Improvement of timber industry logistics using information systems

S Medvedev¹, A Mokhirev², T Rjabova¹
¹Department of economic and natural Sciences, Lesosibirsk Branch of Reshetnev Siberian State University of Science and Technology, 29 Pobyed Street, Lesosibirsk 662543, Russian Federation
²Department of Technology of Logging and Wood Processing Industries, Lesosibirsk Branch of Reshetnev Siberian State University of Science and Technology, 29 Pobyed Street, Lesosibirsk 662543, Russian Federation

*Corresponding email: medvedev_serega@mail.ru

Abstract. The article deals with the problems of using software to solve the problems of timber logistics. Tools for information processing and analysis are proposed. The possibilities of using software products to optimize the activities of enterprises of the forest industry are shown. Further directions on the use of modern information technologies in timber industry logistics are revealed.

1. Introduction

In modern world, the information analysis is an extremely important task and the factor of success of many industrial companies. Information using has a diverse character. The field of the company’s activity and the management system faces are essential here.

It can be used to make various decisions and predict the dynamics of various indicators. Currently, there are many different software packages for data analysis and processing. Software products can be used to solve various application tasks. Various industries may also seriously vary the used software. The use of software should not be an end in itself. Ultimately, the use of modern information technology is designed to solve complex engineering problems with a large amount of computational operations [1].

Timber industry complex (TIC) is a complex system with many structural elements that are significantly different from each other. Each of the subfields has a unique specificity and a set of tasks. As for any other field, the companies and specific indicators of their activity are influenced by a range of factors of internal and external environment. Their analysis, identification of patterns, forecasting, assistance in making managerial decisions and a number of other tasks are the set of priorities in the use of modern information technologies and various software in particular [2].

Logging and timber transportation are the most important areas in the development and achievement of efficiency of activity of the entire TIC. The cost, individual qualitative and quantitative characteristics of essential resource of the field (timber and secondary resources) are formed on the initial stage [3-4]. The purpose of the study is to assess the capabilities and determine the most important directions of the use of certain software products for development of the logging industry, including in the context of timber transportation.
2. Methods and Materials
The process of forest management and information processes at the enterprise of large timber enterprises, including the Krasnoyarsk region were the objects of the study. The following main methods were used: analysis, statistical-mathematical planning, modeling, forecasting, etc. Various application program packages, widespread and potentially used for solving issues of companies in the industry were considered as the tested software products.

3. Results and Discussion

3.1. Results
The studies determined in that the most commonly used software in the companies of logging industry is Microsoft Office. Various companies use various applications starting with the most common Word to, for example, InfoPath. The simplicity of the interface, universalism and popularity determine the priority use of this software for the purpose of solving the applied issues of industry.

The list of tasks for timber industry logistics (regarding harvesting and transportation of timber products) was determined in the study. Various information technologies can be used for solution of this tasks [5-6]:
- optimization of technological process of logging;
- searching of logging sites with the desired characteristics;
- optimization of the storage of timber and wood raw material;
- optimization and improvement of delivery routes;
- selection and optimization of used equipment (both for logging and transportation);
- ensuring unity of transport and warehouse process;
- selection of variants and types of infrastructure facilities;
- selection and justification of technological solutions;
- planning and forecasting company development and various aspects of the activities in timber harvesting and timber transportation, etc.

Ultimately, the activities of logging companies, taking into account timber transport, is designed to solve the essential task of satisfying consumer demand for timber products (not only wood but also secondary wood resources) with minimum costs [7]. The task can be complicated by introducing restrictions on time, product quality, cost of products, related services or the place of delivery. However, the key task is to minimize the cost of delivering the final product to the consumer. Moreover, any optimization decisions should be fully justified. The essential parameters of the justification are the fulfillment of requirements for the compliance of the final product with the expectations (contracts) of consumers and economic efficiency. The latter is directly or indirectly influenced by many parameters - from the used equipment to the change in ambient temperature during the period of timber removal [8].

Based on the tasks described above, the functional diagram of the use of individual information technologies for solution of issues of timber industry was determined (figure 1).

Step 1. Assessment of the current state of the company (if the company is an operating one). The necessary assessment of the current technical, organizational, financial-economic and other conditions. The assessment is to be subject to statistical processing.

Step 2. Making the strategic decision about the necessity of application of information technologies and software for company modifications in order to improve its efficiency and planning peculiarities of implementation of the changes.

Step 3. Identifying potential software and information technologies able to adequately assess and/or contribute to decision making on the choice of possible ways of converting the logging activities and timber transport.

Step 4. "Informatization" (digitizing) of processes. In this case, "Informatization" means the detailing and structuring of all processes of the company, preparing of information cards (reference data) for each of them. In this description ("digitizing") is subject to alternative options of activity, if
any. The latter include, for example, alternative technologies of timber processing delivery chains (routes), transport equipment, etc.

Figure 1. Functional diagram of the management system of logging activities and timber transportation considering optimization using information technologies.

Step 5. Formation and filling in of databases for processes, technologies, equipment, climatic conditions and other aspects of the company and characteristics affecting the company.

Step 6. Calculation of the regulatory indicators system. This step is necessary to facilitate subsequent calculations and form a database for comparison with the actual values of indicators of work of the company.

Step 7. Calculation of the system of actual operational rates of the company. It is necessary to make a complex calculation of various indicators characterizing the efficiency of the individual stages of logging and transport of wood materials.

Step 8. Identification of deviations of actual indicators from the regulatory ones. This step is necessary for identifying the most problematic and underperforming sites, processes, equipment, technologies and reasons for deviations.

Step 9. Determining of the most effective options of the company’s activity (from among alternatives), including necessary investments and organizational changes.
Step 10. Prediction of changes in operating rate and evaluation of effectiveness of changes in accordance with the most efficient solutions, defined in the previous stages.

Step 11. Adoption of changes in practice of activity of the company. After identifying optimal options for the organization, it is necessary either to convert the current activities (alternative routes, equipment, technology, etc.), or to organize the work of the company in the most effective ways.

Step 12. Monitoring of the development involves the evaluation and tracking of location of company within certain regulatory boundaries.

A number of software products that allow to solve the tasks within this functional scheme was identified in the study (table. 1).

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

| Process of implementation of information technology | Microsoft Office Excel | Microsoft Office Project | Microsoft Office Access | Statistica | ArcGIS |
|----------------------------------------------------|------------------------|--------------------------|-------------------------|------------|--------|
| Assessment of the current state of the company     | +                      |                          | +                       | +          | +      |
| “Informatization” of the company work processes     | +                      | +                        | +                       | +          |        |
| Creating and filling in of databases               | +                      | +                        | +                       | +          |        |
| Calculation of the system of regulatory indicators  | +                      |                          |                         | +          |        |
| Calculation of the system of actual indicators      | +                      |                          |                          | +          |        |
| Identification of deviations from regulatory indicators | +                     |                          |                          | +          |        |
| Determination of the most effective options for the company’s activity | + | | | + | |
| Prediction of changes in operating rate of the company and evaluation of effectiveness of changes | + | | | + | |
| Monitoring of the development of the company and the achievement of regulatory indicators in the long term perspective | + | + | + | + | + |

Table 1 shows the use of software products in the process of implementing information technology in the timber industry and timber transport. The given five types of software allow to implement the basic necessary functional as part of the information technology implementation process. At the same time, all information about the work of the studied companies can and are to be connected within the framework of these software products. It should be clarified that the Statistica software package (developed by StatSoft) is used for statistical, graphical analysis, forecasting and a number of other purposes; ArcGIS (developed by ESRI) is used to build geoinformational systems at any level.

As part of the study, a conceptual model of processing and analyzing information of timber industry logistics in selected software products was developed (figure 2).

The essential software product in this case is Microsoft Office Excel. It allows to organize the exchange of data between all other software products. Also, a large amount of calculations is carried out in this program: from the elementary summation of various indicators, for example, the cost or volume of transported wood products, to the cost-effectiveness analysis of alternative options for the development of the company, for example, various delivery routes [9].
While developing the provisions of the conceptual model, it is necessary to provide information regarding the filling of databases in each of the considered software products (basic information):

1. Microsoft Office Project:
   - a list of all the processes of the logging company (timber transport), including alternative options;
   - information on the resources involved in the implementation of the processes (with an assignment to specific types of work);
   - a time schedule of processes implementation;
   - various types of processed (calculated) data regarding the processes of the company (workload of staff, behind schedule, cost of individual stages, etc.), etc.

2. Microsoft Office Excel:
   - technological schemes for the implementation of logging and transportation of wood resources;
   - characteristics of equipment and machines;
   - detailed costing according to various technological schemes;
   - natural and climatic characteristics of the forest territory;
   - requirements for products from customers;
   - regulatory indicators;
   - industry average indicators, etc.

3. ArcGIS [10]:
   - mapping materials;
   - natural and climatic characteristics of the forest territory;
   - information on industrial and infrastructure facilities located in the forest territory, etc.

4. Statistica:
   - regulatory indicators;
   - information on the actual operation of the company;
   - planned indicators of future periods;
   - industry average indicators, etc.
5. Microsoft Office Access:
- information for filling in the databases regarding all processes, works and sites that are subject to
  analysis by the described software products;
- results of calculations and studies using software.

As previously noted, the data connectivity is essential factor in the feasibility of this model. It is
important that all used software products allow not only importing data, but also maintaining
communication and, if one of the parameters in one of them changes, recalculating all the others. The
visualized scheme of work of the applications is shown in figure 3.

![Visualized scheme of operation of software products when optimizing logging company’s activity.](image-url)
It is important to note that it is not difficult to associate data in Microsoft Office applications. For example, when pasting previously copied data, it is necessary to select “Paste Special” \ “Link” command and select the desired insertion option (data or file). Similarly, working with ArcGIS is straightforward [11]. At the same time, it is more difficult to organize the relationship of data with the Statistica program.

This software product allows to associate data with the ability to process only using dynamic data exchange (DDE). DDE communication allows to establish the relationship between the source file (Microsoft Excel spreadsheet) and the STATISTICA data file (client file). At the same time, changes made to the source file automatically appear in the corresponding Data Table (client file).

The use of information technologies must allow the following characteristics of information to function: accuracy, completeness, relevance and clarity. Each of these functions can be implemented through the use of selected software:
- reliability – the use of real data of companies, information on forest areas, standard values, calculated values obtained according to the known and tested formulas and methods;
- completeness – the ability to use a wide (practically not limited) databases, using various software products which allow to evaluate the processes from different perspectives of conducted analysis;
- relevance – the possibility of quick data updating by making adjustments and automatic recalculation of the whole complex of interrelated data;
- clarity – each of the software products allows to demonstrate various aspects of the studied work of the companies – from the presentation in Microsoft Office Project to maps in ArcGIS.

3.2. Discussion
The following priority tasks are determined by the team of authors as promising in the short term for testing the direction of use of data or other software products:
- using the business opportunities to solve issues of the use of secondary wood resources;
- integration of graph theory in applied software products;
- automatic selection of product portfolio for logging enterprises;
- extension of the range of companies that are covered by the survey to all companies of the timber industry complex;
- creation of a standalone product that integrates the capabilities of all the programs represented in the study;
- implementation of possibility of automatic creation on the basis of the conducted calculations of a text document (Microsoft Office Word) with recommendations for changing the activities of the studied company and containing a feasibility study of such changes;
- use of the possibilities of offered software products for development and implementation of a regional policy in logging industry, etc.

4. Conclusion
As the result of the conducted study, the use of a number of software products for the purposes of timber industry logistics was justified. The use of modern information technologies in the field of logging and wood transportation allows to obtain justified decisions on the optimal delivery routes, used technologies and equipment, economic efficiency of individual transformations in the work. The ability to establish a link between the used data is essential for integrated use of various software products. The selected set of software systems can be modified and extended to achieve the specific goals of a company in the industry. Further work of the team of authors is associated with the expansion of the functional use of the suggested software and testing of the suggested solutions.

Acknowledgement
The reported study was funded by a grant from the President of the Russian Federation - for young scientists, candidates of sciences MK-1902.2019.6 and RFBR according to the research project № 18-310-00311.
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