The Application of ABC Analysis to Inventories in the Automatic Industry Utilizing the Cost Saving Effect

Primjena ABC analize za inventar u automatiziranoj proizvodnji koristeći učinak uštede troškova

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Summary

The highest levels of management work towards profit maximization, trying to achieve the lowest possible costs and the highest possible revenues. Managers in the automotive industry have the same goal. Nowadays, the automotive industry in Slovakia is based on direct foreign investments. The industry is a key sector and is considered to be the driving force behind the development of the whole economy. ABC Analysis is one of the tools that enable companies to control their costs. It provides detailed information that enables the monitoring of how resources have been utilized within a company. It enables the management to evaluate whether costs correspond with the purpose of their spending. For this research ABC analysis was applied to the conditions within the automotive industry with the aim of utilizing the effect of cost savings. On the basis of the research and statistical calculations a proposal is put forward that enables companies to reduce their costs bound in the inventories. The new system of inventories management will enable company managements to utilize the saved money in another way and to achieve further optimization of the processes.

KEY WORDS

cost management
inventories management system
ABC analysis
automotive industry

Sažetak

Najviša razina u menadžmentu teži maksimizaciji profita, pokušavajući postići najmanje moguće troškove i najveće moguće prihode. Menađeri u automobilskoj industriji imaju isti cilj. Dandanas, automobilska industrija u Slovačkoj temeljena je na izravnim stranim ulaganjima. Proizvodnja je ključni sektor i smatra se da je pokretačka snaga razvoja cjelokupne ekonomije. ABC analiza je jedan od alata koji omogućavaju kompanijama kako kontrolirati svoje troškove. Ona pruža menadžmentu mogućnost evaluacije nadziranja kako su resursi korišteni unutar kompanije. Omogućava menadžmentu procijeniti jesu li troškovi u skladu sa svrhom njihove potrošnje. U cilju ovoga istraživanja ABC analiza je primijenjena na uvjete unutar automobilske industrije s ciljem korištenja efekta uštede troškova. Na temelju istraživanja i statističkih kalkulacija, postavljen je prijedlog koji omogućava kompanijama da smanje troškove koji su u inventaru. Novi sustav menadžmenta inventara omogućit će menadžmentu kompanije koristiti ušteđeni novac na drugi način i postići daljnju optimizaciju procesa.

KLJUČNE RIJEČI

menadžment troškova
sustav menadžmenta inventara
ABC analiza
automobilska industrija

1. INTRODUCTION

Every business looks for ways to save. In addition, the current financial crisis is putting pressure on companies to reduce costs. In this context, the necessity to optimise company systems has become imperative [1], [2]. Závadský et al. [3] and Tokarčíková et al. [4] take a similar view. They state that the economic crisis has initiated some optimisation and organisational restructuring in companies. The economic crisis is not alone in stimulating change. The highly competitive environment within the market economy is forcing business entities to achieve ever greater efficiencies in their processes [5]. The same tendencies also affect the automotive industry, which is based on direct foreign investments. According to Kucharčíková et al. [6], foreign direct investment represents the characteristics of the current globalization of economic, political and social processes in the world.

Activity-Based Costing, also referred to as ABC Analysis, is one of the methods by which automotive companies can manage

costs, and is being widely discussed in western countries [7]. According to Kupkovič and Tóth [8], Activity-Based Costing (ABC Analysis) is a new managerial system for costing, budgeting and accounting, in both a practical and technical way, which represents the causal relationship between the creation of outputs and the activities that would consume the company´s resources to do so. According to Potkány and Petruš [9], the main idea behind the ABC analysis is the fact that activities and not individual outputs are considered to be the cause of costs. ABC Analysis provides detailed information that enables companies to monitor how resources have been utilized within the company, which in turn enables the management to evaluate whether the costs correspond with the purpose of their spending. ABC Analysis enables the more effective management of resources by pointing out the causes of the cost occurrence [10]. As not all the material inputs are of the same importance for a company, these inputs are divided according to their relative proportion in the whole value, according to the quantity, consumption frequency, etc., into groups A, B and C. The main focus of attention is on the group that is of the greatest importance to the company [11]. ABC Analysis also helps to determine costs with regards to different calculation objects, not only products, but also for example, distribution routes, customers, services, etc. This provides the opportunity to utilise additional tools for decision making e.g. analysis of profitability of customers. Výrostová [7] suggests that the method has a significantly higher application in that the method enables us to understand the activity of a particular organization through the processes that are going on within the organization, and in particular how it manages these processes (or activities). The main goal of this paper is to apply ABC analysis to inventories in the automotive industry and to design an inventory management system that is able to reduce costs within the industry.

2. APPLICATION OF ABC ANALYSIS TO INVENTORIES IN THE AUTOMOTIVE INDUSTRY UTILIZING THE COST SAVING EFFECT

The proposed inventory management system designed for the automotive industry was tested at a subcontracted company. The company specializes in designing and manufacturing a wide range of special tools, single-purpose machines and technological components for production lines for the rationalisation and automation of manufacturing processes designed for the automotive industry. A welding jig, a part of a welding device on an automated line is the subject of the optimization of the inventory management system. The jig, designed for use in the automotive industry, consists of 14 components (see Table 1), which can be classified as Category A in terms of the ABC analysis of inventories i.e. material that forms a substantial part of the jig.

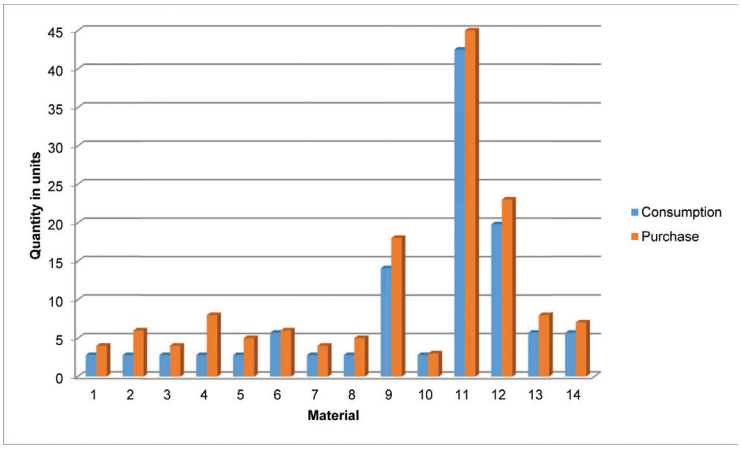
The value of Category A materials required for the manufacture of the jig for the automotive industry is EUR 8,740. However, as can be seen in Table 1, the total value of inventories as of 31/12/2015 was EUR 10,860. This means that, other materials aside, the components for the manufacture of the jig account for 80.48% of the total volume of purchased materials. The other materials have only a small influence on the inventories. Their monitoring is often ineffective in terms of time and costs. It is for this reason that only Category A materials are the subject of this research.

In order to determine the relationship between material purchases and the level of inventories, or to find out whether the real inventories correspond to the material consumption, an overview (see Figure 1) was created of the inventories of the input materials for the monitored product, which takes into account the average monthly purchases and material consumption for 2015.

Table 1 Inventories as of 31 December 2015

Ordinal No.	Material	Inventories (EUR)	Ordinal No.	Material	Inventories (EUR)
1.	201a	6,640	8.	201n	44
2.	201b	140	9.	201o	240
3.	201c	140	10.	201p	48
4.	201d	88	11.	403	600
5.	201e	72	12.	405	224
6.	201f	120	13.	429	160
7.	201g	80	14.	433	144

Source: authors



Source: authors

Figure 1 Summary of automotive industry inventories

Table 2 Materials consumption in 2015

Material / month	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	Total consumption in 2015 (units)	Average monthly consumption (units)	Standard deviation
201a	2	2	4	4	2	4	2	2	4	4	2	2	34	2.8	1.031
201b	2	2	4	4	2	4	2	2	4	4	2	2	34	2.8	1.031
201c	2	2	4	4	2	4	2	2	4	4	2	2	34	2.8	1.031
201d	2	2	4	4	2	4	2	2	4	4	2	2	34	2.8	1.031
201e	2	2	4	4	2	4	2	2	4	4	2	2	34	2.8	1.031
201f	4	4	8	8	4	8	4	4	8	8	4	4	68	5.7	2.059
201g	2	2	4	4	2	4	2	2	4	4	2	2	34	2.8	1.031
201n	2	2	4	4	2	4	2	2	4	4	2	2	34	2.8	1.031
201o	10	10	20	20	10	20	10	10	20	20	10	10	170	14.1	5.149
201p	2	2	4	4	2	4	2	2	4	4	2	2	34	2.8	1.031
403	30	30	60	60	30	60	30	30	60	60	30	30	510	42.5	15.447
405	14	14	28	28	14	28	14	14	28	28	14	14	238	19.8	7.209
429	4	4	8	8	4	8	4	4	8	8	4	4	68	5.7	2.059
433	4	4	8	8	4	8	4	4	8	8	4	4	68	5.7	2.059

Source: authors

The overview of the inventories of input materials confirms the disparity between the actual consumption and the quantities of materials purchased on average every month. The consequence of this disparity is that there is an unnecessarily high proportion of capital tied up in the inventories. This offers an opportunity to reduce the inventories.

In 2015, the consumption of the components necessary for the production of the jig fluctuated from month to month depending on the demand in the automotive industry.

For 2016, a 15% growth in demand is expected. This fact affects the assumed consumption of the individual types of material, the expected monthly consumption and the standard deviation.

In 2016, the material consumption for the manufacture of the jig is likely to equal the expected average monthly consumption. The probability that the consumption values will differ is very low. The probability of the occurrence of the given values will decrease with their distance from the average. This fact would only be worth considering if the expected monthly consumption were lower than the requirements for the material. In the opposite case, all the customers could be satisfied. On the basis of these assumptions, we assigned probability values to the values of the held inventories, for which the consumption would not exceed the specified quantity and the probability values, and for which the consumption would exceed the specified quantity, which would lead to a deficit.

Table 4 shows the quantities of materials that enable the demand to be satisfied. The deviation coverage rate is then:

- coverage rate 1 gives the probability of coverage of the consumption of inventories 82.13%,
- coverage rate 1.5 gives the probability of coverage of the consumption of inventories 92.23 %,
- coverage rate 2 gives the probability of coverage of the consumption of inventories 96.67 %.

Further coverage rates are not discussed because of the high demand for the inventories. With regards to the values of consumption in 2015 and the planned increase in demand i.e. estimated 15%, it is proposed to maintain inventories that are able to satisfy 92.23% of the consumption.

On the basis of a delivery term of 9 days (the period between placing the order for the material(s) and its receipt at the store), we determined the signal inventory, namely by the coefficient 9/30 (for a 30-day month). We rounded the ordered quantity up to whole units because of the delivery conditions and because

Table 3 Material consumption growth

Material	Total consumption for 2015	Expected consumption growth	Expected total consumption	Expected average monthly consumption	Elevated standard deviation
201a	34	15%	39.1	3.26	1.185
201b	34	15%	39.1	3.26	1.185
201c	34	15%	39.1	3.26	1.185
201d	34	15%	39.1	3.26	1.185
201e	34	15%	39.1	3.26	1.185
201f	68	15%	78.2	6.51	2.368
201g	34	15%	39.1	3.26	1.185
201n	34	15%	39.1	3.26	1.185
201o	170	15%	195.5	16.29	5.921
201p	34	15%	39.1	3.26	1.185
403	510	15%	586.5	45.87	17.764
405	238	15%	273.7	22.81	8.29
429	68	15%	78.2	6.51	2.368
433	68	15%	78.2	6.51	2.368

Source: authors

Table 4 Probability of not exceeding the values leading to a deficit

Material	Expected average monthly consumption	Elevated standard deviation (σ)	Average +1σ	Average + 1.5σ	Average + 2σ	Average + 2.5σ	Average + 3σ
201a	3.26	1.185	4.445	5.037	5.630	6.222	6.815
201b	3.26	1.185	4.445	5.037	5.630	6.222	6.815
201c	3.26	1.185	4.445	5.037	5.630	6.222	6.815
201d	3.26	1.185	4.445	5.037	5.630	6.222	6.815
201e	3.26	1.185	4.445	5.037	5.630	6.222	6.815
201f	6.51	2.368	8.878	10.062	11.246	12.43	13.614
201g	3.26	1.185	4.445	5.037	5.630	6.222	6.815
201n	3.26	1.185	4.445	5.037	5.630	6.222	6.815
201o	16.29	5.921	22.211	25.172	28.132	31.092	34.053
201p	3.26	1.185	4.445	5.037	5.630	6.222	6.8150
403	45.87	17.764	63.634	72.516	81.398	90.280	99.162
405	22.81	8.29	31.100	35.245	39.390	43.535	47.680
429	6.51	2.368	8.878	10.062	11.246	12.430	13.614
433	6.51	2.368	8.878	10.062	11.246	12.430	13.614

Source: authors

the materials are supplied as a whole. In this way we determined the optimum size of supply for 2016 as well as the optimum time to place an order (see Table 5).

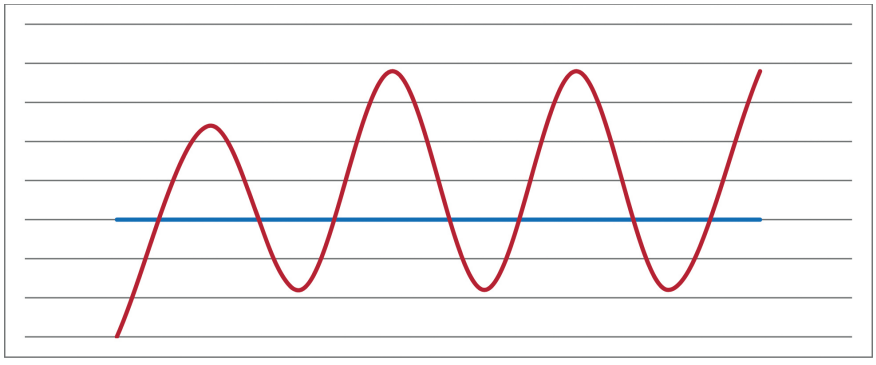
This can be analysed in more detail by looking at one specific item e.g. item no. 405. The size of the safe inventory for item no. 405 is determined as 12 units (i.e. 1/3 of the average consumption). Should the inventory drop below the signal level (the blue line in Figure 2) an order has to be placed (the method for determining the safety inventory for the other material items is the same as for item no. 405).

If a comparison is made between the quantities ordered in the past with those that are being proposed, it can be concluded that the ordered quantity is reduced, thereby releasing capital funds for other purposes.

Table 5 Determination of the signal quantity and the quantity to order

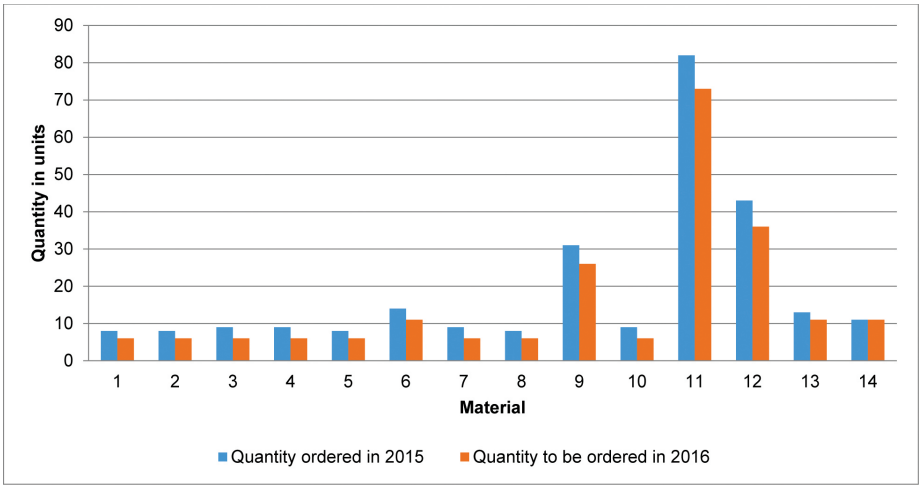
Material	Average +1.5σ	Signal inventories (average +1.5σ x (9/30))	Proposed order quantity rounded to whole units
201a	5.037	2	6
201b	5.037	2	6
201c	5.037	2	6
201d	5.037	2	6
201e	5.037	2	6
201f	10.062	4	11
201g	5.037	2	6
201n	5.037	2	6
201o	25.172	8	26
201p	5.037	2	6
403	72.516	22	73
405	35.245	11	36
429	10.062	4	11
433	10.062	4	11

Source: authors



Source: authors

Figure 2 Expected course of inventory withdrawals



Source: authors

Figure 3 Existing and the proposed ordered quantities

To be able to calculate the cost savings related to the capital tied up in the inventories, it is necessary to express the average inventories of the proposed ordering method to the inventories in 2015. Assuming constant material consumption, the average inventories can be determined as the average of the minimum inventory (at the moment before delivery) and the maximum inventory (at the moment after delivery) i.e. a sum of the maximum and the minimum divided by two equals the average inventory. To determine the average amount of capital funds tied up in the inventories for the individual years, it is necessary to multiply the average sizes of the inventories by their purchasing price. If a 15% increase is taken into account for the comparison of the average value of capital funds tied up in inventories in the individual years, it can be logically assumed that there will be a drop in the average amount in 2016 compared to 2015.

Table 6 shows that the proposed system for ordering inventories assumes a reduction in the size of supplies of ordered material(s), but with a more frequent ordering cycle. This leads to a drop in the average amount of capital funds tied up in inventories. The savings on one delivery are equivalent to EUR 1,902.

3. CONCLUSION

At present, higher demands are being placed on companies due to the global economic crisis and the trend towards the decentralization and transfer of management responsibilities to lower organizational units [12]. More and more companies are increasingly looking for ways how to innovate their management systems [13]. If a company wants to survive in such an environment, it must work towards gaining a greater competitive advantage over its rivals [14], [15]. The market environment and tough competition generates pressure on companies to reduce their costs as much as possible. Numerous cost monitoring methods exist for cost management.

According to Šatanová [16-18], managers of SMEs use indicators for monitoring process performance in order to achieve a competitive advantage. In this case study, the research focused on the ABC analysis of inventories as applied to the automotive industry in Slovakia. A welding jig, part of an automated line, was used to study the cost savings effect. Calculations based on the results of the proposed system for ordering inventories already generated cost savings during one order cycle. It can be assumed that with each repetition of this

Table 6 Expected drop in capital funds tied up in inventories

Material	Average inventories in 2015	Average inventories in 2016	Purchasing price	Average tied up funds in 2015 (EUR)	Average tied up funds in 2016 (EUR)
201a	7	6	1 660	11 620	9 960
201b	6	6	35	210	210
201c	7	6	35	245	210
201d	7	6	22	154	132
201e	6	6	18	108	108
201f	11	10	15	165	150
201g	7	6	20	140	120
201n	6	6	11	66	66
201o	26	23	12	312	276
201p	7	6	12	84	72
403	71	66	10	710	660
405	36	32	8	288	256
429	11	10	20	220	200
433	10	10	18	180	180
Total				14,502	12,600
Difference				1,902	

Source: authors

cycle further cost reductions can be realised, thereby releasing valuable capital funds for other purposes that would otherwise be tied up in inventories. Higher cost effectivity compared to other companies also puts these companies one step ahead of their competitors [18-20].

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