 2018, it was estimated that 28% of U.S. greenhouse gas emissions were contributed by the transportation sector, followed closely by electricity (27%) and industry (22%) (*Fast Facts*, 2020). Over the past decade, the supply chain industry has made some progress, implementing green supply chain practices; however, there is still significant work to be done.

Introduction of Green and Sustainable Trends

Several decades ago, pressures to implement green and sustainable trends originally came from non-governmental agencies. As early as the 1960s, organizations felt pressure from environmental movements demanding corporations be responsible for their impact on the environment. These movements, even in their infancy, pushed Congress to pass the first measures promoting and regulating cleaner air and water (Islam et al, 2017).

Today, the pressure from consumer groups remains strong as the most influential driver towards green supply chain practices. Consumers demand that firms manufacture products under acceptable social and environmental standards and in today's market, organizations implement green practices partially to manage reputational risk and maintain market share (Okongwu, Morimoto, & Lauras, 2013). Many corporations implement green and sustainable practices as an operational strategy but also a marketing tool in order to “buy” brand loyalty, projecting the image of environmental and social concern that is important to the modern-day consumer (Okongwu et al, 2013).

Drivers to Implement Green Supply Chain Practices

External and Internal Drivers

External drivers are those that originate from outside of the firm while internal drivers are derived from within. There are several external drivers to implementing green supply chain practices that are present across most industries. Two key external drivers include a company's stakeholders as well as their competition. However, in today's consumer-driven market, the largest external driver is the consumer whose focus on green and sustainable practices, as well as corporate social responsibility, has grown tremendously in recent years (Kumar, Teichman, & Timpernagel, 2012).

While consumer preferences are an enormous driving force to implement green supply chain practices in customer-facing industries, customer integration also provides organizations with quality improvement processes that most significantly impact the customer including environmentally *and* consumer-friendly design, green packaging, product recycling, etc. with efforts directed at reducing energy consumption and environmental impact without sacrificing customer experience .

As public demand for green and sustainable practices has grown, an increase in environmental laws and regulations, including international guidelines like the Organization for Economic Co-operation and Development (OECD) guidelines and domestic regulations is acts such as the Dodd-Frank Act (Rauer & Kaufmann, 2015), elevating the legal responsibility of corporations to integrate green practices into their supply chains (Lu, Zhao, Xu, & Shen,2018). The increased legislation has also given firms an opportunity to “go above and beyond” by over-performing what is legally required of them. Achieving sustainability levels much higher than what is legally required, presents an opportunity to not only improve their industrial and environmental performance, but also secure additional brand loyalty from consumers who recognize their efforts, which in turn should increase market share and sales figures (Kumar et al, 2012).

Internally, a company is driven to adopting green supply chain practices when it sees the internal opportunities present. Green supply chain practices aim to reduce, limit, and eliminate waste from the value chain while innovating existing manufacturing and logistics processes. All of these initiatives, when successful, lead to increased savings in cost, resources, emissions, and time (Kumar et al, 2012). It is, however, important to note that these internal drivers could pose an external risk. Research conducted by Dam and Petkova (2014) suggested that the

announcement of green supply chain commitments by firms is received with negative shareholder reactions and an average decrease in stock price of approximately 3.2%. These findings suggest that the internal opportunities, especially cost savings, of implementing these practices are not guaranteed nor seen as initially positive by external shareholders, reducing the intensity of internal opportunity drivers (Yu, Zhang, & Huo, 2019).

Improved social reputation and, often, increased market share and financial projections are additional potential benefits (Kumar et al, 2012). Company leadership can help engage personnel through the use of a suggestion system, improving internal communication, and integrating green supply chain practices with long-term strategic visions and goals (Ortas, Moneva, & Álvarez, 2014).

Coercive and Non-Coercive Drivers

Drivers of green supply chain practices can also be split into two categories: coercive and non-coercive. Coercive drivers are mandatory drivers like regulations and environmental standards. They are requirements that the organization must meet. On the other hand, non-coercive drivers do not strictly mandate to an organization and may include competitors, consumers, and financial objectives (Tachizawa, Gimenez, & Sierra, 2015).

Coercive drivers mandate green initiatives that must be met; however, they are often less impactful than non-coercive drivers. This is due to the fact that coercive drivers often require increased monitoring on the entire value chain to avoid environmental penalties. This increase in monitoring, without increased collaboration between value chain partners, may reduce the mutual trust between buyers and suppliers, souring the relationship (Tachizawa et al, 2015).

Drivers by Category

Green supply chain drivers also exist categorically. Key driver categories and their features are listed below in Table 1 (Kaur, Sidhu, Awasthi, Chauhan, & Goyal, 2018).

Table 1

Key Green Supply Chain Drivers

Key Driver Category	Features of Key Driver Category
Design	<ul style="list-style-type: none"> • Cost reduction • Delivery reliability • Agility to combat changes in demand
Procurement	<ul style="list-style-type: none"> • Waste management • Cost savings • Process improvement • Image improvement • Compliance with environmental regulations
Production	<ul style="list-style-type: none"> • Market growth • Technical improvements
Testing and inspection	<ul style="list-style-type: none"> • Compliance with environmental regulations
Packaging	<ul style="list-style-type: none"> • Waste management • Consumer awareness
Transportation	<ul style="list-style-type: none"> • Compliance with environmental regulations • Consumer awareness
Warehousing	<ul style="list-style-type: none"> • Inventory reduction

	<ul style="list-style-type: none"> • Time management
Recycling	<ul style="list-style-type: none"> • Value creation • Waste management • Consumer awareness

Barriers to Green Supply Chain Practices

The largest barriers to deploying green supply chain practices are the financial and time investments required in the short term. While green supply chain practices are being developed and implemented, firms face increased operating costs as well as decreased speed in productivity because of the resources that are being diverted to the additional processes. A firm's resource requirement is also increased to handle the development and deployment of the new processes (Lee et al, 2013).

Supplier selection is another barrier to green supply chain practices. Firms must be willing to actively select suppliers based on environmental criteria. The success of green supply chain management is affected by both the focal firm's actions, as well as the actions of its value chain partners (Roehrich et al, 2017). In addition, increased collaboration with suppliers would have an initially negative effect from the financial perspective as making environmentally minded changes may cause the partner to raise prices, increasing purchasing costs for the focal firm (Longoni, Luzzini, & Guerci, 2018). Improving supplier quality can improve green purchasing practices, leading to increased communication and collaboration regarding environmental practices and goals (Yu, Zhang, & Huo, 2019).

Another barrier firms face is the full commitment by management and company personnel required to implement green supply chain practices. There must be cross-functional

cooperation to drive green supply chain practices successfully (Lee et al, 2013). If the new initiatives aren't imbedded in the company's overall strategic vision and goals, they will likely fail.

Barriers by Category

Additional barriers can also be listed categorically. Key barrier categories and their features are listed below in Table 2 (Kaur et al 2018):

Table 2

Key Green Supply Chain Barriers

Key Driver Category	Features of Key Driver Category
Design	<ul style="list-style-type: none"> • Weak forecasting • Supply chain complexity • Product portfolio
Procurement	<ul style="list-style-type: none"> • Greater collaboration with suppliers • Increased cost of materials
Testing and inspection	<ul style="list-style-type: none"> • Product conflicts with regulations • Lack of technical expertise
Packaging	<ul style="list-style-type: none"> • Generates the most negative environmental contribution • Required for protection and safety of product
Transportation	<ul style="list-style-type: none"> • Largest contributor to negative environmental impact
Warehousing	<ul style="list-style-type: none"> • Risk in hazardous material inventory
Recycling	<ul style="list-style-type: none"> • Complexity of design • Increased cost of materials

Mitigating Barriers to Green Supply Chain Practices

Despite the increasing technology, trends, and information available in this field, overcoming the barriers to green supply chain management still requires significant effort. However, Rauer and Kaufmann (2015) suggest there are three capabilities that firms can manage to help mitigate these barriers: sensing, alignment, and resilience. Sensing capabilities relate to a firm's ability to understand the local, regional, national, and international factors that may impact their green supply chain practices, increasing the validity and reliability of relative outside information. In essence, the better a firm can understand external factors impacting both the focal firm and value chain partners, the more prepared they will be when implementing effective green supply chain practices (Rauer & Kaufmann, 2015).

The alignment capability suggests that in order to successfully overcome the barriers to implementing green supply chain management, environmental sustainability must be a core value in a focal firm's operational efforts as well as the overall supply chain. The ability to align value chain partners with the same environmental goals and, when applicable, practices, is significant to the focal firm's ability to successfully implement green supply chain management. A second piece to the alignment capability also includes alignment politically in order to meet regulation requirements and environmental standards that may vary across industry and country (Rauer & Kaufmann, 2015).

Resilience was the final capability presented in Rauer and Kaufmann's study (2015). It is impossible to guarantee 100% compliance across an entire value chain, creating a need for resilient supply chains that can continue to support green supply chain management and practices while facing failures in-house and within the value chain. Resilience may be found in increased technology, technical skills, reductions in non-environmentally friendly inputs throughout the

value chain, and the building value chain resources to provide potential resources and support in the event of failure (Rauer & Kaufmann, 2015).

Differences in Green Supply Chain Practices Across Industries

The most significant difference found across industries was found between business-to-business and business-to-customer firms. Business-to-customer firms were found to have more downstream supply chain commitments. Therefore, they were more likely to maintain a mature supply chain with green supply chain practices.

Because of their downstream commitments, like the end consumer, business-to-customer firms provided a higher level of visibility regarding their green and sustainable practices than business-to-business firms. Business-to-customer firms were more likely to consider the importance of recognizing and reacting to growing customer demands by innovating products and processes to meet those pressures. It is estimated that 60-80% of business-to-customer companies produce a specific supply chain report, compared to only 0-20% of business-to-business companies. These statistics also demonstrate that the largest driver to implement and disclose green supply chain practices is the end consumer (Okongwu et al, 2013).

In terms of industry sectors, the energy sector has demonstrated the worst levels of green and sustainable practices. Energy business practices, especially considering the fossil fuel industry, have caused many major social, environmental, and ethical dilemmas, partnered with significant consequences. The energy sector will require a substantial investment in dollars and time to make proper strides toward green supply chain practices. However, the energy sector has made strides in renewable energy sources like wind and solar power, but other practices still overwhelm the environment with negative impacts (Okongwu et al, 2013).

Excluding the energy sector, no industry has shown consistent commitment, or lack thereof, to green supply chain practices. Beyond legal requirements, it is a trend that is very company-specific in its adoption and implementation (Okongwu et al, 2013).

Differences in Green Supply Chain Practices Across Countries

The largest difference observed across countries occurred when comparing practices of a developed nation and a developing nation. The drivers, barriers, and trends previously discussed are fairly consistent when considering green supply chain practices in a developed nation.

Developed Countries

In Canada, three significant categories of barriers are knowledge-related, commitment-related, and product design-related. These barriers are largely internal and specific to individual firms. There is a strong lack of awareness of the environmental impact on business, a lack of training for company personnel, and lack of technical expertise. In order to address knowledge-related barriers, companies need to implement plans to develop technical expertise and appropriate training programs, as well as launch investigations into the firm's environmental impact. Firms should also work to build collaboration throughout the value chain and to promote awareness on green supply chain practices (Kaur et al 2018).

The main feature of commitment-related barriers is a lack of corporate and social responsibility. To mitigate this barrier, managers should be actively involved in all phases of green supply chain practices and encouraged to engage with their subordinates on the importance of corporate and personal responsibility. This could be done in several ways including a marketing plan to push the benefits and results of green supply chain practices or additional training on the topic (Kaur et al 2018).

Product design-related barriers include the complexity of design to reuse or recycle used products. New technology and materials should be investigated with sustainability goals in mind and efforts being directed to materials and processes that will eliminate waste long-term (Kaur et al 2018).

Developing Countries

At the time of publication, *Investigating supply chain sustainability in South African organizations* (Niehaus, Feiboth, & Goedhals-Gerber, 2018) reviewed the developing nation of South Africa, analyzing the different junctures that developing nations may be at considering green supply chain initiatives. Companies in developing nations are often still working towards maintaining consistent supply chain processes without considering green and sustainable practices as well. Many countries in Africa, and other developing regions, struggle to move products the “last mile” due to transportation and warehousing issues. However, these countries are also poised to implement these practices because of their geographical location and access to knowledge that wasn’t present when supply chain trends first appeared (Niehaus et al, 2018).

Climate change and global warming are external drivers toward green supply chain practices that affect the entire world. However, developing nations experience their consequences more severely. Volatile states will only become more so as climate change threatens already scarce resources and impacts unstable economies. Companies must work to develop process efficiencies while minimizing waste, costs, and emission (Niehaus et al, 2018).

One looming risk to companies in developing countries is the rising cost of fuel prices. Companies must look for ways to minimize transportation needs and utilize renewable energy sources in place of fossil fuels. This may be achieved, in part, by supporting the sustainability

goals of supply chain partners working to adapt their own processes to achieve green and sustainable measures (Niehaus et al, 2018).

In South Africa, specifically, work is being done to decarbonize supply chains through a reduction in carbon emissions. Areas with the greatest potential to achieve decarbonization include the application of energy-efficient facilities and transportation processes while areas with significant opportunity to reduce carbon emissions include vehicle technology, low-carbon sourcing in agriculture and manufacturing, and package design initiatives. Long term, the country is aiming to reduce overall congestion and construct energy-efficient buildings (Niehaus et al, 2018).

In order to drive these decarbonization goals, South Africa is developing a carbon tax to push companies to reduce their overall carbon emissions. In recent years, South Africa has seen pressures from consumers to implement environmental legislation to require greater commitment from companies regarding sustainability. However, the implementation of the carbon tax has been delayed several times already. Companies should utilize these delays to develop their green supply chain practices and reduce their carbon emissions before they are penalized for them, especially considering that the carbon tax may impose financial difficulties on several major companies in South Africa (Niehaus et al, 2018).

Comparison

The supply chains of developing countries lag behind those in developed countries largely due to a lack of resources and an, often, unstable economy. Supply chains in developing countries are concerned with consistent logistics processes, not developing in-depth and specific training programs for every level of employee. However, the rise in awareness of climate change and global warming is pushing for the implementation of green supply chain practices across the

world. Armed with the knowledge and example of companies in developed countries, developing nations should be able to utilize that information as a framework for their own processes, creating a smoother transition into green and sustainable practices.

Global Certifications

Carbon Trust Standard

The Carbon Trust Standard is a global certification confirming an organization's impact regarding energy usage; carbon emissions; water usage, management, and waste; and waste management and disposal. The Carbon Trust Standard aims to recognize best practice and achievements in pollutant reduction and help organizations reduce their environmental impact while improving operational efficiency and sustainability (*Carbon Trust Standard: Certification: Carbon Trust*, 2019).

ISO 14001

The ISO 14001 is an international standard that was created by the International Organization for Standardization in 1996. It is part of the ISO 14000 series of environmental standards. The ISO 14001 may be issued by any accredited third-party certification body, providing guidelines over environmental categories from all aspects of a supply chain. Adopting ISO 14001 may help an organization achieve a "preferred supplier status" and create a competitive advantage over others in their field (Roehrich et al, 2017).

ISO 14001 specifies the requirements of an environmental management system (EMS) and allows firms to inform stakeholders of the implementation of one. EMS systems are excellent tools to utilize in the measuring of consumption and reduction of waste, providing data useful in effectively reducing, reusing, and recycling materials to increase cost savings, reduce environmental impact, and boost social reputation. Environmental management systems manage

principles describing policies, procedures, and audit protocols and can provide direction towards developing environmentally sustainable practices (Islam et al, 2017).

Eco-Management and Audit Scheme

The European Union maintains its own environmental resource management instrument called the Eco-Management and Audit Scheme (EMAS). Companies worldwide utilize environmental management systems (EMS) in accordance with EMAS in order to evaluate, manage, and improve environmental performance. EMAS is open to all industries and organizational type, spanning all economic and service sectors and geographical regions. Similar to the ISO 14001 accreditation, only licensed and independent environmental verifiers may validate EMAS environmental statements (*What Is EMAS?*, 2019).

EMAS includes ISO 14001 requirements in addition to the following:

- Stricter requirements in relation to the measurement, evaluation, and continuous improvement of environmental performance based on six environmental core indicators;
- Compliance with environmental regulations;
- Continuous performance improvement processes with employee involvement;
- Published annual public environmental statement that is independently verified; and
- Verification and registration by a licensed environmental verifier.

Current Green and Sustainable Trends

Green Supply Chain Practices Affecting Overall Supply Chain Performance

Green supply chain practices enhance overall supply chain and organizational performance by lowering manufacturing costs through the elimination of waste, improving financial outlook by increasing market share as well as decreasing costs, and improving a firm's competitive advantage within their industry. Collaboration with value chain partners can benefit

both manufacturing and environmental outcomes, while increasing the quality and flexibility of the overall supply chain (Lee et al, 2013).

Reductions in inventory have been correlated to achieving supply chain agility, as well as adjusting to market variations efficiently and responding to changes in customer demand. Green supply chain practices force companies to evaluate their supply chain from top to bottom, providing an opportunity for more in-depth collaboration throughout the value chain and to discover opportunities for improvements within the supply chain (Lee et al, 2013).

In addition to supply chain trends that are unique to green supply chain management, there are also related trends that have shown positive relationships with green supply chain management. Just-in-time (JIT) and total quality management (TQM) are positively correlated with green supply chain practices when implemented together as both trends aim to improve outputs while typically decreasing inputs. These concepts align with the waste reduction efforts of green supply chain practices, supporting the implementation of green supply chain management practices and improving the environmental performance of the supply chain (Green, Inman, Sower, & Zelbst, 2019).

Collaborative Approach to Green Supply Chain Practices

Green supply chain management approaches: drivers and performance implications (Tachizawa et al, 2015), found that collaboration among value chain partners created a positive effect regarding green supply chain practices as opposed to focal firms simply monitoring their suppliers. Only monitoring partners is not enough to ensure that environmental procedures are being implemented through the entire supply chain, even though monitoring is largely driven by mandatory regulations (Tachizawa et al, 2015).

Increased global competition has impacted the relationships between buyers and suppliers, sparking a trend of greater collaboration and a wider supply chain management approach. Firms must offer higher quality products at lower prices to maintain a competitive advantage and are realizing the mutual benefits of long-term supply relationships. Green supply chain practices are not only mitigating risks and conforming to regulations – they provide an opportunity to add value to the company (Roehrich et al, 2017).

Global Outsourcing

Global outsourcing is a growing trend as globalized manufacturing continues to shift manufacturing processes to developing countries with lower labor costs. This not only affects the bottom line and total cost of a product but also lead times, logistics processes, packaging design, and warehousing and the environmental implications that come with them. Global outsourcing has also provided significant opportunities to the economies of developing countries, but companies must also consider risks associated with maintaining a broad supply chain (Chin-Chun, Tan, & Zailani, 2016).

Strategic Orientations

Developing strategic visions and goals is a continuing trend used to provide the firm with a framework for the direction the organization wants to move in. Strategic orientations consist of the firm's overall direction and objectives, specifically oriented toward their external environment. Strategic orientations are unique to individual companies, as they do not all operate in the same manner. In recent years, strategic orientations have been utilized to develop green and sustainable practices because those practices require significant time and money to initiate. The more integrated green supply chain practices are within a firm's strategic orientation, the more their operating environment will embody those visions as well (Chin-Chun et al, 2016).

Emerging Green and Sustainable Trends

Reverse Logistics

Reverse logistics is the process of goods moving from customers back to the manufacturer or distributor and presents an opportunity for companies to engage in green supply chain practices. Organizations are implementing systems to collect the remains of a product from customers at the end of a product's life cycle. The trend of reverse logistics allows for the recollection of defective and unused items and either the recycling, reuse, remanufacture, or disposal of materials. Reverse logistics systems should increase system efficiency and improve economic performance through a reduction of waste (Islam et al, 2017). Reverse logistics may be the process of recollecting the actual product or recovering packaging to reuse, recycle, or reclaim those materials and dispose of them properly (Chin-Chun et al, 2016).

In some instances of reverse logistics, waste from one firm becomes materials within another. This is called industrial symbiosis and an example eco-innovation. Companies save money through a reduction in consumption while the circular economy increases green growth (Islam et al, 2017). Firms are also able to extract value from recycled and reused goods and materials instead of wasting time, manpower, and resources through the manufacturing of raw materials. Industrial symbiosis also increases product life cycles and improves customer loyalty by increasing environmental efforts (Chin-Chun et al, 2016).

Green Information Technology Systems (GITS)

Environmental footprints can be mitigated through the use of green information technology systems (GITS). GITS consist of eco-friendly technology utilized to reduce waste, minimize costs, and increase collaboration and flexibility within the supply chain (Islam et al, 2017).

Carbon Management. One emerging trend in green and sustainable technologies is the work being done regarding carbon management. In 2009, it was estimated that supply chains were responsible for 80% of carbon emissions. Companies have begun monitoring carbon footprints and mitigating their impact through innovations in manufacturing and logistics processes. These practices also have a positive impact on the company – often lowering manufacturing costs and total energy consumed. Many nations have implemented legislation to regulate carbon emissions across the globe in addition to the numerous companies who have made public statements on their intent to reduce carbon emissions in order to have a positive environmental impact (Niehaus et al, 2018).

Green Design. Green design is the process of designing products and services with environmental consciousness. Green design considers waste management, resource management, and pollution prevention over the entire lifecycle of the product. One major goal of green design is to avoid the use of hazardous or restricted materials while minimizing production waste and emissions. Green design also considers reverse logistics opportunities to create additional value from a product and its materials at the end of its lifecycle. The design phase has the lowest direct impact on the environment but the highest potential for value-creation and cost savings (Kumar et al, 2012).

Green design often requires significant collaboration with supply chain partners to ensure the product's creation considers environmental impacts throughout the entire supply chain. Successful collaboration in terms of green design should decrease negative environmental impacts, increase technical knowledge on sustainable processes, and allow for a reduction in cost, waste, and pollutants while improving consumer response, loyalty, satisfaction, and sales (Islam et al, 2017).

Green Manufacturing. Trends in green manufacturing include sourcing ecologically conscious materials, including recycled materials, to continuously work to reduce, reuse and recycle product inputs. Green manufacturing should consider the environmental impact of a product throughout its entire life cycle and, if successful, should lower waste, raw material costs, and pollution, and increase production efficiency while also improving brand image (Islam et al, 2017).

Lean theory aligns with green manufacturing with similar goals of eliminating waste, including cycle time, number of defects, scrap, overproduction, work in progress, wait time, and non-value adding activities. Six Sigma can also be used to reduce waste and increase profit margins. Generally, the more efficient a company's manufacturing process can be, the more sustainable and cost-efficient they are as well (Kumar et al, 2012).

Green Packaging. Packaging is a major source of waste for companies. There are two key categories of waste: consumer and industrial. Consumer packaging is the final packaging for a product that serves both a protection and a marketing function. Industrial packaging protects the product as it moves through the production process until it reaches the retailer. Efficient packaging enables efficient distribution of products as well as protects the product from damage. Eliminating or selecting poor materials can have a negative environmental impact if it results in increased damage. However, by utilizing recycled or recyclable materials, companies have great potential to reduce their environmental impact through industrial packaging (Kumar et al, 2012).

Food packaging also accounts for significant packaging waste, contributing both directly and indirectly to climate change, biodiversity reductions, and waste. Food packaging waste has led to increased packaging regulations in Europe with U.S. trends lagging behind but moving towards the same trends. Food packaging and its contribution to environmental pollution is also

difficult to address because packaging provides protection until the product reaches the end consumer. Reducing packaging inefficiently will lead to increased food waste and waste overall if food products aren't protected during transit. Packaging trends are moving to the use of recycled and/or recyclable materials to increase the sustainability of packaging without sacrificing protection to the product (Molina-Besch, Wikström, & Williams, 2019).

Green Logistics. The logistics sector is responsible for a significant amount of the pollution created by supply chains, contributing 15% of greenhouse gases and 23% of carbon dioxide emissions each year. Emissions have increased by 45% since 1990 and are estimated to increase another 40% by 2030 (Islam et al, 2017). All forms of transportation contribute to these pollution levels and in order to combat them, firms should look to reduce the amount of transportation required in a product's lifecycle. By selecting manufacturing facilities closer to target markets, establishing efficient routes, and reducing deadhead miles, firms can immediately reduce the amount of carbon emissions released into the environment. Additional, but less effective steps firms can take include maintaining full truckloads, utilizing the most energy efficient transportation methods, and focusing on energy reduction when initially designing the transportation network (Kumar et al, 2012).

Warehousing should also implement environmentally friendly practices to minimize their carbon emissions and footprint. Using renewable energy to power facilities can reduce costs while also increasing social responsibility. New warehousing technology should also decrease time requirements when moving and storing products within the facility.

Correlation Between Green Supply Chain Management and GITS. Green information systems are technology-driven and complex but when integrated with efficiency-oriented green supply chain management through functional deployment, the two can create a

competitive advantage as well as sustainable development via strategic planning and fit (Yang, Sun, Zhang, & Wang, 2020). In this scenario, GITS should play a subsidiary role, supporting the actions and practices of green supply chain management, creating a positive correlation between the two systems (Yang, Sun, Zhang, & Wang, 2018).

Company Buy-In

The most important piece within green supply chain practices is company buy-in. Firms must work to ensure that managers and employees have proper training to fully engage green and sustainable initiatives. Green supply chain practices must also be included in the company's strategic vision and goals after cross-collaboration and input across all areas of the company to achieve the full benefit of the practices (Islam et al, 2017). Firms must ensure strong stakeholder involvement while engaging employees, customers, and suppliers on their sustainability goals (Okongwu et al, 2013).

Visibility and Collaboration

Visibility and collaboration over the entire supply chain will continue to increase in the future. In order to fully implement green supply chain practices, firms must fully evaluate the entire value chain. This can be done through detailed analysis of each supplier and sector of the supply chain in order to identify strengths and weak points. Sustainability reports, especially those certified by independent third-party organizations, will also continue to trend upward, increasing visibility of supply chain practices to customers and end consumers (Okongwu et al, 2013).

Supplier Selection. Improving supplier collaboration is essential to fully engage with external supply chain members. It can be difficult to impact sustainability levels of suppliers without long term buyer-supplier relationships in place. Some firms are able to influence their

suppliers' sustainability practices through their own purchasing power. However, many firms cannot wield purchasing power effectively and are more successful by further integrating their supply chain (Kumar et al, 2012).

Defining supplier selection protocols will assist in increasing visibility and collaboration. Supplier selection should involve metrics considering price, flexibility, quality, delivery, environmental practices, etc. When considering international suppliers, firms must seriously evaluate environmental practices, especially if the supplier's country does not enforce environmental regulations. Successful supplier selection from an environmental perspective can reduce the costs of implementing green supply chain practices by helping to align the entire supply chain with green and sustainable values (Roehrich et al, 2017).

While initial supplier selection should maintain a process and technique to evaluate all applicable aspects of a potential supplier, firms should also have a review process for existing suppliers to ensure that both firms still maintain similar strategic environmental values and goals. There may be exceptions to preserve a significant, long-term supplier-buyer relationship; however, all suppliers should align somewhat to the focal firm's environmental goals (Roehrich et al, 2017). Focal firms should also realize the role they can play to motivate their supply chain partners to decrease their carbon footprint and improve the environmental impact of their products and services (Roehrich et al, 2017).

Value Internalization. The importance of value internalization will continue to trend upward as the importance of understanding and creating value across the entire supply chain grows. Upstream partners' motivations must be considered to fully understand the complexity of engaging with a supplier. A strong understanding of a supplier's internalized value stimulates reliable and trusting relationships. This level of understanding can also transform the external

factors from value chain partners into internal principles, encouraging an even greater level of collaboration to drive green supply chain practices (Roehrich et al, 2017).

Green Human Resources Management

Human resource management has long played a role in determining the success of an organization. Choosing the right personnel is pivotal to any company's strategic vision and goals. Green human resource management plays a very similar role regarding green supply chain practices. Choosing ideal candidates to meet the firm's environmental objectives as well as attracting personnel already dedicated to environmental movements will positively affect the entire system of green and sustainable practices (Longoni et al, 2018).

Green human resource management will also provide employees with opportunities to train and collaborate on green and sustainable practices to increase the "buy-in" from company employees at all levels. Expanding that involvement will allow employees to improve and develop new skills, boost their motivation to contribute to green supply chain practices, and increase retention, leading to production and financial benefits for the firm overall (Longoni et al, 2018). Further analysis of the relationship between green supply chain management and green human resources management also supported the claim that synergy between the two provided for increased value and operation performance within the organization (Innocent Senyo, Agyabeng-Mensah, & Afum, 2020).

Green Human Resource Management in Relation to Green Supply Chain Management

Without specific green human resource management practices, firms would struggle to identify, acquire, and retain employees who are motivated, engaged, and competent regarding environmental issues facing the firm. A lack of critical personnel will hinder the implementation of green supply chain practices (Longoni et al, 2018).

It has been suggested that human resource management practices provide their greatest impact on an organization by identifying talented employees and developing them into valuable organizational resources that contribute to a firm's long-term strategic vision and goals through their utilization in business processes beyond the assumed creation of a product or service. Green human resource management is crucial to the green and sustainable goals of an organization by deploying the environmentally minded and motivated employees essential to integrate environmental principles into the day to day operation of a firm (Longoni et al, 2018).

Summary, Conclusions, and Recommendations

Summary

Global climate change is an ever-pressing issue that is compounded, in part, by global supply chain practices. The supply chain industry and its related functions contribute significantly to climate change that corporations and their subsidiaries must recognize the social responsibility to combat its effects and mitigate future damage to the environment. However, through the use of the green supply chain practices and technology discussed in this paper, these organizations can reduce their carbon footprint while also building the potential to reduce costs, increase revenue and long-term financial performance, develop innovated processes, and grow a stronger consumer base.

Conclusions

After thorough research and analysis, this seminar paper concluded that traditional supply chain activities do impact the global environment negatively. However, the research also concluded that there are significant mitigating green supply chain practices and technologies that may be implemented to combat those negative effects.

Because green supply chain is still a relatively new field, it presents an opportunity to explore growing trends impacting the industry. Some of the trends discussed in this seminar paper included:

- Global Outsourcing;
- Strategic Orientations;
- Reverse Logistics;
- Green Information Technology Systems (GITS);
- Company and Employee Buy-In;
- Visibility and Collaboration; and
- Green Human Resource Management.

The barriers to entry of green supply chains are still high considering the time and financial constraints required, as well as the level of training and buy-in required of employees. However, in the long-term, green supply chain management practices have been shown to provide tangible organizational benefits beyond reducing an organization's global footprint including reducing costs while increasing total revenue, creating and supporting innovative and continuous improvement environments, and expanding consumer bases.

Recommendations

Based on the findings of this paper, the following items are recommended:

- To bridge the gap between traditional supply chain practices and green supply chain management practices, considering implementing lean supply chain management practices. These practices are successful in reducing waste, a key component in green supply chain practices, but have a more documented history and resources available for implementation and garnering support for the organizational change.

- Utilize innovated-process frameworks already present within an organization to develop new process management systems to support green supply chain implementation.
- Companies working to implement green supply chain management strategies should also implement internal motivational tactics and increase supply visibility and collaboration to encourage the internal support of green supply chain practices and increase the chance of successful implementation of green supply chain practices.
- Develop green human resource management tactics to enable proper training of employees in new practices and technologies as well as improve hiring practices to support green supply chain initiatives.
- Research the existing and potential consumer bases to understand the key drivers behind relevant purchasing power. Utilize the market data to factor in brand-building initiatives to green supply chain implementations to drive support from upper management and the overall consumer base.

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