Methodical approach to increase efficiency of use of wood resource potential of the region

S Medvedev¹*, A Mokhirev², T Rjabova¹

¹ Department of economic and natural Sciences, Lesosibirsk Branch of Reshetnev Siberian State University of Science and Technology, 29 Pobedy Street, Lesosibirsk 662543, Russian Federation
² Department of Technology of Logging and Wood Processing Industries, Lesosibirsk Branch of Reshetnev Siberian State University of Science and Technology, 29 Pobedy Street, Lesosibirsk 662543, Russian Federation

*Corresponding email: medvedev_serega@mail.ru

Abstract. The article deals with the problems of increasing the efficiency of wood resources processing. It shows the developed methodical approach to increase the processing efficiency. It consists of five stages, which all are disclosed in detail providing examples. Approbation of the proposed approach justifies the expediency of its use and substantial economic benefits for wood processing enterprises.

1. Introduction
Solving the problem of efficient processing of resources in the modern world is the most important task for many industrial enterprises. The role of management is to maximize profitability based on the limited resources available. At the same time, the role of waste or secondary raw materials in increasing the efficiency of production grows day by day [1]. The use of this resource provides enterprises with significant benefits in several key aspects at the same time:
- economic;
- environmental;
- industrial;
- social etc.

In theory and practice, there are various approaches to assessing the efficiency of resource use [2]. This is largely determined by the objects of research, the methods and approaches used, the tasks of the development of research methods or mechanisms.

Currently, the forestry sector is one of the most promising among the industries in terms of development. Its uniqueness is determined by the possibility of using almost the entire volume of wood biomass for the production. At the same time, in some cases, secondary raw materials serve as the basis for the production of profitable and/or expensive products. The difference is especially striking compared to the main product of the industry - round timber. This is explained by the use of "remnants" of the main production in the wood and chemical industry area, in their advanced processing. Despite all the technical difficulties, the wood industry in Russia is developing steadily. It is capable of a significant qualitative leap in the direction of the complexity of resources processing and increasing the advancement of processing in the near future [3]. However, this is impossible without serious theoretical and practical research. The role of this work is to present the results of the
development of methodological aspects of improving the efficiency of wood resources processing. The results presented in the article characterize general approaches to the problem and may be used for other objects.

2. Material and methods
The objects of research were wood processing enterprises of the northern wood industry region of the Krasnoyarsk Territory with the main center in Lesosibirsk city. The main methods used were analysis, statistical and mathematical planning, modeling, standard methods of conducting experiments and assessing the quality characteristics of wood processing products, forecasting, etc., which may be used in other developments.

3. Results
The development of mechanisms for increasing the efficiency of wood raw material processing was carried out according to the scheme shown in figure 1 [4]. It should be noted that this principal technique may be used in other areas, since it has a universal character. The presented scheme includes five main stages. Each of them has certain features and requires the fulfillment of a set of works in the process of its implementation. In relation to this study, planning of the necessary works and research areas was carried out at the first stage. Also, literature sources on the possibilities of using wood raw material, ways to increase its efficiency and general approaches to assessing the effect of such measures were analyzed [5–8].

![Figure 1. Scheme of the development of mechanisms to improve the efficiency of wood resources processing.](image)

At the second stage, the evaluation of factors (external and internal) that could affect the choice of the direction of raw wood processing was carried out. At the same time, the factors were evaluated at the theoretical and applied levels. The applied aspect characterized the considered industrial complex. As already noted, the northern forestry region of the Krasnoyarsk Territory was assessed. The strengths and weaknesses in the development of wood raw materials processing were studied in relation to the named region (Table 1) [4].
Also, the volume, structure and dynamics of processing and formation of wood resources (figure 2), as well as the possibilities of their use were evaluated at this (second) stage. During the study, a number of technological factors for promising areas of consumption of wood raw materials were identified. However, such areas require substantiation or suggestion of innovative solutions. This was done at the third stage of the development of the mechanism.

Table 1. Analysis of the characteristics of the northern timber industry region of Krasnoyarsk Territory

| Factor                                | Strength                                                                                                                                  | Weakness                                                                                                                                  |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Geographical and natural potential    | 1. location "in the center" of Russia - the possibility of targeting both the eastern and the western market;                               | 1. sharp continental climate;                                                                                                             |
|                                       | 2. presence of a navigable waterway – the Yenisei River                                                                                   | 2. remoteness from the main (export) markets;                                                                                            |
|                                       | 3. insignificant likelihood of natural disasters;                                                                                         | 3. remoteness (300 km) from the largest industrial center of the region – Krasnoyarsk city;                                                |
|                                       | 4. location in a resourced region in terms of wood.                                                                                       | 4. remoteness of timber harvesting areas (hauling distance – 100 km or more)                                                            |
| General economic development          | 1. significant potential for forestry development;                                                                                        | 1. relatively weak infrastructure development;                                                                                           |
|                                       | 2. presence of a large number of enterprises in the industry (from small private businesses to large joint-stock companies)               | 2. subsidized nature of the region;                                                                                                     |
|                                       | 3. availability of free sites for business creation.                                                                                      | 3. relatively small reserves of energy resources;                                                                                       |
| Labor Resources                       | 1. stable birth rate;                                                                                                                     | 4. overwhelming application of outdated technology.                                                                                      |
|                                       | 2. presence of a relatively large number of qualified industrial personnel;                                                                |                                                                                                                                         |
|                                       | 3. influx of cheap labor from neighboring countries;                                                                                      |                                                                                                                                         |
|                                       | 4. low unemployment level.                                                                                                                 |                                                                                                                                         |
| Education                             | 1. presence of a specialized university training personnel for the industry;                                                               | 1. lack of qualified management personnel;                                                                                                |
|                                       | 2. presence of a wide base of advanced training courses;                                                                                   | 2. relatively high staff turnover at individual enterprises;                                                                            |
|                                       | 3. presence of universities’ branches.                                                                                                    | 3. lack of housing for personnel attracted from other regions.                                                                          |
|                                       |                                                                                                                                           |                                                                                                                                         |
Figure 2. Principal structure of wood resources distribution in Lesosibirsk industrial site.

Also, the following results were obtained at the third stage of the study:

1. A fundamentally new scheme of organizing the processing of first-order wood waste has been developed. It involves the creation of a biochemical plant, fir oil extraction and extraction directions for the use of green wood and a number of other areas (Figure 3) [4, 9].

2. A scheme for the integrated use of second-order wastes has been developed. It includes *inter alia* the application of innovative technological solutions and obtaining new products with high added value.

3. An organizational scheme for the interaction of enterprises in the studied region on the basis of the cluster approach has been developed [10].

4. The models of the processes of a new territorial processing complex creation, moving in the course of production of wood resources have been obtained.

5. The selection of the best regions to place their processing sites has been made.

Thus, the third stage is the largest and most valuable as it suggests solutions to the specific problems of a single territorial complex. As a result, it should involve specialists from various fields of both technical and economic profiles.

The development of scientific and methodical approach to assess the efficiency of wood resources processing and the activities of enterprises of the forestry complex took place at the fourth stage of the research (Figure 4). The need for this step is explained by the feasibility of assessing the activities of enterprises at the present stage of development for various groups of indicators. Except economic, industrial and technological factors, they have to include ecological and social factors [13, 14].
Figure 3. Perspective scheme for wood and logging secondary resources processing in the northern forestry region [4, 9].

Figure 4. The principle scheme of accessing efficiency of wood resources use.

At the final fifth stage, the evaluation of decisions to increase the efficiency of processing wood resources developed at the third stage took place. The assessment was carried out on the basis of the
suggested methodological approach and traditional methods of economic efficiency assessment. Thus, the fifth stage consists of two parts:

1. Approbation of the developed methodology for the integrated assessment of the wood processing enterprises performance, including economic, industrial, environmental and social factors. The assessment was carried out in respect of wood processing enterprises of the northern forestry industry region of the Krasnoyarsk Territory. Information contained in official reports accessible to the general public was used for the analysis. This aspect is especially important in order to be able to use this methodology for evaluating other enterprises in the industry.

2. Technical and economical feasibility study in respect of measures for complex raw wood processing according to traditional methods for the investments effectiveness assessment. Industry average statistical data, information on prices for equipment and products from manufacturers, wholesale and retail networks were used as information for analysis.

4. Discussion

Attention should be paid to the methodical approach associated with the separation of waste (secondary resources) into the first, second, and subsequent orders [4]. The group of authors suggested this division for several reasons. The main of them is the need to improve the efficiency of rational use of resources. In practice, this is reflected in the pursuit of low-waste and non-waste production, i.e. 100% utilization of wood raw material in the production process.

In such conditions, the division of secondary wood resources into waste of the first, second and subsequent orders should become more acceptable. According to the authors, the basic idea should consist in the following: the organization of promising low-waste and non-waste production leads to the fact that waste from one production (first-order) acts as a raw material (resource) for another, also forming some amount of waste (second-order). It, in turn, has to be used in third production, etc. Also, it becomes possible to determine the effectiveness and cause organizational and economic impacts at each stage (figure 5). This approach is necessary to assess the intensity, complexity and effectiveness of the use of raw materials. Multi-stage processing takes place in the most efficient industrial complexes, which is another factor to achieve high productivity of enterprises.

Following the results of the use of n-order waste, it is expected that the manufacturing process either will not produce waste at all, or their number will be minimal. At the same time, organizational and economic measures taken at each stage may be diversified. Their common goal is to determine the direction of the most efficient processing of secondary wood resources. They should allow achieving maximum performance of the enterprise.

At the same time, organizational and economic measures may be as follows [11, 12]:
- creation of a new enterprise or waste processing at the existing one;
- sale of n-order waste in the market;
- pricing of raw materials and products made of secondary resources;
- determination of the best taxation, investment, lending options etc.

The order and structure of events is individual in each specific case and is determined by the owners (management) of enterprises.

5. Conclusion

The obtained data on the volumes of wood resources are the basis for the choice and optimization of directions of secondary raw materials processing. Justification of promising ways to use the resulting secondary resources allows for a detailed analysis of the planning of such industries organization in relation to existing enterprises. When conducting research, a change in the environmental load during the development of options for the use of waste products of various orders is also considered.
Figure 5. Scheme of the organization of multi-stage processing of secondary wood resources.

The assessment carried out at the fifth stage allowed to confirm the effectiveness and expediency of the suggestions made at the early stages of the study. According to the assessment, the recommendations allow using all residues of wood resources that are currently in place, significantly increasing the profitability of existing enterprises. Estimated annual profit from such events may reach 300 million rubles. At the same time, enterprises will significantly increase environmental and social responsibility in the region. Thus, the suggested recommendations are both purely theoretical in nature, and may bring real practical benefits for enterprises.

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