Assessment of the state of digitalization of the agro-industrial complex

M K Chernyakov¹, M M Chernyakova², I A Chernyakova¹,², G M Gritsenko³ and S S Gromov⁴

¹ Novosibirsk State Technical University, 20, Karl Marx Ave., Novosibirsk, 630078, Russia
² Siberian Institute of management-branch of the Russian presidential Academy of national economy and Public administration, 6, Nizhnegorskkaya, Novosibirsk, 630102, Russia
³ Federal state budgetary institution of science Siberian Federal research center of agrobiotechnologies of the Russian Academy of Sciences (FSBIS SFRC RAS), Altai laboratory Sibniieskh, 6, Stroiteley Ave., Barnaul, 656015, Russia
⁴Private institution "RusAtom-international Network", 7/1, stoletova str., Moscow, 119192, Russia

E-mail: mkacadem@mail.ru

Abstract. The article analyzes the state and prospects of the process of transformation of the agro-industrial complex into a digital economy. A comparative analysis of the digitalization process in Russia and its region-the Novosibirsk region. It was found that the rate of digitalization in the Novosibirsk region is higher than the average for Russia and the Siberian Federal district. Agricultural risks of the digital economy are identified. Priority directions for the development of digitalization of the agricultural sector of the Novosibirsk region are outlined.

1. Introduction

The article analyzes the state and prospects of the process of transformation of the agro-industrial complex into a digital economy. A comparative analysis of the digitalization process in Russia and its region-the Novosibirsk region. It was found that the rate of digitalization in the Novosibirsk region is higher than the average for Russia and the Siberian Federal district. Agricultural risks of the digital economy are identified. Priority directions for the development of digitalization of the agricultural sector of the Novosibirsk region are outlined. Digitalization issues are a priority for the country's development of both the social sphere and the real sector of the economy, which includes the agro-industrial complex. In particular, the pilot implementation of the Affordable Internet project is provided by five major Telecom operators: MegaFon, MTS, Rostelecom, Er-Telecom holding (Url brand) and Beeline. This initiative certainly contributes to the digitalization of economic entities, especially small and medium-sized businesses, especially for agricultural producers, since significant infrastructure risks in rural areas have hindered the process of transformation into a digital economy.

In addition, the ICT industry has a higher rate of development compared to other industries, so it can become a locomotive for the introduction of digital technologies in other areas, including agriculture.
2. Materials and methods
As a research method, morphological analysis was chosen, which is an effective methodological approach – a way of seeing and a generalized attitude to reality. Fritz Zwicky [1] proposed to generalize and systematize the concept of morphological research and include in it not only the study of forms of geometric, geological, biological, and material structures in General, but also the study of more abstract structural relationships between phenomena, concepts, and ideas, whatever their nature.

Morphological analysis is based on the concept of a universal connection between all objects, events, and realms of reality. "...in the final and true image of the world, everything is related to everything, and nothing can be discarded a priori as insignificant" [2].

3. Results
The contributions of the agro-industrial complex and ICT are comparable and make up 4.2% of the GRP of the Novosibirsk region (NSO) and exceed the contribution of the education (4.0%), construction (3.8%), mining (2.6%) and electric power (2.4%), giving only 0.1% to health and social services. It is significant that the share of ICT in the national economy is twice as high as the average for the Siberian Federal district and 1.4 times higher than for the Russian Federation.

Based on the results of the research of NP "RUS*SOFT" [3] 40 regions ratings were conditionally divided into four zones of technological risk of digitalization (risk-free, with minimal, small and acceptable risks) – A, B, C, D. the first three zones are rated Top-14 with the subjects of the Federation, which can be said to have a formed software industry (risk coefficient \( K_p < 0.3 \)). Of the regions of the SFD, only the Novosibirsk region entered the TOP 5, and Tomsk was added to the TOP 10.

According to the research results of RUS*SOFT, Novosibirsk, Nizhny Novgorod, Sverdlovsk, Rostov regions and the Republic of Tatarstan are among the contenders for the third position (after Moscow and St. Petersburg) in the rating of Russian regions with minimal technological risk and the highest level of development of the software development industry. Since there are no clear division criteria, it is acceptable to combine them into one group. However, it should be noted that Novosibirsk and Nizhny Novgorod, although not significantly, still stand out a little from this five.

Nizhny Novgorod has a slightly higher export rate, but according to RUS*SOFT, Novosibirsk has more large development centers of Russian (primarily Moscow) companies working for export, and there are also large developers that are more focused on the domestic market (for example, the center for Financial Technologies). The most active company in the labor market of Nizhny Novgorod is MERA, which operates mainly for export. Novosibirsk also has a significant advantage in terms of the total number of companies and the number of open vacancies, which is the reason to put the NSO in third place in the rating.

From regions of the Siberian Federal district in 40 analyzed regions does not include only four: the Kemerovo region and the Republic of Altai, Tyva and Khakassia (figure 1), which according to the criterion digital technological risk can be attributed to the critical zone \( K_p > 0.7 \).

Novosibirsk region by a large margin from other regions of the Siberian Federal district leads in all the parameters of digitization (figure 1).

The development of information infrastructure is also of great importance for the digitalization of the agro-industrial complex, especially in localities with rural residents, since critical infrastructure risk will not allow successful transformation. One of the targets is to increase the share of rural residents of the NSO who have the opportunity to use modern communication services in 2024 should be 93% [4].

By the end of 2019, the Novosibirsk region "prematurely completed the Federal project "Elimination of digital inequality" and provided broadband Internet access to all planned localities with 250-500 inhabitants (279 localities with a population of 96.4 thousand people) [5] (figure 2), this was facilitated by the regional initiative (regional project"500 plus"). The regional initiative provided high-speed Internet access to 137 localities with a population of 500 or more inhabitants, where 105.2 thousand people live, which were not included in the plans of the Federal project.
In addition, the regional project "500 plus" in 2019 provided 3G cellular services to residents of 45 localities in the region with a population of 250 to 1000 people (15.9 thousand people), where cellular communication was not at all or was unstable.

The synergistic effect of synchronizing two projects (utsn and 500 plus) over several years guaranteed the leading position of the Novosibirsk region among all regions of the SFD in providing the population with modern communication services and, above all, broadband Internet access (Fig. 2).

Statistics show that the NSO is two or more times higher than other regions of the SFD, but it lags behind the world leader Switzerland by 10 units (Appendix 5. Low infrastructure risk creates extremely favorable conditions for agricultural producers in the region to transform farms into a digital economy.

In 2019, 400 such entities have already been connected. Fiber-optic communication lines will provide additional technical capability for connecting citizens and businesses to fixed-line telephone and broadband Internet services.

To reduce the social risks of digitalization and the need for specialists of the new digital generation, it is necessary to pay attention to the training and retraining of such personnel. The basis for the possibility of training such specialists is a high-quality primary digital education. In addition to
broadband access to the Internet, students should be provided with access to modern educational digital services, electronic textbooks and online education.

In terms of the number of students per 10,000 population, the NSO ranks 4th in the country. According to the QS Best students cities 2018 rating [7], Novosibirsk is included in the list of the 100 best student cities in the world, although it is in 96th place in it. Highly qualified personnel are trained in 23 universities and branches in more than 500 specialties and areas, teaching about 100.9 thousand students, including 7.8 thousand foreign students. Leading Novosibirsk universities occupy high positions in international and Russian rankings [3].

Since 2000, the region has been carrying out targeted contract training at the expense of the regional budget of the Novosibirsk region in order to promote the staffing of the economy of the NSO. Since 2012, the region has been participating in the presidential program for advanced training of engineering personnel in order to increase the quality of training of engineering personnel for industrial production and improve the system of engineering training.

In order to reduce the psychological management risks associated with the provision of public services, a lot of work has been done to digitalize them. The effectiveness of the work done can be estimated by the number of users of the Unified portal of public services (EPSU), which reached 2.7 million, which is twice as high as the previous year. The work of the EPSU several times reduced the time and material resources spent on obtaining these services, which were much higher for rural residents than for residents of megalopolises, which contributed to creating a more favorable socio-political climate in society.

4. Discussion

In the Novosibirsk region (NSO), the number of business entities using certain digital technologies is growing every year. For example, precision farming and animal husbandry systems based on satellite navigation have already been firmly integrated into the technological process of a number of farms. The use of innovations makes it possible to increase crop yields, meat and milk production. About 12% of agricultural machinery units are equipped with digital systems [8], and their number continues to grow.

Digital technologies help farmers in the region to get state support faster, among other things. Since the beginning of 2019, 1.8 billion rubles have already been allocated from the regional budget to help agricultural producers. Timely receipt of funds allows you to quickly organize the workflow. The introduction of a new system of digital interaction has allowed for more than a month to reduce the time for bringing funds to farmers.

In 2019, a remote mechanism for signing agreements on granting subsidies to agricultural producers using an electronic signature was also introduced. At the moment, 862 agreements are concluded in electronic form, which is 86% of the total number of agreements concluded. In the first half of 2019, 1,926 applications were submitted electronically, 1,743 of them with an electronic signature, which is 90.4%, and the total amount of state support was about 1 billion rubles. Farmers have managed to save more than a thousand working days by interacting with the Ministry of agriculture of the NSO with the help of digital technologies.

The government of the NSO participates and fully helps in the implementation of various projects on digitalization of the dairy subcomplex in the territory of the districts of the region by developing the logistics system. New projects implemented in the industrial and logistics Park open up new opportunities and new formats of work for milk and dairy producers. This system helps to sell products to such large manufacturers as the company "Siberian Niva" [9].

In particular, in the Maslyanyinsky district near the "Siberian field" complex in the village of Elban – the third. The village of Borkovo contains 2,500 head of cattle. At the end of 2017, the modernization of the complex in the village of Pekovo was completed: the number of livestock increased from 1,800 to five thousand heads of dairy cattle.
The total capacity of the Elban livestock complex is 62 thousand tons of milk per year [10]. 6000 heifers of Holstein breed, characterized by high productivity, were purchased for the Elban complex. Holstein cows’ milk contains a lot of fat and protein.

The livestock complex is equipped with a milking and dairy unit with two "Carousel" installations, a computer herd management system, a water treatment system, engineering structures and structures for storing feed, veterinary facilities, as well as five vertical cooling tanks for 156 tons of milk daily. The project cost was over 5 billion rubles.

The opening of such a large livestock complex allows the region to significantly increase gross milk production. The share of milk produced in Yelbani can be up to 10% of the gross milk production in the NSO.

Plant breeders of the Novosibirsk region have combined information technology, agriculture and science in order to effectively produce vegetables, berries and herbs all year round, which radically changes the market for local food cultivation. Digitalization of technological processes for year-round production of vegetables, berries and herbs is mainly used by greenhouse plants on an industrial scale, and small business organizations within the framework of the ultramodern Novosibirsk project "urban greenhouses on roofs".

Under the control of digital technologies are the ventilation system, control of drip irrigation of plants. Consequently, the operation of the equipment is more reliable and efficient, and resources are spent more economically.

The project of an innovative company from Novosibirsk Akademgorodok in the framework of the new business direction “iFarm Project” involves the use of digital technologies on the roofs of houses, in courtyards and directly in stores and shopping centers.

"Smart greenhouses" in the form of vertical farms and modular greenhouses, it is most effective to produce leafy salads, vegetables, berries, herbs, medicinal plants and flowers all year round. Digital technologies allow you to fully automate technological processes, including planting, growing, harvesting and marketing of finished products. The intelligent system controls temperature, humidity, and light.

The operator remotely controls the robot, which is self-programmable, i.e. able to adapt and learn in order to more effectively monitor air humidity, calculate the total volume of green mass and photograph plants.

Digital technologies have been successfully implemented in more than 120 economic entities of the NSO in crop production and about 30 subjects in animal husbandry. Modern agribusiness needs to effectively apply the achievements of scientific and technological progress and the results of the digital revolution to create innovative tools and new business opportunities to become more efficient and competitive.

At the same time, the Novosibirsk region is characterized by all-Russian factors that hinder the development of information and telecommunications technologies. In particular, this process is hindered by insufficient provision of cellular and mobile data transmission infrastructure in sparsely populated and remote localities (digital inequality persists). It is not profitable for Telecom operators to develop their networks in small localities due to the unprofitability of these projects. There is an outflow of highly qualified personnel.

The SFO also lacks specialized events related to the digital sphere and high technologies. There are fewer conferences, hackathons and festivals in Novosibirsk than in Yekaterinburg, so local staff is somewhat disconnected from the General agenda, and students do not get enough practical skills, many combine work with study for the sake of experience at the expense of quality. In Novosibirsk, there is a need to create educational clusters. It is necessary to combine universities with enterprises for student internships and support innovative small business organizations created by students [11].

Further strengthening of the region's investment attractiveness is impossible without the development of the information society infrastructure.
5. Conclusion
As a result of the analysis of the state of digitalization of agriculture, it was found that the Novosibirsk region has great prospects for transforming the industry into a digital economy. This is confirmed by the low level of technological, infrastructural, social and psychological risks compared not only with other regions of the Siberian Federal district, but also the Russian Federation. NSO is the absolute leader in broadband access in Russia. It occupies the third position in the rating of regions of Russia with the greatest development of the software development industry, and in terms of the number of students per 10,000 population, NSO ranks 4th in the country.

However, the Novosibirsk region is characterized by all-Russian factors that prevent the introduction of information and telecommunications technologies in the economic entities of the agro-industrial complex. First of all, it is the preservation of digital inequality in providing cellular and mobile data transmission infrastructure in sparsely populated and remote localities, and the outflow of highly qualified personnel.

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