

ČEDOMIR IVAKOVIĆ, D.Sc.
MARIO ŠAFRAN, B. Eng.
KRISTIJAN ROGIĆ, B.Eng.
Fakultet prometnih znanosti
Zagreb, Vukelićeva 4

Technology and Management of Traffic
Review
U. D. C. 656.025.4
Accepted: Mar. 13, 2000
Approved: Jun. 20, 2000

LOGISTICS AS ELEMENT OF IMPROVEMENTS IN STORAGE, DISTRIBUTION AND TRANSPORTATION OF GOODS

ABSTRACT

The work considers the notion and the importance of logistics as an element of improvements in storing, distribution and transport of goods. There is always room for improvements in this segment of economic activities and they are necessary in order to optimise the flow of goods from the manufacturer to the end user. The purposefulness and real efficiency of business logistics is presented using the example of a Croatian company. Also, the importance of further development and implementation of logistics in Croatia is continuously being emphasised throughout this work.

KEY WORDS

logistics, storage, distribution, transportation

1. INTRODUCTION

The presence of logistics as a notion, scientific discipline or even a philosophy of thinking, is increasingly felt every day in all types of human activities. Logistics has the leading role in the future development of economy and life in developed countries of the world.

Etymologically, logistics is related to several different interpretations. Today, logistics means primarily the skill, efficiency in good organisation of certain resources, i.e. success in good management of resources.

The beginnings of logistics date back to the Roman Empire when Romans started to apply logistics in the army. Over the years, logistics has developed and has been applied in a growing range of human activities.

Logistics represents integral production and distribution combined by a number of factors into an integral system. Combining all components in big production systems is a very complex task, since several production plants, distribution centre or centres, consumers, raw material and reproduction material suppliers, transportation systems of different branches incorporated in all the logistical activities, need to be connected. Expansion and globalisation of single subjects, such as e.g. in pharmaceutical industry, tend toward

optimisation through realising logistical planning in order to achieve savings, which even at a level of 5-10% represent a success of logistical global planning.

This work considers logistics applied in storage, distribution, and transportation of goods, a big segment of the world economy.

2. LOGISTICS IN STORING, DISTRIBUTION AND TRANSPORTATION OF GOODS

High-quality logistical system includes total flow of materials from receiving the raw materials or reproduction material until delivery of final products to the end users. This means then that storing, distribution and transportation of goods represent an important and unavoidable part of the logistical system. For better understanding of further considerations it is necessary to define the mentioned terms and expressions.

Storehouses mean storage spaces within the production plants, regional storehouses, local storehouses, distributor's stock, in some cases stocks "in the hands" of retailers.

Distribution of goods means combination of activities and institutions related to promotion, sales and physical movement (transfer) of products or services.

Transport includes not only transport from the production plant to the storehouse and from storehouse to storehouse, but also transport from the producer to the client. It is always necessary to consider all the transportation links, whether the supplier or the consumer is covering the external transport. Obviously, the cost of this transportation link is the cost of distribution, regardless of who is directly covering it. It is clear how much the optimal organisation of goods transportation can benefit the competition. Key characteristics of transportation are reliability, price and speed.

We are often witnesses of products being described (defined) according to their physical shape or characteristics, regardless of their locations. Sometimes people tend to go so far as to say that only production activities improve the real value of a product, which is unacceptable. Serious research clearly shows that, e.g. tubes of toothpaste which are in the storehouse of the Saponia factory in Osijek, do not have the same efficiency in satisfying the customers' needs in Zagreb, which they would have had they been stored in the storehouse of the Konzum shop in Zagreb district Dubrava. Naturally, the delivery of toothpaste tubes from Osijek to Zagreb increases their price due to transport and the necessary handling manipulations during transportation.

Thus, the usefulness of a product does not depend only on the quality and quantity of the product but also on its location and whether it is there where and when we need it.

This short consideration proves the impact of distribution, storage and transportation of products on their usefulness, but also on the price. This means that the tendency is to achieve greater usefulness of a product with simultaneously most correct price with optimal organisation in distribution, storage and transportation of goods, and this is made possible by applying logistics.

It is precisely the application of logistical models and systems in distribution, storage and transportation of goods which makes possible substantial savings and maximal increase in the efficiency of products and goods. For instance, in the developed countries that have logistics-aided distribution, storage, and transportation of food, greater part of nutritional value is lost by cooking and throwing away, and in "underdeveloped countries" even up to two thirds of produced food are lost under way somewhere between the farms that produce food and the moment it is cooked in the household of the end user, due to inadequate distribution, storage and transportation, i.e. due to the absence of logistical support.

In order to make the concrete logistical system, i.e. logistics in distribution, storage and transportation a reality, comprehensive analyses are necessary. The analyses provide real data on previous operation of a certain system. This is necessary in order to determine mistakes in the previous operating system and to develop a plan for realising a new way of operation with a logistical support. It has to be emphasised that we are rarely in the position to carry out a reconstruction of the whole previous system, i.e. of introducing a completely new logistical model of operation. The costs for discontinuing with the old way of operation, investments in starting the new one and the whole reorganisation are too high. However, it is the logistical models, dealt with in the next chapter, that enable gradual

introduction of new concepts, techniques or equipment.

Not everything in logistical systems depends on physical resources (storehouses, transportation means, telephone lines, computers, etc.). The system also includes adequately trained people, at the same time influencing them. These are people who make decisions about work, business policy, about dealers, and also about "shopfloor workers". Therefore it is necessary to systematically educate and train people who will accept this "philosophy of thinking" and implement the logistical system.

Expansion of logistical systems and possibilities offered by logistics have helped in connecting the countries. This is one of the reasons why national governments constantly and substantially invest in logistical efficiency of their economies, which refers to a great extent to the development of traffic, which is unfortunately not the case in our country.

3. IMPLEMENTATION OF LOGISTICS IN STORAGE, DISTRIBUTION AND TRANSPORTATION OF GOODS IN THE REPUBLIC OF CROATIA

Logistics in theory and practice in Croatia appeared much later than in the rest of the world, i.e. Europe. The very beginning was at some of the Croatian universities. The faculties covering the area of logistics have successfully and promptly followed the development and implementation of logistics in the developed countries. Also, various research projects tend to introduce in practice and to implement logistics in industry, for the realisation of concrete processes and businesses.

On the other hand, constant and big problems faced by the Croatian industry have imposed permanent neglect of logistical principles. Such attitude of national companies and firms towards logistics is even a worse mistake since logistics would certainly improve and help in solving a number of operating problems in a company.

However, there are also good examples showing the benefits and success of implementing logistics in company activities. Further in the text we shall consider the implementation of logistics in the operating activities of the most successful Croatian company **Pliva d.d.**

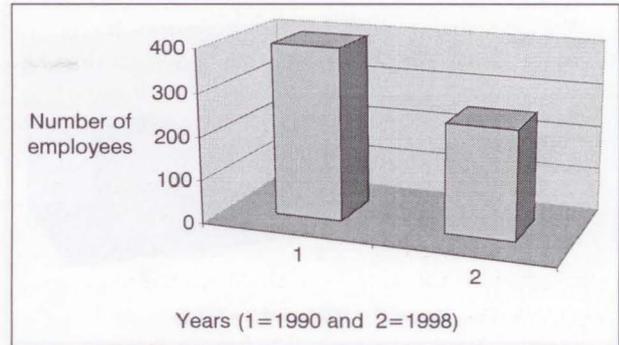
The organisational unit Logistics (Cro: OJ Logistika) has been present in Pliva activities since 1996. At the end of the eighties, Pliva management became aware of the problems in the operations regarding storage-distribution and transport. They defined the problems and using their own knowledge, based on logistical achievements in the developed countries, they

drew up a feasibility study and started a new way of operation based on logistics. Over the years they have improved their model and, as pointed out in 1996, they formed within the organisational map of the company an organisational unit Logistics which operates on the latest criteria of business logistics.

Pliva d.d. is an international corporation with substantial ownership by foreigners. The factory plants are located all over the world (in the Czech Republic, Poland, England, Croatia). On the average, Pliva goods (various kinds of medicine, food articles, etc.) are daily delivered to 450 places in the world. The distribution of goods is demanding and big regarding quantities, and it has to be continuous and on time. The storehouse and transportation systems have to be optimal. The same is true for the production as well. It is the OJ Logistika which controls and optimises the storage of raw materials and products, transportation, i.e. distribution.

OJ Logistika employs 267 people. They plan to reduce the number of workers, but to increase the number of highly-qualified employees. The quality and results achieved by OJ Logistika are clearly seen in the substantial reduction of total costs of production, consumption, storage and transportation of goods. Introduction of logistics and constant improvements have justified the initial investments and have saved large financial means. Logistics has proven its necessity and shown that this necessity will grow in the future due to the increase of goods exchange in the world.

Today, OJ Logistika is preparing for the 21st century. They constantly communicate with their business partners, "listening" carefully and accepting feedback information. Such approach is constantly improving their operation. The motto of OJ Logistika is to be the first and the best.



Graph 1 - Number of employees in storage, distribution and transport of goods, 1990 and 1998.

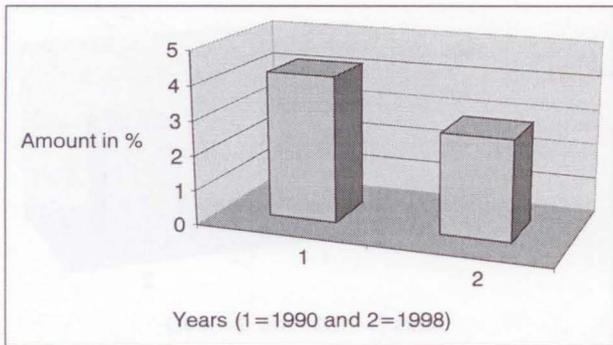
4. LOGISTICAL MODELS IN STORAGE, DISTRIBUTION AND TRANSPORTATION OF GOODS

Logistical models used today were developed as a group of measures that simplify solving of various logistical tasks, at the same time improving the operating efficiency of a certain company. There are various factors that determine the diversity of logistical tasks, the economic-production characteristics being the crucial ones. This includes various types of production according to properties of the product and properties of the production process that refers to a certain product. Which process will be selected depends on the policy of the company itself, and on its aims, i.e. its activities.

The role of logistical models in improving the overall operation lies in linking the processes of movement (transport) with the processes of keeping (storage). A very important component in these processes is time within the production process, which stipulates

Table 1 – Certain values for 1990 and 1998 (prior to and following the introduction of logistics into the system of storage, distribution and transportation of goods) in operation of the Pliva d.d. company, taking into account that the profit in 1998 is greater than the profit in 1990.

Concrete size	1990	1998
Number of employees involved in storage, distribution and transportation of goods	398	251
Pliva-owned storage areas in m ²	14 690	14 870
Rented storage areas in m ²	5 321	3 192
Number of Pliva-owned transport means	103	42
Amount of final products (in tonnes) transported by air	year 1996 = 463	year 1997 = 498
Average price for 1 kg of air transported goods (in US\$)	year 1996 = 1.90	year 1997 = 1.72
Amount of realised costs re. storage, distribution and transportation of goods (in US\$)	1 583 900	1 070 000
Share of costs for storage, distribution and transportation in total costs (in percentages)	4.2	2.89



Graph 2 - Share of costs for storage, distribution and transport in total costs

the possibilities of selecting or creating logistical models.

The basic criterion for creating functional regions in a certain model is the diversity of logistical tasks. These tasks are closely related to the already mentioned factors, as well as to the quantity volume of partial logistical tasks. According to this criterion, logistical system can be divided into elementary logistical operative activities, such as transport, storage and handling, and these activities can be performed at different places along the plant supply chain. Within this chain there are internal-traffic activities which refer to the space within the company and external functional areas. In the further analysis of the system, the characteristics of the manipulated goods have to be taken into account as well as the quantity of goods, location structure and relevant time sample.

Some of the possible criteria for the implementation of the logistical system have been mentioned until now. Depending on whether these are implemented for two or more criteria, we can distinguish between one-dimensional or multi-dimensional models of implementing logistics.

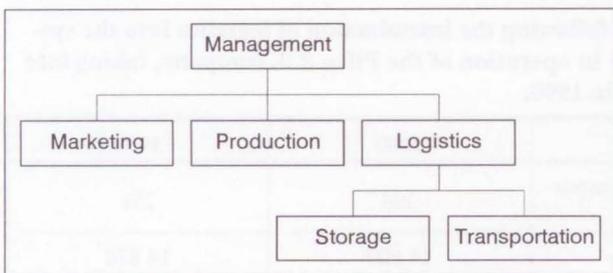


Figure 1 - One-dimensional model for logistics implementation

The logistical model is functional when the authority for stocks, utilisation goods, as well as all transport and goods handling activities are added to the functional area of logistics. In such distribution, logistics becomes the central service point and the main instrument for planning, management and control for the whole company. The additional division according to

geographical zones as consequence of differentiated business policy towards certain areas and capacities of different markets creates the vector model.

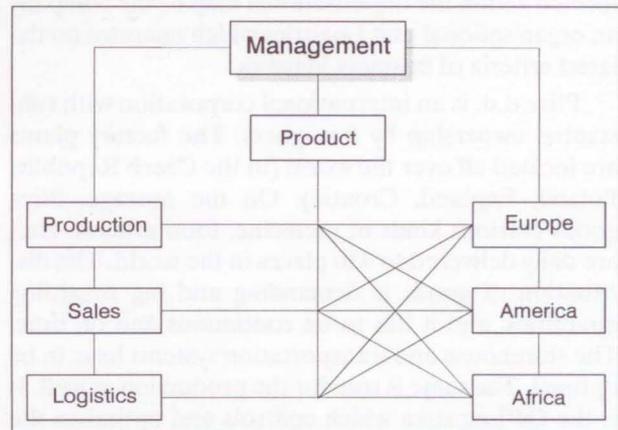


Figure 2 - Logistics in three-dimensional model of organisation

Organisational practice of certain companies shows that certain functional logistical areas within the company itself, have developed for their own requirements organisational units resulting in the model presented in Figure 3.

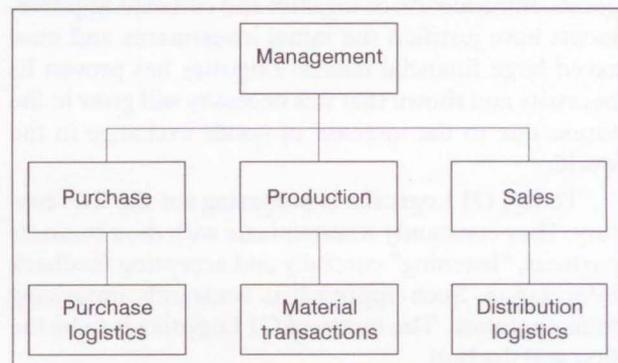


Figure 3 - Decentralised application of logistical tasks

Many examples show how logistical tasks depending on the significance for certain functional areas are combined, classified within a certain existing field.

In order to co-ordinate the interdependence of decisions in certain decentralised fields, some compa-

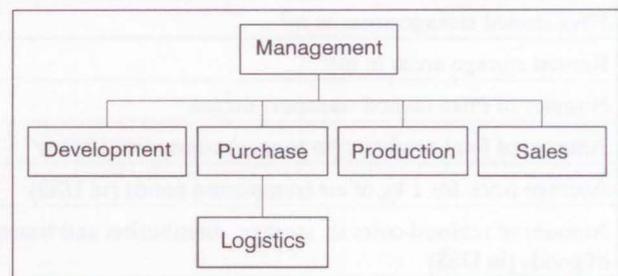


Figure 4 - Centralised implementation of logistics through one main function

nies set auxiliary managing positions for exchange of information, whereas the responsibility for operative tasks remains at the point of the task.

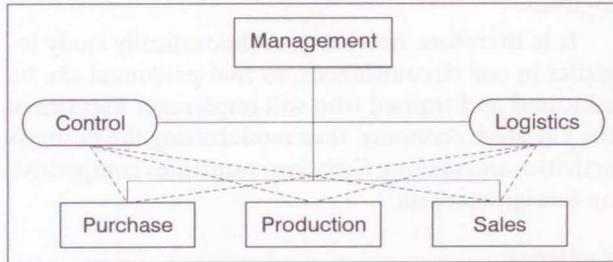


Figure 5 - Central help for departments in decentralised realisation of logistical tasks

The previously mentioned logistical models correspond to certain conditions of operation. These are not the only and final models, and they are modified if necessary, or new systems are developed based on the experiences of the previous ones. Important is that the developed model in the given circumstances provides more efficient and rational operation of a certain industry facility.

4.1. Distribution logistics in the production of stocks

Modern industry tends to produce goods for a known buyer and in quantities required by the buyer. However, this is not always possible since there is a need for certain stocks, i.e. production for anonymous markets. In such production, demand is supplied from the stocks, and their volume is determined by comparing the costs of production, storage and transportation. In pharmaceutical industry there is a wide range of products of various demand regarding the consumers' needs, requiring various stocks at certain supply points. In order to avoid imbalance and excessive stocks, central control of all the stocks is organised, thus avoiding excessive stocks, which is made possible by modern information systems. The application of information systems and introduction of minimal safety stocks eliminates empty rides, empty return transport and other expenditures. According to Ihde, page 254, it may be added that based on the expected demand in the distribution system, the total maintained safety stocks can be reduced, if the independent stochastic demand oriented toward these centralised points of supply is re-oriented towards central stocks. This reduction of safety stocks at certain readiness for delivery is based on the statistical balancing of random events. The volume of balancing effects can be estimated for the random variables x_i with the variance $\text{var}(x_i) = \delta^2$ as difference D between the standard deviation in connected and standard deviation in non-connected demand.

$$D = \sum_{i=1}^n \sqrt{\text{var}(x_i)} - \sqrt{\text{var}(y_n)}$$

where $y_n = x_1 + x_2 + x_3 + \dots + x_n$ is a series of independent random variables of demand. This means that with the greater dispersion of stochastic demand to several supply points, the number of receiving points of the

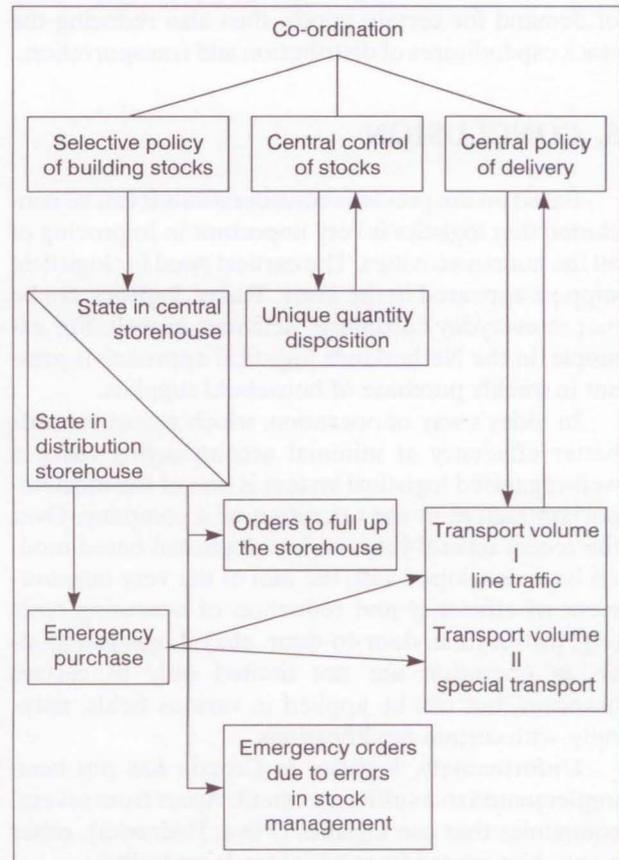


Figure 6 - Interrelations between central storage of stocks and transportation organisation.

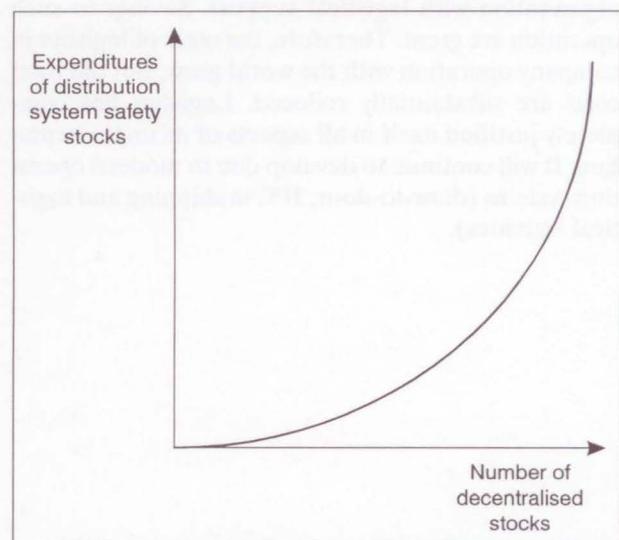


Figure 7 - Relation between centralisation and the amount of stock

stocks falls, thus increasing its insecurity, i.e. dispersion, meaning that safety stocks have to be increased.

Related to physical (space) results, the results regarding time of balancing the stochastic demand for certain time intervals have to be achieved as well,

Defining of temporally distributed single demands for goods enables reduction of safety stocks, i.e. lack of demand for certain goods, thus also reducing the stock expenditures of distribution and transportation.

5. CONCLUSION

Based on the previous considerations it can be concluded that logistics is very important in improving of all the human activities. The earliest need for logistical support appeared in the army. Today, logistics can be met in everyday "ordinary" activities as well. For example, in the Netherlands logistical approach is present in weekly purchase of household supplies.

In today's way of operation, which strives towards better efficiency at minimal accompanying costs, a well-organised logistical system is one of the most important factors in the operation of a company. Over the recent several years various logistical-based models have developed with the aim of the very improvement of efficiency and reduction of operating costs (e.g. just-in-time, door-to-door, etc.). Logistical models in operation are not limited only to certain branches, but can be applied in various fields, naturally, with certain modifications.

Unfortunately, logistics in Croatia has not been implemented to a sufficient extent. Apart from several companies that use logistics (Pliva, Podravka), other companies are far from "thinking logistically".

The example of Pliva which operates along logistical principles clearly shows positive effects of business organisation with logistical support. Savings in such operation are great. Therefore, the costs of logistics in company operation with the world grow, but the total costs are substantially reduced. Logistics has completely justified itself in all aspects of its implementation. It will continue to develop due to modern operation systems (door-to-door, JIT, in shipping and logistical activities).

How much the developed countries appreciate the role of logistics is confirmed by the fact that already in 1977 Germany employed about 300,000 engineers of logistics.

It is therefore necessary to theoretically study logistics in our circumstances, so that personnel can be educated and trained who will implement logistics in the Croatian economy, thus modernising the business activities and making Croatian companies competitive on foreign markets.

SAŽETAK

LOGISTIKA KAO ELEMENT POBOLJŠANJA SKLADIŠTENJA, DISTRIBUCIJE I PRIJEVOZA ROBA

U radu se razmatra pojam i važnost logistike kao elementa poboljšanja skladištenja, distribucije i prijevoza roba. Mjesta za poboljšanja u ovom segmentu gospodarskih aktivnosti uvijek ima. Nužna su u svrhu optimalizacije toka robe od proizvođača do krajnjeg kupca. Svrhovitost i realna učinkovitost poslovne logistike pokazana je na primjeru jedne hrvatske tvrtke. Isto tako kontinuirano tijekom izrade rada isticana je važnost daljnjeg razvoja i primjene logistike u Hrvatskoj.

LITERATURE

- [1] **G.B. Ihde:** "Transport, promet i logistika", Vereay Franz Vahlen, Munich, 1991
- [2] **Z. Segetlija, M. Lamza-Marović:** "Distribucijski sustav trgovinskog poduzeća", Ekonomski fakultet Osijek, 1995.
- [3] **Č. Oluić:** Prilog određenju logistike u industriji, Proceedings FSB, Fakultet strojarstva i brodogradnje, Zagreb, 1992.
- [4] Pliva d.d: *Elaborat o poslovanju Organizacijske jedinice "Logistika"*, Pliva d.d., Zagreb 1998.
- [5] H. Kopfer; Chr. Bierwirth (Hrsg.): *Logistik, Management, Intelligente I+K Technologien*, Springer, Berlin, 1999.
- [6] **M. Goetschalckx; C. Vidal; K. Dogen:** *Modeling and Design of Global Logistical Systems, A Review of Integrated Strategic and Tactical Models and Design Algorithms*, Georgia Institute of Technology, 1998.