Problems of Economic Transition

ISSN: 1061-1991 (Print) 1557-931X (Online) Journal homepage: http://www.tandfonline.com/loi/mpet20

The Modern University as a Driver of Economic Growth

Alexander Karpov

To cite this article: Alexander Karpov (2017) The Modern University as a Driver of Economic Growth, Problems of Economic Transition, 59:11-12, 909-930, DOI: 10.1080/10611991.2017.1431483

To link to this article: https://doi.org/10.1080/10611991.2017.1431483

Published online: 15 Mar 2018.

Problems of Economic Transition, vol. 59, nos. 11–12, 2017, pp. 909–930.

ISSN: 1061-1991 (print)/ISSN 1557-931X (online)
DOI: https://doi.org/10.1080/10611991.2017.1431483

ALEXANDER KARPOV

The Modern University as a Driver of Economic Growth

Models and Missions

This article analyzes the modern university as a driver of economic growth within the framework of the concept of university 3.0 (education, research, and the commercialization of knowledge). It is shown how university 3.0 is becoming the basis for the global competitiveness of national economies and supranational associations, and how its entrepreneurial ecosystem forms new, fast-growing industries, promising technological markets, and leading administrative-territorial spaces.

Keywords: *university 3.0, economics of education, research and development, commercialization of knowledge, innovation, entrepreneurship, networking*

In the higher education systems of economically developed countries, a radical transformation is occurring, which is related to the importance of universities for innovative development and economic growth and, consequently, to the prosperity of the state and the well-being of its

English translation © 2017 Taylor & Francis Group, LLC, from the Russian text © 2017 "Voprosy ekonomiki." "Sovremennyi universitet kak draiver ekonomicheskogo rosta: modeli i missii," *Voprosy ekonomiki*, 2017, no. 3, pp. 58–76.

Alexander Karpov, doctor of philosophical sciences and candidate of physical-mathematical sciences, is a head researcher at the Bauman Moscow State Technical University.

Translated by Peter Golub.

citizens. Reality indicates a change in the socioeconomic functions of the university. Alongside its traditional educational and scientific missions, a rapidly growing sphere of economic activity is emerging. The new scope of the university includes developing and transferring technology, commercializing the products of academic science and introducing them to the market, creating new businesses, and managing intellectual property for profit. The modern university assumes the mission of social and economic development.

In the United States, after the adoption of the Bayh-Dole Act of 1980, universities have created more than 2,000 companies (260,000 jobs), which deal with the commercialization of technology. Prior to the adoption of the act, U.S. universities registered less than 250 patents per year; in 1982 there were 1,500 registered patents and by 2010 the number had risen to 4,500. If in 1989–1990 universities received $82 million in licensed revenue, in 2009 they received more than $1.5 billion. In fact, the Baye-Dole Act institutionalized the American model of the entrepreneurial university.

In the postwar period, there was a significant increase in enterprises created at universities; for example, at the Massachusetts Institute of Technology and Stanford University (Etzkowitz 2008). J. Cole (2010) writes that "a very high proportion of the leading new industries in the United States, perhaps as many as 80 percent, are derived from discoveries at American universities" (p. 4). Currently, the United States is moving away from the model of creating business incubators, such as Silicon Valley, to a distributed partnership scheme where the decisive role is played by universities. The innovative and entrepreneurial activity of students in the United States has become a key factor in the competitiveness of universities.

In the early 2000s in Europe, the universities were assigned the role of building a knowledge society, since they exist at the intersection of research, education, and innovation (CEC 2003). The European Union's concept of *excellence networks* is based on the idea of *uniting the scientific environment* of universities into a global structure that utilizes the strengths of its members (EUA 2003). At a European meeting at Hampton Court (2005), universities, along with research and development, were named the foundation of European competitiveness (CEC 2006). Thus, Cambridge University has transformed the county of Cambridgeshire into an innovation cluster, which has produced ten companies with a billion dollars of capitalization.

A university that positions itself as a corporate entity with the knowledge economy has been dubbed: *university 3.0*. This metaphor is meant to refer to the three missions of the university: university 1.0 was primarily focused on being an educational institution, university 2.0 was focused on teaching and research, and university 3.0 has added a third aspect to the previous two missions—*the commercialization of knowledge*. The emergence of the system of higher education 3.0 is associated with the development of multicampus universities in the United States (Lane 2013).

For Russia, the establishment of the 3.0 model is a significant social and economic goal, because it is precisely such a university that today plays a decisive role in the modernization of society and the transformation of the economy. According to "The Strategy for Innovative Development of the Russian Federation until 2020," the priority of education is "the development of the research and development sector of universities, the deepening of cooperation between universities and advanced companies of the real sector of the economy and scientific organizations … [and] the development of a network of education and research programs" (Section IV, 5).[1] However, the strategy "characterizes the Russian system of innovation as being oriented toward imitation, rather than undertaking radical change and creating new technologies" (Section I, 2).

Indeed, according to a World Bank report (2012), Russia ranks fifty-fifth on the Knowledge Economy Index behind countries such as Qatar, Costa Rica, and Malaysia. In Russia, the proportion of industries that are related to the knowledge economy makes up 15 percent of GDP, in developed countries in Europe this figure is 35 percent, and in the United States it is 45 percent (Sosnova 2013). On the global map of startups (startupblink.com), by the middle of 2016 only 972 startups were registered in Russia while 33,797 were registered in the United States.[2] The National Innovation Report states that "Russia has very little representation in the world's high-tech markets (constituting only 0.4 percent of the world's high-tech exports)"; and in terms of Russia's total exports, high-tech exports make up only 2 percent, while in South Korea high-tech exports make up 26 percent of total exports (in China, 22.6 percent, and in Ireland, 19.2 percent). In Russia, only 11 percent of enterprises could be considered innovative, whereas in the leading countries the figure is 60 percent. Against this statistical backdrop, "The National Report on Innovations in Russia, 2015" considers the

breakthrough Russia has made in the Global Innovation Index (GII): from 2010 to 2015, it climbed sixteen places (National Report 2015, pp. 5, 36, 73, 75). I believe that this is an undeservedly optimistic assessment, and this is why.

From 2007 to 2015 (the entire period that GII measurements have been made), Russia rose only six places from fifty-fourth to forty-eighth; that is, growth was virtually nonexistent (Table 1). This is consistent with the innovation index data for 110 countries, calculated in 2009 by the Boston Consulting Group (BCG), where Russia ranked forty-ninth (Andrew et al. 2009).

In 2016, according to the GII, Russia took forty-third place, but its ranking fell from 39.32 to 38.50 for the year.[3] As can be seen in Figure 1a, the up and down dynamics of Russia's position is similar to that of the index of the two countries closest to it (by index)—Mauritius and Costa Rica. We can speak of a breakthrough or growth in the innovation index of countries like Switzerland, the United Kingdom, and, in part, the United States (Figure 1b), but not of Russia, Costa Rica, and Mauritius, whose indexes show unpredictable dynamics.

Meanwhile, Russia's innovation index shows opportunities for the development of university 3.0. The GII is calculated as the average value of the input and output indicators (subindexes) of innovation. The first characterizes the opportunities that exist for innovation; the second characterizes its economic results. The number of opportunities or resources of innovative development includes, for example, the education system, business environment, research and development, innovative networks, investment activity, information and communication technologies (ICT), and so on. To rate economic results, the GII uses estimates of production, the impact and dissemination of knowledge, nonmaterial assets, creative products and services, and online creativity (e.g., computer technology for education; Dutta et al. 2016).

One of the main reasons for Russia's innovative and technological backwardness is its outdated higher education model. In a knowledge society, scientific research becomes a system-forming factor of university education. If before, when education and research were united within the university, research was part of the education process but did not specify its content and structure, then now research is starting to be used as a teaching method, *shaping* the process and function of education (Karpov 2015a). In Russia, higher education remains in the mode of the industrial culture of the mid-twentieth century. Many

Table 1

Global Innovation Index, Ratings for Specific Countries, 2007–2016

	2016		2015		2014		2013		2012		2011		2009–2010		2008–2009		2007	
Country	Place	Rating	Place	Rating	Place	Rating	Place	Rating	Place	Rating	Place	Rating	Place	Rating	Place	Rating	Place	Rating
Switzerland	1	66.28	1	68.30	1	64.78	1	66.59	1	68.20	1	63.82	4	4.82	7	4.73	6	4.16
United Kingdom	3	61.93	2	62.42	2	62.37	3	61.25	5	61.20	10	55.96	14	4.42	4	4.82	3	4.81
USA	4	61.40	5	60.10	6	60.09	5	60.31	10	57.70	7	56.57	11	4.57	1	5.28	1	5.80
Malaysia	35	43.36	32	45.98	33	45.60	32	46.92	32	45.9	31	44.05	28	3.77	25	4.06	26	3.47
Russia	43	38.50	48	39.32	49	39.14	62	37.20	51	37.90	56	35.85	64	3.03	68	2.93	54	2.60
Costa Rica	45	38.40	51	38.59	57	37.30	39	41.54	60	36.30	45	37.91	41	3.35	48	3.27	51	2.66
Mauritius	53	35.86	49	39.23	40	40.94	53	38.00	49	39.20	53	36.41	73	2.93	66	2.95	60	2.46

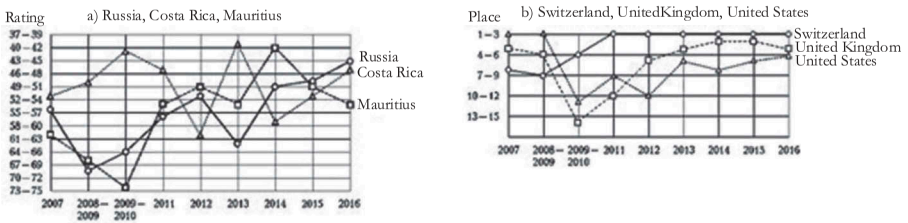

Figure 1. **Position in the Global Innovation Index.**
Source: Dutta et al. (2016).

universities function exclusively as educational institutions (model 1.0); some universities integrate research and development into the learning process to a minimal extent (model 2.0). Universities with a developed system of commercializing knowledge (model 3.0) are nonexistent in Russia.

In 2016, the St. Petersburg National Research University of Information Technologies, Mechanics, and Optics and the Russian Venture Company conducted a study of the innovative potential of forty leading Russian universities participating in the Russian Academic Excellence Project 5-100, developed by the National Research University. The study showed that Russia's elite universities demonstrated a lack of innovative and entrepreneurial activity based on several parameters key to the concept of university 3.0.

In nearly half the universities (nineteen of forty), small innovative enterprises (SIEs) generated no income; the income of the rest was quite modest—an average of 386,000 rubles a year per SIE (mainly due to contracts with the university itself). Since 2009, Tomsk State University has the largest number of SIEs (thirty-eight), but in 2015, it received a total income of only 200,000 rubles (slightly more than 5,000 per SIE). In twenty-four elite Russian universities, the number of SIEs does not exceed ten, and two universities lack them entirely. The number of jobs created by university companies was insignificant: an average of 3.6 jobs per 1,000 students and scientific and pedagogical workers (SPWs). Twelve universities did not participate in the projects created within economic clusters; that is, their impact on the socioeconomic environment was very limited (Monitoring 2016).

The average annual income of elite Russian universities from the management of intellectual property is extremely small—only 280 rubles per SPW. More than half of the universities (twenty-four of forty) had zero income from intellectual property management in 2015; for twelve of the remaining universities the range was from 100,000 to one million rubles. The maximum income was generated by Mordovia State University, which amounted to 5.8 million rubles with seventy-four patents. Meanwhile, in twenty-six universities the number of intellectual property objects on the balance sheet exceeded 100 units. Siberian Federal University had the most objects (1,301), totaling an income of one million rubles. It was followed by South Ural State University with 825 objects but zero income, which was followed

by the National Research Nuclear University (Moscow Engineering Physics Institute) with 744 objects and an income of 200,000 rubles.

As a rule, most elite Russian universities have patents, but no income (or almost no income), and most patents are Russian. In twenty-eight elite universities there were no international patents; eleven universities had one to three international patents. The leader, Tomsk Polytechnic University, had eleven international patents, but in 2015 its total income from managing all intellectual property (515 objects) was only 800,000 (Monitoring 2016).

This data show that the imitational orientation of the Russian innovation system, reflected in 2011 in "The Strategy for Innovative Development of the Russian Federation until 2020," has not been overcome. However, despite these disappointing statistics, Russia not only claims to have established universities 1.0–3.0 but also is now striving to establish university 4.0, which would have the ability "to solve problems unsolvable by industry," linking this model to the German concept of Industrie 4.0 (Platova and Zhabenko 2016, p. 9).[4]

At the same time, a sharp increase in the teaching load of teachers under the guise of wage growth hinders not only the innovative and entrepreneurial activities of the university but also scientific work in general. Attracting "Varangian scientists" to scholarly publications can, of course, improve the scientometric indicators of the university, but at the same time this generates surrogate methods of conducting scientific work and is unlikely to facilitate the growth of innovative activity. Instead, this kind of organization of university science trades the productive activity of scientists—research, development, and the commercialization of knowledge—for the quick reward of raising the prestige of teachers and the status of publications.

The problem of establishing the university 3.0 model in Russia is largely connected with fundamental and poorly studied socioeconomic issues, which are centered around the creation of an effective model of higher education. The initial question is the following: If social development is determined by the paradigm of the knowledge society, then what are the implications of this paradigm for Russian universities from both the structural-functional and the pedagogical perspective? In other words, the university can act as a force of social and economic modernization in Russian society if such a future model is determined and scientifically justified.

It seems that in the scientific development of the university 3.0 concept, three initial models of the university should be at its foundation: (1) the network university, (2) the creative university, and (3) the innovative and entrepreneurial university. I believe that connecting these three models (NCI&E) will allow the university to fulfill its new socio-economic mission.[5]

Creating university 3.0: The experience of other countries

In the middle of the twentieth century, higher education began to lose its elite status. The emergence of the global economy, the expansion of technical and technological knowledge, and the growth of the production of knowledge and its economic significance have made higher education inclusive and directly responsible for the development of society. The mass nature of education is a fundamental resource, which can be effectively used for social and economic development; in particular, for spreading entrepreneurial competencies and technological culture in society.

In 1940, approximately 15 percent of people age 18–21 attended college; by 1963 that figure had risen to 40 percent, and in 1968 the fast-growing sector of public education covered approximately two-thirds of all higher education students (Trow 1972). Back in the early 1940s, even the top executives of large U.S. companies rarely had a higher education. IBM hired its first top executive with a college education a year before the start of World War II (Drucker 2008). In 1958, 42.8 percent of the labor force in the American industry of knowledge was made up of college graduates, and by 1970 it had reached 53.1 percent (Machlup 2014; Machlup and Kronwinkler 1975).

In Europe, higher education on a mass scale was established twenty years later. In the 1960s, European universities covered only 4–5 percent of the comparable age group; today, this is 40–50 percent (Anderson 2010). If in the early 1960s, in the United Kingdom, there was one teacher for every eight students, some forty years later that ratio was one to twenty-one students, with a doubling of the proportion of 9:1 to 17:1 taking place from 1980 to 1999 (Greenaway and Haynes 2003).[6]

The development of higher education takes place under conflicting social trends that began to take shape in the late 1970s. Researchers from the SUN (Steering Universities) project associate them with the changing role of the nation state, the transformation of which they

analyzed on the examples of Germany, France, Italy, the Netherlands, Norway, Switzerland, and the United Kingdom (Ferlie et al. 2009). On the one hand, the government gains ever greater power; on the other hand, its boundaries become less defined as the result of dilution and democratization.

At the turn of the 1970s and 1980s, the public sector (the existence of which in the West was justified by the dominant concept of the welfare state) began to decline under the influence of economic constraints and certain political decisions. The government began demanding economic efficiency and market relevance from public universities, and introduced strategic planning, audits, and evaluations based on performance indicators. To increase the autonomy of universities, their leadership has at times required more power, sometimes to the detriment of the consultative and collegial bodies (Norway). The tuition system has been introduced and tuition hikes are prevalent (e.g., United Kingdom, Germany, and Austria), and a number of countries have introduced the concept of a bachelor-master's degree (e.g., Italy, Norway, etc.).

Also, the institutional interactions of universities have been expanded; administrative functions are delegated above (EU, OECD) and to the regional level. In the 1990s, changes in the social and economic role of education related to the development of society based on knowledge stimulated the division of university missions, thereby diversifying the institutional framework of universities. The latter helped attract both public and private sources of funding. Universities are included in the EU's framework programs for research and development (1984) and the Bologna Process (1999). Administrative functions, particularly in education, are transferred to the territorial level (the United Kingdom and Italy), decentralized institutions receive more autonomy (Germany), and regions are included in the process of forming the national budget of the education sector (France).

Universities are becoming an important part of regional economies, public-private partnerships, and transnational systems of socioeconomic cooperation. A significant interuniversity sector is formed, which has joint ventures with academic organizations and research centers that are allocated separate public funding (France), and research clusters are developed with the participation of universities (Germany; Paradeise et al. 2009a).

As a result, universities are involved in regional, national, and international networks; heterogeneous administrative networks are formed, which affect the development of education along with the state. The pluralist form of the administration of education in Germany, the Netherlands, and Norway is supplemented by its democratization: university boards include external participants who establish a budget, set priorities, and develop strategies. There is considerable attention paid to the administrative culture of universities, the development of decentralized micromanagement, and the elimination of outdated forms of government oversight. University administration is becoming more distributed, increasing the value of its social function.

Thus, universities are undergoing an organizational transformation, which turns them into autonomously managed organizations (Paradeise et al. 2009b). In particular, new administrative concepts are coming to the fore, like new public management (NPM) and network governance (NG; Ferlie et al. 2009).

As part of the NPM model, the education sector is treated as a subject of market reforms, education acquires the status of a service, and the student becomes a consumer. It is assumed that universities should compete for students, and that students should buy their education based on economic indicators—the earnings of university graduates, university ratings, and on the prices students are willing to pay. Based on the NPM model, scientific research in universities is a tool for competitiveness and market relations (Karpov 2014a).

Under these conditions, adherents of the NPM model believe that competition should raise the quality of education, that the government should encourage private institutions to get rid of inefficient public schools, and that funding should be concentrated in the most effective areas. Efficiency is determined on the basis of production indicators that have been applied widely across many industries in the twentieth century (cultural backwardness is ignored by both theoreticians and practitioners of the NPM model). As a result, the university is conceived of as a company whose executives are appointed rather than elected, and salaries are based on higher student numbers, which are interpreted as an increase in labor productivity.

The projection of a network government (NG) model onto universities is characterized by the development of partnerships among educational organizations, as well as between educational clusters and a wide range of social institutions. This kind of network configuration requires

distributed leadership, collective decision making, the indirect participation of the state, and limited wage differentiation. It relies on the internal mechanisms and administrative tools of the self-development of networks, the self-regulation of various processes, collaborative problem solving, dissemination and adaptation of effective pedagogical models and practices (benchmarking), and the concentration and distribution of intellectual resources (Ferlie et al. 2009).

In the concept of the neo-Weberian state (NW model), there are elements of both the market (NPM) and the network (NG) models of administration (Pollet and Bouckaert 2004). It is characterized by the adaptability of public structures to institutional change, and also by the significant role of the government in the governance and provision of public services (market and network models strive toward a fundamental weakening of government regulation of the public sphere). According to this model, education acts as a *public* service for its citizens, rather than a market institution; as a community that supports horizontal agreement between dissimilar subjects; and as a government agent striving to meet the interests of external stakeholders (Paradeise et al. 2009b).

The network university

The term *network university* includes research and educational partnerships, interdisciplinary research collaboration, network training programs, virtual learning environments, distance education, academic mobility, and an administrative structure that is a matrix. The formation of the network university model is the result of the particularities of the knowledge society, which develops as a society of interrelated organizations that are either institutionally integrated in a general administrative platform or interact as a complex network of partnerships.

Today, these partnerships form the basis of highly innovative environments that constitute the institutional basis for the development of a knowledge society. The goals of a partnership of universities include creating effective knowledge-sharing schema (Karpov 2012b), improving the access of enterprises to research and development, increasing investment in technological research, engineering development, and the commercialization of knowledge; the formation of new markets is based on technological advancements and the development of new (including corporate) educational programs.

Thus, the innovative strategy in the United Kingdom includes rapidly increasing the number of knowledge-transfer partnerships, which is publicly funded and provides British companies access to the knowledge and experience of universities and research institutions (Scott 2009). The creation of generalized intellectual resources is becoming one of the most promising directions of European education policy (CEC 2006, p. 3).[7]

Specialized networks of partnerships establish a kind of ecosystem of educational organizations, which provide intellectual investment in human capital. M. Curley and P. Formica (2013b) define an ecosystem as "a network of interdependent organizations or people in a specific environment with partly shared perspectives, resources, aspirations and directions" (p. 4), which the university should coordinate. At the same time, the creative network of partners provides an opportunity to realize the principle of diversity in education, to involve external experts, and enables students to go beyond specific disciplines. Such a network creates research and development clusters, both internal and external, where teachers and experts from different disciplines are given the opportunity to interact, contributing to an interdisciplinary environment (EUA 2007).

The concept of *open innovation*, as described by H. Chesbrough, is at the foundation of the effective organization and functioning of the network of partnerships consisting of the modern university, high-tech companies, research institutions, and venture capitalism. According to the logic of open-market participation, a company receives ideas and advances from the external environment, in this case the university environment (Chesbrough 2007), which produces synergies and network effects (Curley and Formica 2013b). To enter the space of specialized communication becomes the main object of the innovative network (Karpov 2013a).

Knowledge sharing must comply with the principle of social wealth. This widely debated social principle involves the distribution of economic benefits from the activities of educational partnerships to the highest possible range of individuals, communities, and businesses, and thereby increases the quality of life for everyone (EUA 2007).

Building its sphere of knowledge as a network of scientific and educational partnerships, and utilizing the concept of open innovation, the modern university is becoming the global link in the knowledge economy. Partnering with it can not only provide the structures of production with new ideas, technologies, and strategies, but also attract new creative minds.

The creative university

Today, modern education centered around the university is becoming one of the main forces of social and economic development, because it creates individuals whose creative work underlies the system of the production of knowledge and global economic growth. Education exists at the crossroads of economics and creativity. The *creative university* is a system of creative spaces, an environment that attracts and concentrates talent. Creativity contributes to entrepreneurship, innovation, and economic growth. This involves the creation of cultural products, as well as scientific invention and technological innovation. However, "the study of creativity in the context of the economy of the knowledge society is quite recent . . . and here we need a greater theoretical understanding of creativity in education" (Hammershoj 2009, p. 546).

There are three approaches to the definition, description, and construction of creative spaces in the modern university. Within the framework of the *first* approach, a creative space is presented as a model of the environment surrounding the processes of learning and creative activities. This approach is most common because of its broad utility and ability to adapt to different preferences, interests, and opinions. It can be used to describe the physical layout and content of design studios, offices of architects, research laboratories, rehearsal spaces, fab-labs, and so on (Martin et al. 2010). The *second* approach refers to a model of creative knowledge processes. The *third* is a comprehensive approach and assumes that space and thought are interrelated, and that in order to understand this relationship it is necessary to analyze specific sets of social and spatial practices in the relevant context.

The innovative and entrepreneurial university

Modern universities make ecosystems that provide creative spaces for experimental approaches to speculative ventures focused on innovation. Here we see the establishment of entrepreneurial universities, because university ecosystems contribute to the organization of interdisciplinary spaces linking science and technology, academic and business circles. Here knowledge is transformed into innovation through creativity, and the models of new ideas—commercial, social, and political—transcend the boundaries of the academic environment. Thus, the mission of universities is expanding to include not only education and research

but also socioeconomic *initiatives* and the transformation of society. The entrepreneurial university contributes to the development of a harmonious relationship between scientific research and academic enterprise, and its ecosystem is so capable of increasing the resources needed for scientific discovery with commercial potential that it becomes a viable business (Curley and Formica 2013a).

The innovative and entrepreneurial university must anticipate and track economically significant innovations in science and technology in order to change and diversify the field of business—in other words, it must exist in a state of dynamic self-renewal. The most important characteristic of this university is *the expansion of the competencies of students in the socioeconomic sphere and their inclusion in direct economic activity.*

The beginning of the new economic mission of the university is associated with two significant events in U.S. history. On June 22, 1944, President Franklin D. Roosevelt signed the G.I. Bill, which provided a number of benefits to veterans returning from the war, including financial aid for college and technical schools (including housing), as well as low-interest business loans. Another development was the emergence of venture capital firms in 1946, which initially saw themselves as a financial tool for supporting "honorable ideas," and invested in start-up companies headed by soldiers returning from the war.

In *The Age of Discontinuity*, P. Drucker wrote that of all the organizations, the university will play the fundamental role in the development of the knowledge society, and will be the basis of scientific production (Drucker 1969; Karpov 2015b). M. Trow (1972) showed that in modern societies the search for new knowledge and applications had become an important field where universities had to play a central role. D. Bell has pointed out that three factors that drive U.S. technological innovation are strong high-tech research universities, a strong entrepreneurial culture, and venture capital for financing small business (Bell 2008).

In the early twenty-first century, universities are beginning to play a leading role in the commercial development of scientific knowledge (Thursby and Kemp 2002). As a result of the collaboration between universities and industry, scientific discoveries are translated into innovative products and are commercialized within the appropriate business models. Established entrepreneurial universities simultaneously conduct educational, research, and commercial activities that stimulate one another (Etzkowitz 2008).

When considering the development of university 3.0, the model of the *multi-campus university* (a heterogeneous institutional structure controlled in a special way), as described by G. Lane, is of particular practical interest. Multicampus universities combine different types of institutions and geographically distributed campuses. This structure encourages multidisciplinary and cross-institutional cooperation for the solution of complex socioeconomic (and operational) problems. Since more than 40 percent of public university students and approximately 30 percent of all university students attend multicampus schools, they should make a decisive contribution to the renaissance of the United States (Lane 2013). In Russia, some federal universities have a multicampus structure, the first of which were established in 2006.

The expansion of the mission and the institutional framework of universities is reflected in the concept of *post-academic science*. In 1994, M. Gibbons together with several coauthors wrote about the transition from the monodisciplinary production of knowledge, which was poorly oriented toward the practical applicability of knowledge, to the transdisciplinary model geared toward solving problems of critical social importance. The new paradigm is characterized by a socially distributed system of knowledge production (Gibbons et al. 1994). It is often described as a triple helix (Etzkowitz and Leydesdorff 1995), which explains innovation and the process of knowledge transfer as a network of interactions (Etzkowitz and Leydesdorff 2000). A central concept of the triple helix is the *entrepreneurial university*, which, along with the traditional missions of teaching and research, plays an active role in socioeconomic development as one of the main agents of the production of knowledge. This type of university not only endows students with new ideas and skills, but also develops their entrepreneurial talents for science-oriented business (Etzkowitz 2008).

Such hybridization was the result of the development of subject areas where fundamental knowledge has high technological and commercial potential; this includes, biotechnology, nanotechnology, pharmaceuticals, alternative energy, and information systems and technology. Clearly, this new concept of the university has much in common with university 3.0, which functions to produce fundamental knowledge.

In 2009, along with the government, academy, and industry, the model of innovation included the civil society founded on the principles of transparency and the culture of knowledge, together with the culture of innovation (Carayannis and Campbell 2009).

Additional emphasis is placed on the natural environment of society, along with the subjects of the production of knowledge and innovation (Carayannis and Campbell 2010).

Consider several examples of innovative-entrepreneurial ecosystems. The Innovation Value Institute (IVI) was established in 2006 jointly by the National University of Ireland in Maynooth and the Intel Corporation, which supports the activities of an international network of more than ninety organizations, including the Boston Consulting Group, British Petroleum, the energy corporation Chevron, the Cisco telecommunications company, and the manufacturer of electronics and information technology Fujitsu corporation. IVI implements the triple helix model, incorporating academia, industry, and the government in its innovative process.

Singularity University (founded in 2008), NASA Research Park, California, offers educational programs, potential innovative partnerships, and start-up accelerators. Its network of founders and partners includes the biotech company Genentech, the software company Autodesk, the multinational telecommunications company Nokia, the venture capital firm ePlanet Capital, and Google.

In the structure of the innovation-entrepreneurial university ecosystem it is possible to distinguish between the base and meta level. The base level includes venture projects, small innovative enterprises (start-ups), business incubators, investment sites, knowledge distribution offices, technology transfer centers, and innovation-technology centers. The meta level includes technological consortiums, uniting educational institutions and high-tech businesses; generalized knowledge foundations, integrating the research divisions of universities with scientific organizations; science parks, creating a common creative space for high-tech companies and research teams; and industrial parks, providing the necessary infrastructure for the full engineering-technological cycle of materializing scientific innovations (Karpov 2014b).

The innovative-entrepreneurial meta elements of the university should be configured in terms of overcoming three major gaps in the innovative process: (1) in the scientific environment, the gap between basic and applied research; (2) in the environment of contact between the scientific community and technologists, the gap between applied science and prototype production; and (3) during the transition of technology from its developers to its producers, the gap between experimental production and industry (Titov 1999, ch. 4).

One method of overcoming these gaps involves the creation of university engineering consortiums—contact networks uniting the environments of the production of knowledge and their technologization. The following may be considered in terms of market segments in which university consortiums can realize their strategies according to the consortium business model: the management of the introduction of innovation, the selection and training of prospective students for high-tech enterprises, the innovative renovation of high-tech industries, network research and development for industrial purposes, innovative brokerage, the creation of new innovative enterprises, technological ecosystems, and the management of intellectual property (Karpov 2012a).

The transition to the university 3.0 model involves the following sets of components. (1) *The social and academic components*—transforming the university structure; changing the academic environment, the learning process, and pedagogical activity; and advancing scientific and educational development. (2) *The scientific and innovation components*—creating centers for superior research and technology, developing a system of open innovation, and placing the university at the center of the innovative-entrepreneurial ecosystem. (3) *The economic components*—flexible response to labor markets (a dialogue with industry), orientation toward the principles of the network economy, the management of intellectual property, and the economically promising elements of corporate and multicampus universities.

* * *

The field of contemporary education is diverse. Today, higher education systems develop as institutionally complex structures that build on different professional spheres of society (Karpov 2013b). The socially and economically important element of this structure is the sector of higher education 3.0. Its institutional framework consists of scientific institutions, high-tech companies, innovative companies, industry consortiums, and institutions of innovation. Entrepreneurial ecosystems are becoming environments for the formation and development of the effective transfer of technology and scientific and engineering innovations.

Universities that comprise this sector have three main social missions—education, research, and the commercialization of knowledge. These

universities are built on the basis of interconnected models of network, creative, innovative, and entrepreneurial universities. This network model creates an inter-institutional environment for a creative education, and establishes a cost-effective structure of scientific-educational cooperation. The creative model prepares scientific and economically productive professionals needed for the entrepreneurial ecosystem of universities. The innovative and entrepreneurial model creates structures and processes that ensure the competitiveness of the network of innovative partnerships and the socioeconomic expression of individual creativity.

In its complex social role, university 3.0 not only educates students and conducts research, but to a greater extent it also teaches professionals how to make the transition from research to commercialization.

The social role of university 3.0 involves the creation of the basic structures of a knowledge society. University 3.0 is becoming the basis for the global competitiveness of national economies, and its entrepreneurial ecosystem helps create new expanding industries, prospective technology markets, and economically advanced spaces.

Notes

1. "The Strategy for Innovative Development of the Russian Federation until 2020" was approved by the Decree of the Government of the Russian Federation No. 2227-r, December 8, 2011.

2. For comparison, the entire time of its existence (i.e., since 2010), Skolkovo's has received a little more than 8,000 applications. H. Etzkowitz, author of the triple helix concept, believes that "for Russia the key is to create an innovative support infrastructure throughout the country, not just on the island that is Skolkovo" (Etzkowitz 2010, p. 22).

3. Up to 2010, the GII used a scale of 1–7. Since 2011, the GII began using a 0–100 scale in order to refine their estimates. Thus, in the 2009–2010 table, sixty-two countries had the same global innovation index rating as at least one other country; in the 2011 report, only four countries shared the same rating.

4. The national project, Universities as Centers of Innovation, put forward a very ambitious goal: "Ensure the sustainable global competitiveness of no less than five Russian universities by 2018, and no less than 10 leading Russian universities by 2025; by 2018, establish no less than 55 university centers of innovative, technological, and social development in the federal subjects of Russia, and no less than 100 such centers by 2025" (approved of by the Presidium of the Presidential Council for Strategic Development and Priority Projects Protocol No. 9, October 25, 2016).

5. The abbreviation NCI&E stands for (1) network university, (2) creative university, and (3) innovative and entrepreneurial university.

6. The number of students is growing more rapid than the number teachers. For example, in Germany from 1975 to 1995 the number of students increased by 232 percent, while the number of academic positions increased by only 130 percent (Ferlie et al. 2009).

7. For example, the estimated cost of the Oxford library shows that "approximately 45 percent of total spending goes to support users and researchers outside the University of Oxford" (www.ox.ac.uk/gazette/2002-3/supps/1_4660.htm).

References

Anderson, R. 2010. "The 'Idea of a University' Today." *History and Policy*, March 1, http://www.historyandpolicy.org/policy-papers/papers/the-idea-of-a-university-today.

Andrew, J.P., E.S. De Rocco, and A. Taylor. 2009. *The Innovation Imperative in Manufacturing: How the United States Can Restore Its Edge*. Boston: BCG.

Bell, D. 2008. "The Axial Age of Technology Foreword: 1999." *The Coming of Post-Industrial Society: A Venture of Social Forecasting*, pp. ix–lxxxvi. New York: Basic Books.

Carayannis, E.G., and D.F.J. Campbell. 2009. "Mode 3 and Quadruple Helix: Toward a 21st Century Fractal Innovation Ecosystem." *International Journal of Technology Management*, vol. 46, no. 3/4, pp. 201–34.

———. 2010. "Triple Helix, Quadruple Helix and Quintuple Helix and How Do Knowledge, Innovation and the Environment Relate to Each Other? A Proposed Framework for a Trans-Disciplinary Analysis of Sustainable Development and Social Ecology." *International Journal of Social Ecology and Sustainable Development*, vol. 1, no. 1, pp. 41–69.

CEC. 2003. *The Role of the Universities in the Europe of Knowledge*. Brussels: Commission of the European Communities.

———. 2006. *Delivering on the Modernization Agenda for Universities: Education, Research and Innovation*. Brussels: Commission of the European Communities.

Chesbrough, H. 2007. *Otkrytye innovatsii*. Moscow: Pokolenie.

Cole, J.R. 2010. *The great American University: Its Rise to Preeminence, its Indispensable Nation Role, Why it Must Be Protected*. New York: Public Affairs.

Curley, M., and P. Formica. 2013a. "University Ecosystems Design Creative Spaces for Idea Generation and Start-Up Experimentation." In *The Experimental Nature of New Venture Creation: Capitalizing on Open Innovation 2.0*, pp. 13–23. New York: Springer.

———. 2013b. "Introduction." In ibid., pp. 1–12.

Drucker, P. F. 1969. *The Age of Discontinuity: Guidelines to Our Changing Society*. London: Heinemann.

———. 2008. *Concept of the Corporation*. New Brunswick, NJ, and London: Transaction Publishing.

Dutta, S., B. Lanvin, and S. Wunsch-Vincent, eds. 2016. *The Global Innovation Index 2016: Winning with Global Innovation*. Ithaca, Fontainebleau, and Geneva: Cornell University, INSEAD, and WIPO.

Etzkowitz, H. 2008. *The Triple Helix: University-Industry-Government Innovation in Action*. New York and London: Routledge.

———. 2010. "Na puti k Skolkovo." *Troynaia spiral'. Universitety – predpriiatiia – gosudarstvo. Innovatsii v deistvii*, pp. 17–24. Tomsk: Izdatel'stvo Tomskogo gosudarstvennogo universiteta upravleniia i radioelektroniki.

Etzkowitz, H., and L. Leydesdorff. 1995. "The Triple Helix: University-Industry-Government Relations: A Laboratory for Knowledge Based Economic Development." *EASST Review*, vol. 14, no. 1, pp. 14–19.

———. 2000. "The Dynamics of Innovation: From National Systems and 'Mode 2' to a Triple Helix of University-Industry-Government Relations." *Research Policy*, vol. 29, no. 2, pp. 109–23.

EUA. 2003. *Response to the Commission: The Role of Universities in the Europe of knowledge*. Brussels: European University Association.

———. 2007. *Creativity in Higher Education: Report on the EUA Creative Project 2006–2007*. Brussels: European University Association.

Ferlie, E., C. Musselin, and G. Andresani. 2009. "The Governance of Higher Education Systems: A Public Management Perspective." In *University Governance: Western European Comparative Perspectives*, ed. C. Paradeise, E. Reale, I. Bleiklie, and E. Ferlie, pp. 1–20. Dordrecht: Springer.

Gibbons, M., C. Limoges, H. Nowotny, S. Schwartzman, et al. 1994. *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*. London: Sage.

Greenaway, D., and M. Haynes. 2003. "Funding Higher Education in the UK: The Role of Fees and Loans." *Economic Journal*, vol. 113, no. 485, pp. 150–66.

Hammershoj, L. G. 2009. "Creativity as a Question of Bildung." *Journal of Philosophy of Education*, vol. 43, no. 4, pp. 545–57.

Karpov, A.O. 2012a. "Inzhiniringovaia platforma dlia transfera tekhnologii." *Voprosy ekonomiki*, no. 7, pp. 47–65.

———. 2012b. "Lokus nauchnoi odarennosti: programma 'Shag v budushchee.'" *Vestnik Rossiiskoi akademii nauk*, vol. 82, no. 8, pp. 725–31.

———. 2013a. "Otkrytye innovatsii i vysshee obrazovanie." *Vysshee obrazovanie v Rossii*, no. 3, pp. 37–44.

———. 2013b. "Sotsial'nye paradigmy i paradigmal'no-differentsirovannaia sistema obrazovaniia." *Voprosy filosofii*, no. 3, pp. 22–32.

———. 2014a. "'Tovarizatsiia' obrazovaniia protiv obshchestva znanii." *Vestnik Rossiyskoi akademii nauk*, vol. 84, no. 5, pp. 434–40.

———. 2014b. "Sovremennyi universitet: sreda, partnerstva, innovatsii." *Alma Mater. Vestnik Vysshei shkoly*, no. 8, pp. 8–12.

———. 2015a. "Obrazovanie dlia obshchestva znanii: genezis i sotsial'nye vyzovy." *Obshchestvennye nauki i sovremennost'*, no. 5. pp. 86–101.

———. 2015b. "Osnovnye teoreticheskie poniatiia obshchestva znanii." *Vestnik Rossiyskoi akademii nauk*, no. 9, pp. 812–20.

Lane, J. E. 2013. "Higher Education System 3.0: Adding Value to States and Institutions." In *Higher Education System 3.0: Harnessing Systemness, Delivering Performance*, ed. J.E. Lane and D.B. Johnstone, pp. 3–26. New York: SUNY Press.

Machlup, F. 2014. *Knowledge: Its Creation, Distribution and Economic Significance. Vol. I. Knowledge and Knowledge Production*. Princeton: Princeton University Press.

Machlup, F., and T. Kronwinkler. 1975. "Workers Who Produce Knowledge: A Steady Increase 1900 to 1970." *Review of World Economics*, vol. 111, no. 4, pp. 752–59.

Martin, P., R. Morris, A. Rogers, and S. Kilgallon. 2010. "What Are Creative Spaces?" In *Making Space for Creativity*, ed. P. Martin, pp. 23–26. Brighton: University of Brighton.

Monitoring. 2016. *Monitoring effektivnosti innovatsionnoi deiatel'nosti universitetov Rossii*. St. Petersburg: Universitet ITMO; RVK.

Natsional'nyi doklad [National report]. 2015. *Natsional'nyi doklad ob innovatsiiakh v Rossii 2015*. Moscow: Minekonomrazvitiia Rossii; Otkrytoe pravitel'stvo; RVK.

Paradeise, C., E. Reale, and G. A. Goastellec. 2009a. "A Comparative Approach to Higher Education Reform in Western European Countries." In *University Governance: Western European Comparative Perspectives*, ed. C. Paradeise, E. Reale, I. Bleiklie, and E. Ferlie, pp. 197–226. Dordrecht: Springer.

Paradeise, C., E. Reale, G. Goastellec, and I. Bleiklie. 2009b. "Universities Steering Between Stories and History." In *University Governance: Western European Comparative Perspectives*, ed. C. Paradeise, E. Reale, I. Bleiklie, and E. Ferlie, pp. 227–90. Dordrecht: Springer.

Platova, I., and I. Zhabenko. 2016. "Vremia toropit: V gorode na Neve razvivaiut Universitet 4.0. V chem ego otlichie ot drugikh vuzov." *Poisk*, no. 30–31, pp. 8–9.

Pollet, C., and G. Bouckaert. 2004. *Public Management Reform: A Comparative Analysis*. Oxford: Oxford University Press.

Scott, R. 2009. "Innovatsionnaia strategiia Velikobritanii." *Foresight-Russia*, vol. 3, no. 4, pp. 16–21.

Sosnova, A. 2013. "Na svoei poliane. V Rossii est' mesto dlia innovatsii." *Poisk*, no. 26, p. 5.

Thursby, J., and S. Kemp. 2002. "Growth and Productive Efficiency of University Intellectual Property Licensing." *Research Policy*, vol. 31, no. 1, pp. 109–24.

Titov, V.V. 1999. *Transfer tekhnologii: Uchebnoe posobie*. St. Petersburg: Izdatel'stvo SPbGUEF.

Trow, M. 1972. "Sotsiologiia obrazovaniia." *Amerikanskaia sotsiologiia. Perspektivy, problemy, metody*, ed. G.V. Osipov, pp. 174–87. Moscow: Progress.