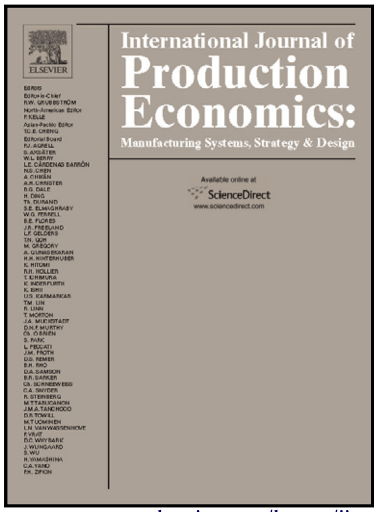
Author's Accepted Manuscript



www.elsevier.com/locate/ijpe

Modeling an inventory routing problem for perishable products with environmental considerations and demand uncertainty

Mehmet Soysal, Jacqueline M. Bloemhof-Ruwaard, Rene Haijema, Jack G.A.J. van der Vorst

PII: S0925-5273(15)00076-6
DOI: http://dx.doi.org/10.1016/j.ijpe.2015.03.008
Reference: PROECO6027

To appear in: *Int. J. Production Economics*

Received date: 27 May 2014
Revised date: 26 November 2014
Accepted date: 10 March 2015

Cite this article as: Mehmet Soysal, Jacqueline M. Bloemhof-Ruwaard, Rene Haijema, Jack G.A.J. van der Vorst, Modeling an inventory routing problem for perishable products with environmental considerations and demand uncertainty, *Int. J. Production Economics,* http://dx.doi.org/10.1016/j.ijpe.2015.03.008

Modeling an inventory routing problem for perishable products with environmental considerations and demand uncertainty

Abstract

The transition to sustainable food supply chain management has brought new key logistical aims such as reducing food waste and environmental impacts of operations in the supply chain besides the traditional cost minimization objective. Traditional assumptions of constant distribution costs between nodes, unlimited product shelf life and deterministic demand used in the Inventory Routing Problem (IRP) literature restrict the usage of the proposed models in current food logistics systems. From this point of view, our interest in this study is to enhance the traditional models for the IRP to make them more useful for the decision makers in food logistics management. Therefore, we present a multi-period IRP model that includes truck load dependent (and thus route dependent) distribution costs for a comprehensive evaluation of CO_2 emission and fuel consumption, perishability, and a service level constraint for meeting uncertain demand. A case study on the fresh tomato distribution operations of a supermarket chain shows the applicability of the model to a real-life problem. Several variations of the model, each differing with respect to the considered aspects, are employed to present the benefits of including perishability and explicit fuel consumption concerns in the model. The results suggest that the proposed integrated model can achieve significant savings in total cost while satisfying the service level requirements and thus offers better support to decision makers.

Keywords: Inventory routing, Greenhouse gas emissions, Energy consumption, Perishability, Chance-constrained programming

1. Introduction

Ensuring collaborative relationships throughout a supply chain is an effective strategy to gain competitive advantage. Vendor Managed Inventory (VMI) refers to a collaboration between a vendor and its customers in which the vendor takes on the responsibility of managing inventories at customers (Hvattum and Løkketangen, 2009). The vendor decides on quantity and time of the shipments to the customers, but has to bear the responsibility that the customers do not run out of stock (Andersson et al., 2010). The VMI policy is often regarded as a win-win arrangement: suppliers can better coordinate deliveries to customers, since the vehicle routes can be based on the inventory levels observed at the customers rather than the replenishment orders coming from the customers, and customers do not have to dedicate resources to inventory management (Coelho et al., 2012a; Campbell et al., 1998; Raa and Aghezzaf, 2009). Due to such benefits, and the increase in availability of monitoring technologies facilitating the share of accurate and timely information among the chain partners, the VMI policy has received much attention in recent years. However, execution of the VMI policy in an effective way is not a simple task, since under this policy the vendor has to deal with an integrated problem consisting of its own vehicle routing decisions and inventory decisions of customers (Campbell and Savelsbergh, 2004; Raa and Aghezzaf, 2009). This