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CONSULTING IN-HOUSE SUPPLYING ROUTES IN THE AUTOMOTIVE INDUSTRY

Marcelus Fabri Lima

Department of Information and Communication Technologies
Universitat Pompeu Fabra
C/ Roc Boronat, 138, 08018
Barcelona, SPAIN

Helena Ramalhinho

Department of Economics and Business
Universitat Pompeu Fabra
C/ Trias Fargas, 25-27,08005
Barcelona, SPAIN

ABSTRACT

This case study presents a consulting work applied in a car-assembling company, SEAT S.A. The focus was on the Logistics field, precisely, the in-house supplying routes, which are the most important logistic flow to supply the workstations' demands. We carried out a methodology compound by the Simulated Iterated-Local-Search to compute the best set of routes to deliver the demands from the company`s warehouse towards the workstations. Concerning the results, it is possible to state that the methodology developed by this work outperformed the current results found in the car-assembling company, regarding the items supplied, the number of waiting materials and the distance traveled. Furthermore, we highlight that our methodology can deal with both small boxes and big containers classes of SKU.

INTRODUCTION

The logistics field has become an important factor to differentiate a company from its competitors, regarding the improvement of the customer satisfaction or the reduction management cost. Therefore, companies have realized the importance of improving the logistics activities, and these companies are developing projects to improve the use of the logistics resources. One example is the computation of the best set of routes to supply the in-house demand of a company, which is the main goal of the present work.

Most of works published focus on the external logistics such as vehicles (trucks) routing and facilities location (Braekers et al. 2016). The present study analyzes the internal warehouse's and production's logistics activities. Precisely, it aims to cope with the delivery of the components from the warehouse to the workstations spread inside a car-assembling line. We highlight that this study 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. The SEAT is present in more than 75 countries, with an annual volume of sales in 2017 of more than 468,000 units. Our study focuses on the internal logistics of one of its factories.

The main problem of this work consists of determining a set of fixed routes to supply the workstations in the car-assembling line. These routes cannot change in a short-term period and the departure frequency is regulated by the number of materials requests by the workstations, which is variable along the time. The requests (demand of material) is stochastic and the demand pattern can vary depending on the material. Moreover, each workstation must be supplied by a specific route among the fixed, predetermined routes set before. Next, we present the study description, methodology and results.

1 THE STUDY DESCRIPTION

To summarize the methodology, we computed solutions by applying an Iterated Local Search (ILS) algorithm, (Lourenço et al. 2010), which executes the inter-route and the intra-route neighborhood searches (Penna et al. 2013). Then, we study the performance of the computed routes through a Monte Carlo simulation method. As a result, we applied a SimILS algorithm that combines the ILS with Simulation (Grasas et al. 2014). Moreover, we carried on a parallel evaluation of an Asymmetric Capacitated VRP model (Crainic and Laporte 2012). The model was analyzed over a reduced sized instance and with deterministic data. The reason to do that is to verify the SimILS's performance regarding the results' quality. Afterword, we analyzed the routes based on stochastic scenarios defined by the company. This evaluation is very important for the company to evaluate future scenarios such as the start of production of a new car. Also, that evaluation enables the company to be better prepared when facing premises changes.

Concerning a solution's evaluation, we measure the results using the company's KPIs: (i) the number of routes, (ii) the total distance traveled, (iii) the number of free spots in convoy, (iv) the delayed demand, and (v) the total of materials supplied throughout the simulation.

Regarding the data applied, we have considered both small boxes (SB) and larger containers (LC) deliveries. The components are supplied through these classes of Stock-Key-Units (SKUs). We highlight that these SKUs must not be combined in the same route. Next, we present two tables: Table 1 that summarizes the data gathered and Table 2 depicts the results computed and a comparison between the current scenario and the proposed one. We highlight the company did not allow us to disclose further data.

Table 1: The Instances table for both small boxes (SB) and larger containers (LC).

Item	Nº of work-stations	Production-Line Level	Nº of days considered	Total Demand (units)
SB	122	524(cars/day)	22	81,341
LC	126	524(cars/day)	22	14,342

Table 2: The Results' summary for both small boxes (SB) and larger containers (LC) set of routes.

Set of Routes	Number of Routes	Distance Traveled all Periods (meters)	Free spots in convoy (Units)	Total Waiting Units	Units Supplied
SB Current	4	1,651,926	12,324	292,677	80,268
SB Proposed	4	1,376,855 (-16%)	10,675 (-13%)	225,151(-23%)	80,693
LC Current	6	3,812,907	1,428	80,004	14,152
LC Proposed	6	2,871,106 (-25%)	2,284 (60%)	33,133 (-59%)	14,156

Therefore, concerning the results achieved, we can state that the methodology developed in this work outperformed the current methodology used by the company. As a result, the company may use the new methodology to be better prepared in case of production's changes. Furthermore, we highlight that our approach can deal with the small boxes and big containers classes.

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