Priority areas of research in the development of the timber industry complex in Russia: technical and logistics aspect

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Abstract. The article deals with the priority areas of research in the development of Russian timber industry complex. The most important areas of research are highlighted. It is determined that the scientific (theoretical) perception does not always coincide with the applied (practical) aspects of the industry. The most problematic areas in the development of the timber industry were identified. Key attention is paid to technological and logistical aspects.

1. Introduction
Timber industry complex (TIC) is a complex dynamically developing system [1]. Its elements are many enterprises with a set of links, attracting an increasing number of diverse resources over time, producing modernizable (improvable) products, as well as producing, using and ceasing to exist under the influence of macro- and microenvironment factors. The latter have been studied in sufficient detail. However, the scientific community has singled out quite interesting aspects within the framework of the study of the influence of various factors on the TIC enterprise and the entire industry recently. Here, the interest in institutional [2], political [3], natural [4] and other aspects is noted.

Natural, ecological, environmental condition, political and institutional aspects gained a new impetus for development and active discussion after serious fires in the forests of Siberia and the Far East in summer 2019. Inspections and practical investigations into the causes and general state of affairs in the forested area have revealed a lot of problems: large-scale violations in logging technologies, lack of strict regulation of individual processes when dealing with a number of wood pulp resources, poor control over forest users, insufficient reliability of information about the condition, quality, and amount of timber in the forest etc. The purpose of this article is to identify the most promising directions of the studies in the field of timber industry complex development in Russia.

2. Methods and Materials
The research materials were the data of scientific works and original developments of domestic and foreign scientists. The main attention was focused on critical analysis of the theoretical developments and practices of the country's timber industry complex. At the same time, various aspects were considered – economic, technical, political, etc. The main research method is analysis.
3. Results and Discussion

3.1. Results

The study found that the most urgent are the investigations of the following areas:

1) Development of technical regulations for the strict adjustment of processes for the treatment of wood resources unused by enterprises directly. We are talking about logging enterprises that leave huge amounts of wood waste in logging sites, which lead to an increased risk of fires, pathogenic environment development and pests. This is also true about woodworking and processing enterprises. For these two, the non-use of wood biomass resources entails similar problems to the ones described above. However, these enterprises are the ones having increased capabilities for obtaining a variety of products of secondary wood resources. It should be noted that logging organizations also have the ability to use the resources left in the logging sites, but a number of objective problems reduce their potential in the right direction.

At the same time, such a way of raising an issue entails the following area of current research.

2) Development of technologies for involving wood resources left by enterprises in the forest territory. The range of problems in this context is extremely wide [5]. In contrast to the processing enterprises, in the territory of which the organization of the use of various secondary wood resources is associated primarily with the choice of the processing direction and the attraction of the necessary resources based on an assessment of the decisions effectiveness, additional difficulties arise in the forest area. The main one is low efficiency, and in most cases the unprofitability of involvement of secondary wood resources in the production. In practice, there are two main approaches to the process of wood resources use:

a) processing of secondary wood resources [6] into products in the logging site;

b) transportation of resources to a large processing center and involvement in production at its facilities.

The first of these areas requires the use of mobile plants, as after the development of a certain site, logging moves to the next one, which is sometimes significantly geographically remote. However, these plants often do not allow processing large volumes of wood biomass and/or require significant energy resources, the cost of which increases with the remoteness of production from industrial centers [7].

The solution to the complex of these problems lies in the plane of development, creation and testing of modern and efficient plants that can operate in difficult forest conditions.

The second of the identified areas in most cases is unprofitable due to the low percentage of output of 1 m³ of secondary resources left in the logging site. One of the obvious solutions in this context is the development of plants (machines) able to compact transported goods (enterprises receive more raw materials at almost the same transportation costs), as well as the development of semi-finished products from secondary resources in the forest area with their subsequent transportation to a large industrial center.

Also, in addition to the two distinctive processes of the use of secondary wood resources of the logging sites, there are combined options, which, while being their particulars, expand the processing capabilities.

One of these options, for example, is the transfer of wood resources from the logging site to an intermediate warehouse, their partial processing (making a semi-finished product) and transportation to a large industrial center for further use. However, this issue, as described above, requires a detailed economic and, above all, logistical justification [8].

3) Development of methods, algorithms and various practical (applied) aspects to solve the complex of logistic problems of TIC enterprises. In this context, it is necessary to highlight the following aspects of the tasks:

a) Optimization of routes for the supply of wood raw materials from the forest territory, taking into account seasonal, climatic, technical and other conditions. The need for this class of surveys is determined by the possibility of significant savings in expenditures for the delivery of wood resources.
in case of using the optimal route. Also, in this issue it is necessary to focus on the following factors (thesis):

- the cost of wood transportation is the highest in the structure of their final price calculation for the enterprise;
- logging, as well as timber taking out, cannot be carried out year-round; and timber is unable to maintain its properties during long-term storage;
- the hauling distance in logging regions may reach several hundred kilometers, where the climatic conditions are extremely diverse;
- enterprises located in certain territories may have both permits and restrictions on the procurement of various types of wood;
- the traffic network in the forested territory of Russia is extremely undeveloped; however, in some cases, there are opportunities to choose various delivery routes, land or water transport, etc.

These factors cause great variability in the formation of the logistics of the delivery of wood resources from the forest territory (figure 1) [9].

The options shown in figure 1 are only a small part of the possible alternative delivery schemes. Moreover, there may be modifications of the routes themselves (the choice of a specific traffic network), the volumes and congestion of the transport network, the equipment used in each particular case, and much more, which ultimately determines the delivery efficiency [10].

b) Optimization of logistics at industrial enterprises engaged in the use of wood resources. As part of the organization of production processes, there are a number of logistical problems at enterprises engaged in woodworking and processing, which require due attention:

- Maximum automation of the movement of wood raw materials. For optimization purposes, it is necessary to organize the movement of resources using conveyors, pipelines and other equipment with minimal human labor and territorial movement. At present, in practice, certain resources (whole section timber, packaged lumber, wood chips, bark, etc.) are transported over a long distance (from workshop to workshop) using specialized equipment (loaders, chip trucks, cranes and other heavy equipment) in large enterprises. This leads to an increase in production costs.

- Organization of efficient warehousing – storage of wood resources. In this case, it is not only about whole section timber (logs) and lumber, but also about secondary wood resources. In this context, the problems of reducing the quality of stored resources (up to the complete loss of consumer properties), increased fire hazard, theft risks, etc. appear.

- The use of closed manufacturing technologies (cycles). The concept, according to which the company does not generate wood waste, has been developing for a long time. However, it is extremely rarely implemented at practice. Currently, it is more correct to talk about low-waste than about non-waste production. Despite the fact that the benefits of obtaining additional products are obvious to everyone, it is problematic to process the entire amount of secondary wood resources even at large processing plants with advanced processing facilities [11]. The main difficulty is strict requirements to the quality of raw materials for its processing into high-quality products, as a result of which many resources cannot be used at the enterprises where they are formed. One of the solutions here is the creation of facilities for preparing raw materials for the further use of their waste (for example, the bark of raw wood) and the collection of secondary resources from all nearby enterprises in a single "advanced processing center" and their inclusion in the technological cycle. Such a center may be, for example, a pulp-and-paper or timber and chemical plant, which organizes the processing of secondary wood resources.

The latter assumption requires the solution of both logistic problems (moving huge volumes of wood resources between geographically remote organizations) and organizational and economic ones, which will be discussed below.

c) Optimization of logistics for the delivery of products of TIC enterprises to consumers. Within this goal, the following tasks are distinguished:

- The use of standard logistics methods to optimize the delivery of TIC goods.
- Creation of an effective warehouse infrastructure on the route of products delivery to consumers in order to quickly meet their needs in terms of assortment and quality of goods. In this regard, it should be noted that most of the large enterprises in the industry work under long-term contracts with consumers and/or intermediaries. At the same time, European competitors, for example, are able to quickly (3-5 days) sell products directly to the final consumer (for example, a chain of building material stores) due to the developed logistics network. Profitability of operation under this scheme is significantly higher than through intermediaries.

- Cooperation of individual timber enterprises in the delivery of goods and work in a single market [12].

![Diagram](image)

**Figure 1.** Some examples of options for routes for raw materials delivery from the logging site (simplification).

### 3.2. Discussion

In the context of the research, the most controversial are issues of technological nature. Indeed, the choice of the most appropriate technology for the production of a certain type of goods is an extremely
important task that may be solved both at the theoretical and applied levels. However, many factors affect this aspect:

- financial opportunities of enterprises;
- characteristics of the raw materials used;
- quality features of manufactured products;
- preferences of management and business owners, etc.

Reducing the influence of these factors may both positively and negatively affect the efficiency of enterprises, including the inability to carry out activities with an inadequate choice of technology.

Thus, the discussion in the scientific field about optimal technological solutions is largely intended to serve as an incentive for the emergence of new, more advanced technologies, the need for implementation of which shall be assessed directly at enterprises.

4. Conclusion
As a result of the study, it was found that, from the standpoint of technology and logistics, the most important studies in the direction of improving the efficiency of timber industry are:

1) Development of technical regulations for the strict adjustment of processes for the treatment of wood resources unused by enterprises directly.
2) Development of technologies for involving wood resources left by enterprises in the forest territory.
3) Development of methods, algorithms and various practical (applied) aspects to solve the complex of logistic problems of TIC enterprises.

Solving each of these issues is a difficult task that is being addressed by many researchers. Moreover, the results are both fundamental and applied. It is important to understand that the development of the timber industry will not stop and industrial enterprises will not fail without these studies. However, science-based solutions will significantly increase the efficiency of timber enterprises. Due to significant increase in the distance of timber transportation from the forest territory to the processing facilities (200-300 km or more), these research areas are extremely relevant.

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References
[1] Zaprudnov V I, Pinyagina N B and Gorshenina N S 2011 Trends and prospects of development of the timber industry in Russia. Bulletin of the Moscow state University of the forest-Forest Bulletin 6 pp 106-116
[2] Kozyreva G B 2016 Institutional problems of forest-resource territories of Russian regions. Economic analysis: theory and practice 5 (452) pp 54-63
[3] Petrov V N 2010 Political economy and forest economy of Russia. Izvestia of the Saint Petersburg forestry Academy 193 pp 288-307
[4] Suturin S B and Belikova D S 2013 Correlation of development of productive forces and rational use of natural resources (on the example of the BITPC timber industry complex). In the world of scientific discoveries. 8-1 (44) pp 252-268
[5] Burmistrova O N and Pil'nik Yu N 2014 Modeling of the principles of concentration of transport flows and wood processing points. Modern problems of science and education. 4 p 157
[6] Goroshko S K 1990 Economy of non-waste technologies of the forestry complex (Moscow) p 184
[7] Medvedev S O, Khramova L N, Sobolev S V and Stepens R A 2012 Prospects for the development of production clusters at the regional level Global Scientific Potential 3 pp 77-81

[8] El'deshajn Yu M, Bolotov O V and Bolotova A S 2015 Solving the problem of optimization of forest development from the point of view of logistics. Krasnau Bulletin 1 (100) pp 188-197

[9] Rukomojnikov K P and Mokhirev A P 2019 Validation of the Logging Operations Scheme through the Creation of Dynamical Model of the Enterprise Functioning. Forestry Journal. 4 pp 94-107

[10] Gerasimova M M, Medvedev S O, Mokhirev A P and Rukomojnikov K P 2019 Optimization of material flows of a logging enterprise based on graph theory. Logistics and supply chain management 6 (95) pp 50-57

[11] Preshkin G A and Vlasova E Ya 2009 The concept of management of forest natural-economic complexes. Proceedings of the USUU 2 pp144-151

[12] Zozulya V V, Sakhanov V V, Medvedev S O, Bezrukikh Y A and Romanenko O V 2017 The features of industrial modernization management in forest complex. International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM 17, Ecology, Economics, Education and Legislation pp 927-934