

# Digital Technology in the Logistics System of a Retail Enterprise

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## ABSTRACT

The development of logistics is unthinkable without the introduction of digital technologies. In times of crisis, it becomes obvious that the most stable are those companies that are able to change rapidly, adapting to the situation. This flexibility can only be achieved by using modern dynamic management models instead of legacy static ones. An indispensable condition for the implementation of such dynamic models is the use of modern digital technologies that allow real-time monitoring of changes in the external environment and promptly respond to it. We will consider this using the example of inventory management in logistics systems, where we will demonstrate the effectiveness of using management models based on the flow approach.

**Keywords:** *information technology, logistics system, inventory management, method for calculating the optimal size of the inventory*

## 1. INTRODUCTION

In the conditions of the modern economy, information technologies penetrate into all spheres of activity. The authors of [1] identified the problems of the existence of paper media in the context of warehouse logistics and, as a consequence, human errors in the movement and placement of stocks. Identified the benefits from the implementation of automated warehouse accounting systems. They showed that the use of bar-coding technology reduces costs and optimizes warehouse operations. The article [2] describes 4 important KPIs for warehouse logistics. The article discusses how to improve KPIs and how to track them using TMS. In [3], the authors go even further in the use of information technology, proposing the concept of 5PL-logistics, which provides a scientific basis for transforming traditional business into virtual organizations. 5PL providers create flexible network interactions of participants and act as a regulator of all flows in logistics systems and networks of a virtual organization [4]. In our opinion, the sustainable development of the logistics system of a book retailer is impossible without the introduction of information technologies for inventory management, the purpose of the work is relevant.

## 2. METHODS

Theoretical research methods are based on a set of scientific ideas about logistics systems, material flows, stocks and inventory management in the logistics system. A process approach is used for inventory management in the logistics system of a retail enterprise. Digital technologies are used to calculate the optimal stock size. The methodology for calculating reserves was developed on the basis of VEN and FMR analysis, taking into account the "three sigma" rule.

## 3. INVENTORY MANAGEMENT USING DIGITAL TECHNOLOGIES IN THE LOGISTICS SYSTEM OF A RETAIL ENTERPRISE

The formation of a logistics system (LS) is carried out with the aim of uniting all participants to meet the needs of customers while achieving the total minimum costs for the implementation of this goal. Consider the concept of a logistics system (Table 1).

**Table 1** Definitions of the concept of "logistics system"

<b>A.M. Gadzhinsky</b>	A logistics system is an adaptive feedback system that performs certain logistics functions. It, as a rule, consists of several subsystems and has developed connections with the external environment [5].
<b>I.V. Domozhirova</b>	The formation of the logistics system is carried out with the aim of uniting all participants to meet the needs of customers while achieving the total minimum costs for the implementation of this goal [6].
<b>V.V. Dybskaya</b>	The logistics system (in the narrow sense of the business) - 1) a relatively stable set of structural (functional) divisions of the company, as well as suppliers, consumers and logistics intermediaries, interconnected in the main and (or) accompanying flows and united by a single management for the implementation of strategic (tactical) ) logistic plan; 2) the totality of the logistics network and administration system formed by the company to implement its logistics strategy (tactics) [7].
<b>V.V. Dybskaya</b>	A logistic system (in a broad sense) is a complex organizationally completed (structured) micro-, meso- or macroeconomic system, consisting of links interconnected in a single process of managing material and related flows, the totality of which, the boundaries and tasks of functioning are united by common goals [7].
<b>B.A. Anikin</b>	Logistic system - a system for managing resource flows in order to give them quantitative parameters and qualitative characteristics in accordance with the requirements of the external environment [8].

As you can see, some authors speak in favor of the streaming nature of the logistics system. In particular, V.V. Dybskaya says that the logistics system consists of links interconnected in a single process of managing material and related flows, indirectly confirming the thesis that the management of a logistics system involves the management of these flows. B.A. Anikin literally says that a logistics system is a system for managing resource flows. Statements about the streaming nature of processes occurring within logistics systems confirm the thesis that the inventory management process, which is the basis of these systems, is actually reduced to flow management.

For a long period of studying the problems of inventory management, scientists have given many definitions of the term "reserves", however, the most successful definition we consider the definition given by N.P. Sivokhina, who defines the stock as a material flow considered in a certain time section [9]. In our opinion, this is the most accurate statement about the nature of stocks, showing the streaming nature of the process of stock circulation at the enterprise and in the supply chain. Based on this definition, we can conclude that inventory management is actually the management of all material flows in the supply chain. Based on the analysis of the existing definitions of the concept of "inventory management" and elaboration of the statements of scientists devoted to the study of the mechanism, functions and role of inventory management, as well as logistics systems and supply chains, we have formulated the author's definition: inventory management at a trade enterprise is aimed at leveling the material flow through synchronization supply and consumption processes.

Let's take a closer look at the relationship between flows and stocks. So, B.K. Plotkin defines material logistics flow as "the flow of production, supply, sales, storage and transportation, represented as a single whole: suppliers, warehouses, production, distribution and consumers. The initial element in planning this flow is the demand for products" [10]. This definition emphasizes the relationship between material flow planning or, in other words, inventory management, and the study of demand. We fully support this idea - in cases where an enterprise cannot work on preliminary requests, its efficiency largely depends on the effectiveness of forecasting and stimulating demand. Considering that the production processes at most enterprises are regulated and cannot arbitrarily change depending on demand, it is inventory management that is responsible for adapting the enterprise's work to the resulting demand.

With ineffective inventory management and the lack of integration and interconnection of the actions of marketing and logistics departments, enterprises often try to cover the resulting gaps between the volumes of purchases, production and sales with inventories. In some cases, stocks can indeed in the long run equalize the work of production in case of uneven demand (for example, in the case of production of products with seasonal demand), but more often this practice only leads to an unreasonable increase in logistics costs.

Analysis of the structure of logistics costs in various industries of economically developed countries shows that the largest share in them is occupied by the costs of inventory management (20-40%), transportation costs (15-35%), costs of administrative and management functions

(9-14 %) [11]. This makes it clear that one of the main ways to reduce costs for an enterprise is to reduce inventory.

Based on this definition, we can conclude that the ideal situation is when the product is manufactured according to the incoming order. Today, many large companies have chosen this path, including in those sectors of the economy where previously such an approach seemed impossible. For example, many automakers assemble cars based on the forecast demand, but some of them, for example, the "big German three" (Daimler, BMW, Audi AG) produce some of the products according to the incoming specifications. For this, a number of approaches and technologies are used: the location of assembly departments near sales markets, the use of equipment with the possibility of quick changeover, the deep implementation of modern enterprise management systems (ERP), etc. This allows, on the one hand, to avoid the production of slow-moving or unclaimed models, and on the other - to achieve maximum customization of products (individual models can have hundreds of different designs (engine and gearbox options, interior trim materials, body and interior colors, wheel models and exterior elements)).

Online commerce technologies make it possible to significantly simplify the task of equalizing supply and demand - the buyer gets the feeling that he is purchasing the necessary goods instantly, as when visiting a traditional store, but in fact, even the minimum difference between the moments of order and delivery allows the supplier to purchase or make the necessary product (prepare an ordered dish from available ingredients, make a SKD assembly, assemble an order from components located in different warehouses, etc.).

However, it is not always possible to use quick response (QR) approaches. For example, goods of impulsive demand usually need a "live" demonstration, in addition, it is critically important that the buyer has the opportunity to immediately purchase the goods he likes (postponing the delivery time is highly likely to lead to the fact that the buyer, who has lost the impulse to purchase, will refuse to buy). The problem can be complicated by the territorial disunity of individual regions - for example, the delivery of products from Moscow to Yekaterinburg, and even more so to the cities of Siberia and the Far East, can take several weeks. In the B2B space, this may not seem like a critical time frame, but in most retail areas, shoppers will refuse to wait for such a long delivery when alternatives are available.

Therefore, for many retailers, on a par with QR technology, or instead of it, it is necessary to have an inventory management system that allows you to synchronize supply and sales as accurately as possible. At the heart of this system should be a certain mechanism for forecasting demand, combined with an algorithm for making a decision on the purchase (which can apply to the entire assortment, groups of goods or individual items).

The ideal situation here is the possibility of using neural networks to forecast demand, or at least sophisticated extrapolation methods. However, for accurate extrapolation, and even more so for the use of neural

networks, a large data array is required, which can be used to train a neural network or build accurate trend lines, that is, a large volume of sales of one commodity item for a long time. For example, this method can be applied in the operation of grocery stores - their assortment is usually relatively stable (the main commodity items can be in the assortment for at least several years), and there is also a large volume of individual sales, which allows drawing conclusions about the nature of demand.

Accordingly, this method is not suitable for enterprises with an unstable assortment - fashion stores, bookstores, etc. For example, the assortment of most publishers is updated annually by 70-80%, while the turnover of some positions may be a month or even more, which allows us to judge the impossibility of accumulating a sufficient amount of sales data to build reliable forecasts. At the same time, some positions can be in the assortment for years without significant fluctuations in demand (classical literature), others - to demonstrate seasonal demand (textbooks, postcards, calendars), and still others - to go through several stages of the life cycle (bestsellers) in a short period.

It is impossible to apply extrapolation or neural networks for the entire assortment in such conditions due to its heterogeneity, it is also difficult to use them for each individual position - with the accumulation of a sufficient amount of data to build an accurate forecast, the season or stage of the product's life cycle will change and the data will need to be collected again. The application of this method to assortment groups will contain disadvantages of both approaches and, in addition, require operator intervention to assign individual items to a particular group, which will neutralize the advantages of automation. Consequently, in the described conditions, where it is impossible to collect a sufficient amount of data to form a reliable forecast (for example, in relation to a regional bookstore), an approach is necessary in which, on the one hand, it will be possible to predict as when extrapolating for each individual commodity item or groups of goods, and on the other hand - rapid adaptation to changing conditions. Modern inventory management models such as a fixed order frequency model, a fixed size model, a minimum-maximum model and a fixed replenishment model are based on demand forecasting as the main tool for solving inventory optimization problems.

In papers [12, 13] we have proposed a model of inventory management, which consists of three stages. All these stages form a cycle, after the end of which we move on to the next cycle with updated information and an optimized assortment structure (according to the "Deming cycle") (Figure 1):

1. It is necessary to highlight several objective features characteristic of each product in the assortment, which determine the importance of finding goods in the assortment. For example, it can be retail price or profit, quantity of sales, date of last sale and others. It is important to make sure that the selected characteristics affect the nature of the demand (that is, they are estimated criteria) or depend on the demand.

2. Products must be divided into groups according to the selected criteria (for example, price / turnover). Some researchers suggest using derivatives of ABC analysis here, but in our opinion this approach is erroneous, since it does not take into account the streaming nature of the inventory management process. The assignment of a product to one or another group according to the Pareto rule depends not so much on the qualities of the product itself and the demand for it from buyers, but on the dynamics of changes in the structure of the assortment. So, for example, if we reduce the number of cheap items in the assortment, then the goods that used to belong to the groups of expensive items will shift to the middle groups, although the price and, therefore, the nature of demand for them will not change from this. Therefore, in our opinion, it is necessary to use absolute values, and not the contribution of indicators of individual items to the overall result, since the criteria for assigning goods to one or another group should not change depending on the nature of the flow of material flow.

3. The logic underlying our approach is to create a large stock of the most important positions (highly profitable and fast-moving ones) and reduce the stock of unimportant positions. For this, we propose to use the "three sigma" rule from the theory of probability. For the most important positions, we propose to maintain the stock at the level of the average demand for a certain period plus three square deviations from the average demand, which will eliminate the shortage of goods with a probability of 99.7%. For those who are next in importance - at the level of average demand plus two square deviations (95.4%), then - at the level of average demand plus one square deviation (68.3%). The stock of the least significant groups can be maintained at the level of the average demand for the period, or even one, two, or three standard deviations can be subtracted from it.

nature of the inventory management process and work only in statics. Giving a good result at the first application, in dynamics, their effectiveness decreases so much that they may not only fail to improve, but also significantly worsen the structure of stocks, leading to catastrophic consequences for the enterprise and the entire supply chain. Thus, only approaches to inventory management based on material flow management are able to improve and maintain the inventory structure in accordance with a given level of customer service.

#### 4. CONCLUSIONS

We have developed and tested a model of inventory management using information technology, based on a process approach, the three sigma rule and VEN and FMR analysis, which allows us to calculate the optimal volume of stocks for book retailers, to ensure minimization of logistics costs and sustainable development. logistics system of the enterprise as a whole.

Using the example of inventory management in logistics systems, we examined the flow management method. A similar method can be used in any spheres of the economy, because everywhere we are talking about material, information or financial flows. Applying management models based on the flow approach, the enterprise will not try to adapt external circumstances to the existing management model, but will change the management model depending on the circumstances. The use of streaming models in the management of the entire supply chain, where the factors of instability of individual participants are multiplied by each other, will significantly enhance the stability of the global economy.

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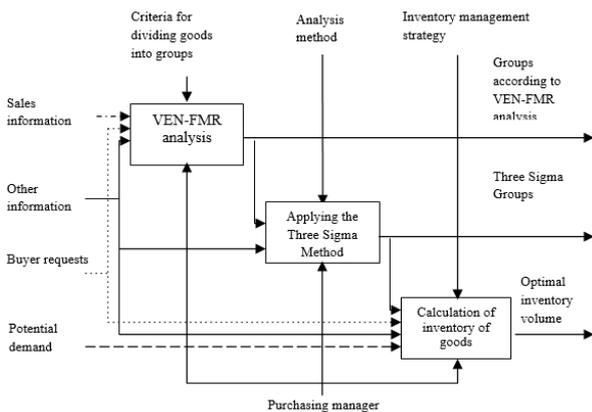
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**Figure 1** The process of calculating the optimal volume of stocks for retail outlets of book products

The obtained results of approbation of the model at retail trade enterprises of book products prove the correctness of the application of this method. Approaches to inventory management based on ABC analysis or other tools based on the Pareto rule do not take into account the streaming

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