MIT SCALE RESEARCH REPORT

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The Global SCALE Network allows faculty, researchers, students, and affiliated companies from all six centers around the world to pool their expertise and collaborate on projects that will create supply chain and logistics innovations with global applications.

This reprint is intended to communicate research results of innovative supply chain research completed by faculty, researchers, and students of the Global SCALE Network, thereby contributing to the greater public knowledge about supply chains.

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Measuring Carbon Footprint of Transportation
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EXECUTIVE SUMMARY

Over the course of the twentieth century, volumetric CO$_2$ concentration in the atmosphere has increased by 24%, which, according to many scientists, is causing significant environmental impact on the Planet. Since last two decades, governments are putting regulations in place for industries to manage their CO$_2$ emissions. This is prompting companies to measure their carbon footprint as a first step. Transportation related CO$_2$ emissions account for 23% of the global emissions. In this context, Print Green has undertaken the task to measure road transportation emissions of its European distribution network.

Methodology

Till date, there is little standardization in approach and framework to calculate transport emissions. The three parameters that determine the carbon footprint of a shipment are the type of fuel, the fuel consumption of transportation method, and the distance travelled, with the first two being out of the scope of our thesis. Based upon the work done by a few governmental and non-governmental entities, we have used the distance travelled approach to create a computational model that takes in raw shipment data available for five countries in Europe, and provides emissions figures for the network at various levels.

Distances travelled significantly influence the carbon footprint; however, Print Green does not have detailed access to such records. Any change in the distances will impact the network carbon footprint directly by the same factor. Hence, it is important for the company to know the distances as accurately as possible, in order to get an accurate picture of its emissions. We have used Microsoft MapPoint software to estimate the road distances between origins and destinations.

Results and analysis

Our computational model handles large sets of data and draws conclusive information about carbon emissions at country level, by direct vs. via-hub shipments, and at unitary level (pallet and shipment) for each country. Relevant additional information made available is number of orders (to different destinations) served by a shipment and analysis of number of pallets per shipment by country. Analysis of emissions split by direct, to-hub, and hub-onwards provides a better evaluation of the company’s distribution network design. This split also enables the company to understand the extent to which they control or affect emissions in their circle of influence.
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We conclude from our analysis that even though Print Green uses third party logistics companies to ship its products, it has 86% of the total network emissions within its radius of influence (as high as 90% for optimistic scenario). Also, from a network design point of view, the choice of location of the hub in each country can impact the emissions significantly.

Recommendations

Measuring the footprint and related statistics using our model is a good first step that can lead Print Green to the next set of possibilities like implementing a continuous monitoring system by month, quarter, and so on; spotting trends in emissions by region, carrier, or season; prioritizing emissions reduction efforts; aiding analysis of the root causes for large disparities between pallet-level emissions across countries; and evaluating supply chain options from a more balanced set of criteria that include emissions, apart from logistics and economics. The model can be used even in the future due to its scalability and adaptability. Incorporating new network structure, including additional countries, and updating assumptions will all be manageable with this tool. It also follows the trends of GHG Protocol, which ensures that future developments on the carbon footprint calculation can be easily incorporated.

Lack of an industry benchmark prevents a comparison, but with this tool, Print Green can involve more companies in the supply chain to participate in the exercise to measure emissions, and stay ahead of the curve.