Author's Accepted Manuscript

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www.elsevier.com/locate/omega

PII: S0305-0483(16)30599-0
DOI: http://dx.doi.org/10.1016/j.omega.2016.09.002
Reference: OME1706

To appear in: *Omega*

Received date: 7 January 2015
Revised date: 25 April 2016
Accepted date: 6 September 2016

Cite this article as: Marcus Brandenburg, A hybrid approach to configure eco-efficient supply chains under consideration of performance and risk aspects, *Omega,* http://dx.doi.org/10.1016/j.omega.2016.09.002

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A hybrid approach to configure eco-efficient supply chains under consideration of performance and risk aspects

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Abstract

Formal models that support multi-criteria decision making represent a strongly growing area in sustainable supply chain management research. However, uncertainties and risks are seldom considered in quantitative models for green supply chain (SC) design. The paper at hand suggests a hybrid approach to configure an eco-efficient SC for a new product under consideration of economic and environmental risks. Discrete-event simulation is applied to assess the financial, operational and environmental performance of different SC configuration options while the value-at-risk concept is adapted to evaluate related SC risks. The analytic hierarchy process is employed to solve the resulting multi-criteria decision problem of choosing the best option. The approach is illustrated at a case example of a fast moving consumer goods manufacturer.

Keywords: Supply chain management, Supply chain risks, Carbon emissions, Discrete-event simulation, Analytic hierarchy process, Fast moving consumer goods

1. Introduction

Selling desirable products and operating efficient supply chains (SC) represent two sources of competitive advantage in today's globalized business environment. Especially in the fast moving consumer goods (FMCG) industry, growing stress of competition and rising consumer expectations increase the manufacturers' pressure to innovate and thus result in shortening product life cycles (PLC). Although a new product is most often launched into an existing manufacturing network (Chauhan et al., 2004; Amini & Li., 2011), FMCG manufacturers need to establish a product-specific SC, e.g. by deciding upon the product-plant allocation in the manufacturing network, in order to maintain efficiency and effectiveness (Schilling et al., 2010). Related decisions on the SC configuration for a new consumer product have to be made prior to product launch, because a short PLC complicates the rearrangement of the SC configuration after the launch (Graves & Willems, 2005). As a consequence, SC configuration decisions are based on uncertain information about future demands of the new product (Amini & Li., 2011). Several studies illustrate that a wrongly estimated market reception of a new consumer product can result in an inefficient and unprofitable SC configuration (Higuchi & Troutt, 2004; Amini & Li., 2011; Amini et al., 2012; Brandenburg & Schilling, 2012; Brandenburg, 2015). Therefore, all phases of the PLC have to be considered when deciding upon the

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