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# MAIN TRENDS OF GOVERNMENT REGULATION OF SECTORAL DIGITALIZATION

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**Abstract.** This paper examines the principal trends of the government regulation of the milk-producing industry. It focuses on the rationale of those trends for improving the government regulation of dairy industry parameters and the development of effective methods for their implementation in the context of transformation into the digital economy. The study explores theoretical positions, approaches, and principles of the government regulation of digitalization of the dairy industry. It also identifies the essence and forms of this regulation. The researchers developed an economic and mathematical model of the relationship between the dairy industry parameters through a multi-level chain of indirect parameter relationship. The researchers also worked out the methodological foundations for modeling the dairy industry using digital technologies. A reverse forecasting technique was developed to estimate the necessary volume of the government support required to achieve dairy industry target indicators at any level of regulation. The model was tested with various scenarios for forecasting the results of the government regulation of the dairy industry in order to achieve the target criteria.

**Keywords:** digital economy; government regulation efficiency; digital models; forecasting technique

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**JEL Classifications:** Q16, Q18

## 1. Introduction

In terms of the gross agricultural output, the Russian Agro-Industrial Complex (AIC), which includes the dairy industry, sufficiently large. As of 2018, the Russian Federation produces about 32 million tons of milk (including

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the marketable milk comprising more than 22 million tons) of milk per year, which provides up to 83% of the population's need for milk and dairy products. Despite a rather high level of overall food security achieved in the country - surpassing the targets of the Doctrine of Food Security of the Russian Federation in most positions, the dairy industry turns out to be a bitter exception. According to the Doctrine of Food Security, the country must produce milk (and dairy products equivalent to milk) to a level of at least 90% (Tultabayeva et al., 2017, 2019; Almeida et al., 2019). Taken together, the insufficient government support of livestock industries, as the raw material basis of domestic food production, and the insignificant expansion of the country's export potential result in low levels of both production efficiency and technical equipment in most agricultural enterprises, especially within the dairy industry (Tikhonov et al., 2019).

A low production efficiency of milk and dairy products negatively affects the quality of life of the country's population. In the pre-reform period, the dairy industry in Russia completely met the population's need for milk and dairy products at the level of medical standards. At present, and at the current rate of consumption, the level of self-sufficiency in milk and dairy products of the population of the Russian Federation (RF) is 70%; in the Siberian Federal District (SFD), it is 75%. There is also a decreasing trend of milk and dairy product consumption per capita of about 1% annually (in the Russian Federation from 75% in 2014 to 70%, and in the Siberian Federal District from 79% to 75%).

To eliminate these negative tendencies, urgent measures are needed to strengthen the government support and stimulation of the dairy industry, primarily because of its effective transformation into the digital economy (DE) (Sharafutdinov et al., 2019; Sycheva et al., 2019; Petrenko et al., 2019**;** El Idrissi et al., 2020). Therefore, the need to develop theoretical principles and practical recommendations for improving the process of the government regulation of the dairy industry in the context of its transformation into the DE determines the relevance of the study.

## 2. Literature review

An analysis of the scientometric databases of the RSCI and WoS shows that more than 20% of the research on the problems of the agro-industrial complex is related to the dairy industry. This indicates its importance and the rationale of choosing it as a study object. At the same time, there are practically no works devoted to the regulation of the dairy industry in the context of digitalization. Only one publication in the RSCI (Kudryashov, 2019) and one publication in the WoS (Hansen, 2019) consider these particular problems. Since the dairy industry is developing in almost all countries of the world as well as in the regions like the Russian Federation and its territorial entities, the Novosibirsk region, which is in the center of the Siberian District, was chosen as an object of the research. The chosen research topic is characterized by three keywords: the dairy industry, regulation, and digitalization.

Digitalization (digital transformation) is most often understood as a change in the form of doing business in digital reality based on data (Yandex Zen, 2019; Prodani et al., 2019). "*The digital economy is an environment that includes a combination of digital infrastructure and innovative diversification of information and communication technologies for doing business*" (Chernyakov, 2016). Considering the transition of the agro-industrial complex to the DE, the research should rely on the following definition: "*the government regulation in agriculture is the real-time economic impact of authorities using digital support for the production, processing, and the sale of agricultural products, raw materials and food, agricultural infrastructure*" (Chernyakova, 2019). Taking into account the industry specifics of the dairy subcomplex, the following definition can be given: "*Regulation of the dairy industry in the context of digitalization is the real-time economic impact of authorities using digital support for the production of milk, milk processing, and the sale of milk and dairy products, on the infrastructure of the dairy sub-complex*."

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Based on various sources of information (Sysuev et al, 2017; Bobkova et al., 2015; Petrik and Oshakbaev, 2015; Pavlyshyn et al., 2019; Rahman, 2017), a system for the development of organizations of the dairy sub-complex of the agro-industrial complex was proposed, which is a closed system consisting of four main elements: causes, goals, functions, and principles of the government regulation of the dairy industry. All of the listed components of the system elements are tentative, not constant, and changing their components requires adjustments of other elements (one or more). Consequently, the system is changing dynamically, and the task of the regulation is to determine the vector of these changes (Hirdinis, 2019; Movchan and Yakovleva, 2019; Ermakova et al., 2016; Dunets et al., 2019; Regaña et al., 2019).

Badalyan M.E. in his study suggests that the system of the government regulation of the dairy industry should be formed in such a way that the regulation should use the paradigm of the "efficient core activity" (Badalyan, 2013) through a clear formulation of the goals of the activities and the choice of more effective means of their implementation. To increase the efficiency of using digital technologies in the dairy industry, it is necessary to 1) introduce innovative technological processes for the production of milk and dairy products and 2) improve the information and technology support for managing these processes (Chernyakov and Chernyakova, 2015).

Agricultural production is developing along the path of automation and computerization (Burda, 2018) including such innovations as electronic herd management systems. Internet of things (IoT) solutions developed in the Russian Federation such as the Rightech IoT Cloud and the kSense IoT platforms can provide for, among other things, livestock management. Thanks to these platforms, farmers can track livestock location, monitor pregnant and sick animals, determine rational milking times, etc. There is a continual improvement of this new technology, and farmers show a great interest in obtaining it; however, only 3-5% of the country's dairy farms have introduced comprehensive automation of herd management (Surovtsev and Nikulina, 2019).

Integrating DE technologies into the dairy industry can reduce the costs by at least 23% (Livestock industry ..., 2019). According to the experts of the PwC group (PwC is the largest audit network), the major challenges for Russian farmers include the growth of domestic and foreign demand for agricultural products as well as the need to increase labor productivity and competitiveness. These challenges will inevitably be a driving force for the technological development of the dairy industry. On November 27, 2018 at the Fifth International Agro-Industrial Dairy Forum, a session was held on the "Digital Agenda of the Dairy Industry" (Ministry of Agriculture of the Russian Federation, 2018). It was attended by Irina Ganieva, who is the Director of the Department of Digital Development and Management of State Information Resources of the Agro-Industrial Complex of the Ministry of Agriculture of Russia. Ganieva introduced the departmental project "Digital Agriculture" (Departmental Project "Digital Agriculture," 2019). Its goal is to provide a technological breakthrough in the agricultural sector through the introduction of digital technologies in agriculture. It is assumed that this change will have doubled the labor productivity in agricultural enterprises by 2021.

One of the stages of the project implementation will be the creation of the Intellectual system of government support measures (Korableva et al., 2018). Integration with the databases of the Russian Meteorological Service and the Ministry of Emergencies will allow for the adjustment of subsidies for the introduction of emergencies in the regions. It is planned that by 2021, 100% of contracts with recipients of the government support will have been made in the electronic form. By the same time, all agricultural products for export will have been accompanied by a paperless system "from field to port."

According to the research from the Ministry of Agriculture of the Russian Federation, the introduction of digital economy technologies provides positive economic effects and can reduce the costs by at least 23% as well as increase agricultural production by 361.4 billion rubles when an integrated approach is followed (Kokova, 2019).

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## 3. Theoretical background

The Strategy for Spatial Development of the Russian Federation identifies the most important and promising areas of effective economic specialization of the Novosibirsk region directly related to the dairy industry for the period up to 2025:

1. Crop production and livestock, provision of appropriate services in these areas,

2. Food production,

3. Beverage production.

The Novosibirsk region shows stable positive dynamics in increasing the production of milk and dairy products per capita, which allowed it to rise in the all-Russian ranking of regions in terms of production from the 14th place in 2014 to the 11th place in 2018 and in terms of consumption from the 11th place in 2014 to the 4th place in 2018. The region's share of total Russian milk production also increased significantly from 2014 to 2018 by 0.2% including the market share by 0.3% and reached 2.3 % and 2.7% respectively. The success of the Novosibirsk region in developing the dairy industry and providing the population with these products is fully correlated with the regulatory impacts of the government support for this industry in the region. The comparison of the data for 2014-2017 does not show a close linear relationship (the correlation coefficient of 0.58) between the volume of government support funds for the dairy industry and the volume of milk produced in the Novosibirsk region, which indicates the complexity of the regulatory impact on the main industry indicator. This necessitates a thorough study of the nature of such an impact in order to find an opportunity to manage it (Yemelyanov et al., 2018).

An assessment of the effect of digital technologies on the parameters of the dairy industry revealed a correlation close to linear between the number of microchipped cattle and daily milk production per cow and gross milk production. The effect of the number of chipped cows (X) on the productivity (Y) is approximated by the following expression:

$$Y = 0{,}0072 * X + 13{,}164$$

The use of digital technologies in dairy cattle breeding ensures the increase in labor costs for obtaining a centner of milk up to one person-hour and increase in profitability up to 40% (Gritsenko et al, 2019). In order to provide the population of the Novosibirsk region with high-quality products, the following tasks are set for agricultural producers of the Novosibirsk region:

1. Enhance productivity of dairy cattle through the use of digital technologies, attracting the best global genetics and significantly increasing output.

2. Create a competitive breeding base, increasing not only the number of breeding animals (up to 25% of the specific gravity), but also the milk quality (milk production up to 9600 kg in breeding organizations).

3. In the framework of the federal project "Export of Agricultural Products," ensure that milk production in farms of all categories will have reached the amount of 733 thousand tons by 2024.

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Achieving the tasks at hand is impossible without the effective transformation of the dairy industry into the DE. To implement the transformation process, it is necessary to develop effective models, mechanisms, and technologies to predict the necessary events to fulfill these tasks. Using the synergistic effect means to hypothesize the existence of a multilevel model of a stepwise interaction of the relationship between the regulatory effect and the parameters of the dairy industry that do not have a direct functional relationship with it. These parameters have a closer relationship not with the regulator, but with the intermediate indicators, and are dependent on it indirectly. The novelty of the hypothesis is that the correlation coefficient between the regulator and indirect indicators may be close to zero, but the results will show a high degree of accuracy in their calculation.
The implementation procedure (algorithm) of the proposed hypothesis in the form of a multi-level model of a stepwise interaction is shown in Figure 1.

1. The "Initial data" block (Fig. 1) contains the information on the number of the parameters under study (K), time periods analysis (P), and the matrix X (K, P) of the values of each parameter in time intervals. In the "Regulator selection" block, a parameter (one or several) is assigned, the influence of which on other indicators is to be analyzed.

2. After the initial data input, a correlation analysis of the matrix X (K, P) is performed. The values of the correlation coefficients of the regulator are removed from the correlation matrix and ranked relative to other indicators in descending order.

3. Then the model level is calculated. By default, in the initial state, the level is equal to zero. As a result, we obtain: U = 0 + 1 = 1 for the first level of (direct) influence, U = 1 + 1 = 2 for the second level of (indirect) influence, etc.

4. Then, a cycle is started to select indicators that are significant for a given level. The indicators are excluded from the matrix of values, and the regression coefficients are determined for their dependence on the regulator (direct, indirect first level, etc.). The cycle is repeated until an indicator appears, for which the criterion of restriction is less than the specified one.

5. In the case of R < 0.5, the number of untested parameters is analyzed. If K > 0, then the indirect regulator of the U-level is selected according to the criterion of the highest correlation coefficient from the significant indicators of the level R => max. The algorithm proceeds to the analysis of the next level of the model and the process is repeated from stage 3.

6. In the reverse situation (K = 0), the mechanism completes its work, and the result in the form of mathematical dependencies can be used for further analysis, modeling, and forecasting.

7. The proposed approach does not deny fundamental laws, theories, hypotheses, or mechanisms, but organically uses and improves them, which makes it possible to use the developed mechanisms as universal in the study of the parameters of the dairy industry, for example, in combination with the simulation mod

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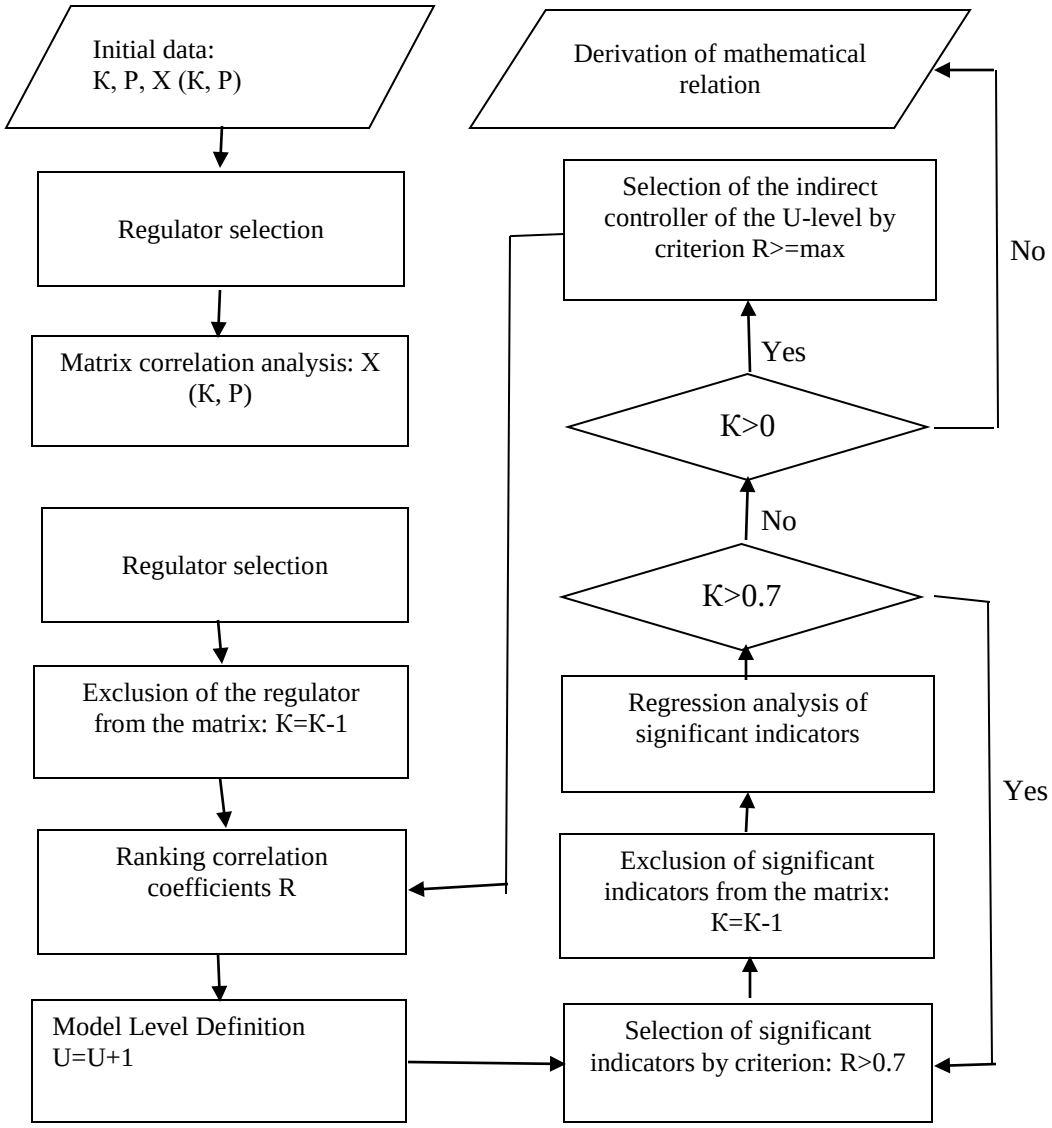


**Figure 1.** Algorithm for modeling the relationship of parameters for government regulation of the dairy industry

*Source:* Glotko et al, 2019

## 4. Data analysis

The algorithm based on the formulas in the form of the mathematical support of a digital model is substantiated. It is proposed to use the regulatory instrument in the form of the government support as the source data in the proposed algorithm, the management of which makes it possible to achieve necessary indicators of the dairy industry. It is also proposed to use the volume of government support funds for the dairy industry as a regulatory impact.

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After checking the correctness of the initial data input, the Information and Communication Technologies conduct an analysis and calculation of indicators of the direct influence of the first level. Having calculated the specific parameters and inserting them into the database, the algorithm proceeds to the next step.

The next step is the calculation of indicators of the indirect influence of the second level, based on the results of the calculation of the most significant parameters of the direct influence of the first level. At this step, the indicators that become the source data for the third calculation step are calculated. At the third step, using the most significant parameters of the second step, the final indicators are determined. At the final step, the calculation results are included in a database and can be transferred to the relevant ICT users in an electronic or paper form.

An action plan was developed in accordance with the proposed hypothesis, which ensured using the digital data taken from the open sources to develop digital models of the dairy industry in the Novosibirsk region. The study of the three-level model algorithm was carried out on the basis of the actual data of the Novosibirsk region during 2014-2018.

As a result of the prior study, a three-level model of the influence of the controlling parameter of the government regulation (the amount of government support funds for the dairy industry) on the quantitative and qualitative indicators of the Novosibirsk region industry was proposed.

The first level (direct impact) includes two indicators: the number of cows at the end of the year in agricultural enterprises (AE) and peasant farms (PF) and milk production of breeding cows. This indicates that the regulator stimulates not only a quantitative increase in the herd from the emphasis on breeding cows, but also on a qualitative increase in its milk productivity.

The second level (indirect influence) includes eight indicators: milk production on the farms of all categories including marketable milk, the share of pedigree cows in collective farms, peasant farms, and private farms including dairy and mixed production directions, milk productivity of cows in the farms of all categories including agricultural enterprises and peasant farms, the production of milk and dairy products per capita, for which the regulator does not have a direct strong impact, but they are strongly influenced by the indicators of the first level and, most of all, by the number of cows at the end of the year in the agricultural enterprises and farms.

The third level (secondary indirect influence) includes four indicators that are almost independent of the regulator (the correlation coefficient varies from -0.33 to 0.26) and of the indicators of the first level (the correlation coefficient varies from -0.71 to 0.26), and these third-level indicators have multidirectional vector manifestations. They have a strong interdependence with only some indicators of the second level. In particular, the consumption of milk and dairy products per capita and the milk productivity of cows in private households are most dependent on the production of milk and dairy products per capita (the correlation coefficient makes up more than 0.55), whereas the indicator of milk processing and dairy production in terms of milk is significantly determined by the production of marketable milk (the correlation coefficient makes up -0.81), but it has a paradoxical opposite tendency - with an increase in milk production, its processing in the Novosibirsk region decreases.

Due to the reduction in prices associated with its large production in the region, milk is exported to the neighboring regions: the Altai Territory and Omsk region, which have efficient milk processing enterprises. An unexpected outcome was obtained as a result of the analysis of the number of cows on the farms of all categories at the end of the year. Its strong relationship was recorded exclusively with the parameters of milk processing and milk production in terms of milk (the correlation coefficient of 0.74).

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The final results of the multilevel correlation and regression analyses are shown in Table 1. It shows that the error of the obtained mathematical equations does not exceed 9%, which indicates the possibility of using the proposed mathematical tools as a mechanism for predicting the effects of the government regulation on the main indicators of the dairy industry of the Novosibirsk region.

The validity check of the digital model in comparison with the actual data for the previous five years shows that with the smallest relative deviation (less than 2%) the last indicator **X3** in the algorithm (the number of cows on the farms of all categories at the end of the year) is calculated, and with the largest (slightly more than 20%) - **X6** (the share of breeding cows of the dairy and mixed directions of productivity).

**Table 1.** Interdependence between the volume of government support funds for the dairy industry of the Novosibirsk region and its main indicators

| Designation | Digital model | Correlation coefficient | Error, % |
|---|---|---|---|
| Level 1 | Direct influence | | |
| X4 | X4 = 0,009878 * X15 + 134,186 | 0,87 | Less than 2,5% |
| X11 | X11 = 1,388184 * X15 + 7187,9351 | 0,73 | Less than 8,3% |
| Level 2 | Indirect influence | | |
| X1 | X1 = 6,634324 * X4 - 255,723 | 0,88 | Less than 3,2% |
| X2 | X2 = 10,37241 * X4 - 949,852 | 0,82 | Less than 8,2% |
| X5 | X5 = 0,467732 * X4 - 51,2205 | 0,89 | Less than 8,8% |
| X6 | X6 = 0,492792 * X4 - 56,2171 | 0,89 | Less than 1,7% |
| X7 | X7 = 58,20987 * X4 - 4410,82 | 0,90 | Less than 4,6% |
| X8 | X8 = 76,64832 * X4 - 6569,93 | 0,89 | Less than 5,7% |
| X9 | X9 = 49,55294 * X4 - 4141,81 | 0,90 | Less than 5,2% |
| X12 | X12 = 1,64969 * X4 - 42,404 | 0,81 | Less than 7,5% |
| Level 3 | Secondary indirect influence | | |
| X10 | X10 = 5,891 * X12 +1738,445 | 0,69 | Less than 2,4% |
| X13 | X13 = 0,5063 * X12 + 186,7629 | 0,55 | Less than 4,2% |
| X14 | X14 =-164,429 *X2+251345,285 | -0,81 | Less than 7% |
| X3 | X3 = 0,00017 * X14 + 162,947927 | 0,74 | Less than 1,2% |

*Source:* own research

Legend:
X1 - Milk production on farms of all categories, thousand tons
X2 - Production of commercial milk, thousand tons
X3 - The number of cows on farms of all categories at the end of the year, thousand heads
X4 - Cows at year-end in AO, peasant farms, PSP, thousand heads
X5 - The proportion of breeding cows in AO, peasant farms, PSP, %
X6 - The share of breeding cows of dairy and mixed directions of productivity, %
X7 - Dairy productivity of cows in farms of all categories, kg / year
X8 - Dairy productivity of cows in agricultural organizations (AO), kg / year
X9 - Dairy productivity of cows in peasant farms (peasant farms), kg / year
X10 - Milk productivity of cows in personal subsidiary plots (PSP), kg / year
X11 - Milk productivity of breeding cows, kg / year
X12 - Production of milk and dairy products per capita, kg / year
X13 - Consumption of milk and dairy products per capita, kg / year
X14 - Milk processing and production of dairy products in terms of milk, tons
X15 - The volume of state support funds for the dairy industry, million rubles

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## 5. Results

The mathematical model developed on the basis of the synergistic approach was the basis for the formation of tools for direct and reverse forecasting of milk production and performance indicators of the dairy industry in the region. The direct forecast of indicators of the dairy industry in the region, in contrast to the existing tools, is based on the use of not only a time factor, but also on the amount of government support funds. It provides an opportunity to predict the performance of the dairy industry depending on the amount of the government support. The reverse forecast solves the problem of determining the necessary amount of the government support to achieve the target indicators of the dairy industry at any level of regulation. The application of the proposed tools enables regional authorities to form intersectoral relations in the dairy industry. The effective formation of intersectoral mutual relations becomes possible thanks to the technical equipment and software of the processes of the government regulation of digitalization in the dairy industry.

The forecasting results for 2019 show that a decrease in the government support could lead to a degradation of the dairy industry in the Novosibirsk region. Keeping financing at the same level can only slow down its decline. This indicates an acute current underfunding of the dairy industry by state authorities. The situation may change for the better with an increase in government support funds by at least twice compared to the ongoing funding.

To achieve the recommended rational consumption rate (of milk and dairy products in total equivalent to milk) 325 kg / year / person, the government support funds in the amount of 5,773 million rubles will be required. As a result, this will lead to an increase in the annual production of milk and dairy products per capita up to 273 kg / person and an increase in the heads of cows by 46 thousand at the end of the year in agricultural enterprises, peasant farms, and private farms. It is unlikely to achieve such a result in one year, so the calculated amount of funds will have to be distributed over several years.

With the optimistic development of the scenario, it will be possible to achieve the recommended rational consumption rate (of milk and dairy products in total equivalent to milk) in the Novosibirsk region not earlier than in four years, but with the expected - in 8 years. However, the estimated time frame will vary depending on the actual amount of government support funds allocated. The mathematical model enables to make appropriate adjustments depending on the regulatory influences. If we exclude from the calculations the factor of regulatory influence depending on the amount of the government support and leave only the time factor, then it will be possible to achieve the recommended rational consumption rate (of milk and dairy products in total equivalent to milk) in the Novosibirsk region not earlier than in 30 years (a pessimistic option).

Providing the population with dairy products in accordance with medical consumption standards in the region implies an increase in the effective growth of all parameters of the dairy industry, which can be achieved only with the use of digital technologies, which make it possible to predict the steps of an effective regulatory impact depending on the amount of government support funds. Without the government support and determining its adequate amount, the development of the dairy industry is unlikely.

## 6. Discussion

Based on various sources of information, the researchers suggest using a system for the development of organizations in the dairy industry of the agro-industrial complex, which represents a closed system consisting of four main elements: causes, goals, functions, and principles of the government regulation of the dairy industry (Frolova et al., 2019; Trofimova et al., 2019). The essential structure of the functioning system is a chain, the first link of which is the sphere of agriculture, the second one is industry, and the final one is services (Safiullin and Akhmetshin, 2019; Murtazina et al., 2018; Plotnikov et al., 2018). It is proposed to consider the essential model of

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the digitalization system of the government regulation of the dairy industry as a closed system consisting of three elements: government regulation, digitalization, and parameters of the industry itself.

Perhaps, in the process of shaping the system of the government regulation of the dairy industry, it will be necessary to abandon some of the advanced principles or supplement them with others (Ermekbaeva et al., 2018). However, the proposed principles, which are interdependent and implemented in real life, can become a guarantee of effective management of the dairy industry using the potential of the DE and considering possible risks.

The studies of various Russian and foreign researchers show that the theoretical prerequisites for regulating the dairy industry are based on the empirical data (Fadiawati et al., 2019; Suryono et al., 2019; Suieubayeva and Utegenova, 2020; Shebashev et al., 2019). Regulation should be aimed at increasing not only quantitative indicators, but also qualitative ones; therefore, it requires the coverage of the greatest possible number of parameters. Mathematical models of influence of regulatory parameters on the performance of the dairy industry in domestic and foreign sources are not found. In addition, a study of the influence of risks associated with the transformation of the dairy industry to the DE is not found in the analyzed information sources.

The imbalance between the agricultural and service sectors of the dairy industry is the main reason for the continuing decline in livestock and the level of consumption of milk and dairy products per capita. To solve these problems of the dairy industry, digitalization of the government regulation of pricing and product promotion processes from a producer to an end consumer, bypassing intermediaries, is necessary (Prokhorova et al., 2016). Therefore, at the present time, the further development of the dairy industry will be impossible without accelerating the development and effective use of digital technologies (Smolnikova et al., 2019; Luzina et al., 2019; Ziyadin et al., 2019; Goryushkina et al., 2019; Cech et al., 2018; Tadeu et al., 2019).

The analysis of digital technologies along with cognitive technologies made it possible to identify and classify the main risks arising from the transformation of the dairy industry into the DE. During the analysis, a hypothesis was formulated about the possibility of regulating the industry using the DE risk management mechanism.

In general, it should be noted that the digitalization of the dairy sector of the agro-industrial complex is an inevitable necessity for the effective functioning of this economic sector; and for its productive implementation a government policy is needed directed at using the organizational advantages of Russian agriculture. To solve this problem, it is necessary to analyze the existing trends in the government regulation of the digitalization of the dairy industry for making managerial decisions.

## Conclusion

1. An analysis of the dynamics of changes in the number of cows over a 5-year period of time in the Novosibirsk region shows an annual wave-like fluctuation in their numbers with a decrease over the analyzed period within 1%. The main reason of this negative tendency is the presence of intermediaries that create an imbalance between the agricultural and service sectors of the dairy industry. There is also an imbalance between the production and consumption of milk and dairy products per capita. The domestic production in 2014 satisfied only 65%, and in 2018 it satisfied 70% of consumption. Despite the positive tendency to increase this ratio, its level is insufficient for the potential of the dairy industry of the Novosibirsk region. Solving the challenges of eliminating the existing imbalances is impossible without the effective transformation of the dairy industry to the DE. To implement the transformation process, it is necessary to assess the state of digitalization in the region.
2. The foundations for digitalization in the Novosibirsk region including the dairy industry constitute the following: an information and communication data transmission network with a length of more than 7 thousand km, the main and backup data centers, the state information systems including “GIS of the Novosibirsk region,”

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"Government Support of AIC of the Novosibirsk region", "Systems 112," and others. An analysis of responsiveness of the of the milk-producing organizations in the Novosibirsk region to digitalization shows that less than 1% of them have a high degree of responsiveness, 5–10% have an average degree of responsiveness, 70–80% can adapt to digitalization, and 15–20% are not able to make necessary adaptations on their own. Consequently, most organizations will require a support in the form of various forms of regulation. An analysis of organizations with a high degree of responsiveness to digitalization reveals the possibility of such a transformation process, the effectiveness of which must be analyzed and evaluated.

3. The assessment of the effect of digital technologies on the parameters of the dairy industry reveals a correlation close to linear between the microchipped livestock of cattle and daily milk production per cow and gross milk production. A technological breakthrough in the agricultural sector due to the introduction of digital technologies in agriculture will make it possible to increase labor productivity in agricultural enterprises by 2 times by 2021. To achieve this goal, it is necessary to develop theoretically substantiated new approaches to the development and practical testing of digital technologies that can solve the tasks.

4. One of the high-priority tasks is the need to develop a non-standard approach to the theoretical foundations of regulating the dairy industry and recommendations for its practical application. The research was based on the methodology of a systemic, integrated, and territorial approaches using the methods of economic interpretation of the results, functional, and comparative analyses. The study is novel in the theoretical justification of a multi-level model of the relationship between the parameters of the dairy industry using the foundations of the synergistic approach. The unusual use of the synergistic effect lies in the hypothesis that there is a relationship between the regulatory impact and the parameters of the dairy industry on the existing functional relationships with it through a multi-level chain of indirect parameter relationships. These parameters have a closer relationship not with the regulator, but with intermediate indicators, and are dependent on it indirectly. The ingenuity of the hypothesis lies in the fact that the correlation coefficient between the regulator and the indirect indicators may be close to zero, but the results obtained will show a high degree of accuracy in their calculation. The proposed approach does not cancel the fundamental mechanisms, laws, theories, and hypotheses developed in the framework of the traditional economy but it organically uses and improves them, which makes it possible to use these approaches as universal in the study of the parameters of the dairy industry, for example, in combination with the simulation modeling.

5. Based on the proposed hypothesis, the developed mathematical model made it possible to use the actual data taken from the open sources and to develop an estimation technique of the effectiveness of indicators of the dairy industry in the Novosibirsk region. The algorithm based on formulas in the form of mathematical support for a digital model obtained by the method of the synergetic approach is rationalized. Moreover, the maximum error does not exceed 10%. Based on the results of developing the digital model and testing its ICT, it can be concluded that it can be used in predicting the development of the dairy industry of the Novosibirsk region depending on the regulatory impact in the form of the invested amount of the government support funds.

6. The study proposes the method for predicting the parameters of the dairy industry which enables to calculate the parameters of the dairy industry depending on the amount of government support funds. This makes it possible to use regulatory influences to control the development of the dairy industry in the regions. A direct forecast of indicators of the dairy industry in the region is developed. Unlike the existing tools, the forecast is based on the use of not only a time factor but also on the amount of government support funds in three scenarios of the industry development: pessimistic, expected, and optimistic. The study developed a reverse forecast for the necessary volumes of government support to achieve the target indicators of the dairy industry at any level of regulation.

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