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An Integrated Optimization Model for Single-product Supply Chain Network Design Considering Supplier Selection

Hao Yu[1], Wei Deng Solvang[1], Shiyun Li[1,2]
[1]Department of Industrial Engineering, Narvik University College, Narvik, Norway
[2]College of Mechanical Engineering, Zhejiang University of Technology, Hangzhou, China
e-mail: {Hao.Yu, wds, Shiyun.Li}@hin.no

***Abstract*—Supply chain management has become increasingly important due to its predominant role for companies to survive in today's rapid-changing market. Managing supply chain in an efficient and effective manner will maximize both profitability and sustainability of the companies within it. Supply chain network design (SCND) is one of the most important strategic decisions in supply chain management and therefore has never lost its appeal to both researchers and practitioners. This paper presents a novel research on the network design of a simplified single-product multi-sourcing multi-facility supply chain. The proposed optimization model incorporates supplier selection with SCND, which is rarely referred in previous literature, and aims to determine the optimal supply chain network configuration in terms of the number and locations of facilities, material flows and supplier selection. Furthermore, numerical experimentation and discussion for future development are also presented for giving a deep insight of this paper.**

Keywords—Supply chain network design; supplier selection; computational optimization

I. INTRODUCTION

In today's rapid-changing market, the competition between companies is no longer products vs. products, but supply chains vs. supply chains [1]. Effective and efficient management of a supply chain will benefit all the players within it in terms of both profitability and sustainability. Supply chain network design (SCND) is one of the most important strategic decisions in supply chain management due to its significant and long-term influence on overall supply chain performance. A well-planned supply chain network will minimize the costs of production, storage and transportation, while maximize the economy of scale and responsiveness to customers' requirements. A poorly developed supply chain network will, however, perform in an opposite way, which may result in the failure of a company or a supply chain, furthermore, it is also extremely complicated and costly for the redesign and reconfiguration of a supply chain network [2]. Therefore, it is of predominant significance to establish comprehensive optimization "toolbox" for the design and planning of supply chain network. In this paper, an integrated optimization model is developed for network design of a single-product multi-sourcing multi-facility supply chain, in which supplier selection is taken into consideration.

The rest of this paper is organized as follows. Section II provides comprehensive literature review of SCND models, and a short comment is also given to explain the significance of this study. Section III formulates the integrated optimization model for SCND accounting supplier selection, and the numerical experimentation is presented in section IV to illustrate the applications of the proposed model. Section V outlines some future improvements of this study, and section VI concludes this paper.

II. LITRERATURE RESEARCH

SCND is the design and planning of the physical network structure of a supply chain [3]. Due to the significant influence on long-term profitability and sustainability, SCND has never lost its appeal to both researchers and practitioners, and a rich literature is provided by previous studies for deciding the optimal facility number and locations, material flow as well as environmental impact of a supply chain network.

Wu and Zhang [4] formulate a nonlinear integer programming (NLIP) model for the design of a single-sourcing multi-products location-inventory supply chain network, and a cutting plane approach is also developed based upon polymatroid inequalities for model computation. Fornandes et al. [5] develop a mixed integer linear programming (MILP) model under deterministic input parameters for planning a multi-level multi-product multi-entity supply chain network in petroleum industry, and the model is tested in a real-life case study of Portuguese petroleum SCND. Sheu and Lin [6] introduce a multi-objective programming (MOP) model combined with hierarchical cluster analysis method for global logistics network design and development, and the goal of this model is to simultaneously optimize the initial set-up investment, overall profit and customers' satisfaction rate of the global logistics network. A mathematical model is proposed by Roni et al. [7] for SCND of mixed biomass combustion in coal-fired power plant, and a benders decomposition-based heuristics is also given in this paper to resolve the optimal solution.

With the promotion of sustainable development, increasing attention has been attached to the environmental issues of SCND, and the design and planning of supply chain network in an environmentally friendly and sustainable manner become

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