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Conceptual model of academic entrepreneurship within the framework of the Triple Helix theory

Abstract

Object: The development of a model of academic entrepreneurship within the concept of the Triple Helix and its derivatives in the context of a regional innovation system.

Methods: Methods of system analysis, comparative analysis, grouping method, content analysis.

Results: The article gives a definition of academic entrepreneurship within the framework of the main approaches to the innovation process. It is shown that the development of academic entrepreneurship is inextricably linked with the evolution of the concept of the Triple Helix on the interaction of elements in the knowledge economy. The article discusses the features of the concept of the Triple Helix and its derivatives. Within the framework of the Triple Helix, the key role of universities in the accumulation and transfer of knowledge in the innovation system is substantiated for the first time. The article shows that in the Quintuple Helix, knowledge acquires an interdisciplinary and transdisciplinary character, which becomes the basis for the development of academic entrepreneurship. The article compares traditional and new views on academic entrepreneurship, its promising areas.

Conclusions: The concept of academic entrepreneurship, which is basically an institutional transfer of research and development to the business environment, is today a popular scientific direction. Academic entrepreneurship is aimed at improving the welfare of society and allows realizing the commercial potential of scientific developments. The development of the mechanism of academic entrepreneurship requires an analysis of the current concepts of innovative development, taking into account the characteristics of a developing economy. The perspective view on the development of academic entrepreneurship considered in the article assumes active involvement in the process of commercialization of university students, student startups, development of networking between the academic environment and industry.

Keywords: academic entrepreneurship, university, commercialization, Triple Helix, innovations.

Introduction

In many advanced economies, the development of the regional economy is largely associated with the realization of its innovative potential. The introduction of new ideas and technologies into production contributes to the economic growth of territories and the well-being of citizens. Academic entrepreneurship as an economic category emerged not so long ago. The concept of academic entrepreneurship is based on the approach of the national innovation system (NIS), linear and the non-linear nature of the innovation process, as well as the concept of the Triple Helix and its evolution. Academic entrepreneurship arose as a response to society's request for the realization of the accumulated innovative potential within a certain region with the participation of the academic community. With the development of legislation in this area, it became possible to introduce scientific developments of scientists at the enterprises of the region, create separate spin-off companies and receive entrepreneurial income. The success of academic entrepreneurship largely depends on the development of the innovation system and the innovation infrastructure of the region. The highest results in the development of academic entrepreneurship were achieved by the United States and the developed countries of EU. In Kazakhstan, in the context of the development of the innovation system, there is a need to further study the problem of commercializing academic knowledge, improving a number of innovation infrastructure mechanisms, taking into account the characteristics of a developing economy.

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Literature review

The concept of academic entrepreneurship is based on the works of domestic and foreign scientists.

Since the end of the 20th century, a systematic approach to the development of innovation has been developed, which was implemented within the framework of national and regional innovation systems (Lundvall, 1992). To date, one of the most common models of national innovation systems is the Triple helix model, the options for adapting to the economic situation of various countries are four- and five-link structures (Leydesdorff & Etzkowitz, 2003)

The impetus for the development of academic entrepreneurship was the evolution of approaches to the accumulation and use of knowledge in society. Gibbons at the beginning of the 21st century identified a new form of knowledge production that was context-oriented, problem-based, and interdisciplinary (Gibbons, 2000, Nowotny et al., 2003). It involved multidisciplinary teams working together for a short period of time on specific real-world problems. Gibbons and his colleagues called this knowledge production "Mode 2". They separated this from traditional research, labeled "Mode 1", which is academic, researcher-initiated, and discipline-based knowledge production. Currently, scientists Carayannis & Campbell (2009) distinguish "Mode 3" as well, which involves the joint development of diverse knowledge and innovative ways at the individual, structural and organizational and systemic levels.

Among foreign scientists on academic entrepreneurship, we can single out the works of M. Wright, M.S. Wood, R. O'Shea, G. Secondo. An important role of academia in producing of new knowledge is discussed in the works of G.W. Matkin (1990), Mowery, D.C., & Shane, S. (2002), D. Siegel (2004). In Kazakhstan, the issues of innovative development and the participation of universities in the processes of knowledge commercialization are discussed in the works of F. Dnishev (2001), O. Sabden (2007), M. Kenzheguzin *et al.* (2005), and others.

The lack of a systematic approach to the issues of commercialization, the transfer of scientific developments into production can lead to unproductive labor and budget costs, reduce the effectiveness of the country's innovative development. Thus, the need to create favorable conditions for all participants in the innovation process and the development of an effective mechanism for the introduction of university developments determine the relevance of conducting research in this area.

Methods

During the study, methods of system analysis, comparative analysis, grouping method, content analysis were used. The methodology of the Triple Helix theory, developed by Western scientists at the beginning of the 21st century, was used, the essence of which is the need for innovative interaction between the three driving forces of the modern economy - the university community, industrial enterprises and public authorities.

Results

Academic entrepreneurship is a relatively new concept in economic theory. In modern research, "Academic entrepreneurship" means "university spin-off" or institutional transfer of research, development, or technology to initiate innovation or venture. Wherein university spin-offs are defined as new ventures that are dependent upon licensing or assignment of an institution's IP for starting their activity (Wright, 2007).

The concept of academic entrepreneurship includes part of the functions of a university teacher and an entrepreneur who promotes his ideas to the market. At the same time, the academic entrepreneur retains his/her connection with the university and is included in the socio-economic infrastructure of the region (Figure 1).

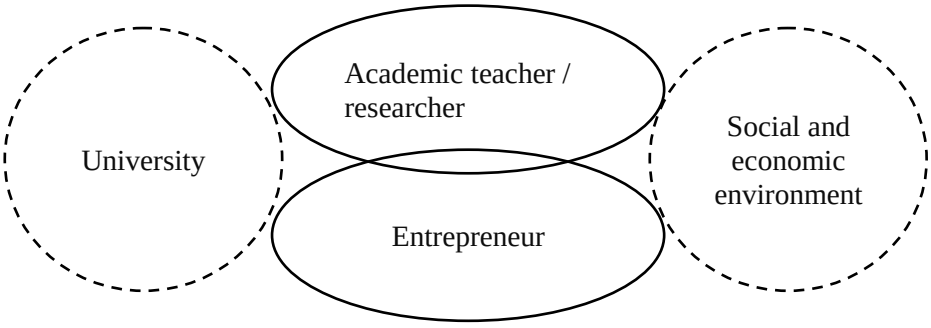

Figure 1. Theoretical model of academic entrepreneurship

Note – Compiled by the authors based on Barth & Schlegelmilch, 2013

Beckman and Cherwitz (2009) define academic entrepreneurship as some kind of "intellectual enterprise", which is created by university in cooperation with local businesses to create new products or ideas.

The term "academic entrepreneurship" is correlated with the university employees and students. An academic entrepreneur is a university scientist, most often a professor, a post-doc researcher, or PhD student who sets up a business company to commercialize the results of the research (Barcik et al., 2017). Academic entrepreneurship as a process includes the efforts and activities that universities and their industry partners undertake in hopes of commercializing the outcomes of faculty research (Wood, 2011).

Academic entrepreneur may be defined as a person who has academic knowledge for conducting research in his/her area, is involved in an academic environment at university and creates income through self-entrepreneur activity (Barth & Schlegelmilch, 2013).

An academic entrepreneur is a university employee who develops his/her own scientific direction, conducts classes and promotes his/her ideas and developments to the market. The interaction of the skills of an academic entrepreneur (education, research abilities, entrepreneurial thinking) allow him/her to increase an income and realize an innovative potential. Thus, the academic entrepreneur acts as an intermediary between the academic environment (research) and the business sector (innovation) (Bartels & Bencherki, 2020).

The most common form of implementation of academic entrepreneurship is a spin-off or startup. At the same time, already created innovative ideas, as well as those in the process of creation, are implemented through these structures. In advanced economies, these forms of commercialization have proven effective and have been widely used over the past 30 years. Startups and spin-offs connect academia and industry to meet society's demands for innovative products and services (Evers et al., 2020).

In a market economy, spin-off activity depends on the demands of private companies and society for new products and services. The commercialization of knowledge in the form of spin-off provides some potential benefits for the regional ecosystem (Benneworth & Charles, 2005), namely:

1. Spin-offs attract employers, paying good wages and promoting entrepreneurship (Etzkowitz, 2001).
2. Spin-offs create new networks to access project financing.
3. Spin-offs help universities with their third mission and make strong linkages with "parent" institution.
4. Spin-offs' activity can impact on the development of regional ecosystem;
5. Spin-offs stimulate creation of an infrastructure that is useful for other new companies in the region.

A study of academic entrepreneurship conditions in the United States (Link et al., 2015) found that the largest number of spin-offs was formed by university professors, as well as academics and divisional directors. The formation of this type of entrepreneurship is associated with a change in innovative models and the role of knowledge in society. Figure 2 shows changes in the production of innovations, the application of knowledge, which have led to an increase in demand for new products and innovations.

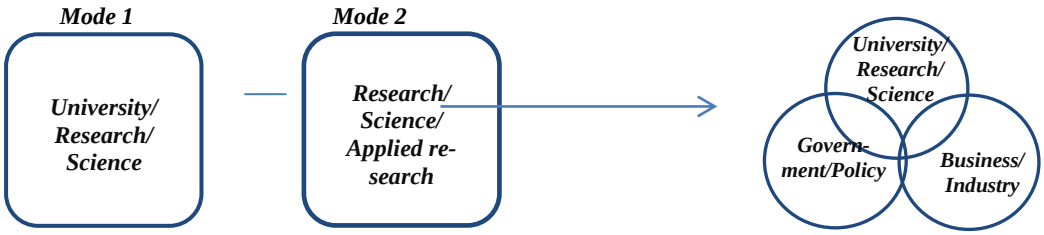

Figure 2. The dynamics of innovation and knowledge

Note – Compiled by the authors based on Etzkowitz & Leydesdorff, 2000

Modern government and enterprise strategies foster direct collaboration with universities, mostly in the form of the creation of university spin-offs. In this regard, universities are establishing links with the business sector to develop new types of cooperation. At the same time, the functions of the teaching staff are expanding due to new opportunities for implementing research results. Mode 1 was characterized by theoretical studies. The dissemination of new knowledge went through academic channels through publication in journals and participation in conferences.

Another model (Mode 2) is focused on practical application of research results. There is an increasing demand for knowledge from society to improve its well-being (Sitenko, 2018). Research organizations are motivated to cooperate with enterprises in the region. The introduction of research results into industry pro-

vides scientific organizations with additional funding for further research. Enterprises, in turn, can carry out an order for certain types of research, thus quickly increasing the competitiveness of their products.

Mode 2 gave a new basis for the relations between main agents of innovation process – the Triple Helix concept by G. Etzkowitz with L. Leydesdorf (1997). According to the concept, successful innovation development is based on the links between important participants: university, business, and government. University is involved in the development of innovation, organizes the cooperation with industry, business, largely by taking the functions of their research units. Classical university turns into an entrepreneurial (innovation) university, developing the business principles in students and academic staff with focus on final implementation of generated inventions and ideas (Sitenko, 2019).

Useful insights can be found in the further developments of the Triple Helix concept, which were named as Quadruple and Quintuple Helix (Carayannis & Campbell, 2009). They add civil society and environment respectively, forming new understanding of university as "organization capable of higher order learning" as well as knowledge as "highly complex and non-linear" (Mode 3) (Carayannis et al., 2018). Table 1 summarizes the key differences between Mode 1 and Mode 2.

Table 1. Key differences between innovation models Mode 1 and Mode 2

Mode 1	Mode 2
Industrial economy	Knowledge economy
Academic context of knowledge	Context of application
Producing of knowledge within one discipline	Transdisciplinary approach
Research objectives are formed by the academic sector	Objectives are formed by multiple stakeholders
Constant structure of institutions	Flexible system based on teams and networks
Low level of engagement of knowledge producers	Knowledge producers are engaged at every stage of the process
Dissemination through publication and academic channels	Dissemination through practitioners and professional bodies
Note – Compiled by the authors based on Limoges et al., 1994	

Mode 2 includes a larger number of agents whose collaborate temporary with each other. In this situation there are no pure "science" of university and "technology" of industry (Jimenez, 2008). The production of knowledge became more a "socially distributed" process.

New Mode 3 has main characteristics of Mode 2, but it closely linked to current societal needs. According to the Carayannis & Campbell (2009), Mode 3 is some kind of innovation ecosystem which combines people, culture and technology. In this ecosystem people may do creativity and inventions within top-down (when policy provides framework) as well as bottom-up (entrepreneurs' networks) linkages. Mode 3 pays more attention not on agents of innovation system but on the networks that may connect them on different levels.

Developing of academic entrepreneurship concept

Indeed the development of academic entrepreneurship concept is largely associated with the Triple helix theory evolution. The Triple helix theory was further developed by Carayannis & Campbell (2009, 2010) with their extended concepts Quadruple Helix and Quintuple Helix, respectively.

Civil society or media is the core of the Quadruple Helix, as determines the focus of the entire system on creating innovations for users, i.e. for society. It is the driving force behind the innovation process, which determines its trajectory, depth and provides efficiency. The task of the media is to support the dissemination of knowledge that is interdisciplinary in nature.

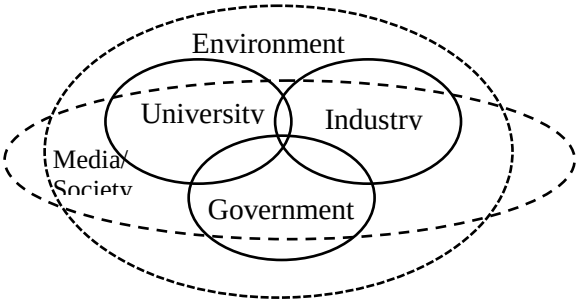

Figure 2. Quintuple Helix model

Note – Compiled by the authors based on Carayannis & Campbell (2009, 2010)

In the Quintuple Helix model, changes are associated not only with the emergence of a new spiral but also with a qualitative transformation of relationships. If the Triple Helix reflects the construction of a knowledge economy, then in the Quadruple Helix there is a transition to building a knowledge society and a knowledge democracy, which continues within the framework of the fifth model. The term "democracy knowledge" refers us to the concept of "democracy", based on political pluralism, heterogeneity, and freedom of opinion. Democracy knowledge implies heterogeneity and diversity of knowledge and innovative models and paradigms (Carayannis & Campbell, 2010). Five innovation spiral accumulates environmental and social development issues.

The Quintuple Helix model shows that in the 21st century knowledge creation is not limited to one discipline or industry. The production of knowledge should be both "transdisciplinary" and "interdisciplinary". This is especially important in research aimed at protecting the environment. In this model, the requirements for the qualification of personnel in high-tech and innovative industries are increasing. At the same time, an academic entrepreneur must have even wider knowledge in related fields to competently regulate and direct the process of introducing new knowledge.

The introduction of new innovative models requires equal involvement from all participants in the process, with the central role of the academic entrepreneur. It is the Five Helix model that creates the conditions under which academic entrepreneurs are considered as important elements in the process of technology transfer from university to industry.

In practice, universities that adopted technology transfer strategies receive different outcomes that are sometimes disappointing because university innovation infrastructure functioned as a facilitator for existing entrepreneurial activity, not as a trigger for it (Fisher et al., 2019). This demands a further research of the academic entrepreneurship concept. From the one side, more stakeholders have become involved in academic entrepreneurship (Siegel & Wright, 2015). From the other side, the process of commercialization of academic knowledge may differ because of level of economic development of the country. Siegel and Wright (2015) provide a new context for the concept with traditional and emerging point of view (Table 2).

Table 2. Comparison of traditional and emerging perspectives on academic entrepreneurship

	Traditional perspective	Emerging perspective
Purpose	To receive direct income from research application	To solve important social and economic tasks of the region (public health, ecology)
Forms	University spin-offs; licensing; patents	Participation of students and alumni in creating start-ups on the base of university infrastructure
Participants	Academic staff	Students, alumni of different faculties and their collaborations; surrogate entrepreneurs
Support mechanisms	R&D transfer through technology transfer offices (TTOs) and technoparks	Accelerators; Entrepreneurship garages; industry-alumni networks; employee mobility; business incubators
Role of academia	Entrepreneurial university	Engaged university
Note – Compiled by the authors based on Siegel & Wright, 2015		

Traditional views on the academic entrepreneurship focused on such metrics as the presence of TTOs at university, number of patents and licensees and promoting university start-ups/spin-offs. Some studies have shown that not all TTOs are effective and their organization requires an individual approach (Siegel & Wright, 2015). Emerging perspective shows that universities may impact socioeconomic environment in many other ways by creating new infrastructure and on-campus support mechanisms which should be studied.

There is rising interest in academic entrepreneurship in developing countries (Gamata & Urban, 2020), but the empirical evidence (Fisher et al., 2019) reveals that countries concentrate more on the identification and protection of IP then on creating start-ups. Low levels of academic entrepreneurship at universities are explained by a weak set of institutional and organisational factors which inhibit the commercialisation and technology innovation process (Boshoff et al., 2018; Chantson & Urban, 2018).

Conclusions

The term “Academic entrepreneurship” appeared last decades and means “university spin-off” or institutional transfer of research, development, or technology to initiate innovation or venture. Academic entrepreneurship arises from the interaction of the university and the local business environment and is aimed at creating a new idea or product.

The development of the concept of academic entrepreneurship is based on the evolution of innovative development approaches, known as the Triple Helix. The Quadruple and Quintuple Helix include new subsystems such as society and the environment. The Quintuple Helix implements a “transdisciplinary” and “interdisciplinary” approach to knowledge and innovation. Within this approach, the links between the elements of the spiral are realized, making it possible to commercialize knowledge through academic entrepreneurship.

In the Quintuple Helix model, the relationships between the elements change qualitatively. Knowledge created within one spiral becomes the source for new knowledge, which is produced by the next spiral. The production of knowledge is “transdisciplinary” and “interdisciplinary” in nature, which contributes to the deep development of academic entrepreneurship, which by its very nature requires knowledge from many fields.

Acknowledgments

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Д.АСитенко, М. Холиенка

Үштік спираль теориясы аясындағы академиялық кәсіпкерліктің тұжырымдамалық моделі

Аңдатпа

Мақсаты: Аймақтық инновациялық жүйе контексінде үштік спираль және оның туындылары тұжырымдамасы шеңберінде академиялық кәсіпкерлік моделін әзірлеу.

Әдістер: Зерттеу барысында жүйелік талдау, салыстырмалы талдау, топтастыру, мазмұнды талдау әдістері қолданылды.

Қорытынды: Мақалада инновациялық процеске негізгі тәсілдер шеңберінде академиялық кәсіпкерліктің анықтамасы берілген. Академиялық кәсіпкерліктің дамуы білім экономикасындағы элементтердің өзара әрекеттесуі бойынша үштік спириль тұжырымдамасының эволюциясымен тығыз байланысты екендігі көрсетілген. Сонымен қатар үштік спираль тұжырымдамасының ерекшеліктері және оның туындылары қарастырылған. Үштік спираль аясында инновациялық жүйеде білімді жинақтау мен берудегі университеттердің шешуші рөлі алғаш рет негізделген. Мақалада бесінші спиральда білім академиялық кәсіпкерлікті дамытуға негіз болатын пәнаралық және трансаралық сипатқа ие болатындығы көрсетілген. Академиялық кәсіпкерліктің дәстүрлі және жаңа көзқарастарын, оның перспективалық бағыттарын салыстыру келтірілген.

Тұжырымдама: Негізінен ғылыми-зерттеу және тәжірибелік-конструкторлық жұмыстарды іскерлік-ортада институционалдық трансферттікке ие академиялық кәсіпкерлік тұжырымдамасы бүгінде ғылыми-көпшілік бағыт болып табылады. Академиялық кәсіпкерлік қоғамның әл-ауқатын арттыруға бағытталған және ғылыми әзірлемелердің коммерциялық әлеуетін жүзеге асыруға мүмкіндік береді. Академиялық кәсіпкерлік механизмін дамыту дамушы экономиканың ерекшеліктерін ескере отырып, инновациялық дамудың қазіргі тұжырымдамаларын талдауды талап етеді. Мақалада қарастырылған академиялық кәсіпкерлікті дамытудың перспективалық көзқарасы университет студенттерін коммерцияландыру процесіне, студенттік стартаптарға белсенді қатысуды, академиялық орта мен өндіріс арасындағы желіні дамытуды болжайды.

Кілт сөздер: академиялық кәсіпкерлік, университет, коммерцияландыру, Triple Helix, инновация.

Д.А. Ситенко, М. Холиенка

Концептуальная модель академического предпринимательства в рамках теории Тройной спирали

Аннотация:

Цель: Разработка модели академического предпринимательства в рамках концепции Тройной спирали и ее производных в условиях региональной инновационной системы.

Методы: В ходе исследования использовались методы системного анализа, сравнительного анализа, метод группировок, контент-анализ.

Результаты: В статье дано определение академического предпринимательства в рамках основных подходов к инновационному процессу. Показано, что развитие академического предпринимательства неразрывно связано с эволюцией концепции Тройной спирали по взаимодействию элементов в экономике знаний. Авторами рассмотрены особенности концепции Тройной спирали и ее производных. В рамках Тройной спирали впервые обоснована ключевая роль университетов в накоплении и передаче знаний в инновационной системе. В статье показано, что в Пятерной спирали знание приобретает междисциплинарный и трансдисциплинарный характер, что становится основой для развития академического предпринимательства. Кроме того, приведено сравнение традиционных и новых взглядов на академическое предпринимательство, его перспективные направления.

Выводы: Концепция академического предпринимательства, которая в своей основе представляет собой институциональный трансфер исследований и разработок в предпринимательскую среду, сегодня является востребованным научным направлением. Академическое предпринимательство направлено на повышение благосостояния общества и позволяет реализовать коммерческий потенциал научных разработок. Развитие механизма академического предпринимательства требует анализа текущих концепций инновационного развития с уче-

том особенностей развивающейся экономики. Рассмотренный в статье перспективный взгляд на развитие академического предпринимательства предполагает активное вовлечение в процесс коммерциализации студентов университетов, студенческих стартапов, развития нетворкинга между академической средой и индустрией.

Ключевые слова: академическое предпринимательство, университет, коммерциализация, Тройная спираль, инновации.

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