Analysis of reliability of the machine building enterprise
supply chains based on information and computer
technologies

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Abstract. The article considers the reliability of supply chains based on information and computer technologies. The systems of supply chain management and the methods of reengineering business processes are analysed. The approbation of the methodology of structural analysis and design is given on the example of a well-known engineering company in Saratov.

1. Introduction
Due to the process of increasing instability in economy functioning, the reliability of supply chains is becoming increasingly relevant in logistics. The works of many Russian scientists are devoted to the formation of logistics systems and supply chains, however, in our opinion, the aspect of increasing the reliability of supply chains of engineering enterprises is not revealed sufficiently. At present, engineering is one of the leading industries; it accounts for about 20% of the total industry output in the Russian Federation. At the same time, in 2018, the production growth in the machine-building sector almost halved compared to the previous period, which was largely due to a decrease in funding for state support measures and a decrease in consumer demand for certain groups of goods. Experts suggest that this year the dynamics of production in the field of engineering will deteriorate, therefore, Russian enterprises need to develop a set of measures to increase production growth and demand for manufactured products, reduce production costs and risks, and increase the reliability of supply chains [1-4].

Constant changes in the global and domestic economies require the immediate implementation of risk management tools to increase the stable functioning of business units, minimize risks and increase the profitability of firms, regardless of the size of the enterprise or industry. Studying the aspects of the work of Russian machine-building enterprises indicates a growing interest in introducing effective risk management systems to minimize the risks of their functioning [1, 2].

2. Theoretical analysis of the problem
Basically, management decisions are made subject to uncertainty and risks, due to the lack of complete and reliable data on the state of the external environment, the actions of competitors, the instability of the financial and economic situation in the country and other factors [5].
For entrepreneurship, the problems of managing and minimizing risks are most relevant, since the formation of supply chains is impossible without risks, because in order to survive in market conditions, it is necessary to introduce innovative, non-standard solutions related to uncertainty.

Mechanical engineering needs to develop measures not only to reduce risks, but also to conduct their competent assessment and develop measures to manage and reduce risk. At the same time, sociological studies conducted at domestic industrial enterprises showed that 20% of organizations do not deal with risks at all, and more than 50% of respondents said that the existing risk management system is not effective.

In the course of their functioning, enterprises may face not only individual risks, but also a whole system of diverse risks that are interconnected, while changing one of the risks leads to a change in others. Functioning of the supply chains of engineering enterprises is associated with logistical risks, which are understood as the possibility of an adverse event resulting from a decision that may be accompanied by a complete or partial loss of material resources, products, goods, their consumer qualities, additional logistics costs. Logistic systems are characterized by openness for the supplier and the consumer; therefore, the risk of the logistics system must be divided into internal and external one.

As a rule, each logistic function and operation is connected with many risks, in particular, disruption of the procurement plan, price increases for purchased resources, delays in deliveries, and others may occur when supplying the enterprise with material resources. Risks can occur both individually and in combination, which only complicates the situation.

Risks very often arise during the transportation of goods, so we will consider this logistics activity in more detail. The main task of transport logistics is to obtain the best possible results depending on the chosen means of transport, transportation routes and direct transportation of goods. But, as practice shows, in the process of cargo delivery enterprises quite often face such tasks as: disruption of supply; shortage of goods; transportation costs; theft and damage to goods; costs due to bad weather conditions; hijacking a vehicle and others [1, 2, 4, 6].

The process of warehousing should ideally include optimization of goods storage processes; however, it is also difficult to avoid various kinds of troubles, including theft and damage of the stored goods. In this regard, the role of risk management in the formation of the logistics subsystems of the enterprise can be noted. Enterprises need to develop measures not to reduce risks, but to conduct their competent assessment and develop measures to manage and reduce risk. Entrepreneurial risk is associated with accidental loss of entrepreneurial profit. Losses in entrepreneurial activity are divided into material, labour, financial, time losses and special types of losses.

Talking about the causes of the above risks, we should notice that in more than 90% of cases, the risks are caused by the human factor, i.e. staff errors. The second place in the ranking are taken by the risks due to erroneous processes. In addition to the logistics activities listed above, information technologies play an important role in modern logistics, so it is important to investigate the risks of information logistics.

Over the past decades, information technology has been increasingly penetrating not only the everyday life of ordinary citizens, but also business processes. E-commerce is gaining special momentum, as the business is slowly merging with Internet technologies and is moving into the virtual plane. In this regard, it is necessary to analyse the risks that arise in the Internet environment [7]. According to experts, the main cyber threats that are faced mainly by small and medium-sized businesses in Russia are spam and malware. European countries suffer from such threats much less frequently, due to more reliable information and computer support. The introduction of foreign software products to domestic enterprises is complicated by their high cost which is much higher than that of the domestic similar solutions. The main problem of information logistics of domestic firms is the lack of resources, while information threats are increasingly sweeping Russian enterprises. According to statistics, more than 40% of information technology specialists noted that cyber attacks almost doubled in 2016. In this regard, enterprises need to pay attention to the automation of existing processes, which ensures the maximum use of personal computers as tools for performing calculations, reducing the time for data processing, information support of intellectual work, a
complete change in the technological process of data conversion, the use of new technologies for radical, creative changes in business processes.

3. Research methods
The introduction of information and computer technologies for managing the supply chain of engineering enterprises is associated with preliminary reengineering of business processes, i.e. researching the enterprise’s business processes, identifying inconsistencies in the chain links, as well as areas of duplication of information, reserves for reducing the time for preparing documents, and then, forming an optimal model of the supply chain [1, 3].

The development of process reengineering is due to the growth and formation of new information and computer technologies (ICT), thanks to which participants in a business process are much faster united in an integrated technological chain, compared to the traditional approach. Modern ICT are an integral part of reengineering, as they provide technological support for the analysis and modernization of business processes of an enterprise [5, 7].

When creating a company management information system, there are various technologies, including: ARIS (Architecture of Integrated Information Systems, CASE (Computer Aided Software Engineering, SADT (Structured Analysis and Design Technique) and others.

In this study, to analyse the business processes of a large machine-building enterprise in the city of Saratov (SEPO-ZEM LLC), the SADT methodology was used, the essence of which is as follows. First, the business process is considered in a general way, that is, a context diagram is created, which consists of a main block and arrows that show which flows are formed at the input and output of the process, what the control element is and what is used as a mechanism (figure 1). Then, the decomposition process begins, when the main function is divided into sub-functions and so on until it is necessary to detail the operations.

![Figure 1. Context diagram of the enterprise logistics system model.](image-url)

Thus, a business process model is formed that allows one to understand what processes are functioning in the enterprise, which objects are involved in the logistics functions and operations, to
identify and precisely determine the business rules used in the enterprise’s activities, and how resources are distributed in business processes. Such functional models make it possible to assess the economic effect of the used material, financial and information resources and help in identifying problem areas for further development of measures to improve the process under study.

4. Research results and discussion

Over 300 diagrams developed as a result of the business analysis of SEPO-ZEM LLC according to the SADT method made it possible to create an existing enterprise model, find out the connections between the process participants, the governing element and mechanism in these business processes, and the the shortcomings in the organization of processes that adversely affect the time to complete operations.

The analysis showed that there are frequent failures in the supply chain of a machine-building enterprise, which are caused by delays in the supply and dispatch of components/materials, finished products. These failures are most often caused by equipment and vehicle breakdowns. In addition, the imperfection of the applied ICT in the enterprise and the lack of modern software of logistic functions also lead to difficulties and problems in the organization and functioning of supply chains.

The enterprise also identified a problem typical for domestic engineering enterprises related to the depreciation of fixed assets, which leads to frequent equipment failures.

A study of the activities of the enterprise revealed the main risks of the supply chains of a machine-building enterprise, including: financial risk; technological risk; the risk of supplying substandard raw materials; rising prices for purchased components; failure in the supply of materials; industrial emergencies. In addition, in a negative way, the activity of an engineering enterprise is affected by a reduction in the volume of state orders, which leads to a reduction in industrial production.

The enterprise’s supply chains have a low level of link reliability due to imperfect management mechanisms, lack of data on inventory volumes, lack of contingency and irrationality in organizing the logistics process, and an excessive reserve for reducing costs in the chain.

Reliability of the supply chain is achieved due to the ability of the logistics chain to operate while maintaining regulatory performance over specified periods of time.

The supply chains of domestic engineering enterprises are subject to various factors, mainly of an informational nature. Modern market relations place high demands on the speed of information flows and the quality of information support for the enterprise’s supply chains. An important criterion is the timeliness of the data. Therefore, enterprises need to implement modern ICT for supply chain management. The aim of introducing such innovations is to ensure constant readiness of the socio-economic system for timely change. Modern supply chains are distinguished by stability, survivability, promise, flexibility, continuity, efficiency, and noise immunity. And this means that the information system is capable of fulfilling tasks in conditions of uncertainty and risk.

Information is one of the main “drivers” in supply chain management. It plays a key role in coordinating business processes in the supply chains and increasing the efficiency of the system, which is why it is so necessary to increase the reliability, quality and timeliness of the information circulating in the system.

ICT in supply chains automate the planning, organization and control processes, and thereby reduce the costs of materials, raw materials, finished products, and related information from application to consumption (including import, export, internal and external movements), that is, to fulfill satisfaction of customer requirements.

Nevertheless, despite the clear advantages of information technology over traditional paper technology, the most important issue is the economic effect of introducing modern ICT.

Decision-making about the use of a new software product should be preceded by determining the necessary costs and calculating the possible economic effect.

Assessment of the usefulness of information is preceded by an assessment of the state of the logistics system for the compared options.
The usefulness of a single informational message is determined by some part of the result of the functioning of the system as a whole or by the degree of influence of the given informational message on its achievement.

The effectiveness of the implementation of information systems can be seen as the ratio of the usefulness of the generated data to the costs of their receipt. Accordingly, larger result leads to higher economic effect of the implementation.

5. Conclusion

Summing up, it should be noted that the modern logistics chain of a machine-building enterprise is distinguished by high dynamism associated with a constantly changing state of the environment, the orientation of the production of goods to the individual needs of customers and customers, continuous improvement of technical capabilities and intense competition. In such conditions, the solution to the problem of prompt and adequate response to external and internal changes involves the use of integrated software and hardware that can ensure the reliability of the entire supply chain.

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