ASSESSING THE INTENSITY OF INSTABILITY IN CONSUMPTION OF STOCKS

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Abstract

Fluctuations in consumption of stocks (inventory consumption) can significantly influence comprehensive strategies for warehouse management. Stocks (inventory items) always mean the emergence of secondary costs arising from their possession. High fluctuations in consumption of stocks may then cause higher levels of safety stock and thus higher maintenance costs. The current extremely competitive environment is forcing all businesses to constantly look for potential sources of savings. An interesting option is the precise identification of the amount of variability in inventory consumption and subsequent optimization of the amount of warehouse stocks. The article deals with the analysis of the possibility of classifying stocks and experimental analysis of variability in inventory consumption. The analysis of the variability in inventory consumption was carried out within a selected company in the Czech Republic. Conclusions of the research performed are presented in the article content.

Keywords: Stocks, methods, costs, price, calculation

1. INTRODUCTION

Stocks can be assessed according to various criteria. The most common procedures are based on an assessment of their structure in terms of volume and variability. These methods are considered elementary for any logistic analysis [1, 2]. Other possibilities for the analysis of stocks relate to their potential availability, the consequences arising from their scarcity, seasonality, maintenance and storage requirements as well as other factors. In order to choose an appropriate strategy for inventory management, we must first divide the stocks into groups according to certain characteristics [3, 4]. For these groups of stocks, we can then define a targeted comprehensive strategy. This article focuses on an experimental analysis of the variability in inventory consumption and definition of follow-up recommendations. The article is based on a long-term research carried out in cooperation with industrial companies in the Czech Republic [5].

2. CLASSIFICATION OF STOCKS ACCORDING TO THEIR AMOUNT IN STORAGE

This method uses the principle of Pareto analysis and is often abbreviated as ABC (according to the title of classification groups). ABC analysis is based on the idea that some consumers and products bring greater benefits to the company than other customers or products. In this case, the benefit is assessed in terms of profitability, sales volume, market share and other parameters which are considered as key indicators by the respective business management. When using profitability as an example, then the most profitable customers and products should receive the greatest attention and thus the highest level of customer services. The area of profitability must then be perceived as the share of the given product revenue with regard to fixed costs and profit [6].

In his famous study, Vilfredo Federiko Damaso Pareto, Italian sociologist and economist, addressed the distribution of assets in Milan. Within this study, he also found that 20% of citizens owned 80% of all assets (today and globally, this number is about 5% / 95%). The assumption that significant attributes such as wealth

or importance are concentrated in a relatively small number (of people, factors) is thence called the Pareto principle. The same principle can also be applied in the context of inventory management where we can identify small groups of stocks that make up the majority of the total volume. We can then define three basic groups (ABC) and classify stocks into them according to their volumes (importance).

Therefore, the ABC analysis can be understood as a differentiated approach to inventory management. It is necessary to realize that manufacturing companies often work with hundreds of different types (items) of stocks. In this system, it is then considerably laborious to devote equal attention to all the items or use uniform methods for their management [7]. The ABC analysis is therefore used; it allows managers to divide inventory items into several groups and manage them subsequently in individual ways. Relative to the volume of various stocks, the individual groups can generally be defined as follows:

A - approximately 20% of the items involved in 80% of the total consumption,
B - approximately 10% of the items involved in 15% of the total consumption,
C - approximately 70% of the items involved in 5% of the total consumption.

It should be noted, however, that this structure of stocks will never be observed in real practice. Pareto principle is particularly important in terms of its idea that the items must be divided according to their importance and then managed adequately. The procedure for implementing the ABC analysis can be summarized into the following steps:

1) Accurate determination of annual consumption values for all inventory items.
2) Determination of the total annual inventory value for all items.
3) Determination of the percentage share.
4) Arrangement of items by descending order from most to less content significant.
5) Determination of cumulative totals.
6) Classification of items into groups A, B, C or further groups - groups A, B and C should contain items participating approximately in 80%, 15% and 5% of the total consumption, respectively. Items in each group should be simultaneously volume-similar. It is not desirable that one group contains items that differ in volume by more than 10%.
7) Assembly of graphical visualization of computed values.

3. ASSESSING THE VARIABILITY IN INVENTORY CONSUMPTION

Variability analysis is also often called as XYZ analysis (according to the title of classification groups). Compared to the ABC analysis, the essential difference lies in the fact that the variability analysis evaluates the regularity of consumption. Inventory management for materials whose consumption is regular differs from that for materials which are used sporadically. Stocks are generally classified into three basic categories. Group X contains items with highly regular consumption, with no significant fluctuations in consumption. Group Y includes stocks which show deviations in consumption or certain trends throughout the year. Group Z comprises items whose consumption is maximally irregular and the possibilities of predicting their consumption are limited. The items are categorized into XYZ groups according to the values of variation coefficient:

X - variation coefficient - up to 50 %,
Y - variation coefficient 50 - 90 %,
Z - variation coefficient greater than 90 %.

The variation coefficient defines the degree of fluctuations in the statistical data set. It is calculated as a quotient of the standard deviation and simple arithmetic average; this quotient is then multiplied by a constant of 100 (formula no. 1).

$$V_x = \frac{S_x}{\bar{x}} \times 100 \quad (1)$$

The procedure for analyzing the variability in consumption of stock items can be summarized into the following steps:

1) Determining consumption values for monitored inventories within the given period.
2) Calculation of average values for each item.
3) Determining the standard deviation.
4) Calculation of the variation coefficient.
5) Classification of items into categories of variability (XYZ).

In logistic practice, both methods for the classification of stocks are often used simultaneously. Stocks are then classified into groups AX, AY, BX. This classification then provides an overview of the volume structure of individual items as well as the regularity of their consumption.

4. ANALYSIS OF THE VARIABILITY IN INVENTORY CONSUMPTION

Evaluation of the variability in inventory consumption related to a total of 11 selected stock items. Regarding these manufacturing stock items, we exactly knew their consumption per year as well as the consumption of each calendar month. **Table 1** lists all the recorded data. For each item of inventory, the table also presents its unit price and the quantity in pieces. This set of stock items was subject to the analysis of consumption variability. Evaluation of variability was performed using the variation coefficient (formula 1). For the calculation of this relationship, we determined all the relevant variables. **Table 1** then shows the determined values of arithmetic mean, standard deviation and variation coefficient. At the same time, the table presents the division of stock items into various groups of variability. For assessment into individual groups, we did not use the traditional division into XYZ groups but more detailed classification as shown in **Table 2**.

Table 1 Analysis of variability for key stock items

No.	Consumption (Kč)	Price - piece (Kč)	No. (piece)	January	February	March	April	May	June	July	August	September	October	November	December	Average	Sx	Vx (%)	Group
1.	1386000	69300	20	0	0	0	0	0	0	10	10	0	0	0	0	1,7	3,7	223,6	Z_2
2.	1382000	13820	100	10	10	20	10	10	0	0	10	10	10	10	0	8,3	5,5	66,3	Y_1
3.	1025000	4100	250	120	0	0	0	0	0	0	100	0	0	30	0	20,8	40,9	196,4	Z_2
4.	590000	590	1000	200	200	200	0	140	140	120	0	0	0	0	0	83,3	86,7	104,1	Z_1
5.	575000	11500	50	0	0	10	0	10	10	0	10	10	0	0	0	4,2	4,9	118,3	Z_1
6.	1125000	2500	450	50	70	40	20	0	30	40	20	60	60	20	40	37,5	17,4	52,3	Y_1
7.	670000	670	1000	90	100	70	90	90	90	110	70	60	80	80	70	83,3	13,7	16,4	X_1
8.	630000	504	1250	120	120	120	110	110	80	120	110	90	80	100	90	104,2	15,0	14,3	X_1
9.	470000	376	1250	90	90	90	120	90	130	90	130	90	90	120	120	104,2	17,1	16,3	X_1
10.	420000	280	1500	140	170	110	110	120	120	110	120	110	140	110	140	125,0	18,0	14,4	X_1
11.	510000	255	2000	190	200	170	170	140	180	160	170	150	170	100	200	166,7	26,6	15,9	X_1

Conventional division assumes, e.g. in case of variability group X, the range of variation coefficient in the interval of 0 - 50%. However, this is a relatively broad range of variability that may include items with very different variability in consumption. With regard to this fact, a more detailed classification of the variability rate

was proposed (**Table 2**). The results presented in **Table 1** show that most of the items were located in group X1 - X2. These are stock items with minimal variability in consumption, which exhibit very little variation. In planning the consumption (purchase) of these inventory items, it is possible to use the arithmetic mean value for the respective time series.

In the case of items with such low variability in consumption, just the given measure of middle position can be used. Stock items no. 2, 6 were classified into variability group Y1 - Y2. These stock items already show a higher degree of variability. It is necessary to consider the necessity of their presence in stock or the possibility of ensuring some form of consignment stock. In the case of items included in group Z1 - Z2, we can talk about stocks with high variability in consumption. Regarding these stock items, it is already very difficult to make forecasts of consumption.

Possible level of consumption can certainly be predicted but probably with a high degree of uncertainty. For these inventory items, it is necessary to assess the damage which can be potentially incurred if the stock is inadequate and the production is interrupted. At the same time, the minimum delivery time for these inventory items must be analyzed.

Table 2 Modified groups of variability

Group		Variability (%)
X	X_1	0-25
	X_2	26-49
Y	Y_1	50-70
	Y_2	71-90
Z	Z_1	91-140
	Z_2	141 and more

Categories of stocks with high variability in consumption must also be analyzed with regard to their share in the total consumption. Stock items being less important in terms of Pareto analysis while the risk of their shortage is small can be ordered at the time of consumption. However, it is always necessary to consider all appropriate aspects that influence inventory management.

5. CONCLUSION

Stocks may substantially affect the competitiveness of manufacturing companies. It is therefore necessary to maximally optimize their amounts. This can be significantly supported by the applied tools for analyzing fluctuations in consumption. Nevertheless, it will always be necessary to assess all the key attributes of stocks. Ultimately, it is decisive whether the lack of inventory can significantly influence the course of the continuous production process. Interruptions in production can generate significantly higher costs than holding of excess amount of inventory. At the same time, it is very difficult to predict all potential threats and market risks under the current dynamic conditions.

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REFERENCES

[1] KOŠTURIAK J., FROLÍK Z. *Štíhlý a inovativní podnik*. Praha: Alfa Publishing, 2006.

[2] STRAKA M. Systém distribučnej logistiky firmy Alfa, a.s. Acta Montanistica Slovaca, Vol. 15, No. 1, 2010, pp. 34-43.

[3] LENORT R., BESTA P. Hierarchical Sales Forecasting System for Apparel Companies and Supply Chains, FIBRES & TEXTILES IN EASTERN EUROPE. Vol. 21, No. 6, 2013, pp. 7-11.

[4] PERNICA, P. *Logistika pro 21. století*, 2. díl. Praha: Radix, s.r.o., 2005.

[5] PERNICA, P. *Logistika pro 21. století*, 3. díl. Praha: Radix, s.r.o., 2005.

[6] WILSON, L. *How to implement Lean Manufacturing*. McGrawHill Professional, 2009.

[7] PERINIĆ M., IKONNIĆ M., MARIČIĆ I. Die casting process assessment using single minute Exchange of diees (SMED) method. Metalurgija, vol. 48, no.3, 2009, pp. 199-202.