ISSUES OF SAFETY STOCK MANAGEMENT OF SPARE PARTS IN INDUSTRIAL COMPANIES

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In recent years the development and dissemination of logistics knowledge have caused that companies have realized the need to optimize the processes related to the movement and accumulation of goods in the supply chain. On the one hand, financial aspects force companies to reduce inventory levels, on the other, the same companies, aiming at maintaining the continuity of production, must ensure safe inventory level of spare parts even for many years. The objective of this article is to demonstrate the selected issues of spare parts inventory management and to identify the criteria of selection of safety stock on the basis of the survey conducted among Polish manufacturing companies.

Keywords: Inventory, Spare parts, Safety stock, Maintenance.

Introduction

The spare parts inventory is one of the crucial material inventories required in the development of the production activity. Considering spare parts inventory management, the key problem becomes to specify the level and structure of the inventory which should be absolutely maintained in a warehouse [7]. The selection of items which need to be stored largely depends on environmental accounting. For this purpose, it is possible to use ready-made forecasting models which determine future demand taking into account historical data and potential changes in external factors [9]. In spite of the fact that the probability of exceeding the allowed lifetime of the device during long-term storage is rather high and its reliability reaches 95% to 99% in the whole lifecycle of the machine [1,5], there occurs the necessity to store the selected group of spare parts. To prevent the consequences of downtime of machines and equipment, the company ought to maintain the buffer stock of spare parts whose task is to ensure security against the threat to the continuity of production, i.e. the occurrence of failure or damage to the component.

Specifying Safety Stock

The issue of spare parts inventory management has been discussed by Z. Sarjusz-Wolski and Cz. Skowronek. The authors rightly notice that the inventory of critical parts may often turn out to be useless but its lack, in case of failure, may bring about greater financial consequences than the cost of perennial maintenance of components [2]. The specific application, stochastic nature of consumption and the time of replenishment, which is irregular and difficult to predict, determine the storage of only selected parts, in accordance with some technical, strategic and economic requirements [3]. Therefore, the level of spare parts inventory should be determined mainly by means of the analysis of risk and costs of downtime of machines depending on its duration [10].
The assessment of whether a specific part should be maintained in a warehouse, most of all, results from the degree of its criticality, i.e. the ability to survive and inactivate the production [11]. In case of criticality, the specific component may be highly or medium critical where the part required immediately is highly critical, in turn, if the removal of failure does not have to take place immediately, the part is characterized by the medium level of criticality [4].

The maintenance of safety stock mainly results from the financial loss which the company may suffer due to lack of availability of the part in the warehouse [6,8]. On the other hand, the problem of maintenance of such components is the cost of their purchase, which brings about freezing a significant part of the capital invested in this stock. The high value of costs of maintenance of spare parts is determined particularly in the course of time after they are used, from the beginning of using the machine.

On the whole, the company has a choice whether to buy the part much earlier than it is needed and to maintain it in the warehouse, at least for a few years, or whether to attempt to purchase it just before the preventive exchange or at the moment of the occurrence of failure while risking it would incur additional expenditure.

The Approach to Creating Safety Stock in Industrial Companies

The research conducted among industrial enterprises manufacturing goods in the area of Poland presents the selected aspects of safety stock management of spare parts.

While listing the data concerning the level of spare parts inventory in the value of material stocks from different industries, there have been obtained the following results presented in Figure 1.

![Figure 1](image.png)

Figure 1. The structure of spare parts inventory in valuable material stocks (%)

Source: Author’s own study.

On the basis of the received data it can be noticed that there predominate the companies where the valuable level of spare parts inventory in material stocks is lower than 26%. Every third analyzed company declared that this level reaches almost half of the value of all material stocks. There were also observed the situations in few companies when the share of spare parts inventory significantly exceeded the value of the total material stocks. The obtained results enforce a closer look at inventory management which, in case of spare parts, may be of great importance from the perspective of the financial situation.

Among all the analyzed enterprises, more than 80% of them admitted that they collect safety stock. Buffer stock, like other stocks, constitutes an important aspect of maintaining the continuity of production.
which, for many companies, particularly the small ones, is usually neglected. To check this out, there have been compared the negative answers with the size of the analyzed companies (Fig. 2).

The obtained results confirm the assumptions that the larger the company the smaller the probability of lack of safety stock of spare parts in the warehouse. Medium and large companies show greater awareness of the necessity of maintaining the specific spare parts inventory in the warehouse. This may result from the scales of costs which are proportionally borne by larger and smaller companies, where the others usually dispose of less numerous or specialized equipment or the one of a lower value.

![Figure 2. The size of the company and lack of safety stock of spare parts. Source: Author's own study.](image)

Possessing the inventory in the warehouse itself does not provide the company with the continuity of production. It is necessary to undertake additional actions effecting the security policy. One of them is the frequency of the update of the required parts, which allows for better adjustment of the warehouse to the current needs related to production orders, seasonal nature of work of machinery and equipment or repairs and inspections. The companies disposing of safety stock of spare parts indicated the following periods of update (the share indicated in Figure 3):

- more frequently than once every six months,
- once every six months,
- once a year,
- less often than once a year.

![Figure 3. The frequency of update of safety stock among the enterprises which dispose of it. Source: Author's own study.](image)
Among the analyzed companies which maintain safety stock of the selected spare parts, 43% of them update them on average more often than once a year, every third company does it precisely once every six months, 16% - once a year. Only 5% of the companies control the contents of safety stock less often than once a year.

The update of stocks is associated with establishing the minimum-maximum level for individual storage items of spare parts. Even if the part does not belong to buffer stocks but the frequency of its removal is very high, this part may be acquired conservatively, also, any repairs or overhauls justify the purchase of the part a bit earlier than they are needed. Satisfying the demand at the proper time significantly results from the way of placing orders. According to the conducted analyzes, the companies do not always establish minimum-maximum levels of orders (Fig. 4).

![Figure 4. The establishment of the minimum-maximum level for spare parts inventory.](source: Author’s own study.)

While analyzing the obtained results concerning the establishment of the minimum-maximum level for individual storage items, it was observed that almost every third analyzed company does not establish such ranges, 17% do that for all spare parts maintained in the warehouse, in turn, more than a half of the companies specify the minimum-maximum level exclusively for the selected storage items. The validity of establishing the minimum-maximum level seems to be comprehensible, particularly for the selected groups of stocks. Specifying the minimum-maximum level allows for better control of the inventory and placing orders accordingly earlier while, at the same time, providing better continuity of production. Analyzing more deeply the groups of stocks for which the companies establish the minimum-maximum level, it turned out that:

- 58% of them indicated the establishment of minimum-maximum level just for safety stock,
- 29% specified the minimum-maximum level for rotating stocks,
- 13%, in turn, indicated the establishment of the minimum-maximum level for “small” inventory.

There was no other case for which the companies would establish the minimum-maximum level for spare parts inventory.

The update of safety stock may be established on the basis of the current knowledge of the technical condition of equipment, however, the condition or lifetime of the component is not predicted in each case, which additionally justifies the fact of the maintenance of safety stock. The establishment of safety stock in the warehouse depends on many factors. To recognize which criteria and how forcefully they determine the collection of spare parts inventory, the analyzed companies made the assessment of the
significance of properties of spare parts on a scale from 1 (definitely insignificant) to 5 (definitely significant). Table 1 presents the results of the assessment of the criteria concerning the time of downtime of the machine or equipment in case of damage to the part, degree of accessibility on the market, order delivery time, costs of purchase of parts, the volume and frequency of removals from the warehouse.

**Table 1.** The structure of indications concerning the impact of the selected criteria on the level of the planned spare parts inventory (%).

<table>
<thead>
<tr>
<th>Specification</th>
<th>Definitely insignificant</th>
<th>Rather insignificant</th>
<th>Difficult to say</th>
<th>Rather significant</th>
<th>Definitely significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downtime of the machine or equipment in case of damage to parts</td>
<td>0%</td>
<td>6%</td>
<td>1%</td>
<td>8%</td>
<td>85%</td>
</tr>
<tr>
<td>Degree of accessibility of parts on the market</td>
<td>4%</td>
<td>10%</td>
<td>4%</td>
<td>47%</td>
<td>35%</td>
</tr>
<tr>
<td>Order delivery time</td>
<td>4%</td>
<td>21%</td>
<td>2%</td>
<td>46%</td>
<td>27%</td>
</tr>
<tr>
<td>Costs of purchase of parts</td>
<td>27%</td>
<td>42%</td>
<td>2%</td>
<td>17%</td>
<td>12%</td>
</tr>
<tr>
<td>Volume of removals from the warehouse</td>
<td>6%</td>
<td>23%</td>
<td>13%</td>
<td>37%</td>
<td>21%</td>
</tr>
<tr>
<td>Frequency of removals from the warehouse</td>
<td>24%</td>
<td>45%</td>
<td>2%</td>
<td>18%</td>
<td>11%</td>
</tr>
</tbody>
</table>

Source: Author’s own study.

The obtained information indicated that in the case of the establishment of safety stock:

- definitely, the most significant is machine or equipment downtime;
- another important criterion of the selection of inventory is degree of accessibility of the part on the market defined as the opportunity to acquire the part depending on the degree of specialization, location of the supplier’s warehouse (local, national, foreign) and the number of suppliers;
- order delivery time is important to every other analyzed company;
- the cost of the acquisition of the part, which includes both unit prices of the item and transport costs, is rarely taken into account;
- the volume of removals from the warehouse, considered in categories of the frequency of removals or rotation, is assessed as rather or definitely significant for the half of the companies;
- the frequency of removals from the warehouse, which is regarded both from the point of view of the regularity of removals of individual items and the number of removals per year, is taken into account the most rarely.
The significance of individual criteria expressed in the average rating is shown in Table 2.

Table 2. The significance of the selected factors in the planning of safety stock of spare parts

<table>
<thead>
<tr>
<th>Name of the criterion</th>
<th>The average rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>machine or equipment downtime in case of damage to parts</td>
<td>4.71</td>
</tr>
<tr>
<td>the degree of accessibility of parts on the market</td>
<td>4.00</td>
</tr>
<tr>
<td>order delivery time</td>
<td>3.71</td>
</tr>
<tr>
<td>the volume of removals from the warehouse</td>
<td>3.52</td>
</tr>
<tr>
<td>costs of purchasing parts</td>
<td>2.44</td>
</tr>
<tr>
<td>frequency of removals from the warehouse</td>
<td>2.77</td>
</tr>
</tbody>
</table>

Source: Author’s own study.

On the basis of the data in Table 2, it can be observed that each criterion was assessed above the level of 2.7 on a five-point scale. Machine or equipment downtime in case of the damage was assessed above the level of 4.5. This criterion, as the first one, indicates the degree of criticality of spare parts and it is important in the establishment of the demand for parts which should be available in the warehouse. In the further decision-making process, there is considered the degree of accessibility of parts on the market, order delivery time and the volume of removals. According to the analyzed companies, the criterion of costs of purchasing parts is the least significant during planning the demand for parts. It is important only when the part is generally available and there are a lot of suppliers who offer different selling price, and the accessibility of the part is not required immediately.

Conclusions

To make spare parts inventory sufficient to provide the effective maintenance of the continuity of production, it should be maintained in the warehouse at least to some extent. Otherwise, production capacity will be reduced. Safety stock, which protects the company against stopping the continuity of production, serves this purpose in a particular way. This stock ought to refer exclusively to the objects and assembly lines which constitute so called the “bottleneck” of production and play a major role in the order execution.

Industrial companies realize how important it is to provide security of the continuity of manufacturing processes. Therefore, they dispose of buffer stocks of spare parts, which are available immediately. More than half of the analyzed companies possess the established minimum and maximum levels required in relation to the buffer stock, which is most frequently updated once every six months. This stock is usually established on the basis of machine or equipment downtime in case of damage to the part, a degree of accessibility on the market and order delivery time. These factors determine the criticality of parts and, at the same time, their maintenance in the warehouse to reduce the risk of long-term and costly downtime of technological equipment.

References


