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# The reduction of greenhouse gas emissions from freight transport by merging supply chains

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## Abstract

It is well known that freight consolidation is an effective way to improve the utilization of logistics resources. In fact, at present this policy is locally and fragmentally implemented at the operational level as it depends on the opportunities taken by carriers to consolidate freight. In this paper logistical mutualisation at the strategic level (merging supply chains) will be explored from the environmental point of view. With real data offered by two main French retail chains and through an optimization model, we are able to estimate the effect on reducing CO<sub>2</sub> emissions by merging supply chains. In addition, two transport modes, road and rail, are the considered in this paper. As regards the general dependency of the emissions produced by the modes of conveyance on their loads, the emission functions of the two modes are both piecewise linear and discontinuous functions. Therefore, by nature it is a MIP problem. The conclusions arrived at in this paper show that the logistical mutualisation proposed in this work is an efficient approach to reducing CO<sub>2</sub> emissions. At the same time, rail transport is an aspect that should be taken into account as well in achieving this objective due to its outstanding performance in terms of CO<sub>2</sub> emissions in some countries.

*Key words:* Transportation, Merging supply chains, CO<sub>2</sub> Emissions, Mixed Integer Programming, Piecewise Linear Function.

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## 1 Introduction

In a context of a global economy and fierce competition, companies made intense use of transport to cope with the demands from their customers. On the other hand, it is well known that the climate change problem and the increasing price of energy have garnered worldwide attention over the past decades. As a significant source of greenhouse gas (GHG) emissions, the transport sector is naturally concerned by global warming. As a result, improving transport efficiency is among the foremost concerns of supply chain management (SCM) initiatives. Several studies show that today the lack of satisfaction regarding transport efficiency is based both on the use of vehicles and on greenhouse gas emissions, see [18, 20, 21]. From this standpoint, the consolidation of shipments was put forward and has been recently studied in several publications, see [3, 4, 9, 22]; and it has been shown that freight consolidation may be an efficient way to achieve lower costs and reduce inventories. In fact, at present this policy is locally and fragmentally implemented at the operational level by using a 3PL for example because it depends on the opportunities available to carriers to consolidate freight. As shown in [18, 20], despite the contribution of consolidation, the mean load factor of road transport is about 70% in general, which is consistent with the result of our data [2]. Thus, new approaches in logistical organization are called for. Furthermore, the achievement of economies of scale that are profitable for both suppliers and retail chains