

# Chapter 15

## The Importance and Applicability of Metaheuristics in Supply Chains: Trends, Gaps, and Methodologies

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### **ABSTRACT**

*The new technologies brought to life by Industry 4.0 have led to the transformation of the digital world and thus supply chains. To continuously improve speed, accuracy, efficiency, and quality, it was necessary to drastically change the information flow and improve the optimization processes. The complex and complicated tasks of supply chains belong to the difficult-to-solve, np-hard complexity class. In many cases, metaheuristics are used to solve these problems, which can provide results much faster than exact methods, but in many cases, they fall short in terms of accuracy. According to the authors, the use of metaheuristics should be treated as part of some kind of trade-off. These algorithms are usually compared to each other, not to a different kind of optimization procedure, and they do not observe the point that can determine which method is the more favorable, more profitable procedure. The authors present the above topic in this chapter, which helps to reveal further research gaps and new research directions.*

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## **INTRODUCTION**

One of the most decisive changes in company structures in the last decade is the organization of supply chains. The specialists realized that it is not individual companies, but supply chains that compete with each other in the global market. Agility has become an important strategic indicator for businesses (Lebosse et al., 2017). They also recognized that individual companies depend on the information and resources of other members of the supply chain (Taghipour, 2014). Since the goal is always to maximize the level of customer service, the path leading to this led to solving increasingly complex tasks. Due to this, the optimization of processes gained more and more space and the number of solution options began to grow exponentially. There are many methods for solving a given task, and researchers have placed more and more emphasis on finding and testing the techniques that achieve the best results. Countless theoretical studies have been created to introduce new optimization procedures to solve a given problem, but many of them remain only at the theoretical level. Exact and heuristic methods offer so many possibilities for solving tasks today that it is difficult to decide and find the best method. But what needs to be examined in order to be able to decide for a given task which optimization procedure is worth using, to call their help for human work? The authors believe that optimization is always a part of some kind of trade-off, as processes have to be compromised at some point: either the calculation time will be longer, or the solution will be less accurate. In general, these two biggest topics push the boundaries of scientific life. Countless factors influence a good algorithm or a heuristic solution, which cannot be used in all cases, even if we want to solve the same problem. Therefore, it is not possible to clearly state which method can achieve the best result for a given problem, since even a data modification or an additional condition can significantly increase the calculation speed or even the accuracy of the optimal solution. This is also why it is difficult, for example, to adapt metaheuristic algorithms to specific problem solutions, even if the algorithm's pseudocode can be found in a scientific work.

The type of supply chains is usually determined by the main activity of the central company, so the design of the chains may vary depending on the industry, which is a separate field and difficult to analyze due to the variety. However, the basic structure of the supply chains is the same in many cases, so it is possible to examine them with the help of Industry 4.0 technologies. The fourth industrial revolution is characterized by increased flexibility, increased productivity, increased efficiency and, of course, sustainability, all of which are essential to ensure the company's competitiveness. Industry 4.0 therefore has an outstanding impact on industrial processes, including logistics and supply chains.

It is fundamentally important to analyze supply chains from several perspectives, for example, Gao et al. (2018) examined the problems related to the coordination of

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