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Interaction of universities, the state, and enterprises of the mining and metallurgical complex of the Pavlodar Region of the Republic of Kazakhstan

Abstract. *Uniform development of territorial-industrial complexes is the main goal of the state's regional policy. Here, the key point is the development of centers and the improvement of the use of regional features. The article explores the interaction of universities, business, and the state in the Pavlodar region of the Republic of Kazakhstan. The issue of intensifying this process is due to the super-task to increase the competitiveness of the territory at the macroeconomic and international levels, where the university, in a single link "state-university-production", can become a certain point of growth of the regional economy. Using the webometric method, an analysis of the potential of three blocks was carried out: universities, enterprises, and the region. Large universities in the educational field demonstrate greater cooperation, small universities that focus on the local market are more active.*

Keywords: *university, mining enterprises, metallurgical enterprises, region, webometric method, Kazakhstan*

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Introduction

At present, the possibilities of economic growth through the sale of low value-added goods have been exhausted [1]. A unified legislative regulation has not yet taken place, the strategic tasks of various state bodies have not been agreed upon, industrial enterprises do not receive the necessary support, and the assistance provided by the state is often ineffective [2]. 36% of Kazakhstan's GDP is formed through the sale of mineral resources and their derivatives. 77% of export earnings are generated by the oil and gas and mining sectors. The COVID-19 pandemic has hit commodity markets, leading to a global recession. Even with an optimistic scenario for the development of events, the global economic crisis will last at least 3 years [3].

The economy reacts to such processes with structural shifts, which is expressed in the redistribution of resources between the three main sectors - raw materials (including the mining industry), manufacturing and service sectors (including universities). It is necessary to catch trends and take decisive measures to support industry and domestic demand, associated with an active industrial and financial policy of the state, in particular, to encourage universities to work more closely with industrial enterprises and turn them into drivers of regional economic growth.

Currently, there are great opportunities that can be realized through cooperation and the establishment of strong ties through technology, research, and government support.

As the experience of the advanced countries of the world shows, one of the indispensable conditions

for the successful implementation of innovations is to increase the role of universities. It is they, together with enterprises and the state, who are able to raise production to a high level, create new industries, reduce unemployment and promote stable economic growth [1].

Today, the commercialization of scientific research is given great importance, and universities are becoming the center of innovative development. New ideas can be used and connected to create new possibilities. The potential of "university - business - state" links is growing rapidly and requires closer cooperation.

This article examines the activities and cooperation of the university, business, and the state in the Pavlodar region of the Republic of Kazakhstan. Pavlodar region is located in the northeast of the Republic of Kazakhstan, the regional center is the city of Pavlodar. Currently, it covers an area of 127.5 thousand km2. The population of the region is 751,011 people (at the beginning of 2021).

Pavlodar region is a major industrial center of Kazakhstan, it is a multidisciplinary industrial complex, the metallurgical industry is rightfully considered the leading industry in the region and makes a significant contribution to its economic development. The region contains 35.7% of the country's coal reserves, 16.0% nickel, 5.2% gold, 3.7% copper, 2.3% molybdenum, 0.9% zinc, 0.3% lead. The region accounts for about 70% of the republican coal production, ¾ of the republican production of ferroalloys, and about 40% of the republican production of electricity and petroleum products [4].

The largest enterprises of the Pavlodar region of metallurgical profile: JSC "Aluminum of Kazakhstan", Aksu ferroalloy plant, a branch of JSC "TNK "Kazchrome", LLP "Bogatyr Komir" - coal mines "Bogatyr" and "Severny", JSC "Maykainzoloto", Bozshakol mining and processing plant, LLP "Maykuben-West", JSC "Kazakhstan electrolysis Plant", JSC "Eurasian Energy Corporation" - coal mine "Vostochny", copper production plant LLP Eurasia Copper Operating, Angrensorenergo LLP, Gamma LLP, KAZ Minerals Bozshakol LLP [5].

The main university of the Pavlodar region for training personnel for the metallurgical industry is the Toraighyrov University, which is the undisputed leader among educational institutions of the Pavlodar region both in terms of the number of students and the quality of educational services provided. Research work at the university is carried out based on 13 scientific and practical centers, the "Ertis" Scientific and Technical Park, the Regional Center for Innovation and Technology Transfer, and the student research Center. The formed research potential allowed the university to become one of the 10 innovation-oriented universities of the Republic of Kazakhstan [6].

The purpose of this study is to study the innovative and production potentials of the elements of the region's innovation ecosystem in order to determine development trends in the course of their cooperation with each other.

The subject of study: the process of cooperation between the elements of the region's innovation ecosystem.

Objects of study: university, enterprises of the mining and metallurgical complex, region. The novelty of the study lies in the use of the webometric method to assess the innovation and production potentials.

Analyzed period: 2021 year.

Research methods

The authors put forward a hypothesis that a more active role of universities in the development of mineral resources and the processes accompanying it can make a significant contribution to the development of the mining and metallurgical industry and the economy of the region.

The research was carried out using the webometric method [7], the essence of which is that the potential of an organization is defined as the number of pages opened on the website of a university (enterprise or institution) when searching by its name. To determine the interaction of factors, the number of pages on the university website (search string "factor_1 factor_2 site: [university website]") containing both factors is counted.

There are three models of the innovation process: the command-and-control model, the market model, and the triple helix model [8]. The activities of the university are divided into three categories of factors: education, science, and business.

The functions of the state in the innovation process at the university level are performed by education - departments, schools, and other educational units. Science is represented by research institutes, scientific laboratories, research centers, and other research units producing scientific products.

Business is represented by institutions, centers, and other units that produce products or provide services.

Factor categories are circling whose area is equal to the number of pages N found, the diameter is proportional to the square root of the area, and the intersections of the circles of two factors are found by counting the number of pages opened when searching for pages where both factors are mentioned.

A simplified version is used here when education (E-education), science (S – science), and business (B – business) are represented by the keywords [9]: education, science, business.

The main object of study for this work is Toraighyrov University (TOU), Pavlodar region, and mining enterprises operating in the region (Table 1). All other objects are served only for comparison purposes.

Table 1. Keywords

Innovation potential (IP) of the region			**Resource potential (RP) of the region**		
Categories of factors	**Keywords**	**Keywords**	**Categories of factors**	**Keywords**	**Keywords**
(G) government	budget	"Local government"	(T) technology	technology	Technology
(S) science	project	project	(C) capital	capital	Capital
(B) business	services	services	(L) labor	labor	Labor
Enterprise Innovative potential (IP)					
Categories of factors			**Keywords**		
(I) innovation			Innovation		
(M) management			Project		
(P) production			Mine		
Innovation potential (IP) of the university			**Educational potential (EP) of the university**		
Categories of factors	**Keywords**	**Keywords**	**Categories of factors**	**Keywords**	**Keywords**
(E) education	faculty	faculty	(D) degree	master's	master's
(S) science	faculty	science	(S) staff	Professor	Professor
(B) business	business	business	(R) room	faculty	Faculty
Source: Compiled by the authors.					

It is important to pay attention on the concepts of "activity" and "cooperation" in more detail. By activity, the number of pages opened in the browser when searching for one keyword is meant; under cooperation - the number of pages opened in the browser when searching for two or more keywords.

The innovative potential of the IP university in our case is the product of activity indices A and cooperation C. Activity index A is the total area of education, science, and business circles, calculated as the sum of their circles, subtracting their pairwise intersections and adding their triple intersection. Activity index A = E+S+B-ES-EB-SB+ESB.

The cooperation index C is an optimization of the intersection of circles, when an intersection equal to half the area of the circle is considered optimal, all other options reduce cooperation. In this work, we used one of the most convenient functions for this - cosine. The cooperation index C can be represented as a product of cosines, namely cos (ES/E-0.5) *cos (ES/S-0.5) *cos (SB/S-0.5) *cos (SB/B-0.5) *cos (EB/E-0.5) *cos((EB/B-0.5).

The data was obtained from the Internet using the Google Chrome search engine. Usually E, S, B> ES, EB, SB> ESB. Due to the peculiarity of the work of the search engine, in some cases, such a ratio for universities was not always fulfilled. In such cases, it was necessary to reduce the data in these cells to the maximum possible value.

The potentials were calculated as the products of activity, cooperation, and the logarithm of the ratio of site volumes to the least in any degree IP=A*C*LOG (N; N min) ^7. The degree was chosen in such a way that an object with a large potential would not be lagging. In our work, a power of 7 was used.

The list of enterprises in the mining industry (subsoil users) can be found on the website of the Electronic Government [10], and the financial indicators of enterprises can be found on the website of the depository of the Ministry of Finance [11].

Calculations and graphical constructions were performed using R, a program for data analysis and visualization [12].

Results

University

Toraighyrov University (TOU),was established in May 1996 based on the Industrial Institute, was formed in 1960 based on the Decree of the Council of Ministers of the USSR of September 20, 1960.

Today it is a multifunctional university of innovative type, the leading university in the region, the largest scientific center, widely known for its innovations and achievements in the Republic of Kazakhstan and beyond. Toraighyrov University has achieved international recognition in the process of integration into the global educational space. As part of the Oxford Summit of leaders in business, science, and art, Toraighyrov University was awarded the international award “European Quality”.

The university has a faculty of metallurgy, mechanical engineering, etc. transport. The faculty has its academic building with a total area of 7,000 sq. meters and a separate laboratory block with an area of 270 sq. meters. All specialties for which training is carried out are provided with specialized training rooms and laboratories: metal forming; quality control of metal products; enrichment; modeling of foundry and metallurgical processes; Metallographic laboratory; non-ferrous metals; Workshop for preparation of samples and materials; Mini-workshop for metal processing and manufacturing of metal products.

Training of specialists is carried out in three specialties: Metallurgical engineering, "Metallurgy" Technological machines and equipment (by industry), including "Metallurgy" trains specialists at three levels: bachelor's, masters and doctoral studies.

Students of the specialties 5B070900 - Metallurgy, 5B072400 - Technological machines and equipment are trained in a dual system. Laboratory and practical classes are held based on the PF KSP Steel LLP. Laboratory and practical jams are carried out based on the PF KSP Steel LLP [6].

To determine the innovative potential of Toraighyrov University (TOU) in comparison with other major universities in Kazakhstan, Table 2 shows the innovative potentials and their structures for ten

universities: Kazakh National Research Institute named after Satpaev (KazNITU, SATBAYEV), Rudny Industrial Institute (RII), Karaganda State Technical University (KSTU, KSTU), Karaganda State Industrial University (KGIU, KGIU), Zhezkazgan University named after Baikonurov (ZhezU, ZhezU), Kokshetau University named after Sh. Ualikhanov (KSU, KGU), Kyzylorda University named after Korkyt Ata (KU, KORKYT), Ural State Mining University (USGU, URSMU), Magnitogorsk State Technical University named after G.I. Nosov (MGTU, MAGTU).

Table 2. Innovation potential of universities

Uni_ name	N_IP	E	S	B	ES	EB	SB	ESB	A_IP	C_IP	IP
TOU	**50400**	**0.887**	**0.718**	**0.488**	**0.476**	**0.208**	**0.450**	**0.208**	**1.17**	**0.86**	**10.46**
SU	14100	0.332	0.296	0.145	0.296	0.111	0.097	0.092	0.36	0.75	1.18
RII	3040	0.747	0.707	1.000	0.674	0.727	0.707	0.602	0.95	0.62	0.74
KSTU	101000	0.173	0.152	0.060	0.152	0.039	0.046	0.039	0.19	0.74	2.23
KGIU	13800	0.719	1.000	0.247	0.719	0.225	0.247	0.225	1.00	0.66	2.80
ZHEZU	2310	0.133	0.202	0.168	0.133	0.133	0.123	0.123	0.24	0.71	0.17
KGU	12300	0.430	0.680	0.114	0.430	0.114	0.097	0.097	0.68	0.65	1.75
KORKYT	5970	0.526	0.425	0.518	0.516	0.518	0.419	0.419	0.44	0.44	0.43
URSMU	41300	0.069	0.065	0.031	0.065	0.023	0.023	0.023	0.08	0.73	0.52
MAGTU	43700	0.874	0.203	0.249	0.203	0.249	0.203	0.203	0.87	0.61	5.04

Source: Compiled by the authors.

Designations: E, S, B - the frequency of keywords, ES, EB, SB, ESB - the frequency of their combinations. All these numbers are taken as a percentage of the volume of the N_IP university site. A_IP activity, C_IP cooperation, and IP innovation potential are calculated using the formulas given above.

As can be seen from Table 2, Toraighyrov University (TOU) has the highest coefficients of A_IP activity (1.17), C_IP cooperation (0.86), and IP innovation potential (10.46). This is because the university has opened and operates branches of the Department of Metallurgy at the following enterprises: Neftekhim ltd Company LLP, KSP Steel LLP. The staff of the department is actively engaged in scientific and innovative activities. Over the past two years, teachers of the Department of Metallurgy have received more than 20 copyright certificates for innovative patents. The demand for research services of the university, research projects, takes place from the state, private enterprises, firms, companies; international organizations.

Including in 2020, 8 contracts were concluded for the implementation of projects at the expense of the state budget, at the expense of private enterprises, firms, companies - 16, at the expense of international grants, funds - 5, for a total amount of 288.1 million tenges.

Larger universities are less prone to both activity and cooperation in their innovation activity. At the same time, smaller universities like RII are more active and more collaborative.

In the next positions after TOU, the small Karaganda and Rudny industrial universities, KGIU and RII respectively, have the greatest innovative potential.

Table 3 shows a similar trend - larger universities cooperate better but are inert in terms of activity.

Table 3. Educational potential of universities

Uni_name	N_EP	D	S	R	DS	DR	SR	DSR	A_EP	C_EP	EP
TOU	**54200**	**0.037**	**0.160**	**0.271**	**0.020**	**0.037**	**0.074**	**0.018**	**0.36**	**0.74**	**2.74**
SU	13100	0.113	0.373	0.052	0.051	0.021	0.044	0.010	0.43	0.77	1.30
RII	3200	0.666	0.675	0.391	0.519	0.353	0.322	0.322	0.86	0.81	0.88
KSTU	97500	0.018	0.076	0.166	0.010	0.015	0.030	0.007	0.21	0.75	2.39
KGIU	13900	0.696	0.193	0.073	0.156	0.073	0.073	0.073	0.73	0.65	1.93
ZHEZU	2450	0.083	0.205	0.030	0.037	0.030	0.030	0.004	0.22	0.68	0.15
KGU	12400	0.133	0.148	0.490	0.060	0.152	0.123	0.047	0.48	0.72	1.30
KORKYT	5030	0.571	0.523	0.108	0.378	0.043	0.099	0.037	0.72	0.76	1.01
URSMU	44000	0.016	0.039	0.024	0.011	0.016	0.023	0.006	0.04	0.74	0.24
MAGTU	51600	0.248	0.168	0.111	0.067	0.106	0.084	0.064	0.33	0.84	2.83

Source: Compiled by the authors.

Toraighyrov University (TOU) is at the level of 0.74 in terms of educational potential, which is an average indicator compared to other universities. This is explained by the low share of the implementation of educational programs together with universities near and far abroad, at the same time, the demand for educational programs of the university is multipolar and formed by the state (state order for training). The maximum demand for educational services comes from the state and private individuals. The minimum share of personnel training is carried out at the expense of enterprises, firms, companies, international financial sources [13].

As a rule, large universities demonstrate great cooperation in the educational field, for example, one can say that the university in the preparation and implementation of educational programs focuses more on its preferences and the requirements of the state (which allocates grants for training), and not on the market and the wishes of employers. Therefore, smaller universities that focus on the local market are naturally more active.

Another factor in the low activity of the educational potential of Toraighyrov University is that in the format of a three-stage training, the maximum demand is for undergraduate educational programs, the minimum demand for doctoral educational programs.

Enterprises of the mining and metallurgical complex

According to the website of the Electronic Government of the Republic of Kazakhstan, there are more than fifty enterprises that have the right to conduct a geological study of the subsoil, exploration, and production of minerals in the territory of the Republic of Kazakhstan. We filtered out all enterprises whose names are rarely found on the website of the region and which do not have financial statements on the website of the depositary of the Ministry of Finance. As a result, 16 enterprises remained (Table 4), which are quite well known in the region. Here we have used three keywords (innovation, project, and mine) to build innovation capacity. The numbers found are the coordinates of the points that are the intersection of the plane with the axes of the Cartesian coordinate system

$$x= - D/A \; y= - D/B \; z= - D/C.$$

where A, B, C, D are the coefficients of the general equation of the plane

$$Ax + By + C\,z + D=0$$

The normal plane equation is written as

$$x\cos\alpha + y\cos\beta + z\cos\gamma - p = 0$$

where p is the distance from the origin of coordinates to the plane (activity in our interpretation). As a potential, we took the expression

$$P = p \cdot \cos\varphi \cdot \ln n$$

where φ is the angle of the plane with the bisector of the trihedral angle with the vertex at the origin and the popularity of the object on the Internet is taken into account in the form of a natural logarithm of the total number of opened pages of the object n

$$p = \frac{|D|}{\sqrt{A^2 + B^2 + C^2}} = \frac{1}{\sqrt{\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2}}}$$

The cosine of the angle φ is given by the following expression

$$\cos\varphi = \sqrt{1 - \frac{(A + B + C)^2}{3 \cdot (A^2 + B^2 + C^2)}} = \sqrt{1 - \frac{\left(\frac{1}{x} + \frac{1}{y} + \frac{1}{z}\right)^2}{3 \cdot \left(\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2}\right)}} = \sqrt{1 - \frac{1}{3}\left(p \cdot \left(\frac{1}{x} + \frac{1}{y} + \frac{1}{z}\right)\right)^2}$$

Table 4. Innovative potential of enterprises

Company	N	Innovation	Project	Mine	Distance	Cos	IP
Bogatyr	5350	5350	420	1440	442	298	0.40
Aljumin	2020	2800	675	1920	1240	566	0.40
Energetic	2040	2040	339	1620	401	256	0.45
Maikain	1560	2020	317	733	378	231	0.30
Elektroliz	1120	1880	408	1190	457	295	0.36
Minerals	267	1560	47	798	195	46	0.69
Majkuben	140	1320	138	514	260	119	0.45
GRES-2	128	1120	154	669	151	106	0.44
Aksu	138	1040	175	700	320	150	0.46
Gamma	61	735	10	158	10	7	0.54
Angensor		267	40	119	86	35	0.43
IBM Gold		140	74	140	81	51	0.24
Kainama		138	3	9	3	2	0.37
Fonet		128	7	88	81	7	0.74
Copper		71	4	30	7	3	0.53
Direct		61	5	10	3	2	0.41

Source: Compiled by the authors.

The cosine of the angle φ determines the propensity of the enterprise to cooperate since the cosine of this angle is the higher, the closer to each other the intersections of the plane with the axes - the values of the three categories of factors that make up the potential.

The closer they are to each other in size, the more they are inclined to cooperate, and, accordingly, the value of structural flexibility can be greater, which allows the enterprise to more easily interact with the environment.

The described methodology for building the potential of enterprises differs from the methodology for universities and the region (see below), since enterprises have poorly functioning websites (most enterprises do not have them at all) and their names are not often found on the websites of universities and the region.

According to Table 4, the Fonet Er-Tai AK Mining LLP is more focused on cooperation, has the highest coefficient of 0.74, while the Pavlodar aluminum plant, Aluminum of Kazakhstan JSC, is an alumina producer on innovative activity. Most businesses score lower on both fronts. Despite this, the enterprises of the Pavlodar region provide about 80% of the total industrial production of the republic, including the mining industry provides about 60% of the republican volume of coal, enterprises of the manufacturing sector almost 12% of the republican volume of processing, while the leading branch of the manufacturing industry is metallurgical (70.4%).

A lot of work is being done in the region to attract investments; in 2019, more than 352 billion tenges of investments were attracted to the region, of which more than 75% are private. In 2020-2021, investment projects are being implemented in the field of metallurgy, petrochemistry, chemistry, including aluminum cluster projects. Many large enterprises are among the top three world leaders in applying the low-cost production model. Due to the introduction of innovations in production, the extraction of copper ores will be increased to 45 million tons [14].

The main factor influencing the innovative activity of enterprises is not only the number of attracted investments and the use of new technologies in industry but also human capital. The innovative development path requires the preparation of better labor resources, new approaches to training personnel, both working specialties and managerial personnel, capable of implementing best practices, increasing the competitiveness of the economy of the region and Kazakhstan. Universities play a key role in the training and retraining of personnel. In addition, the scientific sphere of educational institutions contributes to innovative developments and their implementation in production activities. We calculated the correlation coefficients between webometric data and data from the reporting of enterprises of the metallurgical complex of the Pavlodar region using the Pearson method.

Table 5. Correlation coefficients between webometric data (left column) and indicators of mining and metallurgical enterprises (upper line) of Pavlodar region, calculated using the Pearson method

Indicators	**Average annual number of employees**		**Revenue**	**Current income tax**
Activity	0.857		0.147	-0.029
Cooperation	-0.126		0.405	0.387
Innovation potential	0.905		0.199	0.015
Prominence in the region	0.738		0.320	0.213
Prominence _TOU	0.787		0.193	-0.034
	Source: Compiled by the authors.			

Table 5 shows that the Activity and Innovative Potential of enterprises correlate well with the number of employees, and the degree of popularity on the websites of the region and universities correlates well with the amount of income and tax paid.

A direct relationship between the innovation potential and the number of employees in the enterprise is visible.

The dependence of the average annual number of employees of enterprises on their innovative potential. There are two trends: 1) the number of employees and innovation potential are almost linearly interdependent; 2) the size of enterprises falls with the growth of innovative potential. Thus, smaller enterprises tend to be more active in terms of innovation.

In general, it can be noted that the higher the connection between science, education, and production, the higher the innovation activity and labor productivity. Today, a state order is needed for training personnel, taking into account the needs of the regional labor market, a system of continuous education, and close interaction between manufacturing enterprises and educational institutions.

Region

The economic development of the region is influenced not only by the specialization, economic activity of enterprises and government bodies but also by investment attractiveness and innovative development. We have calculated the innovative potential of the Pavlodar region and compared it with other regions of Kazakhstan.

The innovative potential of the region was calculated using the following keywords: budget, project, services ("local government", project, services).

The Pavlodar region has a low level of cooperation and below the average level of innovation activity among other regions of the Republic of Kazakhstan. The level of innovative activity of the region depends on the innovative potential and the development of its infrastructure. Despite the highly innovative activity of the scientific sector, the innovative activity of the region's industry remains at an average level. The main reasons are the weak connection between science and industry, the insufficient level of innovation activity of the business. The share of organizations performing research and development remains low. The reduction in the share of expenditures on technological innovation in the Pavlodar region and the Republic of Kazakhstan is associated with the consequences of the financial crisis.

The most developed in the cooperation are Almaty, Kostanay, and Kyzylorda regions, the most active in Karaganda. Russian regions have lower indicators in cooperation and average indicators of activity. We emphasize that our calculations are not at all intended for rating purposes. The regions of Russia are taken for comparison purposes, the Russian regions are selected as the industrial regions of a neighboring country, located not far from our northern regions.

In addition to innovative activity, the development of the region's economy is influenced by the effective use of resource potential: minerals, labor resources, existing enterprises, the introduction of innovative technologies and scientific developments in the production process, the level of qualification of workers involved in the industry, and the sufficiency of financial capital. To calculate the resource potential, we used the following keywords: technology, capital, personnel (technology, capital, labor).

The region is at a high level of cooperation, but at the same time, in terms of resource potential, it is inferior to Kostanay and Akmola regions, where these regions stand out both in cooperation and activity. The lowest level of cooperation, with a high level of resource potential, is the city of Kokshetau.

To date, a multidisciplinary industrial complex has developed on the territory of the Pavlodar region. The industrial potential of the region is determined by large export-oriented industrial companies. They produce coal, electricity and heat, alumina, ferroalloys. There are about 5 thousand enterprises of various forms of ownership operating in the region, the industrial and social infrastructure is sufficiently developed.

If we compare 2 factors - resource potential and innovation activity, affecting the development of the metallurgical industry and the economy of the Pavlodar region as a whole, then the region is at a low level of development of resource and innovation potential compared to other areas. Which indicates that there are problems in this area. Akmola and Karaganda regions have the highest resource potential, while the Kyzylorda region has a high innovation potential.

As world practice shows, the development of production and the growth of its competitiveness in the long term depend on innovation and the efficient use of available resources. Science-intensive technologies are developing in the Russian Federation, a favorable operating environment for science-intensive enterprises has been created, conditions have been created for successful interaction between science, business structures, and the state.

Discussion

Several models have been developed in the literature to conceptualize the relationship between universities and business, in particular, including the regional innovation system, which attempts to capture innovation-related interactions in a regional context [15], as well as the closely related national innovation system proposed by Freeman [16].

The authors [17-18] first introduced the concept of the triple helix model, which describes the intersections between government, university, and business in the process of generating new knowledge and stimulating innovation. The concept of the triple helix has become critical in the last few decades to explain the emerging knowledge economy in political and academic circles [19-20].

The triple helix has rethought the importance of universities and increased their involvement in the economy, increasing the importance of knowledge for social development [21-22]. The model proposed a "new position of the university", in which it, along with the government and business, participates in the creation and management of a knowledge society, where public-private relations play a paramount role in improving national welfare [23].

In this regard, universities have added to their traditional core missions - education and research - a third mission focused on their social and business activities, as well as entrepreneurship [24]. The third mission is a set of activities through which the university launches processes of direct interaction with civil society and business to promote regional growth [25].

As for Kazakhstan, several papers have recently been published, which dealt with various issues of the mining and metallurgical industry of Kazakhstan and issues related to the development of clusters. None of them covered in detail the role of universities, especially since they were not considered as support centers for territorial clusters.

Thus, the issue of developing a methodology for assessing the production and innovation potentials of regional universities, industrial enterprises, and the economy of the region as a whole is relevant for determining the impact of such territorial clusters on the macroeconomic indicators of the regional economy.

The most effective way to build an innovative economy in the regions, in our opinion, is the creation of innovative territorial clusters around support centers - regional universities - with the involvement of industrial enterprises and the establishment of close cooperation between the university and business in the transfer of knowledge and building chains of technology commercialization. We will focus on mining and related industries and universities that are in close contact with such enterprises for their training.

The global problem of resources lies in the fact that they are rapidly used; the natural stock of natural resources is sharply reduced and does not have time to be reproduced. Deposits are getting deeper, harder to find, and more difficult to extract, requiring more labor.

There is a growing need to conserve existing resources and focus on recycling and the use of alternative sources, especially renewable energy sources. Although metal production in the 30 years after 1950 exceeded or almost exceeded the reserves available in 1950, by 1980 the reserves far exceeded the reserves at the start. Even today, with higher productivity and a more rigorous definition of what constitutes a "reserve", current reserves will last for 26 years of production (for iron), and more for other minerals [26].

Accordingly, for those involved in the technology and economic evaluation of the mining and metals industry, the situation today offers many opportunities for complex and interesting research and improvement across the entire mining spectrum. Smart use of technology, coupled with more robust valuation processes, can yield greater returns in this environment.

Conclusion

Universities with large sites in their innovative activities are more inclined to cooperate but are inert in terms of activity. At the same time, smaller universities are more active. Less cooperation or activity in the educational field, for example, may indicate that the university in the preparation and implementation of educational programs is more guided by its preferences and the requirements of the state (which allocates education grants), rather than the market and the wishes of employers. Therefore, smaller universities focused on the local market are naturally more active.

Regional universities should strengthen their structural flexibility (cooperation of factors within themselves) and establish wide interaction with the mining enterprises of the region. A more active role of universities in the development of mineral resources and the processes accompanying it can make a significant contribution to the development of the mining and metallurgical industry and the economy of the region.

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Қазақстан Республикасы Павлодар облысы университеттерінің, мемлекет пен тау-кен металлургия кешені кәсіпорындарының өзара іс-қимылы

Аннотация.Аумақтық-өнеркәсіптік кешендерді біркелкі дамыту-мемлекеттің өңірлік саясатының басты мақсаты. Бұл жерде басты мәселе орталықтарды дамыту және өңірлік ерекшеліктерді пайдалануды жақсарту болып табылады.

Мақалада Қазақстан Республикасының Павлодар облысы университеттерінің, бизнесінің және мемлекетінің өзара іс-қимылы зерттеледі. Бұл үдерісті қарқындату мәселесі макроэкономикалық және халықаралық деңгейлерде аумақтың бәсекеге қабілеттілігін арттыру міндетімен негізделген, мұнда университет "мемлекет-университет-өндіріс" бір байламында өңірлік экономика өсуінің белгілі бір нүктесіне айналуы мүмкін. Вебометриялық әдісті қолдана отырып, үш блоктың: университеттердің, кәсіпорындардың және аймақтың әлеуетіне талдау жасалды. Білім беру саласындағы ірі университеттер үлкен кооперацияны көрсетеді, жергілікті нарыққа бағытталған Шағын университеттер белсенді.

Түйін сөздер: университет, тау-кен өндіруші кәсіпорындар, металлургиялық кәсіпорындар, өңір, вебометриялық әдіс, Қазақстан

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Взаимодействие университетов, государства и предприятий горно-металлургического комплекса Павлодарской области Республики Казахстан

Аннотация. Равномерное развитие территориально-промышленных комплексов – главная цель региональной политики государства. Здесь ключевым моментом является развитие центров и улучшение использования региональных особенностей.

В статье исследуется взаимодействие университетов, бизнеса и государства в Павлодарской области Республики Казахстан. Вопрос интенсификации этого процесса обусловлен сверхзадачей повысить конкурентоспособность территории на макроэкономическом и международном уровнях, где университет, в единой связке «государство-университет-производство», сможет стать определенной точкой роста региональной экономики. При помощи вебометрического метода проведен анализ потенциала трех блоков: университетов, предприятий и региона. Крупные университеты в образовательной области демонстрируют большую кооперацию, небольшие университеты, ориентирующиеся на местный рынок, являются более активными.

Ключевые слова: университет, горнодобывающие предприятия, металлургические предприятия, регион, вебометрический метод, Казахстан.

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