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S.K. Yerzhanova[1*], A.E. Mambetkaziyev[2], A. Mukatay[2], Zh.E. Baikenov[2]

[1]*Karagandy University of the name of academician E.A. Buketov, Kazakhstan*
[2]*Kazakh-American Free University, Kazakhstan*
[1]*salta_27@mail.ru*, [2]*kafu_ukg@mail.ru*, [3]*19tas@mail.ru*, [4]*zhas86kz@gmail.com*

[1]*https://orcid.org/*0000-0002-3033-9764, [2]*https://orcid.org/0000-0002-8915-4561,*
[3]*https://orcid.org/0000-0003-3830-0247,* [4]*https://orcid.org/0000-0001-9951-0454*

[1]*Scopus Author ID: 55881651300,* [2]*Scopus Author ID:56658760700,*
[3]*Scopus Author ID: https://doi.org/10.9770/jesi.2020.7.4(14),* [4]*Scopus Author ID: 57194197829*

[4]*ResearcherID: AAC-1459-2022*

The role of academic spin-off companies in improving the competitiveness of universities

Abstract

Object: The development of innovations and commercialization of research results is a complex and important task of university management. Ensuring the relationship between science, education and business is becoming a target priority of the state as a whole, since such an approach is able to ensure the economic development of the country through the introduction of innovative products in various areas of production.

Methods: General methods in economics, a logical description of the components and functions of digital technologies, a systematic approach.

Results: The authors present a model of academic spin-off, developed based on studying various approaches to the content and organization of spin-off companies and the best international experience and reflecting the mechanism of spin-off functioning at universities in Kazakhstan and the role of management in this process. The authors conclude and recommend the improvement of the relationship between science, education, and business to ensure the economic development of the country through the introduction of innovative products in various areas of production.

Conclusions: University should be the link between science and business. Effective university management in organizing spin-off companies at the university will allow businesses to understand its importance and the need to participate in the educational and scientific process. Another problem is the lack of innovative manufacturing entrepreneurship. The university can also play an important role in this problem, which will provide the training of relevant specialists.

Keywords: spin-off, university competitiveness, university management, university innovations, spin-off companies, university entrepreneurship.

Introduction

Globalization of the educational environment significantly expands and intensifies competition between higher educational institutions, which, in turn, requires new innovative approaches to the organization of their activities and, consequently, university management. Increase in the university competitiveness, resilience and adaptability to constant changes in the environment depends on its management organization.

Recent studies in the field of university management constantly reiterate the need for the constant and effective functioning of science, education and business as a whole, which will ensure the interaction of all components of successful student education and their employment. The creation of educational clusters is becoming a reality and is being implemented by various domestic and foreign universities.

Currently, one of the main abilities of university management is the ability to create new innovative products that contribute to the development and growth of the university. Various works devoted to the operation of universities agree that universities are one of the main innovation sources. Thus, creation of educational clusters is an excellent way to commercialize the results of the university research.

In international practice, companies created as a result of the process of forming universities as subsidiaries are called academic spin-offs or spin-outs. These organizations perform the transfer of developed technologies both from their lead organization (university) to themselves and to clients. Over the last decade, the role of spin-offs in the development of the economies of countries is increasing. As innovations are em-

* Corresponding author's e-mail: *salta_27@mail.ru*

braced by organizations, and especially larger ones, collaboration with small companies with advanced research bases and knowledge that makes available multiple research environments and their multidisciplinarity becomes critical. Academic spin-offs usually develop in high-tech industries, such as biotechnology, medical technology, information technology, and their main activity is related to the transfer of technology and knowledge from universities to industry (**Bigliardi** et al., 2013).

This paper aims to show the significance of organizing academic spin-offs, that is, the concentration of science and business around an educational institution.

Literature Review

Scholars have often stressed the importance of knowledge generation and dissemination in universities as an important driver of technological innovation and economic growth (Muller et al., 2004). Authors of works related to management of universities also point to the growing need for universities to disseminate the knowledge they have received beyond the narrow confines of the academic community. Universities and governments in both technologically advanced and developing countries have shown greater interest in academic entrepreneurship and university spin-offs as a means of building links between universities and industry (Kireyeva et al., 2017).

Many researchers approach the content of spin-off concept from different positions. Rogers defines spin-offs as companies based on lead research organizations, namely, a state research laboratory, a university, a university research center, and private research organizations (Rogers et al., 2001). Scott determines spin-offs as high-tech companies whose main business is based on the commercial evaluation of the results of scientific and technological research (Scott, 2004). Other researchers believe that the side effects originated from the university, where a group of researchers is an entrepreneurial unit aimed at using the skills and research results developed at the university (Conti et al., 2011). Nevertheless, it can be argued that an academic spin-off involves the transfer of underlying technology from an academic institution to a company.

However, everyone agrees that spin-offs are the most attractive and convenient forms of interaction between education, science and business. In particular, (Fuster et al., 2019) write that spin-offs are the main participants in the entrepreneurial ecosystem of universities and enhance the transfer of knowledge by interacting with other enterprises outside this ecosystem; and extend the emergent ecosystem approach to the entrepreneurship sphere.

Targeted inflows and outflows of knowledge were used to accelerate internal innovations and expand markets for external use of innovations (Petroni et al., 2012).

Emphasizing the significance of spin-offs, the authors reinforce the importance of universities as centers of cluster formations.

According to Guliaevskaia, the most common and “natural” innovation centers are universities (Guliaevskaia et al., 2006). They are recognized as important contributors to the creation of research and dissemination of knowledge in the academic community. In addition, they train and qualify personnel for industry, thereby facilitating technology transfer.

Spin-off university is an enterprise created by academic entrepreneurs based on the intellectual property obtained as a result of their research (Walter et al., 2011). Additional university companies are the result of university research-related activities and the result of a targeted university technology transfer effort (Link et al., 2005). They are seen as tools for the transfer of knowledge between research centers and companies, especially in the field of new products, new processes or new services (Wikhamn et al., 2013).

Therefore, the authors agree that to increase the competitiveness of the university, the creation of spin-offs is the most correct and effective management decision at present. These subsidiaries should be organized precisely by universities that accumulate knowledge and are sources that transfer acquired scientific knowledge and practical skills.

Methods

As reflected in the literature review, the authors of the article tend to believe that the creation of spin-offs around universities is the most effective mechanism for integrating science, education and business. This, in turn, enhances the role of university management in creating such integrative associations and ensuring the mechanism for their functioning.

By summarizing scientific works, including those describing foreign experience regarding the creation of spin-offs and organization of their operation, the authors propose to present the characteristics and model of the functioning of academic spin-offs in the universities of Kazakhstan.

Results

Academic spin-offs are special startups and cannot be compared to other companies such as university or technological startups in general. Despite the fact that we mostly speak about commercialization of scientific developments, funding, the point of an academic spin-off is to attract attention and funding from businesses interested in sufficient practical training for students, as well as obtaining original scientific developments. The creation of academic spin-off companies is of the interests for students who get the opportunity to gain experience, and for talented department staff who, without leaving their usual university environment, can get the opportunity to reach a new level of entrepreneurial activity.

At the same time, the analysis of studies demonstrates that not all companies created within the framework of universities can be classified as spin-offs. Scientific research has shown that academic spin-offs should comply with the following principles (Audretsch et al., 2013):

1) Organization with the participation of at least one university researcher and his scientific research results obtained at this university within at least 3 years;

2) Involvement of the company in business and manufacture of products created based on the investigations of a university researcher (Audretsch et al., 2013).

Russian scientists note that academic spin-offs should be created by the researcher based on educational or scientific institutions and the results of his scientific works (Rudenkov et al., 2016).

Spin-offs provide channels for the transfer of knowledge between science and industry, which are employment of graduates in relevant areas, joint publications, academic mobility, laboratories working jointly with industrial companies (Pobol et al., 2008).

There are four important stages in the development of academic by-products: Creating a viable business idea, translating the idea into a business process, creating a spin-off company, increasing value for customers, employees, investors and all other stakeholders (Nlemvo et al., 2002). All these stages are dependent on each other, since decisions made at earlier stages can individually affect subsequent stages.

There are five stages of creating a university spin-off (Newbert et al., 2007). The first stage is purely academic, but additional technologies are allowed to be used that may contribute to the emergence of new products and services. In cases where the researcher believes that his new technology is a commercially viable invention, then he discloses it to the university's technology licensing department. Then, at the third stage, the intellectual property protection potential is assessed and a patent application can be filed. Finally, the researcher creates a spin-off company.

Thus, the organization of spin-off companies based at the university, on the one hand, will ensure the functioning of an effective knowledge transfer channel that promotes the interaction of "science + business", and on the other hand, will ensure the operation of the mechanism for the commercialization of scientific developments and innovations.

To develop a model for the functioning of academic spin-off companies, it is necessary to study international experience of their organization. An analysis of the world experience in commercialization of innovations and spin-offs allows systematizing the results in Table 1.

Table 1. Methods for ensuring the commercialization of innovations in developed countries

Country	Ensuring methods	Method implementation mechanism
1	2	3
Australia	Mechanisms of state support for scientific research, stimulation of private investment	The Commonwealth Scientific and Industrial Research Organization of the British Union CSIRO) monitors implementation. Funding is distributed as follows: 33% from research organizations, 23% from private capital and 15% from venture funds; 2-3 employees
Canada	Mechanisms of state support for scientific research, stimulation of private investment	A program of assistance to new developments for the industry, its funding made it possible to launch 40% of spin-off firms based at universities. The equity of research institutions in the spin-off was about 50%

1	2	3
France	Mechanisms of state support	Ministry of Research and Technology. A combination of university own funds, private foundations, banks, venture capital and other firms. There is a special state program to support small innovative businesses. The largest number of spin-offs has a staff of 5 to 10 employees
Italy, UK, Belgium	Mechanisms of state support for scientific research	Preferential state loans and grants, state guarantees for bank loans, state order for R&D in priority sectors, state equity participation in research (up to 50%), tax benefits when investing in own R&D
Germany, UK	Mechanism of innovation support in production and education	Co-financing through the licensing system and creation of joint companies
Austria, Germany, USA, Japan, Sweden	Stimulation of private innovation	In the USA, information about them is collected by the Association of University Technology Managers. Establishment of patent and venture companies as part of holding companies, no double taxation
USA European countries	Supporting quality R&D results for commercialization	Development of a system of innovative mediation between public R&D, private business and university research
Note – Compiled by the authors based on (Guliaevskaia et al., 2006; Markov et al., 2009; Solomatina et al., 2015; Fici, 2016)		

In Canada, large universities can afford to have their own funds for the development of spin-off companies. Only about 20% of academic spin-offs have over 100 employees, in others their average number is 48 people. 387 spin-offs were opened in France in the 80s, including those opened by professors, researchers, students.

The largest contribution (40 firms) to the creation of high-tech companies was made by the French National Institute of Development in the field of computer research. Financing of small enterprises is carried out both at the expense of universities' own funds, and at the expense of private foundations, banks, venture capital, and other firms. At the same time, a special state program is being implemented to support small businesses. The staff of most small innovative enterprises is from 5 to 10 employees (25% of the total number).

In the UK, spin-offs only include companies in which the institution has either full or majority ownership. For all the time, since 1984, there were about 220 of such companies, with a special growth occurring in the second half of the 90s. 1169 spin-off companies with academic licenses were founded in the USA in the mid-1990s (Markov et al., 2009). In the USA, more than 90% of scientific developments are performed in the laboratories of the company itself, and only 10% – in the laboratories of universities (Casson, 2005).

Discussion

The investigation and generalization of international experience allows to note that each country has its own characteristics of organizing spin-off companies, in almost all countries state support for the commercialization of innovations has played an important role, the number of employees varies from 2 to 100 sources of funding currently have a preponderance towards private investment.

Based on the foregoing, it is possible to determine the organization model of academic spin-off companies (Figure 1).

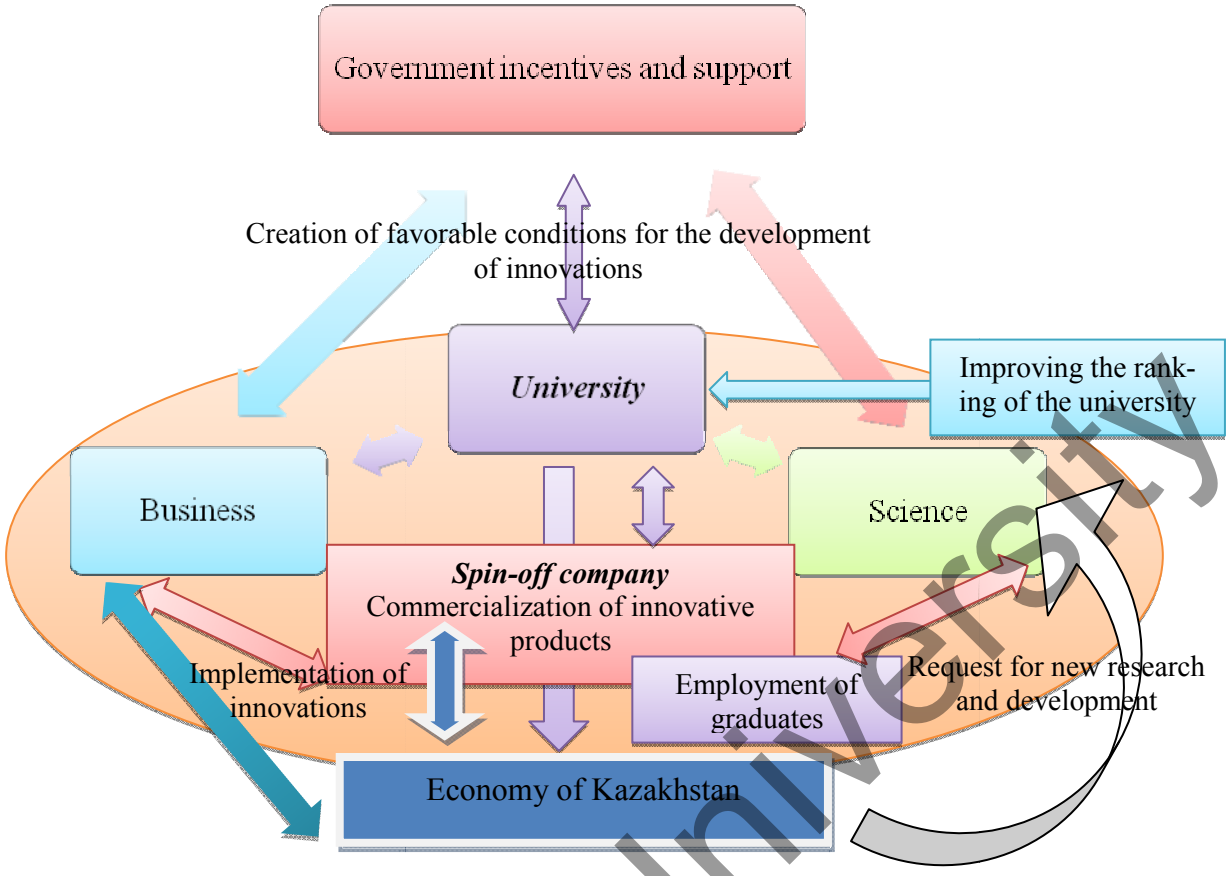

Figure 1. The model of academic spin-off companies functioning in Kazakhstan

Note – Compiled by the authors

In this model, the state is the initiator of the scientific research aimed at obtaining innovations and creates the necessary conditions for the demand for innovative products, and hence the stimulation of the production of innovative products. With such a statement of the problem, as a result of each cycle, the state becomes a consumer of the obtained results. It is on how this academic ecosystem will be organized that the quality and volume of the resulting innovative products will depend, and hence the rate of economic growth of the country as a whole.

The interest of universities and businesses in developing the necessary skills among students will ensure their interaction. The improvement and development of practical skills among students contributes to the growth of their competitiveness as graduates, and hence the competitiveness of the university as an educational institution that trains such specialists (Ruzieva et al., 2020). Based on this, the rating of the university will increase, and so will its competitiveness at the world level.

As a result, certain actions on the part of the university management can be singled out, reflecting the effectiveness of the functioning of an academic spin-off company. Regarding the university, it is necessary to provide:

– official contacts between the university and the spin-off company;
– financial participation of the university in the creation of a spin-off company;
– competent staff in technology transfer offices;
– entrepreneurial skills, training and education of students;
– university policy in the field of intellectual property;
– memorandum of business organizations;
– marketing ideas regarding the implementation of innovative products and the reflection of benefits for business structures.

The above actions on the part of the university management will ensure the competitiveness of the university as an educational institution. Accordingly, the quality and volume of innovative products received will increase, as well as the country's economic growth rates.

Conclusions

The development of academic entrepreneurship is directly the task of university management, associated with the improvement of the university infrastructure, management system and the use of promising standards in scientific and entrepreneurial activities, as well as the analysis of university environmental factors.

Currently, there are a number of problems in Kazakhstan related to the commercialization and implementation of innovations in the industry. The lack of interconnection between science and business and the lack of common interests lead to the development of unclaimed innovative technologies. It is the university that should become the link between science and business here. Effective university management in organizing spin-off companies at the university will allow businesses to understand its importance and the need to participate in the educational and scientific process.

Another problem is the lack of innovative manufacturing entrepreneurship. The university can also play an important role in this problem, which will provide the training of relevant specialists. However, such training will become effective only with the correct management of the university, which directs efforts towards the mutual cooperation of science, business and education through the creation of spin-offs. In their turn, the businesses, realizing the possibility of making profit from the sale of innovative products, will also show interest and take an active part both in both creating spin-off companies and training the university students.

Thus, answering the question of research, the creation and development of academic spin-offs with a focus on the best world experience, considering national specifics and available resources, can develop the process of research commercialization and increase the role of university science in the economic system.

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С.К. Ержанова, А.Е. Мамбетказиев, А. Мукатай, Ж.Е. Байкенов

Университеттердің бәсекеге қабілеттілігін арттырудағы академиялық еншілес компаниялардың рөлі

Аңдатпа

Мақсаты: Инновацияларды дамыту және ғылыми зерттеулердің нәтижелерін коммерцияландыру университетті басқарудың күрделі және маңызды міндеті болып табылады. Ғылым, білім беру және бизнес арасындағы өзара байланысты қамтамасыз ету тұтастай алғанда мемлекеттің нысаналы басымдығына айналуда, өйткені мұндай тәсіл өндірістің түрлі салаларына инновациялық өнімдерді енгізу есебінен елдің экономикалық дамуын қамтамасыз етуге қабілетті.

Әдісі: Зерттеу ғылыми мәселені қажетті терең зерттеуді қамтамасыз ететін жүйелік тәсілді қолдана отырып, олардың маңызды қасиеттерін көрсететін сандық технологиялардың компоненттері мен функцияларын логикалық сипаттауға негізделген экономикалық ғылымда қолданылатын жалпы әдістерді пайдалана отырып жүргізілді. Экономикалық құбылыстарды зерттеу және бастапқы ақпаратты толық өңдеу үшін қолданылатын әдістер талдаудың сенімділігі мен тұжырымдардың дұрыстығын қамтамасыз етеді. Әдебиеттерге шолуда көрсетілгендей, авторлар университеттердің айналасында спин-офф құру ғылым, білім және бизнесті біріктірудің ең тиімді тетігі деп санайды. Бұл өз кезегінде университет басшылығының осындай интегративті бірлестіктерді құрудағы және олардың жұмыс істеу тетігін қамтамасыз етудегі рөлін арттырады. Авторлар ғылыми жұмыстарды, соның ішінде спин-оффтарды құрудың және олардың жұмыс істеуін ұйымдастырудың шетелдік тәжірибесін сипаттай отырып, Қазақстан университеттерінде академиялық спин-оффтардың жұмыс істеу сипаттамалары мен моделін ұсынады.

Қорытынды: Бастапқы деректер негізінде университеттердің бәсекеге қабілеттілігін арттырудағы академиялық еншілес компаниялардың рөлі талданды. Бұл жерде университет ғылым мен бизнес арасындағы байланыстырушы буын болуға тиіс. Университетте еншілес компанияларды ұйымдастыру кезінде университетті тиімді басқару бизнеске оның маңыздылығы мен білім беру және ғылыми процеске қатысу қажеттілігін түсінуге мүмкіндік береді. Тағы бір мәселе — инновациялық өндірістік кәсіпкерліктің болмауы. Бұл мәселені шешуде тиісті мамандарды даярлауды қамтамасыз ететін университет маңызды рөл атқара алады.

Кілт сөздер: спин-офф, университеттің бәсекеге қабілеттілігі, университеттік менеджмент, университеттік инновациялар, спин-офф компаниялар, университеттік кәсіпкерлік.

С.К. Ержанова, А.Е. Мамбетказиев, А. Мукатай, Ж.Е. Байкенов

Роль академических дочерних компаний в повышении конкурентоспособности университетов

Аннотация

Цель: Разработка инноваций и коммерциализация результатов научных исследований является сложной и важной задачей управления университетом. Обеспечение взаимосвязи между наукой, образованием и бизнесом становится целевым приоритетом государства в целом, поскольку такой подход способен обеспечить экономическое развитие страны за счет внедрения инновационных продуктов в различные сферы производства.

Методы: Исследование проводилось с использованием общих методов, используемых в экономической науке, основанных на логическом описании компонентов и функций цифровых технологий, отражающих их существенные свойства с использованием системного подхода, обеспечивающего необходимое углубленное изучение научной проблемы. Методы, используемые для изучения экономических явлений и обработки первичной информации во всей их полноте, позволяют обеспечить достоверность анализа и обоснованность выводов. Как отражено в обзоре литературы, авторы склонны считать, что создание спин-оффов вокруг университетов является наиболее эффективным механизмом интеграции науки, образования и бизнеса. Это, в свою очередь, повышает роль руководства университета в создании таких интегративных объединений и обеспечении механизма их функционирования. Обобщая научные работы, в том числе описывающие зарубежный опыт создания спин-оффов и организации их функционирования, авторы предлагают представить характеристики и модель функционирования академических спин-оффов в университетах Казахстана.

Результаты: В статье авторами представлена модель академического спин-оффа, разработанная на основе изучения различных подходов к содержанию и организации спин-оффов компаний и лучшего международного опыта и отражающая механизм функционирования спин-оффа в университетах Казахстана и роль менеджмента в этом процессе. Авторы пришли к выводам и рекомендациям по улучшению взаимосвязи между наукой, образованием и бизнесом для обеспечения экономического развития страны за счет внедрения инновационных продуктов в различные сферы производства.

Выводы: На основе исходных данных проанализирована роль академических дочерних компаний в повышении конкурентоспособности университетов. Именно университет должен стать здесь связующим звеном между наукой и бизнесом. Эффективное управление университетом при организации дочерних компаний в университете позволит бизнесу понять его важность и необходимость участия в образовательном и научном процессе. Еще одной проблемой является отсутствие инновационного производственного предпринимательства. Важную роль в решении этой проблемы может сыграть и университет, который обеспечит подготовку соответствующих специалистов.

Ключевые слова: спин-офф, конкурентоспособность университета, университетский менеджмент, университетские инновации, спин-офф компании, университетское предпринимательство.

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