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**RUSSIAN UNIVERSITIES: THE INNOVATION CENTRES OF
DIGITALIZATION IN THE REGION**

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Abstract

The purpose of this article is to determine the factors and conditions under which Russian universities, along with the important role of a centre for creating innovations and new technologies in the region, increasingly acquire the role of conductor of digitalization of the regional economy. The contribution of universities to the creation of new knowledge is absolutely essential requirement for the shaping of modern national innovative systems and one of the key links in the system of interrelations of the triple helix model. There is not a single example in the world where the national innovative system would effectively operate beyond the principles of the triple helix, where universities wouldn't be in the centre of these actions. The logic of such reasoning rightly is that only the efforts of young people and experienced scientists can build an innovative economy in its new digital form. The universities are the places of greatest concentration of the younger generation of digital natives. As a rule, there are several large universities in Russian regions, and they do not always act as centres for creating innovations and new technologies. Using the example of Samara National Research University named after academician S.P. Korolev, the article proves that a successful combination of five factors and conditions allows to increase the university involvement in regional innovation, digitalization of the economy and, moreover, to become its leading element.

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Keywords: Innovation, Research University, regional development, ecosystem, sanctions, Samara University.



1. Introduction

In recent decades universities of the developed countries of the world have taken a central place in national innovation systems. New knowledge and technologies created in universities contribute to the digitalization of the economy, to the formation of new markets, and becoming the basis for the creation of fast-growing innovative companies, which develop into global high-tech corporations (for example, Apple, Microsoft) within a short time (Goldstein, 2009; Goldstein & Renault, 2004). However, not all universities are becoming leaders in innovation and digitalization. According to the Carnegie Foundation, only 7% of the total number of universities are research. As before, the question of factors and conditions that contribute to the formation of universities as centres of space for creating new technologies remains debatable and the question of its role in digitalization of the regional economy is completely new (Fortov, 2016).

The relevance of such a discussion is increasing due to the fact that, firstly, the world is on the verge of a new scientific and technological revolution and digitalization, and secondly, under conditions of economic sanctions, Russian universities may find it more difficult to integrate into the global scientific space. The key factors determining the competitiveness of national economies are the high rate of development of new knowledge and the creation of innovative products (Khmeleva, Tyukavkin, Agaeva, Kurnosova, & Sviridova, 2017). In response to global challenges in Russia, the State Program “Digital Economy of the Russian Federation”, the Strategy for the Scientific and Technological Development of the Russian Federation was approved, the implementation of the priority national project “Universities as centres of innovation creation space” is beginning (Vochozka, Khasaev, & Guseva, 2017). In this regard, it is of scientific interest to consider the factors and conditions under which the research environment is formed in universities and they are able to become a central element in the creation of new knowledge and technologies in the region, the formation of the digital economy (Slobodchikova, Goldenova, & Dzhambinov, 2018).

2. Problem Statement

This article partly continues the study of Smith and Bagchi-Sen (2012), in which data from Oxford University and four proposals were tested: the internal characteristics of the university, the reaction of the university to external shocks, the financing of the university, its place in the economy and regional education system. But in the course of the work it became clear that for Russian universities that functioned in conditions close to isolation in the Soviet period, the university should be involved in the international educational and scientific community.

3. Research Questions

The hypothesis of this study is that in Russia it is the major doctoral universities (in terms of the Carnegie Foundation) in the future should act as centres for the creation of innovations and new technologies, guides of digitalization. Then the task of identifying the factors and conditions that contribute to the formation of innovative ecological environment in universities and around them, favorable for increasing university activity in creating new knowledge, technologies, networking in the

implementation of research projects, in disseminating innovative entrepreneurship among students and teachers, comes to the fore by means of creation of small innovative enterprises, etc.

4. Purpose of the Study

The purpose of this article is to determine the factors and conditions under which a university becomes the central subject of innovation and digitalization in the region; further to offer a justification for the five main factors that can create the conditions under which universities become regional leaders in the knowledge economy and digitalization; to test five factors based on the data of the Samara University; in the final section to offer conclusions, discussions and opportunities for future research in the final section.

5. Research Methods

The theoretical basis for this assumption was primarily the triple helix model by Itskovitz (2010), built on the need for close interaction between universities, government and business.

Despite the fact that some large universities have actively declared themselves as research centres for a long time, the question of identifying the role of universities in promoting technology is fairly new. As a rule, the factors of innovation development are considered in a wider context. For example, it is necessary to form a full-fledged and conducive environment for business, business and population — a political, macroeconomic, scientific, educational, social-motivational one to fully realise the innovative potential of a territory (Tatarkin & Kotlyarova, 2013). Just a while ago regional development institutions were considered among the factors of economic development of the regions (Tatarkin & Novikova, 2015).

In the developed countries of the world, the understanding that universities are able to form around themselves a unique environment with a high degree of concentration of young and talented people who create and market their products comes in the second half of the twentieth century (Christy & Ironside, 1987). The phenomenon of Silicon Valley as an entrepreneurial university was talked about in the 1980s, exploring with its example the circumstances that contributed to the emergence of many innovative electronics firms, as well as the consequences for the economies of the region and countries (Saxenian, 1983). At the same time, a significant contribution to the development of high-tech technologies at the University of Cambridge in the UK is under discussion (Breheny & McQuaid, 1987).

In the 2000s, the concept of the significant role of universities in the development of innovation was firmly established in scientific research and public policy. Universities are described in different ways: as economic growth engines, as centres of incubation of new companies. These roles are associated primarily with the ability to interact purposefully with external organizations, the public, the creation of innovative enterprises, etc. (Geuna & Martin, 2003).

If there is a lot of research in which the role and influence of universities on economic growth in the country and regions are discussed, but the question of what exactly leads to such outstanding results of universities is still open. It is proposed to consider the internal characteristics of the university, the university's response to external shocks to politics and economics (Feldman & Francis, 2006), the nature of university funding (Varga, 2001), participation in financing state programs for supporting universities

(Lendel, 2010), characteristics of the regional economy as the factors and conditions for the formation of universities as centres of innovation and digitalization (Smith & Bagchi-Sen, 2012). In our study, along with the factors mentioned above, we also added involvement in the international educational and scientific community. In our study, along with the factors mentioned above, we also added involvement in the international educational and scientific community. All this increases the attractiveness of the university in the international market of educational services, which ultimately increases the scale of activities and incomes of the university, both from educational and from research activities. It is active international activity that distinguishes large research universities in Russia. All this served as a justification for including the international activities of the university in the composition of the conditions that form the university as a centre for creating innovations and technologies in the region.

The information base of the research was made up with the official authorities' open data of Samara University.

6. Findings

6.1. Internal characteristics of the university

The first factor in the formation of Samara National Research University named after academician S.P. Queen (hereinafter - Samara University), the centre of development of innovations and technologies are its internal characteristics. From the very beginning of its foundation in 1942, the institute began to carry out active research.

Considering the scientific and innovative development of Samara University, we can distinguish the most important stages throughout its existence (Table 01).

Table 01. Chronology of scientific and innovative development of Samara University

Periods	Background of the direction of scientific and innovative development of the university	Directions of scientific and innovative development
1942	Great Patriotic War, evacuation of defense enterprises to Kuibyshev	Foundation of the Kuibyshev Aviation Institute
1942-1956	Intensive development of aircraft and engine building in Kuibyshev	The development of the material and technical base of the institute, as well as the research work of scientists in the field of aviation technology
1957-1970	Space exploration	Training of specialists in the field of rocket and space technology
1970-1980- e	The development of the aerospace industry in Kuibyshev	Development of research in the field of vibration durability and reliability of engines, optimization of processes and systems for controlling the movement of spacecraft, development in the field of computer optics and other high technology technologies.
1990-e	Decentralization Processes of Russian Academy of Sciences	Development of research institutes
2000-2010-e	The development of innovative and information technology	Integration of research and educational process Implementation of innovative educational programs Awarding of the status of "National Research University"
2018	Implementation of the state program "Digital Economy"	Scientific and Educational Consortium "Digital Economy"

Source: compiled by the authors according to the official website of Samara University.

The foundation of the university assumed meeting the need for engineering and scientific personnel for the aviation industry newly created in Kuybyshev. In the 1950s-1960s KuAI (The name of Samara University at that time) initiated the creation of the first in the country 18 industry research laboratories, which made it possible to attract funds and bring the university to the innovative path of development through the formation of a unity of educational, scientific and production processes. Since 1957 KuAI was included in the country's Space Program and made an outstanding contribution to the development of the aerospace industry, carrying out the training of highly qualified specialists and the introduction of scientific research into production.

The development of the aerospace industry in Kuybyshev in the 1970s and 80s allowed the Institute to become one of the largest research centres in the region, creating unique scientific schools, primarily in the field of design and design of aircraft engines, airplanes, and spacecraft.

Since 2014, students of the University have been developing Nanosatellites of the SamSat series. The nanosatellite is designed for testing orientation control algorithms. Since 2018, a research and education consortium has been operating on the basis of Samara University, which has been working effectively on many topics included in the Digital Economy of the Russian Federation program (photonics, IT technologies, new educational programs in the digital economy).

Thus, the chronology of the development of Samara University shows its dynamism and focus on solving important national economic problems not only in the region, but also in the country as a whole.

6.2. The ability of the university to respond to external shocks

The economic role of a university in a region is determined by its ability to respond on time to the demands of the labor market, the state, and politics, i.e. to external shocks. Adaptation of a university to external shocks allows the state and society to demonstrate a desire to improve the efficiency and quality of education, involvement in solving national and regional problems in science, education, and economy (Ivanov, Kaybiyaynen, & Miftakhutdinova, 2017). Such universities, as a rule, are central to clusters and innovation systems, combining intellectual resources, experience and funding to solve problems that are important for the country and the region.

Since its establishment, Samara University has been seeking to respond to the needs of the economy and society actively, which allows it to act as an active participant in state and regional programs, attracting public and private funding for research.

Nowadays the range of scientific areas of the university is represented quite widely. At the same time, their main share falls on areas within the framework of the created Strategic Academic Units. Now priority areas are: aerospace engineering, materials and technologies; engine building, dynamics and vibroacoustics of machines; computer science and photonics; basic research for cutting-age IT technologies.

In addition, the university has about 32 scientific directions in the technical, as well as in the natural, economic, and social and human sciences.

Speaking about the role of the university as a research centre in the region, one can consider the share of its participation in the volume of research work carried out in the region and the volume of patents granted (Table 02).

Table 02. Data on the volume of R & D and issued patents across the Samara region and at Samara University

Activities	2012	2013	2014	2015
The volume of research work and services in the Samara region, mln. rub.	40047,8	41899,3	44232,6	52994,8
Share of Samara University in terms of R & D volume in the region,%	1,00	1,07	1,88	2,42
Issued patents on the invention of the Samara region, units.	419	503	423	488
The number of patents obtained by employees of Samara University, units	57	75	97	109
Share of Samara University on patents granted in the region,%	13,60	14,91	22,93	22,34

Note: Source: Compiled by the authors according to the Samarastat and reports on the self-examination of Samara University.

According to the data presented in Table 2, it can be noted that the share of the university's participation in the region's research activities is increasing, which suggests that the university's role is increasing in the region's research and development environment.

In more detail, the structure of issued patents to employees of Samara University in 2015 can be seen in Fig. 01. The largest share in the university's patent activity is given by issued patents on devices and equipment.

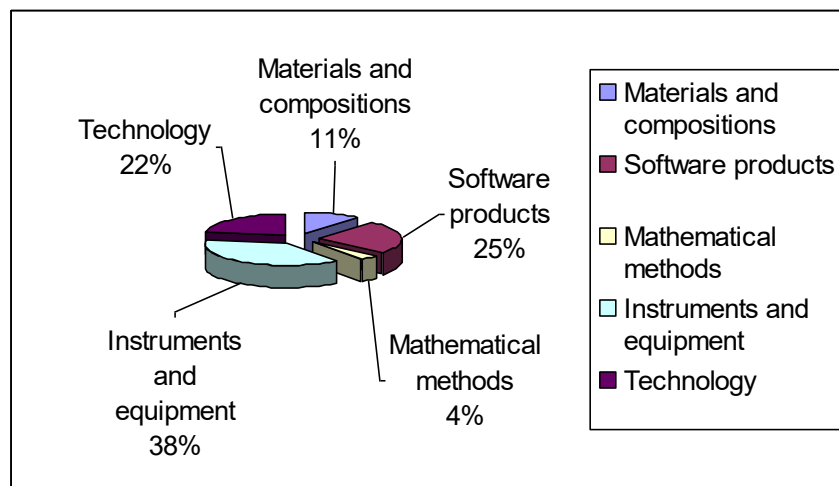


Figure 01. Structure of granted patents at Samara University, 2015
 Source: calculated by the authors according to the 2015 Self-Examination Report

According to the report on self-examination of the university, at present, specialists are being trained taking into account the staffing needs of aerospace enterprises and other high-tech industries of the Samara province, as well as beyond. Plans for the training of specialists on target reception have been agreed with the State Atomic Energy Corporation Rosatom, the Ministry of Industry and Trade of Russia and the State Corporation Roscosmos.

The high demand for university graduates is evidenced by a significant number of applications from enterprises, institutions and organizations located in various regions of Russia. The main employers' market is Russian enterprises of all subordinate entities of the Russian Federation, as well as

international enterprises focused on the IT sector, as well as the production of breakthrough high technology products in the following industries: metallurgical and automotive industry. In 2015, 78% of graduates are officially employed, before obtaining diplomas.

Monitoring the development of the scientific and innovation infrastructure of Samara University, one can note the main stages.

In the 1950s, the first branch of Scientific Research Laboratory in the USSR was established at the university. In the 1960s, the computer centre KuAI was created and the first machine Ural-1 was installed. In the 1970s and 1980s, the institute participated in studies of the vibration strength and reliability of engines, optimization of processes and navigation and control system of spacecraft motion and development of computer optics. In the late 80s, the Research and Technology Centre was created. In the 90s, the University of Samara Regional Centre for Informatization in Education and Science, the educational and scientific center of CALS technologies were created on the basis of the university. In the 2000s, the Centre for Space Geoinformatics and the supercomputer centre of the university were created. As it was noted above, in 2018 the Digital Economy Scientific and Educational Consortium was created.

Nowadays the university has 9 research institutes, 44 research centers, 7 industry research laboratories, 58 research laboratories, 3 research teams.

The research activity and the response of university scientists to the most topical research topics determine the leadership of Samara University among higher educational institutions of the region in publishing activity, as well as high places among National Research Universities (10th place in the total number of publications, 11th place in publications in foreign journals and citation).

The university responds very sensitively to changes in the need for scientific research and the training of the necessary personnel for the innovative and digital economy of the region. At the same time, at the country level, the university has a lot to do to strengthen its position in the scientific community.

6.3. The University Funding

Financing of research activities of the university is carried out in several directions. At present the priority source is funding under the project 5-100. Starting from 2014, Samara University receives about 500 million rubles. annually on the development of scientific and innovative activities. In more detail, the structure of funding for research at the university at the end of 2015 is presented in Table 03.

Table 03. The structure of the University research funding in 2015

Activities	Amount of financing	Structure, %
Number of completed research projects, units	393	-
Amount of project funding	1258162	100
Among other		
Ministry of Education and Science of the Russian Federation	639908	50,9
From the Russian funds	53053	4,2
From the budget of the Samara region	145000	11,5
From the funds of Russian business entities	289666	23,0
At the expense of foreign sources	20645,5	1,6
From other extrabudgetary sources	39373,9	3,1
Scientific and technical services	45193,2	3,6

Note: Source: Compiled by the authors according to the self-examination report of the Samara University for 2015.

The main share of the financing of the university’s research activities comes from budget financing and financing from the funds of Russian business entities. The Endowment Fund established in 2009 should also be singled out as a source of funding. In 2013, the endowment fund was finally formed and transferred to the trust management of the management company Gazprombank - Asset Management. The assets of the fund at the end of 2015 amount to 19.2 million rubles.

6.4. Place in the economy and education system of the region

Samara University is actively cooperating with federal and regional authorities. The members of the supervisory board of the university are representatives of the Russian and regional governments, leading scientists and academicians, heads of large aerospace enterprises.

The significance of the role of the university in the region's innovation space is confirmed by the fact that Samara University is the core of the Samara Aerospace Innovation Cluster established in 2012 in the region (Figure 02).

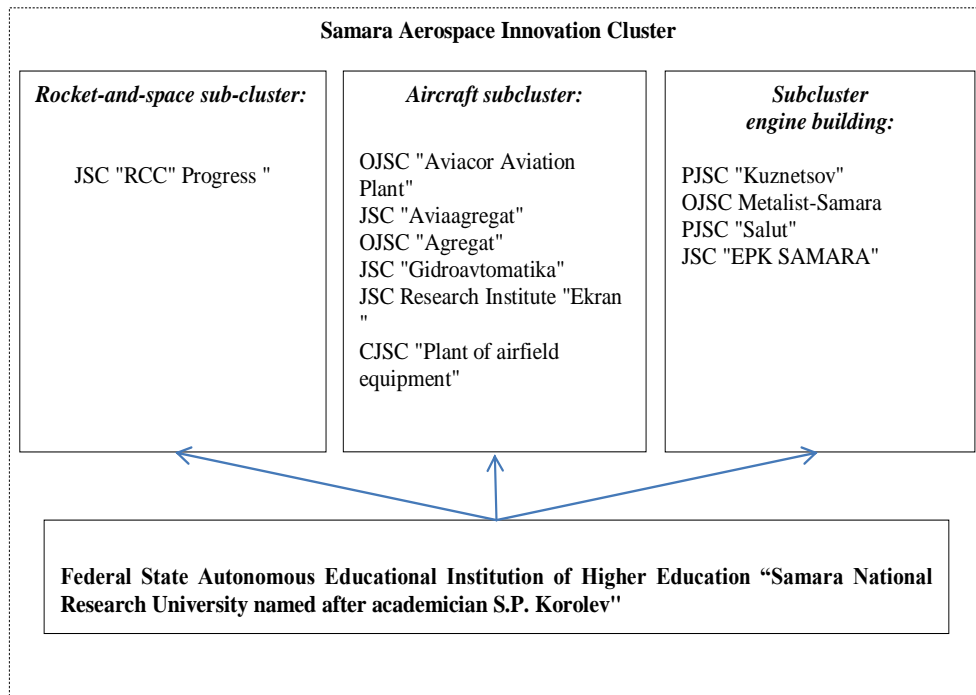


Figure 02. Samara University in the system of aerospace innovation cluster (Ivanenko & Ivanenko, 2015)

Analyzing the role of the university in the system of training specialists in the region, it is possible to consider the share of students in the general result of all students in universities of the Samara region (Figure 03).

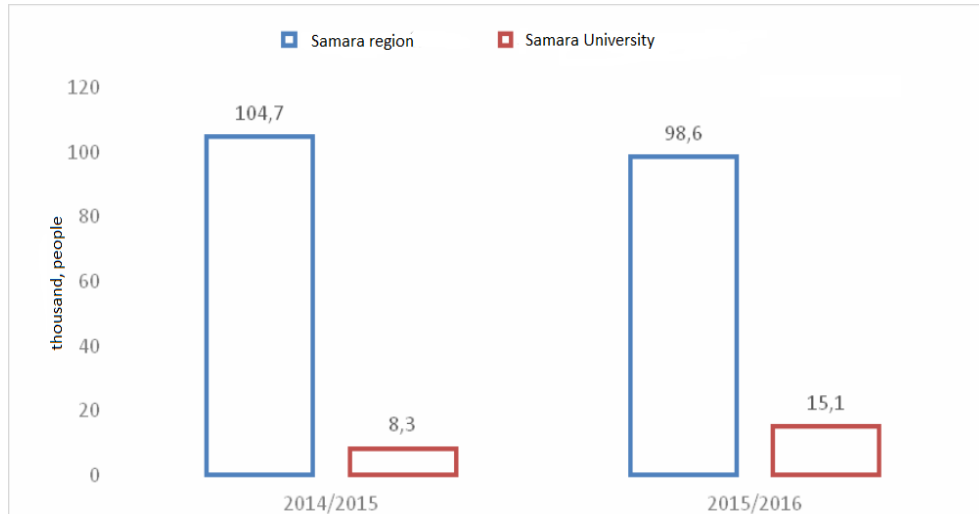


Figure 03. The number of students in universities of the Samara region and Samara University
Source: compiled by the authors according to Rosstat and reports on self-examination of Samara University.

A steady circle of employers seeking for specialists has historically formed around the university, but recently there has been a tendency to increase the demand for acceptance of engineers and programmers to a number of international companies operating in the Russian Federation.

Applications for graduates also come from well-known engineering companies - Renault, Nissan, Bosch, Delphi Samara, National Instruments, Camozzi, Icoa / Samara Metallurgical Plant, Schneider Electric, etc., where engineers - graduates of the university are already working. University graduates work for Google, Microsoft, IBM, Bosch and many other high-tech companies. Despite the fact that the Samara region is in the top three (excluding Moscow and St. Petersburg) in the number of IT specialists, there is a shortage of IT specialists in the region, in terms of volume of the services provided, the region ranks 25th in the country. The university is faced with the most important task of creating small innovative companies in the field of IT-technologies and training personnel for the digital economy in the region.

6.5. Involvement in the international educational and scientific community

The participation of Samara University in Project 5-100 is strategically important for improving the innovative competitiveness of the university and contributes to the transformation of its research management system.

In June 2016, Strategic Academic Units (SAU) were formed on the basis of leading research teams of Samara University, actively participating in educational activities, new interdisciplinary research and educational units.

SAU of Samara National Research University named after academician S.P. Korolev: Aerospace Engineering and Technologies (SAU-1), Gas Turbine Engine-Building (SAU-2), Nanophotonics, cutting-edge technologies for remote sensing of the Earth and intelligent geoinformation systems (SAU-3).

The selected areas have sufficient potential and resources to become world-class research and educational centres, to obtain breakthrough scientific and technical results and to increase the

international competitiveness of Samara University. Accordingly, at present, the strategic goal of the university is to join the world's leading research organizations.

Participation in the national program to improve the competitiveness of leading universities “Project 5-100” acted as a stimulus for the integration of Samara University into the world educational space. Today, more than 15% of foreign students in the Samara region study at Samara University. This is facilitated by expanding the range of joint training programs. In 2011, cooperation with the Institute of Aeronautics and Space Research ISAE (France) was launched and continues as part of a joint student project to participate in the annual competition of the National Centre for Space Research of France (CNES).

Samara University already has good experience and a significant foundation for the further implementation of international double degree programs with Harbin Polytechnic University, Vigo University and Lappeenranta University of Technology (Finland), Bath University (United Kingdom), University of Stuttgart (Germany), University of Houston (USA), Berlin Technical University (Germany), Northwestern Polytechnic University (China), Technical University of Turin (Italy), Swiss Electronics Centre and microtechnologies (Switzerland), the Haldor Topsoe Danish Centre (Denmark), Alcoa Technical Centre (USA).

For students and young scientists from far abroad (the Netherlands, Denmark, Spain, Germany, Latvia, Argentina, Mexico, etc.) the international summer space schools "Advanced Space Technologies and Experiments in Space" are held. The Russian-German school of young engine builders began its work.

In 2015, together with business corporations, a number of modern, bilingual, modern educational programs on the university profile were developed as a part of Samara University Competitiveness Enhancement Program, among the world's leading research and education centres.

Fulfilling the stipulations of a “roadmap” for promotion in ratings, Samara University consistently improves its position in leading international and Russian studies (Table 04).

Table 04. International and Russian university rankings for 2014-2016

Rankings	2014	2015	2016
Russian Rankings			
Russian University Ranking according to to RA Expert	23	27	26
National University Ranking	62	51	21
The Ranking of Universities According to the V. Potanin Charitable Foundation	44	10	59
ARES	29	22	-
Global Rankings			
QS EECA	-	151-200	101-110
QS BRICS	151-200	151-200	151-200
THE World University Rankings	-	-	801-980
THE BRICS & Emerging Economies Rankings 2017	-	-	251-300
4ICU Russia	-	61	31
Webometrics, world ranking	2518	2413	1594

Note: Source: Compiled by the authors according to the official sites presented in the table of ratings.

In addition to entering the QS international subject rating, in 2016, the university was included in the top 801+ best scientific and educational centres in the world in the world ranking of THE, and also entered the TOP 251-300 THE BRICS & Emerging Economies Rankings 2017 for the first time. The university rose immediately by more than 30 positions and was ranked among the 101-110 best universities in developing countries of Europe and Central Asia in the QS University Rankings: Emerging Europe and Central Asia (QS EECA).

The university also was included for the third time among the best universities of the BRICS countries in the QS University Rankings: BRICS. The university is in the group of universities that ranked 151-200 in this ranking.

7. Conclusion

In this article, we investigated the influence of factors and conditions under which universities are formed as regional centres for the development of innovation and digitalization in the region. Five provisions that have been tested using data from Samara University can serve as a basis for further research on the role of research universities in the innovative development of the region. In general, inference should be drawn that at the regional level, the formation of a university as a centre for creating innovations and new technologies, and training for the digital economy depends on: (1) the internal characteristics of university; (2) ability to respond to external shocks; (3) university funding; (4) places in the economy and education system of the region; (5) university involvement in the international educational and scientific community.

In general, the undertaken study allows us to confirm the conclusions that the internal characteristics of the university form the framework for its future development. Established by the state to meet the country's needs for highly qualified personnel, Samara University has constantly improved its educational programs, carried out research and technological development. The ability to respond timely to external shocks has allowed Samara University to remain throughout its history among the most sought-after creation of new technologies and training of personnel for innovation activities and the digital economy, attracting public and private funding. The driver of the development of Samara University in the new conditions is participation in the national Top 5-100 program, one of the requirements of which is the expansion of international cooperation, promotion in world rankings. Facts suggest that the policy of creating national elites, such as national universities, is bearing fruit, both for the region and for the country as a whole. Such programs make it possible to identify universities with a good basic structure, capable of responding to external shocks promptly and actively, financially supporting the university in creating a favorable environment for the productive work of talented students and scientists for the benefit of the region and the country.

The new role of universities as conductors of the digital economy (Kovalev, 2018) offers significant benefits for all participants, which requires an understanding of the interests and strengthening of the interaction of universities, business and government (Kuzyk, Grebenyuk, Kakaeva, Manchenko, & Dovgiy, 2017). To achieve this, it is necessary to conduct targeted work in the regions to stimulate by the authorities the interaction of business and universities in the form of implementation of joint programs for training the digital economy, research projects that solve specific problems of regional development.

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