Chapter 6
Assessing the Environmental Impacts of Green Collaboration in Land–Sea Freight Transport

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ABSTRACT

The purpose of this chapter is to study the benefits of collaboration among shippers in less than truckload transportation and to show the role of transhipments in the collaboration. In this chapter, the authors propose a new model for the pickup and delivery problem with transhipment and time windows to study the role of transhipment in the green collaborative transportation. A transportation network with two transportation modes road and sea is considered. Different scenarios are optimized and compared in terms of cost and CO_2 emissions: with/without collaboration and with/without transhipment. The proposed model is applied to a case study with real data from three agri-food companies in short sea shipping context. With this model, the total cost and the total amount of CO_2 emissions are reduced by using collaboration and transhipment. An experimental study was conducted to illustrate this positive impact.

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INTRODUCTION

Over the past decade, firms have adopted supply chain management as a critical element of their corporate strategies, but many firms do not realize the anticipated benefits of constructing collaborative operating relationships with supply chain partners. One of the directions in supply chain management is that of making the environment a main element of quality instead of considering it as a constraint (Morana, 2013) and defining green supply chain management policies and practices (Srivastava, 2007). Moreover, the term "collaboration" is currently one of the main terms associated with logistics and supply chain management, although it can take various interpretations and is mainly related to relations among supply chain partners at different echelons of the chain (Muckstadt et al., 2001). Despite the barriers that potentially deteriorate collaboration among companies for many industries all over the world, collaboration is becoming more of a necessity than an option. Different kinds of collaboration, namely vertical, horizontal and lateral (Simatupang and Sridharan, 2002), are implemented in several relationships, even in partnerships in supply chains.

Collaboration is about organizations and enterprises working together, and can be viewed as a concept going beyond normal commercial relationships. It is a departure from the anchor point of discreteness, which underlines spot market transactions to a relational exchange, as the roles of supplier and buyer are no longer narrowly defined terms of the simple transfer of ownership of products (Matopoulos et al., 2007). One of the major collaborating mechanisms in supply chains is the sharing of resources, which can take place at the level of warehousing, production and transportation. Concerning transportation, lack of collaboration (sharing, consolidation, transhipment) across the supply chain leads to empty running of vehicles (McKinnon, 2010). If supply chain partners are willing to collaborate, either with other actors in the same supply chain or with competitor companies, then higher levels of utilization will be achieved.

However, it is not possible to examine collaboration in distribution supply chains without exploring in-depth the changes that occur at the transport system level. Indeed, the different forms of collaboration in logistics impact the form and organization of the transport systems used to distribute freight, as well as the different logistics platforms (Gonzalez-Feliu and Morana, 2011). According to Gonzalez-Feliu et al. (2013), collaboration can be carried out vertically (i.e., among complementary stakeholders at different echelons of the supply chain) or horizontally (i.e., among stakeholders of the same echelon in supply chains, sometimes under competition). D'Amours and Ronnqvist (2010) state the opportunities that collaborative planning can give to the different supply chain stakeholders and discuss the main issues in information and decisions technologies.

In this paper, the authors propose a scenario assessment to examine the suitability of collaboration among shippers at the distribution level. To do this, the authors propose a linear model derived from the operations research literature (Berbeglia et al., 2007; Parragh et al., 2007) to study the role of transhipment in green collaborative transportation. A transportation network with two transportation modes—road and sea—is considered. Different scenarios will be optimized and compared regarding cost and CO_2 emissions: with/without collaboration and with/without transhipment. To the best of the authors' knowledge, these transportation network scenarios have not been addressed until now. After the introduction, the second section will be devoted to review existing works in the literature dealing with sharing trucks for distribution in supply chain networks, collaborative transportation management and the modelling and solving processes for transportation problems with transhipments and pick-ups and deliveries. In the third section, the authors address the problem studied and present the mathematical model. Finally, in the fourth section, this study is illustrated by a case study in a short-sea-shipping context.