Chapter 7
A Review of Optimization Techniques for Supplier Selection and Order Allocation

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ABSTRACT

Supply chain is an integrated process in which a group of several organizations, such as suppliers, producers, distributors, and retailers, work together, and where activities such as procurement, production, distribution and demand planning must be addressed. The selection of suppliers is one of the most crucial activities in supply chain management and is conditioned to factors such as lead time, responsiveness, and capacity. This chapter presents an overview of the state of art techniques regarding optimization of supply chain management focussed on the selection of suppliers and order allocation as well as optimization objectives and includes some practical applications. Apart from presenting some of the most common problem categories and optimization techniques, a comparison is provided suggesting the growing importance of heuristic and metaheuristic-based artificial intelligence techniques, given the increased complexity of supply chains and its non-deterministic nature.

INTRODUCTION

Optimization, in simple terms, is a mathematical discipline that focusses on finding the extreme (minimum and maximum) of functions or systems (Motta Toledo et al. 2014). It is undeniable the fact that all of us are optimizers, as we all make decisions for the sole purpose of maximizing our quality of life and productivity as well as our welfare. Since this is an ongoing struggle, optimization was, is and will

always be the core requirement of human life and this fact yields the development of a massive number of techniques, starting from the early ages of civilization until now (Kiranyaz 2014). Additionally, the development of computers, around the 60', boosted the science of optimization due to the fact that calculations with higher complex level and large scale could be done in much less time (Theodossiou, Karakatsanis, and Kougias 2014). This began a new era for optimization, with the presentation of new and more accurate techniques like: heuristic and metaheuristic (Zare-Reisabadi & Hamid Mirmohammadi, 2015), belonging to categories such as: linear programming (Jung, Jeong, and Lee 2008), multi-objective programming (Varsei and Polyakovskiy 2015), stochastic programming (Theodossiou et al. 2014), among others. Those techniques were applied on a wide variety of cases such as: supply chain (Garcia and You 2015), energy efficiency (Wu, Xia, and Wang 2015) and financial (Pan 2012).

A supply chain (SC), can be viewed as an integrated and synchronized system with ordered processes: acquisition of raw materials, transformation of raw materials into finished products and the distribution of these products (Fahimnia, Farahani, and Sarkis 2013), where the selection of suppliers has an critical impact on the performance, considering that it is an important component of production and logistics management for many organizations (Setak, Sharifi, and Alimohammadian 2012). In today's competitive world the success of an organization is highly dependent on the selection of proper suppliers, also, the supplier's capacity constraints demand that buyers order quantities from multiple suppliers being the total demand split. So, they should decide what to buy or make, from who and how many (order allocation), as well as when, being either single or multi-period (Setak et al. 2012) actions. More recently and corresponding to a global trend (United Nations Development Programme 2017), the supply chain management (SCM) has matured from a field that was only addressed from an operational and economic perspective to one that integrate and consider the broader environmental and social issues, giving rise to the green supply chain management (Zinciri et al. 2018).

The main purpose of this chapter is to provide a review of the literature on the optimization field and how it is applied to supply chain management, more specifically to supplier selection and order allocation. The chapter firstly presents a description of supply chain and green supply chain management, including objectives and methods followed by the scope of optimization, history and management techniques. After, a review is given on the applications of optimization techniques in the fields of supply chain management with a focus on supplier selection and order allocation. Additionally, considerations regarding the different optimization techniques are addressed, compared and discussed. This review considers published research in the last five years from indexed databases and with high impact factors, focussed in optimization techniques applied to supplier selection.

OPTIMIZATION TECHNIQUES USED IN SCM

The concept of Supply Chain Management (SCM) is credited to Oliver & Webber (1982) given that they have helped to integrate procurement, operations and distribution into a more unified field giving rise to an increased interest in the field. Since its beginning, there have been some theory development, however there is a crucial point that might be a large omission and oversight in the conceptualization and emerging theories of Supply Chain (SC) (Eskandarpour et al. 2015). The current perspective of SC is usually oversimplified whether we think of it as a chain or a network. The SC can be defined as an integrated system synchronizing a series of interrelated business processes in order to: acquire raw materials and parts, transform the raw materials and parts into finished products and distribute these products to

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