PHD Proposal
CSC 2019

Title :

Operations management to minimize costs and carbon footprint for logistic systems : application to health care systems

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Description of the thesis :

Today the requirements of customers in terms of costs and delays are in constant increase. The simultaneous optimization of the production, transport and holding activities becomes thus a key factor in the success of a company in a particular way, and of the whole supply chain in a general way. Indeed, the world competition led the majority of the industrial companies to recognize the need for taking into account all the activities of the supply chain in order to reduce their costs and to increase their reactivity vis-a-vis the perpetual trends in the market.

Supply chains, and more specifically health care supply chains, have to focus on two different objectives to reduce costs : the traveling costs and the holding costs of the products. Previous studies on the minimization of the total cost in supply chains have been done in our laboratory on different supply chains, with single or multi transporters, and single or multi customers [5, 9, 10, 11].

In this context, this work is focused on the minimization of the cost of the production, storage and transportation of the products and the carbon footprint along the supply chain. Consequently, we will have to consider both several transporters and several clients to visit, as well as the return and reuse of these products in healthcare systems. This problem is closed to an inventory routing problem (IRP) because traveling costs and holding costs will be considered. However in health care systems, there is the need to consider inverse logistic to return either the packaging of the products, the used surgical tools, or biological samples of the patients in the case of home health care. With this consideration, the problem is closed to a Pickup and Delivery Problem (PDP).

The aim of this research is thus to investigate how machine learning techniques (e.g. deep learning) can be used to improve the efficiency of meta-heuristics to improve quality of solutions found by theses latters.

This work will be organized in several steps:

1. The first step will be to analyze the structure and key performance indicators for healthcare systems based on the literature. During this phase, several supply chain integration modeling techniques will be investigated, specially in home health-care systems.
2. The next step aims to develop appropriate mathematical models based on VRP, IRP or PDP models in order to be accurate with the logic and characteristics of the studied systems. These models should then be studied to identify their complexity and mathematical properties.
3. In the third step, appropriate solving methods will be proposed. These methods will range from exact procedures (solver, Branch and Bound) to metaheuristics with appropriate neighbourhood operators. Special attention will be given to the performance evaluation of the algorithms.
4. Finally, machine learning algorithms will be studied and combined with meta-heuristics to increase the quality of solutions for studied optimization problems.

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