

ORIGINAL PAPER



DOI: 10.26794/2304-022X-2026-16-1-89-102
UDC 65.014.12(045)
JEL D23

Structural and Functional Analysis of Organizational Systems of Agricultural Higher Education Institutions

I.S. Konstantinov^a, M.N. Stepantsevich^b, M.I. Gorbachev^c

^a V.G. Shukhov Belgorod State Technological University, Belgorod, Russian Federation;

^{b,c} Russian State Agrarian University – Moscow Timiryazev Agricultural Academy, Moscow, Russian Federation

ABSTRACT

State policy in the field of science and higher education is aimed at the modernization of educational institutions in order to ensure their closer alignment with labor market demands and societal needs. The **purpose** of this study is to assess the current parameters and operating conditions of educational institutions, taking into account the specific characteristics of the agro-industrial complex. The article provides an overview of the agricultural higher education system and presents an analysis of the current state of the network of educational organizations. Particular attention is paid to their structural features, elements, interconnections, and operational efficiency. The **object** of the study is the network of higher education institutions that train specialists for the agro-industrial complex, while the **subject** of the study is the efficiency of these educational institutions, as well as the factors, relationships, models, and algorithms governing the interaction of elements within their organizational systems. The data sources used in the study include strategic, methodological, organizational, and other materials characterizing the activities of educational institutions subordinate to the Ministry of Agriculture of the Russian Federation and the Ministry of Science and Higher Education of the Russian Federation, as well as analytical and statistical information. The **findings** of the study may be used by government authorities (primarily the Ministry of Agriculture of the Russian Federation) in managing the activities of agricultural educational institutions in order to obtain a more comprehensive assessment of the performance of subordinate organizations. In addition, the results can be applied in the development of prospective (strategic) plans for the advancement of specialized universities under contemporary conditions.

Keywords: organizational design; organizational system; higher education institution; information modeling; agro-industrial complex; efficiency

For citation: Konstantinov I.S., Stepantsevich M.N., Gorbachev M.I. Structural and functional analysis of organizational systems of agricultural higher education institutions. *Upravlencheskie nauki = Management Sciences*. 2026;16(1):89-102. DOI: 10.26794/2304-022X-2026-16-1-89-102

INTRODUCTION

The doctrinal documents¹ defining the strategy for national and societal development up to 2030 establish the following priority objectives:

“...the development of human potential...”;

“...the provision of the digital economy with competent personnel...”;

“...the formation of an information space that meets the needs of citizens and society for high-quality and reliable information...”;

“...the use and advancement of various educational technologies, including distance and e-learning, in the implementation of educational programs...”.

Their implementation imposes increased obligations on educational institutions of all levels and specializations, including those that train specialists for the agricultural sector. The high relevance of such training is determined by the designated trajectory of sectoral development, particularly in terms of achieving ambitious targets for increasing production volumes, ensuring food security, expanding exports of high value-added non-resource products of the agro-industrial complex (AIC), integrating into national and global trends, and digitalizing all aspects of social life [1].

The creation of favorable conditions for the sustainable growth and development of the AIC is impossible without adequate human resource provision. Therefore, the issue of aligning educational and professional standards with employers' demands has become particularly pressing. Which workforce needs of agribusiness should be prioritized in the context of rapidly evolving trends in automation and digitalization of the AIC? How can scientific and technological capacity be enhanced, international cooperation expanded, and effective interaction with business strengthened?

¹ Decree on the National Development Goals of the Russian Federation for the Period up to 2030 and for the Outlook up to 2036. URL: <http://kremlin.ru/events/president/news/73986>; Resolution of the Government of the Russian Federation No. 1642 dated December 26, 2017 (as amended on December 17, 2025) “On Approval of the State Program of the Russian Federation ‘Development of Education.’” URL: https://www.consultant.ru/document/cons_doc_LAW_286474/cf742885e783e08d9387d7364e34f26f87ec138f/

Market dynamics compel educational institutions to increase their competitiveness and efficiency through the transformation of their activities. To achieve this, they must be prepared to formulate and implement forward-looking development strategies; optimize their processes and organizational structures; develop new incentives for staff motivation; ensure the preservation of scientific schools; attract internationally recognized experts, and so forth — objectives that are unattainable without the continuous development of the educational institutions themselves. The need for transformation, in turn, implies the improvement of organizational mechanisms, the adoption of new approaches to structural design, and the implementation of advanced managerial solutions, including those based on emerging information technologies developed and applied in agricultural universities and demanded under current conditions.

To achieve the research objective, which consists in analyzing the current characteristics and operating conditions of educational institutions (EIs) training personnel for the agro-industrial complex (AIC), it is necessary to address the following tasks:

- to form a dataset of educational organizations (EOs) and to select the most representative ones for subsequent analysis;
- to conduct an analysis and provide a characterization of the organizational system (org-system) and its key elements;
- to assess the efficiency of the organizational system (with respect to its individual components).

MATERIALS AND METHODS

In the course of the study, the following methods and tools of scientific inquiry were employed:

- at the data collection stage: content analysis and survey methods (collection of statistical data; examination of documentation and information support of management systems in agricultural universities);
- during the processing of the obtained data: functional analysis (where the object of analysis is considered as a set of functions it performs)

and structural analysis (where the object is represented as a hierarchical system of interrelated elements);

- at the stage of graphical modeling of the organizational structure, as well as describing functional relationships among its elements: information modeling based on graph theory;
- for processing statistical data and identifying relationships: the computational-analytical method and comparative analysis.

RESULTS

The study was conducted in several stages.

Stage 1. Data collection and analysis of the educational network

At this stage, data were collected and analyzed based on the following sources²:

- information-analytical materials from monitoring the activities of higher education institutions;
- performance indicators of educational organizations implementing higher education programs;
- the register of state assignments for the provision of services (performance of works);
- selected sections of educational organizations' websites containing mandatory information: charter; regulations on structural units; organizational structure and governance bodies; self-assessment reports; accounting data; financial and economic activity plans, etc.

During Stage 1, it was found that more than 6.2 million people are currently employed in the agricultural and processing sectors. At the same time, current labor demand, according to estimates by the

Ministry of Agriculture of the Russian Federation, amounts to no less than 150,000–220,000 workers³ annually.

The task of ensuring human resources for the agro-industrial complex (AIC) is assigned to the agricultural education network, represented by a wide range of educational institutions that train students under higher education programs (bachelor's, master's, and specialist degrees) as well as secondary vocational education programs in various fields and specialties for the agro-industrial sectors of Russia and foreign countries [2].

Training of highly qualified specialists is carried out on the basis of 54 state universities located in most regions of the country, as well as 153 research institutions, including research institutes (RIs), federal research centers (FRCs), and federal scientific centers (FSCs) [3]. Funding for educational organizations is provided under the State Program of the Russian Federation "Development of Education" until 2030.⁴ As of early 2024, approximately 250,000 students were enrolled, of which 77.2% studied at the expense of public funding, while 22.8% paid full tuition fees.

The distribution of students across specialized groups (fields of study) shows that 44.5% are enrolled in programs related to agriculture, forestry and fisheries, ecology, land management, biotechnology, etc.; 21.5% study veterinary science and animal husbandry; 9.6% are trained in economics and information sciences (accounting, management, informatics, etc.); and 8.3% are preparing for engineering professions in areas such as electrical and thermal power engineering, transport, mecha-

² Information and analytical materials based on the results of monitoring the performance of higher education institutions. URL: <https://monitoring.miccedu.ru/?m=vpo>; Performance indicators of educational organizations implementing higher education programs. URL: <https://fedstat.ru/organizations/?expandId=1565257#fpr1565257>; Register of state assignments for the provision of public services (performance of works). URL: <https://www.budget.gov.ru/>; Order of the Federal Service for Supervision in Education and Science No. 1493 dated August 4, 2023 "On Approval of Requirements for the Structure of the Official Website of an Educational Organization in the Information and Telecommunication Network 'Internet' and the Format of Information Presentation." URL: <http://publication.pravo.gov.ru/document/0001202311290017>

³ New Solutions in the Agro-Industrial Complex as Keys to Global Food Security. St. Petersburg International Economic Forum — 2025. URL: <https://roscongress.org/sessions/spief-2025-delovaya-programma-novye-resheniya-v-apk-klyuchi-k-globalnoy-prodovolstvennoy-bezopasnosti/translation/#/>; The Labor Shortage in Russian Agriculture Has Exceeded 200 Thousand People. Interfax. URL: <https://www.interfax.ru/russia/1004817>

⁴ State Program of the Russian Federation "Development of Education." Strategic priorities in the implementation of the state program of the Russian Federation "Development of Education" up to 2030** (as amended by Resolution of the Government of the Russian Federation No. 1701 dated October 7, 2021). URL: <https://docs.edu.gov.ru/document/f9321ccd1102ec99c8b7020bd2e9761f/download/4444/>

nization, construction, and others. The remaining specialties account for 0.2% to 4.3%.

All educational organizations are characterized by a variety of organizational system indicators (size, functionality, structure, mechanisms of interaction between organizational units, etc.). To analyze them, it is appropriate to group the entire set of educational organizations into clusters with similar parameters using taxonomic methods, and then select, within each group, an organization with average, typical characteristics for subsequent analysis (Fig. 1, left).

To perform clustering of the latter, it is necessary to construct a set of criteria (with uniform measurement scales for each object). Given the specifics of the present study, these may include student enrolment size and staff size.

Based on the characteristics of the subject area and the availability of existing data (statistical, managerial, regulatory, and others), the set of educational organizations (EOs), according to expert opinion, was divided into several intervals, hereafter denoted by the letters “A” to “I” (Fig. 1, right).

Cluster A includes nine educational organizations (16.4% of the total number) with up to 3,000 students. According to its characteristics, approximately 19,000 students are enrolled across all institutions in this cluster, supported by more than 2,500 staff members. The boundary parameters of the cluster are as follows: 1,543 students and

146 staff members (in the smallest institution included in the cluster), and 2,990 students and 288 staff members (in the largest institution). To identify a typical representative, average indicators of the group were calculated—2,164 students and 289 staff members — according to which the Federal State Budgetary Educational Institution “Velikie Luki State Agricultural Academy” can be considered a typical organization (Table 1).

Cluster B comprises educational organizations with student enrolment ranging from 3,000 to 5,000 students, represented by 16 universities (29.1% of the total number of EOs). Overall, this group includes more than 40,000 students and 8,700 staff members.

The minimum number of students and staff (respectively) is 3,589 and 328, while the maximum values are 4,924 and 836. The average indicators are 4,013 students and 545 staff members. A typical representative of this cluster is the Federal State Budgetary Educational Institution “State University of Land Management”.

Cluster C includes educational organizations with student enrolment ranging from 5,000 to 7,000 students. This group consists of 12 universities (21.8% of the total), with a combined student population exceeding 60,000 and approximately 8,300 staff members.

The minimum number of students in this group is 5,156, and the maximum is 6,657. The corre-

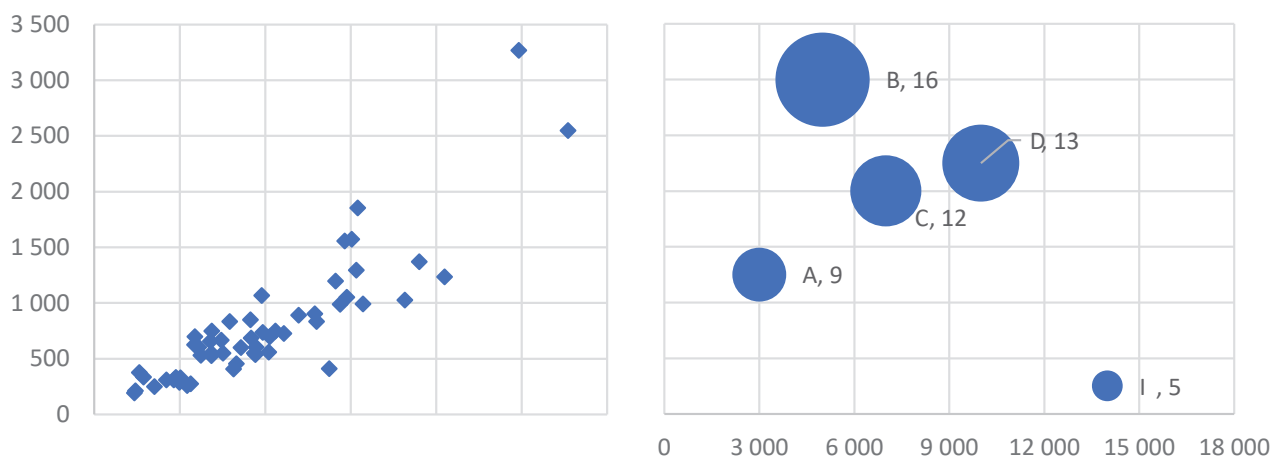


Fig. 1. Grouping of Educational Institutions by the Ratio of the Number of students (x axis) to the Number of Staff (y axis), Persons (left) and the Clusters Identified on This Basis (right)

Source: compiled by the authors.

Table 1

Taxonomic Characteristics of Educational Institutions According to Grouping Indicators

Cluster name	Number of universities in the group (pcs.)	Average number per group (people)		Name of the educational organization (typical organizations are in italics)
		students	staff	
A (up to 3,000 students)	9	2164	289	Smolensk State Agricultural Academy, Yaroslavl State Agrarian University, Voronezh State Agrarian University, Kazan State Academy of Veterinary Medicine, Velikie Luki State Agricultural Academy, Primorsky State Agrarian Technological University, Saint Petersburg State Academy of Veterinary Medicine, Penza State Agrarian University, Kurgan State University
B (3,000–5,000 students)	16	4013	545	Vologda State Dairy Academy, Tver State Agricultural Academy, Chuvash State Agrarian University, Kostroma State Agricultural Academy, Vyatka State Agrarian and Technological University, Buryat State Agricultural Academy, Arctic State Agrarian and Technological University, State University of Land Management, State Agrarian University of Northern Trans-Urals, Samara State Agrarian University, Moscow State Academy of Veterinary Medicine, Nizhny Novgorod State Agrarian and Technological University, Kursk State Agrarian University, Kuzbass State Agrarian University, Kazan State Agrarian University, Far Eastern State Agrarian University
C (5,000–7,000 students)	12	5853	697	Russian State Agrarian Technological University, Oryol State Agrarian University, Dagestan State Agrarian University, Ural State Agrarian University, Kabardino-Balkarian State Agrarian University, Altai State Agrarian University, Saint Petersburg State Agrarian University, Irkutsk State Agrarian University, Ulyanovsk State Agrarian University, Gorsk State Agrarian University, Udmurt State Agrarian University, Perm State Agrarian and Technological University
D (7,000–10,000 students)	13	8556	1129	Bryansk State Agrarian University, South Ural State Agrarian University, Belgorod State Agrarian University, Russian State University of National Economy, Stavropol State Agrarian University, Bashkir State Agrarian University, Orenburg State Agrarian University, Omsk State Agrarian University, Don State Agrarian University, Volgograd State Agrarian University, Saratov State University, Michurinsk State Agrarian University
E (more than 10,000 students)	5	13 227	1891	Krasnoyarsk State Agrarian University, Novosibirsk State Agrarian University, Voronezh State Agrarian University, Russian State Agrarian University, Kuban State Agrarian University

Source: compiled by the authors.

sponding staff numbers range from 602 to 757. The average values are 5,853 students and 697 staff members. A typical representative of this cluster is the Federal State Budgetary Educational Institution “Saint Petersburg State Agrarian University”.

Cluster G is the leader in terms of student enrolment and includes 13 educational organizations (23.6% of the total number). The total number of students is approximately 82,000, while more than 13,000 staff members are employed across these institutions. The boundary parameters of the group are as follows: a minimum of 7,181 students and

891 staff members; a maximum of 9,436 students and 1,854 staff members. The average indicators are 8,556 students and 1,129 staff members per educational organization. A typical representative of this cluster is the Federal State Budgetary Educational Institution “Stavropol State Agrarian University”.

Educational institutions with a student population exceeding 10,000 are grouped into Cluster D. This cluster includes five educational organizations (9.1% of the total number), with a total student population of more than 46,000 and

9,500 staff members. The minimum number of students in this cluster is 10,991, and the maximum is 16,107. The corresponding staff numbers range from 1,027 to 2,550. The average values are 13,227 students and 1,891 staff members. A typical representative of this cluster is the Federal State Budgetary Educational Institution “Voronezh State Agrarian University named after Emperor Peter I”.

Stage 2. Analysis of the parameters of the organizational management system, its elements, goals, and tasks. In the context of the present study, an organizational system is understood as a set of elements of the organizational structure (OS)—including units, levels, and management links—with defined relationships, roles, and hierarchy, as well as the corresponding mechanism for structuring managerial processes and functions (the organizational mechanism), which collectively ensure the achievement of the objectives set for the enterprise [4–6, 8, 9].

The primary purpose of the organizational system (OS) is to manage business processes (or support their functioning) in accordance with pre-defined target orientations. In practice, this is expressed through the following tasks:

- formation of the value creation flow by types of enterprise activity, taking into account the influence of the external and internal environment;
- allocation of business tasks across functional areas and organizational units;
- definition of responsibilities and areas of accountability for each employee or unit in the process of task execution;
- maintenance of linkages between employees (units);
- formation of a management hierarchy;
- description of decision-making procedures across hierarchical levels.

As is well known, the design of an organizational system is influenced, to varying degrees, by a wide range of factors such as the complexity and dynamism of enterprise operations, strategic priorities, production technology (works), and the availability of motivated personnel with appropriate qualifications, etc.

At the same time, a major role is played by the operating conditions of educational organizations, which are determined by their founder—the state. All analyzed educational organizations are publicly funded and operate within the framework of state assignments.

In view of the above, it can be stated that the existing organizational system of educational organizations has been formed not so much under the influence of market requirements expressed in the need to provide (deliver) competitive educational services, but primarily as a result of large-scale reform—territorial and sectoral reorganization (consolidation) of profile educational institutions carried out by the Ministry of Agriculture and the Ministry of Education of the Russian Federation in 2014–2016. Its main objectives were the reduction of duplicated functions, consolidation of educational and research potential in priority areas, as well as attraction of investment and reduction of funding costs for educational organizations of the same sectoral affiliation.

The presence of specific organizational elements is determined by statutory types of activity—educational, research, international, educational (upbringing), etc.—for which the structure is formed, and each element is responsible for a specific set of functions.

Having analyzed the statutory documents of educational organizations, it can be argued that the structure of the organizational system is, in most cases, standardized: it consists of a corporate center (collegial governing body) and a business unit.

The corporate center performs the functions of strategic planning, control, and management of business units and includes several levels of governance (*Table 2*):

- central level: rectorate, Academic Council, trade unions of staff and students, councils of veterans, young scientists, parents, etc., Board of Trustees, Development Fund, representatives of the founder (Ministry of Agriculture);
- peripheral level: heads of subordinate structural units.

Elements of the organizational system that perform strictly defined (specialized) types of activities — educational, research, administrative, financial, economic, auxiliary, etc. — are referred to as business units. These include structural subdivisions of any level of the organizational hierarchy, such as institutes, branches, faculties, colleges, departments, human resources units, accounting departments, educational and methodological offices, swimming pools, catering facilities, IT departments, libraries, publishing units, dormitories, laboratories, garages, security services, museums, apiaries, etc. The structure of each business unit is generally similar, although it retains specific features related to its functional specialization. In this context, the typical elements of the organizational system are employees (executors) and managers at different hierarchical levels.

Analysis of its parameters and architecture shows that, for all studied educational organizations, they are similar. Depending on the size of the educational organization, the organizational system may include from several dozen (as in Velikie Luki State Agricultural Academy) to several hundred (Voronezh State Agrarian University) business units of different levels.

As a rule, a typical organizational system (OS) includes educational and training units (departments, training centers, faculties, workshops, libraries), scientific units (laboratories, experimental facilities, trial fields, farms, technical installations, scientific and dissertation councils, etc.), socio-cultural and welfare units (student dormitories, sports facilities and clubs, tourist bases, medical facilities, cafeterias, museums, etc.), managerial units (deans' offices, directorates of institutes and faculties, teaching and methodological departments, departments for extra-curricular activities, research administration units), as well as various administrative and support units (maintenance services, civil defense and emergency headquarters, legal services, registry offices, human resources departments, archives, garages, etc.).

The study of OS elements and the relationships between them shows that in all educational organizations they are built according to a functional-

hierarchical principle and combine a linear-functional foundation with elements of a divisional structure. This conclusion is based on the grouping of organizational units' functions in accordance with the types of services they provide (or products they generate), as well as the presence of multiple management levels (hierarchy) with predefined levels of subordination and division of responsibilities.

To ensure the functioning of the organizational mechanism, horizontal and vertical relationships are established between business units. Horizontal links represent information flows connecting units of the same hierarchical level (e.g., laboratories, departments, institutes, administrative units, etc.) in order to ensure effective interaction in the execution of all types of activities. Vertical links are managerial information flows and document circulation that ensure communication between levels of the management hierarchy, defining the allocation of authority and responsibility for managerial decision-making at operational, tactical, and strategic levels. This configuration enables unified coordination combined with decentralized management of individual elements of the organizational system at different hierarchical levels.

Schematically, this type of interaction among organizational structure elements can be represented as a graph, where the vertices (objects indexed from 0 to 4) represent nodes — subdivisions (objects of management) subordinate to respective managers (subjects of management), edges indicate their dependence on a specific management element, and color coding reflects the distribution of managerial functions and types of activity across management levels (*Fig. 2*) [7].

The scale of manageability primarily depends on the level of "maturity" and the overall size of the organizational system of an educational organization and may range from several to dozens of elements. A typical pattern of coordination within educational organizations can be described by the following management levels (common to most EOs) (*Fig. 3*) [9–11, 12]:

- five-level structure (for core academic units): collegial governing bodies (rector) → vice-

Table 2

Inter-cluster Comparison of Organizational Design Parameters for Educational Institutions

Name of indicators	Cluster representatives (typical representatives)				
	A	B	C	D	E
Type of organizational system (OS)	Linear-functional, with elements of a divisional structure				
Governing bodies	Conference of employees and students, Academic Council, Board of Trustees of the university, Rector				
Number of management levels	Five-level structure for product units – heads of centers/laboratories, heads of departments (heads of support units) / directors of institutes (deans of faculties) / vice-rectors responsible for areas / collegial governing bodies (rector). Three-level structure for support units (administrative, economic, and managerial) – head of structural unit, vice-rector, rector				
Number of management links	Five links for product units – centers/laboratories, departments, institutes (faculties), rectorate, collegial governing bodies. Three links for support units – structural unit, rectorate, collegial governing bodies				
Level (type) of centralization	Multi-type system with a rigid hierarchy, high formalization of rules and procedures, centralized decision-making, and narrowly defined responsibility for results				
Number of OS elements (units), pcs.	56	89	118	111	137
Structure of OS elements by function, %:					
educational and upbringing	42.9	40.4	34.7	40.5	37.2
administrative and managerial	14.3	30.3	23.7	28.8	27.0
service/support	32.1	15.7	25.4	18.9	25.5
scientific	8.9	11.2	13.6	9.9	9.5
international	1.8	2.2	2.5	1.8	0.7

Source: compiled by the authors.

rector responsible for the area → director of institute (dean of faculty) → head of department → heads of centers (laboratories);

- three-level structure (for support units – administrative, economic, and managerial): rector → vice-rector responsible for the area → head of structural unit.

For example, the management of the educational process, the supervision of academic, methodological, and educational work, as well as the training of highly qualified personnel, is carried out by the Vice-Rector for Academic, Methodological, and Educational Work. His/her area of responsibility covers from 34.7% to 42.9% of organizational units, the main ones being institutes, faculties, and departments, as well as various ad-

ministrative units (academic and methodological administration, educational work administration, doctoral training offices, etc.) (Fig. 4).

Issues related to improving the efficiency of scientific activity, the implementation of research projects (R&D), and the enhancement of publication output are overseen by the Vice-Rector for Research. His/her area of responsibility covers 8.9–13.6% of organizational units, including the administration of scientific and innovation activities, various centers (breeding, information-analytical, technology transfer, experimental, field stations, etc.), laboratories (plant protection, milk quality, agro-ecological monitoring, etc.), teaching and production units, a business incubator, an innovation center, and others.

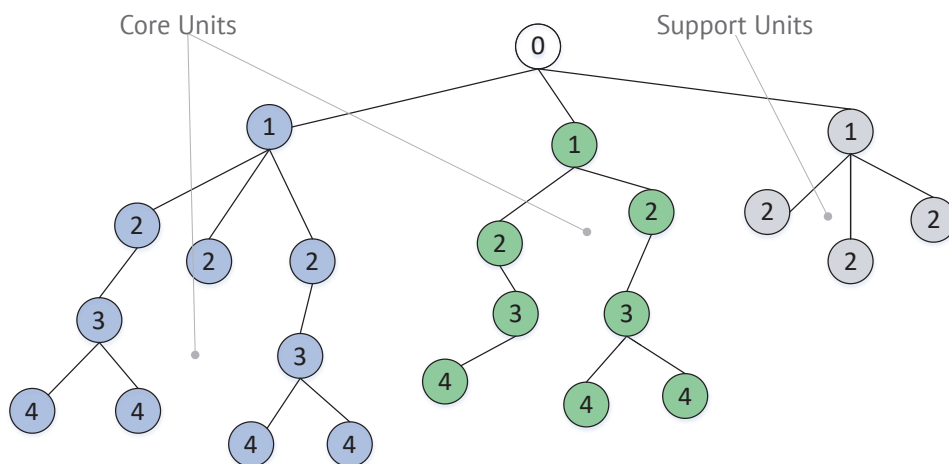


Fig. 2. Tree (Mixed Graph) Representation of the Organizational System of a Typical Educational Institution

Source: compiled by the authors.

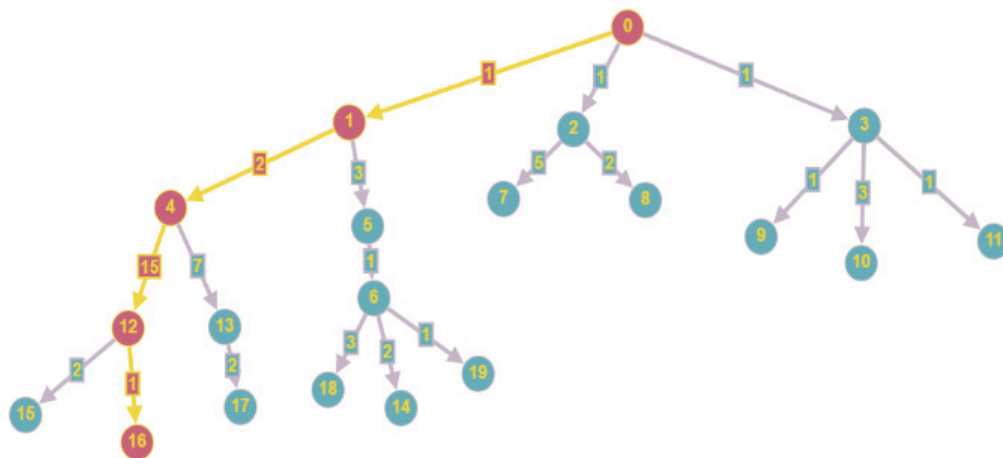


Fig. 3. Visualization of the Subordination of Organizational Units Across Hierarchical Levels Using Weighted Characteristics of Vertices and Edges

Source: compiled by the authors.

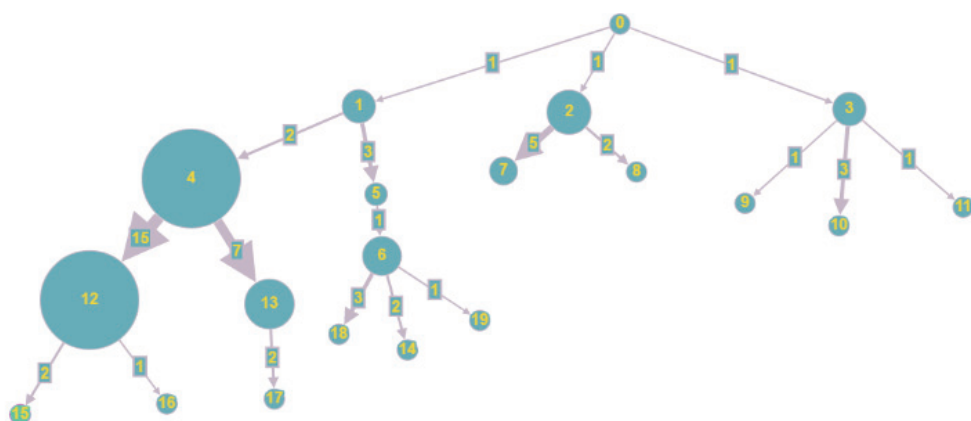


Fig. 4. Visualization of the Intensity of Interaction Between Management Levels Across the Hierarchy Using Weighted Characteristics of Vertices and Edges

Source: compiled by the authors.

Administrative and economic activities are managed by the Vice-Rector for Administrative and Economic Affairs. His/her responsibilities include ensuring the functioning of units related to the use and maintenance of material and technical infrastructure: maintenance and operation services, logistics and technical supply units, vehicle fleet, chief engineer and energy services, procurement and supply departments, student campuses, various administrative units (integrated security, educational and production management, construction and facilities operation), catering services, etc., accounting for a total of 11.2–14.3% of organizational units.

The block of issues related to the strategic development of the university, taking into account current trends in education, science, and the economy, is assigned to the Vice-Rector for Strategic Development. This portfolio covers 5.7–7.4% of organizational units, including strategic development and project management departments, digital transformation units, student (alumni) relations offices, PR (GR) services, career development centers, and project-analytical units, among others.

The Vice-Rector for International Affairs coordinates the implementation of the university's policy aimed at addressing tasks in the field of international cooperation, establishing partnerships and contractual relations with foreign universities, and promoting academic mobility programs, etc. His/her area of responsibility includes 0.7–2.5% of organizational units.

University-wide managerial functions requiring collegial decision-making, including planning and controlling financial and economic activities of the university, are carried out by the central administration (the rectorate and Academic Council), as well as by heads of structural units at the corresponding hierarchical levels: at the lower level — heads of structural units (department heads, chairpersons, laboratory managers, etc.); at the middle level — heads of standalone business units (directors of branches, colleges, canteens, museums, etc.); and at the top level — vice-rectors responsible for specific areas and the rector.

Stage 3. Assessment of the performance indicators of the organizational system of an educational organization

According to classical methodologies, the efficiency of an organizational system can be assessed in several ways. The first approach consists in determining how effectively it ensures the achievement of the organization's overall performance indicators. In this case, a set of indicators is used, characterizing financial-economic, production, commercial, and certain other types of enterprise activity (revenue, profit, output volume, unit price of sold products, various profitability indicators, relative performance measures, etc.) [13].

An alternative approach involves identifying the degree of compliance between the functioning of organizational system elements and the requirements embedded in the strategic development documents of the enterprise, from the perspective of ensuring minimal costs under the existing level of resource potential. The advantage of this method is that it allows for the assessment of the "effectiveness" of both the current composition of OS elements and the procedures of their interaction, i.e., the entire organizational mechanism as a whole, as well as individual elements separately.

From an applied perspective, it is more practical to combine both approaches depending on the research objectives, the availability of input data, the chosen efficiency assessment method, and other factors, in order to obtain a more accurate representation of the analyzed object. In the present case, the use of the indicators presented in *Table 3* and *Figure 5* is considered appropriate.

Thus, the educational activity indicator (E.1) for most of the analyzed educational organizations does not reach the national average and ranges from 55.92 to 63.18, compared to the national average of 61.8 points. This situation can be explained not only by multidirectional dynamics in admission quotas, the updating of training programs, the redistribution of publicly funded places in favor of regional universities, and changes in applicants' preferences, but also by the intention of educational organizations to increase the number of fee-

Table 3

Selected Indicators of Organizational System Efficiency

Name of indicators	Cluster representatives (typical representatives)				
	A	B	C	D	E
Monitoring indicators (by type of activity):					
E.1. Educational activity, score on ... scale	58.30	60.44	61.23	63.18	55.92
E.2. Research activity, score on ... scale	336.2	525.3	410.3	367.9	380.9
E.3. International activity, score on ... scale	1.36	5.23	7.25	3.19	8.67
E.4. Financial-economic activity, score on ... scale	3511.1	5078.6	4229.0	5270.5	2922.3
E.5. Academic staff (PPS) salary, score on ... scale	212.93	207.35	197.17	254.42	221.37
E.8. Additional indicator, score on ... scale	29.87	4.42	—	4.31	3.05
Share of academic staff (PPS) in total workforce, %	50.9	57.0	48.9	49.4	52.7
Share of administrative and managerial staff (AUP) in total workforce, %	26.2	19.3	15.4	14.8	15.6
University expenditures on core activities per student, thousand RUB	141.40	294.03	144.20	178.76	127.96

Source: compiled by the authors.

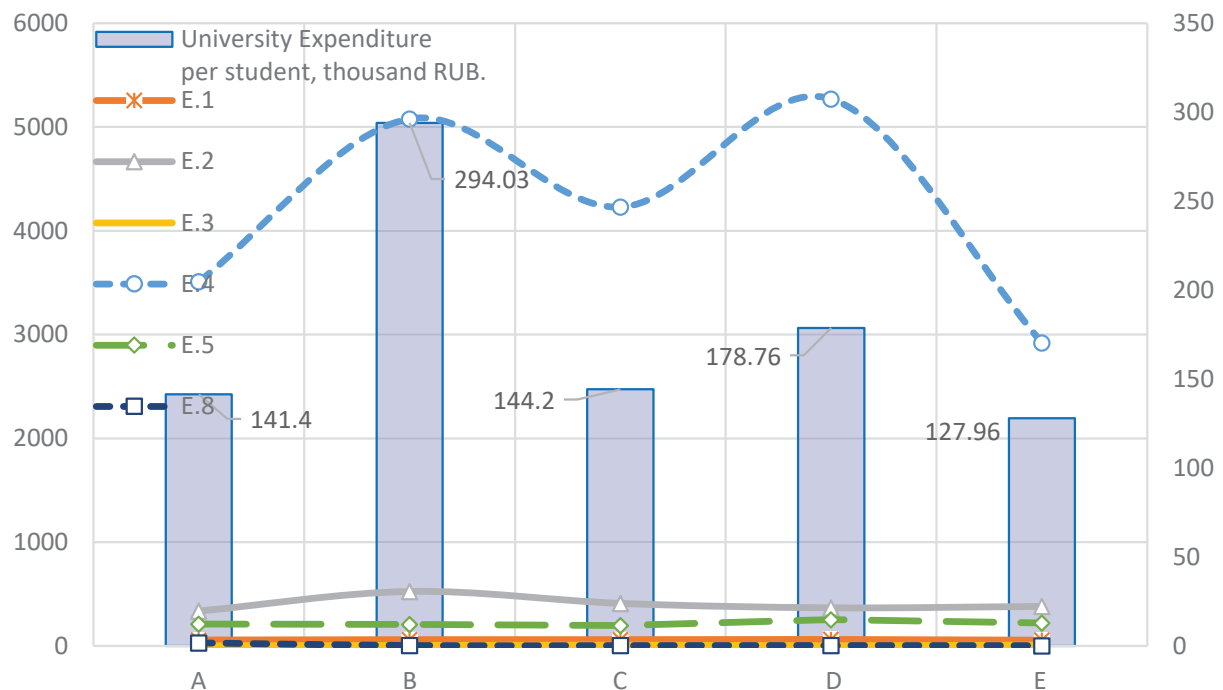


Fig. 5. Indicators of the Comparative Efficiency of Organizational Systems of Educational Institutions (Indicator Names are Provided According to Table 3).

Source: compiled by the authors.

paying students. The latter may, in turn, lead to a certain decline in the quality of graduate training in some specializations.

In terms of research and development (R&D) output per academic staff member (E.2), all analyzed educational organizations exceed the national average values: 336.2–525.3 thousand RUB versus 127.8 thousand RUB, which has a positive impact on their positioning in domestic and international academic rankings.

Indicators of international activity (E.3) in most of the considered educational organizations are higher than the national average: 1.36–8.67 compared to 4.93, which, *ceteris paribus*, can be interpreted as a relatively successful policy of exporting educational services to foreign audiences.

Analyzing the financial and economic indicators (E.4): 2,922.3–5,270.5 thousand RUB (compared to the national average of 3,785.2 thousand RUB), it can be concluded that the revenues of educational organizations are generated from multiple sources, and the more actively a university engages in educational, research, and international activities, the higher its aggregate income.

A consequence of more coordinated staff performance within educational organizations is the high level of academic staff salaries relative to the regional average. As shown in the data, indicator E.5 for most analyzed educational organizations is above the national average: 197.1–221.3% versus 202.4%.

Another indicator characterizing the production potential of an educational organization is its personnel structure (by staff categories), corresponding to defined qualification requirements. According to Table 3, in all analyzed organizations, the share of academic staff in total employment is approximately one half (48.9–52.7%). At the same time, the number of academic staff (adjusted for full-time equivalent) holding Candidate or Doctor of Sciences degrees per 100 students ranges from 3.05 to 4.42, compared to the national average of 3.29 persons. Meanwhile, the share of administrative and managerial personnel varies between 14.8% and 26.2%, which generally indicates a possible imbalance in staffing provision

for certain educational programs, as well as an excessive growth of administrative personnel.

The most important complementary (but not aggregate) indicator characterizing the organizational and economic efficiency of the organizational system is the total amount of expenditures of an educational organization per unit of output — in this case, per student. A relatively low level of such costs (for the provision of educational services), while maintaining the required quality level, indicates the efficiency of the organizational system as a whole, and of the management system in particular.

Considering the above, it can be stated that the lowest per-student unit costs are characteristic of the largest educational organizations (Cluster D), amounting to 127.96 thousand RUB per year. For other participants in the inter-cluster comparison, this indicator is higher by 10.5–229.1%.

CONCLUSION

Based on the results of the study, the following conclusions can be drawn:

- the shortage of labor demand in the agro-industrial complex (AIC) and related industries averages 200,000 persons per year, with a total employed population of 6.2 million (AIC — 4.1 million; processing industry — 2.1 million);
- the agricultural education system is represented by a wide range of institutions (44 universities under the Ministry of Agriculture, 14 universities under the Ministry of Science and Higher Education, and 153 research institutions), with a total student population of approximately 250,000;
- the educational network includes a diverse set of institutions differing in composition, student body, implemented programs, applied technologies, infrastructure, human resources potential, financial provision, and other characteristics, which is determined by current demands of the agro-industrial complex;
- a five-cluster model of the educational network was developed to compare educational organizations, in which a typical institution was selected for each cluster based on defined criteria;

- analysis of the organizational structure of typical representatives of each cluster made it possible to identify factors influencing its formation, including the type of organizational system, composition of governing bodies, number of management levels and links, degree (type) of centralization, number of organizational system elements across levels, horizontal and vertical linkages, etc.;

- based on system modeling methods, a graph-analytical model of the organizational system of a typical educational organization was developed, the structure of which is based on a functional-hierarchical principle;

- comparative analysis of organizational systems of educational organizations showed that, alongside evident advantages (such as centralized authority, clear hierarchy, and ease of control), they also exhibit significant drawbacks, including functional “autonomy” of individual units; focus of some managers on narrowly defined tasks to the detriment of overall organizational outcomes; difficulties in interaction between production and support units due to differing interpretations of business context; lack of rapid coordination under high informational

and managerial workload at lower and middle management levels; and absence of standardized internal process regulations, resulting in employees at operational level becoming “centers of competence,” which significantly reduces organizational stability in the event of key staff turnover;

- low digital maturity and fragmented automation of individual functions and processes, combined with a large volume of routine operations, lead to a significant increase in the workload of management and academic staff and, as a consequence, a decrease in customer orientation;

- assessment of the efficiency of organizational systems of educational organizations based on general and specific indicators revealed that the lowest per-student costs are observed in the largest educational organizations (Cluster D).

Thus, the results obtained in this study may serve as a basis for developing a unified approach to constructing an evaluation system for educational organizations involved in training personnel for the agro-industrial complex, taking into account current technological trends and the evolving needs of the industry.

REFERENCES

1. Khudyakova E. V., Stepansevich M. N., Gorbachev M. I. Digital competencies of a modern manager in agricultural production. *Doklady TSKhA*. 2021;(293-II):251-254. URL: <https://www.timacad.ru/uploads/files/20210901/dokl-tsha-293-2.pdf> (In Russ.).
2. Konstantinov I. S., Stepansevich M. N., Gorbachev M. I. Tools of digital transformation of an agricultural university. In: Information technologies in science, education, and production (ITNOP-2023). Proc. 9th Int. sci.-techn. conf. (Belgorod, May 31 — June 02, 2023). Belgorod: Belgorod State University; 2023:37-40 p. (In Russ.).
3. Medennikov V. I., Mikulets Yu. I. The response of universities and research institutions to the demand of the pandemic economy. *Vestnik Moskovskogo gumanitarno-ekonomicheskogo instituta = Bulletin of the Humanitarian and Economic Institute*. 2022;(1):210-222. (In Russ.). DOI: 10.37691/2311-5351-2022-0-1-210-222
4. Novikov D. A. Theory of management of organizational systems. Moscow: Moscow Psychological and Social Institute; 2005. 584 p. (In Russ.).
5. Murakhtanova N. M., Shevlyakova E. M., Aleksandrova N. V. Organizational design of production systems. Tolyatti: Tolyatti State University; 2013. 290 p. (In Russ.).
6. Antonov A. V. Systems analysis. Moscow: Vysshaya shkola; 2004. 454 p. (In Russ.).
7. Zykov A. A. Fundamentals of graph theory. Moscow: Vuzovskaya kniga; 2004. 664 p. (In Russ.).
8. Young S. Management: A system analysis. Glenview, IL: Scott, Foresman and Co.; 1966. 436 p. (Russ. ed.: Young S. Sistemnoe upravlenie organizatsiei. Moscow: Sovetskoe radio; 1972. 456 p.).
9. Voronin A. A., et al. Mathematical models of organizations. Moscow: Lenand; 2008. 360 p. (In Russ.).

10. Mesarović M.D., Macko D., Takahara Y. Theory of hierarchical, multilevel systems. New York, London: Academic Press; 1970. 322 p. (Russ. ed.: Mesarović M.D., Macko D., Takahara Y. Teoriya ierarkhicheskikh mnogourovnevnykh sistem. Moscow: Mir; 1973. 344 p.).
11. Vlasyuk B.A., Morosanov I.S. Synthesis of a hierarchical control structure in large-scale systems. *Avtomatika i telemekhanika* = *Automation and Remote Control*. 1973;(3):110-120. (In Russ.).
12. Orlov A.I. Network models of industrial control systems. *Upravlenie bol'shimi sistemami* = *Large-Scale Systems Control*. 2010;(30-1):62-75. URL: <https://www.mathnet.ru/links/b93641f0ff15697ac4a01b25300b2e28/ubs488.pdf> (In Russ.).
13. Voronin A.A., Mishin S.P. Optimal hierarchical structures. Moscow: V.A. Trapeznikov Institute of Control Sciences of the Russian Academy of Sciences; 2003. 214 p. (In Russ.).

ABOUT THE AUTHORS



Igor S. Konstantinov — Dr. Sci. (Tech.), Prof., Director of the Institute of Information Technologies and Control Systems, V.G. Shukhov Belgorod State Technological University, Belgorod, Russian Federation
<https://orcid.org/0000-0002-8903-4690>
 konstantinovi@mail.ru,



Marina N. Stepansevich — Cand. Sci. (Econ.), Assoc. Prof., Department of Applied Informatics, Russian State Agrarian University — Moscow Timiryazev Agricultural Academy, Moscow, Russian Federation
<https://orcid.org/0000-0002-7125-3027>
 stepancevich@rgau-msha.ru



Mikhail I. Gorbachev — Cand. Sci. (Econ.), Assoc. Prof., Department of Applied Informatics, Russian State Agrarian University — Moscow Timiryazev Agricultural Academy, Moscow, Russian Federation
<https://orcid.org/0000-0002-9605-4067>
Corresponding author:
 mgapof@outlook.com

Authors' declared contribution:

I.S. Konstantinov — development of the general concept of the work, and scientific and methodological supervision.

M.N. Stepansevich — collection and formation of the initial data array, and processing of performance indicators of educational institutions.

M.I. Gorbachev — information modeling of the work of educational institutions.

Conflicts of Interest Statement: The authors have no conflicts of interest to declare.

The article was received on 08.09.2025; revised on 27.11.2025 and accepted for publication on 11.03.2026. The authors read and approved the final version of the manuscript.