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**MODEL OF PARALLEL PLANNING OF LOGISTIC AND DISTRIBUTION
PROCESSES**

Darko BABIĆ¹, Ivana ČAVAR¹, Petr PRŮŠA²

¹Faculty of Transport and Traffic Sciences, University of Zagreb, Croatia,

²Department of Transport Management, Marketing and Logistics in Transport, The Jan Perner
Transport Faculty, University of Pardubice

1. Introduction

The advent of globalization and market expansion generated increased competition in all the branches of economy. Consequently, the availability to a large number of diverse products has created a very demanding consumer, who insists on momentary availability and continuous purchase of new models. It is precisely for these reasons that the logistic operators are forced to perform additional activities with more transactions in smaller quantities, shorter cargo handling times, at lower costs and greater punctuality.

The logistic activities represent an optimized response to the globalization processes, and the companies involved in such activities, with optimal planning of the logistic and distribution processes, realize higher profit and more stable position on the world market. Therefore, it is necessary to define the logistic and distribution processes, their elements and interrelations, effects, as well as planning process methods, and all this in order to optimize the operation of logistic operators.

The processes included in the decision-making are hierarchically set (or defined), with many interactions and feedbacks. The planning of the logistic and distribution processes can be separated as the most important factor of optimizing the logistic-distribution system. For the planning of these processes to be in the function of

optimization of the mentioned systems, it is necessary to know all the elements of these complex processes, as well as their interrelations and interdependences.

2. Basics of the logistic-distribution process planning

During the logistic-distribution processes hundreds of individual decisions are made and they need to be coordinated every minute. These decisions are of different levels of importance, so that the level of preparation for each single decision is defined according to their level of importance. It is precisely this preparation that can be defined as the planning task. Planning represents the support to decision-making with identification of alternative future activities and the selection of the optimal one.

Planning can be divided into several phases (Figure 1):

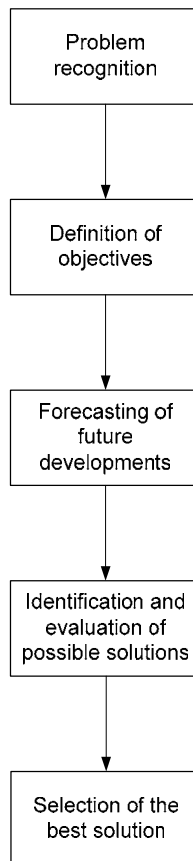


Fig 1 Planning phases of logistic-distribution processes

Logistic-distribution processes are very complex, i.e. they consist of a multitude of details that occur in reality, but cannot influence the planning. Precisely therefore it is

necessary to solve the real problems by simplified copies of these problems, the so-called models, as the basis for making a plan. The presentation of the real problem, the simplest possible but with all the necessary details and not ignoring several serious real factors, is called modelling (“art of model creation”). Simulation models and forecasting models are trying to foresee the future condition and to explain the connections between the input and the output of the system. However, they do not support the choice of one or several solutions which are good in the conditions of certain criteria and the possible activities. This is the purpose of the optimization models which differ from the mentioned ones by additional “function of objective” which has to be either minimized or maximized.

Structural changes in the economy, high level of labour distribution, the “Just-in-time” and “Quick Response” strategies, and the globalization have influenced the transport demand, i.e. transport requirements. The mentioned changes have caused an increase in the frequency of deliveries and reduction of the quantity of goods per single delivery. This has brought to reducing the intensity of individual goods flows and increase in the costs and general increase in the transport volume.

The basic aim of planning the logistic and distribution processes is to achieve the uniformity and consistency i.e. continuity of the goods flows and the best possible usage of the traffic infrastructure and the transport means. Precisely this is of vital importance for the rational realization of the logistic functions, since good exploitation per time and capacity is the basic precondition for reducing the fixed costs which are, as is well known, extremely high in transport.

Based on this it is obvious that planning of logistic and distribution processes has to be performed at the level of the entire system, and that it is necessary also to carry out separate planning of elements of the logistic and distribution systems, taking into consideration their interwoven condition, with the aim of creating optimal logistic processes.

3. Parallel planning model of logistic and distribution processes

From the previous analysis of the logistic and distribution systems one may conclude that their planning is not restricted to the planning of production, transport or distribution, but rather covers the entire logistic and distribution process with all its elements.

It may be claimed that every element of the logistic and distribution process is separate, independent and complex and that it requires separate and independent planning. This is the very fact that represents the biggest barrier in systemic planning of logistic and distribution processes. It is, namely, much easier to analyze and plan the elements of the logistic and distribution processes separately, since good planning can result in certain positive results in the optimization of time, capacity, costs, etc. in a certain element. These are then the very reasons that in literature a host of methods and

models can be found, mathematical, statistical, empirical and heuristic ones, that can be implemented in partial planning of the logistic and distribution processes, i.e. in independent planning of single elements of the logistic and distribution systems. The results obtained by such planning do not suffice, and the logistic and distribution system should be considered as a whole, and consequently, the processes that occur within the system should be planned.

This is precisely the reason that the model of parallel planning of logistic and distribution processes has been developed (Fig. 2) which understands simultaneous planning of all the elements of the logistic process. The result is synchronized, optimal planning of the logistic processes on the whole, based on the real time data.

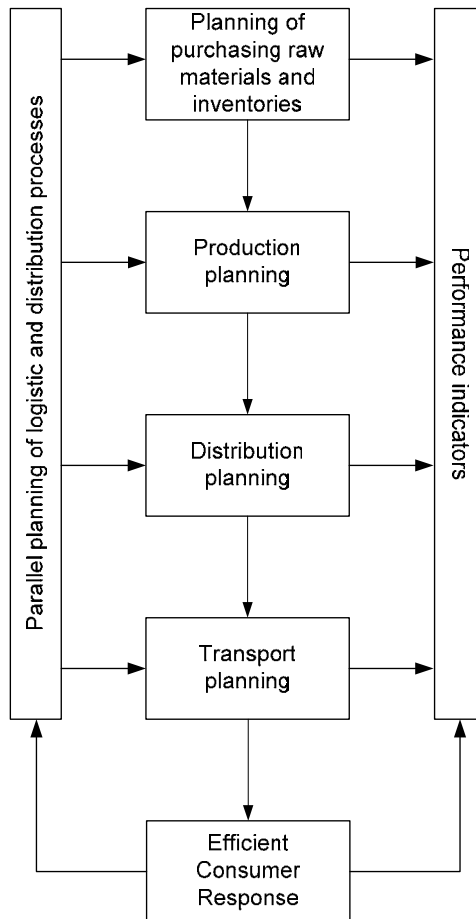


Fig 2 Model of parallel planning of logistic and distribution processes

Planning of purchasing raw materials and inventories

The purchase plan results from the purchase plan, production plan and the inventory plan and directly influences the plan of results. It contains the overview of the situation on the purchase markets, important for the company, information about the most important suppliers for the company, as well as their prices and delivery conditions, information about the prices for the most important articles of purchase, mid-term chances and risks for the most important items of purchase and the possibility of alternatives for certain raw materials, materials and energy.

The purchase plan provides information on the variable purchase costs, and along with a sales plan allows the estimate of contributions to cover the fixed costs and the results plan.

The basic task of purchase is to insure the availability of the necessary goods and services in adequate quantities and of adequate quality, at the right time and at the right place, at affordable prices and under the maximally favourable payment conditions.

Inventory planning of materials is conditioned by smooth flow of the production and business processes. There are two criteria that determine the limits of inventories: the criterion of safety of the production process defines the bottom limit of the inventory level, and the criterion of cost-efficiency defines the upper limit of the inventory level. Therefore, the level of planned inventories has to range within the scope defined by the safety of the business process and its cost-efficiency. The aim in inventory planning is to ensure the availability of the necessary materials according to the type, quantity and time. Thus, too low inventories that jeopardize the performance production are avoided, as well as the too high inventories that reduce the cost-efficiency of the company operation.

Production planning

Production planning is deduced from the objectives of the company operation as an entity. The production and economic objectives of production planning are:

- minimizing the production time,
- minimizing the capital bonding,
- compliance with the production terms,
- optimization of capacity usage,
- minimization of the equipment costs,
- minimization of the transportation costs.

Production planning has the task to determine the time schedule of the production activities as well as the quantity of the produced goods. In the very planning the data are analysed about the expected total demand as well as the condition of inventory, and based on this one tries to determine the production that will satisfy the actual needs without creating unnecessary surpluses. Complex APS (Advanced Planning and

Scheduling) systems set and using computers solve the mathematical models that describe production. The models consist of a large number of restrictions that describe the external conditions and bottlenecks of the production process. Using various complex algorithms the production plans, raw materials purchase, time usage of available capacities and similar fundamental unknowns are determined. These systems perform also simulations based on the actual production data and graphically present the results. These systems are primarily used only for the optimization of production, but expand today to all the activities in the supply chain (distribution, purchase, etc.).

Distribution planning

Distribution of finished products includes the activities of packaging, warehousing, as well as physical transportation of the finished product to the end customer. Organization of distribution is a component of managing the supply chain. Better organization of distribution can achieve substantial savings and increase the satisfaction of the customers.

Planning of the distribution network is a very complex procedure and requires substantial efforts in order to achieve an optimal solution. It is an analysis of a large number of data and the very process would be unthinkable without using information technology.

Planning includes decisions such as the number and the location of the warehouse, policies of delivering goods to the customers, etc. The idea is simple: to minimize the cost! In the very planning of the network the mathematical methods of integer linear programming are usually used. The distribution network is thus adapted to the customers' requirements regarding the quantity and terms of delivery and the place of production. Thus, e.g. a company may decide to implement a direct method of distribution which understands direct transport of products from the factory to the final market. They may also establish a central warehouse in every region in which they operate, and organize from there the delivery to all the local stores. If there are several production locations, then the factory may establish warehouses for every factory and perform deliveries from them. Basically, there are two essential approaches to distribution network organization: centralized, where customers are supplied from a central warehouse or decentralized, where local warehouses are established in the vicinity of final goods destinations.

The combination of both organizational approaches is represented in the "cross-docking" concept, which is of a relatively newer date and refers to the system which tends to use the advantages of both above-mentioned organizational approaches. In the "cross-docking" system the goods arrive to the main warehouse but do not remain there. They are sorted according to the orders of further trading partners or end customers and then immediately transported further. Usually the goods are forwarded to the next location already a day after the arrival to the warehouse. This system is not easy to implement in practice since it requires a coordination of receiving and resorting the goods,

arrangement of transport means as well as the customers' requirements and production of the demanded goods, which cannot be achieved without the support of information system.

Transportation planning

Transportation planning understands determination of the method of transporting goods (by rail, road, water and air), determination of distribution routes, shipment volumes, determination of the volume and type of fleet etc.

Rationalization of transport does not result only in measurable savings which are expressed in physical indicators in transport, but it also influences reduction of total costs through standardization of packages, implementation of handling technology, transport means, infrastructure, etc. It is important that the effects in traffic are achieved only by the action of the transport processes, i.e. application of technology, and the fact that more traffic on roads requires higher control. Therefore, it is obvious that the increase of the transport share in the structure of social reproduction increases also the need for control over the functioning of this transport.

Monitoring customers' reactions (ECR – Efficient Consumer Response)

ECR is an area of logistics which has resulted from the supply chain of food. The concept originated in the early nineties in the USA emphasising the cooperation between Wal-Mart and their suppliers as innovative method of approaching the cooperation in the supply chain. In 1994 the concept was implemented in Europe, and the result is a significant number of projects among co-operative manufacturers and retailers. The European initiative was followed by the activities in most of the local markets.

Two fundamental principles can be highlighted, and they are embedded in all ECR:

- *Customer-orientation.* Commitment to the belief that sustained business success originates only from providing the customers with products and services which consistently meet or surpass their demands and expectations.
- *Working together.* Recognition that the greatest consumer value can be offered only when trading partners work together both within their own company and with their trading partners, in order to overcome the barriers that disturb efficiency and effectiveness.

ECR stimulates enterprises to pursue continuous improvements within three focal areas:

- *supply:* flow of products through the entire supply chain, from elements and packaging, through production, through distribution to wholesalers and retailers, and finally to the stores and shopping carts of the consumers.
- *demand:* the range of products offered to consumers, efficiency of products promotion, introduction of new products and efficiency of related demand management activities.

- *enabling technologies*: technologies that are necessary in order to support supply, demand and fast communication of accurate and complete information to all trading partners.

Within each of these areas, several improvements are proposed that the companies can carry out in order to improve the efficiency and effectiveness. Generally, for the majority of enterprises these are not new proposals. What is new is the integrated method in which these are considered across the entire supply chain and focus of ECR on what trading partners can achieve: “working together” as opposed to what a single company can realize by itself.

Today’s consumer wants products of high quality, no out-of-stocks and moderate prices. These demands are collectively called “consumer value” or total amount of values which a consumer requires of a product or service.

“Consumer value” takes into consideration the following factors:

- product quality,
- consumer's trust in the reputation of the supplier,
- diversity of assortment in the store,
- the price the consumer pays for the product.

The retailer can in no way provide excellent consumer value without cooperating with the suppliers. Partners in a chain have to join forces to satisfy the customer demands. This means that the competition is not adequate any more for individual partners in the chain: instead, the aspect of competition has shifted, so that now entire chains fight for the consumer favour. Cooperation within and outside the company is necessary in order to survive on the market. Companies that are not willing to cooperate will vanish fast from the market.

Performance indicators

The final objective of the strategy of logistic and distribution processes should be a satisfactory and reliable relation between two or more partners in the chain. The level of satisfaction is often expressed by using the performance indicators. When the trading partners assess each other's performance, the basic thing to do is to remove any misunderstandings regarding the method in which the performance indicators are devised and what they measure. In a large number of company sectors initiatives have been undertaken in order to obtain a standard set of performance indicators accepted by an entire industrial sector. In this field the food industry has taken the leading position.

According to them, the performance measurement system has to function in the following way:

- allow understanding and insight into the entire chain;
- influence the behaviour of the entire chain;

- provide information on the results of the entire chain.

In developing the performance indicators, only one thing matters in the end: the end customer must be satisfied. The customer does not care about the delivery time from one location to the next, or the costs involved in the process. What the customer cares for is only how much money and how much time they have to spend themselves in order to acquire the product. Good performance indicators are therefore those that have been developed from the perspective of the end customer. The objective will therefore be to maximally limit the total “throughput” time (production). Besides, the performance indicators have to be developed in such a way that the reasons for any chain problems are made clear, so that appropriate measures (actions) can be taken.

4. Conclusion

If logistic-distribution systems are considered, one may say that they represent the systems of spatial-time transformation of assets, and the flowing processes as *logistic-distribution processes*. The characteristic of the logistic and distribution systems is understanding of the connection of the moving processes (transport) and the stationary processes (warehouses). The moving and stationary processes can be represented by a network upon which objects move, stay at nodes and travel along paths that lead further. Nodes can be connected in different ways, and the object can also move differently, depending on the network structure.

Modern goods flows increasingly rarely use direct sales of goods from the manufacturer to the end consumer. Between the end points of social reproduction – production and consumption more and more mediators are set and their mediatory function is differently named. The basic reasons for the existence of mediatory organizations lie in the necessity of spatial and time connections of the increasingly distant sphere of production from the sphere of consumption, in the possibility of business specialization and in minimizing the number of traffic transactions. The survival of an intermediary, i.e. link in the distributive chain depends on their competence to organize the flows of goods (wholly or partially) so that they exceed the alternative or when the costs of mediation are lower than the costs occurring at the producer's when they perform distribution themselves. The system of mediators is greater in the developed markets, and the economic advantage of mediators as specialist results from the possibility of greater concentration, and then necessary dispersion of the goods flows.

Planning of the logistic and distribution processes can be considered as planning of all the technologies that participate in these processes. It should be noted that the area of planning the logistic and distribution processes is not limited only to production planning, transport planning or distribution planning. It covers the entire logistic and distribution process with all its elements. Planning of the logistic and distribution processes, therefore, understands the optimization and planning of the traffic infrastructure system, traffic systems and the technology of transport included in the

overall logistic system. All the elements are interconnected by the flows of goods from the starting points, over the traffic nodes, to points of receipt, and they form the logistic and distribution network. This fact clearly shows that it is a very complex system whose functionality cannot be simply described.

This is precisely the reason why the model of parallel planning of logistic and distribution process has been developed, and it understands simultaneous planning of all the elements of the logistic process. The result is a synchronised, optimal planning of the logistic processes as a whole, based on real time data.

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Literatura

1. CHOPRA, S., MEINDL, P. *Supply Chain Management*, Pearson Education, Inc., 2004.
2. GHIANI, G., LAPORTE, G., MUSMANNO, R. *Introduction to Logistics Systems Planning and Control*, John Wiley & Sons, Chichester, England, 2004.
3. HUGOS, MICHAEL *Essentials of Supply Chain Management*, John Wiley & Sons, New Jersey, 2003.
4. ROBERTSON, J.F., COPACINO, W.C. *The Logistics Handbook*, Andersen Consulting, New York, 1994.
5. SHAPIRO, J.F. *Modeling the Supply Chain*, Wadsworth Group, Duxbury, 2001.
6. VAN GOOR, PLOOS VAN AMSTEL & PLOOS VAN AMSTEL *European distribution and supply chain logistics*, Wolters-Noordhoff bv Groningen/Houten, 2003.
7. IVAKOVIĆ, Č., ŠAFRAN, M., ROGIĆ, K. *Logistics as Element of Improvements in Storage, Distribution and Transportation of Goods*, magazine Promet, Traffic - Traffico br. 4, volumen 12, Fakultet prometnih znanosti, Portorož, Trieste, Zagreb, 2000.
8. IVAKOVIĆ, Č., ŠAFRAN, M., STANKOVIĆ, R. *Transport Exchange as a Factor in Optimising International Road Freight Traffic*, magazine Promet, Traffic - Traffico br. 5-6, volumen 10, Fakultet prometnih znanosti, Portorož, Trieste, Zagreb, 1998.
9. BABIĆ, D. *Metode planiranja logističko-distribucijskih procesa*, Znanstveni magistarski rad, Fakultet prometnih znanosti, Zagreb, 2006.
10. ŠAFRAN, M., BABIĆ, D., TOMAŠIĆ, D. *Defining the optimization criteria for the functioning of logistics and distribution centres*, International Scientific Conference "Transport Chains and Distribution in Logistic Systems", Zagreb, 28.-29. March 2007.
11. MADLEŇÁK, R. *Logistika ako ključový faktor úspechu pri elektronickom obchodovaní* In: Diagnostika podniku, controlling a logistika : 1. medzinárodná vedecká konferencia. - Žilina: Žilinská univerzita, 2002. p. 190-192. ISBN 80-7100-951-2
12. ŠVADLENKA, L.; KAMPF, R. *Supply and Demand in Transport Model. In New Challenges for Transport and Communications*. Fourth Scientific Conference: 14. - 15. September 2006, DFJP University of Pardubice. Pardubice : University of Pardubice, 2006. p. 39 - 44. ISBN 80-7194-880-2.

Darko Babić, Ivana Čavar, Petr Průša:

Resumé

MODEL PARALELNÍHO PLÁNOVÁNÍ LOGISTICKÝCH A DISTRIBUČNÍCH PROCESŮ

Darko BABIĆ, Ivana ČAVAR, Petr PRŮŠA

Tento článek se zaměřuje na determinaci modelu paralelního plánování logistických a distribučních procesů. Pro plánování těchto procesů musí být brána do úvahy optimalizace zmíněných systémů, pro kterou je nezbytné znát všechny elementy komplexu procesů, stejně tak jako jejich vzájemný vztah a vzájemnou závislost.

Summary

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The logistic activities represent an optimized response to the globalization processes, and the companies involved in such activities, with optimal planning of the logistic and distribution processes, realize higher profit and more stable position on the world market. Therefore, it is necessary to define the logistic and distribution processes, their elements and interrelations, effects, as well as planning process methods, and all this in order to optimize the operation of logistic operators.

Logistic-distribution processes are very complex, i.e. they consist of a multitude of details that occur in reality, but cannot influence the planning. Precisely therefore it is necessary to solve the real problems by simplified copies of these problems, the so-called models, as the basis for making a plan. The presentation of the real problem, the simplest possible but with all the necessary details and not ignoring several serious real factors, is called modelling ("art of model creation").

The basic aim of planning the logistic and distribution processes is to achieve the uniformity and consistency i.e. continuity of the goods flows and the best possible usage of the traffic infrastructure and the transport means. Precisely this is of vital importance for the rational realization of the logistic functions, since good exploitation per time and capacity is the basic precondition for reducing the fixed costs which are, as is well known, extremely high in transport.

Based on this it is obvious that planning of logistic and distribution processes has to be performed at the level of the entire system, and that it is necessary also to carry out separate planning of elements of the logistic and distribution systems, taking into consideration their interwoven condition, with the aim of creating optimal logistic processes.

Zusammenfassung

MODELL GLEICHLAUTEND PLANUNG LOGISTIK UND DISTRIBUTIVE PROZESS

Darko BABIĆ, Ivana ČAVAR, Petr PRŮŠA

Die logistische Tätigkeiten stellen eine optimisierte Antwort auf die Frage an die Globalisationsprozesse. Die Firmen, die sich mit solchen Tätigkeiten beschäftigen, mit optimalen Planen der Logistisch und-distributionsprozesse realisieren einen grösseren Profit und eine stabile Lage auf dem Weltmarkt. Daher ist es nötig Logistisch- und distributionsprozesse, ihre Bestandteile

und Verhältnisse, Leistungen und Prozessplanen zu definieren. Es wird zum Zweck einer optimierten Geschäftsführung der Logistikoperatoren gemacht.

Logistisch- und distributionsprozesse sind sehr komplex, d.h. sie bestehen aus vielen Einzelheiten, die in der Wirklichkeit entstehen, aber sie können nicht das Planen beeinflussen. Daher ist es nötig wirkliche Probleme mit Hilfe ihrer eigenen Kopien, sogenannten Modelle als Grundlage für das Planen, zu lösen. Eine einfachste wie mögliche Darstellung eines Problems mit allen nötigen Einzelheiten, ohne einige ernste Faktoren zu ignorieren, nennt man Modellieren („die Kunst der Modellschöpfung“).

Das wichtigste Ziel des Planens ist eine Gleichmäßigkeit und Dauerhaftigkeit, d.h. Kontinuität des Warenflusses und eine bessere Nutzbarkeit der Verkehrsinfrastruktur und Verkehrsmittel. Das ist auch sehr wichtig für eine rationelle Verwirklichung logistischer Funktionen, weil eine gute zeitliche und kapazitative Ausnutzung die Grundlage für die Verminderung der festen Kosten, die in den Verkehr sehr hoch sind, ist.

Auf Grund obengenannter erkennt man, dass das Planen der Logistisch- und distributionsprozesse auf der Ebene des ganzen Systems durchführen muss, und daneben auch das einzelne Planen von Elementen des Logistisch- und distributionsystems realisieren soll. Das wird alles im Ziele der optimalen logistischen Prozesse gemacht.