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SOLVING OPTIMIZATION PROBLEMS IN A WAREHOUSE WITH MATLAB CODE[1]

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ABSTRACT

Optimization plays an important role in reducing costs, eliminating redundant activities and saving time. Thus, the way to retrieve solutions for optimization, highly depend on the theory, mathematical methods, but first, on imagination and information about the problem. The main goal of this paper is focuses on optimizing each movement, space and extra costs in warehouse through simply concepts of solving the problems.

Keywords: logistics, warehouse, optimization, MATLAB

[1] original scientific paper

INTRODUCTION

Logistics optimization is neither easy nor cheap, but it is the biggest challenge for most companies. Optimization affects directly or indirectly almost every sphere of human activity. Primarily, optimization has a significant impact on the final price, by reducing unimportant things and activities. For instance, we wake up early in the morning to catch a bus or train on time. Our objective is to catch the bus or train on time, while we are forced to use our limited time. Thus, we choose the shortest and accessible paths to arrive from home to the bus/train station. No doubt that optimization is everywhere, from daily activities, through engineering design, to business and profits. Using a correct optimization strategy, operators could reduce the cost by 10% to 40% [1].

Any optimization problem in warehouse has several basic steps. The first step is to map the warehouse. Aim of this step is to analyze inventories and reveal the location of each product. In other words, to find objectives that could help to accomplish the optimization. Understanding which items do not drive revenues, allows for the strategy and reorganization of the warehouse space [1], [2].

Second step are models, whose goal is to translate the data by the first step, into a new form which could be understood and used. Hence, models need to be our guide, but we don't need to be blind followers. We must point out that sometimes we will not get real results, but the results needs to be nearly to the best solution [3].

So, data is what drives the optimization. If the data is not accurate or it is not received in time, the results will obviously be suspect. Anyway, every optimization problem has different “number” of steps, and different access [1].

This paper, the study of a simple optimization in a warehouse would illustrate in three phases:

•The objective of the first phase is a theoretical background about optimization in the warehouse. In this part will be illustrated information about the potential problems that affect the whole logistics process. [9]

•The second phase, gives information about a warehouse strategy where could be implement an optimization. [6] The focus of the second phase is on the simple methodology which could be used in small warehouses (or small markets) where smart-technology is on poor level.

•Finally, the third phase is review on the advantages and disadvantages of this methodology. [8] The objective of the final part of this paper is SWOT-analyze the methodology that is chosen to improve and optimize the small warehouse [10].

WAREHOUSE OPTIMIZATION

A. Usual optimization problems in warehouse

Depends on the type of decision variables, the optimization problems in warehouse could be divided into listed general categories:

•Location problems,

•Unsuitable devices and mechanization,

•Order picking problems,

•Space problem (Incompletely utilized shelves), etc.

In general, warehouse layout design models attempt to implement warehouse optimization objectives [2],[3]. Therefore, in order to achieve and realize the optimization strategy, the importance of warehouse layout design arises. The objectives of the layout design are to use the warehouse space efficiently while using every space on the shelves [7].

This data can help to keep track of the optimization while enabling a better decision- making process in the future. However, the proposed layout of this study is focused on the class based storage in small warehouses, where storing is done based on some criterion such as demand, product type, size, weight etc [8].

A study in the United Kingdom revealed that 55% of all operating costs in a typical warehouse can be attributed to order picking as shown in fig. 1. *(Tompkins et al. 2010)*.

In warehouses usually, for one product, several activities are necessary. Most of those activities can be minimized. Every movement negatively changes the shelves and the floor and it costs money and takes time. In other words, every movement of the product is an opportunity to modify the product [11].

If we have a good layout on the shelves, we can optimize the space, time and cost. We need to think about the major problems in the layout of the shelves [15]. It should be borne in mind that inefficiencies are frustrating and tedious for workers who have to take more steps to handle a task that could be completed in half of them.

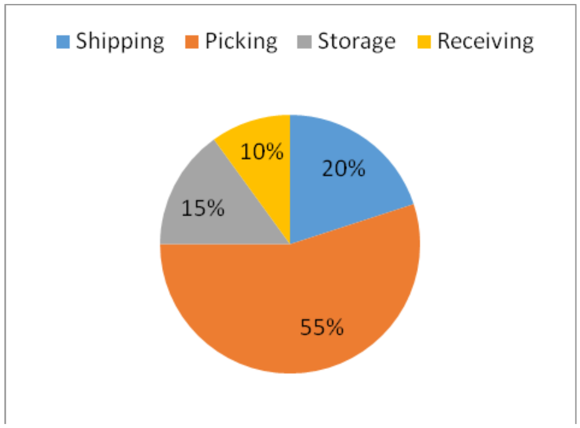

Fig. 1. Percentage of annual operating expense
(Source: Tompkins et al. 2010)

An organization also means to make layout, so things that you used the most are in front of the other products, nearly to the door etc [16]. Another important item is to recalculate in advance numbers of products that can be setup on the shelves. Sometimes there is more space on the shelf, but maybe the construction of a shelf is not designed for those performances (weight). This is one more calculation that is needed in a simply- designed warehouse [14], [17].

B. Methodology

The proposed method consists of two stages and first stage folded into three sections (figure 3). In stage one, the number of the shelves is determined and it follows the weight and dimensions of the products path in the second stage. The computation starts with the particular information of each item (number of shelves, dimensions, weight, dimensions and weights of items) is needed as shown in Table 1. In section 2, comparisons are carried out between two volumes and in section 3; the solution is generated such as maximum number of the particular item. [2], [13].

Section 1

According to the past records and current practice in small warehouses, layout on the shelves consumes a lot from the total production cost and time. In order to eliminate the inefficiencies of them, the maximum number of places of items is calculated as a program, made in MATLAB. By putting data about performances of the shelf: weight, length, width, height and the same performance of the items, the program is starting a calculation.

Section 2

Section 2 is carried out by the data input. The initial solution considers the location where the items are going to be placed based on several factors such as volumes of shelves and volumes of items. In order to finalize the number of items, the total weight of items is compared with the total allowed weight of the shelf by the standard.

Section 3

The resulting solution probabilistically by the program provides a procedure to find sufficiently good solution over the solution space and maximum allowed weight by the standard.

The best thing about this program is that the solution is feasible and satisfies and is the only one (unique) solution: (Current solution = Best solution).

MATLAB CODE AND RESULTS

The result obtained in several case studies which carried out to test the program shows that the program gives the right maximum number. To illustrate the work of the program, one standard palette will be taken as instance. Dimensions on the standard EU palette are: 120 x 80 cm, and height 120 cm. The MATLAB code takes the basic information (height, length, width) in our example it will be 120 x 80 x 60 cm, and also we need to put dimensions of one item that will be set on the palette. To calculate the number of items, the code also needs to compare total allowed weight of the palette by the standard with the weight of item. The quotient will be the maximum number of items. To be sure and to check the accuracy of the code, we calculated how many folders we can put in one shelf. The result shows that the code works correctly.

Fig. 2. Every structure converted into a four sided prism

The structure of the code is simple. We used only an if/ else- function and the standard formulas volume of a four sided prism. The code converted every structure into four sided prism, which is illustrated on the fig.2. On the fig.3 is demonstrated print text to output stream.

```
Command Window
Number of shelves
1
Height between the shelves in cm
120
Length on a shelf in cm
120
Width on a shelf in cm
80
Height of the item in cm
20
Length of the item in cm
50
Width of the item in cm
80
weight on one item in kg
5

ans =

    50

Max items in one shelf : 14items
Max items in the retail rack:14 items
fx >>
```

Fig. 3. Print text to output stream

CONCLUSION

The paper, through one simple SWOT analysis, will present how the program could be upgraded. For that purpose is used a diagram, shown in fig. 4.

In this paper warehouse functions were optimized with the help of a simple program. Results show that the proposed layout is significant in terms of time and cost. Moreover, unnecessary movements were significantly reduced. It can be concluded that the approach used to calculate the maximum item is beneficial in a small and not automated warehousing.

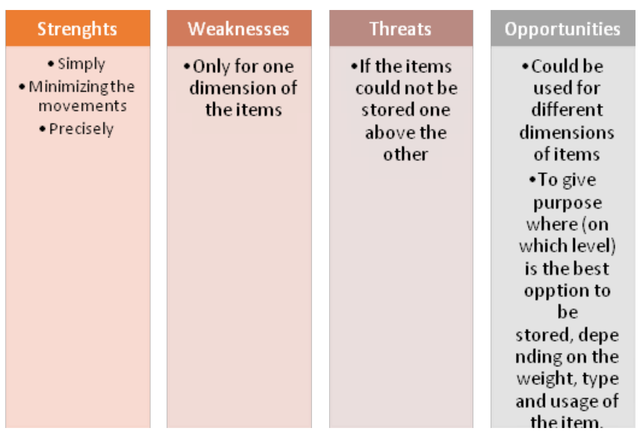

Fig. 4. SWOT analysis

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