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Ampong Afoakwah Emmanuel, Sophia Dauda, and Hannah Kemevor



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¹Ampong Afoakwah Emmanuel, ²Sophia Dauda, ³Hannah Kemevor

¹Faculty of Economics & Business Administration, Catholic University College of Ghana, Sunyani, Bono Region, Ghana. [Email: afoakwahemmanuel1@yahoo.com]

Tel: +233541036930

²Faculty of Economics & Business Administration, Catholic University College of Ghana, Sunyani, [Email: sophia.tfsa@gmail.com] Tel: +233240996987

³Faculty of Economics & Business Administration, Catholic University College of Ghana, Sunyani. [Email: mawuenakemevor@yahoo.com] Tel: + 233209128276

(Corresponding Author): Ampong Afoakwah Emmanuel

Email: afoakwahemmanuel1@yahoo.com

Abstract

Purpose: Within the late 20th century, the world economy set out on a quick prepare of alter. Amid this Mechanical Transformation, modern advances enormously amplified the efficiency of laborers, whereas fossil fills pushed fabricating and industrialization frameworks distant past the characteristic limits of human and creature control. As these progresses drove the fetched of Chemical and mechanical generation down, utilization of waste and merchandise skyrocketed around the world. Sustainability and natural concerns have been critical subjects of discourse in recent decades. Green supply chain administration guarantees the adequacy of open and company policies in greening their operations, expanding the advertise share, progressing the company picture and reputation, and expanding benefits. The objective of this article is to propose a conceptual framework that considers measurements, categories, and hones in green supply chain administration.

Methodology: After an extensive survey of the writing, we distinguished models and a set of green measurements, categories, and practices utilized for green supply chain administration. This research will clarify the impact and necessity of green supply chain, the revolution of how industrialization transformation was and how it revolutionized people's lives. We'll at that point ponder steps and methods needed to control waste amidst the intention to expand industrialization. We will look at the **6R's** in waste Management. Will focus on the impact of 4.0 industrial revolutions and its impact on economic development.

Findings: This study found that the impact of implementation of GSCM practices differs with respect to cost, profit, waste disposal, resource consumption, and greenhouse gas emission. GSCM practices have a statistically significant impact on cost, waste disposal, resource consumption, and greenhouse gas emission. Research has revealed that green supply chain management can reduce negative environmental impacts and environmental risks while eliminating waste and improving eco-efficiency, thereby improving environmental performance

Keywords: *Waste Control, Industrialization, Green Operations, Supply Chain, Industry 4.0, 6R's.*

1.0 Introduction

Green Supply Chain Administration (GrSCM) points to coordinated natural consideration into supply chain administration, *De Sousa Jabbour et al, 2014*. This incorporates item plan, fabric sourcing, manufacturing process, conveyance of the ultimate item to buyers, and end-of-life item administration. Concurring to Vishal Gupta and his colleagues from the Jaypee Commerce School in Noida, India, associations in today's commerce environment know that supply chain capability and capacity are key components for effectively competing within the worldwide advertises economy.

Mechanical Transformation, in cutting edge history, the method of alters from an agrarian and workmanship economy to one overwhelmed by industry and machine fabricating. These mechanical transformation presented novel ways of working and living in a general sense. *Garlet, T et al, 2019*. This process began in Britain within the 18th century and from there spread to other parts of the world. In spite of the fact that it was utilized prior by French journalists, the term Mechanical Insurgency was to began and popularized by the English financial history specialist Arnold Toynbee (1852–83) to depict Britain's financial advancement from 1760 to 1840. This clarifies why a few zones, such as China and India, did not start theirs to begin with mechanical insurgencies until the 20th century. whereas others, such as the States and Western Europe, started experiencing "second" mechanical transformations by the late 19th century.

1.2 Central Concepts Associated with Green Supply Chain

Green purchasing and procurement: entails the selection and acquisition of items and services in order to reduce any negative consequences related with manufacture, transportation, usage, and recycling during the product lifecycle *Ahi, P. Searcy, et al Published in 2013*.

Governments, corporations, and civil society organizations in many nations collaborate to acquire environmentally friendly items. Green manufacturing: a type of manufacturing that has a low environmental impact, is highly efficient, and produces little waste or pollution. Lowering raw material costs, increasing production efficiency, lowering environmental and occupational safety costs, and improving corporate image are all benefits of green manufacturing. Distribution and transportation are influenced by packaging parameters (such as size, shape, and materials utilized).

Reverse logistics is responsible accepting previously transported products from the place of consumption for recycling and remanufacturing, if practicable.

E-waste concentrates on waste related with used electronic gadgets and household appliances that are no longer appropriate for their original use and must be recovered, recycled, or disposed of. *Eschborn, 2011* in Germany. Computers, cellular phones, portable audio equipment, refrigerators, and air conditioners are among the electrical and electronic items that make up e-waste. More than 1,000 distinct compounds can be found in this type of trash, many of which are potentially harmful to the environment and human health.

1.3 Best Practices of Green Supply Chain

The following is a summary of Green Supply Chain Management (GrSCM) best practices and/or insights:

When selecting products and services for your organisation, use green purchasing and procurement practices to minimise potential negative impacts over an entire product lifecycle. *Zimon, D. et al, 2014*. These can include using recyclable materials, and avoiding materials that are hazardous or environmentally damaging.

Employ green manufacturing practices within your organisation to obtain lower raw material costs, production efficiency gains, and an improved corporate image. These practices include improved waste management and end-of-life planning, and reduced product size or mass. Use green distribution, packaging, and logistics systems such as improved environmental design and packaging to gain the benefits derived from less materials, better use of space, and reduced handling.

A fundamental principle of green supply chains is reducing waste and overall energy use. Needless to say, this can lead to big cost savings. According to Inbound Logistics, the office supply retailer Staples saved \$3 million in fuel annually, simply by asking its delivery drivers to slow down. By limiting top speed to sixty miles per hour, Staples reduced its fleet's fuel efficiency from 8.5 miles per gallon (mpg) to 10.4 mpg, equating to 20 percent less fuel.

Using recycled materials during the manufacturing process can save money. For instance, it's now possible to convert waste plastic into 3D printing filament, which manufacturers can use to create new products at lower costs than new plastic. While testing new materials to ensure they meet safety and performance standards takes time, the payoff could be worthwhile.

Think creatively about what your company is throwing away—whether that's at the manufacturing stage or during distribution. It's possible to reuse waste you'd otherwise discard or even unlock new revenue streams from recyclable materials. For instance, some food manufacturers supply local farmers with organic waste to use as fertilizer. And with closed-loop recycling, manufacturers can turn recycled products made of materials like glass or metal into the same products without sacrificing quality. So it may be possible to salvage excess materials or broken products from the manufacturing process and use them to make new goods.

Switching to streamlined packaging uses fewer materials and can lead to lower costs. In addition, a more efficient package design could make it possible to ship more units in the same cargo space, lowering transport costs and reducing greenhouse gas emissions.

Unsustainable practices inevitably have an end date. When businesses don't plan for the future, they can find themselves without a cost-effective supplier if environmental or socioeconomic issues cause disruptions to the supply chain. Proactively planning to adopt supply chain practices that are both smarter and greener can help you prepare for a future in which your former practices are no longer feasible. A great example of this is how sustainable forestry helps preserve woodlands for ongoing use, as opposed to clear-cutting trees.

Reduce your transportation related emissions by:

- a) using vehicle fleets that operate with increased fuel efficiency;
- b) optimising route planning; and

c) choosing or mixing modes of transportation (by selecting between shipping, air freight, road, and rail transportation).

Monitor and reduce carbon footprints to eliminate waste and reduce costs by carrying out a detailed carbon footprint analysis (as outlined in the Measures section of this Best Practice Report).

Gain commitment to GrSCM by comparing your current supply chain with a green supply chain, and calculating the differences in cost, environmental impact, and sales, as a result of improved brand loyalty or marketing opportunities.

Maximise the use of reverse logistics by encouraging reuse, remanufacturing, and recycling.

Provide incentives for consumers to return products that are no longer required.

Enhance corporate brands and reputations by publishing actual performance achievements relating to green objectives and benchmarks that have been based on world-class standards.

According to *Benjamin Hazen* and his colleagues from Auburn University in the United States , green reverse logistics involve the practice of *Reuse, Remanufacturing, and Recycling*.

Reuse requires customers to return products and reusable packaging to the place of purchase for potential cleaning, replacement of accessories, and repackaging. Products that are no longer serviceable must be sent further down the reverse logistics chain for restoration, if possible back to new condition. (*Brunner, and Rechberger, 2015*).

Remanufacturing encompasses the repair, refurbishment or overhaul of products to extend their life. Remanufacturing can create profitable business opportunities and restore value that would otherwise be lost.

Recycled products can be positioned in consumers' minds as environmentally friendly and "green products"; thus, having a positive image among consumers. The reason is that recycling and remanufacturing processes reduce waste, reuse discarded material and require less energy and natural resources than the manufacturing processes of new products (*Michaud and Llerena 2011*). Similarly, the image of "green products" represents the beliefs that individuals hold regarding how effective these products are in reducing threats to the environment (*Chang 2011*).

1.4. Green supply chain applications within the industry 4.0 environment

Industry 4.0 technologies refers to the combination of physical, mechanical, digital, biological systems to significantly impact economies, the environment and other industries to add to the value chain. People and other living things and the benefit they derive from the technology is critical in industry 4.0 green operations.

Industries are expected to use green supply chain approaches to maintain or improve the environment. In Ghana Industry 4.0 is promoted in Aburi Girls Senior High School. The school uses fecal matter to generate electricity benefiting the people and the environment while waste is controlled. Other secondary schools or universities can also adopt this system to reduce electricity bills.

Public institutions such as District assemblies who run public toilets can also use fecal matter to generate electricity for small villages, traffic lights and street lights rather than levying individual homes.

Secondly, Yedent Ghana Limited in Sunyani Ghana is a manufacturing company which produces nutritious tom brown and gari for export.

The company eliminates waste by selling their maize bran and soya bran to poultry farms as a waste control measure. This practice impacts the quality of feed given to poultry reared in enclosed facilities and in free range. When waste is control at the production stage, total waste in the entire supply chain is significantly minimized.

1.5 Best practices of green operations in industries:

It should be possible for material waste of one industry to be consumed by the same industry or another industry without causing harm particularly in the food industry and the rubber industry. Scientists can try using carbon emissions from supply chains to produce another product which is environmentally friendly. Technology can also be developed to process plastic waste to support agriculture. Example plastic waste material can be recycled and used to fence seedlings which are destroyed by ruminants who feed on the plants.

Manual machines or machines which can be controlled using internet connectivity can be developed using engineering techniques. They may use little or no fuel and minimal man power to reduce carbon emissions. Pharmaceutical companies can produce more organic based drugs (as tea or capsules) rather than chemical based drugs to protect people from experiencing damaging side effects and protect the environment from being harmed by chemical waste.

Industries should operate at full capacity such that excesses and waste can also be processed into something useful which has social and economic value. Example in the petroleum industry; crude oil, liquid petroleum gas and petroleum jelly are obtained at different stages of the production process. By doing so production processes don't have to be started repeatedly, helping to reduce volumes of toxins emitted.

In Ghana, plastic waste is the most difficult to control. Government can impose huge taxes on the production of plastic material which cannot easily be recycled while promoting biodegradable materials. Voltic Mineral Water now produces bottled water using biodegradable plastic material.

Companies should be compelled by law to have a recycle plan for their waste produce available before being issued with the authorization to operate. The waste recycling implementation plan should be physically inspected by government agencies every year.

1.6 Suggested Application 6R's in Waste Management

Rethink

Do You Really Need This? You should ask yourself this question according to this sustainability principle. It R seeks to ask and understand peoples' consumption habits and their impact on the environment. (*Masood, and Barlow, et al 2013*). Those who find that natural resources are limited may rethink their daily choices.

Refuse

Don't buy what you don't need. There are many considerations when purchasing a new product, including: Quality, packaging, business ethics, etc. Basically, people should refuse to pay for something that will generate more waste. Overlapping packages filled with paper (look at you, Amazon), for example, a box inside a large box.

Reduce

This R encourages people to make a choice to reduce the usage of unnecessary things and reduce waste.

Reuse

If you don't need something, check if it can be reused or used for other purposes before throwing it away. Instead of buying a replacement, reinvent it and find another use. You are responsible for the cost of the product and packaging. Therefore, use both.

Repair

Please wait before recycling. Can you fix this? Extend the durability of your property. Make the most of what you buy and have and pass it only when it's no longer relevant.

Recycling

If you really can't reuse it, recycle it. There is no reason not to recycle everything that can be done in 2021. By separating your waste, you help it reach the appropriate treatment center. The raw materials for such products can be recovered and reused to make another product. In other words, it can contribute to sustainable development without using new natural resources.

1.7 Benefits of green supply chain in industrial operations over traditional operations

Traditional operations adopted the traditional linear economy system, which utilized the 'take, make and dispose model of production while sustainable operations, which covers the concept of green operations, make use of the economic system which eliminates waste and enforces continual use of resources. It employed recycling, reuse, remanufacturing and refurbishment. *Skool Team (2016)*.

In defining Green Supply Chain Management (GrSCM), *Arora (2020)*, states; it concerns delivering products and services from suppliers or manufacturers to end users in the context environment. It integrates eco-friendly methods into conventional supply chains in order to minimize waste and carbon footprints while increasing efficiency.

The concept of green supply chain practices evolved as a result of increasing awareness and concern of individuals, communities, organisations and government regarding the increase in pollution, carbon emissions and deteriorating environmental conditions.

According to *Arora (2020)*, the traditional Supply Chain Management (SCM) focused on Total Quality Management (TQM), Optimum Cost and Customer Service whiles the GrSCM Incorporates environmental protection in the various stages of the supply chain. The components of GrSCM include green procurement, green product design, green manufacturing or process design, green packaging and storage, green distribution and reverse logistics. *MBA Skool Team, 2016*. Some of the reasons why firms are encouraged to adopt Green Supply Chain Management include Product differentiation, Governmental regulations, profitability, international access, risk reduction, competition and many more. Adopting GrSCM has the following benefits over traditional operations according to (*MBA Skool Team 2016*).

In terms of approach, traditional operations pursue the cradle to grave; where materials are disposed after their benefits have been exhausted.

While GrSCM follows the cradle to cradle approach employing reverse logistics in relation to procurement, Traditional operations do not take into account environmental factors. GrSCM makes environmental protection a priority. Green Supply Chain Management uses the ISO 14000 certification while the traditional SCM does not do so. Through manufacturing, traditional operations focus mainly on improving process efficiency and productivity but GrSCM in addition to this also focuses on minimizing waste creation.

In a traditional supply chain, the flow of materials and information is linear and from one end to the other. There is limited collaboration and visibility. Each supply chain partner has limited information regarding, for example, the carbon footprint and Green House Gas emission of the other partners. Hence, each player may be concerned about his own footprint and may try to reduce this irrespective of the impact on upstream and downstream supply chain. There may be some focus on end-to-end supply chain costs but due to limitations of information sharing, the costs are far from optimized in most cases.

Whereas, Green Supply Chains consider environmental effects of all processes in the supply chain, which is extraction of raw materials to the final disposal of goods. Within the Green Supply Chain, each player motivates other players to go green and provides the necessary information, support and guidance, for example, through suppliers' development programmes or customer support. Environment objectives and performance measurement are then integrated with financial and operational objectives.

1.8 Conclusion

With this integration, the green supply chains then will strive to achieve what any individual organization on its own could not possibly achieve: minimized waste, minimized environmental impact while assuring maximized consumer satisfaction and healthy profits.

1.9 Recommendations

Implementing the right strategies allows you to access the growth and revenue of the supply chains. Moreover, it lets you exploit newer opportunities, like using truck scales, to improve the supply chain.

Check the quantity of the company-owned inventory. Keep exactly what you need; nothing more than that. The cost of holding and storing inventory is quite high. Inventory holding costs could represent almost 60 percent of an item's cost that is held in inventory for one year. Include demand planning and forecasting to optimize company-owned inventory.

Two approaches to improve the distribution network include:

a) **Cluster approach:** Grouping charts, graphs, and similar documents together. This helps in observing the processes for any specific company function.

b) **Holistic approach:** This approach involves reviewing the essential components of the distribution network. It also focuses on understanding how the components work in tandem.

Set up a governing council that offers a clear strategy for functionality and efficiency. The council's aim is to give directions and align the supply chain strategy with the company's core goals. Use technology to improve the supply chain. Review all the existing processes that are producing mediocre results. Determine the areas where implementing technology could improve the processes. The right technology like industrial scales can make the supply chain streamlined, visible and accessible.

Your relationship with the supplier affects the success of the supply chain. Cultivate and maintain the supplier relationships on an ongoing basis, even after the deals are finalized.

Focus on forming strategies to maintain healthy supplier relationships. Make goals for continuing value, measuring performance and maintaining conflict resolution. Minimize the carbon footprint of your supply chain. In fact, supply chain and logistics must become sustainable and socially responsible.

Consider the environmental impact when you choose your suppliers. Have a measurable framework of procedures and policies that promote sustainability. The right strategies have the potential to transform your supply chain and increase revenue. If you already have some of these strategies in place, incorporating the remaining can add immense value to the supply chain.

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