Digitalization as a new factor of sustainable development of the Russian forest industry complex

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Abstract. Digital technologies break new ground for forest management and regeneration though the forest industry complex is behind many industrial sectors according to the digitalization speed. The goal of study is to study the essence, principles and opportunities to implement digital technologies for the purpose of sustainable development of the Russian forest industry complex providing for collective advance international practices. The proposed concept is based on the methods of analysis and synthesis within the framework of the study of the forest industry complex in the integrity, unity and interconnection of its constituent parts in order to analyze, generalize information and to identify the prospects for using digital technologies in the economic systems management. In the framework of the study the context of modern system of forest industry complex management has been brought to light, there have been highlighted the issues which are possible to solve in the course of digital technologies. The result of the research is the proprietary model of the digital platform functioning, taking into account its conceptual characteristics and technological features of the forest industry complex management. Digital technologies give the forest industry a wide range of opportunities for sustainable development.

1. Introduction
The forest is the property of the country and its ecological framework, which ensuring the conservation of water and land resources, as well as playing a leading role in preventing negative climate change. Forests play a key role in the global economy, so the issue of attention and effective forest management is now particularly relevant. The modern world stands at the threshold of large-scale transformations caused by the achievements of information technology. The impact of digitalization on the economy, society and individuals is unprecedented. It is obvious that the growth of quantitative indicators of electronic commerce, the use of digital technologies in various fields of business will lead to a qualitative transformation of the global economic system. The digital revolution will affect all areas of economic life, including traditional industries.

The forest resources are of great social and economic importance, which is related to the production, sale of forest products, incomes to the budget system of the Russian Federation from the forest complex and currency returns from wood products export. The main problem of the competent use of the Russian forest resources is that the Russian forest industry complex is not the leading industry in Russia: Russian Federation acts as the main supplier of cheap raw materials, while its own share of the products on the world market does not exceed 3% [1]. The industry needs modern
technologies and updating of logging and woodworking equipment, effective management methods, which will entail a quantitative and qualitative increase in production. The digital technologies open up new avenues in forest management and reforestation, but so far, the forest industry complex lags behind many industries in terms of digitalization. The digital technologies, such as drone-based data acquisition systems, mobile applications, laser scanners, and high-precision IT programs, now cover the entire forestry and wood processing cycle, from information on forest areas and logging systems to modern forestry management systems. The world producers of logging equipment, collecting and analyzing the accumulated experience offer modern multifunctional forest machines. The digital technologies make it possible to solve issues of strategic and short-term planning, operational monitoring, analysis of the current state of the forest situation and operational management decisions based on two-way communication via satellite channel and / or GSM.

For the time being there is no clear methodological support for the development of the concept of sustainable forest industry complex development under the digital transformation and of its role in the implementation of modern business – models.

The publications of foreign authors consider a wide range of issues related to the sustainable development of the forest industry complex. Researches made by foreign scientists such as V C Jaunky, R Lundmark, A L Hammett, L M Coelho Junior et al. focus on the cause-effect relationship between the sustainable development and economic growth [2-4]. J Buongiorno, C Johnston, S Zhu, J Parobek et al., D N Wear, J P Prestemon, M O Foster [5-7] considered the problems of organizing and managing of business processes in the forestry sector, the analysis of the advantages and disadvantages of tools for researching global forestry markets. In scientific works of P Rougieux et al., G Valenduc, P Vendramin the concept of making management decisions at the enterprises of the forest industry complex was disclosed [8-9].

However, this literature ignores the possibilities of digital technologies and the prospect of their introduction into the forestry complex management practice. A significant contribution to the scientific development of the forest industry problems under the digital transformation was made by Russian scientists M Yu Abramov, M V Kobalinsky, A I Pyzhev, E V Ascheulova, A V Mironov, V F Lapo, S S Morkovina and others [10-12].

The digitalization from the conceptual point of view is defined in the study as a combination of online information and communication mechanisms, the algorithms of which serve the organization and structure of the economic and social activities of the forest industry complex. Due to the hard work of scientists, it became quite clear that the study of digital technologies, its application possibilities provided valuable interdisciplinary information. It plays an important role in managing economic systems and ensuring sustainable development.

The goal of study is to research the essence, principles and opportunities to implement digital technologies for the purpose of sustainable development of the Russian forest industry complex providing for collective advance international practices.

2. Methodology
The necessity of studying the problems of sustainable development of the forest industry complex in the context of digital transformation is conditioned by the integration and globalization processes, which necessitate the need to search for modern methods, tools and strategies of business entities development. The most complex, but also the most attractive, from the point of view of innovative development, are multilateral platforms where several types of participants are presented, between which difficult interactions are formed, covering the distribution and consumption system of platform products, development of complementary products, processes of joint creation of value and use of platform assets. From these positions, a platform economy is a phenomenon of macroeconomic change in the mechanism of value formation of the industrial revolution 4.0.

The Americans Tapscott and Negroponte, who were at the forefront of the study of the economy digitalization, noted in its works that the peculiarity of the transition of the economy to the stage of “digitization” is not simply the introduction of information and communication technologies in the
economic sphere, but the complete replacement of classical economic relations with new types of relations, based on fundamentally new business processes and models [13-14].

From the early Rohlf’s work to recent theoretical advances and schedules to anti-monopoly legislation, thanks to the works of Katz and Shapiro and as well as to Farrell’s and Saloner’s, a large network of scientific works on the industry and markets had been developed [15]. However, this literature ignores the versatility of platforms, the possibility of its implementation in the practice of managing the forest industry complex. In contrast, Baumol, Panzar, and Willig, Wilson have uncovered the interdependence of pricing decisions, however, it does not take into account external factors that are described in detail in digital economy writings [16].

The analysis of works of the mentioned authors shows that nowadays the following approaches to the factual description and structural representation of change management systems dominate in economic science and practice:

1) System approach. The system is considered as an ordered set of interrelated elements and during analysis is decomposed into subsystems.

2) Process approach. The system is considered as a group of change management processes, and the heads of the structural subdivisions of integrated entity included in the system are considered as the “owners” of the processes.

3) Ecosystem approach. The system is presented as a community of change management participants.

The methodological basis of the study are the provisions of the information management theory, including the issues of interfirm and intercorporate interaction, which is formed under the influence of the factor of evolution of digital integration.

3. Results and discussion
The objective of sustainable forest management includes the regulation of forest ecosystems, the conservation of natural biodiversity, the exploitation and reproduction of resources, fire protection, and protection from pests and diseases. Each of these subtasks requires specific information resources and decision-support tools, the core of which, of course, is geoinformation systems.

In the West, the idea of sustainable forest development is no less widespread than the idea of sustainable companies’ development. To compile a sustainable forest management rating in the USA and Canada, the state of forests on 115 million hectares is analyzed, and forest management standards are drawn up [17]. The principles of sustainable, environmental and socially responsible forest industry complex management are shown in figure 1.

The principles of sustainable, environmental and socially responsible forest industry complex management

1. The main and final product of forest management is the forest itself, as a set of ecosystems, capable to perform a wide range of social and environmental functions. The obtaining of material forest (e.g. wood) products is only one of the functions of forest management, the implementation of which to the detriment of other functions is unacceptable

2. Any use of forest resources should be carried out taking into account the interests of all social groups of both present and future generations. All social groups whose material or non-material interests may be affected in the process of forest resources use should have the right and opportunity to receive reliable and verifiable information on the volumes, nature and plans of forest resources use, as well as the possibility of influencing the decision-making process that is significant for it in forest management areas

3. The preserved areas of wild forest nature, developing without human exposure, being the natural habitat of a wide variety of plant and animal species and capable of infinitely long-term self-maintenance, should be preserved as far as possible. The development of new, previously not involved in the intensive exploitation of wild forest arrays cannot be a mean of solving the problems associated with the depletion of wood resources in the «old» areas

Figure 1. The principles of sustainable, environmental and socially responsible forest industry complex management.
Basic block diagram of the organization of sustainable forest industry complex under the digitalization is shown in figure 2.

**Figure 2.** Basic block diagram of the organization of sustainable forest industry complex under the digitalization.

In Russia in 2017 the government approved the state program “Digital Economy”, according to which 30 projects should be implemented by 2025, the number of these projects also includes projects in the forest industry complex [18]. One of the most urgent tasks is the protection of forest ranges. Different methods are used to counter illegal logging. In the jungles of Brazil, trees are equipped with a miniature cellular module. The device developed by Cargo Track is difficult to detect,
it can work without recharging for up to a year and constantly transmits a signal about its location. As soon as the system detects the movement of the beacon, this information will go to the center of operational response and to control departments.

The study confirms that digitalization is becoming an irreversible process, the most important factor in the development of almost any industry. To ensure sustainable development of the forest industry, it is advisable to consider the possibilities of a platform approach.

The digital platform works in two directions, which are closed, providing a constant increase in the number of users and an increase in the profit of business entities. Considering the platform as a business model, it is necessary to understand that the platform is not only the technical part, but a large-scale set of processes, the integration of which into a single system is expressed through the development of a software product. A platform is a system of business processes, each of which ensures the further development of the information flow with its simultaneous processing. The input information is as valuable as the output information, since both flows form the basis of the platform model. The technological content of the digital platform for implementing effective business models is shown in figure 3.

![The technological content of the digital platform](image)

**Figure 3.** The technological content of the digital platform for the implementation of sustainable forest industry development.

The adaptability of the digital platform makes it possible to optimize business processes in the most complex management models. The task of the forest industry complex is to integrate properly into this
reality of the digital economy and its perspective.

The concept of “digital forestry” involves statistical processing and modeling of the data store, including the remote sensing areas. When planning logging, the manager receives information about the state of soil and groundwater, makes a simulation of what quality the wood will be and at what price it can be sold.

Another important tool for digitalizing forest management processes is a concept called Connected forest. It is built on Trimble Forestry’s experience with digital technology in Finland, Germany, Canada, the USA, Brazil, Australia, New Zealand and other countries. It is composed of many components, from cloud technologies and mobile applications to digital maps and equipment. Components of the Connected forest can work autonomously to solve a specific task, as well as aggregate into a single system for managing and end-to-end accounting of wood with the formation of the necessary reports.

Domestic and foreign experts note that one of the bottlenecks in the digitalization of the forest industry is forest protection [19]. The lack of efficacy of the forest conservation and protection system, the loss of forest resources consequent on fires and pests, along with the fleet of obsolete equipment, point to the need to upgrade the forest industry and digitize forest management data.

One of the leaders in the digitalization of the forest industry in the world is Finland. In the mid-2000s, the company MHG Systems was founded, the main purpose of which was a digitalization of the forest industry. The platform developed by the organization allows to connect forest loggers, buyers, government representatives into a single network, and to receive in real time the information on the amount of forest resources. According to Eurostat, Finland was able to achieve labor productivity in the forest industry at the level of €152.5 thousand per year per person, the highest result was recorded only in Sweden which amounted to €156.4 thousand. Canada went the same way at about the same time. According to the Canadian government report, the country's forestry industry reduced energy use by 31% and greenhouse gas emissions by 49% thanks to digitalization, between 2005 and 2015 [20].

Currently, Finland is conducting a study to digitize the entire process of forest growth - from x-ray scanning of the future tree seed to regular monitoring of tree growing conditions and production of finished products based on an understanding of the influence of environmental factors and market requirements.

In the forestry complex, the greatest effect is achieved not by visual assessment, but by digital processing of three-dimensional models obtained on the basis of aerophotos. The emergence of unmanned aerial vehicles in the Russian practice of forestry complex management will make it possible to obtain very high-quality survey materials. This is achieved by reducing the flight altitude and increasing the number of overlapping images. The volume of information increases exponentially, but modern computers and the ability to process information on graphics processors allow you to fully automate this process.

In 2017, in Russia, the Ministry of Industry and Trade and Vnesheconombank launched a pilot project for the accounting of forest resources based on blockchain technology, including a system of monitoring forest sites using drones [21]. Moreover, Segezha Group has been created. It is the latest development of a unified geographic information system that combines the monitoring, collection, processing and updating of information on the state of forest resources. This system is an exclusive integrated solution using unmanned aerial vehicles. The main goal of this development is to ensure the management of the movement of forest resources, from harvesting to transportation to a warehouse and accounting of timber.

4. Conclusion
The experience analysis of using digital technologies in forest complex management shows that the development of technologies for obtaining and processing big data allows for the transition to high-precision intensive sustainable forestry.

Thus, the digitalization of the forestry complex will take into account many aspects, including:
selection and justification of logging methods, planning and designing a road network, creating a cutting plan for the cutting area, managing logistics for the movement of goods, monitoring reforestation and maintaining the boundaries of the cutting area. Also, thanks to the platform system, it will be possible to identify incomplete felling, over-felling, to analyze the effectiveness of the use of equipment, storage and movement of goods.

The academic novelty centers around the concept elaboration of sustainable development of the forest industry complex in the context of transition to economy based on knowledge. The transition is carried out as continuous accumulation of digital technologies leading to efficient management of forest ecosystems, preservation of natural biodiversity, resource exploitation and regeneration.

The introduction of digital technologies in forestry takes the form of a gradual digitization of business processes. The cost of introducing technology pays off rather quickly by reducing losses, increasing labor productivity, modeling and subsequent optimization of business processes. Obtaining the data as such does not create an additional cost of production, except for the cost of its production, but at the same time it allows to increase economic efficiency, as well as to preserve key biotopes and valuable habitats that can be allocated, in particular, based on data from surveys from unmanned aerial vehicles.

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