Automating the formation of statistical data on the results of research activities of the university

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Abstract. The paper considers the formation of the concept of scientific research (SR) of universities with the task of developing an automated tool for evaluating its results. Modern requirements and trends in the organization and management of scientific research work in universities are given. The role of information support and measurement procedures in assessing the results of scientific research are emphasized. The necessity of automating the processes and reporting data of university scientific research is substantiated. An analysis of works and publications on the automation of assessment of research work of universities is provided. Names of university research activity report data are systematized and described. The model of the process of forming the university research reports is presented, which will ensure the effectiveness of information support of scientific research.

1. Introduction

New objectives in today’s conditions and priorities in research activities in higher education in the country are presented in the “Digital Kyrgyzstan 2019-2023” Concept of Digital Transformation. In this regard, the development and implementation of digital technologies are accepted as priorities in the management of scientific activities in higher education in the country. One of the key problems hindering the achievement of a high level of scientific research is the imbalance of supply and demand between the needs of the industrial and technological sphere and research structures. All this is due to the weak competitiveness of scientific and technological developments and insufficient performance of the research carried out.

The relevance of the study is determined by the fact that modern requirements for the organization and management of scientific activity impose new requirements for the assessment of its results, optimization of business processes, as well as providing information support, which is one of the modern methods of modeling research and development work (R&D). Insufficient level of development and utilization of information technology in the KR also causes the need to introduce modern methods and digital

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technologies for planning, organizing and managing research activities in higher education, providing automation of related business processes and objective assessment of the results of scientific work objects. Management of research and development work of higher education institutions, both as a scientific concept and as a tool for practical management activities, has recently been gaining momentum in the field of educational system management.

Organization and management of research and development activities of universities with the target of ensuring its effectiveness are accepted as one of the most important conditions for knowledge economy, formation and implementation of the model of universities 4.0, as well as the transition to innovative development in universities. The focus on the analysis of research activities in universities and its results are also due to current trends in science and education thanks to integration processes and adopted programs at the national and institutional levels on the participation of universities in world university rankings.

The object of the study is the management system of research and development activities in the university, the level of achievement of which is determined by measurable quantitative and qualitative indicators of research.

The subject of the study is the business processes of the organization and the results of research and development work.

The objective of the study is to build an information system to automate the processes of collection and processing of scientific activities reporting data on the example of the I. Razzakov Kyrgyz State Technical University.

Setting the research objective. The process of ensuring the effectiveness of research activities of universities and its assessment is a complex task, to solve which it is necessary to develop methods to automate the reporting of scientific research results according to the regulatory functions of the activity.

2. Materials and methods

Methods of system analysis, mathematical statistics, management theory, process approach, business process modeling and information system design for the educational system are used according to the concept of the organization of scientific research.

Exchange of experience and results obtained in the experimental research and dissemination of experience in the implementation of methods is one of the objectives of the article.

Due to the increasing importance and role of scientific research in universities and its results in achieving recognition of universities by consumers of educational services and the public, as well as ensuring competitiveness, it is necessary to analyze the entire chain of business processes to improve their functioning. At the same time, it is important to establish a clear functional and logical links in the general system of technological processes of scientific research evaluation, which, in the authors’ opinion, is convenient to be considered in the developed scheme of the concept of university research activity organization (Fig. 1).
The main prerequisite for the organization of scientific research in the university as a function of organizational and managerial unit is the needs of industrial and social spheres in solving existing problems, implementation of future tasks, orders of government programs, consumers, etc. In this case, the executors of scientific research should be guided by the requirements of legislation, regulations of technological processes and other regulatory mechanisms of activity.
In order to achieve a high level of work organization the goals and objectives of scientific research should be formulated. The objectives of scientific research activities of the university are to ensure the unity of science and education, its competitiveness among the world’s leading research and educational centers, increasing its role in the scientific, technical, social, economic and cultural development of the country in a global knowledge-based society.

In performance of scientific research, it is necessary to have resource, information, technical, and communication base, which demands formation of scientific schools, realization of scientific personnel training system. Universities should reach a new level of international recognition as a leading research and innovation institution, competitive among the world’s leading scientific and educational centers based on modern scientific infrastructure. At the same time, it is necessary for the university to operate the concept of “knowledge triangle” – a triune function of education, science and innovation development.

New trends in the organization and management of scientific activity impose new requirements for the formation of priorities and commercialization of research results, evaluation of its results, optimization of business processes, as well as providing information support. In this regard, there is a need to develop measures and recommendations to improve the current situation, conduct applied research, which will make a tangible contribution to the growth of competitiveness of the country.

Taking into account the current level of socio-economic development of the country and in order to ensure its compliance with the modern requirements of the international community, the focus is made on the applied research and directions in those sectors of production and social spheres, the results of which will make a tangible contribution to the growth of competitiveness and economic indicators of the country.

Any research requires an experimental base according to the methodology of science. To achieve that it is necessary to develop a system of measuring tools, criteria, reporting data indicators, research results evaluation, data collection and processing, etc. These actions should be defined and justified by appropriate research methods, tools and models.

For quantitative assessment of the research results it is important to form a system of indicators, the value (level of achievement) of which is determined according to the established evaluation criteria. In this case, the assessment of the results and the adoption of recommendations on the research results are made according to achieved indicators.

The research group, according to the objective, conducted the state-of-the-art review on the problem in question.

According to the results of the review studies, it should be noted that various automated systems of research activity management, both on national and institutional levels, have been developed and are implemented in practice [1]. At present, such a methodology has not yet been developed in the system of higher education of the Kyrgyz Republic.

The issues of analyzing the scientific research results, including the automation of its processing and evaluation are considered in various publications and works. Reports on research work of the university based on the automation of activities with the use of software is formed in the “1C: University PROF” information system [2]. This software covers many business processes of the university, including the scientific research results [2-7].

Large-scale transformations acquired in the implemented programs of digital transformation also lead to the need for detailed analysis, description, monitoring, evaluation of business processes for modeling the activities of universities, including the scientific research.

The main task of the theory and practice of scientific activity management is to ensure the effectiveness under given resource, time, information, social and other parameters, criteria from the state, society, consumers of services, etc. In this regard, the study,
form and improvement of instrumental mechanisms for assessing the results of university scientific research becomes an urgent task of current time [3].

An important role in assessing the results of scientific research is played by the work with information materials, analysis, data processing, comparative and evaluation procedures in accordance with boundary and regulatory indicators, etc.

Various forms of information, certificates, tables and other information materials constitute modern characteristic of the analysis of the design of reporting data of scientific research results monitoring and evaluation. A large number of scientific activity participants take part in formation, preparation and summarizing of the above. At the same time, logical links and continuity of the contents of reporting materials in many cases have insufficient information load and disjointed forms that negatively affect the objectivity of results. This state of affairs can be eliminated by the development and implementation of the informational and analytical system of the scientific research management.

3. Results and discussion

Based on the analysis of the organization and evaluation of the scientific research results performed in the country [4], the following main problems and shortcomings in scientific activities can be noted:

- insufficient contribution and results of scientific research to the solution of urgent issues of social and economic development of the country;
- Insufficient mechanisms and lack of an effective system of management of scientific research in the hierarchy of research and development;
- lack of developed procedures for planning, implementation, monitoring and evaluation of the results of scientific activity;
- insufficient post-graduate training of scientific personnel;
- low level of publication in Scopus and Web of Science scientometric databases.

The recommendations concerning the structure of the static data of scientific activity should be considered. In some cases, the following approach to the formation of static data is recommended. The first part of it contains information that allows uniquely identifying the owner and the data in tabular form, describing personal achievements. The second part of the static data contains additional information – a set of documents confirming the achievements described in the first part of the static data [9]. There are also more detailed recommendations for creating static data that contain a precisely formulated structure. The authors consider such structure on the example Kyrgyz State Technical University. The structure is as follows:

<table>
<thead>
<tr>
<th>Full name, academic degree, academic rank;</th>
</tr>
</thead>
<tbody>
<tr>
<td>management of doctoral students and postgraduate students;</td>
</tr>
<tr>
<td>research management;</td>
</tr>
<tr>
<td>Scientific research results;</td>
</tr>
<tr>
<td>publication;</td>
</tr>
<tr>
<td>monograph publication;</td>
</tr>
<tr>
<td>Patents and copyright certificates;</td>
</tr>
<tr>
<td>Hirsch index in the RSCI;</td>
</tr>
<tr>
<td>publication of articles in Web of science / Scopus;</td>
</tr>
<tr>
<td>Publication of articles in the KR and abroad, not included in the indexed bases;</td>
</tr>
<tr>
<td>International and republican scientific projects;</td>
</tr>
</tbody>
</table>
Fig. 2. Structure of the static data on the research activity of the university.

Further using these data it is possible to form the report on scientific activity on structural divisions on the following parameters: number of doctoral candidates and post-graduate students, management of research work, publications of monographs, copyright certificates and patents, articles in the RSCI, Web of science, Scopus, participation with reports in scientific forums, conferences, seminars, number of trainings, guest lectures, mobility [6-7-8].

With the help of the activity diagram the actions are shown, the states of which are described in the state diagram [3-8]. In addition, in the process of designing a functional model of the process of forming reports on scientific research activities of the university in the information system (Fig. 3), the decomposition is built (Fig. 4-7).

![Diagram](image-url)

Fig. 3. Functional model of external report processing.
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**Fig. 4.** Decomposition of functional model.

**Fig. 5.** Decomposition of the functional model on the system level.
Fig. 6. Decomposition of the functional model of static data processing.

Fig. 7. Decomposition of the functional selection of external report.
4. Conclusion

Based on the analysis of the current state of the collection, recording and evaluation of research data in universities, the need to develop and implement an innovative system for automating the processes is an obvious condition of solving current objectives. The process of automating the scientific research of the university based on an automated system provides an operative and objective assessment of the research results, saving time and labor costs. In this paper, the authors consider an example of automation of reporting the scientific research data in Kyrgyz State Technical University. The process of generating reports on scientific research activities of the university in the information system is designed, the decomposition of the process is made.

References


9. Body of knowledge on business process management (Alpina Publisher, 2020)