Green Supply Chain Management Practices: Implementation Strategy and Green Solutions of Logistics Service Providers

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In recent years, the logistics industry has faced increasing pressure to implement environmentally sustainable practices. This thesis aims to uncover how leading logistics service providers, such as DHL, UPS, FedEx, Maersk, and MSC, are navigating the challenges of environmental stewardship in the context of rapid technological advancements.

The methodology used in this research is qualitative, focusing on the analysis of secondary data from these leading logistics companies. Their approaches to green logistics is examined, including the use of alternative fuels, sustainable transportation, energy-efficient infrastructure, advanced data analytics, and stakeholder collaboration.

Key findings highlight innovative practices in the logistics sector, demonstrating how companies are embracing technology and collaborative efforts to improve environmental sustainability. These insights not only enrich academic understanding but also provide practical guidance for logistics service providers seeking to implement green practises.

The final chapter concludes by stressing the crucial role of ongoing innovation and adaptation in logistics to meet both regulatory demands and customer expectations for green solutions, underlining the significance of green supply chain management in the modern business environment.

Keywords
Green Supply Chain Management, Green Logistics, Logistics Service Providers, Green Solutions

Table of contents

1 Introduction

This is a research-based Bachelor's thesis for the Degree Programme in International Business in the major of Supply Chain Management taught at Haaga-Helia University of Applied Sciences. The goal of this chapter is to give readers an overview of background information, the research question, and investigative questions. Demarkation, international aspect, and key concepts will be defined. In addition, benefits of the thesis to the stake-holders will be explained.

1.1 Background

"As the world economy goes global, supply chain operations go boundary crossing: across firms, across countries, and across markets. The environmental impacts of such operations not only cross the physical boundary, but also penetrate into the future. The wellbeing of the future generation will be affected by present business practices, where the logistics manager can play a significant role" (Liu 2011, 483.)

The history of logistics goes back a long way, logistics have been practiced as long as trade in goods or services has occurred, thereby improving the global economy and quality of life in various places around the world. Due to its cross-functional, integrative nature, and its various connections to the environment, logistics management is a crucial area for pro-active environmental management. The natural environment is both the source of resources and the waste sink for all operations, from the procurement of raw materials to the production of the finished goods and after-sales services (Wu and Dunn 1995, 23.)

Our planet, and consequently its habitants are facing major environmental concerns caused by global warming, population explosion, environmental degradation, increasing solid and hazardous waste and resource scarcity. More than ever, human beings are becoming more aware of the "shadow price" of rapid economic development, the severe environmental is-sues created by this development. Increasingly, consumers, businesses, and governments driven by the actions of environmental non-governmental organizations (NGOs) and the media, have begun to use their countervailing power. They are doing this either by demanding and purchasing "green" products, or by boycotting alleged environmental offenders for their actions both at national and international levels (Liu 2011, 483.)

Logistics can contribute to sustainable development meeting the future generations' needs in terms of low greenhouse gas emissions in a socially and economically responsible way. Green Logistics involves all initiatives to minimize the environmental impact of people's movement, transportation

and distribution networks in national and global supply chains, along with the reverse flow of products and resources (Thiell 2011, 335). Green logistics has emerged to be an inevitable direction in logistics development. In the coming years, more and more companies worldwide will adopt green logistics. Therefore, logistics service providers will need to integrate tangible green practices within their business structure, or be exposed to the possibility of being side-lined by the competition.

It is quite beneficial for my career to write a thesis on Green Logistics. This will allow me to deepen my knowledge and expertise in green logistics and green supply chain management and also enable me to cultivate research method skills.

1.2 Research Question

This thesis aims identify the implementation strategies and green solutions programs of logistics service providers. The desired outcome of the thesis would help with implementing and improving the logistics service providers' green strategies and programs.

The research question is worded as How logistics service providers implement green practices?

Research question (RQ) is divided into investigative questions (IQ) as follows:

IQ 1. What are green practices?
IQ 2. What is green logistics?
IQ 3. What are the green implementation strategies of logistics service providers?
IQ 4. What are green solutions programs of logistics service providers?

Table 1. Overlay matrix

Investigative question	Theoretical Framework	Research Methods	Results (chapter)
IQ 1. What are green practices?	Literature review	Qualitative research	2
IQ 2. What is green logistics?	Literature review	Qualitative research	2
IQ 3. What are the implementation strategies of GSCM of logistics service providers?	Existing reports, articles, and interviews	Secondary research, Qualitative	4

IQ 4. What are green solutions programs of logistics service providers?	Existing reports, articles, and interviews	Secondary research, Qualitative	4

1.3 Demarkation

The demarkation in this thesis is done by researching several major companies operating in logistics industry. Moreover, demarcation will limit the amount of knowledge researched and investigated, and enable the author to have straightforward answers to investigative questions and research question that would not entail any needless information.

1.4 International Aspect

This thesis has a strong international aspect, as it focuses on green logistics strategies and solutions of international companies.

1.5 Benefits

This study can be beneficial to both national and international logistics service providers. Additionally, this gives the author a valuable opportunity to delve into interesting research for greater depth of learning in his career area.

1.6 Key Concepts

Supply chain management

Supply chain management is a network of organizations that across upstream and down-stream linkages, are engaged in multiple processes and operations that generate value in the form of goods and services in the hands of the ultimate consumer (Managan & Lalwani 2016, 10).

Green supply chain management

Green supply chain management is the insertion of environmental criteria within the deci-sion-making context of the traditional supply chain management (Emmet & Sood 2010, 3).

Green practices

Green practices are ideologically safe practices that do not fundamentally disturb the driv-ing forces of economic growth and corporate profitmaking. Greener practices prioritize cre-ating a more sustainable business which is kinder to the environment (Ernest 2011, 42.)

Green logistics

Green logistics is defined as the production and distribution of goods that are held in a sustainable manner by the inclusion of activities such as evaluation of the environmental influence of distribution methods used and reduction of the waste and its effective management along with the strategic planning of logistic activities (Tao 2008, 534).

Green solutions

Green solutions which also reflects on green technology, concurrently generates economic interests and protects the environment, reinforces the supply chain through innovation, im-proves process innovation and waste recycling production to avoid net resource-dependent consumption (Xian 2017, 1).

2 Green Supply Chain Management and Green Logistics

This chapter will cover the theoretical framework of the thesis, which will first explain the background of Green Supply Chain Management through its history, benefits, drivers, and practices. Secondly, as it can be seen in Figure 1 below, Green Logistics System will be defined and explained in depth to provide comprehension to the reader.

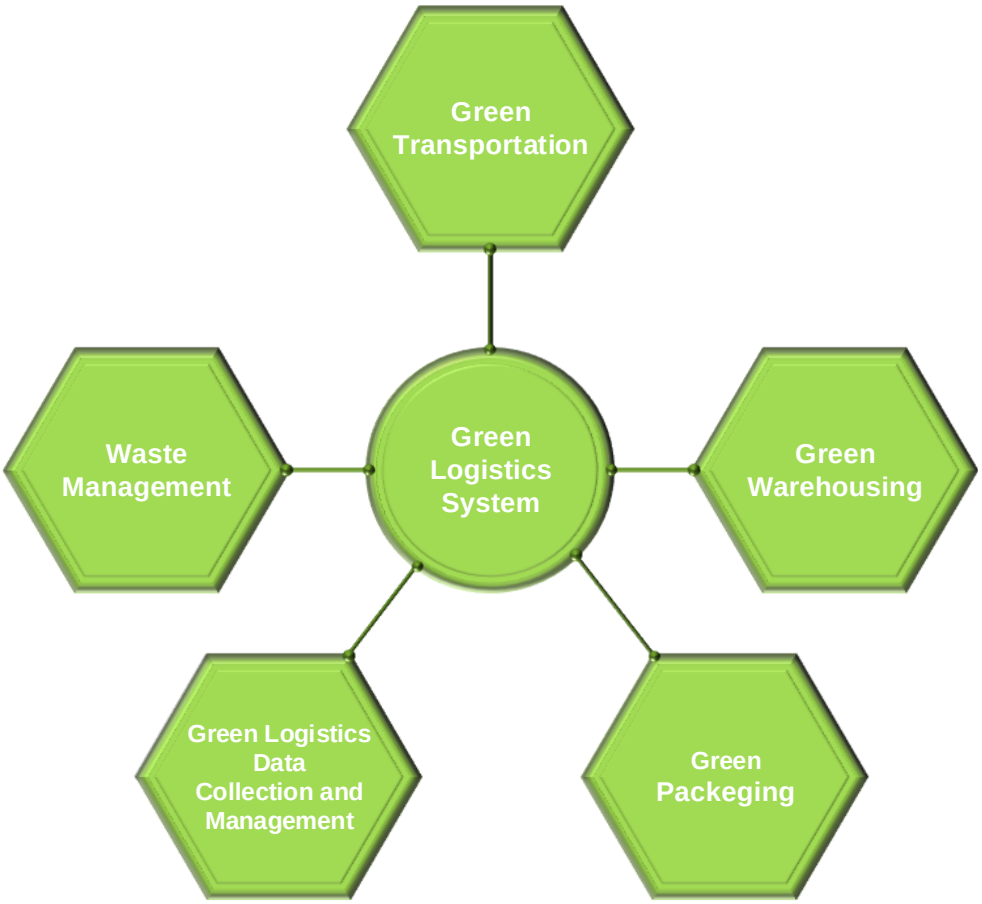

Figure 1. The framework of the Green Logistics System (Thiell, 2011)

Logistics and supply chain management are an integral part of business practices and the driving force behind globalization, but there is general awareness that logistics has a direct impact on the environment. For instance, transportation, which is a logistics operation, has a significant effect on the environment. Atmospheric contamination is caused by CO2 emissions from vehicles, aircraft and vessels, often regarded as the main causes of the global warming impact that threatens the planet today (European Commission 2009).

Consequently, these direct environmental effects have led to the formulation of different approaches for the achievement of sustainable development strategies. Sustainable development has been defined by the Brundtland Commission as a type of development which meets current

needs without reducing the availability and quality of resources to enable future generations of people to meet their needs. (WCED 1987).

As it can be seen in Figure 1 above, green logistics consists of all activities related to the eco-efficient management of forward and reverse flows of goods and information between the point of origin and the point of consumption in order to satisfy or meet consumer demand (Thiell 2011, 335). In light of this definition, green logistics is not "new in terms of re-inventing logistics, but emphasizes the integration of environmental priorities into the target systems of organizations and value chains in order to provide a balanced collection of total value to customers (Carter & Rogers 2008, 368).

2.1 Green Supply Chain Management

Green Supply Chain Management (GSCM) is a broad concept for which there is no distinct, all-encompassing definition. Due to the fact that the concept is defined differently by various researchers, it is challenging to provide a single definition for GSCM (Ahi & Searcy 2013, 330) However, based on the preceding criteria done by renounced researchers throughout the recent decades, GSCM can be properly characterised as incorporating environmental concerns into inter-organizational supply chain management practises across a product's life cycle (Sarkis 2011, 3). Beginning with product design to material sourcing and selection, manufacturing processes, final product distribution to the user, and culminating with product end-of-life management beyond its intended lifespan (Srivastava 2007, 54).

Green Supply Chain Management (GSCM) is a multifaceted concept that encompasses a wide range of environmental and sustainability practices in relation to the sourcing, production, distribution, and disposal of goods. Given the myriad dimensions of sustainability and the vastness of supply chain operations, researchers often approach GSCM from diverse perspectives based on their academic disciplines, industrial backgrounds, and regional contexts. This has led to varied definitions and interpretations of what constitutes GSCM, each emphasizing different elements and priorities. For instance, while one researcher might focus on the ecological footprint of raw material extraction, another might prioritize the social and economic impacts of production processes. This inherent diversity in interpretation means there is no singular, universally accepted definition of GSCM (Smith 2018, 112.) Another contributing factor is the evolving nature of environmental standards and business practices, which ensures that the understanding of GSCM remains dynamic and subject to ongoing refinement (Davies 2020, 279).

Green Supply Chain Management (GSCM) can be understood as the integration of environmentally-friendly thinking and practices into all phases of a product's lifecycle, from raw material extraction to distribution, consumption, and disposal. Essentially, it emphasizes not just traditional supply chain efficiency, but also the reduction of environmental burdens associated with the chain's activities (Zhu and Sarkis 2007, 1). One of the primary aims of GSCM is to reduce waste, conserve resources, and diminish harmful emissions, while still ensuring the economic viability of the organization. This involves practices like sourcing sustainable raw materials, implementing eco-friendly manufacturing processes, optimizing distribution networks to reduce carbon footprints, and considering end-of-life product management such as recycling or repurposing (Seuring and Müller 2008, 1700).

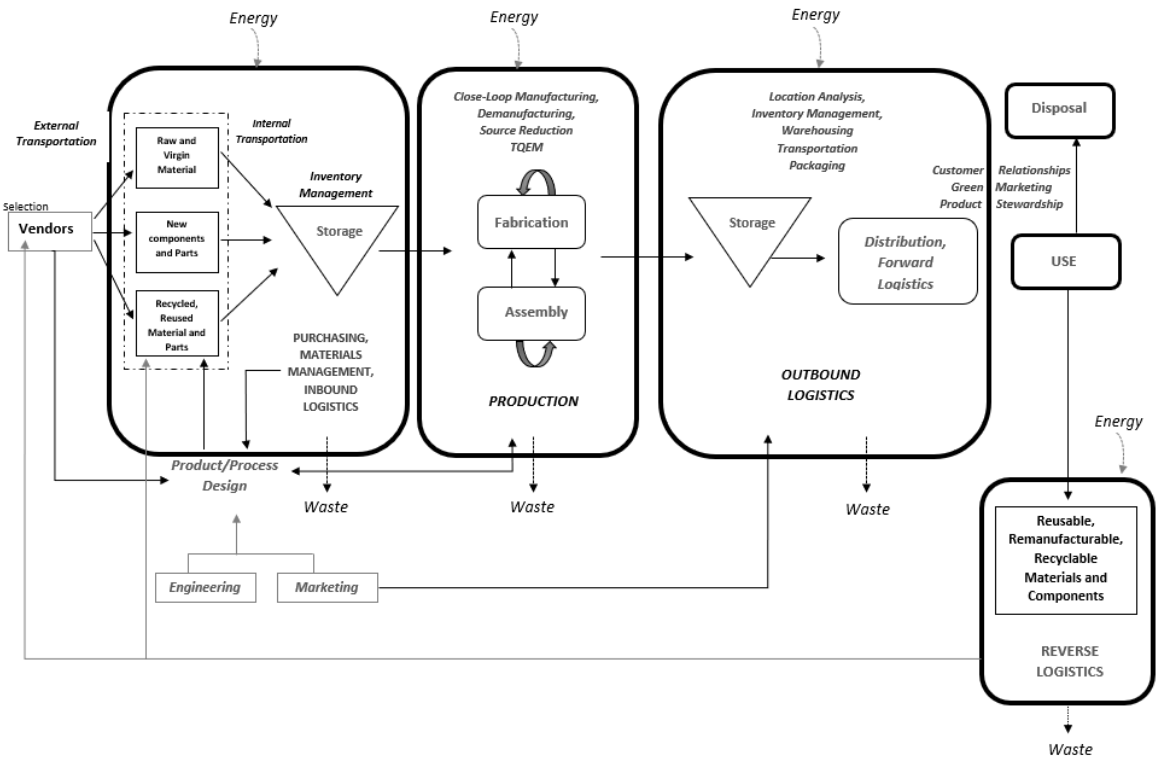

Figure 2. Operational functions and environmental practices within the green supply chain (Toke, 2010)

The Figure 2. illustrates the concept of Green Supply Chain Management (GSCM) by integrating environmental thinking into every stage of the supply chain. It emphasizes the selection of eco-friendly vendors and the use of raw and virgin materials alongside recycled parts, thereby reducing waste from the outset. The energy used in both internal and external transportation is accounted for, aiming to minimize the carbon footprint. Inventory management is optimized to decrease excess production and storage, which in turn saves energy and reduces waste. The production phase includes fabrication and assembly, where close-loop manufacturing and total quality envi-

ronmental management are applied to ensure efficient use of resources. Forward logistics are responsible for the distribution of products in an environmentally conscious manner. The cycle is completed by considering the product's end-of-life through reverse logistics, focusing on reusable, re-manufacturable, and recyclable materials and components. By managing waste and energy use at each stage, the figure number provides a systemic approach to making supply chains more sustainable (Toke 2010, 346.)

2.1.1 Supply Chain Management

Supply Chain Management (SCM) is an intricate process focused on the strategic planning and operational execution of moving raw materials through various stages of production and distribution until they reach the end customer. Fundamentally, it revolves around the transformation of raw materials into finished products, culminating in the final sale of the said product (Beamon 1998, 337). Building on this understanding, the notion of Supply Chain management has become interlinked with the globalization of production, where manufacturers' propensity to source inputs globally necessitates the effective management of intricate international flows of products and resources (Trkman, Stemberger, & Jaklic 2005, 560).

In the backdrop of a globalized production landscape, SCM has become synonymous with managing complex worldwide flows of products and inputs, acknowledging that competition extends beyond the products themselves to the very supply chains delivering them (Trkman, Stemberger, & Jaklic 2005, 560). Effective SCM plays a pivotal role in ensuring timely arrival and the quality of goods, emphasizing coordination between all players in the supply chain. This emphasis on timeliness and quality is in response to the inherent market uncertainties that demand agility and flexibility within the supply chain. The duality of SCM objectives, emphasizing both cost efficiencies and enhanced customer service as routes to bolster global competitiveness. Yet, while many definitions of SCM capture its essence, they often overlook its effectiveness. As such, to gauge the effectiveness of SCM, the ideal definition should encapsulate the goals of maximizing value to the customer while optimizing the operational costs associated with the entire supply chain (Mbang 2012, 195.)

2.1.2 History of GSCM

The concept of GSCM emerged in the late 1980s and early 1990s as companies began to realize the importance of environmental issues in business operations (Srivastava 2007, 53). This period saw the introduction of the Environmental Protection Agency (EPA) in the United States and the emergence of international environmental standards like ISO 14001 (International Organization for Standardization, 2015). This encouraged companies to consider environmental aspects in their operations (United States Environmental Protection Agency, n.d.).

Mid to Late 1990s: Definition and Framework Development

Academic literature started to define GSCM and frameworks for its implementation were developed. The emphasis was on reducing waste and improving efficiencies in processes (Beamon 1999, 337). Companies began adopting the 3Rs (reduce, reuse, recycle) in their supply chains, and Life Cycle Assessment (LCA) started to be used as a method to evaluate the environmental impact of products (Guinée 2002, 311).

Early 2000s: Expansion and Integration

The focus expanded from pollution control and waste management to the design of products and processes with environmental considerations (Guide, V.D.R. and Van Wassenhove 2001, 142). Concepts like Extended Producer Responsibility (EPR) and Product Stewardship were introduced, pushing companies to take responsibility for their products throughout the life cycle (Lifset & Lindhqvist 2008, 144)

Late 2000s to Early 2010s: Globalization and Regulation

With globalization, GSCM became more complex as companies now had to deal with cross-border supply chains and various local and international environmental regulations (Srivastava 2007, 53). The European Union and other regions began to implement stricter regulations on waste management and material restrictions such as the Restriction of Hazardous Substances Directive - RoHS and Waste Electrical and Electronic Equipment Directive - WEEE (Huisman, 2008).

Mid 2010s to Early 2020s: Technological Advancement and Collaboration

Advances in technology, including supply chain digitization and the Internet of Things (IoT), enabled better tracking and improvement of environmental impacts across the supply chain (De Giovanni 2018, 219). Collaborative efforts in green practices became more common, with initiatives like the Carbon Disclosure Project (CDP) encouraging companies to disclose their environmental impact (Kolk, Levy, & Pinkse 2008, 719).

2020s: Circular Economy and Sustainability

The circular economy concept has become central to GSCM, promoting a closed-loop system where resources are reused, repaired, and recycled to minimize waste (Geissdoerfer, Savaget, Bocken, & Hultink 2017, 758). Corporate social responsibility (CSR) and sustainability reporting have become standard for businesses, integrating GSCM practices into broader sustainability goals (KPMG, 2020).

2.1.3 Benefits of GSCM

Green Supply Chain Management (GSCM) has become an increasingly important part of organizational strategy, offering multiple benefits across different dimensions of performance. Below, the key benefits are expanded upon with reference to academic and professional literature, demonstrating the tangible and strategic advantages that organizations can reap by implementing GSCM practices.

Financial Performance

Organizations that adopt GSCM practices often experience improved financial performance due to increased efficiency and waste reduction. Companies that integrate environmental management into supply chain operations tend to see financial gains due to the reduced cost of waste disposal and energy savings (Rao & Holt 2005, 911) Additionally, (Zhu and Sarkis 2004, 270.) indicated that companies with higher levels of GSCM practices reported significantly better financial performance.

Sustainability of Resources

GSCM ensures the sustainable use of resources, which is critical for long-term business operations. sustainable practices lead to the conservation of resources and the maintenance of the ecosystem, which in turn ensures the availability of raw materials in the future (Vachon & Klassen 2006, 797).

Lowered Costs/Increased Efficiency

Greening the supply chain can lead to significant cost reductions. For example, implementing energy-efficient processes or reducing material waste can lower production costs. (Hervani, Helms, and Sarkis 2005, 334) indicates that GSCM practices contribute to operational efficiencies and cost savings.

Product Differentiation and Competitive Advantage

GSCM can also provide a competitive edge. When companies offer environmentally friendly products, they differentiate themselves in the marketplace. Pollution is often associated with wasted resources, so reducing pollution often coincides with increasing efficiency and product innovation, thus creating competitive advantage (Porter & van der Linde 1995, 128).

Adapting to Regulation and Reducing Risk

By proactively engaging in GSCM, organizations can ensure compliance with environmental regulations and reduce the risk of penalties or lawsuits. They can also better anticipate and adapt to new regulations. Firms that exceed regulatory requirements can gain first-mover advantages in their industries (Christmann 2000, 668).

Improved Quality and Products

Sustainable supply chain practices often lead to improvements in product quality. For example, using non-toxic materials can result in safer products for consumers. Incorporation of GSCM principles is positively associated with both operational and environmental performance improvements (Melnyk, Sroufe, & Calantone 2003, 342).

Environmental

Implementation of GSCM practices significantly influences cost, profit, waste disposal, resource consumption, and greenhouse gas emissions, thereby contributing to environmental sustainability (Rupa & Saif 2021, 451). A recent study by (El Khoury et al. 2023, 2139-2165) indicates Green Supply Chain Management practices have shown significant impacts on environmental performance, especially during the COVID-19 period among discretionary companies in G-20 countries.

2.1.4 Drivers of GSCM

The drivers of GSCM are diverse and encompass a range of internal and external factors that incentivize organisations to embrace environmentally sustainable practises within their supply chain. The drivers can be classified into various fundamental matters. Firstly, the identification of environmental sustainability as a strategic goal has emerged as a prominent catalyst for Green Supply Chain Management. The implementation of internal environmental management practises and the utilisation of green information systems have a direct influence on GSCM practises. (Green 2012, 299).

In addition, it has been shown that GSCM practises in emerging economies are significantly influenced by external pressures exerted by stakeholders, including the public, suppliers, and competitors. Conversely, coercive pressures emanating from government and regulatory bodies were found to have negligible impact on driving GSCM practises (Sabat 2022, 1349).

Furthermore, the drivers influencing Green Supply Chain Management (GSCM) can be categorised into three main groups: government-related, organizational-related, and societal-related. This categorization highlights the wide array of variables that impact the adoption of GSCM practises inside organisations. (Ososanmi 2021, 14705).

2.1.5 Green Practices

The four dominant Green Supply Chain Management (GSCM) practices that are integral to GSCM implementation are green purchasing, eco-design, environmental cooperation, and reverse logistics. These practices can be adopted by any member within the supply chain. Moreover, Zhu (2008,262) emphasised in a scientometric review and analysis on GSCM, a range of activities within GSCM, beginning from green purchasing and extending to product life cycle management and closing the loop with reverse logistics.

2.2 Green Logistics

2.2.1 Definition of Green Logistics

The concept of "green logistics" was first proposed in the mid-1980s. The term "green logistics" refers to any activity involving the environmentally responsible management of information and product flows both forward and reverse between the point of origin and the point of consumption with the aim of meeting or exceeding customer demand (Beamon 1999, 332). According to this definition, green logistics is not about completely reinventing logistics, but rather emphasises the incorporation of environmental objectives into the target systems of organisations and value chains (Thiell 2011, 335). This is done in order to deliver a well-rounded and comprehensive value proposition to customers (Carter & Rogers 2008, 368).

2.2.2 Green Logistics System

Green Logistics Systems can be defined as an integrated approach to logistics management that prioritizes environmental sustainability. This encompasses various components such as green transportation, green warehousing, green packaging, green logistics data collection and management, and green waste management (Green 2012, 297).

2.2.3 Green Transportation

The goal of green transportation logistics is to minimise transportation energy consumption, discharge discard material, and transport tool occupancy road by using an effective project and material circulation system. Green transportation logistics recommends approaches such as improving routing management, enhancing loading, market operation, and inter-management based on cost increases over time (Tao 2008, 525.) Clean vehicles, reusing pallets and containers, freight consolidation and load optimisation, truck size standardisation, lowering CO2 emissions, and choosing sustainable carriers are a few examples of green transportation (Thiell 2011, 335).

2.2.4 Green Warehousing

Green warehousing is the term for environmentally sustainable procedures used in the warehousing industry with the goal of minimising the impact that distribution and storage activities have on the environment. This can involve taking steps to reduce waste and recycle, using renewable energy sources, installing eco-friendly building materials and designs, and installing energy-efficient heating and lighting system (Bartolini 2019, 243). Today's warehouses frequently incorporate environmentally sustainable elements, such solar walls, on-site recycling facilities, and heat-reducing power plants, thereby mitigating the ecological footprint associated with their operational activities. Warehouse management often utilises specialised tools and technology, including flow optimisation, automatic warehousing systems, automatic guided trucks, and inventory minimization programmes. (Thiell 2011, 340).

2.2.5 Green Packaging

Green packaging serves two main purposes: environmental protection and the utilisation of renewable resources. These goals are accomplished through the implementation of the 4R1D principles, which are: reduce, reuse, reclaim, recycle, and degradable. The process of reduction entails the minimisation of packing material, while simultaneously assuring its functionality in both logistics and sales operations. The practise of reuse involves the recurrent utilisation of packaging containers following a process of basic treatment, resulting in a substantial reduction in waste volume and an improvement in recycling rates. The process of reclamation, also known as recycling, entails the conversion of packaging waste into alternative energy sources, while minimising the generation of additional pollutants. This is achieved through many ways, such as thermal incineration, which not only facilitates the disposal of waste but also contributes to the enhancement of land conditions. The practise of recycling centres around the utilisation of environmentally friendly, easily recyclable substances with minimal negative effects, with the aim of mitigating pollution and preserving finite resources. At last, the utilisation of degradable packaging serves to facilitate the breakdown of

waste, hence preventing the accumulation of permanent waste. This approach prioritises the adoption of biodegradable materials, such as paper, as a substitute for plastics (Zhang & Zhao 2012, 902.)

2.2.6 Green Logistics Data Collection and Management

The systematic process of green logistics data collection and management involves a methodical approach to gathering, storing, analysing, and interpreting data pertaining to environmentally conscious practises in logistics. The primary objective is to monitor and evaluate several aspects, including carbon emissions, energy usage, waste generation, and resource allocation, that are connected to logistics activities such as transportation, warehousing, and distribution. The aforementioned procedure holds significant importance in the identification of areas requiring enhancement, the optimisation of operational processes, and the mitigation of the negative environmental impacts associated with logistics (Li 2019, 37).

Green information systems (GIS) offer the necessary data for decision-making pertaining to green purchasing, customer collaboration, product design, and return on investment. Green information systems will deliver the requisite data for making educated choices regarding eco-design, encompassing aspects such as material and energy usage, as well as the reuse, recycling, and recovery of resources. Information systems in the context of green practises play a crucial role in facilitating the retrieval of the needed data required for the recuperation of an organization's investments in excess inventories, scrap materials, and excessive capital equipment (Green 2012, 291.). The role of Green Information Systems in driving green product innovation and collaborative relationships across the supply chain are vital components of GSCM (Silva, Gomes & Sarkis 2019, 4).

2.2.7 Green Waste Management

In green logistics, waste management refers to the procedures and strategies used to control, minimise, and recycle waste produced during the logistical process in an environmentally conscious way. This covers a number of topics, including recycling, reusing, and reducing waste, as well as eco-friendly packaging, waste audits, reporting, and compliance with environmental regulations. Logistics companies that prioritise green waste management not only help to protect the environment, but they also often realise that these methods can result in cost savings and enhanced efficiency (Li 2019, 35.)

In waste management, reverse logistics plays an integral part by encompassing a number of key practices: recycling and reusing materials, refurbishing and remanufacturing products, facilitating

proper disposal, and optimising transportation. The process entails the collection of useable elements from returned products and components for the purpose of turning them into new products, resulting in waste reduction and the extension of product life cycles. This phenomenon is notably apparent in the handling of electronic devices and machinery, whereby they are frequently subjected to repair, upgrading, or replacement of components. Reverse logistics plays a crucial role in enabling the environmentally friendly safe disposal of goods that are not worthy of recycling or refurbishment. Furthermore, it has an instrumental part in promoting sustainability through the optimisation of transportation procedures aimed at reducing carbon emissions. This is achieved by combining return shipments and employing environmentally friendly vehicles. The implementation of this comprehensive approach not only facilitates efficient waste management but also promotes sustainability in both environmental and economic aspects (McKinnon, Cullinane, Browne & Whiteing 2010, 243.)

3 Research Methods

The desktop research better known is secondary research would be the most suitable for my thesis' development since my research would focus on current trends of the transportation industry which is called green solutions. The research can be categorized further by a second type which is descriptive research meaning that it focuses on describing the characteristics of the phenomenon.

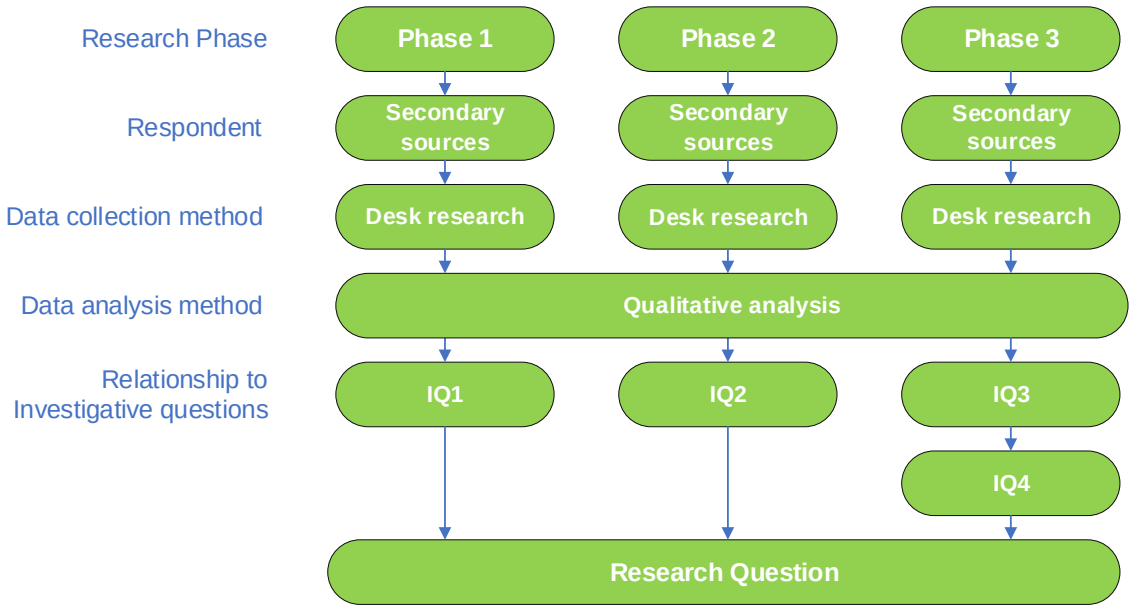

Figure 1. Research methods.

3.1 Research Design

The research design for a thesis that combines a literature review and secondary data within a qualitative framework requires a rigorous and methodical analysis of pre-existing material and data in order to delve thoroughly into the research question. The purpose of the literature review is to systematically collect, evaluate, and integrate prior literature investigations, facilitating a thorough comprehension of the subject matter (Ridley 2012, 3). In addition, qualitative secondary data analysis is the examination and interpretation of pre-existing qualitative data sets, such as interview transcripts, observational records, or historical documents or reports, with the purpose of extracting meaningful insights and identifying recurring patterns that are relevant to the research objectives (Johnston 2017, 620). This dual methodology facilitates a comprehensive examination of the topic, utilising qualitative data to provide detailed insights and interpretations within the framework of existing academic literature.

3.2 Data Collection

The data collecting approach used for the thesis centres on qualitative data obtained from companies' reports, interviews, and observational records. Qualitative data collecting emphasises the complexity and interconnectivity of real-world processes, which cannot be reduced to simple, measurable quantities. This approach recognises that the researcher's perspective and engagement in data collecting are crucial. Qualitative researchers frequently see themselves as the primary research instrument, emphasising the importance of their active engagement, interpretation, and reflexivity (Leedy 2015, 99.)

Qualitative research uses a smaller, more focused sample than quantitative methods, which aim for broad generalisations from large samples. Those examined are chosen for their ability to provide deep, rich insights on the research question being investigated. Instead of generalising findings, the purpose is to comprehend those involved factors, experiences, and views. This comprehensive data collection method helps qualitative researchers build a more nuanced and contextualised view of the topic (Leedy 2015, 99.)

3.3 Secondary Data

The collection of secondary data from companies' reports, performance analysis, interviews, and observational records is a key methodology utilised in this thesis for the purpose of acquiring relevant data. Company reports are classified as secondary data due to their primary goal of serving the company's own objectives, such as sustainability reporting, performance analysis, or compliance, rather than being particularly intended for the researcher's individual study. When utilising this data, we are dependent on information that was collected for an alternative primary objective. This approach demonstrates notable efficacy in examining distinct industry patterns, organisational practises, or market dynamics, while also providing the inherent advantages of efficiency and accessibility associated with secondary data research (Hassan 2023.)

3.4 Research Validity and Reliability

Reliability and validity are often regarded as fundamental aspects of trustworthiness, rigour, and quality within the qualitative paradigm. The link between qualitative researchers and the achievement of validity and reliability in research is influenced by the goal of eliminating bias and enhancing the researcher's truthfulness in making propositions about social phenomena, which is facilitated by the use of triangulation (Golafshani 2003, 604.) Triangulation is a methodological approach applied in research to ensure the validity of findings. It involves the systematic examination

and comparison of diverse sources of information in order to identify patterns and establish broad themes or categories within a study (Creswell & Miller 2000, 126).

The qualitative research conducted in this study rigorously examined secondary data in order to maximise the reliability and validity. The study encompassed a comprehensive analysis of the leading five logistics service providers in the industry, with particular emphasis on their sustainability reports, press announcements, and interviews. The chosen methodology was purposeful and systematic, with the objective of acquiring a thorough comprehension of the organisations' green logistics strategy and implementations. The selection of these industry leaders as the primary sources of information provided a robust and representative sample of the current practices and innovations in green logistics. Through meticulous examination of these diverse yet relevant sources, the study ensured a comprehensive and precise portrayal of the status of green logistics within the industry, hence supporting the research findings with a high level of credibility and trustworthiness.

4 Findings and Analysis

In this chapter, a strategic selection of the top five logistics service providers across various sectors was conducted based on preliminary research findings. The selection was motivated by the need to obtain a diverse yet representative understanding of the industry. Following this, a concise yet thorough examination of their implementation strategies and green practices is provided. The aim of this research is to provide an overview of the current practises and innovative approaches in the subject of green practises.

4.1 DHL

4.1.1 Substantial Reduction in Carbon Emissions

DHL Supply Chain recently issued a press release announcing its plan to transition about 2,000 of its vehicles from traditional internal combustion engines to more greener solutions such as hydrotreated vegetable oil, biogas, electric, or hydrogen-powered alternatives. DHL Supply Chain recently disclosed that it intends to invest an additional 200 million euros in the next three years towards the development of fossil fuel alternatives. This commitment is expected to result in a significant reduction of about 300,000 tonnes of CO2 emissions. This strategic move reflects the company's strong dedication to promoting environmental sustainability and reducing carbon emissions. The magnitude of these savings equates with the reduction of CO2 emissions produced by a fleet of 2,200 trucks, each travelling a distance of 500 kilometres on a daily basis, for the duration of a year. Initially, this novel concept focuses on allocating investments in 17 countries that exhibit the most significant environmental footprint. DHL Supply Chain has set a target to ensure that by the year 2026, 30% of its proprietary fleet would be powered by sustainable fuel and recently disclosed its intention to implement a significant number of biomethane trucks in Ireland in alignment with its Green Transport Policy. Additionally, they have made a commitment to a 10-year agreement for the investment in the production of domestic biomethane energy (DHL Group 2023.).

Picture.1 Green Transport (DHL Group, 2023)

4.1.2 GoGreen Plus Service for Decarbonizing Air Freight

DHL Global Forwarding has observed a growing need for sustainable transportation solutions that rely on the utilisation of sustainable fuels, in particular Sustainable Aviation Fuels. Therefore, they have introduced the GoGreen Plus service, which assists customers in decarbonizing their transport. For example, the life-science company Novo Nordisk has begun decarbonizing its air freight shipments with this service, aiming to reduce at least 30,000 tonnes of CO2e in 2023 (DHL Group 2023).

4.1.3 New Train Connections for Freight Transport

DHL Freight implemented a new and environmentally friendly intermodal rail freight solution connecting Germany and Denmark. Since May 2023, DHL Freight trains have been performing three round trips per week between Duisburg, Germany, and Padborg, Denmark. The newly established connection enables the transportation of up to 240 truckloads per week to be switched from road to rail. This shift results in a reduction of 1.05 tonnes of CO2 emissions per relocated lorry, equating to a total of 250 tonnes of CO2 savings per week or 11,500 tonnes of CO2 savings per year (DHL Group 2023.).

4.1.4 Green Carrier Certification

The DHL Green Carrier Certification is an integral component of the comprehensive sustainability strategy implemented by the Deutsche Post DHL Group in order to achieve its environmental objectives. The Group intends to allocate a total of €7 billion towards the implementation of climate-neutral logistics solutions until the year 2030, thereby matching its efforts with the goals outlined in the Paris Climate Agreement (DHL Group 2021.).

4.2 UPS

4.2.1 Carbon Neutrality Goal

UPS aims to achieve carbon neutrality in all its operations by 2050. This ambitious goal involves a comprehensive approach across scope 1, 2, and 3 emissions, highlighting the company's broad commitment to sustainability:

2025 Scope: 25% renewable electricity supplying its facilities which exceeded 8% in 2022. 40% alternative fuel was utilized for its ground operations which was achieved 26.5% in 2022.

2035 Scope: A 50% decrease in CO2 emissions per package transported has been achieved for the global operations of the organization, using the year 2020 as the baseline. The facilities are powered exclusively by electricity derived from 100% renewable sources. The air network of UPS has a proportion of 30% sustainable aviation fuel.

2050 Scope: Carbon neutrality in all of its global operations. The Roadmap to 2050 is founded upon robust engineering principles and a fiscally sensible methodology (UPS 2023.).

Picture 2. Carbon neutrality (UPS, 2023)

4.2.2 UPS My Choice Membership Program

Launched in 2011 with the aim of providing customers with the ability to select a suitable location and time for their deliveries. This feature serves to minimize unsuccessful delivery attempts, thereby leading to a reduction in both fuel expenses and emissions for UPS.

4.2.3 UPS Access Points

These are typically situated at locations such as petrol stations or grocery stores, serving as designated points for the drop-off and collection of shipments. This approach facilitates the reduction of drivers' journey time, expenditures, and carbon emissions.

4.2.4 Route Optimization Software ORION

The utilisation of ORION (On-Road Integrated Optimization and Navigation) by UPS enables the strategic planning of routes that prioritise fuel efficiency, resulting in a reduction in emissions. The ORION system achieved a significant conservation of resources by saving a total of 10 million gallons of gas and effectively mitigating emissions by 100,000 metric tons. This commendable accomplishment resulted in substantial cost savings of up to $400 million.

4.2.5 Eco Responsible Packaging Program

This programme provides environmentally mindful customers with the opportunity to utilise sustainable packaging. Additionally, the offering encompasses a consultancy service aimed at assisting organisations in meeting the necessary criteria for programme eligibility and achieving their sustainability objectives.

4.2.6 Investment in Electric Vehicles

UPS possesses a fleet of more than 13,000 vehicles that utilise alternative fuel and innovative technology on a global scale. As mentioned in their 2025 Scope, the organisation has set a target to utilise alternative fuels for 40% of its ground activities by the year 2025. A recent collaborative endeavour was undertaken with the objective of procuring 10,000 electric vans for the purpose of constructing and implementing them on a global scale, so reinforcing its dedication to mitigating carbon emissions (Route4me 2021.).

4.3 FedEx

4.3.1 Carbon-Neutral Operations by 2040

FedEx has set a target to attain carbon neutrality in its operations by the year 2040. This objective is in line with the company's broader activities that prioritise vehicle electrification, sustainable fuels, fuel conservation, aircraft modernization, enhanced facility efficiency, and natural carbon sequestration. The organisation has established precise schedules and objectives, and is engaging in partnerships with non-governmental organisations (NGOs) and other institutions in order to actively safeguard the environment.

4.3.2 Investment in Sustainability

The company has committed an initial capital investment exceeding $2 billion in order to facilitate the realisation of its objective by the year 2040. This statement elaborates on the ongoing efforts that have successfully decreased emissions intensity by 45% from fiscal year 2009 to fiscal year 2021, despite a significant increase of 180% in average daily package volumes.

4.3.3 Sustainability Strategies

FedEx's sustainability strategy encompasses many initiatives aimed at mitigating emissions and waste, upgrading outdated technology with more efficient alternatives, and transforming operational processes through the use of innovative technologies. The company has successfully implemented a packaging system that is entirely recyclable, with around 49% of the materials used in the packaging being derived from recycled materials.

4.3.4 Electric Vehicle Integration

A growing number of electric vehicles (EVs) are being added to FedEx's network. In the AMEA region, a total of more than 250 electric vehicles (EVs) have been implemented in various locations throughout China. It is anticipated that this number will be further increased to exceed 460 EVs by the middle of the year 2023. EV trials are being conducted in India and other regions as well.

Picture 3. Electric Vehicle (FedEx, 2023)

4.3.5 Sustainable Facility Design

FedEx has strategically prioritised sustainability in the development of its facilities, integrating various sustainable elements such as energy-efficient construction materials, lighting systems, ventilation mechanisms, insulation techniques, water recycling systems, and renewable power generating methods. As an example, the Incheon gateway located in South Korea is a building that has obtained G-SEED certification. It is equipped with 2,400 solar panels and incorporates several sustainable attributes.

Fleet Electrification Goals

FedEx is aiming for 50% of new car purchases to be electric by 2025 and 100% electric by 2030. In addition, it is utilising digital technology to enhance the operational effectiveness of its vehicle fleet.

Managing Last-Mile Delivery

FedEx is actively tackling the obstacles associated with last-mile delivery through the implementation of various strategies, such as the deployment of delivery lockers in easily accessible local areas and the use of digital technologies that enable recipients to conveniently arrange their deliveries.

Sustainability in Aviation

FedEx is currently engaged in the strategic initiative of aircraft modernization, while actively promoting the expansion and development of the sustainable aviation fuel (SAF) sector. A commitment of $100 million has been made to Yale University in order to establish the Yale Centre for Natural Carbon Capture. This centre will primarily concentrate on developing methods for carbon sequestration, with the aim of mitigating greenhouse gas emissions to a level comparable to those produced by the aviation industry at present (FedEx 2023.)

4.4 Maersk

4.4.1 Net Zero Emissions by 2040

Maersk has recently updated its climate objectives, aiming to achieve carbon neutrality by the year 2040. In order to bolster these objectives, the company established nine partnership agreements in the field of sustainable fuel in the year 2022. The primary goal of these partnerships is to procure a minimum of 750,000 metric tonnes of green fuel by the year 2025, with the intention of utilising such fuel for the development of new green vessels. In addition to the existing order of 13 vessels, the company has recently disclosed the purchase of six additional vessels (Maersk 2023). The maiden voyage of the first green vessel fuelled by green methanol, named Laura Maersk, is scheduled for late 2023 (CNBC 2023).

4.4.2 Sustainability in Logistics Facilities

Maersk is responsible for the supervision and management of a global network of approximately 600 logistics facilities that are operated autonomously. The company is primarily devoted to expanding its presence and enhancing the sustainability of its operations to address the increasing need for emissions data throughout the supply chain.

Picture 4. Green vessel, Laura Maersk (Maersk 2023)

4.4.3 Energy Transition Program

Maersk has implemented an energy transition programme for its logistics facilities with the objective of achieving net-zero emissions by the year 2040. The programme establishes benchmarks for the advancement of forthcoming facilities and the modification of current ones, with a particular emphasis on techniques aimed at reducing carbon emissions.

4.4.4 Key Decarbonization Strategies:

The strategies encompass various approaches to improve energy performance through the utilisation of energy-efficient technologies, the electrification of equipment and assets, the utilisation of renewable electricity to power facilities, the attainment of building certification from reputable schemes such as LEED and BREEAM, and the adoption of natural refrigerants in cold storage facilities.

4.4.5 Alignment with Sustainability Requirements:

Maersk is making sure that any investments the company makes in new facilities comply with strict sustainability requirements, and it has plans to achieve these goals by 2030. In order to achieve the objective of powering 90% of global activities with renewable electricity and non-fossil fuels by

2030, current facilities are undergoing development with customised energy transition roadmaps (Maersk 2023.)

4.5 MSC

4.5.1 Net-Zero Transition

MSC is dedicated to facilitating the acceleration of the net-zero transformation and making a positive contribution to an inclusive global trade system. The Cargo Division of the company implements a comprehensive strategy towards sustainability, with a particular focus on reducing carbon emissions in logistics, promoting inclusive trade, and tackling social issues.

4.5.2 Net Decarbonization by 2050

MSC has established a definitive objective of achieving full decarbonization by 2050, without dependence on external offsetting measures. The main goal is to investigate potential strategies for speeding the worldwide shift towards zero-carbon fuels and to equip MSC's fleet with the capability to utilise zero-carbon fuels when they become accessible.

4.5.3 Investment in Energy-Efficient Ships

MSC is making investments in energy-efficient, record-sized ships in an effort to lower CO2 emissions per container. In 2022, the firm implemented its initial fleet of liquefied natural gas (LNG)-powered vessels as a transitional measure. Subsequently, the company has outlined its intention to include an additional 95 ships into its fleet between 2023 and 2026, equipped with the capability to operate using a variety of fuel types.

Picture 5. LNG-powered containership, MSC Washington (Yangzijiang Shipbuilding)

4.5.4 Low- and Zero-Carbon Fuels

The company is currently prioritising the implementation of low- and zero-carbon fuels. MSC envisions a future in which the shipping industry adopts a fuel selection comprising a blend of bio and synthetic liquefied natural gas (LNG), synthetic and bio-methanol, and green ammonia. This fuel combination is intended to be utilised specifically for greater maritime vessels engaged in oceanic transportation.

4.5.5 People-Centric Decarbonization

MSC recognises the fundamental significance of its personnel, encompassing research, development, and technical teams, in facilitating the achievement of decarbonization. The organisation is dedicated to guaranteeing a fair and equitable transition, actively participating in collective initiatives within the sector to facilitate the training, development of skills, and learning of new skills for its workforce on a global scale.

4.5.6 Intermodal Solutions and Logistics Hubs

MSC is concentrated on creating dependable connections to ports by means of logistics hubs and intermodal solutions. The implementation of this strategy plays a vital role in effectively managing intricate and fragmented supply chains, as well as providing assistance to remote and vulnerable

economies. It achieves this by eliminating trade obstacles and upholding critical market connections.

4.6 Conclusion

As the logistics industry rapidly evolves, five industry leading companies that have been studied are leveraging cutting-edge technologies and innovative strategies to enhance efficiency and foster environmental sustainability.

4.6.1 Key Findings

Five key strategies stand out, each offering unique methods to revolutionise logistics operations:

Electrification and Alternative Fuels
Adoption of electric vehicles and exploration of sustainable fuels like biofuels and synthetic LNG.

Energy-Efficient Infrastructure
Investment in energy-efficient facilities and adoption of green building standards.

Advanced Data Analytics and AI
Utilisation of AI and machine learning for route optimization and operational efficiency.

Sustainable Supply Chain Integration
Incorporating sustainability into every aspect of the global supply chain, from packaging to delivery methods.

Stakeholder Collaboration and Training
Engaging with industry partners, upskilling workforce, and aligning with global sustainability goals.

Each of the aforementioned solutions demonstrates a dedication to enhancing the efficiency and environmental sustainability of the logistics industry. These solutions aim to tackle several issues, including technological advancement, compliance to regulations, and the delicate balance between profitability and environmental stewardship.

4.6.2 Further Development

As the logistics industry continuously evolves, the relentless drive for innovation in GSCM and environmental sustainability becomes increasingly crucial. Given the quick pace of technological advancements, it is highly likely that corporations such as DHL, UPS, FedEx, Maersk, and MSC would actively pursue advanced solutions. Future developments may include the integration of autonomous vehicles for delivery and warehousing operations, further adoption of AI for predictive analytics and logistics optimisation, advanced biofuel technologies, and more thorough digital supply chain management tools. The push to meet both regulatory requirements and customer demands will necessitate ongoing research and adaptation, focusing on cost-effective, environmentally conscious solutions that align with global sustainability goals.

4.6.3 Reflection on Learning

During the course of my research into green solutions within the logistics sector, my knowledge of environmental sustainability within supply chains has undergone substantial enhancement. This research illuminated how logistics service providers are not just reacting to environmental challenges but proactively shaping a more sustainable future. The findings of my research unveiled the complex interplay among operational efficiency, technological innovation, and environmental stewardship. This experience has broadened my understanding and appreciation of the complex dynamics that exist. Moreover, it has underscored the significance of collaborative efforts and the sharing of technological developments in fostering collective advancement.

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