Low-cost Reduction of Inventory in Storages

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Abstract Companies are attempting to save in every aspect of their production. That is why optimization of storages and warehouses is one of the goals of companies. There are many studies about optimization of storages and inventory reduction in big and serial production. In custom production there is also need to have simple tool for inventory reduction. This paper describes a concept of inventory reduction process for storages linked to a custom production. This process is a simple eight steps procedure which can be used without any big expenses. Reduction process is verified on a case study also included in this paper. Results shown, that with use of this process it is possible to reach almost 30% reduction of number of parts in storage and approximately 10% inventory value reduction.

Keywords Inventory reduction, spare parts, lean

1. INTRODUCTION

Nowadays, companies are trying to save in every part of its production system. Storages are not exception [2, 3, 5, 6]. There is pressure to lower the value represented by inventory inside of warehouses and storages [11]. That was proved by many authors before, for example: Pawasan and Niamnoy [9], or Lieberman and Demeester [7]. The ideal state is to store only number of parts which are needed for production. In reality it is harder, because of defects in production and possible claims there is need to have spare parts. In manufacturing where final products are often the same, there it is not a big problem. Parts are stored on some amount which allows to have unexpected consumptions from storage in case of defects and etc. Simplest way how to reduce the inventory level in this case is to implement the Warehouse Management System – a software solution [8, 4, 1] or use the Just In Time tool [10]. On the other side in warehouses and storages linked to a custom production it could be a problem. Because in a custom production it is very hard to predict if the rest of spare parts will be used in a near future project or not. That can lead to accumulation of these spare parts inside of the storage. These parts are often shortly occupying big area of the storage. Orientation in the storage is worsened and overall value of storage's inventory is bigger and bigger. This could be a big problem, because several wastes appear. The solution for it can be removing of all parts after the end of production. But what if deficiency claim comes and company needs few of these parts? The purchase cost of the few spare parts could be even higher, than costs for storing of these parts. It is also possible to find use for some types of the parts in other projects. The aim of this paper is to find a systematic approach on how to reduce inventory inside of storages, which leads to lower value of stock, lesser space requirements, and lower level of wastes, without any special warehouse management system. This paper also includes a case study from storage of glass parts from company in Czech Republic.

2. METHODS

The goal is to find types of unused parts. Parts without consumption in the production or parts with no gain into storage. Next interesting parameter is the current stock of parts - it is a difference if there is one piece without movement or thousands of them. A possible procedure to reduce the number of stock in the storage is described below and it contains eight steps.

Step 1: Determination of duration for data collection
Step 2: Data collection
Step 3: Data sorting / removing of unnecessary data
Step 4: Calculation of the comparative coefficient
Step 5: Comparison
Step 6: Calculation of amount of parts for removal
Step 7: Removing of parts
Step 8: Repeating

2.1 Determination of duration for data collection

Before the whole analysis and reduction begins, it is necessary to collect information about parts in storage. The first step is to determine from how long time span data will be collected. One of the ways could be to determinate it by duration of possible claim. Because parts can be stored for some time before production, so it is good to expect the time for storing before production begins and the duration of production itself. That means to determinate the duration for data collection like possible claim duration and one year extra. For example, if company have duration of possible claims for 3 years, collected data will be taken from 4 years long interval. This time span is chosen because of possible needs for spare parts used in claimed products.

2.2 Data collection

For an analysis data is needed. The easiest way to get the data is from information system.
For every stored type of part, there is need to know: current stock, number of consumptions, number of consumed parts, number of gains, number of gained parts, date of last consumption, date of last gain. If cost calculation is needed, it is also desirable to collect the value of stock or parts.

2.3 Data sorting / removing of unnecessary data

After data is collected, it is good to sort it and remove unnecessary parts from analysis. All parts which have zero current stock are not in storage, so they can be removed from analysis. Next step is to "remove the good parts" from analysis. Parts which have any movements (consumptions or gains) in last half year are "active parts", so they should not be reduced. That is why it is possible to remove these parts from analysis too.

2.4 Calculation of comparative coefficient

Comparative coefficient is used for deciding which types of parts can be reduced. The coefficient depends mainly on number of consumed parts and on current stock and it is defined by equation

$$K = \frac{NCP(T)}{S} \quad (1)$$

where *K* is the comparative coefficient, *NCP* is number of consumed parts per time span *T* - determined in step one, and *S* is the current stock of parts.

With low value of this comparative coefficient there is higher possibility of part reduction. In cases with no movements in the whole time span, the coefficient becomes zero, so it is obvious that these parts should be removed.

2.5 Comparison

Calculated coefficients are compared with value *1/T*, where *T* is analysis duration, determined in step one. If coefficient is lower than *1/T* value, part should to be reduced.

Comparison is described by equation

$$K < \frac{1}{T} \quad (2)$$

where *K* is the comparative coefficient (from step four), *T* is s analysis duration (determined in step one). All the parts which have lower value of *K* coefficient than *1/T*, must be reduced.

2.6 Calculation of amount of removed parts

After it is known which parts are possible to reduce, number or amount of pieces for reduction must be calculated.
From equation (2) Number of pieces in storage might be T-times a Number of consumed parts. That leads to equation for number of remained parts in storage

$$R = T * NCP(T) \quad (3)$$

where *R* is number of pieces remained in storage, *T* is determined time and *NCP* is number of consumed parts. This equation tells how many pieces of material remains in storage. Number of removed parts is then easily calculated by subtraction of remaining pieces (3) from current stock.

$$E = S - T * NCP(T) \quad (4)$$

where *E* is number of parts for removal, *S* is current stock, T is determined time and *NCP* is number of consumed parts.

From these numbers it is also possible to calculate the value of removed and remaining parts and compare it with state before.

2.7 Removing of parts

This step is practical removing of computed parts. In this step is good to think if there is way how the rest of parts could be stored better. For example, better system of shelves which could also save space in storage.

2.8 Repeating

Because parts in storage are continuously changing, the whole process must be periodically repeated, for example every year. If there is no change in possible claim duration time, it is good to begin again from step two.

The whole procedure is visualized in figure (Fig. 1)

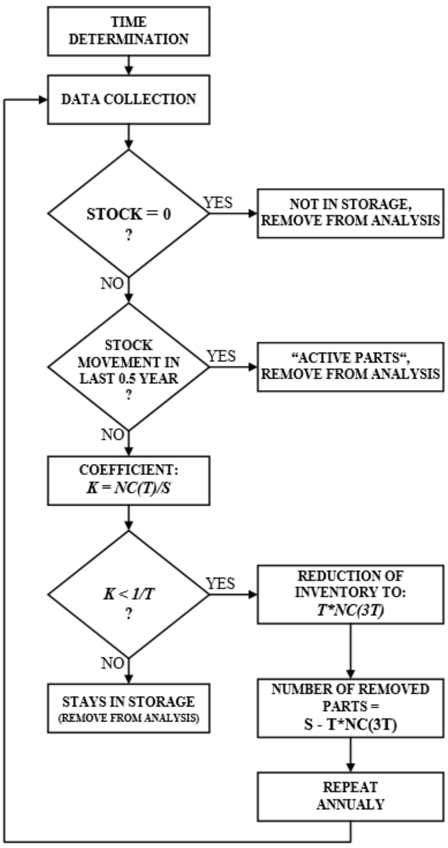

Fig. 1: Visualization of inventory reducing process

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2.9 Case study

This reduction procedure was done on a real storage in a company in Czech Republic which deals with custom production of glass and metal assemblies. Reduction was done on storage of purchased glass parts. Whole process traced the steps from figure (Fig. 1). Possible claim time of final products is two years, that is why data were collected for three years back. For collection of data, an information system software - SAP was used. Step 2 as it is described above is sorting of collected data. Data was sorted in a way for simpler work in Excel software. Deleting of unnecessary columns - there is only need for the name of parts, current stock, value of stock, and number of movements with its last date. After that, data of parts without current stock was deleted. Number of rows was lowered from 6829 to 1212 rows. After these first few steps of analysis, it is possible to determine current state of the storage. There are 83 526 pieces of parts divided into 1 212 types of parts, with overall value 7 790 451,36 CZK (Czech crowns). Next step was to remove data of active parts, that means parts with movement in last half year. Movement could be calculated as number of consumptions plus number of gains in time duration, in this case it is half of a year. Or it is possible to only look at the date of last consumption and gain. If there is any change in last half year, part is active and should be removed from the analysis. Because there is no need to reduction of active parts. Number of rows for analysis were reduced to only 594 rows, after active parts were removed from analysis. Calculation of comparative coefficient was the next step. Calculation was done by equation (1), and then, the numbers were compared with value ⅓ determined by equation (2).

3. RESULTS AND DISCUSION

Steps described above leads to case study results. Only 43 types of parts were selected for its reduction, where 12 types of parts were selected to complete elimination. Number of parts for elimination was calculated from equation (4).
24 009 pieces were selected for elimination from storage. Value of eliminated pieces is 827 442,39 CZK. All reduction results are shown in table (Tab. 1) below.

Tab. 1: Results of inventory reduction process

Category	Current state	Reduction	Reduction [%]
Part types	1 212	12	0,99%
Number of pieces	83 526 pcs.	24 009 pcs.	28,74%
Value [CZK]	7 790 451,36 CZK	827 442,39 CZK	10,62%

As Table (Tab. 1) shows, when inventory reduction process (Fig. 1) is used, there could be 20-30% reduction of number of parts in storage, with approximately 10% inventory value reduction. Real results could also depend on type of storage, frequency of projects and production processes. For the best effectivity of this tool, there is need to use it periodically. Most likely, second and every next use will have smaller effect on reduction.

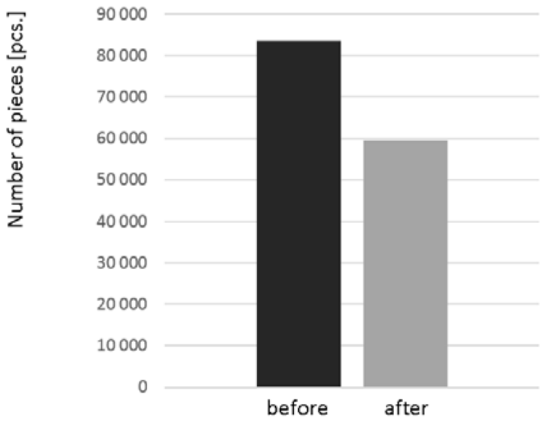

Fig. 2: Number of parts reduction

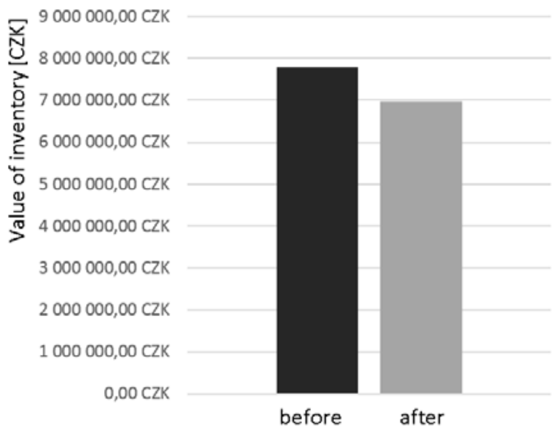

Fig. 3: Inventory value reduction

Figure 2 shows decrease of number of pieces in storage from case study above. Number of parts was reduced by more than 20%, which is relatively good result. For example in [9], the inventory reduction was only 3%. In figure 3, there is comparison of overall value of inventory in storage before and after parts reduction, also form case study above. Value decreased by approximately 10% which is also quite good result, in comparison with other results, for example [10] where value of inventory was reduced by 27%.

4. CONCLUSION

It was proved that special software management for reducing of number of parts in warehouses and storages in companies with custom production is not necessary needed. Only few basic steps and simple software (like Microsoft Excel) could help with effort to storage inventory reduction. This method is good for companies where warehouses and storages have direct link to custom production with very low probability to repeated use of same parts in other projects. And where it is needed to store spare parts for possible claims or defects in production.

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