

Cognitive Model Parameterization For Decision Support Of University Internationalization Management

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Abstract—The model of indicators for managing of university internationalization is the main focus in this article. The proposed model is aimed at improving the validity of assessing the degree of internationalization of a higher education institution and increasing the efficiency of internationalization of a higher education institution by obtaining information from object database, a broad knowledge base (external assessment) and a group of subject matter expert assessments (internal assessment), rather than from a single data source.

Keywords—internationalization; cognitive modeling; expert analysis

I. INTRODUCTION

The globalization imposes new requirements on the system of higher education, which becomes a priority both for the state and for business. It has traditionally been associated with the dissemination of knowledge, the formation of human and intellectual capital. In modern conditions, higher education, on the one hand, is a service that forms a new sphere of economic activity, on the other - an indicator of a country's potential, a parameter of its international competitiveness [1].

The maximum integration of Russian universities in the global education space is possible provided the level of education would meet the needs of the international labor market, the economy of a new type so called “knowledge economy” and global digitalization [2].

The increasing of the competitiveness of the national higher education system in the global educational market and obtaining additional opportunities for accelerated development are possible only through innovative development and advances in the academic international activities [3].

II. METHODS

The model of management performance of the university internationalization has been developed in order to study the

university activities, research of its properties, finding optimal solutions and increasing the efficiency of internationalization of a university. The novelty of the model developed is viewed in the integrating the procedure of experts' polling, external factors evaluation, which describe the effectiveness of the university internationalization based on cognitive modeling. The foreign students of a university, Russian and foreign students participating or willing to participate in academic mobility programs, faculty members, foreign researchers and scientists collaborating with a university are seen as experts for internal assessment.

Cognitive modeling contributes to a better understanding of the problem situation, identifying of contradictions and qualitative analyzing of the system. The purpose of simulation is to form and refine the hypothesis about the functioning of the object under study, considered as a complex system, which consists of individual, but still interconnected elements and subsystems. The development of such model is a formalization process of the knowledge gained at the stage of cognitive structurization [4].

The most important task of the proposed model is to collect, store and process the information. Later on, the structured information on the assessment results is provided to the decision-making authorities. The decision support system will evaluate the results and select the appropriate measures aimed at improving the efficiency of university internationalization.

The parameters describing the internationalization of a university are the result of a consensus between the international measurements of the education system and the national performance system for educational organizations. They can be divided into three levels:

1. Macro level:

- macroeconomic indicators of the country;
- demographic indicators of the country;
- average cost of study in the region;

- average cost of living in the region.

2. Meso-level: indicators that measure the degree of university internationalization in the national ranking.

3. Micro level: indicators that relate to the individuals participating in the education and training.

The sources of primary data for parameterization at the macro- and meso-levels are databases of universities, activity reports of higher educational institutions and regional sources of relevant information. [5-8].

To form the indicators at the micro level in the framework of the research, it was proposed to apply the procedure for interviewing experts [4], using decision support at each of the assessment stages. To improve the reliability and objectivity of evaluation process it is proposed to obtain primary information directly from foreign students studying at the university, Russian and foreign students participating or willing to participate in academic mobility programs, the faculty staff, foreign researchers and scientists collaborating with the university and etc.

Wide area of the interview coverage and methodology of obtaining primary information directly from students and staff of the university ensure the completeness and relevance of the assessments. The proposed approach of using both external (at the macro- and meso-levels) and internal assessments (at the micro level) differs from the classical ones, which usually offer an assessment by external experts.

For parameterization of the university internationalization at the macro- and meso-levels a set of primary data P_j ($j = 1 \dots 30$) is offered, which is described in Table 1. The method of constructive assessment of the university internationalization effectiveness involving a variety of criteria for monitoring the effectiveness of educational organizations in the Russian Federation, international ratings, macroeconomic indicators and regional specificity was used for parameterization [9-14].

The procedure of interviewing experts was proposed to apply in order to form the indicators at the micro level in the framework of research [9-12].

The essence of expert methods, both when solving problems of the research for management systems, and when using in the practice of making decisions in other areas of science, technology, management, is averaging the experts' opinions (judgments) on the issues under consideration in various ways [15]. The most common expert methods for classifying by preference evaluation are the rank method and the direct estimation method. [16].

TABLE I. PRIMARY DATA FOR THE PARAMETERIZATION OF THE UNIVERSITY INTERNATIONALIZATION

№	Data description
<i>Macro-level</i>	
P_1	Total net income
P_2	Currency exchange rate
P_3	GDP level
P_4	GDP level per capita
P_5	Number of employed people in educational area
P_6	Unemployment rate in the country
P_7	Population size in the country
P_8	Population size aged 15-24 in the country
P_9	Average cost of education fees in the country

№	Data description
<i>Macro-level</i>	
P_{10}	Average living cost in the country
<i>Meso-level</i>	
P_{11}	Number of foreign students from CIS countries
P_{12}	Number of foreign students (except CIS countries)
P_{13}	Number of bilateral and multilateral agreements with foreign organizations
P_{14}	Number of international associations and organization education institution participate
P_{15}	Number of joint international projects financed by grants from the EU and other funds (Erasmus +, Horizon, etc.)
P_{16}	Position in international ranking (QS, THE, or others)
P_{17}	Budget for international activities of the university
P_{18}	Number of courses taught in English
P_{19}	Number of educational programs taught in English
P_{20}	Number of double degree programs with foreign partner institution
P_{21}	Number of professors, teachers and researchers received a master's degree, or PhD, or others in foreign educational and scientific organizations
P_{22}	Number of professors, teachers and researchers working in an educational organization abroad for at least 1 month (outgoing academic mobility)
P_{23}	Number of foreign professors, teachers and researchers working in an educational organization for at least 1 month (incoming academic mobility)
P_{24}	Number of foreign postgraduate students from CIS countries
P_{25}	Number of foreign postgraduate students (except CIS countries)
P_{26}	Number of educational programs developed and implemented in partnership with leading foreign universities
P_{27}	Number of publications in international rating journals (Q1-QIV)
P_{28}	Number of students received a double diploma in the educational program, implemented in partnership with leading foreign universities
P_{29}	Number of foreign students received scholarship for credit mobility for one semester in the educational organization (incoming student mobility)
P_{30}	Number of students received scholarship for credit mobility for one semester in the foreign educational organization (outgoing student mobility)

In the current research, the direct estimation method was used to form the experts' evaluation. This method organizes the objects studied in dependence of their importance by assigning points to each of them (for example for the development of a parametric model). In this case, the most important object is assigned the highest number of points on the accepted scale.

The list of indicators is based on the SWOT and PEST analysis of the university internationalization, considering the external requirements, as well as the organizational structures of the university (Table 2).

TABLE II. INDICATORS OF THE UNIVERSITY INTERNATIONALIZATION AT THE MICRO-LEVEL (INTERNAL)

№	Data description
<i>Micro-level</i>	
P_1	University infrastructure for study of foreign students
P_2	University infrastructure for accommodation of foreign students
P_3	Conditions of integration and adaptation for foreign students, postgraduate students, teachers.
P_4	Quality of educational programs in English
P_5	Quality of training programs for the Russian language as a foreign language
P_6	Quality of foreign languages training programs in educational institution
P_7	Conditions for the participation of foreign students and postgraduate students in youth research laboratories
P_8	Conditions for participation of students, postgraduate students,

№	Data description
<i>Micro-level</i>	
	teaching staff in programs of foreign academic mobility
P_9	Conditions for the participation of students and postgraduate students in double degree programs
P_{10}	E-infrastructure of the university
P_{11}	Performance of the international department activity with foreign trainees
P_{12}	Performance of the international department activity for providing the information about academic mobility programs, scholarships and etc.

For interviewing the experts, a questionnaire form consisting of two parts has been developed. The first part of the questionnaire applies the method of direct assessment on a scale from 0 to 10. In the second part of the questionnaire, each expert is asked an open question, for which any recommendations/proposals aimed at improving the state of internationalization of the university are supposed to be given. The results of the survey are entered in the DSS (decision-support system) for processing and calculating group opinion.

III. CONCLUSION

Thus, in the current study a new model of system of indicators for the assessment of university internationalization has been developed. This is aimed at improving the validity of assessing the degree of internationalization of a higher education institution and increasing the efficiency of internationalization of a higher education institution by obtaining information from the object database, a broad knowledge base (external assessment) and a group of subject matter expert assessments (internal assessment), rather than from a single data source.

This model provides the basis for the cognitive map of the university internationalization. By using the cognitive map developed, the following management tasks can be solved in the future research: to forecast the situation self-development, i.e. study of the dynamics patterns for the values of factors under zero management; to forecast the development of the situation with a fixed management (a direct task is the analysis of various scenarios with variations in management); to find a management system that would provide the implementation of the required or desired scenario (inverse problem).

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