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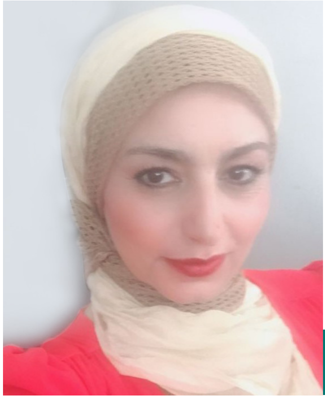

Supply chain management and optimization in transportation logistics

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Editorial

Supply chain management (SCM) is the decision-making process that steers numerous activities in order to generate added values for all stakeholders. The aim of this process is to optimize each activity in terms of advantageous profits to the suppliers, retailers and customers. In addition, the efficient planning of activities can be profitable for product development, sourcing, logistics and all flows that can link those activities. SCM can also be seen as the process of optimizing a set of decisions that generate cost-effective solutions which provide efficient plans for acting on numerous levels while considering all decision-making standpoints. SCM can therefore be defined as the set of activities utilized to efficiently integrate the different elements of the SC so that products are produced and distributed at the right quantities, to the right locations and at the right time, in order to maximize system, gain while satisfying service-level requirements.

One of the most effective activities in the SC is the transportation and delivery of products to traders and end users. As this activity impacts all stakeholders, it has a direct effect on the pricing policy of the final products.

In the area of SCM, transportation problems are related to determining optimal routes for vehicles going from one or more distribution centers to a set of customers' locations. These problems are known as vehicle routing problems and have a fundamental economic importance in the field of distribution and customers' satisfaction. The main objective of transportation logistics is to deliver predefined demands to a set of customers while minimizing the transportation costs. Alternatively, the transportation logistics can be viewed as finding the set of routes for a predefined set of vehicles while satisfying all customers' requirements. By involving additional constraints on routes' construction, various types of transportation logistics problems are stated.

Today's complex global supply chains are full of uncertainty. The volatile economic environment and customers' demands variability require supply chains to be able to anticipate, control and react to disruptions and volatility, in collaboration with customers, suppliers and logistics partners. In order to restore SC stability, companies are looking for ways to optimize their global SC operations and execute on a customer value strategy of selling and fulfilling the right products and services at the right price, place and time. Transportation is one of these world players that have a daily struggle to offer their customers not only the best products but also the best experience, at the right time, price and quality. The main purpose in the delivery activity is to optimize the transfers between all sites that can produce different varieties of items and make sure they are available in the right quantities demanded at the right point of sale. Traditionally, two alternative objectives are considered:

the minimization of the total distance traveled or the minimization of the total travel cost. This minimization is subject to system constraint as the route continuity, the delivery to each customer once and the fulfillment of trucks' capacity limitations. The delivery problem thereby specified gives rise to a routing solution that uses a subset of the available trucks while detailing each truck's pathway.

To sum-up the above discussion, we can say that the delivery in the SC consists of specifying:

- *A warehouse that constitutes a procurement source for customers' orders.*
- *A set of customers to be served, their locations, their demands and the tie windows for the delivery of their orders.*
- *A set of available trucks to be used for the delivery of orders.*

Hence, given such input data, the transportation logistics consists of minimizing the travel cost of the set of trucks used for the delivery process, while fulfilling routing constraints. Hence, the delivery in the SC can be formally modelled as an optimization problem which is a formal specification of a set of proposals related to a specific framework that includes one decision maker, one or several objectives to be reached and a set of structural constraints. Optimization has been practiced in numerous fields of study as it provides a primary tool for modeling and solving complex and hard constrained problems. Throughout the 1960s, exact and approximate approaches received considerable attention as useful tools in solving optimization problems. Depending on the problem structure and its complexity, appropriate solution approaches were proposed to generate high quality solutions in a reasonable computation time. Several optimization studies were designed in such a way to find the best solution, which corresponds to the optimal value of a single objective function. The challenge of solving combinatorial problems lies in their computational complexity since most of them are hard constrained. This complexity can mainly be expressed in terms of the relationship between the search space and the difficulty to find a solution. The search space in combinatorial optimization problems is discrete and multidimensional. The dimensionality of the search space greatly influences the complexity of the decision problem.

A decision-making problem is the quantitative modeling of a problem situation. Generally speaking, a decision-making problem is split into the following three main components:

- *The decision maker(s).*
- *The objective(s) to be reached.*
- *The set of structural constraints that bound the feasible set.*

Depending on these components, we can point out the solution approaches that solve a decision-making problem. To do so, it is required for the decision maker to study the problem complexity in order to identify the class to which the decision problem lies. We can point out two main solution approaches for a decision problem: the optimization and the game theory approach. For the optimization modeling, two main classes of decision-making problems are:

1) *Constrained decision problems modeled as the optimization of an objective expressed while fulfilling a set of structural constraints that bound the decision space. In such case, the problem is designed in terms of two components: the objective and the set of constraints.*

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2) *Unconstrained decision problems that consist of minimizing or maximizing a function. The main concern is the finding of the solution value that corresponds to the global optimum. In this case, there is neither consideration of system constraints nor the range of the solution.*

Generally, the inputs and outputs (after optimization) are to be specified in order to well express the needs and the calibration of an optimization problem. For this reason, we choose, in the current part, to classify broadly solution approaches into two major categories which are exact and approximate methods.

- *Exact methods that guarantee the convergence to an optimal solution for the transportation problem. As this problem is hard, only small sized instances can be solved using an exact method.*
- *Approximate methods as heuristics and meta-heuristics, are techniques that solve problems in a reasonable runtime and memory consumption, compared to exact algorithms. But, it no guarantees the optimality of the generated solution. These methods are typically used for solving real life problems because of their speed and their ability to handle large instances. In the class of approximate methods, we point out heuristic and meta-heuristic approaches. For transportation logistics, the most used approaches are the approximate methods since the problem is very complex to solve.*

Transportation is an important activity in the SC as it influences the whole process in terms of cost and quality of service. An introductory scheme pointed out for the delivery in the supply chain. Then, we stated some basics of the transportation as an optimization problem. As the transportation activity is a hard optimization problem, two solution approaches are to be considered: exact and approximate methods. These two classes can scan all problem sizes while generating optima and near optimal solution. As potential perspectives, we can study the importance of implementing a decision support system for a right management of transportation logistics within the supply chain.

BIOGRAPHY

Saoussen Krichen *is a Full Professor in Quantitative Methods and Artificial Intelligence with an experience of almost 30 years in teaching computer science, mathematics and decision theory. She's currently Director General of the "Centre de Calcul Al-Khawarizmi" (CCK), Ministry of Higher Education and Scientific Research of Tunisia. From 2017 to 2020, she was Vice-President charged of the scientific research and international cooperation at the University of Tunis. During the period 2015-2018, she was Director of the Doctoral School, "Institut Supérieur de Gestion de Tunis", that includes data science, management, finance and marketing PhD students. At the scientific research level, she's a member of the LARODEC laboratory where she supervised 27 PhD theses and 60 master degrees. She also published around 200 papers in peer reviewed and impacted international journals and 5 scientific books related to artificial intelligence, game theory, optimization and supply chain management. She's member/leader of numerous scientific national and international projects for students' capacity building and learning processes.*