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DIGITAL BUSINESS MODEL OF THE AGRICULTURAL ORGANIZATION OF THE REGION

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Abstract

The aim of the work is to study the theoretical and applied aspects of digitalization of the agricultural sector for the formation of new management concepts and specific models. Their relevance is confirmed by their significance for the adoption of effective strategic decisions by the participants of the agricultural business. We used a combination of analytical and synthetic approaches, monographic, empirical, statistical-economic and abstract-logical research methods. The composition of the digital business model of an agricultural enterprise and its technological, information and management characteristics are determined. The principle of forming a process-oriented management system is applied. The novelty of the research consists in constructing the structure of the digital business model of the crop industry based on the digitalization of the technical, information and management components of its functioning and the industry-specific detailing of technologies. These elements of the business model are grouped and described for accounting of work and agricultural operations, monitoring of equipment, "assistant agronomist", reporting and analytics, cadastral accounting and scouting. The mechanism was studied and the results of the work of the agricultural organization of the region, which implements and develops digital technologies, were evaluated. The results obtained confirm the growth of economic efficiency in the implementation of digital technologies in agricultural production.

Key words**:** *digitalization, business model, digital model, system of production, agricultural organization, crop production*

INTRODUCTION

The theory and methodology of digitalization of business are stated in works of many scientists-economists, the first domestic publications on its basic technologies and problems of development in Russia and are abroad dated 2016-2018. The object of research is described as information and digital revolution and a form of manifestation of regularities of development of new economy [8, 9, 21], approaches to realization of "digital economy" in general are offered [2, 5, 13, 20]. A significant amount of works is devoted to an opportunity and expediency of use of digital technologies in various spheres of activity of the person, to questions of transformation of the existing traditional institutes owing to formation of new technological way, to technical character of digital economy.

The agro-industrial complex which is its major part undergoes high-quality changes in a type of agrarian policy on the basis of technological breakthrough and instruments of innovative development [1, 7, 16, 18, 19]. In the direction of creation of digital business models of the agricultural organizations of regions methodological approaches and the principles [15], expected and analytical and optimizing components are developed [3, 4, 10, 17]. Now the scientific community is faced by problems of formation of certain digital business models and development of a technique of assessment of their economic efficiency both of separate branches, and for the enterprises in general.

MATERIALS AND METHODS

During the forming of structure and creation of processes of a digital business model of activity of the agricultural organization in the region the combination of analytical and synthetic approaches since the modern enterprises are characterized by existence of

close ties of the economic subjects entering them with the environment is applied and are based on creation of system of the interconnected models. Analytical approach in total with a monographic method of a research formed base for development of the general scheme of a digital business model, synthetic – for creation of private model of branch of crop production of the enterprise within which are used by authors empirical, statistic and economic; abstract and logical methods of scientific knowledge. In work materials of LLC "Infobis" — the Saratov IT company proposing solutions for digitalization of agriculture are used. LLC "Beryozovskoye" of the Engelssky municipal district of the Saratov region acted as an object of a research.

RESULTS AND DISCUSSIONS

For the purpose of justification of structure of a digital business model of the modern agricultural enterprise the technical, information, managerial characteristics relating to the stages "Agriculture 1.0" – "Agriculture 5.0" are revealed and systematized [6].

Agriculture 1.0 (– the 18th century of century):

-*concept* – traditional agriculture, prevail: labor-consuming small-scale enterprise, manual labour, disperse resettlement;

-*stages:* 1) internal consumption of production, 2) development of the commodity (exchange) relations;

-*technological aspects* – application manual and primitive instruments of labor;

-*information aspects* – use of experience of generations, holding pagan rites, application national (after Christian) calendars;

-*administrative aspects* – transfer of experience from the senior generation to younger (orally and on paper).

Agriculture 2.0 (the XIX-XX century of century - development of scientific and technical progress):

-*concept* – replacement of manual skills with means of mechanization;

-*stages:* 1) partial mechanization (primary mechanization with use of horse and manual agricultural cars), 2) complex mechanization (on the basis of the tractor, etc. cars, on the basis of electrification), 3) automation;

-*technological aspects* – processing of the soil and performance of other agricultural works and operations with the help of specialized cars and equipment (technical means), global use of agrochemicals;

-*information aspects* – at the last stage (automation, electrification) emergence of programs of systematization and data processing, computerization of accounts and finance (1-C);

-*administrative aspects* – the direction on increase in productivity of work, development of productive forces in direct ratio to development of relations of production.

Agriculture 3.0 (the 20-21st century of century since 1990):

-*concept* – condition of intensive and exact agrotechnological revolution, information agriculture with elements of exact agriculture and livestock production;

-*stages*: transition to digital agriculture;

technological aspects – use of labor-saving technologies, exact agriculture, GPS - signals, monitoring and control, the first scientific developments on adaptive landscape agriculture;

-*information aspects* – processing and the analysis of Big Data within separate objects (elements) of a production cycle;

-*administrative aspects* – the first steps of management taking into account use of the COMPUTER, realization within application computer programs of problems of optimization of agricultural processes, works and operations.

Agriculture 4.0 (21st century -since 2010):

-*concept* – use of intellectual technologies, agronomical modeling, integration of external and internal networks and operations in agricultural production;

-*stages:* digitalization of control and account at all stages of a production cycle;

-*technological aspects* – exact agriculture, the robots interacting with each other and also with the centers of collecting, storage, the analysis and data processing, integration with systems financial and business planning, warehouse account, AIoT-platforms

(application), the means of mechanization and automation of production complemented with IoT (the Internet of things);
-*information aspects* – processing and analysis of Big Data;
-*administrative aspects* – geographical information and analytical system "Management of the Agricultural Enterprise", GIS "Agroupravleniye", realization within application computer programs of problems of optimization of agricultural processes, works and operations.

Agriculture 5.0 (perspective future) (XXI-...):

-*concept* – the created extensive digital ecosystem (total), universal digitalization of all stages from production before realization of agricultural production;
-*stages*: full automation – transition to artificial intelligence;
-*technological aspects* – robotics and artificial intelligence;
-*information aspects* – collecting, processing and the analysis of data, adoption (offer) of possible decisions on the basis of artificial intelligence;
-*administrative aspects* – development of systems of support of decision-making, based on artificial intelligence.

The received result demonstrates transformation of traditional paradigms of business management (emotional and rational) in the system of concepts of new level which is based on computer technologies. The offered model represents the evolutionary product created in the course of integration of modern digital instruments for support of decision-making into their classical algorithms, methods, approaches, including the systems of the automated planning of adaptive and landscape use of lands, databases and technologies of monitoring of a livestock, the appropriate digital technologies of business in crop production and livestock production, the key results united by the through intellectual system of support of decision-making of a full cycle [12].

Result of implementation of the offered theory and methodological provisions is the development and justification of a digital business model of the agricultural organization (Fig.1) as the most perspective form of strategic planning based on information and technological improvement of agricultural production with the expressed multiplicative effect (*KPI – Key Performance Indicator*) consisting in parallel modernization of production, administrative, logistic, economic, marketing and other business processes and the organization in general according to the main domestic and foreign tendencies [11].

Specification of the making elements looks as follows:

(1) technological block: the equipment of differential positioning on signals of GLONASS/GNSS and application of fertilizers and chemicals for systems digital and "exact agriculture", the platform of objective monitoring and management of transport and logistic infrastructures, the platform of "the Internet of things", the system of identification, life cycle and traceability of animals, other automated and robotic mechanisms;

(2) information block: databases of production technologies (including preserving and an organic), properties of means and objects of the labor, the regional selection and seed-growing centers on the basis of digital technologies, bases of local data of telemetric control, digital soil cards, a matrix of digital solutions of formation of crop rotations, the analysis of big data (soils, crops, wreckers, etc.), through digital chains of a full production cycle of production of livestock production, the through platform of control of processes of production for the systems of social food, the system of the auction, purchases, managements of export and import;

(3) administrative block: methods and algorithms of forecasting of a condition of agroecosystems, economic models of conducting agricultural business, technique, algorithms and technologies of management of "the digital enterprise", technical and economic models of use of the equipment and units, intellectual systems of support of decision-making.

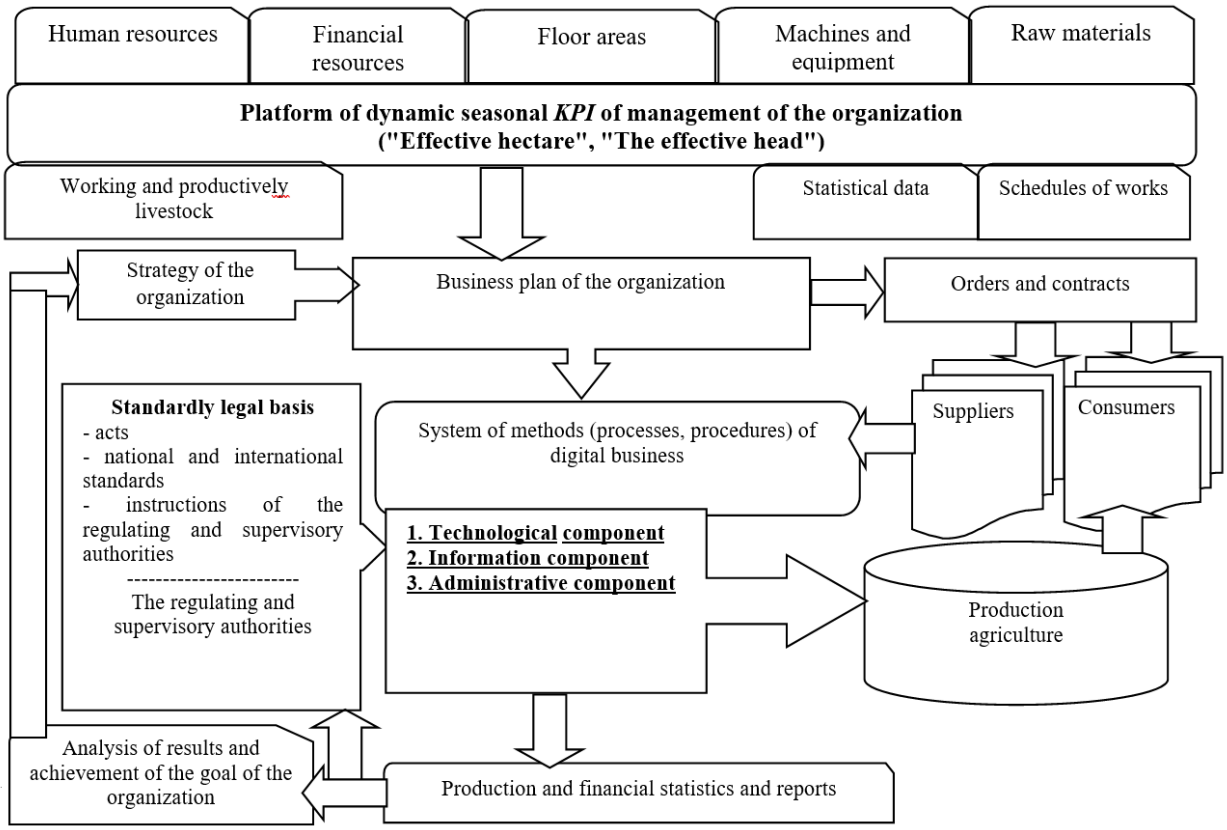

Fig. 1. The offered scheme of a digital business model of activity of the agricultural organization
Source: developed by authors.

The efficiency of digitalization of branch of crop production of the separate organization is investigated by us on the example of the agricultural enterprise LLC "Beryozovskoye" of the Engelssky municipal district of the Saratov region organized in 2006 in view of the enterprise of a course towards automation and digitalization of business processes chosen by the management. Primary activities – crop production (a winter wheat, a carthamus, soy, sunflower, a millet yellow, etc.) and livestock production (dairy cattle breeding, sheep breeding). The area of agricultural grounds in 2019 was 6,346 hectares, including arable lands – 5,619 hectares, of them irrigated – 645 hectares, the general number of cattle – 1,047, sheep – 620. The enterprise is one of perspective farms in the Saratov region in the sphere of dairy livestock production, since 2018 has the status of a breeding loud-speaker on cultivation of cattle of black and motley breed, cooperates with scientists of the Saratov State Agrarian University in the name of Vavilov N.I. and Bashkir State Agrarian University. In 2018-2019 reconstruction of the livestock placement on 150 heads is carried out (cost - 7 million rubles), the cattle feeder is acquired (cost – 2.5 million rubles), are conducted construction of the milking hall design power the 500th goal now. (cost - 25 million rubles).
The crop rotation is chosen taking into account production of cultures for creation of a steady food supply for cattle stock in economy, such as lucerne, a grain sorghum, corn on grain and on a silo, grain mix with a Sudanese grass on haylage, a part of soy is used on a forage. According to the head of economy, the 5-polny crop rotation allows to keep fertility of the soil and to observe the evidence-based system of agriculture. The irrigated site is engaged in the basic with forage crops. For the winter and stall period in 2019 it was prepared: a silo – 6.12 thousand tons, a haylage – 3.2 thousand tons, hay – 1 thousand tons.
Advanced technologies take root into productions of LLC "Beryozovskoye", the modern high-performance equipment is bought. The agricultural enterprise has the modern machine and tractor park, a necessary set of hook-on stock and automotive vehicles.

For preparation of high-quality seed material the mechanized current is equipped not only sifted cars, but also an aerodynamic separator, as a result of it in economy try to obtain high viability of seeds (on a winter wheat – not lower than 99%). In due time there is an updating of seeds on the highest reproductions, for example, the winter wheat is sowed by seeds not below the second reproduction. For the purpose of management of the potential of cultures in economy seek to apply the modern integrated system of protection of plants.

In the organization since 2015 the platform "Agrosignal is introduced. Management", developed by LLC "Infobis" — the Saratov IT company proposing solutions for digitalization of agriculture. For providing with information for the purpose of adoption of strategic and operational decisions the digital system informs on history of fields, agrotechnical operations with dates of their actual performance, has dynamics of indicators of productivity, a fuel consumption, etc. For example, in real time it is possible to see where there is any tractor or the combine at what works the machine operator what development at it, how many to it is added salaries is engaged. The software product allows to operate remotely all processes and to exercise control, is intended for increase in productivity and allows to reduce the volume of losses of fuel and lubricants and influence of a human factor on any process by production of agricultural products, i.e. it is "Online service" of control and accounting of works in agrobusiness.

Table 1. The cost characteristic of the systems of satellite monitoring and account used in LLC "Beryozovskoye" of Engelsky district (selectively)

Payment order No.	Subject to application	Maintenance of system	Cost, rub.
1	The system of satellite monitoring and account on the combine harvester Terrion SR2010 of 2010 of release	telematic device	12,900
		housing	900
		fuel level sensors	15,900
		the readers RFID map marking	13,000
		unit adapter	2,700
		blocking of the screw without identification of the recipient	7,000
		connection to regular conducting for registration of operation of the harvester of the combine	3,600
		screw sensor	6,800
		the grain level sensor in the bunker	55,000
		in total	**117,800**
2	The system of satellite monitoring and account on the combine harvester ACROS– 550 of 2015 of release	blocking of the screw without identification of the recipient	7,000
		connection to regular conducting for registration of operation of the harvester of the combine	3,600
		the grain level sensor in the bunker	55,000
		tag on the unit	2,000
		in total	**67,600**
3	The system of satellite monitoring and account on auto repair shop 3813D0 on GAZ base 33081 of 2015 of release	telematic device	12,900
		housing	900
		fuel level sensors of 700 mm	15,900
		the readers RFID map marking	4,000
		in total	**33,700**
4	The system of satellite monitoring and account on the Versatile 23755 tractor – V24 2013 of year of release	telematic device	12,900
		housing	900
		fuel level sensors	20,000
		the readers RFID map marking	4,000
		unit adapter	2,700
		seeding control system	8,000
		tag on the unit	2,000
		deepening sensor	19,000
		in total	**69,500**

Source: made and calculated by authors.

The selective characteristic of the systems of satellite monitoring and account used in economy is provided in table 1. So, equipment sets on combine harvesters cost the enterprise in the sums from 67.6 to 117.8, on the tractor – 69.5 thousand rubles.

The comparative analysis of results of activity of LLC "Berezovskoye "before investments

on acquisition, creation, modernization, reconstruction of fixed assets and introduction of elements of digitalization of business showed that equal rates revenue and cost of sales – for 60 %, net profit – by 3.2 times, profitability level – more than on 6 items (Table 2) increased. The quantity of the main production received counting on 1 thousand rubles of investments on digitalization increased considerably: grains – in 5.3, milk – by 9.5 times. Significantly indicators of effectiveness of business counting on 1 average worker and also the head and experts increased. Cost values of production and crop production, and livestock production counting on 1 people - increase hour equal rates.

Table 2. Indicators of activity of LLC "Beryozovskoye" of Engelssky district of the Saratov region at the initial stage of digitalization of business

Indicator	Years					Growth rate, %
	2015	2016	2017	2018	2019	
Investments on acquisition, creation, modernization, reconstruction and preparation for use of non-current assets, thousand rubles.	1,907	19,464	44,183	8,061	8,322	436.4
including on digitalization		1,166	3,983	207	206	
from them: a set of the software and sensors for maintenance of system		543	1,958			
sensors on combines, tractors, cars		410	1,817			
subscriber services of system		213	208	207	206	
Revenue, thousand rubles.	90,605	105,205	141,871	141,035	145,369	160.4
Cost of sales, thousand rubles.	81,365	83,645	122,686	128,956	129,924	159.7
Net profit, thousand rubles.	4,978	20,679	22,190	11,312	15,982	321.1
Level of profitability, %	6.12	24.72	18.09	8.77	12.3	201.0
It is received production counting on 1,000 rub of investments on digitalization:						
grains, c		51.74	19.34	226.53	274.36	530.3*
milk, c		16.09	5.45	135.71	152.08	945.2*
Revenue counting on 1 worker, thousand rubles.	1,104.94	1,143.53	1,493.38	1,439.13	1,468.37	132.9
Revenue per the number of heads and experts, thousand rubles.	4,768.68	4,782.05	6,448.68	5,641.40	5,814.76	121.9
Net profit counting on 1 worker, thousand rubles.	60.71	224.77	233.58	115.43	161.43	265.9
Net profit per the number of heads and experts, thousand rubles.	262	939.95	1,008.64	452.48	639.28	244.0
Labor input of production of grain, people hour/c	1.26	0.50	0.43	0.70	0.60	47.6
It is made production of crop production counting on 1 people - hour, rub	1,342.32	1,858.17	1,805.58	2,097.12	1,522.53	113.4
Labor input of production of milk, people hour/c	0.69	0.69	0.64	0.64	0.61	88.4
Production of livestock production counting on 1 people - hour, rub.	1,668.79	1,106.76	1,702.98	1,417.00	1,873.40	112.3

Source: for the reasons with lack of data in 2015 calculation is made relatively 2016; it is calculated by authors by data [14].

The elements of the digital platform and their functionality introduced in production and administrative processes and also the new making business model components recommended for development for branch of crop production of the agricultural organization are presented below.

The bold-face type allocated the new elements of digitalization recommended for development

The system of methods (processes, procedures) of digital business – complex digital platform of management of agrobusiness Agrosignal (elements):

(A) Administrative component:

(1) Strategic part – Module "Agrosignal. Planning":

- drawing up plans of a crop rotation,
- formation of the budget with the maximum profitability,
- annual planning and budgeting taking into account different cultures,
- formation of plans for needs of different divisions,
- creation of several variations of the budget for the choice optimum,
- design of an optimum logistics system,
- elaboration of optimum marketing strategy;

(2) Operational part – Mobile application "Agrosignal. Mobayl" (web interface):

- quick information on the performed works,
- creation and editing daily tasks, schedules of changes,
- receiving numerous reporting information on the presented forms.

(B) Technological component:

(1) Accounting of works and agrooperations – elements of the Agrosignal system are integrated with system 1C for formation of waybills for the purpose of automatic unloading of data on the carried-out works and development of machine operators;

(2) Monitoring of the equipment:

- the main sensors on vehicles – gps-trackers, sensors of operation of the engine, speed of the movement, fuel level, analyzers of discharges,
- additional sensors on vehicles - the level of fuel and unloading of the screw;

(3)Assistant to the agronomist – functionality for:

- definitions of the index of vegetation (NDVI) for each field, its certain sites and carrying out pointed inspections,
- differentiated application of fertilizers and means of protection with the indication of norms in each separate zone,
- monitoring of weather conditions with an opportunity to set own threshold values and maintaining notes in a digital format,
- **definitions of indexes of a stress of plants (MSI) and moisture security (NDWI);**

(4) Reporting and analytics:

- the system in real time reflects dynamics of key indicators of performance of agrooperations and provides information in a simple and clear look,
- individual control under needs of the specific user;

(5) Cadastral registration – the equipment of differential positioning on GLONASS/GNSS signals;

(6)Agrosignal. Skauting – mobile application for carrying out inspections and control of a condition of fields and plants:

- fast identification of problems,
- preservation of notes without Internet access,
- information transfer about work in the field to the chief agronomist even before return to office.

(C) Information component:

(1) Accounting of works and agrooperations:

- daily plans for the processed area and for each operation,
- schedules of changes of personnel for distribution of daily development,
- "Registration sheets of the tractor" with the indication of time, idle times, fuel and lubricants, weathers,
- individual and group operating plans,
- freight weight binding to data on operation, equipment, points of visit,
- control of development of the field equipment to which transportation was made;

(2) Monitoring of the equipment – platform Agrosignal collects data on location, movement and speed of the movement of the equipment from devices, it is possible to look at all information in system in real time and also to adjust any instant notifications:

- control of expenses, statistics of idle times, identification of discharges of fuel,
- definition of unauthorized unloadings and violations of technical norms,
- detection of inappropriate use of the equipment on foreign fields,
- control of following to the set routes and standards of speed,
- respect for quality of processing of sites and high-speed mode,
- correct calculation of the processed area taking into account different factors;

(3) Assistant to the agronomist:

- expeditious monitoring of a condition of crops and uniformity of shoots,
- identification of focuses of the disease of plants and appearance of wreckers,
- viewing and analysis of information on each field,
- arrangement of priorities when planning technological operations
- optimization of costs of fertilizer and chemical medicines,
- improvement of quality of the soil and control of phases of maturing and development of cultures;

(4) Reporting and analytics:

- the daily and annual analysis in the plan/ fact format,
- data on performance of work and course of separate agrooperations,
- monitoring of expenses of fuel and lubricants and idle times, movements on warehouses and weighing,
- observance of terms of works and control of technologies of cultivation of cultures,

- an opportunity to add/diminish key indicators for tracking,
- data on volume of the introduced fertilizers and means of protection of plants;

(5) Cadastral registration:

- full legal information on cadastral sites (comparison of the legal and actual areas), automatic detection of the crossed sites,
- reminder on the termination of term of rent and obligatory payments,
- confirmation that processing is conducted on the lands,
- the actual understanding, what fields and the areas are included into each cadastral site;

(6) Agrosignal. Skauting:

- identification of negative tendencies of development of plants at an early stage,
- drawing up notes on inspections of the soil and crops,
- cloudy data processing of satellite pictures and obtaining maps of vegetation,
- addition of media files and tags of a geolocation even without Internet access,
- algorithm of remote control of irrigation,
- reduction of time for receiving and data processing.

Values of labor input are indicative: decision-making on modernization and digitalization of branch of crop production was led to decrease in their values for the analyzed five-year period by production of grain crops more than twice. It allows to bring up a question of diversification of digitalization of the enterprise and transfer of the got experience on branch of livestock production. Increase in the outputs and size of revenue of the enterprise happened against the background of fixing of prime cost and reduction of labor costs of personnel. The specified factors visually emphasize efficiency of digital business models regarding removal for staff of the superfluous and released personnel at the expense of which economy blocks costs of introduction of digital technologies and complex system decisions.

For specification and increase in reliability of researches the digital business model has to be developed discretely on basic process and branch (crop production, livestock production, processing, sale) to elements. In crop production have to act as such elements the system of the automated planning of adaptive and landscape use of lands (including collecting, updating, monitoring of a condition of lands, multi-purpose assessment of suitability and modeling of potential productivity, forecasting of productivity, planning of placement of grounds and crops, design of agrotechnologies, cadastral assessment of sites and their mortgage cost) and also a complex of digital technologies of business in crop production (field collecting *Big Data*, monitoring of grounds and crops, data transmission for decision-making, robotic means of decrease in the limiting factors of productivity, technology of exact agriculture). Planned implementation of digitalization by the agricultural organizations will allow to pass to intellectual management of productivity of plants that will lead up to 20% to its growth.

CONCLUSIONS

The digital business model of activity of the agricultural organization including administrative (strategic and operational parts), technical and information components with a specification is developed for branch of crop production of blocks of accounting of works and agrooperations, monitoring of the equipment, the assistant to the agronomist, the reporting and analytics, the cadastral registration and a scouting, on the principle of replacement of traditional receptions and ways of production economic activity with the progressive digital decisions introduced in process of creation of consumer cost of production.

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