Proceedings of the 2018 Winter Simulation Conference
M. Rabe, A.A. Juan, N. Mustafee, A. Skoogh, S. Jain, and B. Johansson, eds.

OPTIMIZING THE IN-HOUSE SUPPLYING ROUTES IN THE AUTOMOTIVE INDUSTRY

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ABSTRACT

Many works have put their focus on the external logistics and its several applications, such as trucks routing. In contrast, the present research would like to focus on the internal warehouse's activities. Precisely, it aims to cope with the delivery of the components through the workstations inside a car-assembling company. The solutions are computed through a MILP formulation and an ILS, which executes an inter and intra-route neighborhood searches. Next, a Monte Carlo simulation method is embedded, giving rise to the SimILS. Finally, a car-assembling factory's model based on the Discrete-Event Simulation is developed through the PlantSimulation software. Moreover, the routes are studied based on likely stochastic scenarios. Concerning the results achieved so far, it is possible to state that the methodology developed outperformed the current results found in the company, regarding the number of items supplied, the number of waiting materials and the total distance traveled.

1 INTRODUCTION

The logistics field has become an important factor to differentiate a company from its competitors, regarding the customer satisfaction and the cost management, for instance. So, different businesses sectors are facing challenges to cope with the improvement of the logistics activities. Therefore, companies have realized the importance of having organized logistics procedures. In that sense, these companies are allocating loads of resources to improve their logistics activities, such as optimizing the fleet by both meetings the demand and reducing the number of vehicles. Also, computing the best set of routes along the supply chain.

On the one hand, many works have put their focus on the external logistics and its several applications, such as trucks routing and facilities locations (Braekers et al. 2016). On the other hand, the present research would like to focus on the internal warehouse's activities. Precisely, it aims to cope with the delivery of the components over the workstations spread inside a production line. In particular, considering a production line of a car-assembling factory. We highlight that this research was carried out under an agreement with SEAT S.A., which provided us with all necessary data and support. The SEAT (Sociedad Española de Automóviles de Turismo) is a Spanish company, a subsidiary of the Volkswagen Group.

Next, the research description is presented in the following chapter. It is noteworthy to observe that the text is written in the first person and the plural (we) because it is a work that has been doing in collaboration between the student and his advisor.

2 RESEARCH DESCRIPTION

The student's Ph.D. research is resumed as follows. First, we develop a Mixed Integer Linear Problem (MILP) and get it solved through the commercial solver CPLEX. Afterward, we took advantage of the solution computed by the MILP by introducing it as the initial solution of the Simulation Iterated-Local-

Search (SimILS) Metaheuristic. According to (Grasas et al. 2014) the SimILS is a proper tool to deal with Combinatorial Optimization Problems (COP). Because of the integration of simulation methods and the Iterated-Local-Search (ILS) Metaheuristic. The ILS is responsible for looking for possible better solutions over the set of feasible solutions (Lourenço et al. 2010). Also, the ILS's purpose is to limit the search for candidate local optimal solutions returned by an auxiliary-inserted algorithm. We adopted the local search as the auxiliary algorithm. So, we introduced two search strategies, which will compound the local search strategy. These searching strategies are the intra-route neighborhood searches and the inter-route ones (Penna et al. 2013).

To summarize, we computed solutions through the ILS, which executes the inter-route and the intra-route neighborhood searches. Next, we study the performance of the computed routes through a Monte Carlo simulation method. Finally, we present the car-assembling factory's model based on the Discrete-Event Simulation. The model was developed through the commercial software *PLANT SIMULATION* from Siemens. The goal is to validate the solution proposed by the mathematical model and the SimILS, regarding the defined indicators, such as the interferences along the tracks and intersections. So, we analyze the routes based on likely stochastic scenarios. Notice that this evaluation is very important for the company since it can get better prepared for future scenarios, such as the launch of a new car model.

Concerning a solution's evaluation. It is measured through the company's KPIs, which are the following ones: (i) the number of routes, (ii) the total distance traveled, (iii) the number of free spots in convoy, (iv) the waiting demand, and (v) the total supplied throughout the simulation. It is noteworthy to remember state to the reader that the routes must be kept fixed in a short and medium-term period, which means weeks.

Therefore, concerning the results achieved so far, it is possible to state that the methodology developed by this research outperformed the current results found in the car-assembling company.

To conclude, we remark the main contributions of the student's PhD project as follows: (i) to study a real in-house logistic routing problem in a car-assembling factory, (ii) to design a mathematical model to optimize these supply routes, (iii) to develop a SimILS capable of computing good solutions and (iv) to evaluate the performance of the obtained routes through a Monte Carlo and Discrete-Event simulation methods, considering a realistic and stochastic environment. It is remarkable to observe that real data was considered as well as the KPI's proposed by the car manufacturing company. Also, the company's Logistics department go interesting business comprehension through that approach.

REFERENCES

Braekers, K., K. Ramaekers, and I. Van Nieuwenhuyse. 2016. "The Vehicle Routing Problem: State of the Art Classification and Review". *Computers & Industrial Engineering* 99:300-313.

Grasas, A., A. A. Juan, and H. R. Lourenço. 2014. "SimILS: A Simulation-based Extension of the Iterated Local Search Metaheuristic for Stochastic Combinatorial Optimization". *Journal of Simulation* 10(1):69–77.

Lourenço, H. R., O. C. Martin, and T. Stützle. 2010. "Iterated Local Search: Framework and Applications". In *Handbook of Metaheuristics*, edited by Glover F. and G. A. Kochenberger, 363-397. New York: Springer.

Penna, P. H. V., A. Subramanian, and L. S. Ochi. 2013. "An Iterated Local Search Heuristic for the Heterogeneous Fleet Vehicle Routing Problem". *Journal of Heuristics* 19(2):201-232.