

# Developing a Strategy to Improve Reliability in Supply Chains

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## ABSTRACT

The current stage in the evolution of logistics theory and supply chain management is characterized by an increasing interest in a range of new concepts, such as sustainable development, sustainability, strength, flexibility, adaptability, reaction speed, and reliability. The improvement of reliability and efficient organization of supply chains have an impact not only on the activities of individual economic entities included in this supply chain, but also on the pace and proportions of economic development of the Russian national economy as a whole. The article analyses domestic and foreign scientific works, which consider issues of supply chain reliability, essence and concept of strategic approach and strategic alternatives for optimal strategy formation of supply chain reliability improvement. Factors affecting the formation of reliability strategies in supply chains, requirements and methods ensuring reliability of supply chains are systematized. An integral indicator for evaluating the reliability of the supply chain is proposed and a system of reliability indicators is formulated. This indicator measures the quality of the developed strategy for improving the reliability of the supply chain and compares the reliability of the supply chain before and after the formation of the strategy and the reliability of the various supply chains.

**Keywords:** logistics, supply chain, reliability, evaluation methods, strategy, strategic horizons, strategic alternatives

## 1. INTRODUCTION

The emerging market relations in the domestic economic space stimulate the possibility of moving away from traditional enterprise management, make it inevitable and economically feasible to switch from management in general sense to management and marketing suggesting the creation of a system of effective management decision-making algorithms taking into account changing market conditions.

Russia is among the countries with a high level of logistics costs, which significantly reduces the efficiency of production and trade, negatively affects the competitiveness of companies and the country as a whole. In 2018, according to Russian experts, the share of logistics costs in the gross domestic product of the Russian Federation reached 19%, while in China it is 18%, in Brazil and India - 11-13%, in the USA - 8.5%, in Italy - 9.7%, in Japan and Germany - 8.5% and 8.8%, respectively. The average world logistics cost in 2017 is estimated by Armstrong & Associates Inc at 11.7%.

Developing a supply chain reliability strategy is becoming increasingly important for both large and small and medium-sized enterprises. Enterprise participation in the supply chain is a critical factor in maintaining and

improving income and competitiveness in current and future markets.

The term "supply chain management" was first proposed by the consulting firm Arthur Andersen in the early 1980s. The advent of SCM control concept is attributed to the publication of K. Oliver and M. Weber [13], in which the authors defined control of indivisible SCMs as a material flow going through distribution channels from supplier to buyer.

There are currently many definitions of the term "supply chain management," but it is generally accepted that "Supply chain management is the integration of key logistics processes starting from the end-user and covering all intermediaries and suppliers of goods, services and information that add value to consumers and other stakeholders." Common properties of SCM [15,18] are: safety, persistence, damage, stability, reliability, robustness, flexibility.

Supply chains are a complex multi-structure adaptive system with active elements operating in a dynamic market environment [19,20].

Supply chains during evolution and operation demonstrate reactivity, i.e. the ability to target adaptable behavior in complex environments, adequately to changes in both internal and external conditions. [16].

The theory of development of strategic and operational partnership has been considered in the works of many

scientists such as JTMentzer, SMin, ZGZacharia, AOtto, HKotzab[1,2,4,5,12]. Considering the theory of vertical partnership within supply chains, the authors do not highlight the industry features that are characteristic of the functioning of those or other economic entities in a given sphere of national economy.

The increasing competition in the logistics services market, the increasing complexity of logistics systems, and the increasing demands for maintaining a given level of logistics services have increased the interest and practical importance of research in improving the reliability of supply chains[17].

Bockarev A.A., Gregory M.N. Dolgov A.P. Uvarov S.A.[4,5,6,7] named the following as the most important tasks of study and improvement of supply chains:

- Improvement of the basic conceptual apparatus;
- Development and justification of criteria and indicators of reliability of supply chains and their elements taking into account technical, organizational-technological, economic, social and environmental factors;
- Development of a supply chain model;
- Development of models and methods for reliability analysis of supply chains;
- Development of recommendations to ensure the specified requirements for supply chain reliability.

The operation of supply chains is subject to considerable uncertainty. The sources of uncertainty can be demand fluctuations, forecast errors, resource failures, data inaccuracies, erroneous decisions of managers, inaccurate transmission of information and interpretation of certain events, targeted actions to destroy the supply chain (terrorism, theft of goods), as well as extreme cases such as changes in political or natural conditions.

At the same time, in a number of works [6,9,10,21] there is a more detailed approach to evaluation of reliability of supply chains, suggesting investigation of chains in more detail, dividing them into a sequence of the simplest events possible. The most complex part of the work is the generation of a logic diagram of the sequence and mutual operations into which the circuit is broken

## 2. OBJECT (PURPOSE)

The purpose of improving the reliability of supply chains is to meet the needs of consumers as quickly and qualitatively as possible. It is the efficient operation of supply chains that can ensure that the necessary resources are delivered at the right time, place and quantity.

## 3. THEORETICAL, INFORMATIONAL, EMPIRICAL, AND METHODOLOGICAL GROUNDS OF THE RESEARCH

The need for a specific theoretical apparatus and practical tools for supply chain management depends on a number of factors that determine the level of development of productive forces, technologies, political situation, and

maturity of market relations established at a certain historical stage. The possibility and pace of development of logistics approaches in domestic business should be considered in close connection with socio-economic, political factors affecting the economy of the Russian Federation.

The fundamental difficulties encountered in the development of the logistics concept in Russia can be formulated as follows:

1) High level of monopolism and state ownership in the most important sectors of the economy and social tensions in many segments of society. These factors hinder the promotion of logistics technologies for the development of domestic business.

2) Traditionally, for a long time in the domestic economy the role of the sphere of circulation (supply and marketing of products), which in the West occupies a key position in logistics, has been underestimated. Historically, in our country, the development of the circulation sphere has lagged far behind the production sphere, especially in the organization of the sale of goods and services. The sphere of circulation was characterized by slow promotion of goods from producers to consumers, high level of unmet demand, low reliability and insufficient quality of service to consumers.

3) Russia today is far behind even the average world level in the development of the infrastructure of the economy. There are some negative points such as

- Unsustainable development of distribution structures (lack of a well-thought-out strategy for the development of industrial and trade distribution systems, lack of organized commodity markets at large and medium wholesale levels);
- Weak level of development of modern electronic communication systems, electronic networks, communication systems and telecommunications;
- Weak transport infrastructure, especially in the area of roads; insufficient number and low technological level of road freight and multimodal terminals;
- The absence of modern vehicles in almost all modes of transport; High degree of physical and moral wear of rolling stock of transport;
- Low level of development of the production and technical base of the warehouse; Lack of modern technological equipment for cargo processing of products;
- Weak development of modern packaging industry, etc.

It was used such methods of a research as the dialectic and analytical methods, methods of justification of trends of development of chains of deliveries, a method of dynamic ranks, methods based on application of theorems of probability theory, function of algebra of logic, methods of search of hypotheses and others in work.

A strategy is like the path, which an organization chooses to move from the current state to the target state on the strategic horizon (fig.1).



**Figure 1** Strategic alternative in strategic targeting system

The mission of the organization (enterprise) is its main purpose, the *raison d'être* of its existence. Mission is one of the fundamental concepts of strategic management. Michael Meskon, Michael Albert, Franklin Hedoury [11] defined mission as the primary common purpose of an organization in which the reason for its existence is clearly expressed. The objectives of the organization are chosen to carry out this mission"

Konosuke Matsushita is a Japanese businessman, founder of Matsushita Electric, defined his organization's mission as fighting society's poverty and improving its well-being [8].

The expanded definition of mission discloses aspects such as:

1. purpose of the organization functioning,
2. sphere of the organization activity,
3. philosophy of the organization,
4. Methods of achieving the objectives
5. Methods of interaction of the organization with society (social policy of the organization).

By strategic horizon, in this case, we will understand the period that the organization considers appropriate to use to set goals and develop a strategy.

The strategic objective is a system of basic guidelines for long-term development of the enterprise, according to which a corporate strategy is developed and a policy on the main aspects of activity is formed: increase of income; growth of sales volumes; increase in a share of the market; creation and improvement of the image, fame of the enterprise and its products, etc.

The strategic alternative is possible options for moving from the current state to the target state on the strategic horizon.

## 4. RESULTS

The strategy for improving the reliability of supply chains (fig. 2) in terms of the system approach is to develop a mechanism that balances the amount of uncertainty space with that of the system..

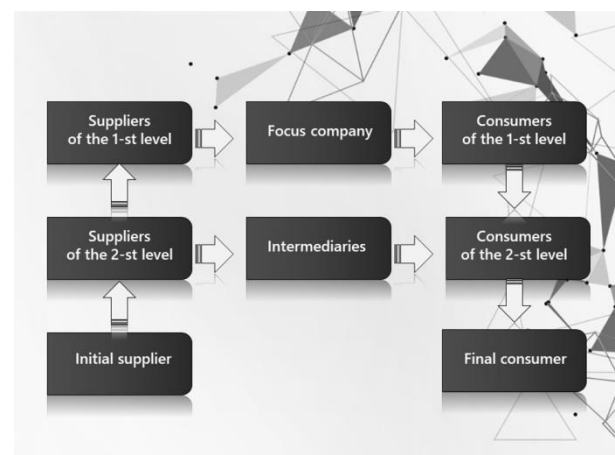
The development of such a strategy should be preceded by an in-depth analysis of the factors affecting their reliability. One of the main problems encountered in developing a strategy for improving reliability in supply chains is the limited visibility of actual demand. Since the requirements caused by the reliability condition in different parts of the supply chain differ, it is possible to solve this problem by using a hybrid strategy.

To do this, transfer the order generation point to the lowest supply chain links. In this case, we will have the following benefits:

- reduction of the number of options of the delivered products, which helps to reduce the volume of stock;
- increasing inventory management flexibility because the same components can be used in different types of finished products.

A hybrid supply chain reliability management strategy that divides the supply chain into two parts - up to the point of order, where it is advisable to use lean strategies that are characterized by standard product characteristics, long product life cycle, price and quality are selected as supplier selection criteria. After the point of order, it is useful to use strategies focused on a wide range, short product life cycle, speed, flexibility and quality as the main characteristics of supply chains.

Reliability of supply chains is ensured by a set of elements of supply chains, these include: Reliability of demand forecast, reliability of planning of need for material resources, reliability of suppliers, reliability of a control system of orders and purchases, reliability of delivery, reliability of delivery, reliability of entrance control. For each reliability element, It is necessary to choose a method of ensuring reliability.



**Figure 2** Supply Chain Schematic Diagram

**Table 1** Factors Influencing Supply Chain Reliability Strategy

Factors	Characteristics of supply chain strategies	
	Under conditions of relative stability of the external environment	Under conditions of high uncertainty of the external environment
BasicOrientation	Performance	Efficiency
Product characteristics	Standard	Wide Variety
Life Cycle Products	Long	Short
Supply chain focus	Economy on scale	Speed, flexibility and quality
Capacity Utilization	Level is set by the production schedule	Flexibility
Supplier selection criteria	Quality and price	Speed, flexibility, quality. Presence of reserve capacities.

**Table 2** List of requirements ensuring the reliability of supply chains

Requirements	Specification of the requirement
Adaptability	The SC property changes its behavior to preserve, improve, or acquire new characteristics according to its intended purpose.
Security	Resistance to a deliberate act of unlawful interference to harm
Reliability	The ability of the SC to operate without failure for a certain time in accordance with conditions
Recoverability	SCrecoverability
Serviceability	SC condition, when its operation corresponds to all
Reliability of delivery	Combination of criteria: performance of orders, quality of services provided, product range, total cost of delivery
Margin of Safety	SC 's ability to perform its functions despite breach of contract between participants
Response speed	End-user service speed expressed in terms of indicators, order execution cycle time, production cycle time, logistics cycle time.
Damage	External impact causing invalid SC deviations
Operability	Ability to perform its functions in accordance with contracts
Failure	Self-recovering failure resulting in short-term partial loss of operability.
Stability	Planned mode of stable functioning of SCwhen small perturbations result in limited small changes of output parameters

**Table 3** Connection of supply chain reliability elements and supply methods.

Reliability	Methods of ensuring reliability
Reliability of demand forecasting	Selection of the most efficient method of demand forecasting
Reliability of Planning Material Requirements	Selection of the most efficient method of calculating requirements: Direct billing method, calculation of requirements based on data on the recipe composition of the manufactured products, calculation of requirements based on standard wear and tear dates, etc.
Supplier Reliability	Selection of the most reliable suppliers based on analytical or expert methods.
Reliability of the Order and Purchase Management System	Reliability of the Order and Purchase Management System Selection of an appropriate inventory management strategy. Selection of the best type of purchase. Determination of optimal delivery conditions
Delivery reliability	Supplier reliability assessment based on KPI.
Reliability of delivery	Planning of optimal cargo delivery routes. Selection of the most effective method of cargo safety (selection of package, transport packaging, method of loading unloading, etc.)
Reliability of input control	Reliability of input control Selection of the most effective method of quality and quantity control

To ensure reliable and efficient operation of supply chains, it is necessary to share tools of reliability theory, methods of risk management, methods of planning based on operations research.

To evaluate the reliability of the supply chain, you can use the integral key figure and calculate it using the following formula:

$$Y = \sum_{i=1}^m [\beta_i P_i N_i]$$

Where  $\beta_i$  - weight coefficients of reliability indices;

$P_i$  - probability of achieving the required values of reliability indicators;

$N_i$  level of reliability indicators;

$M$ - number of indicators of logistics circuit reliability.

Indicators such as:

- Ensuring the smooth operation of the production system;
- Ensuring a sustainable financial condition;
- Support of business activity analysis;
- Information and communication reliability, accuracy and timeliness;
- Production costs (cost);
- Costs of internal and external transportation;
- Costs related to product quality (damage due to insufficient quality level, loss of sales, return of goods, etc.);
- Freight and warehousing costs;
- Costs related to order procedures;
- Accuracy and reliability of forecasting;
- Losses, theft, spoilage, etc.;
- return of goods;
- Order cycle time;
- Replenishment time;
- Time of order processing;
- Time of order delivery;
- Time of order preparation and picking;
- Production and technological cycle time;
- Reporting cycle time;
- The time of the procurement cycle for material resources;
- Execution of production schedule;
- Accuracy of order parameters;
- Completeness of order satisfaction.

## 5. CONCLUSION

Due to the increasing vulnerability of supply chains in the condition of aggressive factors of different nature, the need for an effective reliability strategy is greatly increased.

The integral indicator allows you to evaluate the quality of the developed strategy for improving reliability, compare the reliability of the supply chain before and after the formation of the strategy or the reliability of different supply chains.

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