Chapter 20

Searching for the Optimum Number of Capacitated Materialistic Cars for an Automotive Manufacturing Cell Using a Shuffled Frog Leap Algorithm

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ABSTRACT

Due to the worldwide strengthening of the automotive sector, it presents itself as a challenge for the companies that comprise it to immerse themselves in processes of continuous improvement that contribute to increasing the satisfaction of the needs of its customers, as well as achieving a better positioning in the market. This goal is impossible to reach without proper design and management of the supply chain, consideration of issues related to logistics and inclusion of innovative techniques. In the chapter, the authors considered a manufacturing cell responsible for making the assembly of seats for the automotive industry. Waiting times and blocking of machines are incurred by not using the optimum number of vehicles to be used for the transfer of materials and the capacity with which they should count. The objective of this research is to know near-optimum quantities and capacities of the vehicles, materialistic cars, to avoid this situation. The use of mathematical formulations, simulation, and optimization techniques will be used to solve the problem.

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INTRODUCTION

Issues related to logistics in the supply chain are especially important since they are linked to most of the processes that are carried out and seen as the action of the labor collective aimed at guaranteeing the activities of design and direction of material flows, informative and financial, from their sources of origin to their final destinations that must be executed in a rational and coordinated manner with the objective of providing the client with the products and services in quantity, quality, terms, costs, place and with the information demanded, with high competitiveness and guaranteeing the preservation of the environment (Acevedo & Gómez, 2007).

Worldwide, the automotive sector is strengthened while being affected by a vertiginous growth of demand, changes in the organizational environment among other factors that makes it submerge in a process of continuous improvement that manages to increase the satisfaction of its customers and to resort to novel methods that restructure their processes, translating into profits for organizations and a better positioning in the competitive market (Restrepo, 2013).

Specifically, within the automotive industry there are present a large number of suppliers, customers, workers, parts and machines involved in the production process (Boysen, Fliedner, & Scholl, 2007; Emde & Gendreau, 2017; Sali & Sahin, 2016), so the logistics of parties is proposed as a challenge for the organizations involved (Boysen, Emde, Hoeck & Kauderer, 2015). The present study will focus on the point of delivery to line, around which a series of affectations that affect its performance may arise.

Several factors influence the client to be more demanding in terms of the characteristics of the product they demand, which means that companies deal with major challenges to meet the desired specifications and delivery deadlines, for what should be assumed by multiple distribution channels, different means and modes of transport, short life cycles and shorter delivery times for products (Restrepo, 2013).

In this sense, regulated by the increase in customer specifications and the accelerated changes that occur in the market, the life cycle of automotive vehicles increasingly tends to be smaller, so manufacturers are forced to launch a greater number of car models following a strategy of mass customization, which has been adopted by major vehicle factories such as Volkswagen, BMW or Tesla (Manenti, 2016).

However, the degree of individualization of the products is a challenge for the current factories, an environment in which flexible production systems offer alternatives to streamline production cycles and meet the needs of consumers (Flores, Vega & Chávez, 2014).

In the present investigation, it is considered a manufacturing cell which is in charge of making the assembly of seats for the automotive industry. There are workstations with cycle times that vary from one to another; work is carried out under the flexible production principle in terms of the types of seats that are processed in each machine, also varying according to the time of day in which the pieces are processed. At present, there are blocking and waiting times in the workstations due to the fact that the optimum number of vehicles responsible for moving the material from one station to another, as well as its capacity, is not known.

To solve this problem, the present investigation is carried out, being its main objective to determine the optimal amount of materialistic cars and the capacity with which they must count to avoid stoppages in the production process, using the Shuffled Frog Leaping Algorithm (SFLA). This algorithm is selected because it has been used frequently, obtaining good results in several study areas as shown in the following section.