Study of the readiness of forestry enterprises to use digital technologies

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Abstract. The forestry system of the Russian Federation uses information and communication technologies in order to bring the necessary legal, regulatory, organizational information to the participants of forestry relations, stakeholders and the public. It is necessary to pay attention to improving the infrastructure for supporting information and communication technologies. In this regard, the results of an expert survey of representatives of forestry enterprises on the state of affairs and the level of technical readiness of the use of digital technologies in the field of use, protection, protection and reproduction of forests, afforestation (forest relations) are extremely important. Methodological recommendations were developed for the questioning of participants in forestry relations, allowing to assess the use of information and communication technologies in forestry. Based on the results of the study, the most relevant measures for the implementation were identified, and a conclusion was drawn up on the state of affairs and the level of technical readiness of the use of digital technologies in the field of use, protection, protection and reproduction of forests, afforestation (forest relations). The results obtained open up new areas of scientific research in the field of digital technologies application in the forestry complex.

1. Introduction

The digital economy is based on the ubiquitous use of digital technology. Currently, the topic of the digital economy is being actively studied by both Russian and foreign scientists. They all come to the same conclusion: digitalization of all spheres of society is one of the main trends in the world economy [1]. Digital technologies in the economies of countries are the basis for the development of business, social sphere, society as a whole [2].

The need for a transition to digital business models, digital transformation of the economy and its various industries, the creation of digital entrepreneurship and innovation are noted in their works by foreign researchers [3,4]. For example, Räisänen J and Tuovinen T in their work explore the opportunities that digitalization gives to micro-enterprises in rural areas. To do this, first of all, the problems and digital competence of micro-enterprises in rural areas of Central Finland are investigated in order to better understand what they need [5].
Such scientists as Ardito L, Raby S, Albino V and Bertoldi B investigate the direct and complementary effects of digital and environmental orientation on the likelihood that small and medium-sized enterprises will adopt product and/or process innovations [6]. Wu L and Zhang Z in their work consider the impact of Internet technologies on the optimization and coordination of the forestry production process based on the use of Internet technologies to stimulate the development of forestry [7]. Thus, the relevance of research in the field of digitalization of economic sectors, including the forestry industry, is recognized by the world community. The digital transformation of the forestry industry in the Russian Federation has significant potential.

The implementation of the current Strategy for the Development of the Forestry Complex of the Russian Federation until 2030 [8] and the program “Digital Economy of the Russian Federation” [9] involves the implementation of a number of measures for the development of information and communication technologies and the introduction of digital technologies in the field of forestry relations: providing an opportunity to modernize existing and creation of new data systems on the state of forest resources, systematization of documented information about forests, their use, protection, protection and reproduction in order to develop a single digital platform to provide information and analytical support for the activities of officials in the field of forest relations [10].

In modern conditions, the introduction of digital technologies is actively carried out in all sectors of the economy of the Russian Federation, including in the field of forest relations, and in matters of forest management, however, this process in the forest industry is dispersed. At present, digital technologies are implemented in the timber turnover control system [11], in the monitoring and detection of illegal logging and in the fight against forest violators [12].

In the Russian Federation, at the regional level, different models of forestry digitalization are applied. These are both general-purpose software products and specialized software tools. The use of digital technologies in the practice of forestry management and the improvement of forestry processes is the result of the development of modern society. Digital technologies contribute to increasing the efficiency of forestry functions due to the existing possibility of fast and error-free processing of information, design of forestry activities, generation of analytical information and statistical reports [13]. However, the problem of improving weasel management in a digital market economy remains unresolved. In this regard, it is necessary to develop certain digital solutions in forestry [14].

All participants in the forest industry are interested in the development of digital technologies in the field of forest relations, forest management: government bodies, users of forest resources, forest business. However, not all forestry enterprises have opportunities to leverage digital advances. In the current conditions, it is necessary to study the state of affairs and the level of technical readiness for the use (implementation) of digital technologies by entrepreneurial structures of the forest sector of the economy in the context of the considered global trends in this area.

The purpose of this study is to analyze the state of affairs and the level of technical readiness for the use (implementation) of digital technologies by forestry enterprises, which are the basis for the functioning of the entire forestry complex of the Russian Federation.

2. Methodology
When organizing events aimed at studying opinions on the state of affairs and the level of technical readiness of the use (implementation) of digital technologies by forestry enterprises at the level of the constituent entities of the Russian Federation, the authors independently developed methodological recommendations. Methodological recommendations regulate the conduct of an expert survey of legal entities operating in the field of use, protection, protection and reproduction of forests, afforestation. They provide a process for monitoring indicators of the state of affairs and the level of technical readiness of the use (implementation) of digital technologies in the field of forest relations, which is implemented through the use of unified tools (questionnaires) and unified approaches to constructing a sample population. The methodological recommendations take into account the collection of operational information on the state of affairs and the level of technical readiness for the use (implementation) of digital technologies in the field of forestry relations by forestry enterprises. It is
carried out by conducting an expert survey using special questionnaires containing a list of the most significant indicators.

The methodology for conducting an expert survey (questionnaire) of legal entities operating in the field of use, protection, protection and reproduction of forests, afforestation on the state of affairs and the level of technical readiness of the use (implementation) of digital technologies in the field of forest relations determined the object and subject of research, the purpose and objectives of the research. It is advisable to collect significant information on the state of affairs and the level of technical readiness for the use (implementation) of digital technologies in the use, protection, protection and reproduction of forests, afforestation (forest relations) using the questionnaire method. This method allows you to interview a fairly large number of respondents with minimal time investment. To achieve the goal and objectives of the study, it is permissible to conduct a questionnaire in two ways: by the method of formalized interviews and by the method of respondents’ self-completion of questionnaires (questionnaires).

Conducting surveys includes the following stages of work: 1) preparatory stage; 2) conducting questionnaires; 3) processing and analysis of information. To analyze the state of affairs and the level of technical readiness for the use (implementation) of digital technologies in the use, protection, protection and reproduction of forests, afforestation (forest relations), a majority system was used, according to which the state of affairs and the level of technical readiness for the use (implementation) of digital technologies for each of the block questions is determined by the highest percentage of answers given by respondents.

Thus, in the process of conducting the research, both general scientific methods were used: analysis and synthesis, abstraction, generalization, analogy, and specific: system analysis, formalization, graphical, tabular, questionnaire method. When performing preparatory and desk research, methods of statistical processing of data arrays were used.

3. Results and discussion
A survey was conducted of two hundred legal entities operating in the field of forestry relations in the following regions: Voronezh Region, Tambov Region, Kursk Region, Lipetsk Region, Belgorod Region, Kabardino-Balkar Republic. Based on the results of processing the completed questionnaires, the following was revealed:

1. To the question “Do you use information systems in your work?” The opinions of the respondents were divided as follows:
   - 33.3% use the automated information system “State Forest Register” (AIS GLR) in their work;
   - the unified state automated information system for wood accounting and transactions with it (EGAIS for wood accounting) is used by 100% of the respondents;
   - 33.3% of respondents use the interactive map “Forests of Russia”;
   - GIS “TopoL” version 10 Digit (forestry) option (fixed license for two workplaces) is used by 33.3% of respondents;
   - geographic information system “Panorama x64” (Professional GIS “Panorama x64”) version 12, for the platform “x64”) is used in work by 33.3% of respondents;
   - geographic information system (GIS) “M.GIS” is used by 33.3% of respondents.

   Thus, all interviewed legal entities – participants in forestry relations use information systems, this allows automating the most important processes of the organizations’ activities.

2. Evaluating the usability of the information systems used, all respondents consider the information systems they use to be quite convenient in their work. Thus, the created information systems and software products find their application and can become part of a single digital platform. Legal entities are provided with the necessary technical means for the reliable use of software products.

3. None of the respondents publishes information about the state of forests in the form of open data – 100% “no”.
4. When answering the question “The volume of reporting will decrease with the use of digital technologies in forestry”, the opinions of the respondents were divided as follows: yes – 33.3%, no – 33.3%, I find it difficult to answer – 33.3%.

5. According to the data, 100% of the respondents are confident that the use of digital technologies in the use of forests will contribute to their multipurpose, rational, continuous, sustainable use.

6. The use of digital technologies in the field of forest protection will help to prevent or eliminate the harmful effects on forests of natural and anthropogenic factors of non-biological origin, including the prevention, detection and extinguishing of fires, 100% of the respondents are sure of this.

7. To the question “The use of digital technologies in the field of forest protection will help prevent damage to forests from all biological factors”, all respondents answered “yes”.

8. The use of digital technologies in the field of forest reproduction will contribute to improving the condition and species composition of forests, increasing their productivity, seed production of forest plants, according to 100% of the respondents.

9. All respondents (100%) believe that the use of digital technologies in the field of afforestation will contribute to the development of areas previously unforested.

10. The use of digital technologies in the field of forest inventory will contribute to the effectiveness of measures to check the condition of forests, their quantitative and qualitative characteristics – this is the opinion of 100% of the respondents.

11. That the use of digital technologies in the field of forest management will contribute to the efficiency of forestry design; design of production forests, protective forests, reserve forests, as well as especially protective forest areas; fixing on the ground the location of the boundaries of forest districts, district forest districts, forest areas and lands on which production forests, protective forests, reserve forests, especially protective forest areas are located; forest taxation; the design of measures for the protection, protection, reproduction of forests, 100% of the respondents are sure.

12. The use of digital technologies in the field of cadastral registration will contribute to the effectiveness of determining the location of the boundaries of a forest area – this is the opinion of 100% of the respondents.

13. When asked if the use of digital technologies in the forestry industry will improve the quality of products, all respondents answered “yes”.

14. According to the data 100% of respondents are sure that the use of digital technologies in forestry will increase the efficiency of industry management.

15. The introduction of digital technologies will attract new investors to the forestry industry and increase the investment attractiveness of forest regions, 66.7% of respondents are sure of this, 33.3% found it difficult to answer this question.

16. According to the data 66.7% of respondents are sure that innovation activity and the level of innovation implementation with the introduction of digital technologies in forestry will increase, 33.3% found it difficult to answer the question.

17. The question “The introduction of digital technologies will improve the quality of life in forest areas, create new jobs and increase the level of socio-economic development of forest regions in general” divided the respondents’ opinions as follows: 66.7% agreed, 33.3% found it difficult to answer.

18. The use of digital technologies will help improve the impact of climate on forestry and forest conservation: 33.3% of respondents agree with this, 66.7% found it difficult to answer this question.

19. When introducing digital technologies, state support is necessary, as all respondents believe.

20. Answering the question about the adequacy of the competence of forestry specialists for the digitalization of the industry, all respondents agreed that the competencies are not enough and answered “no”.

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21. According to the data 66.7% of respondents agree that digitalization will allow to involve workers of new professions in forestry production, 33.3% found it difficult to answer this question.

22. All respondents speak with confidence about the need for a department of digital technologies in forestry in forestry universities - 100% of respondents answered “yes”.

23. The lack of educational technologies for training specialists for digital forestry is confirmed by 33.3%, 66.7% are sure that there are enough educational technologies.

24. The opinions of the respondents that there are no highly qualified teachers in forestry universities to train specialists in this area were equally distributed: 33.3% of respondents agree with this, 33.3% do not think so, and 33.3% found it difficult to answer.

25. A unified information system is more in demand than a scattered information system, 66.7% of respondents are sure of this, 33.3% found it difficult to answer.

26. To the question about the existence of technical readiness for the use (implementation) of digital technologies in the use, protection, protection and reproduction of forests, afforestation (forest relations), the answers of the respondents were distributed as follows: 66.7% of respondents use wired Internet; 100% of respondents use wireless Internet; 66.7% of respondents use electronic document management; 33.3% of respondents use satellite communications; 33.3% of respondents use GIS; 66.7% of respondents use wired Internet, wireless Internet and electronic document management at the same time; 33.3% of respondents use wireless Internet, satellite communications and GIS at the same time.

Thus, the technical readiness of the use (implementation) of digital technologies in the field of use, protection, protection and reproduction of forests, afforestation (forest relations) exists, as evidenced by the high percentage of use of wired Internet (66.7%), wireless Internet (100%) and electronic workflow (66.7%).

27. The relevance of the implementation of measures of technical readiness for the use (implementation) of digital technologies in the field of forestry relations. According to the survey, the most relevant to implementation, in the opinion of legal entities operating in the field of forestry relations, are measures of technical readiness for the use (implementation) of digital technologies in the field of forestry relations: providing coverage with broadband Internet (4G, 5G, Wi-Fi) forest lands, unification of sectoral databases of forestry, Unified State Register of Real Estate (USRN), Federal Tax Service (FTS) and Federal Customs Service (FCS), end-to-end information support system in the field of forestry, traceability system for concluding forest lease agreements using blockchain, traceability system for certain types of products using blockchain, seed material traceability system with use of blockchain, end-to-end traceability system from forestry production to finished products using blockchain, digitalization of forest breeding technologies and seed stock, use of domestic software by government agencies, local authorities self-government and organizations, the creation of a global competitive infrastructure for the transmission, processing and storage of data mainly based on domestic developments, the possibility of purchasing modern equipment by forestry enterprises, ensuring the training of highly qualified personnel for digital forestry.

The results of the expert survey of forestry enterprises are presented in table 1. Thus, according to table 1, the respondents could not decide on only two issues: a decrease in the volume of reporting when using digital technologies in forestry and the availability of highly qualified teachers to train specialists in this area in forestry universities. On the rest of the questions, the respondents managed to reach a common opinion by a majority vote.

The relevance of the implementation of measures of technical readiness for the use (implementation) of digital technologies in the field of forestry relations from the point of view of the forest business is presented in table 2. With regard to the relevance of the implementation of measures of technical readiness for the use (implementation) of digital technologies in the field of forestry relations, entrepreneurs could not decide on ensuring the possibility of choosing a forest plot for lease using the blockchain and using augmented and virtual reality (AR/VR) to train personnel to act within
the framework of the emergence protocol or emergency situations of forestry. In other events, it was possible to identify the opinion of the majority of respondents.

**Table 1.** Results of an expert survey of legal entities carrying out their activities in the field of forestry relations.

| Question title                                                                 | Answer options |
|--------------------------------------------------------------------------------|----------------|
| 1. They use information systems in their work:                                 |                |
| − State Forest Register (AIS GLR).                                           | 33.3           |
| − Unified state automated information system for wood accounting and transactions with it (EGAIS for wood accounting). | 100            |
| − Interactive map “Forests of Russia”.                                       | 33.3           |
| − GIS “TopoL” version 10 Digit Option (forestry).                            | 33.3           |
| − Geographic information system “Panorama x64”                                | 33.3           |
| − Geographic information system (GIS) “M.GIS”.                               | 33.3           |
| 2. The applied information systems are easy to use.                          | 100            |
| 3. You post information about the state of forests in the form of open data. |                |
| 4. Reporting volume will decrease when using digital technologies in forestry.| 33.3 33.3 33.3 |
| 5. The use of digital technologies in the field of forest use will contribute to their multipurpose, rational, continuous, sustainable use. | 100            |
| 6. The use of digital technologies in the field of forest protection will help to prevent or eliminate the harmful effects on forests of natural and anthropogenic factors of non-biological origin, including the prevention, detection and extinguishing of fires. | 100            |
| 7. The use of digital technologies in the field of forest protection will help prevent damage to forests from all biological factors. | 100            |
| 8. The use of digital technologies in the field of forest reproduction will help improve the condition and species composition of forests, increase their productivity, seed production of forest plants. | 100            |
| 9. The use of digital technologies in the field of afforestation will contribute to the development of areas previously unforested. | 100            |
| 10. The use of digital technologies in the field of forest inventory will contribute to the effectiveness of measures to check the condition of forests, their quantitative and qualitative characteristics. | 100            |
| 11. The use of digital technologies in the field of forest management will contribute to the efficiency of forestry design; design of production forests, protective forests, reserve forests, as well as especially protective forest areas; fixing on the ground the location of the boundaries of forestries, district forestries, forest areas and lands on which production forests, protective forests, reserve forests, especially protective forest areas are located; forest taxation; design of measures for the protection, protection, reproduction of forests. | 100            |
| 12. The use of digital technologies in the field of cadastral registration will contribute to the effectiveness of determining the location of the boundaries of a forest area. | 100            |
| 13. The use of digital technologies in the forestry industry will improve the quality of products. | 100            |
| 14. The use of digital technologies in forestry will increase the              |                |
efficiency of industry management.
15. The introduction of digital technologies will attract new investors to the forestry industry and increase the investment attractiveness of forest regions.

16. The introduction of digital technologies in forestry will increase innovation activity and the level of innovation implementation.

17. The introduction of digital technologies will improve the quality of life in forest areas, create new jobs and increase the level of socio-economic development of forest regions in general.

18. Leveraging digital technologies to help improve climate impact on forestry and forest conservation.

19. Is government support necessary for the introduction of digital technologies.

20. The competencies of specialists for digitalization of forestry are currently sufficient.

21. Digitalization will allow to involve workers of new professions in forestry production.

22. Do forestry universities need departments of digital technologies in forestry.

23. Currently, there are no educational technologies for training specialists for digital forestry.

24. There are no highly qualified teachers in forestry universities to train specialists in this area.

25. In forestry, a unified information system is more in demand instead of disparate information systems.

26. Technical readiness for the use (implementation) of digital technologies in the use, protection, protection and reproduction of forests, afforestation (forest relations):

- use wired internet;
- use wireless internet;
- use electronic document management;
- use satellite communications.

The study of the opinions of the respondents made it possible to prepare recommendations for organizing the digitalization of processes in the field of use, protection, protection and reproduction of forests in the Russian Federation.

The most relevant measures for the implementation of measures of technical readiness for the use (implementation) of digital technologies in the field of forestry relations, according to the research carried out, are:

- introduction of the latest modern technologies of mobile and fixed communication 5G in cities and towns;
- provision of coverage with broadband Internet (4G, 5G, Wi-Fi) of forest lands; the use of “big data” (big data);
- integration of sectoral databases of forestry, USRN, services of the Federal Tax Service and the Federal Customs Service;
- ensuring the possibility of choosing a forest plot for lease using the blockchain;
- a traceability system for concluding lease agreements for forest plots using blockchain;
- digitalization of technologies for forest selection and seed stock;
- use of domestic software by state bodies, local authorities and organizations;
- creation of a global competitive infrastructure for transmission, processing and storage of data, mainly based on domestic developments;
- ensuring the training of highly qualified personnel for digital forestry.
Table 2. Relevance of implementation of measures of technical readiness for the use (implementation) of digital technologies by forestry enterprises.

| Name of events                                                                 | Answer options (level of relevance) |
|-------------------------------------------------------------------------------|-------------------------------------|
| Introduction of the latest modern technologies of mobile and fixed communication 5G in cities and towns. | High, %  Medium, %  Low, %  Outdated, % |
| Providing broadband Internet coverage (4G, 5G, Wi-Fi) of forest lands.          | 66.7  -  66.7  - |
| Construction of a federal narrowband communication network using LPWAN technology for collecting and processing telematic information. | -  66.7  -  - |
| The use of “big data” for processing various information of different formats in huge volumes, located in various sources in order to improve the efficiency of work and increase the competitiveness of the forest sector. | -  -  66.7  - |
| Application of robotics components in the field of use, protection, protection and reproduction of forests, afforestation (robots for extinguishing fires, drones, etc.). | -  -  66.7  - |
| Integration of sectoral databases of forestry, USRN, services of the Federal Tax Service and the Federal Customs Service. | 66.7  -  -  - |
| End-to-end information support system in the field of forestry.                | 66.7  -  -  - |
| Ensuring the possibility of choosing a forest plot for lease using the blockchain. | 33.3  33.3  33.3  - |
| A traceability system for concluding lease agreements for forest plots using blockchain. | 66.7  -  -  - |
| System of traceability of certain types of products using blockchain.         | 66.7  -  -  - |
| Seed traceability system using blockchain.                                    | 66.7  -  -  - |
| End-to-end traceability systems from forestry production to finished products using blockchain. | 66.7  -  -  - |
| Digitalization of forest breeding technologies and seed stock.                | 66.7  -  -  - |
| Use of domestic software by state bodies, local authorities and organizations. | 66.7  -  -  - |
| Creation of a global competitive infrastructure for the transmission, processing and storage of data, mainly based on domestic developments. | 100  -  -  - |
| The possibility of purchasing modern equipment by forestry enterprises.        | 66.7  -  -  - |
| Ensuring the training of highly qualified personnel for digital.              | 66.7  -  -  - |
| The use of augmented and virtual reality (AR/VR) to train staff to act within the framework of the occurrence of protocol or emergency situations in forestry. | 33.3  33.3  33.3  - |

4. Conclusion
Based on the results of the study, a conclusion was prepared on the state of affairs and the level of technical readiness for the use (implementation) of digital technologies in the use, protection,
protection and reproduction of forests, afforestation (forest relations) at the level of the constituent entities of the Russian Federation:

- all respondents use in their work information systems designed to perform certain functions, however, there is a need to create a unified information system instead of separate information systems;
- technical readiness to use (implement) digital technologies in the field of use, protection, protection and reproduction of forests, afforestation (forest relations) exists, since the majority of respondents in their professional activities use wired Internet, wireless Internet, electronic document management, a small proportion of respondents use satellite connection;
- the use of digital technologies in the field of use, protection, protection, reproduction of forests, afforestation, forest inventory, forest management, cadastral registration will contribute to the effective development of forestry;
- the use of digital technologies in forestry will increase the efficiency of industry management;
- the introduction of digital technologies in forestry will increase innovation activity and the level of innovation implementation;
- the introduction of digital technologies in forestry will attract both domestic and foreign investors to the forestry industry;
- the introduction of digital technologies in forestry will increase the investment attractiveness of forest regions;
- for the introduction of digital technologies in forestry, government support is required.

In general, measures for the digital transformation of forestry in Russia must be carried out in order to:

- a technological breakthrough in forestry and the achievement of a significant increase in labor productivity of forest users using modern automation and computerization technologies;
- transformation of the processes of state forest management, ensuring the efficiency and effectiveness of decisions based on the formation of a single information space, ensuring the completeness and consistency of information within the framework of state monitoring of forest resources and cadastral data of forest areas, forest management, regional planning, accounting and inventory of forests;
- monitoring of the state of forests to ensure environmental safety not only of the Russian Federation, but of the entire world space.

The generated analytical opinion will serve as the basis for the development of expert recommendations of an organizational and legal nature on possible areas of application of information and communication technologies in the use, protection, protection and reproduction of forests in the Russian Federation and state forest management.

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