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A heuristic approach to allocate products in a warehouse: mathematical model and real applications

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Abstract

In this study, we focus our attention on the warehouse logistics process. This project was developed in two phases: firstly, we made a comprehensive review on the basic concepts, mathematical models and some management strategies using a classical book; then, in the second phase, we propose an heuristic optimization method for positioning the products in the picking area of a warehouse, looking for minimize the walking distance to shipping orders. In the end we applied our method in a real Warehouse, aided for a partner Industrial Engineer Consulting and the results shows that our approach could reduce the tour length in all cases.

Key words: Optimization, Warehouse, Heuristics.

Introduction

The process of order picking in a Distribution Centre (DC) is the most labor-intensive and costly activity for almost every warehouse[1]. The efficiency of an order picking process greatly depends on the policy used to locate products within the warehouse[3].

In our problem, picking orders are dictating a list of products that should be separated and stored on pallets to be loaded onto trucks and then, delivered to final points of sale. In this case, we investigate a way to place the products in a given (fixed) layout in order to minimize the expect distance to retrieve the set of picking orders.

This work is part of a real project that aims to optimize the performance of a forward area in a DC of a big beverage company in Brazil and was partially presented in [3].

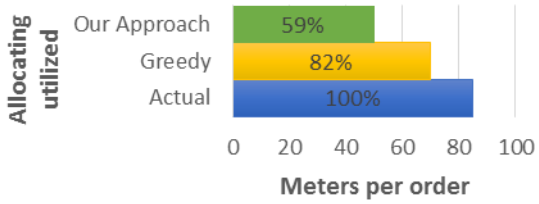
Results and Discussion

The mathematical models proposed for this problem may be viewed as a bi-level optimization because we need first allocating the products (AP) and them to solve a traveling salesman problem (TSP), to minimize the travel distance among all orders.

Those types of problems are very hard to solve using exact algorithms and so, to handle that, our approach consists of using a two-stage Simulated Annealing[2]. In the first stage, we solve an AP and then the other layer evaluate the quality of the first solution by solving multiples instances of TSP.

To improve the solution we also have used the relative frequency of items and the relative frequency with the items appear in pairs. This strategy leads us to improve the results in all real cases analyzed. In **Image 1** we compare the results obtained in a real DC of our heuristic approach with both, a greedy heuristic and the real solution we found in the practical case.

Image 1. Chart that present the average meters per order with different allocating types.



Conclusions

In this paper we studied the problem of allocate products in a warehouse in order to minimize the average distance to deliver a given set of pick orders. We proposed a heuristic optimization approach and applied our method in a real case in Brazil. The results shows that although the difference of layouts, the heuristic was able to reduce the distance in all cases, with some examples of really important gain of performance.

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