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Features of Management of Research Activity in Higher Educational Institutions

Gregory Lutsenko and Olena Lutsenko

Abstract

Modern pedagogical science and practice seek to comprehend the holistic pedagogical process from the standpoint of management science, to give it a clear scientifically sound character. The statement of many domestic and foreign researchers that management is real and necessary not only in the field of technical, production processes but also in the field of complex social systems, including pedagogical, is true. The introduction of innovation management is important for successful research at the university. Therefore, the main **idea/goal** of our study is to develop the concept of innovation as new ideas and knowledge (radical and those that improve the result), mechanisms for their practical implementation, and, most importantly, mechanisms for the dissemination of innovations. On the one hand, in many countries there are tendencies to create largely, often international clusters of research work, on the other - now in the staff of universities are introduced positions of research management specialists in existing projects and centers. Unlike pure administration, innovation research managers must make decisions based on scientific knowledge and information about society as a whole. Some authors note a growing similarity between non-university research centers, industrial laboratories, and classical universities. In fact, scientists from industrial and large research organizations have greater autonomy, for example, there are optimal conditions for creative research (at the university it is combined with the educational process). Large joint projects and the commercialization of research results in many disciplines represent this trend. The main **methodology** of our study was methods of theoretical and empirical nature. In the process of researching the problem outlined by us, we found that thus, it is established that the introduction of a system of information management of research activities in higher education, in general, contributed to the growth of performance management of research activities and improve the level of training of future professionals. Therefore, we dedicate our research to the peculiarities of educational management in educational institutions of Ukraine.

Keywords: management, management of educational institution, innovations, administration, projects

1. Introduction

The accumulation of financial, cognitive and instrumental means allows to ensure a higher degree of division of labor during research. For large research projects, the involvement of engineers, technicians, managers, specialists in the field

of information and computer technology, ie the construction of a new structure of organizational and functional division of labor is inevitable. Thus, systematic planning reaches a higher degree of formalization [1, 2].

In the scientific literature on the management of scientific activity, two terms are used, which have a slightly different meaning - “management” and “management”. More general, in our opinion, is the term “management”, but “management approach” reflects important aspects of the same topic. The management of scientific activity is divided into a large number of practically independent entities located at different levels of the hierarchy within research organizations, and not only at the management level of the research system [3, 4]. Therefore, it is worth focusing on management as a decision-making process that is imposed on specific organizational and cognitive contexts. Management research is a day-to-day activity that takes into account the complex and ever-changing institutional environment of research in order to enable successful and productive research. Such an environment is characterized by competition and cooperation of entities that have different, sometimes conflicting goals and different access to the resources of the organization, government and assets. Sometimes research management is associated only with reforms of individual university administration positions, although in many other cases the set of skills necessary for successful research management is determined [5]. The need to manage research is due to at least three interrelated factors. First, an increasing number of research organizations compete with each other to obtain resources from governments and the private sector. Second, complex scientific problems require transdisciplinary collaboration within research institutes or between them and non-scientific organizations [6]. Third, many industries depend on expensive infrastructures, equipment, and devices (such as particle accelerators, gene synthesizers, supercomputers, or even satellites) that require government support and inter-agency cooperation.

The growing demand for social support for research has created new opportunities for politicians to conduct social research programs [6, 7]. Funding for grant programs is increasingly combined with external non-scientific goals, such as increasing international competitiveness, solving urgent social problems [8, 9]. Scientists should take into account new external influences on research objectives and their evaluations and structure, respectively.

In the general analytical basis, scientists distinguish three levels of research of the management system of scientific activity: the level of the state, the strategic level and the level of implementation, or operational level [10].

The analysis shows that conducting large-scale research on national systems of organization of scientific activity helps to establish national priorities and development strategies of scientific institutions. However, such studies do not provide answers to the specific mechanisms of functioning of scientific institutions. Unlike previous large-scale research, modern researchers are working on the development of specific technologies, new programs, which are often required by scientists themselves in order to justify the usefulness of their activities [7, 11].

Basic research programs are still the main ones, although their financial support has slightly decreased compared to applied and problem-oriented research. However, expanding cooperation with firms and external stakeholders is not only an empirical observation [12], but also an important state goal. Discursive concepts such as “transdisciplinarity”, “relevance” or “competitiveness” are among the new goals of the study. Management of strategic cooperation provides an opportunity to achieve them [8, 13].

The next aspect of research management can be defined at the level of funding of institutions. Managers’ actions not only turn existing unresolved scientific problems into promising research, but managers are also intermediaries who actively monitor scientific developments and try to integrate innovative research areas.

The third level of management is the management of research organizations, such as universities or consortia of higher education [14]. Nowadays, university administrations, as a rule, promote the introduction of management control systems that are similar to those existing in business organizations [15]. They are characterized by formalized control and evaluation procedures to increase the productivity and responsibility of scientists for the use of resources and results of scientific activities. One of the risks is that university leaders are beginning to give preference to more productive industries and, consequently, increase domestic funding for these areas of research.

Finally, the last level is project management in research groups, research clusters, research centers and departments, where research is actually carried out. In such groups, decisions are made taking into account the cognitive dynamics of the scientific field.

Due to the great need for resources and the growing complexity of the extensive structure of research institutions of various scales, the organization of research projects is extremely time consuming. One of the consequences is the emergence of specialized links between organizations, a kind of bridge between different branches of science and the application of new scientific knowledge. Prominent examples of this are the transfer of technology or other information between departments in universities. All research structures perform integrative functions in the sense that they regulate the relationship between science and society. It is much easier for organizations to mobilize resources for research. In fact, modern research is virtually impossible outside of formal organizations. They provide the legal framework and legitimacy, and scholars are hired and paid for by certain organizational structures.

However, the management of research is not limited to the work of establishing links within one organization or between several different ones. Some actions of a complex management complex require the performance of non-traditional functions for scientists. Accordingly, the management of research projects requires well-trained managers who clearly understand both the specifics of creative research and have the ability to solve practical organizational problems.

Management of research work is an activity performed at the intersection of science and public interests [16–18]. The term “boundary work” was first used as an alternative to the logical criterion for demarcating scientific and non-scientific concepts. It should be noted that in this case, such a term does not mean the isolation of scientific activity, but, on the contrary, makes it possible to ensure contact, to maintain control over complex research in such an environment [19, 20]. Indeed, the organization of research projects is an extremely time-consuming activity. This is due to the huge need for resources and the complexity of the structure of scientific institutions. In such conditions, research structures must regulate the relationship between science and society. With the help of such structures it is much easier to mobilize the resources needed to conduct research.

Of course, scientists, consciously or not, but always engaged in “work at the border.” Such activity, in particular, was conditioned by the norms of scientific communication, when scientists had to bring the input research data, experimental data or working records to a unified form [21, 22]. Scientists are usually members of committees, expert councils, responsible for the redistribution of funds allocated by the state, international or private funds for research.

However, the management of research activities is not limited to such activities, as the structural links between science and society are increasingly difficult to unify and formalize [23, 24]. No organization can focus only on scientific issues. There are departments responsible for human resources, public relations, planning, legal issues, intellectual property issues.

The university is an example of how to find a compromise between different objects of the management process in the organization of research activities. On the one hand, of course, the university administration is trying to gain more control over research. At the same time, some scientists (research groups) maintain their own external relations with financial institutions, partner organizations, etc. This state of affairs reflects situations where tensions may arise between different sectors, which need to be mitigated by modern management methods.

Management of scientific activity belongs to the processes related to both scientific dynamics (knowledge production) and social (introduction of scientific knowledge into practice). Thus, the boundary between the administrative and scientific spheres is quite blurred. The ultimate goal of research management is to produce selective links between certain organizational elements. The question of the mechanisms of formation of such connections remains open. Nowadays, we can observe a great variety of management mechanisms, as research contexts have become more diverse [12]. Concentration of some distributed management tasks within specialized management positions could contribute to the development of new professional roles.

The place and role of higher education institutions in the scientific sphere. Higher education has always been considered in the light of its fundamental contribution to the social, cultural and intellectual life of society, which is carried out by increasing human capital. In recent years, competition between countries to grow their role in the global economic space has forced governments to think more strategically about the economic value of knowledge production and dissemination.

The governments of the leading states are currently reviewing the structure of the higher education system, organizational superstructures and mechanisms for their financing. The attention of government agencies is focused on the allocation of resources for research and development, on the formation of human capital through education and specialized vocational training, knowledge management and the organization of relevant institutions. In turn, the status and prestige of research institutions is determined by the quality and scope of research. The quality of research is reflected as a place in the ranking, which is occupied by research groups and the university in general. The volume of research is related to economic factors, which are reflected in the direct profits of the institution and in the profits from innovative ideas. Universities are looking for ways to reorganize optimally to address the challenges they face.

A common requirement for all universities is to increase academic productivity within the available financial capacity and increasingly accountable. Many universities were initially established in response to initiatives related to the mass and democratization of higher education, the needs of the labor market and other socio-economic factors. In recent years, innovations in education and professionalization of disciplines have forced the university to offer postdoctoral programs and strengthen its own research capacity. Today, universities offer comprehensive higher education, supported by growing experience in research, development and consulting.

Governments respond to the needs of the time in different ways: some create unified university systems. At a time when others choose to maintain the distribution of universities by type as a key policy that determines the differentiation of research areas and diversification of sources of financial support. Universities position the need to strengthen scientific capacity and capacity as the basis for their functioning and survival. Accordingly, all universities are engaged in the development of research strategies to increase research activity and organizational support and management of research structures within the university.

At present, research activities can bring significant financial benefits for both scientists and their institutions. This is reflected in the activities to determine institutional priorities, the creation of research units, the emphasis on the work of permanent research groups working within specialized units (centers), in cooperation with other institutions or organizations.

Taking into account the scientific and pedagogical orientation and analysis of the teaching staff, modern universities carry out traditional academic research (fundamental, applied or strategic); organize the transfer of knowledge and technology. With some exceptions, the research priorities of higher education institutions reflect the national priorities and criteria of donor financial institutions. Each institution develops its own concept of development of scientific and educational process on a scale from extremely scientific-oriented to extremely pedagogical-oriented activity.

Successful research is associated with certain difficulties. Financial support provided to universities by public institutions or public foundations is often determined by non-scientific considerations (historical conditions, traditions, established contacts), or by a limited number of universities and traditional research institutes. Without alternative sources of funding and increased autonomy, it is difficult for universities to quickly reshape their research to meet the requirements of donors.

Identifying priority areas for research and research on funding allocation models is an important and urgent task. Universities are developing development strategies related to human resources as a key component of the scientific field. With some exceptions, universities do not want to be transformed into knowledge-intensive institutions, but are forced to intensify research. Analysis of the scientific literature allows us to identify the following strategies of the university:

- investment-oriented strategies and budget restructuring;
- creation of new organizational structures, in particular new postgraduate courses;
- creation of independent commissions to identify and support the most competitive at the international, national, regional level research groups and projects;
- organization of research clusters and centers of interdisciplinary research to optimize external funding;
- distribution of resources and needs in accordance with the built scale of priority research;
- creation of strategic alliances with other universities, research centers, industrial enterprises, etc.;
- active cooperation with relevant ministries, sponsorship organizations, etc.;
- finding funds to establish additional scholarships and grants.
- The tasks facing the university under such conditions are:
- expanding access to knowledge (in fact, the formation of a knowledge society);

- overcoming the difficulties caused by the so-called “late start” (which is extremely important for the system of Ukrainian higher education) - obtaining grants to create and improve infrastructure, such as laboratories, libraries, etc.;
- providing funding not only for applied but also for basic research under agreements between the government and universities from various sources, identifying and promoting research at all levels - from students to full-scale research groups.

Mechanisms of formation of priorities of research activity. Global changes and diversification processes are forcing universities to reassess their capabilities in order to find competitive resources. At the same time, research is actively developing, becoming more complex and needs, above all, financial support to ensure quality results. Obviously, public funding in such a situation is only one source of support for research disciplines. Therefore, most universities are beginning to change the organizational and managerial aspects of research. One of the ambiguous consequences of such societal demands is the fact that universities choose as the goal of strategic development activities that will bring the maximum funds, rather than just activities that they can best implement under the existing conditions. A strategy focused on a radical change of priorities is not always the most promising. Most universities have a well-established tradition, history, specialization and, as a rule, limited resources. Thus, the priority should be the optimal use of scarce resources (financial, human and material) by finding a balance between the university's reserves and the needs of the environment. Priorities must be determined not only by current strengths but also by future potential. Plans for research should be long-term.

The characteristics of the project activity are the focus on the implementation of the defined goal, the need for coordination measures (events and project participants), the need to take into account the limited resources (time, labor, material resources) and the uniqueness of each project [22]. When research activities are established in the university, the management activities are mainly coordination. However, the objects of management in this segment (vice-rector for research, head of research, directors of institutes, etc.) must be the concentrators of innovative ideas and generate their implementation.

In general, the task of project management is to achieve the set goals in terms of volume, time, cost and quality. Setting priorities is an important step in the presented scheme. In our opinion, setting priorities is a fundamental task for building the future, not for monitoring it. Higher education institutions will constantly take care to expand the list of areas of research. The process of setting priorities for higher education is considered a necessary and mandatory practice. It pushes higher education institutions to make difficult choices between external, university and research priorities. Ideally, the priority plans for the long-term development of the university should be developed as a superposition of all three priorities. However, the reduction of public funding, the identification of national priorities force the university management to focus on the latter two. In addition, the survival of the educational institution and the preservation of its status become essentially inseparable processes (competitive positioning significantly affects the priorities of the university).

For many universities, this means focusing on applied, interdisciplinary research that is strongly linked to regional interests, and on developing it by attracting innovative grants and commercializing research.

The main criterion for selecting priorities is the urgency and importance of research areas and the social response to their results. General management is conditioned by general guidelines for matching researchers' needs with educational

needs. All priorities are built in accordance with the indicators of research effectiveness, and the concept of effectiveness can and should be discussed.

Another important factor influencing the choice of priorities in universities (and, consequently, funding schemes, organizational structure, planning processes and personnel strategy) is the time that universities can devote to building research capacity. This problem is due to the multifaceted nature of the challenges facing the university. In particular, the integration of research and teaching is a fundamental task of the university. However, researchers (research and teaching staff) are dissatisfied with the fact that their workload absorbs the time needed for research; successful researchers sometimes neglect their educational responsibilities, etc. [11, 25].

Let us define the basic directions of researches which can be realized on the basis of universities, and their characteristic features.

As we can see, the main sources of funding for science are external to the university (public funds, regional projects, orders from industry, private funds, etc.).

At the internal level, the structure of the organization of scientific activity is similar for all universities. The position of deputy head (vice-rector) for scientific issues is practically obligatory, and his responsibilities include the management, organization and implementation of competitive research methods. The formulation of a research strategy is a benchmark on the basis of which each unit identifies a number of priority studies or interdisciplinary topics. Depending on the structure and specialization, the university administration acts as a coordinator and helps to build links between faculties and individual research groups, working with deans or project managers.

Units are required to explain the process by which priorities were set, who is involved in the research, and the expected consequences. In this case, informal or informal factors that may affect the research process should also be considered.

All sources of funding can be divided into three groups. The first of these is centralized financing (financing from above). At the same time, priorities and own funding can be distributed by the management, in accordance with the urgent needs and the current state of the university. The second group includes decentralized funding (bottom-up funding), which actually reflects the real state and capacity of individual research groups. This type of funding should include grants, projects, etc. And the third group, which is the most common, involves combined funding (for example, raising funds, on the one hand, and experimental capacity, on the other).

In any case, a mechanism for coordinating actions with the involvement of all units is mandatory. Strictly centralized mechanism operates in the interests of the whole university and allows not to lose individual research units, which at a certain stage of work do not form a request for centralized funding and do not perform research. Numerous ways to implement such a mechanism include research committees (scientific council, scientific council) or management committees. The creation of centralized mechanisms for setting priorities does not have a clear positive response from scientific groups, but such an approach has a right to exist. The regulatory mechanism for its application should be a clear provision defining the rights and powers of all committees and individual representatives. In terms of active external funding, cooperation with partners outside the university comes to the fore.

Information-analytical system "Science" based on web-technologies is an example of innovative management of research activities in an educational institution.

Scientific activity is the most important component of the work of the university as a whole, as well as its individual departments and staff. According to the intensity and effectiveness of scientific activity, the presence of an innovative component in it, we can say how the higher education institution corresponds to the status of the university.

Solving the problems of innovation economy development requires a significant deepening of knowledge about high, science-intensive and information technologies; management of intellectual potential of personnel, economic essence of intellectual capital, features of its formation and use, and also tools and methods of effective management of innovative processes. Therefore, the question of the effectiveness of research management, the need to develop special management tools and methods that would form effective organizational and economic mechanisms for the accumulation and expansion of scientific knowledge, introduced into domestic science-intensive enterprises.

Systematic research of the process of formation, accumulation, effective use and commercialization of scientific activity is becoming increasingly important today, especially for knowledge-intensive enterprises, especially those related to the reform of the national economy.

In analyzing the problem of research management, much attention is paid to the approaches to the organization and classification of sciences, research and selection of their stages [26]. However, despite the significant number of works performed, theoretical, methodological and methodological aspects of the research management process are not sufficiently disclosed. Let us dwell on this in more detail.

At the beginning of the XX century. P. Freeman formulated a hypothesis about the feasibility of describing the process of conducting research on the management process [26]. But in the currently developed concepts of management of scientific activity consider only its separate spheres that does not allow to form the general theoretical base. The lack of purposeful integration of all components of the management system of scientific activity and the orientation of all structures of the scientific organization to achieve the set goals prevents the effective transformation of employees' knowledge into profitable assets.

Successful implementation of the tasks of managing the scientific activity of educational institutions allows to increase the level of scientific and educational potential and financial independence of universities, to ensure close integration of business and education. Modern software and methodological solutions allow you to effectively implement these tasks. However, the analysis of the current practice of using information systems in this area shows that none of the technologies provides the following tasks:

1. increase the transparency and relevance of data;
2. providing access to scientific personnel to the relevant information within a single information system;
3. increase the efficiency of preparation of current and final reports on research activities;
4. operational control over the implementation of current research projects and other tasks.

As modern business and production are inconceivable without the automation of their business processes, so the modern process of scientific research cannot exist without the use of new information technologies and project management techniques. Modern innovative science can be considered as a business that implements a set of business processes. And so naturally there is a need to describe business processes, research processes, etc.

We have previously considered the existing problems of project management in various fields, including in the process of scientific research. Proven fact is

the effectiveness of project management in solving engineering problems. This approach has shown in practice its advantage over network or calendar planning methods. In our opinion, the application of the project approach in research will also be effective. But for this purpose it is necessary to develop methods and on their basis - the corresponding tools, considering rules and the accepted standards in the field of project management and in scientific activity of high school.

Unlike the engineering industry, where all stages can be described and the results of intermediate stages known in advance, in activities such as research and implementation of intellectual property results, it is not possible to predict all expected results in advance. In the best case, you can know exactly what is coming in and what the end result should be. All intermediate stages will be adjusted taking into account the results achieved in the previous stages of the study. This is the main difference in the use of classical methods and tools of the design approach (in the field of engineering) in relation to the research process.

The process of research management is characterized by two main aspects - methodological and informational. Modern development of methods and mechanisms of project management in various subject areas and improvement of information technologies allows to introduce methods of project management in universities to support research. But since the application of standard methods and tools does not take into account the specifics of research in higher education, their direct use is impossible.

Currently, one of the effective management tools is information-analytical systems (IAS). IAS support of scientific activity, which is part of the corporate information environment of the university, is a perfect management tool, as it is able to operate huge arrays of information related to the object of management, integrate information and analytical support of scientific activity with support of other university activities. Educational, etc.

When building a model of information management system for the organization of scientific activities of a classical university, the object of management is scientific activity. As a mechanism for managing scientific activities, it is proposed to use IAS using modern web-solutions.

Based on the historically formed traditional notion and legally established interpretation, we state that the classical university differs from other types of educational institutions:

- a wide range of areas of training, retraining and advanced training of specialists, bachelors, masters and graduate students in educational programs of higher, postgraduate and additional professional education;
- a wide range of areas of research in which basic research and applied development.

Only classical universities combine traditionally university natural sciences, physics, mathematics and humanities. This multidisciplinary determines the specifics of the management model of the organization of scientific activity.

To control a real object, you need to develop a model that describes the behavior of the object. In our case, as a model it is advisable to use a formalized description of the set of business processes that underlie the organization of scientific activities of the university. The application of the process approach in management is now a promising area [27]. Using this approach, each business process can be considered as an information flow that receives information at the input and generates new information at the output. In the course of the business process, specific information describing the behavior of the process must be accumulated.

Different business processes are in constant interaction, exchange information (information flows circulate between them). To accurately describe the interaction in such a system, there must be an information model that would allow the accumulation of relevant information about business processes. Such a model and a model of processes that describe the organization of scientific activity form a management model. Thus, the information-analytical system developed on the basis of a set of these models can be considered as a management system for the organization of scientific activities of the university.

The creation of the model should begin with a study of the functional units of the university, which participate in the conduct and organization of scientific activities. Establish a common map of business processes, the place and role of each unit in the overall system of processes. Such a model will allow a global assessment of the research subject area and present a general system of interaction of objects of the subject area, in our case - the university departments and individual officials responsible for the organization of scientific activities. It is recommended to characterize each process according to such plan [28]:

1. The name of the business process.
2. Conditions for starting a business process.
3. Documents and information that arise during the business process.
4. Persons involved in the business process.
5. The purpose and results of the business process.
6. Other characteristics of the business process.

After completing the initial stage of modeling, we must obtain a detailed description of the subject area in the form of a business process model with a full definition of each process, identify the main functions to be provided by IAS, and, consequently, the main system modules to perform these functions. According to the received information we will develop functional requirements to IAS and to formulate strategy of its development for performance of the main task - management of the organization of scientific activity. The effectiveness of the proposed method of building a model of the processes of the studied subject area in the creation of IAS is due to the following factors:

- the model summarizes and systematizes information about the studied subject area;
- the received description of the system of business processes is a model of interaction of objects of the subject branch;
- the business process model visualizes information about the subject area, business process diagrams are clear and understandable to a wide range of people;
- the complete model of business processes describes in detail the functions performed by the participants of the activity, therefore, on the basis of the process model it is possible to identify the functions of the IAS.

To create a full-fledged model of management of scientific activity of the university within the IAS, only the functional requirements and the business process

model of the subject area are not enough, because there is a lack of “foundation” of the IAS - the data model. The next important step in the creation of IAS is the design of an information system data model. The data model is the structure of the relationships between the entities of the subject area, as well as a description of these entities. Entities are structures for storing the elementary components of information (a set of facts that describe a particular business process).

To build a data model, it is convenient to use entity-relationship model (ERM) and entity-relationship charts to represent the data model. The entity-relationship model (ER-model) is a data model that allows describing conceptual diagrams of the subject area. This approach is formalized, it is a set of rules that describe the method of modeling. In the course of ER-modeling we obtain a detailed data model of the studied subject area. The success and further development of IAS, and hence the reliability of the management model of the organization of scientific activity, depends on the quality of the constructed ER-model.

ER-model is used for high-level (conceptual) design of information systems and databases. You can use it to highlight key entities and identify the connections that can be made between those entities. When designing databases, the ER model is transformed into a specific database schema based on the selected data model (relational, object, network, etc.). The ER-model is a formal construction that itself does not determine the graphic means of its visualization. An entity-relationship diagram (ER diagram) is usually used as a standard graphical notation to visualize an ER model.

At this design stage, we focus on the data model architecture for IAS. As a result of ER-modeling, ER-diagrams of the studied subject area were obtained.

The complete ER-model for the studied subject area allows to get a global idea of the logical levels of IAS. With the help of diagrams at the final stage of ER-modeling, a clear idea is formed as to whether the IAS can meet the requirements set for it or whether it is necessary to make additional refinements and refinements of the data model. Thus, the ER-model allows without writing prototypes of IAS and implementation of program code to get an initial idea of the future of IAS. This technique is effective because it reduces labor costs in the creation of IAS. Thus, the data model obtained by the above method is an important element of the management model of the organization of scientific activity. At the end of the data model creation stage, the “foundation” of the IAS is laid and it is possible to create a database for the IAS (tables, keys, indexes, constraints and other objects) on the basis of the ER model. After completing the main stages of modeling, when there is a model of the studied processes of the subject area and a data model, the functions of the system are defined, you can start designing and creating IAS applications. After completion of all stages of development we receive integral system.

As the experience of creating and operating IAS support of various activities (educational, scientific, etc.) in educational institutions, for a successful implementation requires a high degree of readiness of universities to use automated information and analytical management systems.

The essence of monitoring the effectiveness of the information support system of research management in a higher educational institution.

The introduction of information support system for research management requires the use of monitoring, because the current activities of the educational process, identification of major trends in their development and objective assessment of actual results require long-term monitoring of scientific, educational and management activities.

Information about the main aspects of the educational institution allows to make effective management decisions in a timely manner, based on the reality of the state of the higher educational institution. After all, it is important to strengthen

management actions for quality indicators in education [29]. The initial data of monitoring include information on the current state of the higher education system, the main problems that inevitably arise in the process of implementing innovative approaches. The obtained data are analyzed in order to determine the main directions of development of the educational system and further forecasting.

Sources define the concept of “monitoring” as “control with periodic monitoring of the object of monitoring and mandatory feedback” [30]. Monitoring, are used to comprehensively study certain aspects of the functioning of the education system and its components. It can be performed to study various aspects of the educational process, such as monitoring the use of information and communication technologies during the educational process, monitoring the training of specialists in a particular educational profile, and so on. In fact, the process of obtaining and processing data on student achievement or research is also a form of monitoring.

Scientific sources use such concepts as “monitoring in education”, “educational monitoring”, “monitoring the quality of education”, “psychological monitoring”, “pedagogical monitoring”. S. Silina interprets “monitoring in education” as a process of continuous, scientifically sound tracing of the pedagogical process of training in order to optimize educational tasks, as well as means and methods of solving them, in order to optimally manage the pedagogical process. Close to the above is the concept of “educational monitoring”, which is defined as a system of organization of accumulation, storage and processing of information about the functioning of educational systems in their various manifestations, used to track the current state and predict major trends.

Using the term “tracking”, which actually relates to the concept of control, however, we consider it necessary to emphasize that there is a difference between the concepts of monitoring and control.

Another basic concept related to the concept of monitoring is diagnosis. Diagnosis is made to obtain information about the status of the monitored object at a certain point in time or under certain circumstances. In this case, the current state of the object is determined relative to some normal (corresponding to the plan) state of the object. The evolution of the system over time, changes in operating circumstances lead to changes in the conditions of diagnosis. As stated in [31], in management diagnostics involves the study of the state of educational work on the subject.

According to researchers monitoring can be considered as a system of measures aimed at the accumulation and analysis of information used to study and assess the quality of training and management decisions, identifying characteristics and trends. Thus, in the field of educational activities, the purpose of monitoring is to build new and improve existing management systems for research activities of higher education in general and its structural units in particular. The object of monitoring is the system of management of research activities in the structural units of higher education institutions. The subject of monitoring the effectiveness of management of research activities at the departments of university institutes is the quality of training of future professionals. In accordance with the above purpose of monitoring, we will define its main tasks. These include the development of a clear system of criteria for evaluating the research activities of faculty and students and methods of applying such criteria in practice; development of methods of analysis of the received data on various parameters (quantitative and qualitative), for establishment of the positive and negative factors influencing functioning of system of research activity; creation of reporting documentation indicating possible ways to overcome negative trends.

The monitoring tasks formulated above make it possible to assume the plurality of monitoring objects, which is consistent with [14]. In general, structures,

roles, scenarios, situations, or functional aspects may be monitored in the research system. These include some components of the research system, the process of research, the process of training future scientists, methods and technologies used, the individual components of this process, its results, various activities of the subjects of the scientific sphere (units, managers at different levels, leaders of research projects, individual researchers).

To clearly define the subject of monitoring, we will explore the interaction of such concepts as efficiency, effectiveness and quality. According to Fazivtzi, the quality of education is a complex concept, which includes the quality of educational services provided and the quality of training results for future specialists. In this case, the quality of services provided in the field of education is considered as a set of characteristics of the educational process. The evaluated criterion is the results demonstrated by graduates (for example, evaluations of the final state certification or the number and rating of published scientific papers).

Let us establish a connection between the concepts of educational monitoring and the quality of educational services. To ensure quality training, it is necessary to comply with the requirements of the vocational education program, educational standards; availability of qualified complexes of educational and methodical materials, which received positive approvals of experts from among the teaching staff. In modern conditions, quality training is impossible without the use of modern information and communication technologies; taking into account the changes that have taken place in recent years in the field of mechanisms for dissemination and exchange of information. It should be noted that such changes affect the student community the most. An important factor is the use of practice-oriented teaching methods for maximum adaptation of graduates to practical activities, which, in our opinion, is fundamental for the formation of positive motivation. Quality training is impossible without a well-developed system of monitoring learning outcomes and providing feedback mechanisms for teachers to adequately assess their own activities. The direct indicators of the quality of the teacher's activity include the programs of educational disciplines and educational-methodical complexes of disciplines developed by him.

Effectiveness is an indicator of how well organized the management of research activities in the university and the extent to which the activities of the teaching staff affect the functioning of the management system and the training of future researchers.

The effectiveness of training allows you to assess the results of the functioning of the research system according to pre-established criteria.

The subjects of monitoring are the heads of higher educational institutions and their structural subdivisions, teachers and students. An important feature of monitoring the effectiveness of research management was its multilevel nature, which took into account the complex inter-entity relationships. Monitoring involved the use of control by heads of universities, research departments, research groups, heads of departments, student assets, as well as mutual control and self-control. The latter factors were clearly preferred during the monitoring.

An important feature of monitoring was its focus on the actual results of research activities. For this purpose, their expert analytical assessment was carried out, based on the results of which recommendations were formulated in the field of management of research activities of the university. This approach contributed to the development of all subjects of education and ensured the implementation of their subjective functions.

In practice, researchers usually focus on the functions of managing the process of obtaining information about the characteristics of the object under study, the next stage is forecasting and determining further response measures.

The main functions of monitoring include diagnostic, informative, evaluative, predictive, stimulating, anticipatory and feedback function. The diagnostic function is to identify the level of readiness for professional self-realization in the research field of the future specialist. The informative function is responsible for obtaining information by the researcher about the specifics of the professional evolution of the future specialist. The evaluation function works with real and expected parameters by comparing them. The predictive function provides prediction of ways of realization of own possibilities by the future researcher. The stimulating function is responsible for increasing the motivation to develop their own professional qualities. The preventive function is aimed at identifying and neutralizing those factors and conditions that have a negative impact on the development of professional qualities. The feedback function ensures that the future researcher receives adequate information about the level of their own professional development through self-diagnosis.

The information obtained during monitoring includes the following requirements - adequacy, accessibility, objectivity, completeness, relevance, timeliness, structure, accuracy.

The main requirements of monitoring researchers include: validity, objectivity, reliability, systematics and systematicity, humanistic orientation, taking into account the characteristics of monitoring participants.

Let us define these concepts in more detail. The concept of validity is associated with a complete and comprehensive correspondence between control measures and the studied characteristics, the presence of pre-established criteria for measurement and evaluation and methods of confirming positive and negative results. Objectivity is aimed at creating a unified environment for all participants in the monitoring, the use of generally accepted research methods and taking into account both positive and negative results. Reliability reflects the degree of similarity of research results performed in different places. Systematic and systematic is the conduct of stages and types of monitoring according to a predetermined scheme, taking into account all significant aspects of the object under study. The humanistic orientation is associated with the formation of a genuine interest in the results of those involved in monitoring, by creating a psychologically comfortable psychological atmosphere and helps participants to reveal themselves as much as possible. Taking into account the psychological and pedagogical characteristics of participants is associated with determining the educational level, qualifications, general development, individual orientation of the object to certain types of scientific activities, as well as the conditions of research that differentiates diagnostic and control tasks.

Let us define the most widespread types of monitoring. Basic monitoring is to control quantitative performance indicators by periodically measuring the basic characteristics of the functioning of research activities. Dynamic monitoring allows you to track changes in performance over time. Comprehensive monitoring can combine the above types and is aimed at obtaining the most complete array of information. Universal monitoring combines different types of techniques and can be applied to a wide range of research objects (scientific, educational, organizational, etc.). Competitive monitoring also works with different systems, but focuses on a comparative analysis of their structure and functioning.

The purpose of monitoring management systems is to create algorithms of actions of management structures to perform new tasks and improve existing algorithms according to native criteria. At the same time, the received information is collected and generalized to study the current state of affairs, problem situations, consider the prospects of certain innovations, etc. The result of monitoring is the formation of systems of recommendations for further activities of management

structures. The subject of management monitoring is the interaction of different management levels: rector - vice-rector for research - research department; supervisor - student.

In the literature, pedagogical monitoring is considered as a pedagogical technology of educational activities aimed at obtaining information about the educational process, its results in the educational institution [32].

Monitoring methods are aimed at:

- accumulation of factual information (verbal: conversation, survey, practical: qualimetry, questionnaires, practice, term papers and dissertations);
- information processing and recording: qualimetry, mathematical and static;
- systematization of the received information about the researched object (formation of conclusions);
- forecasting, forming recommendations for further activities.

The information obtained can be presented in various forms. For example, dynamic indicators on a certain time interval (academic year, semester), presentation of information by comparison with similar researches, complex representation (a number of parameters are considered at once) are displayed.

Successful monitoring requires compliance with a number of requirements described in detail in previous studies.

Thus, monitoring the effectiveness of research management in higher education - is to identify trends to improve/reduce the quality of training of future researchers by collecting, processing, storing and using information, assessing the effectiveness of the management of research and forecasting prospects for university development in general.

Monitoring the effectiveness of research management in higher education is a complex system, the elements of which are the purpose and objectives, object and subject, requirements, forms, functions, methods, conditions, types, evaluation base and levels of monitoring. In our opinion, one of the important elements of a holistic monitoring system is the control and evaluation of scientific achievements of future specialists.

Criteria and performance indicators of the information support system of research management. Evaluation of the effectiveness of management of research activities in higher education is carried out using appropriate indicators - indicators.

The indicator in education is interpreted as a significant statistical array that provides information about the parameters, operation in static and dynamic modes and the results of the management system of research activities and its individual components.

Monitoring the effectiveness of management of research activities in higher education depends on a correctly defined assessment base, ie a set of criteria and indicators by which the level of quality training and activities of teachers and students. Evaluation of the results of management of research activities in a higher educational institution was carried out according to such criteria as the quality of research work of the teaching staff in the higher educational institution; scientific achievements of students of higher educational institution; the quality of the research component of the organization of the educational process in a higher educational institution. Consider them in more detail.

1. *The quality of research activities of teaching staff in higher education.*

The growth of the effectiveness of management of research activities in higher education is achieved through quality training of faculty, in particular the state of scientific potential of teachers. The higher the percentage of teaching staff has academic degrees and academic titles, the higher the indicators in the educational process and scientific work are recorded.

The effectiveness of research activities of the teacher was determined by the preparation of a PhD or doctoral dissertation, the availability of scientific publications (monographs, articles in peer-reviewed publications, abstracts, other publications), scientific guidance of graduate students, applicants, graduate students, students.

2. *Scientific achievements of students of higher educational institution.*

Monitoring of the quality of students was carried out for a different number of students, starting with individual academic groups, streams or courses and ending with the higher education institution as a whole. The qualitative composition of students was assessed by the following parameters: the average score of the certificate, the results of external independent assessment; average score of input control scores; participation in various types of university activities (research, education, public); attitude to scientific and industrial practices; current and semester success.

Participation in these activities (except for the actual educational and research) testified to the active life position of students. If a student did not participate in the mentioned types of extracurricular activities of the university, it was evaluated at 0 points, if he performed one-time assignments - 1 point, showed leadership and organizational qualities in extracurricular activities of the university (in self-government, conferences, competitions, etc.) - 2 points.

To study the effectiveness of the system of information management of research activities, the following system of criteria was formed:

- formation of graduates' professional knowledge and skills that meet the educational and qualification characteristics and the list of competencies of the specialist);
- assessment of graduates' readiness for independent scientific activity (high, medium, low levels);
- self-assessment of graduates' readiness for independent professional activity (high, medium, low levels);
- assessment of graduates' ability to innovate;
- rating of graduates;
- personal achievements of graduates (scientific works, victories in competitions, Olympiads, awards, inventions, patents);
- shortcomings in the work of graduates;
- management's attitude towards graduates.

3. *The quality of the research component of the organization of the educational process in higher education.*

We take into account the fact that the quality of the content of training of future researchers is due to the availability and proper implementation of regulations by the university management, faculty and students.

It is recommended to check the availability and quality of the long-term university development program approved by the rector's order for 5–7 years at the level of the Academic Council and the Scientific Council.

We have identified the following indicators that determine the level of development of the subjectivity of the participants of joint interconnected activities: tolerance, initiative, activity, organization, responsibility, focus on colleagues, understanding and acceptance of others, desire for cooperation, etc. The main indicator of the development of subjectivity is the guideline for cooperation and mutual understanding (multi-subject orientation).

Analysis of the organization and monitoring by the subjects management in higher education. In the process of implementing a system of information support for the management of research activities by the university administration, heads of structural units (identified as the object of monitoring) together with the research department of the university, the following actions can be implemented (as an example):

- organization of monitoring the implementation of development programs of educational and scientific institutes (faculties), departments, research groups, laboratories, their target programs, current projects, as well as analysis of monitoring results;
- organization of a comprehensive analysis of the implementation of university projects, measures aimed at ensuring the implementation of the concept of university development, as well as programs for the development of research activities; integration of self-assessment and self-analysis with mutual analysis and mutual assessment;
- formation of annual reports of structural units on the implementation of research development programs;
- conducting weekly operational meetings (directorates of educational and research institutes/deans of faculties) in order to analyze the activities of structural units of the institute/faculty;
- identification of problematic moments in the implementation of projects, implementation of individual tasks, formation of special conditions for those participants who have difficulties in performing common tasks, providing operational assistance, adaptation of activities to objective external conditions, ensuring positive dynamics of results;
- assistance to individual subjects of research activities in adjusting their own activities in accordance with the decisions obtained in the course of multi-subject interaction;
- discussion and coordination of positions on the adjustment of the research development program and its management system, joint refusal to implement ideas that are ineffective under the given conditions, as well as on new ideas that appear during the work;
- support of individual and group subjects on the way to rethinking their own experience, finding the implementation of new forms of activity by developing and testing innovative ways of working.

During the monitoring, the heads of institutes (deans), departments, temporary creative teams use the following forms of work:

- group analysis and evaluation of the process of preparation and implementation of all activities, projects related to the implementation of promising and targeted programs of educational and scientific institute (faculty), department, research group with simultaneous self-analysis and self-assessment of individual plans;
- annual progress reports on the implementation of research development programs and targeted programs;
- monitoring of subjective development of participants of research activity and efficiency of organization of scientific, educational, methodical, and other projects within the institute/faculty;
- trainings and seminars for teachers and students aimed at forming reflection;
- modification of target programs of the institute/faculty, scientific groups, departments on the basis of group reflection of innovative and experimental activity;
- modification of the content and methods of the institute/faculty, departments, research groups by taking into account modern requirements for training, processing the results of the experiment and producing new ideas;
- adjustment of the activities of entities through a comparative analysis of the basic plans and the actual results of activities;
- active acquaintance of subjects with innovative approaches to the organization of scientific activity and management;
- support of individual subjects on the way to comprehension of own experience on the basis of exchange of experience between institutes/faculties, departments, separate researchers, acquaintance with modern technologies;
- organization of mutual correction of actions on the basis of joint activities to involve the most competent specialists.

Monitoring of the effectiveness of the information support system for the management of research activities in institutes (faculties) is organized and controlled by directors (deans) and their deputies for scientific work. The organization of monitoring the effectiveness of the implementation of the system of information support for the management of research activities in higher education consists of the following stages: preparation of monitoring; data collection and analysis; generalization and publication of results; formation of a report and recommendations on the prospects of development of the studied object.

At the initial stage, the initiator of the monitoring and its direct executors agreed on the main goal. In the future, the main goal defined was specified and separate goals were outlined for it. After such clarification, the information needs of monitoring, criteria and indicators by which the observed objects or phenomena were to be assessed were determined. To successfully pass this stage, the customer had to clearly define a number of tasks, namely, what necessitated the need for

monitoring, what characteristics need to be assessed during monitoring, what is the purpose of the information, as the customer sees his own actions based on monitoring results.

At the next stage, a monitoring plan and methodological principles for its implementation were developed. To do this, the objects of research and evaluation criteria were determined, indicators for evaluation were established, and adequate methods of data collection and processing were selected. Also at this stage it is important to determine the research methodology and the main issues of the actual organization of monitoring, which will allow it to be conducted successfully. Particular attention should be paid to supporting the motivation of all participants to participate in the study.

Completion of the preparatory stage is the compilation and testing of all diagnostic materials, development of its program and coordination with the customer. Diagnostic materials include questionnaires, tests, documentation processing algorithms, etc.

Data collection and analysis. Sociological methods and tools were used to study the activities of experimental groups. The most common of them are: examination of curricula and programs, sociometric surveys and pedagogical measurements, study of the opinion of recipients, analysis of available documentation. The main criterion in choosing methods and tools was their ability to best meet the information needs of the study, namely, to form the most complete array of data reflecting the real state of affairs of the object under study, the peculiarities of its operation under current conditions. The principle of reasonable sufficiency was applied to the amount of data obtained - they should not be too much, which would complicate the process of processing and detection of significant factors, as well as not too little, which, of course, would not give a complete picture of the object.

The processes of collecting and analyzing information took place simultaneously. The parallel performance of these tasks made it possible to adjust the process of searching for additional data, use other sources of information and promptly process the data that were needed during the monitoring process. The obtained results were checked for reliability and validity. For quantitative processing of the obtained materials, statistical methods were used, calculating the basic statistical characteristics (arithmetic mean, variance, correlation coefficients).

The results of the monitoring revealed a list of promising areas of work of the administration, directorates, departments, research groups, teachers aimed at improving the quality of scientific work of future professionals, in particular:

- focus on high-quality mastering of basic professional knowledge and skills: development of special courses and special seminars dedicated to current scientific issues of today and aimed at forming in future professionals a sense of belonging to promising areas of work, relevance of knowledge not only now but also in the future; increase in the number of hours allocated for seminars and practical classes; involvement of leading specialists from specialized and related fields of science, industry for thematic lectures, seminars, focus groups, in order to form in students an objective picture of future professional activity;
- organization of students' scientific work: involvement of students in international, national, regional scientific-practical conferences and seminars and Internet conferences; involvement of students in scientific competitions, Olympiads, exhibitions; creation of a university journal for the publication of student research; increase in the number of hours of study load for the management of scientific works of students, taking into account the results of scientific work of students in the rating assessment of the faculty;

- taking into account the requirements of the credit-module system to improve the content, methods and forms of the educational process: bringing indicators of study time and characteristics of training programs in line with the standards of European universities; reduction of teaching load of teachers and optimization of document flow; introduction of information and communication technologies in higher education, in particular, development of an Internet portal dedicated to topical issues of science and professional activity for teachers and students, use of modern interactive technologies for research, interaction of teachers and students (groups, forums, etc.); use by teachers of various forms of individual work with future researchers; assistance to students in organizing independent work;
- logistical and informational support: equipping educational and scientific laboratories with modern devices and installations; increasing the number of audiences equipped with multimedia; increase funding aimed at providing scientific literature and modern periodicals, in particular, connection to existing electronic libraries, funding subscriptions to the most current publications; financial support for the participation of teachers and students in international and national scientific conferences, competitions;
- advanced training of teaching staff: organization and financial support of internships for teachers in leading universities; organization of lectures and seminars of specialists from other higher educational institutions of Ukraine and abroad; organizational and financial support for teachers who use modern methods of organizing educational and research activities; assistance to teachers in mastering foreign languages and in introducing bilingual courses into curricula.

The above promising areas of work reflect the expectations of the subjects of monitoring, aimed at improving the conditions of research activities of the university as a whole. The nature of multi-subject interaction of recipients, their involvement in joint activities at different levels and the ability to perform different roles in the mode of collective work, to find mutual understanding with partners, the desire to cooperate were assessed by the nature of individual actors. Yes, there was a fixation of the frequency of business contacts initiated by the subject; accounting for conflicts to which the entity has been involved; study of the degree of coordination of actions and the degree of satisfaction of subjects with joint activities.

The results of monitoring showed that in order to form a stable motivation for scientific activity in the system of higher education, initiative, tolerance, activity, responsibility, democratic principles of organization of relations of subjects of educational and scientific activity should be actively implemented, their functions should be expanded.

Generalization and publication of monitoring results. At the initial stage, the conditions of use of the information obtained as a result of monitoring, its dissemination and ownership were determined. The importance of this issue is due to the fact that the subjects of monitoring are university staff and, in fact, monitoring is a certain interference in their professional activities and teamwork.

To address the issue of information circulation, the organizers acquainted teachers and students with the preliminary observation data, adjusted the diagnostic monitoring materials, its methods and plan to avoid inaccuracies and misunderstandings, and ensured the confidentiality of information. Summarizing the results helped to obtain truly objective information, and its disclosure did not violate ethical standards. Each participant received information about his participation in

the study. The initiator received the most complete information on the results of monitoring, the actual content of which was determined by a previously concluded agreement. One of the conditions of the agreement was that the initiator has no right to data that subordinates, for personal reasons, do not want to disseminate.

The purpose of publishing the results of the monitoring was to provide feedback to obtain information on its effectiveness. Based on this information, the evaluators made adjustments to the strategy, methods and tools. This type of activity is extremely important.

As a result, the customer received sufficient information to form and make a certain set of decisions, adjust their own activities. On the other hand, during the discussion of intermediate and final results, the monitoring performers were able to include in the report only verified information and make an objective assessment of the state and possibilities of the research object and take into account inaccuracies and errors in organizing and conducting monitoring. .

Reporting and making recommendations. The report is the final document that was executed after the end of the monitoring. It is based on data and generalizations obtained in the process of monitoring research. The prepared report had the optimal volume and measures of detail, contained differentiated information on all aspects of the study, took into account the requests of the initiator. To do this, the degree of detail of the report was previously stipulated in the part concerning the intermediate results and methods. The main part of the report was devoted to the final results, general conclusions and recommendations.

Based on the results of the monitoring study, the following recommendations were formulated:

1. For long-term and multi-parameter monitoring research it is expedient to prepare the most complete report containing the description of conceptual bases, the received results in the textual, graphic or tabular forms, examples of the used methods and means, analytical comparisons and generalizations. A short summary is formed separately, containing generalized results and conclusions with reference to the materials of the full report.
2. The report should reflect not only the current state of the object of monitoring research. It should contain analytical generalizations, a description of trends and patterns that form the basis of conclusions and recommendations on possible ways of development of the subject, proposals for changes that should be implemented, strategies for future development of the object. Such data are of a recommendatory nature and should help the initiator of the monitoring study to develop its own program of changes in the system of organization of work in certain areas.

Monitoring the effectiveness of the information support system of management of research activities in the structural units of the university allowed to provide feedback between the process of achieving goals and the goals themselves, defined by educational and scientific institutes, departments, research groups, educational institution; to evaluate the effectiveness of innovations, the productivity of management activities of heads of institutes, departments; identify typical problems characteristic of the activities of institutes, departments, research and teaching staff; control over the implementation of promising and targeted development programs of educational and scientific institutes, departments, research groups, self-development plans of participants in the educational process; develop action programs to adjust the management system of research and educational activities, identify areas for addressing existing problems. The analysis of the results of the

monitoring study made it possible to determine the generalized indicators of the effectiveness of the research management system of the university according to the following criteria: the quality of the educational process in the part responsible for research activities in the university; the quality of research activities of the teaching staff; the level of scientific achievements of university students. It was important in determining the effectiveness of the information system of management of research activities of the university was compliance with certain requirements:

1. the relationship between performance indicators of research management and its objectives;
2. reflection of both procedural and effective aspects of management activities with the help of a certain set of indicators;
3. full reflection of the main connections, relationships characteristic of the studied system.

The identified generalized indicators of the effectiveness of the information management system of research activities reflect such a feature as the focus of activity of individual and group subjects of the educational process on the development, implementation and implementation of long-term plans and programs for the pedagogical system of universities and its subjects.

To identify the effectiveness of the information management system of research activities in the university, a comparative analysis of statistical data of the research department, reports of heads of departments of the university, documentation of departments, divisions, research groups, observation results, questionnaires in 2007 and 2012.

It is established that the most significant increase in the effectiveness of research management occurred in terms of indicators that characterize the system of planning and information support. This is explained by the fact that the introduction of a system of information support for the management of research activities primarily involved the provision of forecasting, identification of development prospects, long-term goals and ways to implement them.

Significant improvement in the effectiveness of research work has also occurred in those indicators that characterize the formation and development of international research activities of participants in the educational process. These results are explained by the focus of management activities to intensify research activities to ensure multi-subject interaction of participants in the educational process, joint regulation of activities, constant business communication, communication between entities, the dominance of cooperation; to mobilize the team to implement the development strategy, the maximum possible realization of the potential abilities of teachers and students.

2. Conclusions

It is established that the introduction of a system of information support for the management of research activities contributed to improving the quality of teaching staff, the growth of student achievement.

Thus, it is established that the introduction of a system of information management of research activities in higher education in general contributed to the growth of performance management of research activities and improve the level of training of future professionals.

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