Control and analysis of material flows in logistic systems

N. Rusadze, T. Morchadze

Akaki Tsereteli State University, Kutaisi

Abstract: In the paper is presented applied to reduce the risk of loss of stock, movement within warehouse, quantity, and material values in the isolated integrated logistics system: ABC analysis, ZYZ analysis - (probabilistic impact on the demand for the stock decisions), and the method of determining the boundaries that are used to divide the nomenclature, by divide of object under study on A, B and C groups.
Keywords: Logistic, material flow, stock, method, analysis, stillage, risk, warehouse, goods, nomenclature, management.

1. Introduction

The subject of the study in logistics represents the material and its corresponding, financial and information flows. These flows on their way from primary sources of raw materials to the final consumer are passing various manufacturing, transport and warehouses links. Due the traditional approach, the tasks of material management in each of the links are performed separately. At the same time, separate links represents the closed systems that are technically, technologically, economically and methodically isolated from the partner systems of. In the framework of the closed system, management of economic processes are carried out through planning, production and economic management, commonly known methods [1, 2]. The application of these methods continues at logistics approach in managing of material flows.

2. Management of high-performance warehouses

The transition on the isolated integral logistics system depends on the necessity for managing material flows in systems.

The application of ABC analysis in logistics is aimed at:

The idea of ABC analysis is that from the set of whole uniform objects, in terms of the achieved target, to outline the important. Such objects, as a rule, are

not numerous and we should focusing rather on them the main attention and forces [3].

The ABC method stipulates deeper division into three parts, as well as the overall statistical distribution.

The first major step of ABC analysis is to determine the goal. The management of same objects will be divided into subsets A, B and C.

The main part of the theft, in the same warehouse, comes in a small group of assortment. However, the composition of this group differs from the composition of the main group. This group also needs strict control, but already another kind of control: frequent inventory, placement in special cameras, arrangement on shelving that makes it difficult for theft.

Management of high-performance warehouse stipulates and attends large attention to the problems of extra movement in the warehouse. The goal is economy of time and energy, i.e. the resources that always are in deficit. It is possible to avoid the overrun of the turnover resource, if we place this assortment in the so-called "hot zones", i.e. in the zones that are located in convenient for transition of goods places.

The second stage of the ABC analysis is identification of the analytical management objects. However, other objects also would be selected for solving these tasks. For example: the stock in warehouse may be reduced if you pay particular attention to suppliers on which the main part of the warehouse stock is coming. In this case, the objects of management will be the suppliers. This is a sign that the classification of suppliers (3rd stage of algorithm - the share of goods obtained from the given supplier in the warehouse) will occur.

After this we have identified the classification sign, each supplier is evaluated according to the sign (stage 4). Next we are organizing the grouping of objects. Depending on the reduction of outlined signs (stage 5). An insignificant part of the ordered list will play a major role in terms of the goal set.

The dividing by the A, B, C groups of the ordered list by reduction in sign is not always possible. A well-known rule for everyone 20/80 represents the averaged relation and in many cases it is unusable for dividing of a specific nomenclature. Suppose that 8% of the created bulk nomenclature gives 80% turnover and the 20% –96% (Fig. 1). How can we do this in this case, transfer 20% of the nomenclature in A group, or limit it up to 8%? This task can be solved graphically by construction of the ABC analysis curve. The solution method is described in the following manner.

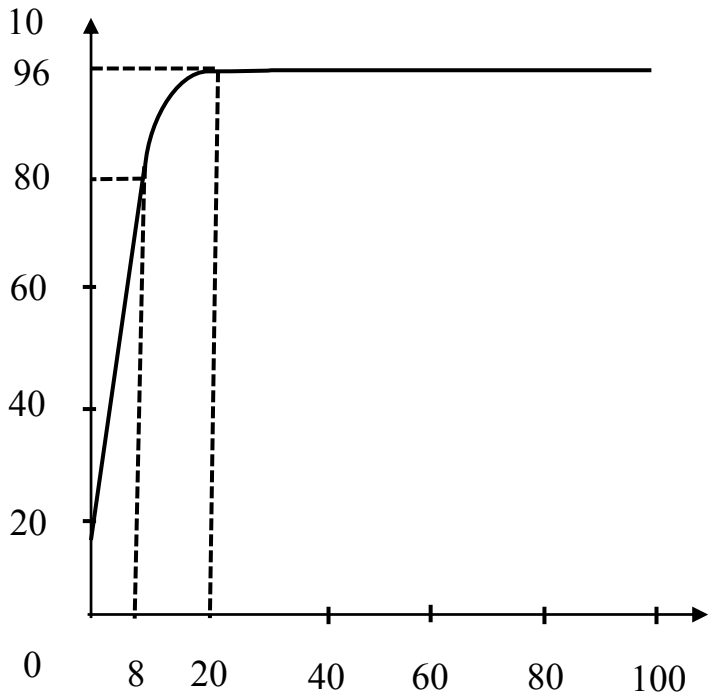

Fig. 1. - Curve of ABC analysis

The first is the method of determining the boundaries by the ABC curve.

Let’s consider the dividing of the management objects set that is ordered according to the object's data reduction [4, 10, 11].

Due the ABC analysis curve, the curve is constructed in the orthogonal coordinate system. The OX axis are management objects (e.g. assortment positions) that are located in common results, depending on the reduction of share.

Second is the method of determining the boundaries as the boundaries of A, B and C setwill be determined the sharp changing spots in ABC diagram.

Real ABC curves consist from elementary spots that are characterized by a specific curvature. The curvature centers of elementary spots as a rule do not coincide with each other. However, in the A, B and C sphere they are relatively close to each other and create the so-called clouds of the curvature centers

Let's make at the ABC curve in its starting point the normal that is directed towards the right from the curve. Let us choose the length of the normal so that it would not be achieved to the multiple points of the corresponding curve in the initial and final spots of diagram. However, at the same time, passes outside of the clouds range between the centers of curvature. Let's transfer the tangents from start of curve up to the end of ABC diagram.

Obviously, while the radius of the curvature slides on the having large magnitude spots (the starting part of the diagram, group A) the end of normal that is located between the curve and the center of the curve, is moving upward. At the introduction in curves, in the intermediate spots of curve with small values of radius, the end of the normal moves in the direction of motion, which turned out beyond the cloud of the center of curvature, is replaced by the opposite direction. The end of normal stars to move left and downward. The curve point that corresponds to the direction of motion at the end of normal, indicates the border between the A and B groups. The normal's movement down and left, i.e. in the opposite direction of the motion of tangents, continues until the arrival of the aligned spots of diagram [5, 7, 9]. Here's the end norm of normal occurs between the diagram strip and center of the curvature, again starts the movement towards motion of tangents. The point on the curve where performs the repeat change in the direction of the motion of end of the normal, indicates on the border between the B and C groups. There is terminated a nomenclature that provides the smooth

increasing in turnover and starts the nomenclature, in that all positions that gives extremely low increment in turnover, i.e. in the nomenclature of C group.

The final shape of the figure outlined by the normal with respect of the tangents, at the sliding on the ABC curve of latter, is shown in Fig. № 2.

A certain complexity is to determine the normal with respect of the length. The end of normal should be located between the clouds of the center of curvature and is determined by the iteration of a unity of several scales. Starting calculations is possible from the value 20; by the obtaining the values of boundary between the groups for length of this normal.

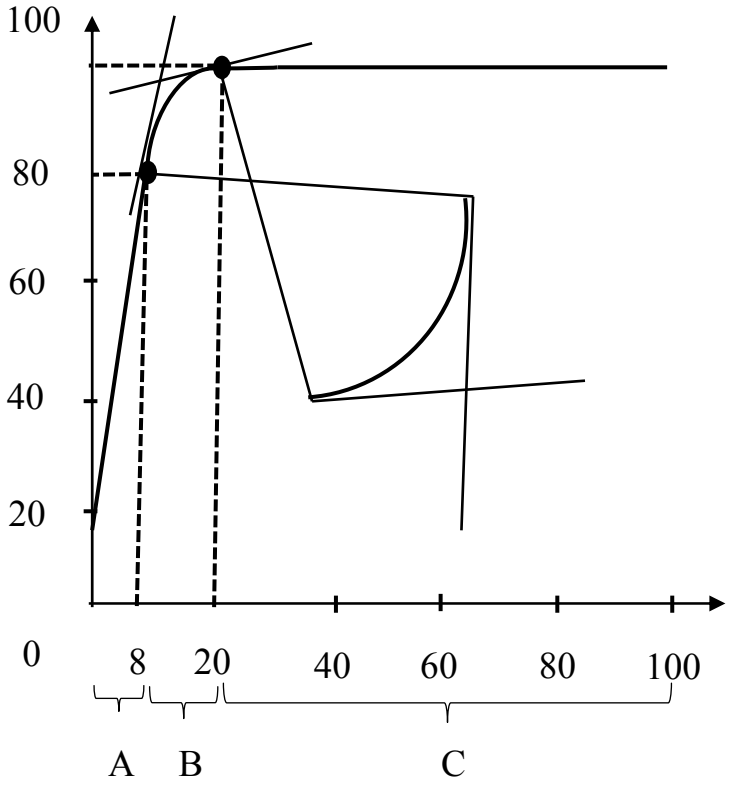

Fig. 2. - The dividing into A, B and C groups by analysis of ABC curve.

Then, gradually, step-by-step should be increased the length of normal by 5-10 units, at the start. At each increment of the length, occur changes of the boundaries value (that prove that in the last movement of the normal it is yet in the middle clouds of the center of curvature). At the specified moments, when the end of the normal leaves "intermediate cloud", the values of the boundaries will stop

the changes with the changes in length of normal. The given values of boundaries must be obtained at differentiations between A, B and C groups.

The further increasing in the length of normal finally will lead us to continue the change in boundaries at each integration. This takes place at the drowning of the end of normal at the beginning of the ABC diagram and at the termination of aligned spots in the clouds. In other words, we should choose the length of the normal with respect of the tangents that provide relative stability to the boundaries of A, B, and C sets.

The described method can be used to divide the nomenclature.

3. Judgement and results

Analysis of ABC gives us the differentiation of assortment according to the contribution presented in the aimed result. The principle of differentiation of assortment is different at the XYZ analysis. There entire assortment (resources) are divided into three groups, according to the equidimensional demand and prediction accuracy.

The X group includes goods where the demand is equidimensional or subject to minor deviations. The volume of realization of goods in the given group will be well calculated.

The Y group includes goods that are consumed in changing volume. Namely, the item of seasonal demand can be included in this group. Forecasting the need for Y group products is average [6, 8, 12].

The Z group includes goods where the demand occurs only episodically. It is impossible to predict the volume of sale of Z group goods. The sign, accordingly of that specific assortment belongs to the X, Y and Z group is the requirement variation coefficient on this position. Between the variation relative indicator the variation coefficient represents the most commonly used relative variation indicator.

$$v = \frac{\sqrt{\frac{\sum(x_i+\bar{x})^2}{n}}}{\bar{x}}.100\%$$

where, x_i– is the demand indicator based on the assessment position; $\bar{x}$- is the average indicator of demand based on n period of the assessment position; n – is the size of the period in which the assessment is carried out; The variation coefficient is changing from zero up to infinity. The dividing onto X, Y and Z groups is possible to perform, for example, based on the stated in Table №1 algorithm.

Table №1

The solution algorithm of task by Excel

Column	Column title	Calculation formula
A	Code of the goods	is given
B	Realization in a certain section	is given
C	share of goods in general realization	$C_i - B_i \frac{100}{B\ total}$
D	Number of enumerated list row	D1=1; D2=1+1 ets, up to end of the list
E	number of rows that is added to an increasing percentage of the total number of rows	$E_i = D_i.100/D_{max}$
F	share of goods with increased result	$F_1 = C_1; F_2 = F_1 + +C_2 и\ т.д. (F_i = F_{i-1} + C_i)$
G	working parameter	$C_i = ATAN(E_1/C_i)$
H	End of abscissa of normal	$H_i = E_i + J_i.\cos(G_i)$
I	End of ordinate of normal	$I_i = F_i - J_i.\sin(G_i)$

J	Values of normal	$J2 = J1, J3 = J2$ и т.д. $(J_i = J_{i+1})$ J1=natural number in the range of 20-200
The point diagram is constructed accordingly of H and I columns		

The general algorithm for the carrying out X, Y, Z analysis is given in Table 2,3.

X, Y, Z curve is arranged in rectangular coordinates (Fig. 2). The position of the assortment is placed on the OX axis, with the increase of the demand variation coefficient that is expressed in the percentage of the assortment position.

Table №2

The possible differential algorithm on the assortment of X, Y and Z groups

Group	interval
X	$0 \leq v < 10\%$
Y	$100\% \leq v < 25\%$
Z	$25\% \leq v < \infty$

Table №3.

The order of XYZ analysis

Determining the coefficient of the change of individual assortment positions
Grouping the objects of management according to the increase of the change coefficient
Construction of XYZ curve
The separation of management objects in three groups: X Group, Y Group and Z Group

References

1. Chkhetia I., Butkhuzi N., Rusadze N. Basics of logistics. Auxiliary textbook. Georgian Technical University. Tbilisi. 2017. 262 p. (In Georgian).

2. Veshapidze Sh, Osadze D., Sexniashvili D. Logistic. Auxiliary textbook. Georgian Technical University. Tbilisi. 2012. 155 p. (In Georgian).

3. Botsvadze L., Eradze K., Botsvadze V. Management and modeling of logistics. Auxiliary textbook. Georgian Technical University. Tbilisi. 2010. 805 p. (In Georgian).

4. Logistics Seqtor Developments: Planing Models for Enterprises and Logistics Clusters. United Nations ESCAP. New York 2007. 144 p.

5. Vinnikov V.V. System of technologies on marine transport. Moscow. 2010. – 570 p. (In Russian).

6. Mirotina L.B. Integrated logistics of storage and accumualtion-distribution complexes (warehouses, transport hubs, terminals): Textbook for transport HEI/Under general editorship of Moscow: Publishing "Ekzame". 2003. 165 p.

7. Eliceeva T.A., Plaxotnikova E.B. Colobiob C.I. Inženernyj vestnik Dona (Rus), 2016, №3. URL: ivdon.ru/ru/magazine/archive/n3y2016/3681.

8. Kuznecov K.K. Inženernyj vestnik Dona (Rus), 2009, №1. URL: ivdon.ru/magazine/archive/n1y2009/250/.

9. Yulia Stukalina. Professional English for Students of Logistics. Riga. 2014. 187 p.

10. Tallinn College of Engineering. English for Students of Logistics Tallin. 2006. 72 p.

11. USD. From the American people. Role of transportation and logistics on international trade. The Developing Country Context.. Prepared by Carana Corporation Delivering Global Development Solutions. September 2003. 85 p.

12. Inner urban fieight transport and city logsistics portal. Transport teacning material. Written Material. 2003. 112 p.