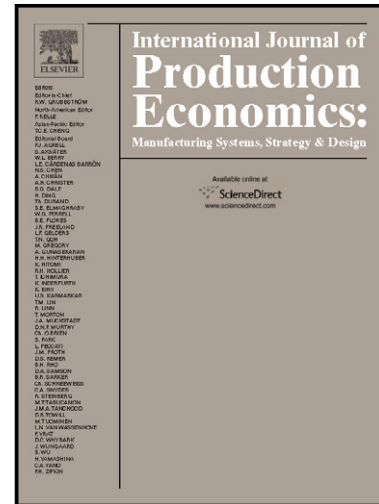


Carbon Constrained Integrated Inventory Control and Truckload Transportation with Heterogeneous Freight Trucks

Dinçer Konur



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Abstract

This paper analyzes an integrated inventory control and transportation problem with environmental considerations. Particularly, explicit transportation modeling is included with inventory control decisions to capture per truck costs and per truck capacities. Furthermore, a carbon cap constraint on the total emissions is formulated by considering emission characteristics of various trucks that can be used for inbound transportation. Due to complexity of the resulting optimization problem, a heuristic search method is proposed based on the properties of the problem. Numerical studies illustrate the efficiency of the proposed method. Furthermore, numerical examples are presented to show that both costs and emissions can be reduced by considering heterogeneous trucks for inbound transportation.

Keywords: Inventory Control, Carbon Emissions, Truckload Transportation

1 Introduction and Literature Review

Environmental awareness throughout supply chains is growing due to the regulatory policies legislated by governments (such as Kyoto Protocol, UNFCCC, 1997), voluntary organizations established to curb emissions (such as Regional Greenhouse Gas Initiative and the Western Climate Initiative) and the concerns of environmentally sensitive customers (see, e.g., Liu et al., 2012, Zavanella et al., 2013). As a result, supply chain agents review their carbon footprints, and they replan their operations or invest in carbon emissions abatement projects to fulfill their environmental responsibilities (Bouchery et al., 2011). Supply chain operations such as inventory holding, freight transportation, logistics, and warehousing activities are the main contributors to emissions generated in many manufacturing, retailing, transportation, health, and service industries.

In particular, transportation is one of the major contributors to greenhouse gas (GHG) emissions: approximately 13% of global GHG emissions in 2004 was due to transportation sector (Rogner et al., 2007). Contribution of transportation to 2010 GHG emissions of Europe Union was almost 20%: 25% of France GHG emissions, 17% of Germany GHG emissions, and 20% of the U.K. GHG emissions were due to transportation in 2010 (EEA, 2013). Furthermore, emissions from road transportation

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