УДК 004
МРНТИ 20.15.00

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AN INFORMATION SYSTEM FOR THE PREPARATION OF APPLICATIONS FOR PARTICIPATION IN GRANT FUNDING OF SCIENTISTS IN SCIENTIFIC PROJECTS

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Abstract. One of the factors of development in the research direction is the activity of university staff and teachers in participating in grant funding competitions. The high activity of researchers in this direction will allow the implementation of new projects, which, in turn, will contribute to attracting additional funding to the university, obtaining significant research results. Applications for participation in grant funding competitions are submitted according to the announced competitions for their holding. According to the terms of the tender documentation for grant

financing, applications submitted must meet a number of requirements. The article is devoted to developing an information systemdesigned to record applications submitted by the faculty and staff of the university for participation in grant funding, as well as assisting in the design of the application and preparation of tender documentation. The authors offered innovative approaches to automate the process of checking applications to find errors.Based on the application's verification results, recommendations or errors to modify the application to increase its level are being constructed.This task has relevance, as it affects the development of scientific activities of the university. The developed software solutions and the results of their successful integration with the information management system of the university offered. In addition to checking applications, the developed system allows for collecting statistical data on submitting applications to universities in general and individual units.

Keywords: information system, information technology, research projects, verification rules, database, application registration

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ҒАЛЫМДАРДЫҢ ҒЫЛЫМИ ЖОБАЛАР БОЙЫНША ГРАНТТЫҚ ҚАРЖЫЛАНДЫРУҒА ҚАТЫСУҒА ӨТІНІМДЕРІН ДАЙЫНДАУДЫҢ АҚПАРАТТЫҚ ЖҮЙЕСІ

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Аннотация. Ғылыми бағыттағы даму факторларының бірі университет қызметкерлері мен оқытушыларының гранттық қаржыландыру конкурста-

рына қатысу белсенділігі болып табылады. Зерттеушілердің бұл бағыттағы жоғары белсенділігі жаңа жобаларды жүзеге асыруға мүмкіндік береді, бұл өз кезегінде университеттен қосымша қаржы тартуға және маңызды ғылыми нәтижелерге қол жеткізуге мүмкіндік береді. Гранттық қаржыландыру конкурстарына қатысуға өтінімдер беру оларды өткізуге жарияланған конкурстарға сәйкес жүзеге асырылады. Гранттық қаржыландыруға арналған конкурстық құжаттаманың шарттарына сәйкес берілетін өтінімдер бірқатар талаптарға сәйкес келуі тиіс. Мақала гранттық қаржыландыруға қатысу үшін ЖОО ПОҚ мен қызметкерлері беретін өтінімдерді есепке алуға, сондай-ақ өтінімді рәсімдеу және конкурстық құжаттаманы дайындауға арналған ақпараттық жүйені әзірлеу мәселелеріне арналған. Авторлар қателерді табу мақсатында өтінімдерді тексеру процесін автоматтандырудың өзіндік тәсілдерін ұсынады. Өтінімдерді тексеру нәтижелері бойынша қателерді түзету қажеттілігі немесе конкурста оның деңгейін арттыру мақсатында өтінімді өзгерту жөніндегі ұсынымдар қалыптастырылады. Бұл міндеттің өзектілігі бар, өйткені ол университеттің ғылыми қызметінің дамуына әсер етеді. Әзірленген бағдарламалық шешімдер және олардың университетті басқарудың ақпараттық жүйесімен сәтті интеграциясының нәтижелері ұсынылады. Өтінімдерді тексерумен қатар, әзірленген жүйе жалпы ЖОО-ларға және жеке бөлімшелерге өтінімдерді беру процесі туралы статистикалық деректерді жинауға мүмкіндік береді.

Түйін сөздер: ақпараттық жүйе, ақпараттық технологиялар, ғылыми жобалар, тексеру ережелері, деректер базасы, өтінімдерді тіркеу

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ИНФОРМАЦИОННАЯ СИСТЕМА ПОДГОТОВКИ ЗАЯВОК ДЛЯ УЧАСТИЯ В ГРАНТОВОМ ФИНАНСИРОВАНИИ УЧЕНЫХ ПО НАУЧНЫМ ПРОЕКТАМ

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Аннотация. Одним из факторов развития в научно-исследовательском направлении является активность сотрудников и преподавателей вузов в участии конкурсах грантового финансирования. Высокая активность исследователей в этом направлении позволит реализовать новые проекты, что, в свою очередь, будет способствовать привлечению дополнительного финансирования университета, получению значимых результатов исследования. Подача заявок на участие в конкурсах грантового финансирования осуществляется согласно объявленным конкурсам на их проведение. Согласно условиям конкурсной документации на грантовое финансирование, подаваемые заявки должны соответствовать ряду требований. Статья посвящена вопросам разработки информационной системы, которая предназначена для учета заявок, подаваемых ППС и сотрудниками вуза для участия в грантовом финансировании, а также помощи при оформлении заявки и подготовки конкурсной документации. Авторы предлагают оригинальные подходы по автоматизации процесса проверок заявок с целью нахождения ошибок. По результатам проверки заявок формируются необходимость исправления ошибок или рекомендации по изменению заявки с целью повышения ее уровня в конкурсе. Данная задача имеет актуальность, так как влияет на развитие научной деятельности университета. Предлагаются разработанные программные решения и результаты их успешной интеграции с информационной системой управления вузом. Помимо проверки заявок, разработанная система также позволяет собирать статистические данные о процессе подачи заявок в вузы в целом и в отдельных подразделениях.

Ключевые слова: информационная система, информационные технологии, научные проекты, правила проверки, база данных, регистрация заявок

Introduction

The purpose of evaluating the activities of teachers is to stimulate the growth of qualifications, professionalism, effectiveness of pedagogical and scientific work, the development of creative initiative of teachers. The evaluation results are the information of the educational institution and can be used as a basis for determining the validity of the contract, material and moral encouragement of teachers and the development of measures to improve the quality of training specialists.

If a teacher's performance evaluation system contains a small number of obvious and generally accepted evaluation parameters, regardless of subjective factors, then

it can be considered optimal if it is relatively simple and understandable for the teacher's activity, if it provides an adequate assessment of the teacher's activity. It is known that the activity of a teacher covers such types of work as teaching, research, organizational and educational. Accordingly, the evaluation of the teacher's work should be carried out taking into account the quality indicators of each type of work.

The effectiveness of implementing scientific activity processes determines the quality of solving such problems as search and provision of access to research papers. Providing timely information about scientific events and participation planning ensures the opportunity to publish the research results in high-ranking publications. The involvement of the teaching and research staff in this direction allows the opportunity to implement new projects that contribute to attracting additional funding to the university and obtaining significant scientific results. The realisation of the scientific interests of the teaching staff through grant funding is very relevant.

When the teaching staff and researchers are informed about new competitions, it is necessary to organise business processes and deliver pieces of advice to them when completing the application. Therefore, it is essential to increase the number of university applications submitted and ensure their quality content—the solution to this issue by information technology in the organisation of application processes. The use of IT will allow users to organize assistance in decision-making.Thus, the transfer of Kazakh science to new principles of financing, which are associated with the development of the grant system, requires new forms of information work.

Literature Review

The development process of most software products sooner or later leads to implementing mechanisms for adding, storing and retrieving information for subsequent processing. The optimal information retrieval path is one of the critical problems in computer science. The leading solution to this problem is a variety of database systems perfectly cope with these tasks at the software level. However, if in the system's functionality, there is a need to work directly with the user's query, often consisting of several criteria, the processing of the results ultimately falls on the shoulders of the user (Silva et al., 2021). In such a situation, the problem of creating a conceptual model of automatic verification of technical documentation that optimally meets the needs of users becomes particularly relevant.

In their work, the authors (Sonia Bergamaschi, 2016) consider solving the problem of keyword searching in relational data by transforming keyword queries into one or more SQL queries to run a relational DBMS. Finding such questions is challenging because the modelled information can be in different tables and attributes. It means identifying the schema elements where the data of interest are stored and discovering how these elements are interrelated. The authors have divided the problem into three stages: the first considers what the user has in mind when formulating keyword queries, and the second is how the data represents in the database schema. Finally, the third stage combines the two processes.

It noted that ontologically controlled information systems today are one of the most significant branches of the development of intelligent information systems. Construction features of their have a close relationship with the development of the theory and design bases of automatic text checking models, as well as to develop of theoretical foundations and design methodology, including the formal approach, fundamental principles and mechanisms, generalised architecture and system structure, the standard model and design methodology of the subject area ontology, formal model of knowledge representation, generalised algorithms of knowledge processing procedures, etc. (Palagin and Petrenko, 2008). It is vital to create an automatic system for checking technical documentation. In this context, a comprehensive formulation of specific problems should increase the value of automated text checking programs and facilitate the search for their solutions.

According to (Panos Constantinides, 2018), cutting-edge research in information systems, strategic management, and economics has deepened our understanding of platforms and infrastructures in the digital age over the past few years.

The results of scientific work come in different forms, arise at different stages of the research process and are determined by various concepts associated with them. Firstly, these are the stages of research at which they are produced. There are several stages: from the search for information to the dissemination of results.

In each of them, the researcher conducts activities aimed at achieving the result. Secondly, the research results themselves come in various forms: from traditional articles to data sets obtained from experiments or the researcher's knowledge underlying hypotheses. They can be divided into content, data and information. Thirdly, a number of tools are used to obtain results, which can be classified according to the result provided by them.

Fourth, another level of accessibility can be achieved to the results, consisting of the degree of openness to the scientific community and integration into existing systems of organizing research information. The study for the first time offers an information model of the results of the study, combining the considered characteristics. This material can be useful for organizing research work, especially at the level of managers and heads of research groups (Begler, 2017).

As such, a review of the available literature on the topic allows us to conclude that the transition of Kazakh science to new funding principles associated with developing the grant system requires new forms of informational work.

Materials and methods

Figure 1 presents an information model which analyses the process of implementing the scientific activities of researchers (undergraduates, doctoral students) and university teachers. This model describes the methods of interaction between the participants and the results of their scientific activity in the university's information system.The analysis of the model and the subject area allowed us to identify the main problem areas related to decision-making and the search for relevant information:

— Selection of the supervisor or students, taking into account scientific interests;
— Selection of periodicals for publication of scientific results;
— Selection of scientific events for participation;
— Selection of competitions, grants for research funding (Popova, 2013);
— Search for significant publications on a given topic.
   The following vital objects distinguishin the built model:
— Supervisors and researchers - users of the information system;
— Scientific events - conferences, seminars, round tables, etc.;
— Publications in periodicals;
— Publications (periodicals).

The methods of frequency analysis and information technology make it possible to analyse the links between the scientific interests of the participants, ongoing research, relevant grant funding competitions and events. According to the analysis results, recommendations creates to solve the tasks. As the presented model shows, the leading information objects considered in this article connect through keywords, which form the object's profile or the so-called «area of scientific interest».
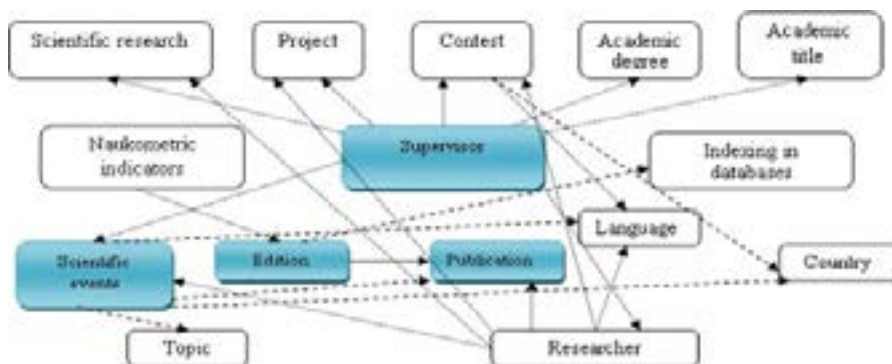
Fig. 1. Information model of the scientific activity implementation process

The proposed approach allows for forming a scientific user profile of the information system. Completeness of profile information depends on the accuracy of recommendations, therefore — effectiveness of the development of the scientific activity of the university. When analysing the data, it is necessary to prioritise those or other scientific interests properly. The solution to this problem has its features since the formation of the profile uses many sources of information.

Results

The researcher's Automated Information System (AIS) develops to assist researchers and research staff in submitting applications for competitions and projects. This AIS makes it possible to perform the initial processing of applications and the preparation of data and documents.

Using information technology, namely the development of an automated system

of verification of documents, will check the frequently occurring errors, which will improve the quality of applications. It is necessary to develop algorithms for automating processes, use the experience of practical work in creating decision support systems and practice their implementation in the education field.

Currently, in Kazakhstan does exist a system via applications for participation in various competitions held by JSC «National Center of Science and Technology Evaluation» (JSC «NCSTE»). Applications develop by completing interactive forms on the website. The most frequently asked questions and answers, instructions, submission of applications from individuals and legal entities, and forums are published by the site where the competitive documentation is placed [https://is.ncste.kz/login].

These application systems allow users to avoid basic mistakes when completing online forms and check all sections filled with information. There are some difficulties and inconveniences in filling the project data on the website of JSC «NCSTE» (Table 1).

Table 1. Disadvantages when filling out the application

№	Name of sections	
1	Basic information	The list of publications filled in the profile does not automatically transfer. The rubric must correspond to the profile If there is no foreign partner, you cannot put a "-" sign
2	Calculation of requested funding	Total amount only when clicking on data for years 1, 2, 3 Funding for business trips is counted only per person No export of data to Excel The plan is not exported Cannotsave data for each item individually
3	Research Group	-
4	Required documents for participation in the competition	-
5	Abstract	1. You need to add a save button for each field separately

Based on existing research analyses, organisation of information systems training and decision-making assistance and the application process through the NCSTE AIS — approaches developed to facilitate checking applications process and identifying the most typical errors in their compilation through information technology. The main idea of the used approaches is the researcher registers the application in the AIS by completing a card with the basic information. When saving the card, the system checks have the main areas filled correctly and, if necessary, prompts an error message and offers changes or recommendations to improve the application's competitiveness. Monitoring the correctness of the information is conducted with the methods of data integrity control in information systems. For each case, different verification rules follow the conditions of the tender documentation.

Discussion

In the scope of this work, the following information characteristics provide to determine the verification rules:

− Name. The name of the validation rule.

− The type of rule verification. It could take two values: restriction or recommendation. If a rule with the restriction type violates, the system will display a message and will not allow the application to save the card until the user changes it to execute the verification rule. In another case, the system will display a message about the recommendation to change the application, and the final decision will remain with the user.

− Validation condition. It is set with the SQL language and returns two possible values of boolean type:
true and false.
− Description. A detailed description of the test rule.
− Warning. If the rule violates, a message will display to a user.
− Contest. Information about the contest rule.

The choice of the SQL language sets the conditions for checking because, as a DBMS, the ORACLE DATABASE uses. Therefore, SQL queries will be convenient to check the fields of the application card and access the data of other entities used as reference information. For example, check participants' age, scientific degrees, and positions.

Approximately ten rules have been formed for checking applications. These rules are collected based on the competitive documentation on grant financing of scientists on scientific and scientific-technical projects of the Committee of Science of the Ministry of Education and Science of the Republic of Kazakhstan. Table 2 provides examples of several screening rules. This table will be supplemented with additional restrictions and recommendations by the tender documentation in the future.

Table 2. Restrictions and recommendations in accordance with the tender documentation

Contest	Name of the rule	Type	Description	Message
MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN	Checking overlap by executors within a lot	Restriction	According to the requirements of the tender documentation item 5 [5]. an individual has the right to participate: as a scientific supervisor - not more than 1 (one) project, and as a team member - not more than 1 (one) project	The employee is already participating in this lot as a leader of another project; The employee is already participating in another bid for this competition.

			as a team member, not being a scientific supervisor - not more than in 1 (one) project	
MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN	Checking for the number of keywords	Restriction	According to the requirements of the tender documents, there are not more than 15 terms	No more than 15 terms are listed
MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN	IRSTI (Interstate Rubricator Of Scientific And Technical Information) code	Recommendation	There are no more than 5 codes	No more than 5 IRSTI codes are given
MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN	Verification of the research group of the project for the number of people	Restriction	According to the requirements of the tender documentation, the total number of members of the research team of the project, including the project manager - not more than seven (7) people	The total number of members of the research group of the project, including the project manager - not more than 7 (seven) people

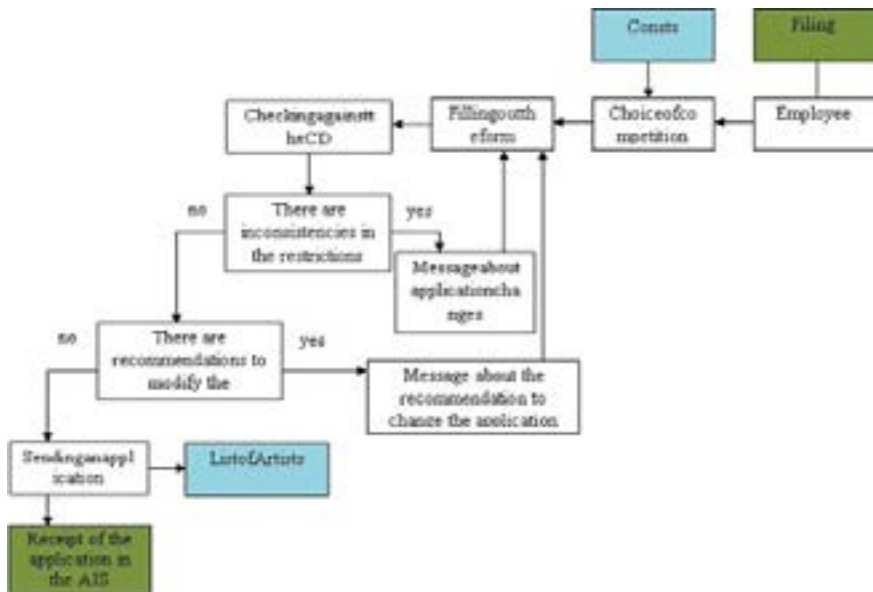*Fig. 2.* shows the application registration process in the AIS system.

Fig. 2. Registration of an application in the AIS system

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The first step is selecting the necessary contest. The user only has access to the current competition, and the second step requires filling fields in the form. The next step is performing an automatic checking process of information according to the requirements of the tender documentation. In the fourth step, a message about needing to change the application if there are violations of restrictions or errors in the form displays.In this case, information is not to be saved by the system, and the user proceeds to edit the form to the second step. If there are no errors and violations, the customer moves to the next step. The following stage is performing data analysis and offering recommendations for modifying the application to improve it.The appropriate suggestion is presented to the user when the system forms the recommendations.

Consequently, the user can proceed to the editing of the request or reject the offers and save the application in this form. In the sixth step, the data comes into the AIS database. In the last stage, the user needs to print an application appendix with a list of performers from the system after sending the application. This document will have a unique code. This stage is necessary that all changes in the application made by staff members are recorded in the system and permit directly finding the application using a unique code.
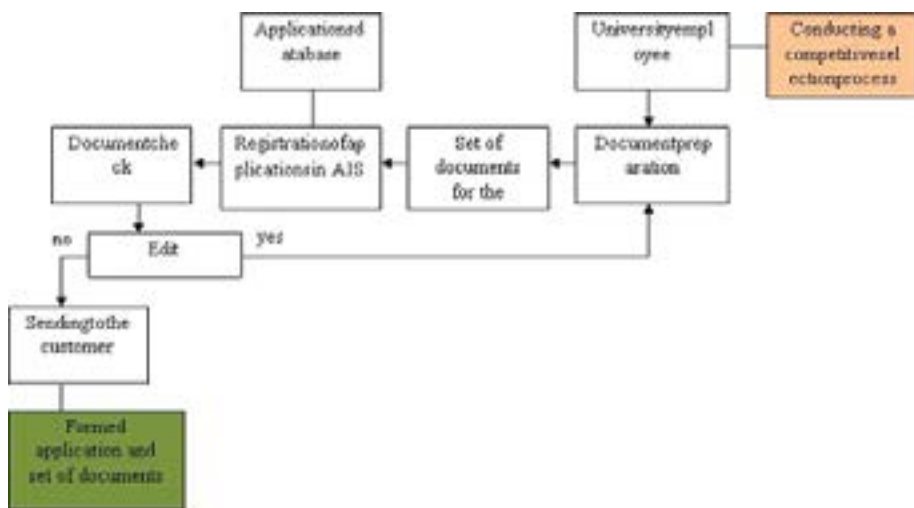

Fig. 3. Scheme of the process of preparation of application documents

The proposed method of verification of applications has been implemented in the subsystem of applications accounting. Figure 3 shows the general scheme of preparation and reviews of the provision of documents on the application, and Figure 4 presents an example of work with the application.

Fig. 4. Example of working with an application

Conclusions

When checking the application card, a violation of the rule with the type of restriction was detected. According to the check results, the user is informed that two performers are participating in another application in the same competition, which is unacceptable based on the terms of the tender documentation. The proposed method of automatic verification of the card and the data model allows for further system development to improve the quality of submitted applications. The developed information system has been implemented and is functioning successfully. In addition to the initial processing of applications, it also allows the staff of the scientific department to receive information about the application process, collect information for internal use and provide it to other organisations, if necessary. It also planned to create a training system for preparing «highquality» and «competitive» applications for participation in various competitions. This system makes it easier for employees to fill out an application and for specialists to check it.

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