Implementing Sustainability Initiatives in Logistics

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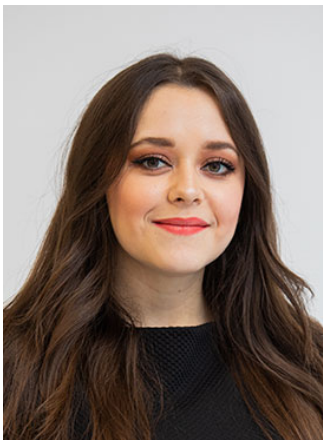
Summary:
This thesis proposes a dynamic model for identifying sustainability opportunities in a pharmaceutical company. Setting a target for cutting logistics related greenhouse gas (GHG) emissions is a new experience for most companies. The main goal is to understand and measure GHG emissions generated per unit of output during the transportation flow framework.



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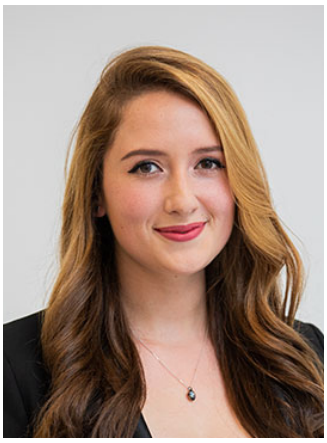

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KEY INSIGHTS

1. The company's strategic goal of replacing air routes with sea transportation is precise, as the air mode totally reflected the highest CO_2e per thousand tonne-kilometers and the transition of the most pollutant routes per origin location resulted in a beneficial proposal for a decrease in the total CO_2e emissions WtT and freight costs.
2. The model creation through the defined routes will help to strength the control of the emissions generated in the warehouses (Scope 1&2) and of the direct primary suppliers (Scope 3), contributing as a device to track the system and make more accurate decisions on the desired tradelines and the supplier agreements.
3. The key benefit of the model is its possible replication for other/new routes considering changing or adding the variables and constraints that would be respectably involved, this dramatic improvements in its supply chains sustainability performance not only would reduce costs significantly but also allow for strong growth and profitability for the company.

Introduction

In recent years, environmental responsibility has found its way into the international agenda and the relevance of the topic has intrigued the freight transport sector. According to a study in sustainability and resource productivity from McKinsey & Company (2019), a worldwide management consulting firm, most of the environmental impact associated with the consumer sector is embedded in supply chains.

Although consumer companies incur more in social and environmental costs than their own manufacturing operations, 80% of greenhouse-gas (GHG) emissions impact air, land, water, geological resources, and biodiversity, but only 25% of companies are engaging their suppliers to address the Scope 3 emissions (Nyquist & Rogers, 2019).

Multinational consumer companies have more awareness of integrating carbon emissions in supply chain management and minimizing the undesired side-effects of their operations on the environment. Starting from a greenfield project with no established structure in place, the expectation of the sponsor company is to be the pioneer by committing to the implementation of sustainability initiatives that define

a clear policy contributing to a better carbon footprint in the bottom line.

Due to the increasing pressure from regulators, shareholders, employees, and customers to make their supply chains more sustainable, companies around the world are paying more attention to their environmental impact considering the declaration of the United Nations Sustainable Development Goals in 2015 (McKinnon, 2018).

The transportation sector is considered the main growing contributor to global climate change, and according to International Transport Forum, freight transport is mainly responsible with about 39% of its releases. In Europe, freight constitutes 6% of its total CO_2 emissions, and worldwide around 8% of CO_2 emissions (Punte, 2019).

Despite this acknowledgment, freight transport has been identified as one of the hardest socioeconomic activities to decarbonize due to a continued robust growth justified by economic development, cross-sectoral decarbonization, and the climate-proofing of settlements and infrastructure. This future growth is expected to have a triple increase in freight tonne-kilometer between 2015 and 2050, and a rise of freight transport emissions from 3.2 to 5.7 Gt CO_2e. (McKinnon, 2016:2019).

Considering this described complex situation around the world, the thesis sponsor company is a European multinational firm in the pharmaceutical sector that works towards commitment, integrity, and excellence in all their products and philanthropic activities. Consequently, they decided to analyze the impact of their transportation and logistics activities from their main warehouses' location of Dublin-Ireland, Ballerup-Denmark and Vernouillet-France.

According to European Commission Eurostat (2018), for the main centers of distribution of the company, the economic activity excluding households that represents the highest amount of greenhouse gas emissions is transportation and storage. This activity represents approximately 56% of the emissions in the total production activities in Denmark, 24% in Ireland and 13% in France.

This project aims to develop a dynamic model that helps the firm to identify sustainability issues by understanding and measuring the greenhouse-gas emissions generated per unit of output during the transportation flow framework of each site. Measuring the releases in the warehouses, which involves Scope 1 emissions for the direct emissions produced by the firm's activities, and Scope 2 emissions for the indirect emissions of the energy and water consumption. Following this, the measurement of the direct primary suppliers' releases with Scope 3 emissions represent all the indirect emissions excluding those from Scope 2, that are generated as part of the company's upstream and downstream supply chain and logistic activities.

Methodology

Because of the complex and shifting nature of supply chains, there is no international standard for companies to follow regarding footprint measurement in logistics. Therefore, to be able to provide accurate carbon footprint accounting in freight transport without a globally and recognized certification, the information on different guidelines and standards sources was compared and compiled to follow an appropriate framework to achieve the objective of the company of ensuring transparency and a higher degree of sustainability performance in collaboration with the direct primary logistics suppliers. The project applies mainly the GLEC Framework principles because it covers all the main factors for the carbon footprint accounting, direct and indirect emissions, all modes of transportation and scopes, and it homogenizes and harmonizes the data.

This framework, the Global Logistics Emissions Council (GLEC)[1], was developed in partnership with leading multinationals, associations, and experts in freight movement as the first universal methodology of calculating the carbon emissions in the logistics services. The GLEC Framework provides helpful guidance for accounting and reporting greenhouse gas emissions based on existing practices from relevant associations within a single framework ensuring simplicity, transparency, accuracy and flexibility. It plays a crucial role in tracking and reducing carbon emissions from freight transport by providing a common language to manage climate impacts (Greene and Lewis, 2019).

The GLEC Framework links the base methodologies and the different modes of transportation to make them comparable by using the emission factors that arises from the fuel use. Therefore, the homogenization of transport modes helped to define the project not by product but by a specific route.

[1] **GLEC Framework:** https://www.flexmail.eu/f-844a1f54174eb51e

Data Collection and Main Formulations

There were two challenges faced in the data collection stage. First, the information of warehouses is not commonly registered separately from the other activities within a company; therefore, some of the values were given as approximations with reference of the total production cycle. Second, the data collection from the direct primary transportation suppliers is part of the indirect third scope; hence, this information management was not within the control of the company but of the business partners and their willingness to share their records.

The main register of the emissions accounting in the transportation flow within the company warehouses and the LPS services, would be given by the calculation and knowledge of Greene & Lewis (2019).

$$\text{Warehouse kg } CO_2e = \sum_1^n (fuel\ consumption(kg) * fuel\ emission\ factor\ (\tfrac{\text{kg } CO_2e}{kg\ fuel})) + \sum_1^n (refrigerent\ consumption(kg) * refrigerent\ emission\ factor\ (\tfrac{\text{kg } CO_2e}{kg\ refrigerent})) + \sum_1^n (energy\ consumption(kWh) * energy\ emission\ factor\ (\tfrac{\text{kg } CO_2e}{kWh\ energy})) + \sum_1^n (water\ consumption(m^3) * water\ emission\ factor\ (\tfrac{\text{kg } CO_2e}{m^3 water}))$$

$$\text{Route kg } CO_2e = \sum_1^n (total\ tkm * fuel\ efficiency\ factor\ (\tfrac{\text{kg fuel}}{tonne-km}) * fuel\ emission\ factor\ (\tfrac{\text{kg } CO_2e}{kg\ fuel}))$$

$$\text{Route kg } CO_2e = \sum_1^n (total\ tkm * CO_2e\ intensity\ factor\ (\tfrac{\text{kg } CO_2e}{tonne-km}))$$

Starting Point

The company has established a Corporate Social Responsibility Policy and is working on a suitability strategy for 2025. With the greenfield project in mind, its current objectives include establishing a regulation for airfreight expeditions. To accomplish the strategy goal of reducing freight costs and carbon footprint, the airfreight is not considered by the company as a standard transportation option, as it is up to ten times more expensive to use airfreight for a standard-size shipment.

The following information was provided by the firm, regarding the amount of CO_2 grams emitted by each mode of transport per 1 ton of goods per 1 km according to the updated shipping guidelines in 2019: 3 g by sea, 47 g by road and 560 g by air. Its actions have led the company to reflect in the environmental performance of 2017 a percentage decrease of 4.3% compared to the previous year.

The proposed measurement methodology is considered highly related to the current guidelines of the company, since after the input of the specific characteristics given by the main 3PLs, the average amount of CO_2 grams emitted by each mode of transport per 1 ton of goods per 1 km to be used in the model corresponds to 3.5 g by sea, 40 g by road and 568 g by air.

Model Structure

The model design includes in its composition Excel Sheets with the input data of the Scopes 1, 2 and 3 according to the templates provided and information shown in the TtW[2] Detailed Report and WtT[3] Detailed Report, as well as a detailed cost analysis of the warehouses consumption types and the monthly costs presented by transport mode in the Costs sheet. The output of the model is shown in the WtW[4] Basic Report, the Performance, WtT per location, WtT per transport mode, Ranking and Alternative.

Emissions Impact and Alternatives

The final model output showed a total CO_2e WtW emission of 1,871.5 tonnes in the 12-months scope analyzed. Denmark represented 356 tonnes of CO_2e WtW, France with 291 tonnes of CO_2e WtW and Ireland with 1225 tonnes of CO_2e WtW. Pointing out, this parameter allows to account the release carried out with the freight transport, however, a comparison of the most polluting location cannot be established since the number of tradelines determines the value for its total calculation.

Furthermore, it can be determined that for all the sites, the WtT CO_2e produced by the transport from each source location represents more than half of the total WtW CO_2e, even representing 91.8% for Ireland. Regarding TtW CO_2e, France produces a greater release due to its higher energy consumption. Additionally, it is important to mention that for the three origin countries the mode of transport with the highest CO_2e WtT emissions is the air mode, which represents 92% of the CO_2e WtT emissions in Denmark, 85% in France, and 89% in Ireland.

Considering the financial performance of the company in these three main locations, the total cost related to the WtW freight is € 3,510,591.43. For the warehouse TtW cost, Denmark represented the most expensive facility due to its highest energy and water costs. For

[2] **Tank-to-Wheel (TtW):** Final energy consumption and vehicle emissions, equal to the operation.
[3] **Well-to-Tank (WtT):** Upstream energy consumption and upstream emissions, equal to energy provision, production, and distribution.
[4] **Well-to-Wheel (WtW):** Total energy consumption and total emissions is the sum of operation and upstream figures.

the transport WtT cost, Ireland represents the highest value for origin country with a total of € 2,507,784.39, but once again it can be attributed to the number of shipments departed from it; consequently, the latter also represents the highest WtW cost.

Thinking about a more precise evaluation, it was analyzed the difference in terms of total CO_2e per shipment. For air transport, even Denmark presented a smaller number of flights, the impact in terms of CO_2e /flight is greater with 3,449.23 emissions but with a similar average of 3,243.93 emissions compared to other countries. For sea mode, France did not ship, however, in the case of Ireland, which presented a greater number of ships, the impact in terms of CO_2e /vessel is greater than that of Denmark with 199.7 emissions and with 56.48 more emissions compared. Then, in the case of road mode, Ireland had the highest number of shipments and also the greatest impact in terms of CO_2e /road with 98.54 emissions but with a minimum average of 59.43 emissions compared to the other countries.

In general, for the annual period determined in the thesis, it could be observed that the road mode presented the highest number of shipments with a total weight of 8,043 tonnes distributed in 1,977 shipments. However, the airfreight mode produced the greatest polluting impact in terms of CO_2 emissions per thousand tonne-kilometers with 582 releases, which represents approximately 15 times the effect of the road and 146 times the effect of the maritime.

Regarding the need of improvement tradelines given in the Top 3 Ranking per transport mode per location, it can be seen for Denmark, France, that the main pollutants tradelines with highest CO_2e WtT emissions are located in China and United States, because of the greater distance between these destiny locations and the origin warehouses located in the European Union.

Taking this into significance, the alternative option analyzed for the tradelines in need of improvement per origin location was developed considering the company's Environmental strategy of switching air transport mode to the sea transportation, as it has a lower emission intensity factor. The shifting of the routes maintained the same distance and weight and the results were positive for both an environmental and financial perspective.

Denmark showed a reduction of 28% of its total WtT CO_2e emissions and a decrease of 7% incurred in its total WtW costs. Ireland showed a reduction of 15% of its current total WtT CO_2e emissions and a decrease of 1% incurred in its total WtW costs. And France showed a reduction of 32% of its current total WtT CO_2e emissions and a decrease of 6% incurred in its total WtW costs. With this alternative option, the overall the logistics carbon footprint can have an advantage of 19% less total WtT CO_2e emissions and of 2% less total freight costs.

The model allows to have an accurate measurement output of the total WtW CO_2e emissions produced by the company within the scope time period, and allows to have a visual representation of the effect of these emissions in detail by warehouse location and the transport mode in place on each, as well as rank the need of improvement tradelines at each origin country to facilitate and give an initial acknowledgement for a decision-making starting point.

This thesis has identified the most representative factors that lead the emissions production; therefore, it will provide companies with the tools to evaluate the best actions towards a smaller sustainable disruption in the supply chain, while at the same time benefitting the company in a financial aspect because of cost minimization caused by the system optimization, a high marketing potential for taking action as pioneers in the pharmaceutical area of sustainable logistics. It is also a relevant contribution to the environmental strategy of the company since it would help to develop an approach to an eco-label possibility.

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