



JÖNKÖPING UNIVERSITY  
*International Business School*

# SABIC Green Logistics Systems & Profitability

To explore chemical industries green logistics practices  
and contribution to profitability with a particular case  
study of SABIC

**MASTER THESIS WITHIN:** *Business  
Administration*

**NUMBER OF CREDITS:** *30 ECTS*

**PROGRAMME OF STUDY:** International  
Logistics & Supply Chain Management

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**JÖNKÖPING** May 2017

## Master Thesis Degree Project in Business Administration

Title: To explore chemical industries green logistics practices and contribution to profitability with a particular case study of SABIC

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Date: Friday, 30 June 2017

Key terms: green port, green logistics, zero emissions and environmental friendliness

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Abstract

**Background:** Logistics is paramount in the business operations as it ensures transit of goods from one point to the other. Green logistics are measures in the logistics systems that are put in place to minimize the environmental implication of logistics operations while at the same time saving on cost. Thus, green logistics is adopted as it conveys a competitive merit which enhances performance of a company. Saudi Basic Industries (SABIC) is one of the biggest petrochemicals in Saudi Arabia and holds the fifth position in the world among the leading producers of petrochemicals. The company already has green logistics in place.

**Purpose:** To explore chemical industries green logistics practices and profitability with a particular case study of SABIC. The goal of this paper was achieved by investigating how has SABIC incorporated green practices into supply chain operations to remain profitable. The study answers “how has chemical industries incorporated green practices into supply chain operations to stay profitable?” And “how do logistic managers recognize green logistics and to what level do chemical industries apply green logistics? Investigating a chemical industry green logistics is important as it contributes to literature since no single study has been carried out in this area. Suggestions from this study are crucial to SABIC, other chemical industry besides any other industry since in one way or the other companies do logistics.

**Method:** The study utilized interpretivism. This study was a case study type of thesis focusing merely on SABIC, and it employed induction approach as well as the qualitative method of collecting data. Interviews were used to explore the

experiences, beliefs, motivations and views of individual participants. Using non-probability sampling method, five members in SABIC supply chain department were selected.

**Conclusion:** The results show that SABIC or chemical industries utilize most of the green logistics activities (fuel efficiency, route optimization package optimization and calculating carbon emission). However, it was found out that fuel efficiency, route optimizations, and packaging optimization were most common activities. It was also discovered that one major objective of chemical industries going green was to cut cost which contributes positively to its profitability. However, reverse logistics was not familiar because of its nature; it cannot be sufficient on its own.

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## CHAPTER I

### 1.1 INTRODUCTION

#### 1.2 Background of the study

Gustafsson, & Göransson (2014) defines logistics as the section of management of the supplied series that devices, develops, and manages the active and efficient movement of services, tangible goods, besides associated info in place of utility so that producers can achieve customer needs. Gustafsson, & Göransson (2014) have also defined transport as the process that moves goods and services along the supply chain. A network of transportation could be defined as how consistent the means of transport, their locations geographically and the routes of transit are so that goods can be shipped smoothly. The importance of logistics, as an important issue, has changed over the last ten years to become a very noteworthy determinant of business activities (Lekovic & Milicevic, 2013; Tseng, Yue & Taylor, 2005). A duly managed transportation network increases efficiency and decreases the production cost. Out of the increased knowledge and sensitivity to the environmental issue, logistics as an industry is significantly affected due to pressures demanding green operations (Angheluta & Costea, 2011, Saroha, 2014). These authors have agreed in one solidarity that green logistics will possibly lead to reduced transaction costs, efficiency as well as the promotion of firms' goods and services.

Green logistics concepts began in the 1980s and 1990s and grew up out of published environmental awareness concerns, such as CFS, global warning, and acid rain (Rodrigue, Slack, Comtois, 2011). Green logistics refers to the measures that are put in place to minimize the environmental implication of logistics operations. Its focus is on handling materials, packaging, transport and waste management (Saroha, 2014). Companies go green because green logistic earns competitive merits since even consumers are demanding green operations (Saroha, 2014; Rodrigue, Slack, Comtois, 2011). Companies are making 'green products' to create responsible lifestyles that fulfil buyers' needs, for instance, self-identity and social affairs. Companies chose to go green in an effort to minimize pollution, save transport cost and promote social harmony. Saroha (2014) also mentions that, when an organization goes green, it establishes infrastructure for the completely green logistics system. In 1990s and 1980s, 'green' became a catchy word in the transportation sector, making environmental and developmental authorities set environmental sustainability

policies giving 'green' a notable push in political and economic fields. Thus, going green was seen as a chance to adopt more green operations that guarantee environmental safety.

Bringing into practice green logistics is never simple, and it requires a strong move to demystify the paradoxes that come along with the topic by doing the following; (1) Designing a product and producing it. The main idea of designing and developing the product is to improve the characteristics that enable it to compete commercially in the market such as the features, performance, quality, and price (Rodrigue, Slack & Comtois, 2008). This happens to be a widespread phenomenon in electronic goods where every new model is usually better regarding quality and quantity compared to those in the previous generation. Examples of these electronics include phones, TVs, and computers. (2) Distribution- which involves making efforts to ensure that transportation of goods and warehousing do not impact negatively on the environment (Rodrigue et al., 2008). This could include making use of methods approved to be efficient environmentally by LEED (Leadership in Energy & Environmental Design) which earns world recognition as a scheme for certifying energy consumption. It may also involve the use of transport means that follow the principles of environmental friendliness. (3) Management of materials- this includes lowering the adverse effects of all the production stages related to a given product to the environment along the whole chain of supply (Dekker, Bloemhof & Mallidis, 2012; Rodrigue et al., 2008). An efficient method will be concerned with parking and packaging processes so that we can achieve the highest load density with reduced packaging materials and little wastage. Last but not the least (4) reverse distribution which refers to the processes involved in repossessing or taking back products that had been sold so that they can be recycled or thrown away.

Green logistics has brought new opportunities to the market in the area of management of materials especially recycling produced goods and channels of collecting and physically distributing the product (Rodrigue et al., 2008). A good look at the standard properties of systems of logistics unravel some challenges as far as controlling environmental harm is concerned. This involves five factors which include time, reliability, cost, storage and IT (Dekker et al., 2012)

In business performance measurement refers to the activity of assessing the effectiveness and efficiency of what has been done (Laird, 2012). In the supply chain, performance management is essential to understanding the effectiveness of logistic operations (Laird, 2012). The evaluation values are important for managers to help them point out where they have failed and where they have succeeded. They also help understand the possible effects of a decision and understand the consequences of the ones that have been applied previously.

With that in mind, the level of profitability can be assessed using income and expenditure. Profitability is the main objective of every organization in business because, without profit, no organization can exist in the long run. For this reason, it is imperative for every business manager to assess the past, current and future profitability of the organization (Goldmann, 2017). Cash and accrual methods of accounting are the most commonly used in calculating profitability (Goldmann, 2017). There is a practical understanding of every branch of economics that every organization aims at expanding their profits. However, despite the fact that different businesses earn various levels of profit, most of them make only a competent return on investment (Aguirregabiria, 2017). Literature argues that organizations that implement green logistics in their operations make more profit due to saving cost resulting from route optimization as well as being fuel efficiency. One such organization that will be investigated in this paper is SABIC.

In the year 1976, Saudi Basic Industries (SABIC) was launched as one of the biggest petrochemicals in Riyadh. It holds the fifth position in the world among the leading producers of petrochemicals. The company has branches in more than 50 countries globally, and employs over 40 000 people (SABIC, 2013). It comprises six units of business, each one different from the other and includes: polymers, metals, chemicals, fertilizers, performance chemicals and innovative chemicals (SABIC, 2013). SABIC products are sold in markets all over the world, although a third of the market is in Asian countries, while Europe and the Middle East procure approximately 19 and 26% respectively (Albilad Capital, 2013). SABIC and all its branches work by subsidiaries (they wholly own joint investments). It has shares of about 42.99% in the Saudi Arabian Fertilizers Company (SAFCO), about 51.95 percent of YANBU National Petrochemical Company (YANSAB) and about 35% shares in Saudi Kayan. The factory manufactures nitrogen fertilizers like ammonia and urea (Albilad Capital, 2013). Kayan produces Ethylene Glycol, Propylene, Ethylene, Acetone, Natural Alcohol, and Polyethylene. Yansab manufactures Low-Density Poly Ethylene (LDPE), Propylene High-Density PolyEthylene (HDPE), Poly Propylene, Methyl Tertiary Butyl Ether (MTBE), Aromatics, and Ethylene Glycol.

For SABIC, logistics are vital operations in the modern transport system since logistics form a remarkable part of the corporation's activities (Nylund, 2012). Logistics might be costly and damaging to the environment and thus going green creates a sustainable business. Sustainability is a process whereby companies manage their social, financial and environmental obligations, risks and opportunities (Abdullah, Daud, Ahmad & Shukti 2016). Thus, to overcome negative implications of environmental pollution, 'green logistics'

concepts come into play. When the general logistics organizes distribution (carriers, packaging, warehousing and portfolio management) from producer to buyers, ecological reflections opened up ideas for disposal, reusing and handling its products besides its implementation of green logistics. Green logistics brings benefits, such as cost saving, reduced carbon dioxide production, boosted business operation and amplified supply chain. That being said, SABIC has already implemented green logistics in its activities (in 2013, it was awarded Ministry of Economy, Trade, and Industry (METI) awards) (SABIC, 2013) therefore, this study will endeavor to explore SABIC green logistics and profitability or financial impacts that are brought about by green logistics.

The relocation of SABIC in Geleen chemical industry park, that houses supply companies, chemical companies as well as a Research and Business Campus, means that the results of this study could be relevant to both SABIC and its neighboring industries. Innovation in green logistics will continue to play a major role in the chemical industry. Innovation, such as green logistics, turns knowledge into cash besides creating improved innovative abilities that result in increased profits (Saroja, 2014). SABIC has a depth global network of storage, distribution and sales offices as well as a high number of growing manufacturing sites. Thus, the importance of green logistics to this company cannot be overlooked because environmental orientation is the firms' high recognition of the importance to minimize the environmental impact that comes from its business activities (Lawson, & Petersen, 2012). It should be a firms' culture and norms to acknowledge green values as well as address environmental issues that face the company. It needs a firm to put strategic emphasis in place that will promote the culture to protect the environment.

### **1.3 Specific purpose**

There are few studies on the topic of this paper that have been covered by literature. This study will therefore contribute to the research on how green logistics can be embedded in business operations and impact profits. This study will also complement studies, such as (Angheluta & Costea, 2011) who studied "Sustainable go-green logistics solutions for Istanbul metropolis" and (Sandén Gustafsson & Göransson, 2014), who studied "Green Logistics in South Africa". These authors have argued that the purpose of logistic systems is to coordinate storage, transport, inventory management, information processing and materials handling in a manner in which the buyers' needs are met at minimum cost. This study is in agreement with (Rodrigue, Slack & Comtois, 2001 and Vasiliauskas, Zinkevičiūtė, & Šimonytė, 2013), who asserts that green logistics is, now

more than ever, becoming crucial in the corporate operations. It is because the demands on these transactions are becoming stricter that green logistics should be taken into account in the entire business process. However, this study is different from the stated studies as it is a case study research focusing on a chemical producing company (SABIC) application of green logistics and their profitability.

Indeed, this current research will complement the above-stated studies by arguing that the link between environment and business activities (logistics system) has a direct influence on supply chain management besides the firm's profitability and thus this study fits in between the two studies stated above. It will be argued that green logistics activities such as route optimization reduces expenses such as saving in fuel consumption which is attributes to profit through cost saving. Understanding this relationship would answer two study questions in this paper (1) 'how has chemical industries incorporated green practices into supply chain operations to remain profitable?' and (2) "How do logistic managers recognize green logistics and to what level do chemical industries apply green logistics? The responses to these questions lie in a path that has already transformed many companies in the world, and thus need to take account of SABIC (to represent other chemical industries) in this particular study. A company that halves its impact on the environment through carbon dioxide emission, energy usage, water usage and waste disposal represents a vital contribution in its saving that contributes to its profitability (Hsu, Tan, & Mohamad Zailani, 2016).

#### **1.4 Main aim of the study**

- To explore chemical industries green logistics practices and profitability with particular case study of SABIC.

#### **1.5 Research questions**

1. How has chemical industries incorporated green practices into supply chain operations to remain profitable?
2. How do logistic managers recognize green logistics and to what level do chemical industries apply green logistics?

#### **1.6 Study organization**

The first chapter covers the background to the study. The qualitative research shall continue by reviewing existing literature on 'green logistics' in chapter II. Chapter III

follows with a presentation of the detailed qualitative approach to be used, including sample selection, data analysis, and data collections. Chapter IV, which could be the longest chapter and will be the ‘heart of the thesis’, will display the results in a narrative form, in the author’s own words. Chapter V shall be a synthesis of the data with the current literature and the study questions to explore SABIC green logistics and profitability. In this chapter, the author shall illustrate research outcomes. Lastly, Chapter VI summarizes the entire thesis, and suggestions for the SABIC, other chemical industries and future research.

### **1.7 Chapter summary**

The main of this study was to explore chemical industries green logistics practices and contribution to profitability with a particular case study of SABIC. Gustafsson, & Göransson (2014) explained logistics as the aspect of devising and managing the transport of goods, services as well as information efficiently to ensure that the company can meet the consumer requirements. The concept of green logistics arose in the 1980 and 1990 from increased environmental awareness and considerations of chlorofluorocarbons, acid rain, and resultant global warming. Therefore, green logistics mean the corrective actions that companies take to reduce the effects of logistics activities to the environment. The business decides to “go green” out of the associated competitive advantages linked with green logistics. Applying green logistics in company operations involve environmental consciousness in processes of product development, actual production, transport, material management as well as recall processes. However, making environmental considerations does not mean sacrificing profit. Profitability is the main objective for every business since without profit, none of them would survive in the long run.

SABIC is made up of 6 business units where every one of them differs from the others. These are chemicals, polymers, fertilizers, metals, innovative and performance chemicals. According to SABIC, applying green logistics is a key concept in today’s transport operations as logistics constitute a bigger percentage of the company’s operations and doing it right gives them a competitive merit. Applying greenness results to a sustainable business. For this reason, a sustainable business may be termed as that which has succeeded in managing their financial, social duties, environmental duties, opportunities as well as risks. Because no any previous research has been carried out in this particular field, this current study is meant to investigate the degree to which green logistics can impact on the profitability of chemicals manufacturing companies. Some aspects of green logistics for example route optimization

and package optimization reduces some spending on fuel which means saving and hence wider profit margin. Conceptualizing this relationship between green logistics and profitability will provide answers to two study questions. (1) *'how has chemical industries incorporated green practices into supply chain operations to remain profitable?'* and (2) *'How do logistic managers recognize green logistics and to what level do chemical industries apply green logistics?'*

## CHAPTER 2

### 2.1 LITERATURE REVIEW

#### 2.2 Green Logistics

##### 2.2.1 Definitions

Logistics can be classified as both an art and science. As an art, it refers to the management of the chain of supply (Christopher, 2016). As a science, it relates to the control and management of the movement of products, people, information, sometimes energy and any other resource from where it is produced to where it will be consumed for the purpose of meeting the customer needs (Christopher, 2016). Logistics can take place on any transport means i.e. rail, road, water or air. It makes bringing together all the information from transport, assets, silos, handling of raw materials as well as packaging. In a nutshell, the main aim of green logistics is to achieve the synchrony of all activities of the chain of supply so that the needs of the beneficiary are met without forfeiting the environment (Sbihi, &Eglese, 2007). The aspect of environmental consideration requires the logistic managers to operate at a minimum cost to the environment which is a fundamental component of reverse logistics. Previously, the cost of logistics only considered monetary cost incurred while this day's cost is considering even logistics impact on the external surrounding which includes degradation of the soil, noises, accidents, air pollution, dumping solid waste especially packaging materials, vibrations and changes in climate (Sbihi & Eglese, 2007).

Dekker, Bloemhof & Mallidis, (2012) refers to green logistics as the study of the activities that are geared towards minimizing the environmental pollution especially emitting greenhouse gases, accidents together with noises from logistics activities so that businesses can achieve a sustainable balance of social, economic and environmental targets. Ubeda, Arcelus & Faulin (2011) refers to green logistics as the issue of embracing activities in the supply chain that are friendly to the environment. As mentioned by (Saroaha, 2014), green logistics means connecting the social, economic and environmental perspectives of logistics and hence may refer to the efforts made geared towards decimating the negative effects of logistics to the environment. The main reason as to why business organization is going the green way is out of the competitive advantage associated with it since many customers' demand that companies conserve the environment and are ready to pay high for those who have done it (Saroaha, 2014).

It is clear from the above definitions that green logistics takes into consideration the social, economic and environmental aspects likely to be influenced by supply chain practices. A study by (Dekker et al., 2012) however attempts to give a more reasonable definition of the same. They indicate that green logistics refers to the study of all the activities carried out with the aim of reducing pollution of the environment especially greenhouse gases emission, accidents as well as the noises from logistics activities. All this to ensure that a business achieves a sustainable balance in economic, social and environmental targets.

## 2.22 Development and Application of Green Logistics

As in many other areas of human activity, the term “greenness” became popularly used in the transportation industry from the late 1980s to 1990s (Rodrigue, Slack, & Comtois, 2001). The increase in awareness surrounding environmental problems, particularly in issues of global warming, CFCs, and acid rain, was the main reason behind its growth. The World Commission on Environment and Development Report (1987), through its establishment of environmental sustainability as its primary objective for international action, highly promoted green issues in economic and political arenas. Through its various modes, (Banister and Button 1993) argues that infrastructures and traffic, the transport industry has emerged as one of the main contributors to environmental degradation. The developments in the logistics field were seen by many as an opening which would offer a more environmentally friendly expression in the transport industry. In the early 1990s, many studies, opinions, and reports surfaced to suggest various ways incorporate the environment and the logistics industry (Muller 1990; Murphy, Poist & Braunschweig, 1994).

The use of logistics in the waste management of all kinds of waste materials, including hazardous and toxic waste, has recently become a major new market. According to (Rodrigue et al., 2011), there are, however, several variants in this market, one of the most significant segments of this market being customer driven. In this, the home dwellers set aside their domestic waste for recycling, and it has become trendy in many communities, particularly due to the involvement of the public in the process. Another type is the transportation of non-recyclable materials comprising even hazardous waste, to designated areas for disposal. Due to the scarcity of landfills near urban centers, the waste is transported greater distances for disposal. Another approach is the use of a continuous embedded reverse distribution process, where the manufacturer or distributor is responsible for delivering goods and their take-back (Murphy et al., 1994). This would ultimately entail environmental consideration throughout the life cycle of a product, i.e., from production, distribution, consumption

through to its disposal. For instance, the BMW Company is designing a vehicle with entirely recyclable components (Giuntini and Andel 1995).

## **2.23 Green logistics activities**

### 2.231 Reverse Logistics

It refers to all the things that take place once the product has been sold (Christopher, 2016). The primary objective of reverse logistics is to maximize the activities taking place after selling the product such as customer service, warehousing and inspecting the quality which can act as another source of income, increase the satisfaction of the client as well as conserve the environment (Christopher, 2016). Reverse logistics is based on the 4Rs i.e. refund, restock, refurbish and recycle (Murray, 2012).

### 2.232 Estimating carbon dioxide emissions

Estimations of carbon dioxide (CO<sub>2</sub>) emitted in the air is usually based on the fact that all fuels containing carbon are burned and released into the atmosphere as CO<sub>2</sub> (Ćirović, Pamučar & Božanić, 2014). In order to internalize the estimates of carbon dioxide released to the surrounding, the emissions can be gotten by multiplying the amount of fuel consumed with the carbon dioxide emissions factor. The sum of well-wheel CO<sub>2</sub> emitted in every unit of fuel used that is referred to as emission factor is approximately 2.67kg of CO<sub>2</sub> from every liter of diesel (Murray, 2012). The amount of fuel used depends on the following factors i.e. the amount of weight carried, the distance to be travelled and the type of vehicle (Ćirović et al., 2014).

### 2.233 Fuel efficiency

Raising the efficiency of fuel use while transporting goods is a technique that can be friendly to the environment. When alternative fuels are used combined with maintaining the vehicles as well as co-driving, the efficiency of fuel use can be raised (Elkington, 2004). Making of alternative and environmentally friendly fuels with high efficiency can help in improving the greenness of the supply chain (Saroha, 2014). According to a research carried out by (Wu and Dunn, 1995), other fuels that can be used as an alternative to diesel were discovered and found to be cleaner, affordable and safe. Examples of these fuels are liquefied natural gas (LNG) and compressed natural gas (CNG). According to (Wu and Dunn, 1995), compressed natural gas was found to be 40% lower in terms of cost compared to petrol. For

this reason, if logistic firms would like to change to eco-friendly energy sources, then they need to consider using alternative fuels.

#### 2.234 Route Optimization

This can be defined as the coordination of a number of vehicles carrying a given amount of goods that is fixed and using the most efficient route (Lu, 2011). A high efficiency of routing aims at finding a method that can reduce the number of vehicles used the level of voyages as well as the total time travelled by each vehicle. Any logistic firm that is environmentally considerate uses direct routes, utilizes the space in vehicles to the maximum, ensures less handling and moves for short distances (Wu & Dunn, 1995). The above-mentioned factors reduce the amount of pollution to the environment since vehicles running at the most efficient speeds will be eco-friendly and consume minimum fuels (Novy-Marx, 2013). For this reason, route optimization is a cost reduction technique since every vehicle that is on the road is utilized to the optimum and moves the shortest distance.

#### 2.235 Packaging Optimization

Optimizing packages is a very important method of reducing the environmental effects of logistics. Lessen the amount of solid waste such as materials used in packaging, organic materials as well as scrap metals is vital to any organization that aims at implementing an environmental program (Min & Galle, 1997). According to (Min & Galle, 1997), waste from packaging materials is responsible for about 30.3% of all the waste dumped by logistic companies which necessitates the need to come up with a green packaging program so that the firm can minimize its carbon footprint. It is also very important to raise the packaging optimization and come up with reusable and returnable packaging materials that are currently in high demand. These are combined with two-way freight flows to decimate packaging waste in a bid to conserve the environment (Zhang & Zhao, 2012).

### **2.24 Blueprint for Green Logistics**

Ensuring a healthy environment is necessary for efficient transport and, at the same time, its capacity to open markets and promote economic development plays a significant role in ensuring an effective and lasting management of the environment (Klassen & Johnson, 2005). However, with the growing internationalization of trade, the concept of logistics has extended to global logistics. As a matter of fact, globalization, as well as global logistics, has in many instances been responsible for the warming and degradation of the

environment. Rodrigue et al. (2001) resolves that the two aspects have influenced the governments and firms in various countries to compete in the international market which include lowering environmental standards in some countries and maintaining higher standards in others. Consequently, there has been increased support for environmental initiatives implemented at international level (Klassen & Johnson, 2005). Similarly, there has been a considerable increase in reliance on the local communities' efforts to address the environmental problems since the underlying environmental issues vary within and between countries. For successful practice of green logistics, there must be a complex interchange of both the global and environmental governance to help strengthen efforts of the state (Rodrigue et al., 2001). It is equally important to note that the most significant workable policy recommendations, implementations, as well as the operationalization of green logistics, occur at the local level (Rodrigue et al., 2001).

When compared with regional or local trade, it is evident that international trade causes less environmental harm and this could be attributed to the fact that there has been increased support for environmental initiatives implemented at international level (Klassen & Johnson, 2005). Nevertheless (Hakami, 2016) views that proper green logistics assessment is essential, since the state of the future of world trade, as well as freight transport, will highly depend on multimodal sharing of infrastructure and rising consumption of energy. Thus, there exists a need to support green Logistics' regional approach, and this is one of the gaps that this review of literature present. The main idea, however, is not to make smaller and more frequent shipments, which would provide for more trips by smaller vehicles, but to decrease the number of trips made. According to Sari & Yanginlar (2013), the main aim is to reduce the movements through the implementation of land use policies and measures, so as to minimize the level and geographical separation of industrial operations. Hakami (2014) indicates that the extent to which regions contribute to logistics remains unclear. Despite this, their role is usually important to enhance effective decision making towards environmental protection. The conflict between the economic importance of logistics and the effects it has on the environment remains an original political topic Hakami (2014).

As the changes in climatic conditions continue to be experienced through global warming and various abnormal weather conditions, people are rapidly and extensively employing many resources to bring these conditions under control Rodrigue et al. (2001). Society is preoccupied with measures to prevent global warming, conserve natural resources and encourage their reuse (Tamulis, Guzavičius & Žalgirytė, 2012). The global environmental problems are mainly contributed by logistics as a major source of pollution and use of

resources. For this reason, Abubakar (2014) believes that the green energy solutions should not leave logistics behind. In many nations, the government is encouraging the use of green technologies as well as recycling in the field of logistics. The process of logistics is hard to stop or change to green entirely since the primary resource is fuel. Rao & Holt (2005) complains that completely stopping logistics would mean a complete halt of the economy. When the logistics process does not run efficiently, it leads to a waste of resources (Sari & Yanginlar, 2013).

## **2.25 The paradoxes of green logistics**

### 2.251 Cost

The aim of logistics is to lower costs, especially that of transport. Other objectives include economizing on time, improving reliability and increasing flexibility in service (Rodrigue et al., 2001). However, (Rodrigue et al., 2001) accept as true that corporations involved with distributing freight physically are usually open to ideas that can help them lower transport costs, especially in this competitive world. However, (Chopra & Sodhi, 2012) claim that the methods used to save costs in logistics differ from environmental considerations. The costs on the environment are externalized, which shows that the advantages of logistics are enjoyed by those who use it and by the customers if they are divided within the supply chain (Chopra & Sodhi, 2012). The general public is finding it difficult to meet these costs, while a lot of pressure is being exerted on corporations and government to increase environmental considerations (Abubakar, 2014).

### 2.252 Time/ speed

In logistics, time is critical. By decreasing transport time, distribution speeds up thereby increasing efficiency too (Laosirihongthong et al., 2013). This is achieved through the use of the most environmentally polluting transport means, with the least energy saving methods (Rodriguez et al., 2001). The remarkable rise in air freight and trucking is brought about, to some extent, by the time challenge resultant from logistic operations. Rao & Holt (2005) mention that the time problems are caused by the improved flexibility of the system of production, as well as the retail sector. The logistics provider Door-To-Door (DTD) services that are combined with Just-In-Time (JIT) methods. Existing models cannot adequately meet the needs created by such a situation, which creates a vicious cycle. Hence, (Chopra & Sodhi, 2012) suggests that a distribution that is very physical is seen to be efficient, since the processes of producing, transporting and selling consider distance to be a challenge. An

increase in traffic caused by trucks has been observed, and the average length of the haul has increased (Cooper et al., 1998). Although McKinnon (1998) said, that road freight might not be regarded as one of the green solutions since an increase in door-to-door and JIT usage leads to an increase in resultant adverse environmental effects.

#### 2.253 Reliability

Reliability of the service is the critical importance that lies in the heart of logistics. Its success is measured by its capacity to provide timeous freight with the least risk of damages or breakages (Chopra & Sodhi, 2012). Those modes of transport considered least pollutants to the environment are also the least reliable in the criteria of safety, timeliness, and risk of breakages (Rodriguez et al., 2001). But (Rodriguez et al., 2001) think that water and railway transport yield the lowest customer satisfaction experience and logistics operators prefer air and truck transportation, which are considered the highest pollutants of all transport means.

### **2.26 The model of green logistics system**

When coming with a green logistics, the concept must be looked at as an interlinked system. Green logistics can only be implemented with the cooperation of the government, corporate sector as well as the public since if it is left in the hands of one arm of the society, then it might never be achieved (McKinnon, Browne, Whiteing & Piecyk, 2015). The famously known as system's architecture refers to both the internal as well as external environment that supports green logistics (Peng, Li, Zhao, & Wang, 2015). The system of Green Logistics does not work in isolation and hence need to share information with other external bodies. For this reason, coming up with a green logistic system calls for the compound and integrated process. As mentioned by McKinnon et al. (2015), a system of green logistics comprises five factors both mixed and antagonistic sections whose structure has been shown in figure 1. The model of green logistics system has several intersections and mutual constraints that are linked to one another. Despite this, the many subsystems in the green logistics system have their positions and specific functions. No wonder Brădescu (2014) concludes that many firms understand that practices that are socially responsible have an impact in the company's image to the shareholders, customers, the financiers as well as the public. According to Brădescu (2014), socially responsible activities and environmentally friendly practices not only give the company a good image but also increases the level of sales and reduce the cost of production. In the green logistics system framework model below,

there are green suppliers, green manufacturers, green retailers and green consumers who are connected to green logistics information system

Figure 1 Green Logistics System Framework Model

	<b>Green Logistics Monitoring System</b>			
<b>Green Supply Chain System</b>	Green Suppliers	Green Manufacturer	Green Retailers	Green Consumer
<b>Infrastructure</b>	Green Logistics Information System			
	Green Logistics System (Distribution, recycling, packaging, etc.)			
	Integrated Green Transport System (Transport hub, means of transport, transport network)			

Source: McKinnon et al (2015)

### **2.27 Green Supply Chain Management –GrSCM**

A green, sustainable supply chain refers to the aspect of getting raw materials that are friendly to the environment and processing them where the by-products can be used to improve the surrounding environment or be recycled for use in the production of more useful products (Brădescu, 2014). Such a process gives products that can be reused and reclaimed at the final stage of their useful life hence making a chain of supply that is sustainable (Van den Broek, 2010). Green SCM takes advantage of the function played by the environment in value addition in the chain of supply (Stevens, 1987). GrSCM practices improve the value to the shareholders, improve the satisfaction of the consumers and employees, conserve the environment and improve the quality of life of the community. Still, on the same, GrSCM support better use of assets, maximize results from the resources, creates and advances technology, creates continued and sustainable alliances and finally improves the company’s image. To sum it up, it fosters cost reduction and maximizes profits while conserving and improving the environment and finally makes the world the best place to live in.

## **2.28 Implementing Green Supply Chain Management**

For companies to go green in the chain of supply, they must put emphasis on the following considerations. First, they should conduct training on green supply chain and employ their resources and energy in making changes to the chain so that it can become greener or environmentally perceptive (Brădescu, 2014). Secondly, they should also be concerned with reverse logistics which refers to what happens after the product is sold (Murray, 2012). Third, consider becoming a green industry since several companies are getting a lot of attention due to their green processing, green marketing, green chemistry, geothermal power, retrofitting of buildings, solar energy, improved biofuels, smart grid technology as well as agriculture that is sustainable (Brădescu, 2014). Fourth, they may consider using recycled packaging materials since the public awareness on environmental consciousness has increased and customers' desires are likely to be fulfilled when buying products where the green packaging has been applied (Zhang & Zhao, 2012).

## **2.3 Supply chain**

### **2.31 Definitions**

A supply chain can be defined as a group of separate firms that have been brought together by the goods and services to which they do value addition whether jointly or independently so that they can be transported to the end user (Brădescu, 2014). In the above explanation, several aspects have been included to portray a chain of supply. A chain of supply must have more than one company failure to which it ceases to become a supply chain (Lu, 2011). Secondly, the companies involved in the supply chain should not belong to the same business owner who gives the companies a certain level of independence that is legal among them (Lu, 2011). Third, the participating companies are brought together by the common goal or commitment in adding value to the materials that run through the supply chain (Lu, 2011). The chain of supply, therefore, involves the movement of raw materials from the source to processing and finally to the consumer (Handfield & Nichols, 1999). For the above stated reasons, managing the supply chain is very critical and involves the integration of important processes in business from the consumer via the suppliers who will avail products, services as well as information that will help in value addition to the customer as well as other stakeholders (Croxtton, Garcia-Dastugue, Lambert, & Rogers, 2001).

Thus, from the above definitions, a supply chain could be defined as an act that is performed by different actors who are brought together by the aim of adding value to a

product or a service to move it from one location to another place where the consumer is located. However, among the three cited authors (Lu, 2011) seems to offer the best definition of a supply chain.

He starts by indicating that a supply chain will need to have more than one failure for it to cease being a supply chain. Secondly, he suggests that in the supply chain, the companies involved should come from different business owners to provide them with some level of independence legal among them. Thirdly, the associated companies are linked together by a shared goal or mutual commitment towards adding value to the materials flowing through the supply chain.

### 2.32 Green Supply Chain Practices

A green, sustainable supply chain refers to the aspect of getting raw materials that are friendly to the environment and processing them where the by-products can be used to improve the surrounding environment or be recycled for use in the production of more useful products (Brădescu, 2014). Such a process gives products that can be reused and reclaimed at the final stage of their useful life hence making a chain of supply that is sustainable (Van den Broek, 2010). Klassen and Johnson (2002) propose five possible green supply chain management practices. They include pollution prevention, environmental certification, life-cycle assessment, reverse logistics and design for environment. Besides, it is equally necessary to take a general approach in environmental programs analysis where Rodrigues et al. (2006), indicates that reverse logistics should be one of the core themes in Green Logistics. However, in cases where the supply chain systems are capable, the need for reverse flow can potentially be mitigated.

### 2.33 Supply chain problems

Supply chains are a complex adaptive system, which evolves spontaneously and contingently according to the interactions between the network elements. To understand the behavior of a system, it is important to first understand its complexity (Choi, Narasimhan, & Kim, 2012). In an organization, complexity is usually associated with the number of formally separate structural components (Blau & Schoenherr, 1971), and is defined as the degree or the extent of formal structural differentiation in an organization (Price, 2011). In supply chains, complexities result from uncertainties, which are created as a consequence of the number of elements as well as the degree in which these elements are differentiated. Also, supply chain complexity can arise from the upstream side of the supply chain in obtaining

materials from the suppliers, downstream to the products retailing, and inherent complexities in manufacturing (Bozarth et al., 2009).

It is also important to note that the terminology in use, together with the intention of the researchers, comprise the major factors affecting the supply chain analysis. For instance, a study by Flynn, Huo & Zhao (2010) on manufacturing supply chains, questions the decision by researchers to adopt the term as inter-organizational between the customer and the producer, instead of the complete chain configuration, that also includes the processes of intra-organization. By employing the comprehensive approach, i.e., the customer, supplier and internal integration, (Price, 2011) established that there was a relationship between the integration of supply chain and the business performance and indeed, the term “network,” “complexities” or “upstream” may be used to explain the supply chain side issues.

#### 2.34 Manufacturing supply problems

Hakami (2016) has recently revealed that managing the upstream supply chain in the manufacturing sector can account for about 80% of the actual costs. However, (Hakami, Zhang, & Kumar, 2014) believes that these costs include the cost of purchasing raw materials and delivering materials or goods from external vendors, together with all other relevant activities capable of adding value to the focal company. In most cases, the problems which arise from the upstream complexity vary from minor to serious. Chopra & Sodhi (2012) resolve that the study of this supply chain is supported by two dimensions; (1) some risks may result from the compound nature of the upstream supply chain resulting in unexpected changes in flow because of the delays. (2) Recurrent disruptions, which involves the uncertainty of the purchase outcome, supplier risks, packaging, and handling and even transport issues. Mate (2015) also adds that it may include the various social standards.

The direct effect on the performance of the firm, for instance, cost reduction, timely delivery, an improvement in quality and efficiency, among other benefits, are directly connected to the performance of the upstream supply chain. About this, some researchers provide valuable insights into the nature and effect of upstream manufacturing complexity of supply, as well as its measures, so as to prevent any possible disruption or losses on sales (Bozarth, Warsing, Flynn, & Flynn, 2009). However, a standard universally accepted definition on what determines the supply complexity effects and how it can be measured, as well as remains lacking (Giunipero & AlyEltantawy, 2004). Besides, studies such as (Bozarth et al., 2009), carried out on the compound nature of upstream supply chain have based their

findings and conclusions on anecdotal evidence for the proposed solutions. The methodological approaches used in the literature are confined to the study of the impacts from a simple linear regression, which has only one independent variable to measure the effects on performance. This, according to Mate (2015), as opposed to using the more appropriate multiple linear regressions to provide better predictive results. Indeed, this was the primary reason behind the focus on managing the interaction between some components.

## **2.4 Profitability**

### 2.4.1 Definition

Profitability can be defined as the capacity of an organization, enterprise, firm or company to derive profits from every business activity that it engages in. It is a criterion that measures the level of efficiency the management has been able to achieve in making use of the available sources in the market (Mullins, Ahearne, Lam, Hall & Boichuk, 2014). Profitability can also mean the capacity in which a business benefits from its investments (Novy-Marx, 2013). Despite profitability being an important criterion for assessing the level of efficiency, it may not express the efficiency to finality (Narve & Slater, 1990). Determining the profitability only sheds light on the effectiveness issue. It is important to note that, the net profit gained alone does not suffice in expressing the performance and efficiency of the business organization not unless it has been combined with other business aspects like amount of capital invested, the volume of sales, the operational expenses as well as the cost of the products sold (Tulsian, 2014). For this reason, the ratios of profitability are usually computed to shed light to the final outcomes and to compare the performance of different companies thus acting as the only yardstick for assessing the overall efficiency of the concerned organization (Tulsian, 2014). The secret of raising the profitability of any organization lies in reducing the cost of operations.

Profitability of a business is hence the measure of the capacity in the which a business practices efficiency with all the resources that are available in order harvest something from the investments. Hence, unless a company reduces its operation cost, it will not realize good profits. This idea links well the green logistics concepts that from the literature it gives a business a competitive advantage because a business can have reduced operations cost thought to be fuel efficient, optimizing routes and optimizing packaging.

However, a study by (Mullins et al., 2014) looks to give a much better definition of profitability. They define profitability as a criterion that measures the efficiency level that the management has attained in using the sources available in the market (Mullins, Ahearne, Lam, Hall &Boichuk, 2014).

#### **2.42 Companies' profitability**

In many cases, the words profitability and profit are considered to mean the same, while in the actual sense; there is a difference between them. Profit is an absolute term, while profitability is a relative concept. Despite this, the two words are related and mutually independent, having different functions in the business world. Profit means the amount of money the company has earned within a given period (Raaij Vernooij & Triest, 2003). The term profitability indicates the company's efficiency in its operations and its capacity to make a profit from the sale of its products (Raaijet al., 2003), in other words, how much the company can earn as returns from investment and the workers who are employed in that business activity. Knowledge about the performance of a company and, more significantly, their profitability is necessary for making management decisions concerning possible variations in the economic resources that a company will be in a position to command in the days to come. Burja (2011) suggests that the objective of every organization is to improve its economic results that will assist it in improving its ability to compete, as well as meet the needs of the shareholders. Burja (2011) in his study, therefore, highlights several models for the analysis of company performance. These models are based on the regression analysis where the results show a strong connection between an organization's management of resources and returns on investments.

#### **2.43 The impact of green logistics practices on firm performance**

For both the manufacturing and service organizations to achieve a competitive advantage in the market, they have to embrace the idea of logistics activities. Levi et al. (2008) acknowledge that logistic operations have its principal objective being to acquire the right amount of material or product, at the right time and the right place. In the past, (Murphy & Poist, 2000) claims that the cost was the only factor considered in planning logistics activities to achieve this objective. However, Rao & Holt (2005) think that the growing emphasis on green issues has created a need to consider other factors, like environmental damage associated with their sourcing and distribution activities. Hence, for this purpose, some organizations have taken to implement some green logistics

practices; however, it is evident that the degree of application varies from one firm to another. For example, some companies will only follow a proactive strategy, while others will try to meet the regulatory requirements only.

Many organizations are anticipating doing their best for green logistics because there lacks a clear relationship between firm performance and green logistics practices. Studies, such as the study by Rao & Holt (2005), indicate that the connection between the two is very advantageous. At the same time, other studies have suggested that there is no economic contribution by green logistics on the firm's performance (Laosirihongthong, Adebajo & Tan, 2013). It has therefore created a need to conduct research which will explore the relationship between green logistics and firm performance and that is why this current study want to understand whether SABIC green logistics is somehow related to it going green. Such research will be of significant importance to managers wanting to implement green logistics in their businesses. Hence using findings of this current study, the managers can make educated decisions and develop a strategy for green logistics operations. Laosirihongthong et al. (2013) view that, despite the fact that this knowledge is crucial for all industries; the healthcare industry requires it more as it is more important to implement the green logistics practices in this industry; the reason being that the waste from health facilities is potentially more harmful to the environment.

Laosirihongthong et al. (2013) have, however, revealed that no research had been carried out yet to investigate the relationship between green logistics and performance of a firm. These authors, therefore, examined this relationship in their research, and the empirical data analysis showed that three of green logistics practices had had a positive influence on solid performance as specified by the three hospital performance indicators in Turkey. These green logistics practices include green manufacturing, green purchasing, and reverse logistics. For green marketing and distribution, the empirical data reveals that only the hospital's economic performance is supported. Similarly, (Sari & Yanginlar, 2013) results from the statistical data analysis indicate that improvement of return through the use of green logistics practices is significantly greater in private hospitals compared to public and university hospitals in Turkey.

## 2.5 Sustainability

### 2.51 Definition

The aspect of sustainable development according to World Commission on Environment and Development looks at the concept of dynamic equilibrium which considers the level of population and the capacity of the environment to handle it (Bosselmann, 2016). This is to make sure that the people in the world can exploit their full potential without exerting negative pressures on the capacity of the environment to accommodate other living things. It is because this would lead to irreversible and deleterious effects on the same environment reducing the ability of the coming generation to meet their needs (Bosselmann, 2016). The primary objective of sustainability is to encourage an alignment of people, society, and economy as well as the regenerative ability of the earth's capacity to support life (Benn, Dunphy & Griffiths, 2014). Sustainability can also be defined as the process of coming up with growing economy with very high life quality while being considerate to the natural resources and conserving the environment (Calero, Bertoa & Moraga, 2013).

Thus, the most important aspect of sustainability is cross generation equity. The simplest definition of sustainability is when everybody on the earth's surface can live a good life and not compromise the possibility of the coming generations to do the same. On the other hand, (Benn et al., 2014) tries to give a reasonable definition of sustainability. They indicate that the main aim of sustainability is to help align people, economy, society and the earth's regenerative ability capacity towards life support. Accordingly, it is the objective of businesses to heed that in its exploitation of the resources that are provided by nature for free; it should take care of the present and the future generation through the responsive operation and taking of the environment.

### 2.52 From environmental awareness towards social responsibility

Duin (2012) posits that environmental awareness has become a common phenomenon in multinational organization's logistics. Strategic aspects indicate how the companies are supposed to deal with the changes in green logistics by reorganizing the systems of logistics, as well as the chain of supply (Harris, Rodriguez, Naim & Mumford, 2010). McKinnon (2010) designates that sustainability is now gaining the highest priority among the managers in logistics. Literature such as (Woodburn & Whitening, 2010), contributes to the knowledge of sustainability, where green port, green logistics, zero

emissions and environmental friendliness are keywords to becoming sustainable. In this case, (Harris et al., 2010; Woodburn & Whitening, 2010) views green logistics as the study of activities that have an objective to decrease the environmental emissions for the logistic operations related to a large extent to emissions of gasses from the greenhouses, tragedies and noises, therefore, coming up with a balance that is sustainable between economic, environmental and social aims. The social perspective aims at achieving health, safety, equity, and access. However, (Woodburn & Whitening, 2010) asserts that due to increased pressure from the government, the logistics use this strategy to find more lasting solutions, like the development of electrically driven vehicles, as well as a more intermodal transport system. Even if the practice of logistics has become greener, there are a number doubts that need to be mentioned at this stage.

#### 2.53 Sustainability in the Oil and Gas Supply Chain

The main aim of (Abubakar, 2014) was to find the factors that support and those that hinder implementation of sustainability from the oil and gas industries in the United Kingdom. It also aimed at defending market as the driver of sustainability, i.e. achieving a competitive advantage for the manufacturing companies by implementing sustainability. The aspects that affect the sustainability in the supply chain were also seen to influence sustainability, practices of sustainability as a whole (investing, strategies, and assessment of sustainability- both signs and systems of reporting them), strong aims and measures of business success. The objective is to determine the effects which the implementation of sustainability will have on the strength of the corporate system in the gas and oil industry in the UK. This study is different from the previous researchers, such as (Sari & Yanginlar, 2013; Mate, 2015), as it looks at the aspect of sustainability driven by the market by empirically linking the characteristics of sustainability's supply chain with the strength of the business organizations. It is, therefore, according to (Hakami, 2016) prudent to realize that sustainability refers to the ability of the current generation to meet its needs without negatively influencing the ability of the coming generations to meet theirs. Green sustainability dwells more on the environment showing that sustainability does not leave the environmental and social perspectives (Tamulis et al., 2012).

#### 2.54 Triple bottom line approaches (TBL)

The triple bottom line is also referred to as the three Ps i.e. profits, people, and planets. Corporate social responsibility (CSR) has never assumed a high rank among the

priorities of organizations as it has done in the recent past. It is based on the triple performance line that comes from the concern of sustainable development whose bases are in seeking a balance between the three aspects of ecology, economy, and ethics (Zak, 2015). However, (Norman & MacDonald, 2004) think practically and conceptually and concludes that the triple bottom line is an unnecessary addendum to the prevailing topic of discussion i.e. CSR. The triple bottom line acts as a framework of accounting that brings together the three aspects of finances, social and environmental performances (Hall, 2011). This framework is different from the conventional ones since it includes the issue environment or ecology and social aspects which are very hard to derive their accurate measurement methods.

The economic aspects must be variables that are concerned with the bottom line that is the flow of finances (Elkington, 2004). This concerns may be factors related to business diversity, employment, income and expenditure, taxes as well as factors related to the business climate. The aspect of ecology should be concerned with measuring the natural resources and any negative or positive impacts on its viability (Hall, 2011). The ecological factors may include the quality of air and water, energy utilization, land use and coverage, and solid toxic waste (Norman & MacDonald, 2004). In essence, being aware of the trends in every environmental aspect mentioned above would be instrumental to every stakeholder in determining the impact any endeavor or policy will cause to the area. The social dimension represents the societal measures of social variables and may take the perspectives of accessing social resources equitably, social capital, education, quality of life as well as measures of health and well-being (Norman & MacDonald, 2004).

Triple bottom line and its importance in sustainable development have become very critical of doing business out of their ability to provide real evidence of supporting long-lasting profitability. An actual instance is when a company lowers its packaging waste which consequently reduces cost. Some of the best examples of companies that have used the methods mentioned above include Proctor and Gamble, Unilever, General Electric, and 3M and Cascade Engineering (Hall, 2011). The business firms must, therefore, embrace methods that are economically viable, environmentally friendly and socially acceptable (Zak, 2015). This will, however, involve being able to visualize the organization's vision and considering in its endeavors the expectations and needs of every stakeholder. Putting the mentioned approaches into practice is never simple. According to (Jamali, Mezher&Bitar, 2006), results from research prove that business firms in third world countries find it very formidable to maintain a sustained performance in the three

variables and that bringing into integration the TBL has continued to become a faraway dream. The TBL has continued to prove very valuable in matters related to the development of the economy, but the field has not been given sufficient attention *quid pro quo*.

## **2.6 Chapter summary and research gap**

The literature review given above has highly focused on the following aspects; green logistics activities, supply chain, sustainability, and profitability. Green logistics involves connecting the economic, social and environmental logistics viewpoints. Thus, it may be used to refer to the efforts made towards reducing adverse impacts of logistics on the environment. The main reason behind many organizations deciding to go green is to maintain their competitive advantage. The main green logistics activities practiced include; estimating the amount of carbon dioxide emitted, reverse logistics, package optimization, route optimization and fuel efficiency. It is important to note that the main reason that influenced the growth of green logistics concept was the increase in environmental problems awareness, particularly in issues of CFCs, global warming, and acid rain.

The green logistics system model framework is comprised of green suppliers, green manufacturers, green retailers and green consumers, all linked together by the green logistics information system. Green Supply Chain Management (GrSCM), creates a sustainable supply chain by offering products that can be reclaimed or reused in their final phases of their useful life. This helps reduce costs and maximize profits while at the same time conserving and improving the environment thus making the world a good place. However, implementation of GrSCM requires green supply chain training, use of recycled materials for packaging, implementing reverse logistics as well as general developments in the green industry.

Bearing all that in mind, the supply chain has thus been defined as a group of different organizations brought together by the products and services that they do value addition either independently or jointly so that they can be transported to the final consumer. Moreover, the process of green supply chain ensures a sustainable chain of supply by providing products that be reused and reclaimed at the last phase of their useful life. The existing literature has, on the other hand, proposed five possible practices in green supply chain management. They include prevention of pollution, environmental certification, design for environment, reverse logistics and life-cycle assessment. With that being said, problems or complexities in the supply chain can thus emerge from the

upstream side of the supply chain in acquiring materials from the suppliers, downstream to the retailing of products and eventually to the end user not forgetting the inherent complexities in manufacturing. Studies on supply chain are hence supported by two critical dimensions. One, some risks may arise from the upstream supply chain complex nature. Second, the recurrent disruptions in the supply chain which include supplier risks, the uncertainty of the purchase outcome, handling, packaging and also issues on transport.

Profitability refers to a criterion that determines the level of efficiency that the management has been able to attain by making use of the available market sources. Profitability models that are designed based on the regression present a secure connection between the management of resources in an organization and profitability or returns on investment. A few studies have been conducted to determine the correlation between green logistics and cost-effectiveness. From these studies, it has emerged that green manufacturing, reverse logistics and green purchasing positively influence the proper performance in healthcare. According to the literature reviewed, profitability and sustainability have been seen to walk hand in hand. In simple terms, sustainability can be defined as a situation where everybody on the surface of the earth can live a healthy life without compromising the possibilities of the coming generations to do the same. Therefore, it can be concluded that the triple bottom line acts as the accounting framework through which the three aspects of finances, environmental and social performances are brought together. Triple bottom line together with its associated benefits in sustainable development has become very crucial to helping businesses conduct their activities out of their ability to give a real evidence in support of sustainable profitability.

#### 2.61 Research Gaps identified

From the studies reviewed, it can be noted that the key workable policy recommendations, implementations and green logistics operationalization all take place at the local level. However, these studies did not attempt to discuss how the three have influenced the local industries. Also, these studies have also been unable to determine the extent to which different regions have contributed to green logistics. Thus, it would have been important for the study to explain how companies interested in implementing the green logistics could do to set up high institutional factors that can help in enforcing and monitoring environmental sustainability. Some organizations are looking forward to doing their best in green logistics though there lacks a stable relationship between green logistics practices and firm performance. On the other hand, this has created a need to carry out

more studies which will aim at exploring the relationship between green logistics practices and firm performance. The current study examines this last research gap in its effort to explore and understand green logistics and profitability at SABIC

## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1. Introduction**

This chapter presents the method that was used to conduct the study on the Investigating SABIC green logistics systems and profitability. The chapter covered the research approach that was used, strategy and research design. Data collection was addressed with regards to sources, population and sample size determination. The chapter proceeded to outline the study determinants before highlighting the limitations and delimitations foreseen. Finally, the section discussed the instrument and study variables.

#### **3.2 Epistemology**

Epistemological factors cover the type of knowledge that is regarded as acceptable in a given subject. It is also concerned with whether social sciences should apply the same principles as those implemented by natural sciences (Ritchie, Lewis, Nicholls & Ormston, 2013). After all, this agrees with (Moon & Blackman, 2014) who calls epistemology a branch of philosophy dealing with truths in the way they are acquired empirically from research results. There are three aspects of scientific knowledge and include realism, positivism, and interpretivism (Moon & Blackman, 2014). This research applied interpretivism aspect because the knowledge together with theories that we've come up with originate from social constructs that have been interpreted. The aspect of interpretivism is usually considered very useful in management and business studies more accurately behavior in an organization, HRM as well as marketing (Ritchie et al., 2014). This study will be classified under organizational behavior and management since the one who authored this research paper considers the philosophy of interpretivism as to match its needs. Considering how a manager perceives green logistics will give this researcher a chance to understand their social life from their point of view as well as how they socially act. The basic aim of this study is to find out how the respondents would experience and interpret green logistics at a personal level which again favors interpretivism as most appropriate in solving the research question.

### **3.3 Selecting the subject**

The author has selected SABIC as the topic because he is interested and curious about how sustainable the logistics are. The sustainability of the supply chain is a serious issue in business that affects the company's supply chain frameworks on the part of costs of wastes, risks as well as those on the environment. It is becoming critical to make environmentally sensitive decisions in the management of the supply chain. The author firmly believes that matters concerning the environment are critical in today's life especially in countries that have many manufacturing companies and usually transport their finished products from the factories to both internal and regional markets. For this reason, it is important to raise environmental awareness so that we can reduce its pollution and at the same time improve business performance in the current highly competitive world.

### **3.4 Research Method**

Two expansive categories of study methods are deductive and inductive (Soiferman, 2010). Induction methods start with general and end with the specifics. Creswell & Clark (2007) asserts that arguments that are based on observations and experience are categorized as inductive. For this study, an inductive approach was used (general to specific approach). This study was a case study type of thesis focusing merely on SABIC. The aim of the study was to discover the precise end results concerning investigating SABIC green logistics systems and profitability and in the end, generate relevant recommendations to SABIC, chemical industries, other companies as well as contribute to the literature.

### **3.5 Research Strategy and design**

A master plan that guides the research is called a research design (Creswell, 2013). It shows how different activities can be carried out, such as sampling and treatments in an attempt to address the research problem (Barreiro & Albandoz, 2001). The context where the research took place in SABIC and the data was gathered using qualitative approach; interviews option.

Two research strategies commonly used are qualitative and quantitative. Their usage depends on the nature of the study purpose and context that build the research. A qualitative study is comprised of observations, interviews, and questionnaires among others, where the statistical analysis is not needed (Creswell, 2013; Hancock, Ockleford & Windridge, 1998; Hancock et al., 1998). This study utilized qualitative approach because it

allowed the researcher to develop a thorough understanding of how green logistics activities were applied in SABIC which were attributed to its profitability.

As mentioned by (Ozanne, Graneheim, Eksted & Malmgren, 2016), qualitative analysis refers to the use of a small number of participants in collecting data which will give detailed information about a topic. A qualitative analysis has been regarded as appropriate for this study since it is based on the opinions and interpretations of just a few participants- it involved five respondents. The researcher has the objective of understanding the aspect of green logistics inside SABIC through the business organizations hoping to make important suggestions that will assist and better it. (Bakker, Creemers, Schipper, Beelen, Grupstra, Nollet & Abma, 2015) Approves that defending the qualitative analytical method will help get accurate data as to “why” and “how” to get things done. In this research, the writer has the objective of understanding how business managers view green logistics within SABIC which according to (Bakker et al., 2015) will give a reason for using a qualitative analysis.

When interpretivism together with constructivism are applied, the qualitative analytical approach is very appropriate and is likely to provide more data to the study topic- the green logistics. The research also aims at investigating to what degree logistics companies within SABIC implement green logistics principles which best requires a qualitative approach. The qualitative method will involve semi-structured interviews out of their strength in digging the opinions of the manager about green logistics.

The collected data was analyzed using content analysis (to be explained later), which involves summarizing contents on various aspects of the content to enable a better objective evaluation rather than carrying out a mere comparison of content based on impressions of the listener (Creswell, 2013).

### **3.6 Data Collection Method**

This being a qualitative study, interviews were used. Interviews explored the experiences, beliefs, motivations and views of individual participants regarding the theme of this study (Gill, Stewart, Treasure and Chadwick, 2008). There were three sorts of qualitative interviews (unstructured, structured and semi-structured), this study focused on semi-structured interviews as they follow a setup rule that the whole dialogue follows. They were verbally administered in the form of questionnaires, where a list of predetermined questions was presented to participants (Gill et al., 2008) A sample comprised of 5 management members who were selected based on their relativity on the

chosen research topic randomly so that every person had equal chances of being selected. Also, the researcher was aware of the group mix impact on the data collection, such as age, social, professional status and sex of members. Mathers, Fox & Hunn (2009) recommends pretesting of the interview questions before the actual study through a pilot study. The author arranged for specific dates for interviews with the participants to prepare them physically and psychologically.

The interviews were directed with continuing problems, leaving the participants with the freedom of expounding with the response. However, the questions were in the form of a questionnaire and each member was supposed to answer them individually. All the discussions were directed in English and in a time span of 1 hour.

### **3.7 Data Source (Primary & Secondary)**

The data source for this study came from both primary and secondary sources. However, primary sources were best encouraged and most focused on. Hox & Boeijs (2005) states that primary data refers to original info that is attained through, for instance, interviews and questionnaires, while secondary data is the data that is already available in books and reports. Secondary sources came from SABIC annual reports highlighting the company progress regarding sustainability in its supply chain activities. The data collected from the secondary source ranged from; SABIC efforts to reduce carbon emission, innovation and sustainability solutions, development of human capital, resource, and energy efficiency all which play an important role in implementation of green logistics. Thus, since interviews consume a lot of time, the author decided to consult secondary sources as a way of supplementing his study results and for the purpose of answering the research question in full.

### **3.8 Population**

A research population is a large collection of individuals or objects that are the primary focus of a scientific query (Gill et al., 2008). However, due to the large sizes of SABIC population, the researchers did not test every individual in the population because it could be too expensive and time-consuming. The researcher selected 5 members (sampling method explained later), based on their relativity in the research study, from the senior position because the senior management of an organization, regardless of size, are integrally involved in the design, development, and implementation of the inclusiveness initiative.

### **3.9 Sampling method & techniques**

A non-probability sampling method where respondents are chosen due to how accessible and their proximity to the researcher is referred to as convenient sampling (Barreiro & Albandoz, 2001). Hence, because this research deals with logistics, the researcher found it prudent to concentrate on the departments that handle logistics within SABIC which makes convenience sampling more appropriate. The researcher wrote to the companies by using emails where he first expressed his personal details, where he comes from and the thesis of the research. In some instances, he was forced to make calls to get the person he wanted together with his personal contact, and these were given to him when the company gave a response. This is considered a good method of dealing with biases in sampling. Despite this, the respondents selected had to be in logistics department with experience of not less than 24 months or in a related area and had to have worked with SABIC for not less than 12 months. Since managers usually have very tight schedules, some of them were not available for the interviews, and the researcher had hardships in organizing interviews with the appropriate ones. This is one of the reasons as to why the study had few participants.

### **3.10 Data analysis methods**

Qualitative analysis of data involves searching for the general statements concerning relationships between categories of data. This being a qualitative study and the data being gathered using interviews and focus groups, content analysis was adopted for data analysis. As stated earlier, this method involved categorizing behavioral data or verbal messages for summarization, tabulation, and classification (Allan, 2003). The content was analyzed using two methods (Creswell, 2013): (1) Manifest level or basic level, which involved what was said without comments or theories presented. (2) Latent level or higher level, which required greater interpretive analysis about the responses.

### **3.11 Presentation techniques**

According to (Anderson, 2010), data from the interview and focus group should be presented using quotes. In this case, the researcher will select quotes that would be most representative of the study results and will avoid taking large portions of interviews into the research report. Similarly, the speakers and the settings shall be established at the end of the quotes.

### **3.12 Advantages and disadvantages of chosen methods**

The method selected for this study was the qualitative approach. It had the merit of providing the in-depth evaluation that could not be easily answered using quantitative approach (Kanane, 2014). The interviews are never restricted to specific questions, and could also be guided and readdressed by the researcher in a real-time context. Also, data gathered is contingent on the human experience, which is more convincing and influential than the data collected using quantitative approach (Mathers, Fox, & Hunn, 2009). However, it has demerits such as it depends on abilities of the researcher and can be impacted by individual predispositions. Also, it is time-consuming to interpret and analyze the data as compared to statistical software, like SPSS, for a quantitative study that could analyze a significant amount of information in a few seconds.

### **3.13 Limitations and Delimitations**

According to (Simon, 2011), limitations refer to the weaknesses in that research that are beyond the researcher's control. Delimitations are the characteristics that tend to limit the scope of the study. In this study, the researcher did control that the data was interpreted to fit the SABIC and chemical industries but would be limited to companies, such as horticultural companies. The researcher assumed that such results would also be derived if a similar study was carried out in other industries, such as food industries which do a lot of transportation. Only interviews were used with a few participants, which might cause limits on the type and amount of data gathered (Kanane, 2014). Data analysis was done at the end of the interview. However, it is recommended that data analysis is necessary from the start to create room for adjustments (Peersman, 2014).

Concerning the quality of the research as well as it being deficient of informed consents, the researcher used the ethical practices given by (Brinkman, 2014). According to Brinkmann (2014), there exist some critical statements that explain the moral protection systems that established social and medical survey groups have come up with to shield the rights of those who take part in their research. For example, the aspect of voluntary participation calls for people not to be coerced to become respondents in research without their will. Very close to the aspect of voluntary participation is the issue of informed consent. According to (Peersman, 2014), the issue of informed consent requires that the researcher gives enough information to the person and allow him to decide whether he will take part in the research or not. To show adherence to this ethical conduct, the author introduced himself as well as his intentions and the thesis of the study, as adequate

information to the respondent. Privacy was highly considered to the extent that the respondent had the freedom not to answer a question they felt was more personal. In fact, there was one participant who chose to remain anonymous, and this was agreed on.

### **3.14 Reliability and validity issues of the study**

Good data management is needed. Peersman (2014) defines validity as the instance where data measures exactly what it was planned to measure. On the other hand, reliability is the instance where the data measured is consistent with the standard definition as well as the study methodologies, and if the study is repeated, almost similar results would be achieved. Validity in qualitative research means “appropriateness” of the tools, processes, and data (Leung, 2015). The researcher ensured that the research question was valid for the desired outcome, the choice of methodology was appropriate for answering the research question, the design was valid for the methodology, the sampling and data analysis was necessary, and the results and conclusions were valid for the sample and context. Validity was also ensured through paying attention to the negative cases as well as creating a fair treatment among the participants. Reliability was guaranteed through eliminating the researcher biases in particular through the use of qualitative study protocols for carrying out interviews, analysis, and population selection. For instance, similar questions were asked to all members and reliability was also ensured through verifying findings as the study process continues.

In this specific research, the social factor of the Bottom Line Theory (TBL) was added. TBL refers to a framework of accounting that includes the three aspects of performance i.e. financial, environmental as well as social dimensions (Govindan, Khodaverdi & Jafarian, 2013). This is different from the conventional methods of reporting because it includes the social and environmental aspects that are difficult to assess. The TBL aspects are also referred to as the 3 Ps i.e. people, planet and profits which mean that the social impacts of green logistics are part and parcel of this research. Social sustainability endeavors aim at promoting a symbiotic relationship between the society, consumers, and workers. Sustainability of the environment aims at looking at the impact of resource use and disposal of harmful waste in the form of gasses and waste to the physical surrounding. Economic sustainability aims at achieving the highest level of efficiency in business, maximum profits as well as productivity. These three aspects together are referred to as the planet, people, and profit (Henriques & Richardson, 2013).

## CHAPTER 4

### 4.1 RESULTS

#### 4.2 Chapter overview

This section presents the analyzed data as well as the findings obtained from the primary data acquired from the respondents. Further, the section accessed the secondary data for 2013 in regards to certain components of profitability in the firm. All the responses on questions were cross-checked for accuracy completeness and consistency to make sure they were done well. Besides, the author in this section of the thesis provides the results obtained from the interviews conducted with the respondents. The interviews began with a list of general questions about the respondents. This was to make them comfortable before introducing the main topic, green logistics. Indeed, the findings have been categorized into three major dimensions. They include the green logistics activities, Impacts associated with green logistics on SABIC and green logistics sustainability and environmental concern.

#### 4.3 Response Rate

The target group in this research was the head of supply chains from large scale manufacturing firms, which were highly concerned with the issues and practices of reverse logistics as well as waste management. The questionnaires that were delivered and completed was 5 out of 7, which presented 80% of the responses required to achieve a satisfactory representation of the whole population.

#### 4.4 Respondents information

Table 1: information about the participants

	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5
Position	First-level management (supply chain)	Middle-level management (supply chain)	Top management	First-level management (supply chain)	First-level management (supply chain)
Professionalism	7 years experience in logistics	15years experience in supply chain	Extensive years in	4 years experience in logistics	6 years experience in supply chain

		managerial positions	managerial positions		managerial positions
Educational background	BBA	BBA	Master of Science	BBA	BBA
Years worked at SABIC	4 years	4 years	25 years	3 years	5 years

Table 2: Results summary

Categories	Response
Green Logistics Activities	<ul style="list-style-type: none"> <li>• SABIC apply most of these activities; <ul style="list-style-type: none"> <li>✓ Fuel Efficiency,</li> <li>✓ Route Optimization,</li> <li>✓ Reverse Logistics,</li> <li>✓ Packaging Optimization</li> <li>✓ Measuring Carbon Emissions.</li> </ul> </li> </ul>
Supply chain	<ul style="list-style-type: none"> <li>• Thus, green logistics is very essential part of the firm and thus ongoing research is part of the firm ongoing research and development.</li> <li>• Application of green logistics is a demand from the company and partly from the clients.</li> <li>• Supply chain is faced by problems of lack of enough special fleet for diverse chemicals transport</li> <li>• There are no enough chemical disposal mechanisms and this leads to unsafe means of disposing waste which would latter affect the universe.</li> </ul>
Profitability; Impacts of green logistics on SABIC	<ul style="list-style-type: none"> <li>• Green logistics is important as it saves ecological life in SABIC surrounding ecosystem.</li> <li>• Green logistics is an incentive that SABIC efforts to apply in all its activities</li> </ul>

	<ul style="list-style-type: none"> <li>• Green logistics is cost save and hence part of SABIC profit.</li> <li>• Nevertheless, it face barriers such as lack of enough of green infrastructure and high standard demand by the government.</li> </ul>
Sustainability and environmental concern	<ul style="list-style-type: none"> <li>• SABIC has a big responsibility towards sustainability and setting a good example to other small companies.</li> <li>• Regarding environmental concern SABIC constantly measures its greenhouse effects and then act responsibly.</li> <li>• SABIC is ISO-standards certified (ISO-9001 and ISO-14001) meaning it adhere to ISO standards in their daily activities.</li> </ul>

#### 4.5 Green Logistics Activities in Place

The members were requested to mention the current green logistics activities they have in place. In addition, they were asked to explain a bit on what the firm does regarding green logistics. Despite the different ways of telling the answer by the members, the responses among all the members showed some similarity. The following were the responses;

When asked; Out of the following green logistic activities, which one(s) does SABIC apply?

- Fuel Efficiency
- Route Optimization
- Reverse Logistics
- Packaging Optimization
- Measuring Carbon Emissions

Respondent 1

*We highly apply fuel efficiency since most of our deliveries use fuel. Therefore we try our best to optimize our deliveries routes which reduces fuel consumption too. Finally I could also say that we measure carbon emissions for us to find ways in how to avoid high carbon measuring in the future.*

Respondent 2 clearly stated that:

*We use all the mentioned activities. Since fuel is number one usage in our activities, we pay a lot of attention on how to conservatively use it in the right time and for the right place. The government also raised fuel prices and that caused additional expenses on us. And that also forces us to use the optimized route for our fleet. And as I mentioned before, regarding measuring green effectiveness, we measure carbon emissions and find reasons why the carbon emission is, for example, higher than the last six months' measure.*

### Respondent 3

*I am mostly knowledgeable on the carbon emissions measurement. We do use our systems to examine the data on our fleet. For example the time they took to deliver the materials, and the vehicle speed. It is known from my experience that the ideal speed is 90km/h for road transportation. That is when the truck can go as fast as possible with least fuel consumption.*

### Respondent 4

*The Saudi government raised the price of oil, and raised taxes on big companies. This makes us try to find other ways to balance and save money. In your mentioned activities, we use most of them. Like fuel efficiency is a perfect use in our LNG fleet, and for some of our hybrid vehicles. We save lots of money from them in the long-run. Also with the route optimization. If fleet takes random routes to their destinations, then there will be waste in fuel, engine life, extra unnecessary pollution to the environment. We try to draw a map using many decent software like ArcGIS to figure out the ideal routes for our transportations. And measuring carbon emissions is the indication of how well we are doing in being green*

### Respondent 5

*SABIC does use green logistics in that it tries to reduce the effect of the production system in the environment by ensuring proper packaging and proper waste disposal. This allows for less wastage of the materials being transported. In waste disposal, the process involves the sale of waste products. To the other companies that that make use of our waste products as their raw materials*

From the responses, it is clear that SABIC currently undertakes green logistics activities. Regarding fuel efficiency as part of being emission compliant, the vehicles and tracks used by SABIC are also required to go for regular checks and to service all which could be termed as responsible driving. SABIC practices on energy efficiency are in agreement with the green logistics definition, that is, the ratio of traveled distance to the energy used. This is a function that mainly involves the driving behavior, the characteristics of the vehicle and the traffic conditions.

On the other hand, on estimation emission SABIC ensure that they are compliant with the emission regulations and at the same time, to keep up with the vehicle's maintenance. The managers believe that SABIC is taking part in activities like calculating the carbon emissions and implementing training programs for drivers to help reduce the consumption of fuel. SABIC calculation of emission is in line with green logistics. This is because SABIC transport activities result in environmental effects like emissions of large quantities of CO<sub>2</sub> which in turn leads to climate change and emission of particles which are on the other hand responsible for air pollution. Hence, their emissions per unit of energy are the amount of

CO<sub>2</sub> and other toxic gases that are emitted per the consumed unit of energy. In most cases, these costs usually vary with the energy/fuel type used, the exhaust filtration systems as well as the nature of the engine which converts this energy into logistical activity, for example, movement, refrigeration and heating among other activities.

Package optimization cannot be left out when it comes to implementing green logistics. The SABIC drivers have to ensure that they have the right amount of packages before commencing on the journey. Also, the company uses payload optimization to ensure the best utilization of their tracks as well as avoiding trucking half-empty. This primarily helps reduce carbon emissions per every kilometer traveled. Optimization of packages also concurs with the green logistics context. This is because of the two key vehicle utilization parameters; the average payload on laden trips and the average percent empty running. The average payload is usually calculated solely regarding weight. However, with the decline in average density of freight and a growing proportion of loads, it is significant to measure the physical dimensions of cargo consignments.

For route optimization, SABIC drivers correctly follow up the route sequence in the delivery cycle. These activities ensure that fewer distances are covered and hence low costs of transportation and increased efficiency, which on the other hand reduce the number of carbon emissions. It is important to note that SABIC Company has successfully managed to take trucks off the road, reduce costs and the carbon emissions, all from optimizing their routes. This is important as customers expect deliveries to be made on time and with correct orders regardless of the last minute changes, the breakdown of equipment or even heavy traffic. SABIC route optimization is in agreement with the green logistics context. This is because routing solutions optimize the daily operations through dynamically arranging for deliveries, loads, and resources. Route optimization provides for various options in the what-if-scenarios, making decisions on multiple routes and deliveries basing on facts as well as in adjusting to the last-minute order changes.

#### **4. 6 Green Logistics impacts; profitability**

When the members were asked whether they considered green logistics a cost-saver or an unnecessary cost, they all stated that it could definitely be a cost saver. The following were responses;

Respondent 1

*I believe it saves a lot of money in the long-run. For example in reverse logistics, we dissolve metal and re-manufacture it for other purposes.*

Respondent 3

*According to the data I see on my screen, it is definitely important because it saves the company lots of cost.*

*It could be in terms of cash, or in terms of that we can use the same product or material again.*

Respondent 4

*It is part of the profit definitely.*

Respondent 5

*I am very pleased with Green Logistics due to various reasons. For example, the company can benefit from the reverse logistics by making use of some of its wastes, and at the same time, we can sell most of those wastes to the other companies that take advantage of them as raw materials. To the company green logistics is a cost saver.*

Also when asked, do you think SABIC green logistics is associated with profits that the firms makes? The following were the answers;

Respondent 1

*Of course. It is part of the profit. Imagine by not applying green logistics how much waste of money we will incur*

Respondent 2

*As I mentioned before, yes it is associated with the profits. Because for example if required from our customers to return their used materials, we can either recycle or sell it to other parties. Also, using hybrid logistics saves a lot of fuel consumption.*

Respondent 5

*Yes, we have made a lot of profit from reusing waste products that could have otherwise gone into waste and also selling the same wastes to the other companies in need of them. This also applies in the area of disposal where we are incurring almost zero cost when it comes to the disposal of the wastes.*

On the side of the transport, the respondents agree that activities like fuel efficiency and optimization of routes can help save costs. In case drivers stop within the course of their routes, then it costs the company money. Thus, the driver-training program has helped the company save costs as it has limited the number of trucks going off route or sitting idly. Additionally, the respondents also indicated that the original investment would cost the company a lot of money though it will be a cost saver in the long run. Thus, managers view green logistics as a massive cost saver although the whole concept is based on reducing the carbon emissions, which directly relates to consumption of diesel. Low consumption of diesel means fewer costs with route optimization and better utilization. About the evidence from the SABIC case study, innovation of logistics, which is often based on the emerging green technologies, is precisely linked with the development of considerably sustainable and

environmentally friendly approach to Supply Chain Management. This builds on the reduction of ecological impacts from the main activities, cost saving, reliability, quality performance as well as energy efficiency. In this case, observing the regulations on the environment is important as it helps in reducing the ecological damage as well as in achieving overall economic profits.

For an organization to become profitable, the overall incomes must be more than the expenses. Costs refer to the cost of resources consumed in the business activities. The profits of an organization are determined by considering what is left after subtracting the expenses from the total revenue. Profitability ratios indicate the ability of a company to make profits that are satisfactory and capable of ensuring returns on investment. Findings from this study concur with (Lesakova, 2007) who revealed that the ratios are indicators of financial position of the organization and help in monitoring how effective the assets of the organization are managed. To achieve the overall corporate objectives, improvement of the firms of profit is essential. Good corporate governance promotes economic stability which in turn reduces the vulnerability of an organization to financial crises. Further, it reduces the capital cost as well as the expense of the transaction.

Sustainability promotes efficiency, particularly in supply chain logistics. Organizations do not necessarily need to sacrifice their profitability to achieve sustainable logistics. Instead, the two should go hand in hand. Thus, organizations view sustainable supply chains as a win-win setting. The framework on green profitability can successfully be used to quantify the impacts of both the environmental and profitability green supply chain initiatives. When compared to other frameworks in the literature, the green profitability framework is considered to be more appropriate to chemical companies. This is due to its ability to quantify both sustainability and the profitability in short-term as well as long-term scenarios in planning. To maintain their competitiveness in the market, most chemical businesses are compelled to reduce costs, and at the same time improve their customer services with operations that are more efficient (Kumar 2013). According to (Kumar 2013), shifting from a functional to an end-to-end, or total, supply chain view is seen as one way of achieving this. Green supply chain initiatives that are appropriately designed can help in saving costs in a case where the overall supply chain cost of a product is considered. Thus the implementation of well-designed green supply chain initiatives can help improve the market competitiveness of a company (Porter & Van der Linde 1999).

## 4.7 Supply chain

What asked; Are there supply chain problems when transporting chemicals? There were almost similar statements among the participants regarding this question and the following were the responses;

### Response 1

*Safety is the biggest problem we face. Some of our materials are highly flammable and due to the hot weather in our country (Saudi Arabia) the danger is higher.*

### Response 2

*Problems are everywhere, but when it comes to chemical transportation, I would say there is a problem with the type of fleet that carries the materials. For example, flammable substances need specific type of vehicles or vessels for safety carry.*

### Response 3

*Some materials require certain standards to be transported safely. If the responsible team failed to check the fleet that will transport the substance, there could be leaking of those chemicals during transportation. Also if a client fails to receive the delivery in a safe way, it might cause harms to the person handling the delivery.*

### Response 4

*Each type of chemical substance needs to be handled differently. Some of them cannot be transported in regular trucks due to its nature. Others need certain temperature storage to keep the substances safe and not go corrupted.*

### Respondent 5

*We'll at times we face the problem of inclement weather especially the high temperatures during the day in Saudi Arabia where our firm is located bearing in mind that most of the chemicals that we produce are extremely flammable. At other times we have problems with the terrorist who sometimes have their members working within our firm target the chemicals that are being transported for their gain.*

It has been found out that for any company that produces and transport chemicals such as SABIC, supply chain faces problems from all corners. Companies operating in Saudi Arabia must be cautious due to the high temperature of the regions. Thus this calls for specialized vessels suitable for transmitting the chemicals. Also, the team needs to be made aware through appropriate training on the danger that comes along mishandling chemical substances. This harms may be to human, animals, plants and the general environment.

In general, it can be declared that supply chain management involves providing the right goods in the right quantity in the right place and at the right time notwithstanding any problems encountered along the way. The increasing pressure on manufacturers to make safe products that are of high quality has, on the other hand, turned to be a great challenge. An increase in the cases of product recalls each day can damage the reputation of the company and can prove to be very costly in the long run. Evaluating the performance of a supply chain may help identify problems and opportunities. Again, having a good strategy as well as regularly measuring the core parts is critical in understanding and maintaining control of the supply chain. Besides, it is necessary to put the process, technology, and people in a position to achieve a competitive advantage both for today and in future.

The results also indicate that conducting periodic assessments and redesigns is important as it will ensure efficiency and effectiveness. Such adjustments are made in response to changes in the market like for instance the launching of a new product, availability of credit, global sourcing together with the need to protect intellectual property among others. To control and mitigate these risks, they need to be identified and quantified first. Executives in Supply Chain Management (SCM) encounter with some distinct challenges when incorporating accurate supply chain management with the general corporate business strategy.

Additionally, the findings also mean that the success of supply chain involves the process, technology as well as people, together with which all define the purpose of a company. With the three elements, that is, process, technology and population, the organization needs to have useful metrics. The three parts work together in an organization to provide unified and coordinated efforts that are used in the supply chain management to promote customer satisfaction and achieve a competitive advantage, with both services and productivity. Supply Chain Management (SCM) is, therefore, forms a crucial part in giving the company drive and direction. It represents a way to growth and retention of customers, competitive advantage as well as profitability.

#### **4.8 Sustainability**

The insights in the above section bring to the topic sustainability. When members were asked what they consider SABIC responsibility towards sustainability the they and environment there were almost similar views.

Respondent 1

*Since we are one of the biggest chemical companies, we feel like we have a big responsibility towards sustainability. It is like we are a model for other companies to follow. If we don't apply green logistics, why the smaller companies would apply?*

Respondent 2

*Since we are a chemical company, responsibility is high. Chemicals are dangerous materials and we need to deal with them with most care from producing them to disposing them. We are located in an industrial city, and near residents. We have to make and follow strict rules.*

Respondent 4

*Educating the employees about the hazardous issues if it doesn't follow the green standards. We are procuring or investing in environmentally-friendly cargo ships, hybrid vehicles and research on green human activity.*

Respondent 5

*The products that we deal with need us to be more sustainable; we have to act as role models for the other companies to ensure that the ecology becomes clean and healthy.*

The question, what they consider as incentives for SABIC applying green logistics? acquired similar views in regard to both the internal and external business environment. Below were the responses;

Respondent 2

*A cleaner environment. In our industrial city, a lot of residents complain that the pollution is high and they are worried about their health. Therefore, SABIC is doing their best to reduce its pollution and apply green activities.*

Respondent 4

*Healthier workplace to reduce employees quitting their jobs because of unhealthy environment. And the more money we save from green logistics, the more money we make and the more bonus the employees will get.*

Respondent 5

*Well, the government is very pleased with the firms that use Green Logistics in their production thus at times we enjoy incentives from the government at various levels. We are also able to work in a clean and safe environment.*

The main idea stressed in these results is the cost saving although the company can reach a competitive advantage by being sustainable. Also, being green can further be used for marketing. The consumers desire to be associated with a company that goes green and from a brand perspective, this is significant towards the image of a company. However, most of the managers cited that one of the challenges to going green is the fact that green logistics

education has not been delivered entirely and that means that leadership is vital aspect when a company desires to be sustainable. They also added that this education needs to be improved as this will on the other hand help promote the employees awareness as well as educate them on the environmental effects that may happen due to negligence. Also, the results are an indication that businesses need to focus more on cutting the costs of operations to ensure that their processes become more sustainable. Similarly, they can reduce the costs of production and capital costs of their products, educate the employees on sustainability efforts and goals or change the behavior of employees, all to ensure sustainable business processes.

It is important to note that only a small number of companies are formed with a broad-based idea of commitment to sustainability. To help establish such, companies need to have a committed leadership, the ability to engage with several stakeholders about value chains, participate widely with the employees and ensure disciplined execution mechanisms. Traditionally, the main aim of starting a business is to provide products and services that meet the demands of the customers at a profit. However, most of the businesses today have forgotten that the only business success strategy of the future is sustainability. These findings concur with the study by (Raderbauer, 2011) which indicates that for a business to be successful, it first needs to become an ego-centric one before turning its focus on sustainability with all these requiring a lot of efforts and time. Further, the results are in agreement with (Eccles, Perkins & Serafeim, 2012) who stated that the strategic sustainability indicates a commitment emulated by the top management and which moves beyond efficiency and compliance to minimize costs and avoid risks.

To create a long-term shareholder value, business sustainability tries to embrace the opportunities as well as manage risks which emerge from the economic, social and environmental responsibilities of the organization. It is important to note that business sustainability is linked to a broad range of diverse areas which comprises the business strategy, the organizational behavior management of operations, finance and accounting, economics, ethics and environmental science among many others.

The findings also concur with the study by (Narwal & Jindal, 2015) which reveal that there are an increasing number of means that are accepted within the business sustainability field. This involves the knowledge and practices which are, or need to be, uniformly applied in all programs of business sustainability. This is despite the fact that the organization which is implementing business sustainability is always responsible for determining what is suitable for its operational context. Thus, it is important to establish a common lexicon around the

corporate sustainability practice which will be useful in discussing the lessons learned as well as for benchmarking common achievement elements.

#### 4.9 Improvements or Changes Recommended

The managers recommended a number of improvements and changes that could be implemented in the organization. However, the answers varied as different managers had different views in relation to how green logistics could be improved in the organization.

When asked If they were advising SABIC on green logistics, what are the main changes or improvements that they would recommend? The following were the responses;

Respondent 1

*I would recommend investing more on green environment education in the research center. Also get rid of the current fleet and replace them with hybrid trucks.*

Respondent 2

*I would like to see a full hybrid vehicles replacements in the company as well as cooperation from our clients to be fully green when dealing with us.*

On the other hand when asked from their experience in road transportation, what advice would they offer to other managers when implementing green logistics?

Respondent 4 declared that:

*do some research on how to make the department green. It is not just because saving the environment, but also think about the small portions you will gain from your green activity in your department. You cannot leave free money on the table.*

Respondent 5

*I would advise them to release the trucks with some security personnel to ensure that the products get to their destination safely and also to research on the hours when there is less traffic. This ensures that these trucks spend less time on the roads which in return leads to less jam and low fuel consumption.*

Educating the staff as well as raising awareness and environmental issues about green awareness is thus the major improvements or changes that would be recommended. There is a need for management to raise the training levels and increase the awareness. Besides, it will continually be required to restate it as well as continuously send out information on green logistics as well as its associated benefits. Moreover, education, training as well as awareness are essential in both the working level and the senior level. Additionally, it needs to be

implemented from the top Chief Executive Officer of the organization downwards. Also, being innovative, considering the various ways in which one can be innovative as well as conducting research on what is available in the market for implementation like, purchasing new hybrid vessels, is also important.

#### **4.11 Secondary data**

This research has included the Sustainability Report of SABIC, 2016 as a source of its secondary data. The findings from the report will give more details on SABIC's logistic concerns. The data below has exclusively been obtained from the SABIC's 2016 Sustainability Report as it gives a clear, in-depth information on the sustainability of SABIC in the 50 countries it operates in. Further, the report looks at the innovation and sustainability solutions, development of human capital, resource, and energy efficiency, development of supply chains, Environmental Health and Safety Services (EHSS) and product safety, the social impacts and community relationships.

One of the notable progress that SABIC has continued to make is reducing the greenhouse gasses, water intensities, and energy by 25%. Similarly, it has also advanced in lessen the intensity of material loss by 50% from levels in 2010 by 2025. From 2010, the company has managed to lessen the intensity of material damage by 41 %, that of water by 10.4 %, greenhouse gas emission by 8.3% and energy by 6%. SABIC created a global energy policy, which ensures that reliable and cost-effective energy is available. The system also provides a commitment to continuous improvement of efficiency and design. All through the year 2016, SABIC continued investing in learning and development of skills, senior leadership expertise, and cross-functional expertise. This provided an opportunity for continuous learning and rewarding of best performers.

With about 20,000 delivery locations distributed in 140 countries, SABIC's complex supply chain experienced an exceptionally safe with no major incidents. For this reason, the company was able to achieve significant progress on initiatives aimed at reducing emissions. They included the establishment of a supply chain academy to facilitate the core supply chain competencies, development of new generation of vessels that are friendly to the environment as well as the implementation of more metrics in the Supply Chain and Procurement Sustainability Initiative. In general, all these practices will lead to high-energy savings, technological innovations, improved efficiency of resources and cost savings.

SABIC conducted a critical review of its environment, health, safety as well security organizations. This changed it to the global structure with regional support from a locally

based structure. Notably, the company achieved an EHSS incident rate of 0.62, which was 29% lower than that of the previous year. Though there was an increase in the overall severity, the company was able to reduce the total number of both the minor and major incidents that influenced the EHSS incidents rate by 13%. In addition, it reduced the release of less hazardous chemical substances by about 21%.

SABIC has managed to score 97 out of 100 in environmental reporting to CDP (Carbon Disclosure Project). This translates to 37 percent of the average score in a global program which has its main objectives is to achieve a sustainable supply chain management and the same time reduce the effects of climatic change. CDP is a global organization with its primary purpose is to transform how the world conducts business to prevent climate change as well as protect natural resources.

#### **4.12 Chapter Summary**

SABIC managers believe that the company has made a lot of efforts towards reduction of fuel consumption in their vehicles. Implementation of the drivers training program, as well as the calculation of carbon emissions, are some of the ways the company has used to help this. Emissions per unit of energy refer to the amount of CO<sub>2</sub> together with other gases that are emitted for every unit of energy consumed. SABIC has performed well in environmental reporting to CDP (Carbon Disclosure Project), scoring 97 out of a 100. The company's drivers have to make sure they have the correct amount of packages before they begin their trip. Besides, SABIC uses payload optimization so as to make sure the trucks are used well and they do not track half-empty. However, this is in effect of the two key vehicle optimization parameters. Namely, the average payload on trips Laden and the average percent empty running. When it comes to optimization of routes, SABIC drivers ensure that they strictly follow the route sequences provided in their delivery cycle. These practices, on the other hand, helps to minimize the distance covered hence low transportation cost but increased efficiency and hence reducing the number of carbons emitted. However, it is important to note that, through optimizing their routes, SABIC has been able to successfully take trucks off the road, minimize the transport costs as well as the amount of carbon emitted.

As a matter of fact, practices such as optimization of routes and fuel efficiency can help save costs. Reduced amount of diesel consumption resulting from load or package optimization and route optimization will, in turn, reduce costs. Also, the respondents in the study suggested that the company will have to incur huge costs to conduct the original

investment though it will later help in saving costs. Innovations in Logistics, which in most cases are based on the recent green technologies, are specifically associated with the development of significant sustainable and environmentally friendly approach to Supply Chain Management. This is enhanced by the reduced ecological effects from the main activities, energy efficiency, cost saving, quality performance, and reliability.

Supply chain management entails providing the right products and services, in the right amount, at the right place and at the right time, regardless of any problems that may arise along the way. There has been increased pressure on manufacturers to make products that are safe and of high quality. This, in turn, has posed a challenge in the supply chain management. However, the findings reveal that it is entirely necessary to carry out regular assessments as well as redesigns on supply to ensure efficiency and effectiveness and eventually increased profits. Also, the results suggest that the success in the supply chain involves three essential elements; the process, people, and technology. The three elements define the purpose of the company and work together to provide coordinated and unified efforts essential in promoting customer satisfaction and competitiveness of the enterprise.

The key point emphasized in the study findings is cost saving which in turn leads to competitive advantage through sustainability. Business sustainability has a purpose of ensuring a long-term shareholder value in the organization. To achieve this, it attempts to take the opportunities and manage any risks emerging from the social, economic, and environmental responsibilities of the organization. Secondary sources have indicated that one of the most significant progress that SABIC has continued to make is reducing the emission of greenhouse gases, energy, as well as water intensities by about 25% which in turn makes it a sustainable and a very profitable move. Finally, it can be concluded that the company can now be able to make notable progress on initiatives that are intended to improve its logistics practices. Examples of these advances include the development of a new generation of vessels that are environmentally friendly, the establishment of a supply chain academy to enhance the critical supply chain competencies and implementation of more metrics in the Procurement Sustainability and Supply Chain Initiatives among others.

## **CHAPTER 5**

### **5.1 DISCUSSION**

#### **5.2 Green Logistics**

Reddy, (2011) asserts that companies will get involved in green logistics for three reasons: to gain the associated profits, as an obligation and to meet the social requirement as a corporate body. Fleischmann and Dekker (2002) also highlight three driving forces namely: Indirect and direct Economics, Legislation and corporate citizenship. The forces are aligned to the objective of sustainability of the companies. However, reverse logistics are not without delimits. (Olariu, 2013) Points out that the two guidelines driving reverse logistics (profit and legal regulation) bring about difficulties in management, control, and processing as opposed to the conventional forwarding system. This can be attributed to the associated complexities.

#### **5.21 Green Logistics Activities**

##### 5.211 Reverse logistics

SABIC is undertaking the following logistic activities as illustrated in the results summary table: fuel efficiency, route optimization and measuring of carbon emissions. However, the reverse Logistic strategy was the least mentioned activity. This is because reverse logistics is not sufficient by itself (Hoek, 1999). Also, it could be due to the limitation of the method to dealing with production-oriented activities such as remanufacturing, refurbishing, disposal and recycling to utilize resources, whereas SABIC deals with Chemicals production. By definition, reverse logistics deals with ordering or shipping of parts by manufacturers for consumption, recycling, remanufacturing or disposal. The method has become more applicable to the transportation industry as new customer policies in this field have led to rising in product yields (Rogers and Tibben-Lembke, 2001).

Reddy (2011) articulates various reasons as to why customers return purchased goods. Such instances are such as; when a customer's expectation is not met, when the client opts for another product which suits their needs better, when the product may be faulty, or the customer simply decides to return it for no good reason thereby infringing the terms and conditions governing return of the product. While there are many reasons as to why a customer can return a product, those above are the main associated with most customers

As observed by (Saroja (2014: Sbihi & Eglese , 2007) the concept of reverse logistic has received an immeasurable recognition in both academic application and practice. However,

its literature coverage has a deficit in the theoretical aspect. This may have limited the participants while discussing SABIC's reverse logistics in the sense that the limited research on reverse logistics goes beyond a specific direction, e.g. considering a particular product or an industry in a study. To understand reverse logistic, De Brito and Dekker (2002) proposes a framework which explains the design process. The framework defines the typological nature of issues being addressed, and the decisions made while taking into consideration the relationship between them. This way, the framework helps understand the concept of reverse logistics as a whole.

#### 5.212 Package optimization

Besides the activities, packaging optimization is also very standard to minimize adverse impacts of the supply chain logistics. This was in agreement with Gustafsson & Göransson's (2014) argument that lessening solid wastes in production materials, packaging, scrap metal, and organic materials was imperative for organizations undertaking environmental programs. An element of packaging, Eco-packaging which involves recycle and re-use in the transportation sectors is emphasized by Srisorn (2013). The technique optimizes packaging by optimal selection of the packaging machines. Packaging is a critical phase in the supply chain of consumer goods for all the parties involved. According to (Mastromatteo, Lucera, Esposito, Conte, Faccia, Zambrini & Del Nobile, 2015), optimum packaging allows for better communication to consumers, reduces wastes and helps preserve product quality while also protecting them from theft. The packaging also makes products more shelf-ready and keeping logistics more efficient.

It is, however, a challenge to meet these goals if the packaging is considered in isolation. This is because the packaging is a part of an overall product life and is affected by the other processes. To account for this variation, retailers and producers have focused solutions that will optimize packaging by reducing adverse environmental impact and reduce operational costs with fewer transportation expenses. Where food is involved, innovative studies have been made to eradicate contamination. This way, (Mastromatteo et al., 2015) argues that it will also give the firm a competitive advantage over other companies while benefiting the consumers. As such, optimized packaging helps the company regarding operating costs and results. The economic benefits associated with the optimized packaging have been discussed by (Costa, Lucera, Lacivita, Saccotelli, Conte & Del Nobile, 2016). Some of the direct economic advantages include reduced costs in waste processing and purchasing of materials, reduction in transport and storage losses from deterioration or damage. Indirectly, it can

economically lower the safety risks while simplifying the manufacturing or product production process.

#### 5.213 Route Optimization

Also, Wu and Dunn (1995) recommend proper maintenance of vehicles by the logistics companies as a green activity. This not only saves costs but also lessens the pollution by vehicles. Moreover, Wu and Dunn argued that this has the effect of reducing the accident rate and improve a vehicle's lifespan and efficiency regarding fuel consumption. This is in accordance to Gustafsson & Göransson (2014) who articulates the effectiveness of fuel efficiency in fleet management and its positive environmental outcomes.

With this understanding, the author calls attention to route optimization techniques used by SABIC in the form of a tracking system. This coupled with the control dispatch system helps monitor vehicles for reckless driving, unnecessary usage, speeding and other fleet discrepancies (Janota et. al 2010). This information will help in route optimization process while at the same time meeting the requirements of the triple bottom line factors. From the research findings, the route optimization had the effect of reducing the amount of fuel used, distance traveled and led time as observed by the participants. By the bottom line factors, it lowered carbon emissions and facilitated information relay concerning reckless driving, reduced accident rates, and vehicle/road regarding social impact. It also has changed on the economic factor regarding reduced fuel usage. With this approach, SABIC has saved on expenses optimizing on profits.

Route optimization involves control of various components. These include; the vehicles, the working staff, and the goods under transit. In the supply chain management, it is very crucial that the distribution of consumer goods be carried out efficiently and in a cost-effective manner. To optimize on this, the manager selects the best vehicle for the task and the most economical route for the same. To achieve an efficient distribution network, (Vivekanandhan, Anand & Paramasivam, 2013) emphasizes the use of Computer-based simulation software as an optimization technique. An example is Evolutionary Algorithm (EA) technique. The author argues that to ensure that the least number of vehicles is used while using the shortest distance is covered, the route of the vehicles should be arranged conveniently to provide that; (1) The total demand for any vehicle route must not exceed the capacity of the vehicle. (2) Any given customer is served by one, and only one vehicle. (3) Customer delivery should be done efficiently and economically. Depending on the demand and capacity of a vehicle and by using permutations and computations, a vehicle is assigned

a set of stations from the possible routes computed. Route optimization requires minimal change in vehicle positioning and personnel posting. This is achieved by basing the route combinations on the shortest distances available. This is not without challenges as noted by (Addis, Belabed, Bouet & Secci, 2015) that developing routes that cover all deliveries and pickups to from several customers can bring complexities and pose challenges in optimizing for efficiency.

#### 5.214 Measuring carbon emissions

According to Hart & Ahuja (1996), the importance of measuring carbon emissions cannot be understated. They point out that by regulating carbon emissions, a company is in a position to become more efficient by reducing costs and undesirable environmental impact. The author found out that SABIC measure values for carbon emissions as reported by the interviewed participant. Based on the empirical findings of the previous chapter, the members agreed this was a company responsibility towards sustainability. Furthermore, the participants observed SABIC exercised packaging optimization by practicing the load optimization model whereby the packages were organized in an optimal pattern during loading in trucks for transportation. Piecyk and McKinnon (2010) approve this activity and claim it has an impact on green logistics. They assert that the design of packaging affected load optimization hence fuel usage and subsequently the environment.

According to (Scott, Smith, Rehmatulla & Milligan, 2017), when businesses identify their level of emissions they can then quickly come up with ways to curb it while also optimizing on finances. This assertion applies to both small and big businesses. Helping these businesses understand how they generate emissions can a huge step in minimizing pollution. To measure carbon emissions a carbon footprint is used. A carbon footprint is the total greenhouse gas (GHG) emissions caused directly and indirectly by an individual, organization, event or product, and is expressed as a carbon dioxide equivalent (CO<sub>2</sub>e) (Smit, Reimer, Oldenburg & Bourg, 2014).

On the basis that 'what gets measured gets managed,' the carbon footprint should be measured first. Carbon footprint accounts for all six Kyoto GHG emissions: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF<sub>6</sub>) (Smit et al., 2014). To compare the different greenhouses gases a coefficient known as Carbon dioxide equivalent (CO<sub>2</sub>e) is used. The ratio is based on one unit of CO<sub>2</sub> whereby its calculated by multiplying the emissions of each of the six greenhouse gases by its 100-year global warming potential. By comparing and

quantifying the emissions, the managers can then understand the impact their organizations are having on climate change. This knowledge facilitates prioritization on emission reduction strategies resulting in costing savings. When the businesses reduce their emissions, they are also benefiting from the higher and more volatile energy costs, sharing the information or findings on emissions is also a notable trend. According to (Röös, 2013; Singh, Mishra, Ali, Shukla & Shankar, 2015), Companies can share their calculated carbon footprint with fellow corporations or the public for reasons such as (1) To meet the necessary requirements as per legislation regarding reporting, (2), to meet the social obligation of a corporate social entity ad (3), as a response to requests from businesses , investors etc. The companies can also participate in data collection and research and release their reports through initiatives such as Carbon Disclosure Project.

#### 5.214 Fuel efficiency

Energy in transport usually involves the consumption of fuel. According to (Poultney, Chopra & Cun, 2007). Fuel consumption constitutes the highest cost of energy in both the logistics sector and in supply chain though it also a part of the general costs which may add up to about a half in some fleet operators. In other words, energy efficiency is mostly concerned with the reduction of costs so as to improve business. There are some factors to consider when determining the energy used by a truck when transporting freight. However, two factors are most significant to the others; the truck type and the duty cycle upon which the vehicle is used (Halldórsson & Kovács, 2010). The vehicle type helps in determining the size and power of its engine, the overall weight, physical size, the capacity of the payload as well as the kind of loads it is likely to carry. All these factors will determine the total energy needed to move the truck at the proper speed. The duty cycle on the other is used to refer to the description on the usage of a vehicle. Some of the descriptors used include the load, terrain, speed, and the frequency of braking or making stops. These factors hence have a large impact on the energy consumption. For example, Driving a vehicle at high speed produces aerodynamic drag, long durations spent idling means more time of non-productive running, and frequent stops require subsequent accelerations.

From a fleet management point of view, some strategies can be implemented to enhance fuel efficiency (Halldórsson & Kovács, 2010). Some of these strategies include; (1) improving the equipment specifications, (2) operating existing equipment with more efficiency, (3) replacing the existing trucks with new ones. However, many small to medium businesses are often unable to buy new vehicles due to the high up-front costs. Upgrading the existing old

trucks with near-new second-hand vehicles can, however, bring some benefits at low costs (Poultney et al., 2007). Combining various vehicle configurations with appropriate duty cycles means that what works to improve fuel efficiency in one truck may fail to produce similar results on another truck. As a matter of fact, there are only a few generic opportunities that can apply to all vehicles. Thus, it is necessary to group together but consider different vehicles with similar features when analyzing the fleet for opportunities.

### **5.3 Impacts of green logistics; profitability**

It's evident from the participant's response that green logistics have been beneficial to companies. They termed the move as a cost saver as well as an advocacy of efficiency in the business. They based these arguments on the positive impact observed from the techniques such as route optimization and cost reduction. They also pointed that green logistics could come in handy in the event of fuel price rise. In such a situation, companies would apply optimization to reduce fuel usage. Also, SABIC has exhibited progress in various aspects of environmental sustainability. For instance, for there has been an 8.3 percent reduction in greenhouse emissions, energy intensity has dropped by 6 percent, water usage intensity went down by 10.4 percent and real loss intensity by 41 percent since 2010, as established by secondary findings.

Another valuable aspect of the green activities was the impact it had on the image of the firm. The respondents argued that these events acted as incentives attracting both inside and outside-the-company acknowledgment. On the inside, the internal projects operated to strengthen the bond between the employees and management while on the outside it served to draw potential staff and customers who would want to be associated with such a company. Bansal and Hunter (2003, p. 293) describe this effect in that besides boosting its authenticity, a supply chain can benefit a company by refining its image and its reputation as a socially responsible organization. By being an environment-friendly, such companies stand better chances in the market segment as consumers would prefer them to their counterparts. This gives them leverage against their competitors. (Bansal & Hunter, 2003). Moreover, the author accentuates the attribute of being a sustainable company to be a massive marketing tool.

### **5.4 Supply chain**

Due to the emphasis placed on the green supply chain and its impacts, companies are making changes in their supply chains to make them more environmentally-friendly. To achieve this, education courses on supply chain have been introduced in businesses and

institutions. The trained supply chain personnel then work to meet the company's mission, goals, and targets. Also, green supply courses help prepare students in related institutions to prepare for their future roles in such enterprises. For instance, by learning about a company's sustainability strategies, corporate social responsibilities, and green procurement measures, they can help cultivate more efficient logistics. However, an economical compromise may arise between the triple bottom lines and the green movement option when evaluated on a short-term basis (Markley & Davis, 2007).

By incorporating green logistics in their operations, companies are bound to benefit. The author points out that there exists a relationship between corporate responsibility and the economic benefits associated with it. To meet the expectations of participants who are concerned more with the triple bottom line factors than financial or social factors, companies responsibly use resources to achieve sustainability. As they reduce carbon emissions, they employ optimization methods such as lowering fuel consumption thus saving on both costs and environmental pollution. From this perspective, the author interprets efficiency to contributing immensely to greener operations.

The importance of green logistics is to ensure sustainability and usage of resources responsibly. However, the participant's views are stimulated more from the environmental factor of the triple bottom line than either the economic or social. The participants also believe that it is a company's corporate responsibility to reduce the carbon emissions. The author of this paper also interprets that the enterprise is responsible for optimizing their operations to lower their fuel consumption and their carbon emissions. The author perceives this as an economic driver in conjunction with an environmental one. Thus, efficiency is a driving factor that leads to greener activities due to optimization.

### **5.5 Sustainability; Triple bottom lines**

For companies to achieve sustainability, there are key considerations to make. From the research findings, companies should major on the triple bottom lines namely: economic, social and environmental aspects. Among the three, the environmental impact of a company has been a great concern to managers. The three bottom lines play a role in the logistics of supply in their direct relation to the theory of green logistics (Bloemhof, 2005). All the correspondents concurred that the transport department in companies should make an effort to reduce carbon emissions to the environment as a corporate social responsibility, a

response in agreement with empirical findings. However, while carrying out such measures, managers should ensure increased efficiency by taking into consideration the operation costs.

To avoid problems, triple bottom lines should deliberate on all the three aspects to ensure a balance in its social, economic and environmental activities. De Giovanni, (2012) points out the need for a sustainability approach that incorporates social, ecological and economic aspects for a company to be efficient. However, the economic dimension of the triple bottom line is critical in operating a financially stable business. As such, while facilitating a combination of social and environmental is the ideal situation, SABIC undergoes costs and financial expenses which should be factored into the sustainability equation. Besides, findings from the respondents show consumer's unwillingness to cover up for the additional expenses incurred in green logistics. Hence it lies on the company to finance these activities. From this economic outlook, SABIC has a significant role to play while undertaking the responsibility of going green.

### **5.6 Participants advice**

The member's response indicated an understanding of the roles played by the employees in the activities aimed to a sustainable company. It's on this ground that they recommended improved awareness among employees and advanced education as one of the strategies to achieve this. They also emphasized the role of management in carrying out green logistics alongside optimization. On this note, the author identified categories that can be implemented in the education of managers. These included: Education, Planning, and Holistic. Wu and Dunn (1995) acknowledged that logistic managers need these categories as they face challenges in carrying out green logistics. As they optimize on operations with environmental impact under consideration, the categories will ease the implementation process.

### **5.7 Chapter summary**

There are three reasons behind most companies involvement in green logistics; to meet the social requirements as a corporate body, as an obligation and to benefit on the profits associated with green logistics. By itself, reverse logistics has been found not fully sufficient. Besides, it could be because of the limitations of the method when conducting various production activities like refurbishing, remanufacturing, disposal as well as recycling so as to utilize the available resources. There are several reasons as to why customers may consider returning goods they have already purchased. Some of them include when they opt for

another product which will suit their needs better when they realize the product is faulty or even when their expectations are not met. Some customers may decide to return some products for no valid reason hence infringing the terms and conditions guiding the return of products.

Packaging optimization is another significant aspect towards minimizing the supply chain logistics negative impacts. Reducing the amount of solid wastes from the production materials, scrap metal, packaging and organic materials was indeed very important for organizations involved in environmental programs. In fact, optimum packaging reduces waste, allows for better communication to consumers and helps preserve the quality of the product and at the same time protecting them from theft. Again, it helps in keeping logistics more efficient and makes the products be more shelf ready. Route optimization on the other hand entails the control of various components. Such components include; the goods under transit, the working staff, and the vehicles. In the supply chain management, it is important to ensure that consumer products are distributed in a cost effective and efficient way possible. To ensure an efficient network of distribution, companies are advised to use a computer based simulation software as their primary optimization technique. Measuring the level of carbon emissions is very crucial as it helps assess if the company is a position to achieve more efficiency by reducing the costs as well as the undesirable impacts to the environment. Identifying the level of emissions can help a business develop ways of curbing it while at the same time optimizing on finances.

A lot of emphases have been put on the green supply chain alongside its associated impacts. Due to this fact, many companies are modifying their supply chains so as to make them be more environmentally friendly. In order to accomplish this, companies and institutions have introduced educational courses on supply chains. It is quite clear that green logistics has brought many benefits to companies. Findings from the study together with the reviewed literature agree that the move has brought efficiency in companies and helped cut costs. Again, the green activities acts as an incentive to attract both the acknowledgment of the company both from the inside and outside hence building on its image. The supply chain can be used by a company to refine its image as well as build on its reputation as an organization that is socially responsible.

In order for companies to achieve sustainability, they need to first make a number of key considerations. From the study results, it has been revealed that companies should focus on the triple bottom lines, that is, the social, economic and environmental aspects. The three bottom lines are very crucial in the logistics of supply especially through their direct relation

to the green logistics theory. However, the triple bottom line economic aspect plays an important role in running financially stable business whilst facilitating a combination of both social and environmental aspects to achieve an ideal situation.

## CHAPTER 6

### 6.1 CONCLUSION

#### 6.2 Summary

This study tried to answer the research questions: How has chemical producing incorporated green practices into supply chain operations to remain profitable ( a case study of SABIC)?, How do logistic managers recognize green logistics in their operations and to what level do chemical industries apply green logistics? Answering these questions explains the entire purpose of the study ” to explore SABIC logistics system and profitability. This study was a case study a thesis with a focus on SABIC. The findings of this paper aim at extending theoretical knowledge about green logistics. Indeed these results offer important suggestions based on the recommendations from the supply chain managers, and hence these suggestions could be applicable across a wide range of industries. There was a higher degree of consensus among the interviewed managers view of green logistics.

This study offers a complex relationship scheme between green logistics activities and their related effects on the environment as well as costs. Companies through their focus on the optimization of the logistical activity can significantly minimize their impacts on the environment, reduce costs and at the same time make savings. All these can be achieved through implementing a green supply chain management. Indeed, green supply chain management influences the role of the environment towards supply chain valued addition. It is important to note that GSCM programs help increase the stakeholder's value, ensures employee satisfaction, customer satisfaction, environmental sustainability and improves the quality of life in the community. Also, it also leads to better utilization of assets, optimization of resources, raising the reputation of the firm, ensuring continuity and maintaining long-term strategic alliances, creating and improving a sustainable technology among others. Green Supply Chain Management is based on the following key concepts; reverse logistics, Green supply chain education, the use of recycled packages, new green industries, waste reduction as well as promoting green practices among others. Essentially, these methods should be implemented in 4 steps which include; (1) determining the environmental costs within the facility or process, (2) identifying the opportunities which would substantially save costs and minimize environmental impacts. (3) evaluate the benefits linked to the proposed alternatives, (4) Decide, implement and monitor the solutions provided for improvement.

Also, it was found that it has become a trend for many companies in the world like SABIC to use logistics management in promoting their green credentials. However, according to the author's point of view, it is challenging to determine the extent this reflects a genuine desire towards helping the environment and the society at large as opposed to strengthening and improving public relations. Besides, large organizations can afford to make those considerable investments that are environmentally conscious so as to achieve on a long-term operational and efficiency of capital. All the same, the fundamentals of the economy comprise the small and medium enterprise sector. Thus, the question whether they will also be able to follow the trend remains.

This research further indicated that green innovation practices influence not only the performance of the environment but also the performance of the firm. Green innovation should, therefore, be considered as both a reactive fulfillment of requests by the government and as a proactive practice to improve the performance of the business as well as achieve a competitive advantage. This empirical evidence reveals that companies can improve both their financial and non-financial performances if only they emphasize on the green practices. Top managers in the business can play a fundamental role towards conveying the importance associated with green innovation to all stakeholders.

Companies are continuously being put more pressure to develop operations that are more environmentally responsible and friendly. However, commitment to the natural environment is an important factor of consideration in competitive scenarios. Organizations usually face their internal or external green logistics factors at a corporate level. The literature review indicates several interesting facts. One is that managers should understand that incorporating environmental issues into corporate strategies will highly depend on some factors which usually change with time. Factors which determine the adoption of environmental logistics practices differ from one company to another. Indeed, these factors will mostly depend on the geographical location, the activity sector, and the level of environmental requirements from the customers. The study findings also give an interesting fact that the green logistics influence does not vary about the pressure put by customers on the environmental behavior of the company. However, it may be associated with the different companies positions standing in the supply chain. Despite the fact that organizational factors are the key elements in most industries, technological factors should also be considered important by the green logistics managers in the future. A firm's environmental behavior cannot only be fostered through pressuring the legislations but also through other factors like increasing the

environmental awareness to both the managers and the employees. However, this may not provide a long-term objective at a corporate level.

Indeed, the results of this paper are in greater agreement with the reviewed literature because, for instance, the literature states that green logistics if applied effectively cut on cost such as fuel expenses. Regarding the first questions, How do logistic managers recognize green logistics in SABIC and to what level do SABIC apply green logistics?, the study found out that SABIC uses most of the green logistics practices, but fuel efficiency was most emphasized as it leads to cost saving on fuel and thus less carbon emission. However, reverse logistics was not very common regarding application directly because literature states that it is not enough when applied alone. Managers view are almost similar meaning that they are well aware of the SABIC moves to going green.

Regarding questions "How has chemical industries incorporated green practices into supply chain operations to remain profitable?" the SABIC managers stated that it saves on cost and thus contributing to profitability. Again, they indicated that green logistics is one kind of a marketing tool as consumers would like to be associated with a company that takes care of the environment. Hence green logistics helps create a better image of a company which in theory is seen a marketing tool. Thus, it would be correct to conclude that green logistics at SABIC have a connection with the profitability.

The author finds that the economic aspect of green logistics is considered first and then environmental and social consideration second when implementing green logistics activities. Hence SABIC principal object when implementing green logistics was to cut on cost which would later contribute to carbon emission.

As a practical recommendation, the managers suggested that education would work better in creating awareness among the workers about green logistics and its importance. However, the author of this paper thinks that enhancing better internal communication together with education would be paramount in ensuring that all workers understand what and why SABIC implements green logistics.

This study focused on SABIC logistic system, and future studies should investigate green logistics in another industry such as freight industry or a food industry and focus on whether green logistics in this industries has a connection to profitability. It could also be more interesting to carry out a comparison of the two different industries regarding the implementation of green logistics activities. It could also be interesting to conduct a quantitative research of this same topic covered in this paper.

A procurement strategy that is environmentally oriented does not only reduce the impacts of the products from the local firm on the environment but can also be used to identify and exploit green competencies that are available in the supply chain. Thus there is a need for the company to adopt more green practices as green supplier development and green procurement is predicted to result in significant supplier performance as well as increased competitiveness.

About the managerial practices, two interesting conclusions can be made from this study and can be of direct interest to practitioners working in the chemical industry. One of the findings is that sustainability is increasingly valued during recession periods. In chemical industries, green practices through Green capability, have a direct impact on the performance of the firm and can result in efficiency as well as competitive improvements upon which companies can use to survive economic downturns and achieve better market positioning. Second, practitioners should take into account that green practices are a way of increasing competitiveness. Internally, the top management needs to understand that adoption of certain green practices will help in improving the performances of employees and at the same time reduce the consumption cost. Therefore, both the application and the communication of these policies increase the worker's motivation as they feel like part of the environmentally sustainable project. Customers ultimately start receiving services of a higher quality which in the long run may positively influence the profit and loss statements. Externally, senior managers should understand that green practices can be used to build and reinforce the brand. As a matter of fact, being a green chemical industry will help build customer loyalty to the brand and at the same time generate new customer interests to products in the restaurant. Therefore, attaching the brand to a “green-friendly concept” may play a significant role towards helping many practitioners satisfy their customer needs more efficiently.

## References

- Aguirregabiria, V. (2017). Empirical Models of Firms and Industries.
- Abubakar, T. (2014). *A Study of Sustainability in the Oil and Gas SupplyChain* (Doctoral dissertation, University of Central Lancashire).
- Angheluta, A., & Costea, C. (2011). Sustainable go-green logistics solutions for Istanbul metropolis. *Transport problems*, 6(2), 59-70
- Addis, B., Belabed, D., Bouet, M., & Secci, S. (2015, October). Virtual network functions placement and routing optimization. In *Cloud Networking (CloudNet), 2015 IEEE 4<sup>th</sup> International Conference on* (pp. 171-177). IEEE.
- Bakker, M., Creemers, H., Schipper, K., Beelen, A., Grupstra, H., Nollet, F., & Abma, T. (2015). Need and value of case management in multidisciplinary ALS care: A qualitative study on the perspectives of patients, spousal caregivers and professionals. *Amyotrophic Lateral Sclerosis and Frontotemporal Degeneration*, 16(3-4), 180-186.
- Banister, D. and Button, K. (eds) (1993) *Transport, the Environment, and Sustainable Development*. London: E & F N Spon.
- Bansal, P., & Hunter, T. (2003). Strategic explanations for the early adoption of ISO 14001. *Journal of Business Ethics*, Vol. 46,289-299.
- Blau, P. M. & Schoenherr, R. A. 1971. *The structure of organisations*, Basic Books New York.
- Bloemhof, J. (2005). Sustainable Supply Chains for the Future. *Medium Econometrische Toepassingen* , Vol. 13, No. 1, 12-15.
- Bozarth, C. C., Warsing, D. P., Flynn, B. B. & Flynn, E. J. 2009. The impact of supply chain complexity on manufacturing plant performance. *Journal of Operations Management*, 27, 78-93.
- Brădescu, G. (2014). Green logistics-a different and sustainable business growth model. *Studies in Business & Economics*, 9(1).
- Brădescu, G. (2014). Green logistics-a different and sustainable business growth model. *Studies in Business & Economics*, 9(1).
- Brinkmann, S. (2014). Interview. In *Encyclopedia of Critical Psychology* (pp. 1008-1010). Springer New York.
- Burja, C. (2011). Factors influencing the companies 'profitability. *Annales Universitatis Apulensis: Series Oeconomica*, 13(2), 215.

- Butner, K., Geuder, D., & Hittner, J. (2008). Mastering carbon management: Balancing trade-offs to optimize supply chain efficiencies. *IBM Institute for Business Value*.
- Benn, S., Dunphy, D., & Griffiths, A. (2014). Organizational change for corporate sustainability. Routledge
- Bosselmann, K. (2016). *The principle of sustainability: transforming law and governance*. Routledge.
- Brădescu, G. (2014). Green logistics-a different and sustainable business growth model. *Studies in Business & Economics*, 9(1).
- Calero, C., Bertoa, M. F., & Moraga, M. Á. (2013, July). Sustainability and Quality: Icing on the Cake. In RE4SuSy@ RE.
- Costa, C., Lucera, A., Lacivita, V., Saccotelli, M. A., Conte, A., & Del Nobile, M. A. (2016). Packaging optimisation for portioned Canestrato di Moliterno cheese. *International Journal of Dairy Technology*, 69(3), 401-409.
- Choi, K., Narasimhan, R. & Kim, S. W. 2012. Postponement strategy for international transfer of products in a global supply chain: A system dynamic examination. *Journal of Operations Management*, 30, 167-179.
- Chopra, S. & Sodhi, M. 2012. Managing risk to avoid supply-chain breakdown. MIT Sloan Management Review (Fall 2004).
- Cullinane, M. Browne & A. Whiteing (Eds.), Green logistics - Improving the Environmental sustainability of Logistics (pp. 3-30). London: United Kingdom: Kogan Page.
- Croxtan, K. L., Garcia-Dastugue, S. J., Lambert, D. M., & Rogers, D. S. (2001). The supply chain management processes. *The International Journal of Logistics Management*, 12(2), 13-36.
- De Brito, M., & Dekker, R. (2002). Reverse logistics-a framework (No. EI 2002-38).
- Dekker, R., Bloemhof, J., & Mallidis, I. (2012). Operations Research for green logistics An overview of aspects, issues, contributions and challenges. *European Journal of Operational Research*, 219(3), 671-679.
- Davis, G. F., & Adam Cobb, J. (2010). Chapter 2 Resource dependence theory: Past and future. In Stanford's organization theory renaissance, 1970–2000 (pp. 21-42). Emerald Publishing Limited.
- De Giovanni, P. (2012). Do External and Internal Environmental Management Contribute to the Triple Bottom Line? *International Journal of Operations & Production Management*, Vol. 32, No. 3, 265-29
- Dekker, R., Bloemhof, J., & Mallidis, I. (2012). Operations Research for green logistics

- An overview of aspects, issues, contributions and challenges. *European Journal of Operational Research*, 219(3), 671-679
- Doherty, S., & Hoyle, S. (2009). Supply Chain Decarbonization: The Role of Logistics and Transport in Reducing Supply Chain Carbon Emissions. In *World Economic Forum, Geneva*.
- Dowlatshahi S. 2000, Developing a theory of reverse logistics, *Interfaces* 30: 3 May-June 2000 p143-155
- Dekker, R., Bloemhof, J., & Mallidis, I. (2012). Operations Research for green logistics  
An overview of aspects, issues, contributions and challenges. *European Journal of Operational Research*, 219(3), 671-679.
- Dowlatshahi, S. (2010). The role of transportation in the design and implementation of reverse logistics systems, *International Journal of Production Research*, 48 (14), 4199-4215.
- Eccles, R. G., Perkins, K. M., & Serafeim, G. (2012). How to become a sustainable company. *MIT Sloan Management Review*, 53(4), 43.
- Elkington, J. (2004). Enter the triple bottom line. *The triple bottom line: Does it all add up*, 11(12), 1-16.
- Giunipero, L. C. & Eltantawy, R. 2004. Securing the upstream supply chain: a risk management approach. *International Journal of Physical Distribution & Logistics management*, 34, 698-713.
- Goldmann, K. (2017). Financial Liquidity and Profitability Management in Practice of Polish Business. In *Financial Environment and Business Development* (pp. 103-112). Springer International Publishing.
- Giuntini R. and Andel T.J. (1995) "Advance with reverse logistics". *Transportation and Distribution* Feb.73-6.
- Govindan, K., Khodaverdi, R., & Jafarian, A. (2013). A fuzzy multi criteria approach for measuring sustainability performance of a supplier based on triple bottom line approach. *Journal of Cleaner Production*, 47, 345-354.
- Group Flynn, B. B., Huo, B. & Zhao, X. 2010. The impact of supply chain integration on performance: a contingency and configuration approach. *Journal of operations management*, 28, 58-71.
- Hakami, A. Y. (2016). Analysing and managing upstream manufacturing supply complexity (Doctoral dissertation, RMIT University).
- Hakami, A., Zhang, L. & Kumar, A. 2014. Managing Upstream Supply Chain

- Complexity based on Purchasing Competencies - A Framework. The 2014 International Conference on Industrial Engineering and Operations Management. Bali, Indonesia.
- Halldórsson, Á., & Kovács, G. (2010). The sustainable agenda and energy efficiency: Logistics solutions and supply chains in times of climate change. *International Journal of Physical Distribution & Logistics Management*, 40(1/2), 5-13.
- Harris, I., Sanchez Rodriguez, V., Naim, M. & Mumford, C., (2010). Restructuring of logistics systems and supply chains.
- Hart, S.L., & Ahuja, G. (1996). Does it pay to be green? An empirical examination of the relationship between emission reduction and firm performance. *Business Strategy and the Environment*, Vol. 5,30-37
- Hawks K, 2006, What is reverse logistics, Reverse logistics magazine Sanchez-Rodrigues, V. (2006), Supply Chain Management, Transport and the Environment—A Review. *GreenLogistics White Consortium Working Paper*.
- Henriques, A., & Richardson, J. (Eds.). (2013). The triple bottom line: Does it all add up. Routledge.
- Hall, T. J. (2011). The triple bottom line: what is it and how does it work? *Indiana business review*, 86(1), 4.
- Hammer, J., & Pivo, G. (2017). The Triple Bottom Line and Sustainable Economic Development *Theory and Practice. Economic Development Quarterly*, 0891242416674808.
- Handfield, R. B., & Nichols, E. L. (1999). *Introduction to supply chain management (Vol. 183)*. Upper Saddle River, NJ: prentice Hall.
- Kumar, D., 2013, 'CSIR 2013 10th state of logistics survey', viewed 10 January 2015, from <http://www.csir.co.za/sol/>
- Jamali, D., Mezher, T., & Bitar, H. (2006). Corporate social responsibility and the challenge of triple bottom line integration: insights from the Lebanese context. *International journal of environment and sustainable development*, 5(4), 395-
- Janota, A., Dado, M., & Spalek, J. (2010). Greening Dimensions of Intelligent Transport. *Journal of Green Engineering*, 55-66
- Jensen, S., Mohlin, K., Pittel, K., & Sterner, T. (2015). An introduction to the Green Paradox: The unintended consequences of climate policies. *Review of Environmental Economics and Policy*, 9(2), 246-265.
- Klassen R and Johnson P. F. (2005), The Green Supply Chain in Understanding Supply

Chains.

- Krajnc, D. and Glavic, P. (2003) 'Indicators of Sustainable Production', *Clean Technology Environmental Policy*, VOL. 5 (2003): 279-288
- Kroon, L. and Vrijens, G. (1994). Returnable containers: an example of reverse logistics, *International Journal of Physical Distribution & Logistics Management*, 25 (2), 56-68.
- Kumar, V. N. S. A., Kumar, V., Brady, M., Garza-Reyes, J. A., & Simpson, M. (2016). Resolving Forward-Reverse Logistics Multi-Period Model: An Artificial Immune System Algorithm Based Approach. *International Journal of Production Economics*.
- Lesakova, L. (2007, June). Uses and limitations of profitability ratio analysis in managerial practice. In *International Conference on Management, Enterprise and Benchmarking* (pp.1-2).
- Lu, D. (2011). *Fundamentals of supply chain management*. Bookboon.
- Lajili, K., & Mahoney, J. T. (2006). Revisiting agency and transaction costs theory Predictions On vertical financial ownership and contracting: Electronic integration as an Organizational form choice. *Managerial and Decision Economics*, 27(7), 573-586.
- Laird, M. (2012). *Logistics Management: A Firm's Efficiency Performance Model* (Doctoral dissertation, Ohio University).
- Laosirihongthong, T., Adebajo, D., & Choon Tan, K. (2013). Green supply chain management practices and performance. *Industrial Management & Data Systems*, 113(8), 1088-1109.
- Lawson, B., & Petersen, K. J. (2012). Capturing the Economic Benefits of Green Logistics: The Roles of Visibility and Exploratory Links.
- Lekovic, S., & Milicevic, N. (2013). The importance and characteristics of logistics in electronicCommerce.
- Markley, M.J., & Davis, L, (2007). Exploring Future Competitive Advantage Through Sustainable Supply Chains. *International Journal of Physical Distribution & Logistics Management*, Vol. 37, No. 9,763-7745
- Mate, B. 2015. Supply Chain Management: Upstream Activities
- McKinnon, A. (2010). Green logistics: the carbon agenda. Heriot-Watt University, Edinburgh, United Kingdom. *Electronic Scientific Journal of Logistics ISSN*.
- McKinnon, A.C., (2010). Sustainability: A new priority for logistics managers.

- Murphy, P., Poist, R.F. and Braunschweig C.D. (1994) "Management of Environmental Issues in Logistics: current status and future potential". *Transportation Journal*, 48-5.
- McKinnon, S. Cullinane, M. Browne & A. Whiteing (Eds.), Green logistics – Improving the Environmental Sustainability of Logistics (pp. 101-120). London: United Kingdom: Kogan Page.
- Mele, C., Pels, J., & Polese, F. (2010). A brief review of systems theories and their managerial Applications. *Service Science*, 2(1-2), 126-135.
- Moon, K., & Blackman, D. (2014). A guide to Understanding social science research for Natural scientists. *Conservation Biologies*, 28(5), 1167-1177.
- Muller E.W. (1990) "The Greening of Logistics" Distribution, January, 27-34.
- Murphy, P. R., & Poist, R. F. (2000). Green logistics strategies: *An analysis of usage patterns*. *Transportation Journal*, 5-16.
- Mastromatteo, M., Lucera, A., Esposto, D., Conte, A., Faccia, M., Zambrini, A. V., & Del
- Nobile, M. A. (2015). Packaging optimisation to prolong the shelf life of fiordilatte cheese. *Journal of Dairy Research*, 82(02), 143-151.
- McKinnon, A., Browne, M., Whiteing, A., & Piecyk, M. (Eds.). (2015). *Green logistics: Improving the environmental sustainability of logistics*. Kogan Page Publishers.
- Mullins, R. R., Ahearne, M., Lam, S. K., Hall, Z. R., & Boichuk, J. P. (2014). Know your customer: How salesperson perceptions of customer relationship quality form and influence account profitability. *Journal of Marketing*, 78(6), 38-58.
- Murray M.(2012). Green Supply Chain Education, available at:  
[http://logistics.about.com/od/greensupplychain/a/Green\\_Education.htm](http://logistics.about.com/od/greensupplychain/a/Green_Education.htm)
- Narver, J. C., & Slater, S. F. (1990). The effect of a market orientation on business profitability. *The Journal of marketing*, 20-35.
- Niwa, K. (2014). Fujitsu group's green logistics activities. *Fujitsu Scientific & Technical Journal*, 50(4), 99-103.
- Nylund, S. (2012). Reverse Logistics and Green logistics: A comparison between Wärtsilä and IKEA.
- Narwal, K. P., & Jindal, S. (2015). The impact of corporate governance on the profitability: An empirical study of Indian textile industry. *International Journal of Research in Management, Science & Technology*, 3(2), 81-85.
- Norman, W., & MacDonald, C. (2004). Getting to the bottom of "triple bottom line".

- Business Ethics Quarterly*, 14(02), 243-262.
- Novy-Marx, R. (2013). The other side of value: The gross profitability premium. *Journal of Financial Economics*, 108(1), 1-28.
- Olariu, I. (2013). Conceptual issues regarding reverse logistics. *Studies and Scientific Researches. Economics Edition*, (18), 2344-1321.
- Peng, M., Li, Y., Zhao, Z., & Wang, C. (2015). System architecture and key technologies for 5G heterogeneous cloud radio access networks. *IEEE network*, 29(2), 6-14.
- Christopher, M. (2016). *Logistics & supply chain management*. Pearson UK.
- Porter, M.E. & van der Linde, C., 1999, 'Green and competitive: Ending the stalemate', *Journal of Business Administration* 1, 1–15.
- Ozanne, A., Graneheim, U. H., Ekstedt, G., & Malmgren, K. (2016). Patients' expectations and experiences of epilepsy surgery—A population-based long-term qualitative study. *Epilepsia*.
- Pagell, M., & Shevchenko, A. (2014). Why research in sustainable supply chain management should have no future. *Journal of supply chain management*, 50(1), 44-55.
- Piecyk, M., & McKinnon, A. (2010). Forecasting the carbon footprint of road freight transport in 2020. *International Journal of Production Economics*, 128, 31–42
- Poultney, C., Chopra, S., & Cun, Y. L. (2007). Efficient learning of sparse representations with an energy-based model. In *Advances in neural information processing systems* (pp.1137-1144).
- Raderbauer, Marita (2011). Strategic Sustainability-Strategic implementation of Sustainable Business practice in Viennese Accommodation, University of Exeter, United Kingdom
- Reddy, D. (2011). A study on reverse logistics.
- Röös, E. (2013). *Analysing the carbon footprint of food (Vol. 2013, No. 56)*.
- PRICE, A. 2011. Human resource management, Cengage Learning.
- Rao, P., & Holt, D. (2005). Do green supply chains lead to competitiveness and economic performance? *International Journal of Operations & Production Management*, 25(9), 898-916.
- Ritchie, J., Lewis, J., Nicholls, C. M., & Ormston, R. (Eds.). (2013). *Qualitative research practice: A guide for social science students and researchers*. Sage.
- Rodrigue, J. P., Slack, B., & Comtois, C. (2001, July). The paradoxes of green logistics. In *World Conference on Transport Research (WCTR)*. Seoul.

- Rodrigue, J. P., Slack, B., & Comtois, C. (2008). Green logistics. In *Handbook of Logistics and Supply-Chain Management* (pp. 339-350). Emerald Group Publishing Limited.
- Rodrigue, J. P., Slack, B., & Comtois, C. (2001, July). The paradoxes of green logistics. In *World Conference on Transport Research (WCTR)*. Seoul.
- Rogers, D. S. and Tibben-Lembke, R.S. (1999). *Going Backwards: Reverse Logistics Trends and Practices*, Pittsburgh, PA: Reverse Logistics Executive Council: USA
- Rogers, D.S., & Tibben-Lembke, R.S (2001). vol. 22, No. 2, 129-148
- Wu, H., & Dunn, S.C. (1995). Vol. 25 No. 2, 20-38.
- Sanchez-Rodrigues, V. (2006). Supply Chain Management, Transport and the Environment—A Review. *Green Logistics White Consortium Working Paper*
- Sandén Gustafsson, H., & Göransson, H. (2014). Green Logistics in South Africa: A study of the managerial perceptions in the road transportation industry in South Africa.
- Sari, K., & Yanginlar, G (2013). The impact of green logistics practices on firm performance: Evidence from Turkish healthcare industry.
- Sarooha, R. (2014). Green Logistics & its Significance in Modern Day Systems. *International Review of Applied Engineering Research*, 4(1), 89-92.
- Sibbel, A., (2009) 'Pathways towards Sustainability through Higher Education', *International Journal of Sustainability in Higher Education*, VOL. 10 (1): 68-82
- Simchi-Levi, D., Kaminsky, P and Simchi-Levi, E. (2008). *Designing and Managing the Supply Chain*. New York: McGraw-Hill/Irwin.
- Srisorn, W. (2013, August). The Benefit of Green Logistics to Organization. In *Proceedings of World Academy of Science, Engineering and Technology* (No. 80, p. 920). WorldAcademy of Science, Engineering and Technology (WASET).
- Stead, W. E., and Stead, J. G. (1995) 'An Empirical Investigation of Sustainability strategy Implementation in Industrial Organisations', *Research in Corporate Social performance and Policy*, Supplement 1 (1995): 43-66
- Sarooha, R. (2014). Green Logistics & its Significance in Modern Day Systems. *International Review of Applied Engineering Research*, 4(1), 89-92.
- Sbihi, A., & Eglese, R. W. (2007). Combinatorial optimization and green logistics. *4OR: A Quarterly Journal of Operations Research*, 5(2), 99-116.
- Scott, J., Smith, T., Rehmatulla, N., & Milligan, B. (2017). The Promise and Limits of Private Standards in Reducing Greenhouse Gas Emissions from Shipping. *Journal of Environmental Law*, eqw033.

- Singh, A., Mishra, N., Ali, S. I., Shukla, N., & Shankar, R. (2015). Cloud computing technology: Reducing carbon footprint in beef supply chain. *International Journal of Production Economics*, 164, 462-471.
- Smit, B., Reimer, J. A., Oldenburg, C. M., & Bourg, I. C. (2014). *Introduction to Carbon Capture and Sequestration (Vol. 1)*. World Scientific.
- Stevens, J., (1989), "Integrating the supply chain", *International Journal of Physical Distribution and Materials Management*, 19 (8), 3-8.
- Tulsian, M. (2014). Profitability Analysis (A comparative study of SAIL & TATA Steel). *IOSR Journal of Economics and Finance (IOSRJEF) e-ISSN*, 3(2), 19-22.
- Tamulis, V., Guzavičius, A., & Žalgirytė, L. (2012). Factors influencing the use of green logistics: theoretical implications. *Economics and Management*, 17(2), 706-711
- Trochim, W. M. K. (2002). "Structure of Research" *Research Methods Knowledge Base 2<sup>nd</sup> Edition*. Accessed 2/24/09.
- Tseng, Y. Y., Yue, W. L., & Taylor, M. A. (2005). The role of transportation in logistics chain. Eastern Asia Society for Transportation Studies.
- Ubeda, S., Arcelus, F. J., & Faulin, J. (2011). Green logistics at Eroski: A case study. *International Journal of Production Economics*, 131(1), 44-51.
- Van den Broek F., (2010), Green Supply Chain Management, Marketing Tool or Revolution? Ed. Breda- Zoetermeer, Holland.
- Van Duin, J. H. R. (2012). *Logistics concept development in multi-actor environments* (Doctoral dissertation, TU Delft, Delft University of Technology).
- Van Raaij, E. M., Vernooij, M. J., & van Triest, S. (2003). The implementation of customer Profitability analysis: A case study. *Industrial Marketing Management*, 32(7), 573-583.
- Vasiliauskas, A. V., Zinkevičiūtė, V., & Šimonytė, E. (2013). Implementation of the concept of Green logistics referring to it applications for road freight transport enterprises. *Business: Theory & Practice*, 14(1).
- Vivekanandhan, P., Anand, S., & Paramasivam, A. (2013). Routing Optimization of Third Party Logistics Operations Using Greedy Search Approach. *Journal of Logistics Management*, 2(1), 1.
- Wainaina, G. (2014). Reverse logistics practices and profitability of large scale manufacturing firms in Nairobi, Kenya (Doctoral dissertation, University of Nairobi).
- Woodburn, A. & Whiteing, A., (2010). Transferring freight to greener transport modes.

- In A.C. McKinnon, S. Cullinane, M. Browne & A. Whiteing (Eds.), *Green logistics - Improving the Environmental Sustainability of Logistics* (pp. 124-139). London: United Kingdom: Kogan Page.
- Wu, H., & Dunn, S.C. (1995). Environmentally responsible logistics systems. *International Journal of Physical Distribution & Logistics Management*, Vol. 25 No. 2, 20-38.
- Xia, Y., & Wang, B (2013). Green logistics in logistics industry in Finland: case: Inex Partners Oy and Suomen Kaukokiito Oy.
- Żak, A. (2015). Triple Bottom Line Concept in Theory and Practice. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, (387 Social Responsibility of Organizations Directions of Changes), 251-264.
- Zhang G., Zhao Z., (2012), *Green Packaging Management of Logistics Enterprises*, Ed. Elsevier, China.

## Appendixes

### Appendixes 1: interview answer 1

#### Interview questions

#### Company of interest: SABIC

1. **Topic being investigated:** To explore chemical industries green logistics practices and contribution to profitability with a particular case study of SABIC

a. **Background Information**

1. **Name (Optional)**

2. **What is your position?** First-level management (supply chain)

3. **What is your professional and educational background?** BBA – 7 years experience in logistics

4. **How long have you worked with SABIC?** 4 years

b. **Green Logistics Activities**

1. **Does SABIC apply Green Logistics? If yes, describe how and in what way.**

SABIC does apply green logistics. We are reducing greenhouse effects by using the last technology in sea shipping which is called LNG. Also, we make truck deliveries less frequently for a less pollution.

2. **In case SABIC does not apply one or more of the previous mentioned activities, explain why not?**

3. **Is SABIC planning on introducing any new green logistics activities in the near future? Describe**

So far, I am not aware of any new green activity in logistics.

**4. Out of the following green logistic activities, which one(s) does SABIC apply?**

**Describe**

- Fuel Efficiency
- Route Optimization
- Reverse Logistics
- Packaging Optimization
- Measuring Carbon Emissions

We highly apply fuel efficiency since most of our deliveries use fuel. Therefore we try our best to optimize our deliveries routes which reduces fuel consumption too. Finally I could also say that we measure carbon emissions for us to find ways in how to avoid high carbon measuring in the future.

**5. If you apply Reverse Logistics, is this a demand of your customer or do you actively apply it?**

I am not sure about this but I think it is a demand from the company itself.

**6. What problems do you face as a chemical producing company in terms of waste management?**

There are not many safe disposal areas for chemical wastes. In the past we used to throw the chemicals in the sea and that affected the environment.

**7. Are there supply chain problems when transporting chemicals?**

Safety is the biggest problem we face. Some of our materials are highly flammable and due to the hot weather in our country (Saudi Arabia) the danger is higher.

**c. Impacts of green logistics on SABIC**

**1. Do you consider green logistics important? Why? Why not?**

It is very important because it saves our ecological life.

**2. what do you consider as incentives for SABIC applying green logistics?**

A clean healthy environment and governmental incentives when a company applies green logistics.

**3. Do you consider Green Logistics to be a cost saver or an unnecessary expense?**

I believe it saves a lot of money in the long-run. For example in reverse logistics, we dissolve metal and re-manufacture it for other purposes.

**4. Do you think SABIC green logistics is associated with profits that the firms makes?**

Of course. It is part of the profit. Imagine by not applying green logistics how much waste of money we will incur.

**5. Is green logistics important from a client perspective in SABIC?**

Unfortunately, no. Because usually the clients just want their service or products to be delivered on-time so they can continue their business.

**6. What barriers do you consider exists for SABIC applying green logistics?**

The country's infrastructure is not yet built for a green environment. If we are green within our area, once we leave the company's zone, it becomes difficult to be green. For example, there are not enough train network within the country to reduce usage of trucks.

**D. Sustainability and environmental concern**

**1. What do you consider to be SABIC responsibility towards sustainability? If none, describe why.**

Since we are one of the biggest chemical companies, we feel like we have a big responsibility towards sustainability. It is like we are a model for other companies to follow. IF we don't apply green logistics, why the smaller companies would apply?

**2. What does SABIC do to be responsible regarding environmental issues?**

Educating their employees about the hazardous issues if it doesn't follow the green standards. Procuring or investing in environmentally-friendly cargo ships, hybrid vehicles and research on green human activity.

**3. Is SABIC certified with the ISO-standards? If yes, which one? If no, why?**

We are ISO-9001 certified and ISO-14001.

**e. Recommendations**

**1. If you were advising SABIC on green logistics, what are the main changes or improvements that you would recommend?**

I would recommend investing more on green environment education in the research center. Also get rid of the current fleet and replace them with hybrid trucks.

**2. From your experience in road transportation, what advice would you offer to other managers when implementing green logistics?**

Be strict with the time the fleet leaves to its destination. For example, there is less traffic after 11pm which is ideal for trucks to reach its destination as soon as possible with less fuel consumption

## Appendix 2: interview answer 2

### Interview questions

#### Company of interest: SABIC

1. **Topic being investigated:** To explore chemical industries green logistics practices and contribution to profitability with a particular case study of SABIC

#### a. Background Information

##### 1. Name (Optional)

2. **What is your position?** Middle-level management (supply chain)

3. **What is your professional and educational background?** BBA – 15 years experience in supply chain managerial positions

4. **How long have you worked with SABIC?** About 10 years

#### b. Green Logistics Activities

1. **Does SABIC apply Green Logistics? If yes, describe how and in what way.**

1. We do. We use varieties of green methods such as reverse logistics and measuring the effectiveness of our green activities.

2. **Is SABIC planning on introducing any new green logistics activities in the near future? Describe**

There are always on-going research on improving our green activities. But I cannot tell you more about this.

3. **Out of the following green logistic activities, which one(s) does SABIC apply? Describe**

- Fuel Efficiency
- Route Optimization
- Reverse Logistics
- Packaging Optimization
- Measuring Carbon Emissions

We use all the mentioned activities. Since fuel is number one usage in our activities, we pay a lot of attention on how to conservatively use it in the right time and for the

right place. The government also raised fuel prices and that caused additional expenses on us. And that also forces us to use the optimized route for our fleet. And as I mentioned before, regarding measuring green effectiveness, we measure carbon emissions and find reasons why the carbon emission is, for example, higher than the last six months measure.

**4. If you apply Reverse Logistics, is this a demand of your customer or do you actively apply it?**

Some customers demand reverse logistics so they can get rid of their products easily without worrying about its disposal.

**5. What problems do you face as a chemical producing company in terms of waste management?**

We need more areas for safe non-disposable materials

**6. Are there supply chain problems when transporting chemicals?**

Problems are everywhere, but when it comes to chemical transportation, I would say there is a problem with the type of fleet that carries the materials. For example, flammable substances need specific type of vehicles or vessels for safety carry.

**c. Impacts of green logistics on SABIC**

**1. Do you consider green logistics important? Why? Why not?**

It is important because mainly it saves the company lots of money and it is part of the company's profit or return in investment.

**2. what do you consider as incentives for SABIC applying green logistics?**

A cleaner environment. In our industrial city, a lot of residents complain that the pollution is high and they are worried about their health. Therefore SABIC is doing their best to reduce its pollution and apply green activities.

**3. Do you consider Green Logistics to be a cost saver or an unnecessary expense?**

It is a cost saver definitely.

**4. Do you think SABIC green logistics is associated with profits that the firms makes?**

As I mentioned before, yes it is associated with the profits. Because for example if required from our customers to return their used materials, we can either recycle or sell it to other parties. Also, using hybrid logistics saves a lot of fuel consumption.

**5. Is green logistics important from a client perspective in SABIC?**

We try to require our clients to be green when dealing with SABIC.

**6. What barriers do you consider exists for SABIC applying green logistics?**

There are not enough of green infrastructure or high standards in the country. One hand cannot clap.

**E. Sustainability and environmental concern**

**1. What do you consider to be SABIC responsibility towards sustainability? If none, describe why.**

Since we are a chemical company, responsibility is high. Chemicals are dangerous materials and we need to deal with them with most care from producing them to disposing them. We are located in an industrial city, and near residents. We have to make and follow strict rules.

**2. What does SABIC do to be responsible regarding environmental issues?**

Purchasing environmentally friendly vehicles or fleet. Applying green logistics and measuring our greenhouse effects.

**3. Is SABIC certified with the ISO-standards? If yes, which one? If no, why?**

ISO-9001 certified and ISO-14001 and Responsible Care.

**f. Recommendations**

**1. If you were advising SABIC on green logistics, what are the main changes or improvements that you would recommend?**

I would like to see a full hybrid vehicles replacements in the company as well as cooperation from our clients to be fully green when dealing with us.

**2. From your experience in road transportation, what advice would you offer to other managers when implementing green logistics?**

Always think about your surroundings. Do you want to live in a polluted area? We have to spread the idea that green activities are cost saving and better for a healthy environment.

## 2. Appendixes 3: interview answer 4

### Interview questions

#### Company of interest: SABIC

3. **Topic being investigated:** To explore chemical industries green logistics practices and contribution to profitability with a particular case study of SABIC

##### a. Background Information

###### 1. Name (Optional)

2. **What is your position?** Top management

3. **What is your professional and educational background?** Master of Science – extensive years in managerial positions

4. **How long have you worked with SABIC?** 25 years

##### b. Green Logistics Activities

1. **Does SABIC apply Green Logistics? If yes, describe how and in what way.**

Green logistics is an essential part in the company. Whether it is in logistics, supply chain or IT etc. . We try to eliminate paperwork in our company and make most of them in electronic version because as you know, we don't want to, first, waste spend money on papers and second, to save the environment. Also, we procured LNG (liquefied natural gas) vessels to transport our products or materials to our clients or other destinations in the most efficient way with least cost. Procuring of such fleet is very expensive about 100-200\$ million dollars, however, in the long-run we will profit from that.

2. **Is SABIC planning on introducing any new green logistics activities in the near future? Describe**

We are always working along with Jubail Royal Commission to innovate or develop or bring ideas to make the green greener. It is as I told you an essential part in our business.

**3. Out of the following green logistic activities, which one(s) does SABIC apply?**

**Describe**

- **Fuel Efficiency**
- **Route Optimization**
- **Reverse Logistics**
- **Packaging Optimization**
- **Measuring Carbon Emissions**

The Saudi government raised the price of oil, and raised taxes on big companies. This makes us try to find other ways to balance and save money. In your mentioned activities, we use most of them. Like fuel efficiency is a perfect use in our LNG fleet, and for some of our hybrid vehicles. We save lots of money from them in the long-run. Also with the route optimization. If fleet takes random routes to their destinations, then there will be waste in fuel, engine life, extra unnecessary pollution to the environment. We try to draw a map using many decent software like ArcGIS to figure out the ideal routes for our transportations. And measuring carbon emissions is the indication of how well we are doing in being green.

**4. If you apply Reverse Logistics, is this a demand of your customer or do you actively apply it?**

It is both. Some customers want to return their materials or products because they don't have the infrastructure to recycle or re-use them. They therefore send them back to us and we handle it. Also, we actively use it and encourage reverse logistics because it is profitable for the company. It is not necessarily a cash profit, but it indirectly saves us cost when we re-manufacture it for other purposes instead of producing a whole new set.

**5. What problems do you face as a chemical producing company in terms of waste management?**

The chemicals are generally dangerous. Either plastic or flammable substances. For plastic we cannot just leave them because they take ages to dispose. Also we cannot burn them because it produces harmful gas. And problems with the flammable materials we also have to handle them carefully especially in our hot country. Generally we need to handle each type of chemical substance differently to avoid hazards.

**6. Are there supply chain problems when transporting chemicals?**

As I just said, each type of chemical substance needs to be handled differently. Some of them cannot be transported in regular trucks due to its nature. Others need certain temperature storage to keep the substances safe and not go corrupted.

**c. Impacts of green logistics on SABIC**

**1. Do you consider green logistics important? Why? Why not?**

I consider it essential. Despite the regulations that we came up with Jubai Royal Commissions to follow high standards with being green, I see it an essential part for company's profit and health of its workforce.

**2. what do you consider as incentives for SABIC applying green logistics?**

Healthier workplace to reduce employees quitting their jobs because of unhealthy environment. And the more money we save from green logistics, the more money we make and the more bonus the employees will get.

**3. Do you consider Green Logistics to be a cost saver or an unnecessary expense?**

It saves cost.

**4. Do you think SABIC green logistics is associated with profits that the firms makes?**

It is part of the profit definitely.

**5. Is green logistics important from a client perspective in SABIC?**

Usually we don't see care worth mentioning from clients.

**6. What barriers do you consider exists for SABIC applying green logistics?**

The only thing I can say is I hope other companies and society applies green activity.

## **F. Sustainability and environmental concern**

- 1. What do you consider to be SABIC responsibility towards sustainability? If none, describe why.**

As a big company, we have the sense of responsibility towards society and environment.

- 2. What does SABIC do to be responsible regarding environmental issues?**

We see future in the next generations. Every then and a while we have an open day for youth to come through school trips and we introduce them to our company's activities and the environmental issues connected with it. Also raise awareness among youth to encourage them to use green products and how to safely dispose them.

- 3. Is SABIC certified with the ISO-standards? If yes, which one? If no, why?**

ISO-9001 certified and ISO-14001 and Responsible Care.

## **g. Recommendations**

- 1. If you were advising SABIC on green logistics, what are the main changes or improvements that you would recommend?**

I prefer not to answer.

- 2. From your experience in road transportation, what advice would you offer to other managers when implementing green logistics?**

Do some research on how to make your department green. It is not just because saving the environment, but also think about the small portions you will gain from your green activity in your department. You cannot leave free money on the table.

#### 4. Appendixes 4: interview answer 5

##### Interview questions

##### Company of interest: SABIC

**The topic being investigated:** To explore chemical industries green logistics practices and contribution to profitability with a particular case study of SABIC

##### a. Background Information

1. Name (optional):
2. **What is your position?** First-level management (supply chain)
3. **What is your profession and education background?** 6 years' experience in supply chain managerial positions; BBA
4. **How long have you worked with SABIC?** 12 years

##### b. Green Logistics Activities

##### 1. Does SABIC apply green logistics? If yes, describe how and in what way.

SABIC does use green logistics in that it tries to reduce the effect of the production system in the environment by ensuring proper packaging and proper waste disposal. This allows for less wastage of the materials being transported. In waste disposal, the process involves the sale of waste products. To the other companies that that make use of our waste products as their raw materials.

##### 2. In case SABIC does not apply one or more of the previously mentioned activities, explain why not?

Unless if there is an issue with the government policies or with the organizations making use of these wastes as their raw materials, then there might be no problem. But still, we always find an alternative way of ensuring that our ecology is healthy.

##### 3. Is SABIC planning on introducing any new green logistics activities shortly?

##### Describe:

Well, we have researchers and innovators in the field working on different best ways of applying Green Logistics in SABIC. But I might not be in a position to reveal what is cooking out there because we still don't have enough materials and information to support our innovations but when we do, we will be the first to let you know.

**4. Out of the following green logistic activities, which one(s) does SABIC apply?**

**Describe**

- Fuel Efficiency
- Route Optimization
- Reverse Logistics
- Packaging Optimization
- Measuring Carbon Emissions

We apply all of them in diverse degrees at every level

**5. If you apply Reverse logistics, is this a demand of your customer or do you actively apply it?**

As I had stated earlier, the company applies all of the methods of green logistics that you stated, so, it does not only depend on what the client wants but what the company's administration demands.

**6. What problems do you face as a chemical producing company regarding waste management?**

With the move to preserve the environment, many rules have been put in place when it comes to companies in this line of production. Therefore, disposing of the wastes is our primary challenge most of the times since we do not have many firms that make use of our waste products as their raw materials. We also have a problem with labor. The kind of human labor that is needed in such a company when it comes to dealing with the wastes we produce is costly to hire.

**7. Are there supply chain problems when transporting chemicals?**

Well at times we face the problem of inclement weather especially the high temperatures during the day in Saudi Arabia where our firm is located bearing in mind that most of the chemicals that we produce are extremely flammable. At other times we have problems with the terrorist who sometimes have their members working within our firm target the chemicals that are being transported for their gain.

**c. Impacts of green logistics on SABIC**

**1. Do you consider green logistics important? Why? Why not?**

It is important in that the health of our environment depends on it.

**2. What do you consider as incentives for SABIC applying green logistics?**

Well, the government is very pleased with the firms that use Green Logistics in their production thus at times we enjoy incentives from the government at various levels. We are also able to work in a clean and safe environment

**3. Do you consider green logistics as a cost saver or an unnecessary expense?**

I am very pleased with Green Logistics due to various reasons. For example, the company can benefit from the reverse logistics by making use of some of its wastes, and at the same time, we can sell most of those wastes to the other companies that take advantage of them as raw materials. To the company green logistics is a cost saver.

**4. Do you think SABIC Green logistics is associated with profit that the firm makes?**

Yes, we have made a lot of profit from reusing waste products that could have otherwise gone into waste and also selling the same wastes to the other companies in need of them. This also applies in the area of disposal where we are incurring almost zero cost when it comes to the disposal of the wastes

**5. Is green logistics important from a client perspective?**

The customers are not concerned with green logistics since all that they want is timely delivery of their products and the safety of these products too.

**6. What barriers do you consider exist for SABIC applying green logistics?**

Well, there is a problem with the infrastructure in the country and other modern means of transport that we can make use of in transportation of our products to the clients. This leaves us with no choice but to make use of the trucks.

**d. Sustainability and environmental concern**

**1. What do you consider to be SABIC responsibility towards sustainability? If none, describe why.**

The products that we deal with need us to be more sustainable; we have to act as role models for the other companies to ensure that the ecology becomes clean and healthy.

**2. What does SABIC do to be responsible regarding environmental issues?**

We have made it procedural for every employee in the company to be undergoing education about risky subjects. We are also investing heavily on carriers that are environmentally friendly.

**3. Is SABIC certified with the ISO- standards? If yes, which one? If no, why?**

SABIC has already acquired the ISO-9001 and ISO-14001 certification.

**e. Recommendations**

**1. If you were advising SABIC on green logistics, what are the main changes or improvements that you would recommend?**

My advice to SABIC is not to cease the investment on the modern carriers that are environmentally friendly and to continue educating as many people as they can on matters regarding green environment.

**2. From your experience in road transportation, what advice would you offer to other managers when implementing green logistics?**

I would advise them to release the trucks with some security personnel to ensure that the products get to their destination safely and also to research on the hours when there is less traffic. This ensures that these trucks spend less time on the roads which in return leads to less jam and low fuel consumption.