The Perfecting of Product Distribution Management; Supply Chain Demand Approach

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Abstract: The distribution process includes, beside the transport of the products, the operations of purchasing, of consignment, of concession, of depositing and storage and a lot of other commercial operations. The aim of this paper is introduce a model for supply chain demand. Also, this paper investigated the role and the status of the transport system in the distribution management.

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1. Introduction

The concept of distribution concern, above all, the itinerary covered by the goods from the moment in which they are furnished by the producers to the moment in which the end customers receive-buy them; this itinerary includes, besides the producers and the consumers, the commercial intermediates (who, sometimes, play an important economic role). The distribution process includes, beside the transport of the products, the operations of purchasing, of consignment, of concession, of depositing and storage and a lot of other commercial operations. The objectives of the distribution politics can have both a strategic importance (for example, the image of the distribution channel) and an operative importance (for example, the increase in a short time of the turnover). These objectives include in their structure:

- The objectives of the economics-oriented distribution politics;

-The objectives of the supply-oriented distribution politics;

-The objectives of the psychology-oriented distribution politics.

Due to the place it occupies in the economic processes, the distribution performs an important economic and social role.

The main functions of the distribution process are:

-the change of ownership over the product through the purchasing agreement;

-the moving of the product, meaning the transport, storage, conditioning, handling and wrapping of the product;

- The choice and the usage of the distribution channels;

-the establishment of the itinerary (route) that will be followed by the product on the market.

The distribution management can be defined as the complex process of planning, organization, coordination and control of all the flows of materials and products, with the information flows related to them, including the collecting and refund of the waste materials and defective products. The physical distribution can be defined, according to Peter Drucker, as being "another way of naming the entire business process", or according to Philip Kotler being the "planning, manufacturing and control of the materials and end products from their origin to the place in which they are used, to satisfy the customers and to obtain a profit". Sufficient literature exists about various aspects and facets of GrSCM. Comprehensive reviews on green design (Zhang *et al.* 1997), repairable inventory (Guide *et al.* 1997c, 1999a), production planning and control for remanufacturing (Bras and McIntosh 1999; Guide 2000; Guide *et al.* 1997b,c), issues in green manufacturing and product recovery (Guide *et al.* 1996; Gungor and Gupta 1999), reverse logistics (RL) (Carter and Ellram 1998; Fleischmann *et al.* 1997) and logistics network design (Fleischmann *et al.* 2000, 2001; Jayaraman *et al.* 2003) have been published. In addition, Bloemhof-Ruwaard *et al.* (1995) deal with interactions between operational research and environmental management, and Roy and Whelan (1992) discuss recycling through value-chain collaboration. Min *et al.* (1998) and Lippmann (1999) discuss combined location-routing problems and elements for success in GrSCM, while Dowlatshahi (2000) develops a theory of RL. Sufficient literature also exists in the related areas of green purchasing (Zhu and Geng 2001), industrial ecology and industrial ecosystems (Bey 2001; Boustead 1979; Cairncross 1992; Frosch and Gallopoulos 1989; Graedel 2002; Hui *et al.* 2001; Kaiser *et al.* 2001; Klassen 2001; Min and Galle 2001; Nasr 1997; Owen 1993; Sarkis 1998, 1999, 2001; Sarkis and Cordeiro 2001; van Hoek 1999; Zhang *et al.* 1997; Zhu and Sarkis 2004). The aim of this paper is introduce a model for supply chain demand. Also, this paper investigated the role and the status of the transport system in the distribution management.

1. A Model for Supply Chain Demand

The concept of management of the distribution line implies the responsibility of integrating the organizational unities into an sales channel of the products, starting from the upstream (from the producer), to downstream, attracting into this system, depending of the context, even the end costumer; this complex action implies the efficient coordination of the entire informational flow, of the material and financial resources, in order to ensure an optimal service for the clients and this way to enhance on the whole the competiveness of the distribution chain, (the distribution chain being considered as a unity). If a company produces end products out of various components acquired from the suppliers, and then these products are sold to the clients, the situation represents a supply chain. In the paper it was mentioned the place of the supply chain management in the context of the advanced planning of the product distribution. The objective that governs all the efforts in a SCM is that of increasing the competiveness, a characteristic that, through that system, is extrapolated to the entire distribution chain. The elements that are specific to the supply chain are, in general, the following: the client; the planning; the acquirement of the material resources necessary for the manufacturing; the stocks from the distribution channel; the production; the transport. A supply chain management presents three levels of activity: strategy-oriented, tactics-oriented and operation-oriented. The specific components are: the planning, the source, the production, the delivery, and the refunds. The utility of a punctual and precise supply chain stands in its ability to distribute products, as much products as the market demands. This is, in fact, the practice of the Japanese system "Just in Time", which allows the companies to reduce the stock of products they possess for a better efficiency. The supply chain management structure (SCM) has many levels, according to its main objective, the actions presented to be performed and the factors involved into the system. The fundaments of SCM are integration and coordination: the integration involves choosing the partners, network organizing and inter-organizational collaboration – the distribution chain management. The activity's coordination along the distribution chain can be an excellent one through the usage of the greatest developments in the communication and information technology. It involves three dimensions: the technology, information and communication usage; the process' orientation, the advanced planning. The supply chain management is interpreted as a greatly efficient and effective modern system – these characteristics being proved by the results of its implementation by some successful companies. SCM's valorization necessitates, besides desire and interest, important informational, material, technical and financial resources. The advantages it generates justify in a significant way the effort involved into the implementation of SCM system. The management of the stocks which constitute inside the distribution channel, at the level of the distribution centers, of the storages and at the selling places raises a problem. The most important aspects of the stock management are related to the types of stocks which must be formed, the reasons they are constituted, the advantages generated by their existence, related to the effort implied by obtaining them. Considering the main features of stocks' creation and possession, it was specified in the paper, besides the objective necessity that led to their creation, the managers' orientation towards the optimization of the stocking processes, of the stocks' level and of the elements associated to them. In order to do that, several variants of the Wilson model were presented, variants that lead to obtaining some positive results, optimization of the current stocks, of quantity of the order and supplying, of the level of replenishment of the stocks, of the costs involved in the storage process. On this line it was approached the question of the safety stock, for which it was recommended the IMPACT method. The running of the storage processes in conditions of increased efficiency and effectiveness leads to the enhancement of the competiveness and performance in the product distribution and in serving the customers.

ANFIS is an *adaptive network*. An adaptive network is network of nodes and directional links. Associated with the network is a learning rule - for example back propagation. It's called adaptive because some, or all, of the nodes have parameters which affect the output of the node. These networks are learning a relationship between inputs and outputs. Adaptive networks cover a number of different approaches but for our purposes we will investigate in some detail the method proposed by Jang known as ANFIS. The ANFIS architecture is shown below. The circular nodes represent nodes that are fixed whereas the square nodes are nodes that have parameters to be learnt.

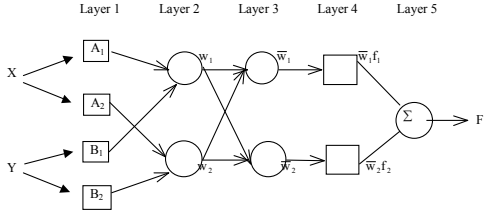

Figure1. Architecture of the ANFIS structure

An ANFIS architecture for a two rule Sugeno system

A Two Rule Sugeno ANFIS has rules of the form:

If x is A_1 and y is B_1 THEN $f_1 = p_1x + q_1y + r_1$
If x is A_2 and y is B_2 THEN $f_2 = p_2x + q_2y + r_2$

For the training of the network, there is a forward pass and a backward pass. We now look at each layer in turn for the forward pass. The forward pass propagates the input vector through the network layer by layer. In the backward pass, the error is sent back through the network in a similar manner to backpropagation. An ANFIS system is a kind of adaptive network in which each node performs a particular function of the incoming signals, with parameters updated according to given training data and a gradient-descent learning procedure. This hybrid architecture has been applied to the modeling and control of multiple-input single-output (MISO) systems [4]. The architecture of the ANFIS is constituted by several layers (fig. 2). If we consider for simplicity two inputs x and y and two outputs f1 and f2 for a first-order Sugeno fuzzy model, with Ai and Bj being the linguistic label associated with x and y respectively, every node in layer 1 represents a bell-shaped membership function or with variable membership parameters. Usually we choose the bell-shaped functions. Nodes of layer 2 output the firing strength defined as the product, where the set of nodes in this layer are grouped for each output j. A normalization process is computed in layer 3 giving the normalized , and the Sugeno-type consequent of each rule with variable parameters pi, qi and ri is implemented in layer 4 yielding fj as the output of the single summation node and finally the single node of layer 5 computes de overall output as a summation of all incoming signals. The learning procedure consists of two stages. In the forward pass training input data go forward the ANFIS architecture, and in the backward pass the error rates propagate backward, being the both the consequent and the membership parameters updated by gradient descent.

Layer 1

The output of each node is:

$$O_{1,i} = \mu_{A_i}(x) \qquad for\ i = 1,2$$

$$O_{1,i} = \mu_{B_{i-2}}(y) \qquad for\ i = 3,4$$

So, the $O_{1,i}(x)$ is essentially the membership grade for x and y.

The membership functions could be anything but for illustration purposes we will use the bell shaped function given by:

$$\mu_A(x) = \frac{1}{1 + \left| \frac{x - c_i}{a_i} \right|^{2b_i}}$$

Where a_i, b_i, c_i are parameters to be learnt. These are the premise parameters.

Layer 2

Every node in this layer is fixed. This is where the t-norm is used to 'AND' the membership grades - for example the product:

$$O_{2,i} = w_i = \mu_{A_i}(x)\mu_{B_i}(y), \qquad i = 1,2$$

Layer 3

Layer 3 contains fixed nodes which calculate the ratio of the firing strengths of the rules:

$$O_{3,i} = \overline{w_i} = \frac{w_i}{w_1 + w_2}$$

Layer 4

The nodes in this layer are adaptive and perform the consequent of the rules:

$$O_{4,i} = \overline{w_i} f_i = \overline{w_i}(p_i x + q_i y + r_i)$$

The parameters in this layer (p_i, q_i, r_i) are to be determined and are referred to as the consequent parameters.

Layer 5

There is a single node here that computes the overall output:

$$O_{5,i} = \sum_i \overline{w_i} f_i = \frac{\sum_i w_i f_i}{\sum_i w_i}$$

This then is how, typically, the input vector is fed through the network layer by layer. We now consider how the ANFIS learns the premise and consequent parameters for the membership functions and the rules.

1. The Role and the Status of the Transport System in the Distribution Management

The transports represent the costliest logistic activity, representing over 40 percent of the distribution costs of the majority of the companies; only in the United States these costs exceed 400 million dollars per year. The global transport costs exceed 2000 billion USD per year (Michigan State University). The transport expenses are raised proportionally to the other distribution costs and very fast; this is caused by some factors, as: the oil price, the lack of labor force, the increasing in the number of small orders and their frequency, the expansion of the exterior commerce, etc.

Resulting from the increasing interdependence between the companies, between various geographical areas, between the national economies and even between continents, the matter of the transports becomes especially important. Any kind of distribution activity necessitates, in a certain amount, a transport system. Under the circumstances, we can assert that the transports represent one of the components of the distribution, ensuring the connection between production and consumption, concurrently, the transport system manifests itself as a factor that links the economic national circuit and the international one. "The transports represent the circular system of economy, playing a vital importance into the optimum development of the economic activities, in general, and of the other components of logistics, in particular, any kinds of deregulations or malfunction of this process generate perturbations in the domain of production or of consumption."

In consequence, in the third chapter of the paper there were distinguished the elements that were specific to some ways of transport. It was proven that the transports are characterized by several main particularities, which are:

- They are intermediary activities that ensures the product and materials' flow towards the storages, from the storages to the places in which they are used, to the distribution centres and to the end users ;
- They use special technical systems;
- They provide services and they don't create any material goods;
- The transports' infrastructure necessitates a lot of space and this fact results into a special influence over the social and economic space , etc.

In order to perform with efficiency and effectiveness the distribution activities, the transports must answer to some requirements, like: low costs, a great degree of flexibility, minimal pollution of the environment, the quantitative and qualitative integrity of the products; great mobility. All these requirements depend on the modes and means of transport, on the transport's infrastructure, on the nature of the products, on the costs implied.

The development of the process of transport presupposes the following stages: the dispatching; the initial terminal transport; the initial transhipment; the actual transport; the final transhipment; the terminal transport, the good's arrival. Among the stages that are characteristic to the process of transport, the dispatching and the destination of the products are compulsive; these stages delimit this process from the spatial point of view. The other stages depend of the concrete conditions of the communication lines that compose the transport route, of the status of the goods of loading and discharge and of the types of means of transport.

Nowadays the global economy, the systems of production are becoming more and more integrated, interdependent and connected to the product flow. This flow represent an integral and functional network composed by production commerce and services unities which cover all the components of logistics, from the ensuring of the materials, the products' manufacture to their distribution on the market. The transport process takes care of the products' flow on their entire distribution route.

The distribution system must be characterized by a high flexibility, according to its component of transport, in such a degree that it can adapt, at any time, to the nature of the goods that are transported. This requirement materializes into a series of measures, some of them being mentioned:

- The practice of a competitive management;
- The detailed knowledge of the area it covers;
- The performing of the transport in due time;
- The exact knowledge of the nature of the products and of the quantities that must be transported;
- The usage of the most adequate mode of transport.

The choice of the most efficient mode of transport and of the most economical means of transport available to this mode of transport presents a special interest. The choice implies the knowledge of the modes of transport that can be used and the means of transport that are specific to these. In order to do so, in the third chapter were presented some issues characteristic cu different ways of transport, in order to be ensured the necessary documentation for the distribution managers to choose the ways of transport considered the most efficient and effective.

2. Conclusion

The distribution process must be managed in such a way that it must ensure, in the first place, a unitary product flow, which must determine the improvement of the firm's performances. One course of action,

oriented towards the shipment optimization, is represented by "the optimization of the volume of goods that must be distributed and transported". To that effect the distribution managers must analyze the factors that contribute to the optimization of the product distribution chains from the supplying sources to the distribution sources and from them to the sales outlets or to the end costumers. Choosing the distribution chain (channel) represents the distribution management's main objective; therefore, a fundamental analysis is necessary as a result of this action's impact on the efficiency and effectiveness of the product distribution to the customers. The decision of choosing the distribution chain and of the way of transport is complex, due to the great numbers of potential options.

The distribution managers must be informed, must quantize and monitor the volume of ordered products, transported and handled integrally. This allows those factors to optimize the distribution activities through: treating the shipment as a unity; improvement of the relationship with the transporters; the efficient coordination of the receiving and shipping of products; investments in the infrastructure and modern equipment; the increase of the circulation speed of the stocks; the appeal to third parties for services with a great degree of specialization; the creation of heterogeneous companies, etc.

To create a rational system of itineraries (routes), it's necessary to consider some requirements that are particular to the goods distribution, such as:

-determining the consequences of small stocks;

-designing urban sales outlets;

-determining the variation of the report between volume and weight, according to the nature of the product;

- Organizing and grouping the diversity of goods wrappings;

- mentioning the restrictions of circulations specific to various transport routes;

-identifying the program of storages, centers or shops, etc.

There are some other actions that can be taken to ensure the optimization of the product distribution, such as: the automation, robotizing and complex mechanization of the loading and unloading of the merchandises, the usage of efficient procedures and techniques of prevention and protection against the deterioration and qualitative depreciation of the wrappings and products; the massive usage of modern techniques of shipping, storage and handling, etc. In the context of the approach of the possibilities of optimizing the distribution management both considering its components and on the whole, the optimization of the distribution network plays an important role, due to its impact to clients. The optimal solutions are unique for each type of distribution network, being the result of a procedure that is recommended by some specialists, which involves taking some steps; we mention some of them:

-Evaluating the performance of the existent distribution network;

-Designing the new network's configuration and the data base's implementation for its optimizing;

-The identification of alternatives for each route;

-The selection of the design needed for optimizing the distribution network and the design of the soft used in this optimizing;

-The implementation of the network model in the calculation technique chosen, etc.

In order to achieve the optimization of the distribution actions, it was suggested in the paper as a mathematic model to be used (the forth stage from above) the critical itinerary method (or the critical itinerary analysis –ADC in the specialized papers), along with the methods CPM or PERT, for which it was presented concretely the theoretical methodology in their implementation. The indicators through which it can be expressed the efficiency of the shortage of the performing of the distribution management's constituent activities were also mentioned in the context.

To draw a conclusion, we consider that the usage of CPM and PERT models in the distribution management, as tools of rendering efficient the activities in this field of activity is beneficial both for the product distribution system and for the whole economic activity particular to the members of a distribution channel.

Another contribution of our own, which we consider to be very important for enhancing the efficiency of the distribution systems, is related to the optimization of the emplacement of the objectives particular to these, as the storages and distribution centers or another sales outlet – an action that must sensitize the management at the superior level of the organizations. To that effect there were presented three economic-mathematic models, with concrete exemplifications under the guise of case studies. Before presenting the case study's solving, there were stated the criteria that must be considered in choosing the emplacement of de investment objectives, in this case the distribution objectives: economic criteria, functional-technological, social, restrictive-strategic criteria, natural factors (for which there were specified the elements of characterization and justification). The optimization models are included in the economic criteria that take precedence over the others. In the end of chapter six it was discussed the inverse distribution system, as representing an objective necessity for the modern

distribution management. Specialists in the domain approached the distribution process in their attempt of designing a total distribution system, starting with the producer and with the product flow from the producer to the end consumer. Nowadays the specialists' preoccupations are related to designing an efficient inverse distribution system. The inverse distribution process, from the point of view of withdrawing a product from the distribution chain and even withdrawing it from its user, must be considered as being an integral part of the distribution strategy. This includes:

- The rational design of the products' physical distribution chains;
- The implementation of an effective informational system, which allows the operative knowledge, in due time, of the products that must be withdrawn from the distribution chain;
- The periodic revision of the systems and procedure of orders' process;
- the revision of the management systems and of the shipping and traffic, paying a special attention to the identification of the shipping data, the orders' book, the products' destination, the means of transport used, etc.

Having the same goal, the clients' localization and their direct notification represent essential factors in the product's safe withdrawal.

The distribution activities involved into the flow of the products to be returned are integrated in the process and interdependent. The main objectives of the distribution system are: the cost's minimization and the elimination of the service' malfunction. If these objectives can be fulfilled, in each concrete circumstance, then this action, more and more frequent on the market, will be easy to perform.

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