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The Environmental Impact of Logistics: Evaluating and Reducing the Environmental Impact of Transportation and Warehousing by Using the Example of a Pharmaceutical Company
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The Environmental Impact of Logistics
Evaluating and Reducing the Environmental Impact of Transportation and Warehousing by Using the Example of a Pharmaceutical Company

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Summary:
This thesis addresses the question of how to measure and reduce environmental impacts from logistics activities. Therefore, a measurement framework for the most relevant environmental factors - CO₂ emissions, waste production, and energy consumption - is developed and then applied in a case study to a pharmaceutical company.

KEY INSIGHTS
1. Air transportation is the driving factor in the CO₂ emissions from transportation. This can be addressed through mode shift. Other reduction activities include increased capacity utilization and fuel efficiency for truck transportation.
2. Collaboration regarding warehousing and temperature regulation methods minimizes material use and disposal in a company’s logistics chain.

Introduction
Nowadays, companies are facing increased pressure from a broad group of stakeholders to minimize their environmental impact:
Governments are increasing environmental regulations related to waste as well as emissions, forcing companies to rethink their processes in order to prevent fees and penalties. Moreover, increasing pressure from customers and the public, which poses greater awareness concerning environmental issues, also has to be taken into account. Additionally, because of increasing raw material and oil prices, a reduction of environmental impact is usually related to significant cost reducing goals.

At the same time, globalization of sourcing, manufacturing, as well as marketing of products, has extended the reach of supply chains and increased the need for global transportation and warehousing. These increased logistics activities cause multiple impacts on the environment, namely CO₂ emissions from transportation actions as well as waste production and energy consumption from warehousing activities.

Because of the constant growth of such global logistics activities, a need emerges to manage the environmental impacts from logistics activities. However, to begin to manage the environmental impact of a company’s global logistics activities, it is first necessary to measure it. It is therefore crucial for a company to clearly understand the source and quantity of its environmental impact and track it over time.

Therefore, a framework for the measurement of each of the named factors will be defined in this work and...
then applied in a case study to a pharmaceutical company’s distribution activities. Distribution in this context is understood as the storage and movement of finished goods from the destination warehouse to local warehouses. Consequently, production and packaging activities are not included in the case study, nor are distribution to and waste at the final customer.

After determining the current CO₂ emissions, waste production volume, and energy consumption, recommendations for reductions of these factors are given and quantified.

**Case Study Background**

The company profiled in this study is a major pharmaceutical company based in Europe. The central warehouse and packaging facilities are located in Europe and they serve about 40 markets across the world. The company is committed to developing and introducing new products to the market, and invests heavily in research and development. Their primary focus is on producing branded, nongeneric medicines that are sold under patent protection. In addition, most of their goods are cold-chain products that require temperature regulation transportation and warehousing conditions. Due to strict quality standards and tight regulatory guidelines, the supply chain of this company is faced with short lead times, high levels of inventory, and stochastic demand for certain products. The high value density of the products also places additional pressure on the supply chain to protect the pharmaceuticals from pilferage and tampering. These are factors that must be considered when evaluating current and potential logistics scenarios.

In order to determine the environmental impacts of the company analyzed, it was decided to employ the methodologies presented by the Greenhouse Gas Protocol [WRI and WBCSD, 2004] and by the Chartered Institute of Management Accountants [2002] for all calculations performed.

**Environmental Impacts from Logistics Activities**

The analysis of the data yields the result as seen in the following table:

<table>
<thead>
<tr>
<th>Annual Environmental Impact</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂ Emissions</td>
<td>50,000 t</td>
</tr>
<tr>
<td>Solid Waste Disposal</td>
<td>68,000 t</td>
</tr>
<tr>
<td>Energy Consumption</td>
<td>38.6 mil kWh</td>
</tr>
</tbody>
</table>

Regarding the CO₂ emissions, the analysis showed that around 95% of the emissions are caused by air transportation, while only around 5% of the emissions are caused by road transportation. Other modes of transportation play no significant role. It also showed that the vehicle capacity utilization, especially in trucks, is usually low.

Because of the high share of emissions resulting from air transportation, a shift from air to other modes of transport offers the biggest potential for reduction options. However, it might also be one of the most complex ones to implement. The longer lead times require more inventory in transit as well as an increased safety inventory at the destination warehouse. Additionally, it has to be taken into account that other issues like lead time reliability, product value, shrinkage, or product safety in general have a significant impact on cost and risk of a mode shift from air to sea transportation.

Another possibility that could also significantly influence emissions is the improvement of the utilization of vehicle space. Better capacity utilization, by keeping the freight volume constant, means that less trips are needed, which leads to less CO₂ emissions. This could be achieved by either sending larger shipments less frequently, pooling shipments, or by redesigning product packaging in order to make it more dense. However, because of the high value density of pharmaceutical products, security issues like insurance limits for the total value in a shipment, have to be kept in mind.

A different option could be to increase the fuel efficiency of trucks, leading to lower fuel consumption for the same transportation performance. Research showed that basic measures such as properly inflating tires or training drivers in fuel efficient behavior might have a significant impact. However, because of the relatively small share of this mode of transportation in total emissions, the results on total emissions of all this measures remain rather limited.

For the solid waste analysis, each waste product is analyzed by the volume generated (see table below) and the environmental implications. Even though wood is the smallest component of the entire waste stream, it represents a material that could be completely avoided by introducing a plastic pallet system into this segment of the supply chain, resulting in an annual savings of over 1 million Euros.
In contrast, corrugated fiberboard comprised almost half of the entire tonnage of the waste stream, resulting from passive cooling containers used to regulate the temperature of the product. The disposal of these goods could be addressed simply by communication and collaboration of the different stages of the supply chain. Instead of disposing of these containers at the first destination, they can easily be reused further down the supply chain by local distributors and primary customers. Other waste streams, specifically plastic wrap and styrofoam, could also be significantly reduced by greater communication and collaboration about the use and utility of certain materials, and how these can be extended beyond its first destination. Also, the inherent value of the waste generated can create logistics operations that are amenable to reselling these materials to avoid disposal costs and possibly gain additional revenue streams.

In relation to energy consumption, the data collected indicated the total amount of energy being consumed to operate the central warehouse in Europe and the 40 regional warehouses in the logistics network. Until the company can identify specific functions of the warehousing operations and allocate certain energy flows to these operations, determining specific reduction strategies remains difficult. However, based on site visits and discussions with logistics providers, the main source of energy consumption was the direct cooling of goods through refrigeration, even though this method was often combined with other temperature regulation mechanisms. Due to the sensitive nature of pharmaceutical products, it is not recommended that these policies be modified unless more detailed data that specifies the cooling methods used at each facility individually become available.

The table below summarizes the complexity and impact of the discussed measures aimed at reducing emissions and waste.

<table>
<thead>
<tr>
<th>Area of Reduction</th>
<th>Measure</th>
<th>Complexity</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂ Emissions</td>
<td>Mode Shift</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td></td>
<td>Increased load factor</td>
<td>mid</td>
<td>mid</td>
</tr>
<tr>
<td></td>
<td>Increased fuel efficiency</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td>Solid Waste Disposal</td>
<td>Extend life of cooling containers</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>Plastic Pallets</td>
<td></td>
<td>mid</td>
<td>mid</td>
</tr>
</tbody>
</table>

**Implications**

Pharmaceutical companies can use the information from this case to measure, manage, and possibly minimize the environmental impacts of their logistics and distribution functions. For further actions, it might be helpful to collect further-reaching data and also standardize the data collected as well as the data collection process. Another possible action could be to extend the scope of the study. Although this study extends only to the regional warehouses, it could be expanded to include environmental impacts of the supply chain downstream of this point. For example, this analysis would be more robust if it included the transportation from the regional warehouses to consumers and the waste generated from the actual consumption of the goods. However, the scope of this study does allow pharmaceutical companies to understand the magnitude and nature of the environmental impacts over which they have greater control and influence. Testing the reduction strategies within this scope makes it easier for them to understand how to minimize environmental impact. This information can then be passed down to other entities in the supply chain, and the pharmaceutical company can assume a more active role in helping to manage those impacts for activities further removed from direct company operations.

**Cited Sources**
