



## IMPACT OF SUSTAINABLE SUPPLY CHAIN MANAGEMENT PRACTICES ON EGYPTIAN SEAPORTS PERFORMANCE

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**Abstract:** The adoption of the Sustainable Supply Chain Management practices in seaports in Egypt aids to achieve its sustainable development strategy: Egypt Vision 2030, which aligns with the seventeen SDGs launched by the United Nations in 2015. There is a trade-off between sustainable development and economy. The trade-off lies between the benefits that result from adopting environmental, social or resilient practices by organisations, versus the costs incurred due to conducting these practices. The research problem is that sustainable practices are usually regarded as a burden to the profitability and continuity of the organisations. In addition to that, organisations do not link application of Sustainable Supply Chain Management (SSCM) practices with their performance. The hypothesis tests whether or not there is a significant impact for applying Sustainable Supply Chain Management (SSCM) practices on the seaports performance measures in Egypt. The research studies the impact of this application on the economic, environmental and operational performance of these seaports. A survey tool is designed to collect the data from managers and employees in the supply chain and operations functions of the Egyptian seaports in the Suez Canal zone.

### INTRODUCTION

Sustainability is currently a major concern on the international and local levels. It is a multi-discipline issue due to its broad nature and applicability across different specialisations. In this research, sustainability is examined from a business perspective related to the sustainability of the supply chain and its impact on seaports performance. Sustainable Supply Chain Management research is mainly derived from the link between the two main streams of research; supply chain management and sustainable development.

The supply chain concept has gradually developed from the original one, whose focus is on purchasing functions and inventory management, to a more comprehensive concept. Supply chain management is the control of the supply chain operations, resources, information and funds in order to maximise the supply chain profitability or surplus where supply chain surplus is the difference between the revenue generated from a customer's order and all the costs incurred by the supply chain while satisfying that customer's order (Chopra & Meindl, 2012).

On the other side, "sustainability is about ensuring that our choices and actions are not only economical but also environmentally and socially responsible. It is the development that meets the needs of the present without compromising the ability of future generations to meet their needs" (Brundtland Commission, 1987).



## MARITIME SUPPLY CHAIN

As for a maritime supply chain, it can be defined as the joined series of mutual activities to shipping operations as well as managing the flow of cargoes from the point of origin to the point of destination (Lam, 2011). Furthermore, Port sustainable development is the situation in which the port is able to meet its needs without endangering its own future (Lu, Shang & Lin, 2016). Thus, for ports, sustainability implies business strategies and activities that meet the current and future needs of the enterprise and its stakeholders, while protecting human and natural resources. This means ports must balance their roles as coastal stewards, facilitators of commerce and transportation, and members of their respective communities (Goulielmos, 2000).

The maritime supply chain has a special nature. Its structure can be categorised as follows (Lam, 2011):

1. Carriers including operators and shipping lines (international and domestic operations), road hauliers (conventional trucking, container truck transportation and bonded truck), railway and airlines carriers;
2. Terminal operators including maritime ports, inland port systems, freight terminals and inland container depots;
3. Carrier intermediaries including shipping agents, air cargo agents, off-dock depot operators, non-vessel operating common carriers, ship brokers and i-ports;
4. Cargo intermediaries including freight forwarders, customs agents, multimodal transport operators, warehouse operators (bonded and non-bonded), private warehouses (bonded and non-bonded), international procurement centres and regional distribution centres;
5. Inland water transport including barges, tugs and riverine vessels;
6. Ancillary services providers including cargo handlers or stevedoring companies, packaging service providers, cargo consolidators and equipment maintenance and material handling suppliers; and
7. Integrated logistic service providers including third party logistics providers (3 PLs) and lead logistic providers (LLPs) often called fourth-party logistic providers (4PLs).

### 1. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

The Sustainable Supply Chain Management has multiple definitions. A comprehensive literature review by Ahi and Searcy (2013) analysed definitions for Green and Sustainable Supply Chain Management. It clarified that Sustainable Supply Chain Management (SSCM) is an extension of Green Supply Chain Management (GSCM). That extension lies mainly in both the social and the resilient characteristics of business sustainability. In this paper, the researcher considered SSCM practices to comprise GSCM practices in addition to both the social and the resilient aspects of the supply chain (Ahi & Searcy, 2013). The following is an elaboration of these practices.



### 1.1 Green Supply Chain Management

Green Supply Chain Management has emerged as an important organisational philosophy to achieve corporate profit by reducing environmental risks while improving ecological efficiency of these organisations and their partners (Van Hoek, 1999). According to Zhu, Sarkis and Lai (2008) GSCM has emerged as an effective management tool and philosophy for proactive and leading manufacturing organisations. The scope of GSCM practices’ implementation ranges from green purchasing to integrated life cycle management that comprises supply chains flowing from supplier, through to manufacturer, customer, and closing the loop with reverse logistics. This paper considers the five practices that Zhu et al. (2008) utilised: internal environmental management, green purchasing, customer cooperation, eco-design and investment recovery.

### 1.2 Social and Resilient Supply Chain Practices

It is essential to recognise the social impacts across the supply chain stages for the organisations that are committed to sustainability. Social issues in the supply chain are defined as “product -or process- related aspects of operations that affect human safety, welfare and community development” (Klassen & Vereecke, 2012). The social supply chain practices that are tested in this paper are collected from previous literature and are categorised according to Klassen and Vereecke’s (2012) definition of social issues in the supply chain. This includes five characteristics: healthcare, child labour, philanthropy and workplace safety.

Ponomarov and Holcomb (2009) introduce supply chain resilience as “the adaptive capability of the supply chain to prepare for unexpected events, respond to disruptions, and recover from them by maintaining continuity of operations at the desired level of connectedness and control over structure and function.” Furthermore, Fiksel (2006) defined resilience in the business context as the capacity for complex industrial systems to survive, adapt, and grow in the face of turbulent change. That definition clarifies explicitly that resilience is an essential variable in the sustainability of a supply chain because the definition contains the term “survive,” a synonym to sustain (“survive”, 2017). In this research, the resilient practices examined are adopted from Carvalho, Azevedo and Cruz-Machado (2012) and are matched with the seaport activities and functions. Table 1 includes all SSCM practices and their measures that are investigated in this research.

Variables	Measures
Internal Environmental Management (IEM)	Senior managers' commitment to Green Supply Chain Management
	Support for Green Supply Chain Management from mid-level managers
	Cross functional cooperation for environmental improvement
	Total quality environmental management



	Environmental compliance and auditing programs
	Acquisition of ISO 14001 certification
	Existence of environmental management system
	Adoption of Life Cycle Assessment technique
Green Purchasing (GP)	Suppliers are selected using environmental criteria
	Eco-labeling of purchased products
	Cooperation with suppliers for environmental objectives
	Environmental audit for suppliers' internal management
	Suppliers' ISO 14000 certification
Customer Cooperation (CC)	Cooperation with customers for environmentally friendly design
	Cooperation with customers for cleaner production
	Cooperation with customers for green packaging
Eco-design (ECO)	Design of product/ service for reduced consumption of material and/ or energy
	Design of product/ service for reuse, recycle and/or recovery of materials
	Design of product/ service to avoid or reduce use of hazardous products
Investment Recovery (IR)	Investment recovery
	Sale of scrap and used materials
	Sale of excess capital equipment
Social Supply Chain Practices (SSC)	Ensures provision of healthcare to sea port employees
	Ensures no child labour occurs in sea ports
	Participates in programs that serve the community such as reducing hunger, disease and poverty or help in education
	Trains employees for workplace safety
	Collaborates planning with suppliers to enable alerts of potential supply disruptions
	Exerts efforts that enable reducing lead time
	Sea port has procedures in place for monitoring and mitigating risk
	Seaport maps the network that connects the seaport to its downstream customers and upstream suppliers by identifying bottle necks (where there's limited resources) and critical paths (where there's long lead times or single source of supply)
	Seaport has one single source of supply for an item or service



	Seaport uses supply Chain IT software to provide access and reporting of transaction data between the seaport and its supply chain members
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Table 1: Sustainable Supply Chain Management practices investigated in this research

### 1.3 Performance Measurement

Performance improvement is an important driver for seaports to encourage them to apply sustainable management practices. However, the business case for the implementation of Sustainable Supply Chain Management (SSCM) practices has to be proved and laid down for seaports in order to adopt these practices. In this paper, the researcher will evaluate three performance measures: environmental, economic and operational. These are the most cited measures in the related literature adapted from Zhu et al. (2008) and Azevedo, Carvalho and Machado (2011). Table 2 includes performance measurement variables used in this research.

Performance Variable	Measures
Environmental Performance (EnvP)	Air emission reduction
	Water waste reduction
	Solid wastes reduction
	Reduction of consumption of hazardous materials
	Reduction in frequency of environmental accidents
	Improvement of seaport’s environmental situation
Economic Performance (EconP)	Decrease in cost for materials purchasing
	Decrease in cost for energy consumption
	Decrease in fee for waste treatment
	Decrease in fee for waste disposal
	Decrease in fine for environmental accidents
	Increase in revenue from green products/ services
Operational Performance (OperP)	Increase in amount of products/ services delivered on time
	Decrease in scrap rate
	Increase in quality of product/ service
	Improvement of capacity utilization
	Increase in customer satisfaction

Table 2: Performance measurement variables investigated in this research



## 2. RESEARCH OBJECTIVES AND HYPOTHESES

Sustainable development, specifically its environmental and social dimensions have been always regarded as constraints to business. This research aims to investigate how the adoption of sustainable supply chain management (SSCM) practices would improve the Egyptian seaports performance measures. The research aims to investigate different economic, environmental and operational performance measures adopted by Egyptian seaports. Moreover, the research intends to propose a framework for applying sustainable supply chain management (SSCM) practices to improve Egyptian seaports performance.

After investigating the previous literature review, the researcher has concluded that sustainable supply chain management is an extension to the green supply chain management added to it social & resilient supply chain practices (Figure 1.2). From this perspective, the following hypotheses are developed.

Ample scholars argued that implementing green supply chain management practices improves environmental and economic performance (Zhu & Sarkis, 2004; Rao & Holt, 2005; Azevedo, Carvalho & Machado, 2011; Vanalle, Ganga, Fielho & Lucato, 2017). Moreover, Tseng, Tan & Chiu (2016) state that implementation of GSCM help firms reduce hazardous material thereby improve environmental performance. From a financial perspective, when companies invest in GSCM practices, they are able to reduce inventory investments, increase recovery of assets and contain costs which lead to economic performance improvement (Huang, Jim Wu, Rahman, 2012). Previous literature argues that adoption of GSCM practices by a company depends on the intraorganisational environmental management (Kuei, Chow, Madu, & Wu, 2013; Youn, Yang, Hong & Park, 2013; Geng, Mansouri, & Aktas, 2017). Internal environmental management as a practice of GSCM has higher impact on economic performance than collaborative practices with suppliers or customers (Geng et al., 2017). However, Yu, Chavez and Feng (2014) and de Soussa Jabbour, de Oliveira Frascareli and Chiapetta Jabbour (2015) debated that the relationship between GSCM and operational performance is significantly positive. While Vanalle, Ganga, Fielho and Lucato (2017) find no significant evidence observed for the relationship between GSCM and operational performance.

Thus, the above presented argument will be tested empirically through the following hypothesis:

**Hypothesis 1 (H1): There is a significant impact of applying green supply chain management (GSCM) practices on seaport performance.**

H1a: There is a significant impact of applying green supply chain management (GSCM) practices on environmental seaport performance.

H1b: There is a significant impact of applying green supply chain management (GSCM) practices on economic seaport performance.

H1c: There is a significant impact of applying green supply chain management (GSCM) practices on operational seaport performance.





On the other hand, previous studies observed that social supply chain practices have a positive link with economic performance (Orlitzky, Schmidt & Rynes, 2003; Ağan, Kuzey, Acar, & Açıkgöz, 2016). However, Margolis, Elfenbein and Walsh (2009) argued that there is a negative or a mixed link between corporate social practices and economic performance. Moreover, Carter and Jennings (2002) have found that social supply chain practices improve operational company performance in terms of shorter lead time, better quality and higher efficiency.

Furthermore, Liu, Shang, Lirn, Lai, & Lun, (2018) argued that resilience in the supply chain specifically the risk management culture, has a positive strong effect on company's operational and economic performance. By contrast, resilient supply chain practices as agility, integration and supply chain re-engineering have no significant direct influence on company performance in terms of operational and economic measures. However, they impact company performance through risk management performance (Jun & Rowley, 2014; Ping & Muthuveloo, 2015). To the best of the researcher's knowledge, there is a lack in research that studies the relationship between social and resilient supply chain practices and environmental performance. Thus, the preceding argument will be tested empirically through the following hypothesis:

**Hypothesis 2 (H2): There is a significant impact of applying social resilient supply chain (SRSC) practices on seaport performance.**

H2a: There is a significant impact of applying social resilient supply chain (SRSC) practices on environmental seaport performance.

H2b: There is a significant impact of applying social resilient supply chain (SRSC) practices on economic seaport performance.

H2c: There is a significant impact of applying social resilient supply chain (SRSC) practices on operational seaport performance.

Chu, Yang, Lee and Park (2017) argued that GSCM practices accumulate social capital and resilient supply chain practices which in turn bring improvement to operational and environmental performance. The adoption of green practices is believed to improve the conditions that employees work under and the local community, where people can enjoy a healthier life (Rani and Mishra, 2014). Although the scarcity of empirical studies on the relationship between GSCM and social supply chain practices, the available empirical evidence shows that green supply chain practices, in general, have a considerable social function such as promoting customer loyalty (De Giovanni, 2012), enhancing the corporate image (Eltayeb and Zailani, 2011), healthcare, equal opportunity, safe products and working conditions, and respect towards the law and ethical behaviour (Porter and Kramer, 2006; Zaid, Jaaron & Bon, 2018). Accordingly, the following hypothesis postulates that:

**Hypothesis 3 (H3): There is a significant impact of applying green supply chain management (GSCM) on social resilient supply chain (SRSC).**



H3a: There is a significant impact of applying green supply chain management (GSCM) on the social supply chain management practices (SSC).

H3b: There is a significant impact of applying green supply chain management (GSCM) on the resilient supply chain management practices (RSC).

Some research studied the role of mediators and moderators in the relationship between GSCM and company performance. Geng, Mansouri and Aktas (2017) tested the role of the firm size, industry type, ISO certification and export orientation as moderating the relationship between GSCM and firm performance in terms of economic, operational, environmental and social measures. According to Chu, Yang, Lee and Park (2017), social capital had a partial mediating role between GSCM and company performance in terms of operational and environmental measures. Constructs that measure the social capital in the research of Chu et al include not only social supply chain practices, but also resilient supply chain practices that implicitly revolve around collaborative acts with suppliers. Namazi and Namazi (2016) debated that the sophisticated nature of business problems can be better contained by observing and identifying mediating variables in the examined relationship. In this study, since social and resilient supply chain practices are considered as an extension of GSCM forming the SSCM, they will be tested as a mediator in the relationship between GSCM and company performance. The preceding argument will be tested empirically through the following hypothesis:

**Hypothesis 4 (H4): Social resilient supply chain (SRSC) mediates the relationship between green supply chain management (GSCM) and company’s performance.**

Given the preceding argument that discussed the relationship between GSCM and company performance, in addition to the relationship between SRSC and company performance in previous literature. And given that the researcher defined SSCM as an extension to GSCM added to it social and resilient supply chain practices, thus the following hypothesis postulates that:

**Hypothesis 5 (H5): There is a significant impact of applying sustainable supply chain management (SSCM) practices on company’s performance.**



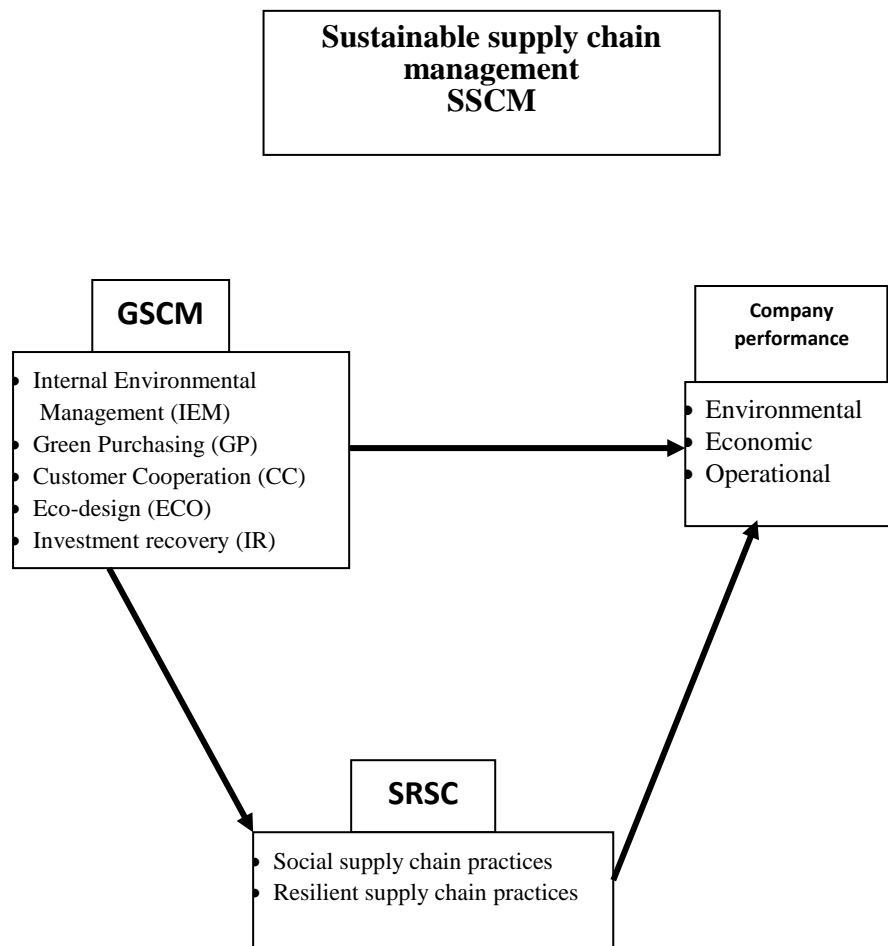


Figure 1.2: Research Model (*GSCM: green supply chain management, SRSC: social resilient supply chain*)

Source: Developed by the researcher

### 3. SAMPLE AND DATA COLLECTION

Secondary data is collected from various sources; textbooks, articles, previous literature and organizations' websites. In addition to that, primary data for the purpose of testing the hypotheses is collected via using a survey instrument. It will be administered using convenience sampling. The researcher limits the study population to the managerial levels and employees in the supply chain and operations management functions in Egyptian commercial seaports in the Suez Canal zone. They are six commercial seaports; Port Said port, East Port Said port, Arish port, Adabiya port, Sokhna port and Al-Tour port.



The draft survey (in the pilot study phase) consists of three sections that include (1) respondent description, (2) application level of Sustainable Supply Chain Management practices and (3) seaport performance measures results.

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