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FINANCIAL-MATHEMATICAL MODEL FOR ENSURING NATIONAL TECHNOLOGICAL INITIATIVE PROJECTS IN HIGHER EDUCATION INSTITUTIONS

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Abstract

This work considers the financial and economic and organizational model to stimulate the priority development of the project and practical component of the implementation process of educational programs in terms of per capita financing of the educational process for inclusion in the ecosystem, ensuring the implementation of projects of the national technological initiative. This methodology takes into account features of the EP, the degree of complexity of organization of the educational process, saturation of each block of different disciplines, the student body, the possibility to combine different student groups. Research and academic and innovation system of the University can be represented as a structure of interrelated project groups. A set of targeted and threshold indicators for each reporting period is defined for each project. The implementation of qualitative and quantitative indicators of the thresholds is a prerequisite for the recognition of the successful implementation of the project in the reporting period. The achievement degree of the targeted indicators is an indicator of the effectiveness of the project and determines the amount of its further funding.

Keywords: Educational process, financial-mathematical model, higher education institutions, national technological initiative, project activities.

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1. Introduction

This work is devoted to the financial and economic functioning models of innovative ecosystems in higher education institutions. It should be noted that there are several approaches to the definition of this concept. In particular, in (Ivanov, 2010) the innovation system is defined as a set of institutions that ensure the acquisition and use of new knowledge. As noted in Ermolenko et al. (2018), the main feature of the innovation ecosystem of the University is that it includes several different objects of innovation infrastructure. They included about 30 objects (business incubators, technology transfer centers, technology parks, venture funds, etc.). All this makes the innovation ecosystem of the University a complex environment as a subject to management, which does not have clear structural bonds, hierarchical links, target goal, development strategies, etc. In the same work, a project-oriented approach to the management of the University ecosystem is proposed (Aleshchanova et al., 2017).

2. Problem Statement

The control should be established not only over functions and processes but also over a portfolio of projects bound together by common goals and resources. At the moment, the infrastructure of the University ecosystem may include small innovative enterprises, engineering centers, common use centers, research and educational centers at universities, organizations and structural units included in the circle movement of NTI (centers of youth innovation creativity, quantoriums, houses of scientific collaboration, etc.), all of them are engaged in the implementation of certain projects of NTI, which are included in the specified portfolio of projects. Each project can be financed from different sources: federal budget, regional budget, municipal budget and extra-budgetary funds of the educational organization.

3. Research Questions

The work of Korolkov et al. (2019) proposes a model for the inclusion of practice-oriented educational programs of higher education in the innovation ecosystem of the University, ensuring the implementation of projects of the national technological initiative. The present work develops the ideas proposed in this article and offers a mathematical and economic model to form budgets of project groups.

Efficiency issues of financial management in higher education are reflected in a number of studies. Gukova et al. (2015), Korolkov et al. (2014), Losev et al. (2017) have developed a financial and mathematical model for the budgeting of the structural units of higher education institutions, including a new algorithm to form the payroll fund (PRF) for the academic teaching staff of the University departments. Within the framework of the proposed approach, department financing is carried out in proportion to its shares sum in the implementation of the educational process of all education programs (EP). The share of each department in implementing the EP educational process in a study year is determined on the basis of the EP curriculum. In addition, a management model for the financing of scientific-research and project groups of the University was developed, the ultimate goal of which is to achieve the main performance targets of the University. Let's consider this model in more detail.

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4. Purpose of the Study

This work considers the financial and economic and organizational model to stimulate the priority development of the project and practical component of the implementation process of educational programs in terms of per capita financing of the educational process for inclusion in the ecosystem, ensuring the implementation of projects of the national technological initiative.

5. Research Methods

We presuppose on the basis of the curriculum EP (Korolkov et al., 2014):

Coef_disc is the coefficient of the workload of the discipline, which takes into account the specifics of the educational process in teaching particular discipline (the method of determining this coefficient will be described below);

Work_disc is the workload of the discipline within the curriculum in credit points;

Work_enum is the enumerated workload (in credit points) of this educational course considering the EP calculated according to the formula

$$\text{Work\_enum} = \sum \text{Coef\_disc} \times \text{Work\_disc}, \quad (1)$$

where the summation is conducted in all disciplines of this educational course, considered EP.

The share of each discipline Sh_disc curriculum considered EP in the current year of study is defined as

$$\text{Sh\_disc} = \frac{\text{Work\_disc}}{\text{Work\_enum}}. \quad (2)$$

The share of each department Sh_dep in the implementation of the educational process EP specific study year is calculated as the sum of the shares of disciplines for which the department is providing:

$$\text{Sh\_dep} = \sum \text{Sh\_disc} \quad (3)$$

PRF ATS (PRF_dep) is determined finally. It is necessary for the functioning of the specialized department, in the form of total funding for all EP, in the implementation of which the department is involved:

$$\text{PRF\_dep} = \sum_{all\ EP} \sum_{all\ courses} \text{Sh\_dep} \times \text{B\_stud} \times \text{Norm\_financ\_EP} \quad (4)$$

Here B_stud is the actual student number attending a specific course under consideration, EP,

Norm_financ_EP is a normative part of financing the EP (in rubles per student) allocated by the University to pay the ATS (routed to the PRF ATS). The normative part may differ both for different EP and for different courses of one EP.

Value Coef_disc was defined as follows (Korolkov et al., 2014). On the basis of the curriculum of EP and internal regulations of the University, we believe the following values are known:

x – the number of classroom hours in the current academic year, according to the curriculum assigned to the lecture on the discipline;

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y – the number of classroom hours in the current academic year, according to the curriculum allocated to seminars on the discipline;

z – the number of classroom hours in the current academic year, according to the curriculum assigned to laboratory practicals on the discipline;

S_p is the standard official salary of the professor (Doctor of Science) established at the University;

S_ap is the standard official salary of associate professor (candidate of sciences), established at the University;

S_sl is the standard official salary of a senior lecturer (without a degree), established at the University;

S_a is the standard official salary of an assistant professor (without a degree), established at the University.

Let l be the average number of subgroups in the group for laboratory work.

We define the coefficients of the workload intensity of different teaching load as follows:

$k\_x = \frac{O\_\partial}{O\_c}$ – the workload coefficient of the implementation of lectures load;

$k\_y = 1$ – the workload coefficient of the implementation of the seminary's load;

$k\_z = l \cdot \frac{O\_a}{O\_c}$ – the workload coefficient of the implementation of the laboratory load.

Note that one of the possible options for determining the coefficients of the workload intensity for different teaching duties is given.

The coefficient of workload for the disciplines of the basic and variable part of block 1 of the curriculum is calculated as follows:

$$Coef\_wl = \frac{\xi \cdot k\_x \cdot x + k\_y \cdot y + k\_z \cdot z}{x+y+z}, \quad (5)$$

where the value $\xi$is formed as a coefficient of the complexity of the organization of the educational process, linking the contingent of the student body and the possibility of combining different student groups into streams. Let us dwell on this. In many universities, internal regulations established mandatory for inclusion in almost all curricula EP disciplines, lectures on which are held in large united streams. Moreover, the timetable of such lectures is strictly regulated and is mandatory for almost all EP. It is obvious that the financial expenses of lectures on general disciplines are relatively small because one lecture with a large number of students involves one teacher. Accordingly, the definition of the share of such disciplines in the curricula of the EP on the same principle as the definition of the share of other disciplines in the curricula of the EP will lead to an unjustified increase in the PRF ATS providing these disciplines of the departments. In this paper it is proposed to determine the coefficient ξas follows:

$$\xi = \begin{cases} \frac{Q+A*M_{\text{stream}}}{Q+A*M_{\text{stream}}} \cdot \frac{M_{average}}{M_{\text{stream}}}, & if\ the\ discipline\ is\ a\ general\ univercity\ course; \\ 1, & if\ the\ discipline\ is\ not\ a\ general\ univercity\ course. \end{cases} \quad (6)$$

Here:

Q - the size of the annual classroom lecture load (in hours) on the discipline,

A - the cost for an extracurricular load of the teacher in total for the whole year per student in hours (in the Volga accepted for 0.5 hours),

M_{stream} - the average value of a contingent of one stream during the sessions of lecture-type,

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$M_{average}$ - the average value of the contingent constitutes one academic group.

The coefficient workload for the disciplines of blocks 2 and 3 of the curriculum (practice, research work, and final certification) is defined as

$$Coef\_wl = \frac{O\_n}{O\_c}. \quad (7)$$

As indicated in Korolkov et al. (2014), the described methodology and algorithm of formation of the PRF ATS of structural divisions, which is based on the definition of the share of providing departments in the curricula of the EP, solves the following problems: overcoming the costly nature of most currently used in some universities methods of distribution of financial resources, leading to an increase in the total study load of the University and, as a consequence, the volume of the average study load per 1 rate of ATS; overload curricula specialties and program track, their imbalance, duplication of the same topics in the study of various disciplines, leading to overload of the classroom fund, the problems of its technical re-equipment, etc. This methodology takes into account features of the EP, the degree of complexity of organization of the educational process, saturation of each block of different disciplines, the student body, the possibility to combine different student groups. In addition, it allows you to configure the planning system of the educational process in the educational organization to the optimal parameters, including the average study load per 1 rate of ATS, the composition of lecture streams, the number of implemented professional educational programs, the load of the classroom fund, etc. (Matova, 2019; Politsinskaya et al., 2019; Tarakanov et al., 2019).

6. Findings

In the financial and mathematical model developed in Korolkov et al. (2014), the following values are provided as parameters:

$coef_p$ – coefficient of the workload of the p discipline of the curriculum, which takes into account the specifics of the educational process in the studying of specific disciplines;

TR_p – the workload of the p discipline of the curriculum in credit points.

Further, the given workload of each specific studying course is proposed to be calculated by the formula

$$TR_{priv} = \sum coef_p \cdot TR_p,$$

where the summation is conducted in all disciplines of the training course of the educational program (EP). The share of the p discipline of $D(p)$the curriculum of the considered EP of the current year of study is determined by the formula

$$D(p) = \left(coef_p \cdot TR_p\right) \cdot \left(TR_{priv}\right)^{-1}.$$

In turn, the share of the department D_{dep} in the implementation of the educational process EP in the planned study year is calculated as the sum of the shares of disciplines for which this department is providing the following: $D_{dep} = \sum D(p)$.

Finally, the payroll fund of the academic teaching staff of the department is defined as the amount of all EP, in the implementation of which the department is involved:

$$FOT_{dep} = \sum D_{dep} \cdot Kont \cdot Norm_{FOT}.$$

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Here is $Kont$ the actual number of students of a particular course considered EP,

$Norm_{FOT}$– normative part of the funding EP sent to the PRF of ATS.

As stated in Korolkov et al. (2019), the practical implementation of project-oriented educational programs (POEP) is much more costly in the financial plan, compared with traditional programs. Consider one of the solutions to this problem.

Research and academic and innovation system of the University can be represented as a structure of interrelated project groups. In turn, the implementation of practice-oriented educational programs is quite reasonable to include in the work plan of the relevant projects. This allows you to organize continuous financing of projects through the allocation of part of the federal budget subsidy for the implementation of state tasks or funds from income-generating activities for the implementation of practice-oriented educational programs that are part of the projects.

Implementation of innovative projects in the educational process of educational programs is possible within the framework of such sections of the curriculum as "Final state certification" and "Practice" (in the process of preparation of course papers, graduate qualification works, passing training, productive, pre-degree and other types of practices). The formation of funds intended for the implementation of these disciplines of practice-oriented educational programs makes sense to be divided into two parts C_1 and C 2. The first part of the C_1 funds can be formed in accordance with the model proposed above (Gukova et al., 2015; Korolkov et al., 2014; Losev et al., 2017) and sent to the payroll fund of the academic teaching staff, intended for the implementation of all educational programs, including practice-oriented. The second part of C_2 funds is intended for the implementation of innovative projects within the framework of these disciplines within practice-oriented educational programs and can be spent both within the framework of the payroll fund of ATS or other employees, and for the purchase of necessary goods and services required for the effective implementation of innovative projects (supporting fund of practice-oriented educational programs).

The value of C_2 for each practice-oriented educational program is determined by the formula:

$$C_2^{\text{POEP}} = Kont_{\text{POEP}} \cdot Norm_{C_2}$$

Here: $Kont$ - the students enrolled in this educational program,

$Norm_{C_2}$ - normative part of financing POEP directed to the fund supporting the implementation of practice-oriented educational programs.

The supporting fund of practice-oriented educational programs (SF POEP) will be formed from the funds of the subsidy federal budget for the implementation of the state task or from income-generating activities in the University according to the formula:

$$\text{SF POEP} = \sum_{all\ \text{POEP}} C_2^{\text{POEP}}$$

We will also describe the process of selecting educational programs for inclusion in innovative projects and assigning them the status of practice-oriented. Once in a certain period of time, at the university, a competition will be announced for financial support of innovative research projects in priority areas of activity. Applicants form applications including the implementation of the curriculum component for the project of educational programs. The projects submitted for the competition undergo research and educational and financial feasibility expertise, the purpose of which is to establish the degree

of compliance for the projects with the strategic program of the University development. It also takes into account the compliance of projects with priority areas of research, their practical orientation, the relationship with the real sector of the economy and the prospects to commercialize the obtained results. In case of the application approval, the project supervisor receives at his disposal the relevant part of the SF POEP, that is directed for the individual component implementation of the curriculum of the relevant practice-oriented educational programs.

At the end of the year, the project supervisor provides the competitive commission with a project report on the implementation, which decides on the continued funding of the project and its volume on the basis of data on the achievement of the stated targets.

A set of targeted and threshold indicators for each reporting period is defined for each project. The implementation of qualitative and quantitative indicators of the thresholds is a prerequisite for the recognition of the successful implementation of the project in the reporting period. The achievement degree of the targeted indicators is an indicator of the effectiveness of the project and determines the amount of its further funding.

7. Conclusion

Thus, this work proposes a financial and economic and organizational model to form budgets of project groups and to promote priority development of the project and practical component of education programs in terms of per capita financing of the educational process in the framework of implementing the projects of the national technological initiative.

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References

Aleshchanova, I. V., Frolova, N. A., Morozova, E. V., & Zheltukhina, M. R. (2017). Psychological and Acmeological Aspect of Educational Cognitive Competence Development. *Proceedings of the 7th International Scientific and Practical Conference Current Issues of Linguistics and Didactics: The Interdisciplinary Approach in Humanities (CILDIAH 2017). Advances in Social Science, Education and Humanities Research (ASSEHR), 97*, 19-24.

Ermolenko, V. V., Lanskaya, D. V., & Meteleva, E. P. (2018). Model of the system of problem-oriented infrastructure management of the innovation ecosystem of the university. *Bulletin of the Academy of knowledge, 3*(26), 129-40.

Gukova, A. V., Dorzhdeev, A. V., Kizatova, N. A., Losev, A. G., Loseva, N. V., & Tarakanov, V. V. (2015). Model of the formation of the salary fund for the teaching staff of universities. *Financial Analytics: Problems and Solutions, 46*(280), 2-11.

Ivanov, V. V. (2010). A spatial approach to the formation of the national innovation system. *Innovations, 5*, 122-128.

Korolkov, S. A., Losev, A. G., & Loseva, N. V. (2019). Financial management of programs for the development of the innovation ecosystem of the university. In *Materials of the XIII All-Russian conference on management problems VSPU-2019* (pp. 2320-2324). Moscow.

Korolkov, S. A., Losev, A. G., Reshetnikova, I. M., & Tarakanov, V. V. (2014). Budgeting model of structural units based on normative per capita funding. *European Researcher, 3-1*(70), 498–508.

Losev, A. G., Korolkov, S. A., & Tarakanov, V. V. (2017). Model of financial support for the implementation of target indicators of the university's performance. *University administration: practice and analysis, 21*(6), 49-57.

Matova, N. I. (2019). The Problems and Conditions of Effective Public Participation in Creating a Smart Sustainable City. *Vestnik Volgogradskogo gosudarstvennogo universiteta. Seriya 3, Ekonomika. Ekologiya, 21*(2), 65-77. https://doi.org/10.15688/jvolsu3.2019.2.6

Politsinskaya, E., Lizunkov, V., & Ergunova, O. (2019). Organization of student project based activities through individual learning routes. *International Journal of Emerging Technologies in Learning, 14*(11), 186-193.

Tarakanov, V. V., Inshakova, A. O., & Dolinskaya, V. V. (2019). Information society, digital economy and law. *Ubiquitous Computing and the Internet of Things: Prerequisites for the Development of ICT, Studies in Computational Intelligence. Springer Science + Business Media, 826*, 3-15.