I ● ECONOMICS

UDC 82.15.17.

[1]Hofmeister Gerd, [2]Mukhtarova Karlygash, [3]Abdykalikova Marta,
[4]Yerimpasheva Aida, [5]Abikenov Arkhat

[1]Doctor of economic sciences, professor, Economic faculty
University of Applied Sciences, Erfurt, Germany, e-mail: hofmeister@fh-erfurt.de
[2]Doctor of economic sciences, professor, International relations faculty al-Farabi Kazakh National university,
Almaty, Kazakhstan, e-mail: kmukhtarova@rambler.ru
[3]Professor of the National School of Public Policy,
Academy of Public Administration under the President of the Republic of Kazakhstan,
Astana, Kazakhstan, e-mail: marta_nd@mail.ru
[4]Candidate of economic sciences, associate professor, the 'Management and Business" chair,
University of International Business, Almaty, Kazakhstan, e-mail: aidaerempasheva@gmail.com
[5]Candidate of legal Sciences, assistant professor, Legal Faculty al-Farabi Kazakh National university,
Almaty, Kazakhstan, e-mail: abykenov.arhat@kaznu.kz

Ecosystem of Technological Business: Methods of Analysis and Development Factors

The study covers a challenge of innovative entrepreneurship as a key institutional factor for developing the appropriate ecological system. The purpose of the paper is to formulate fundamental theoretical and practical provisions of a research, which largely focus on the concept of technological entrepreneurship ecosystem. Such factors as a transfer of technologies to ensure a stable model of an innovation and business ecosystem in conditions of a high level of risk and uncertainty in external environment become important internationally. The study provides formulation of the concept of economic ecosystem, basic principles and factors of its functioning. The main findings of the study are due to the fact that the sources of the innovation-entrepreneurial ecosystem's growth are not only the internal potential of the managerial system, but also external factors of development. External factors include a proactive innovation policy at the regional level with support of science-intensive manufactures, interregional and inter-sectoral economic relations and the ecosystem's ability to get integrated into the international economic space.

Key words: innovative ventures, innovations, innovative ecosystem, sustainable development system, transfer of technologies, adaptive institutional environment, ecosystem of technological entrepreneurship, industrial technological park, innovative corridor, game theory, optimal resource allocation, system compromise.

[1]Хофмайстер Герд, [2]Мұхтарова Қарлығаш, [3]Әбдіхалықова Марта, [4]Еримпашева Аида, [5]Әбікенов Архат

[1]Экономика ғылымдарының докторы, профессор, Экономика факультеті
Қолданбалы ғылымдарының университеті, Эрфурт, Германия, e-mail: hofmeister@fh-erfurt.de
[2]Экономика ғылымдарының докторы, профессор, Халықаралық қатынастар факультеті
Әл-Фараби атындағы ҚазҰУ, Алматы қ., Қазақстан, e-mail: kmukhtarova@rambler.ru
[3]Ұлттық мемлекеттік саясат мектебінің профессоры, Мемлекеттік басқару академиясы
Қазақстан Республикасы Президентінің жанындағы, Астана қ., Қазақстан, e-mail: marta_nd@mail.ru
[4]Экономика ғылымдарының кандидаты, доцент, "Менеджмент және бизнес"кафедрасы,
Халық аралық бизнес университеті, Алматы қ., Қазақстан, e-mail: aidaerempasheva@gmail.com
[5]Заң ғылымдарының кандидаты, доцент, Заң факультеті, Әл-Фараби атындағы ҚазҰУ,
Алматы қ., Қазақстан, e-mail: abykenov.arhat@kaznu.kz

Технологиялық бизнес экосистемы: талдау және даму факторлары

Мақалада тиісті экологиялық жүйені дамытудың негізгі институционалдық факторы ретінде инновациялық кәсіпкерлік мәселесі қарастырылады. Мақаланың мақсаты экожүйенің технологиялық кәсіпкерлік тұжырымдамасына көп көңіл бөлінетін іргелі теориялық және практикалық ғылыми ережелерді

қалыптастыру болып табылады. Халықаралық деңгейде тәуекелдердің жоғары деңгейі және сыртқы ортадағы белгісіздік жағдайында инновацияның тұрақты моделін және бизнес экожүйесін қамтамасыз ету үшін технологиялар трансферті сияқты факторларға айналады. Мақала «экономикалық экожүйенің» тұжырымдамасын, оның негізгі қағидаттарын және оның жұмыс істеу факторларын тұжырымдайды. Зерттеудің негізгі нәтижелері инновациялық-кәсіпкерлік экожүйелердің өсу көздері басқару жүйесінің ішкі әлеуеті ғана емес, сондай-ақ дамудың сыртқы факторлары болып табылады. Сыртқы факторлар білім беруді қажет ететін салаларды, өңіраралық және салааралық экономикалық байланыстарды және экожүйенің халықаралық экономикалық кеңістікке қосылу мүмкіндігін қолдауымен аймақтық деңгейде белсенді инновациялық саясатты қамтиды.

Түйін сөздер: инновациялық кәсіпкерлік, инновация, инновациялық экожүйе, орнықты даму тұжырымдамасы, технологиялар трансферті, адаптивті институционалдық орта, технологиялық кәсіпкерлік экожүйесі, индустриялық технологиялар паркі, инновациялық дәліз, ойын теориялары, ресурстардың оңтайлы бөлінуі, жүйенің ымыралығы.

[1]Хофмайстер Герд, [2]Мухтарова Карлыгаш, [3]Абдыкаликова Марта, [4]Еримпашева Аида, [5]Абикенов Архат

[1]Доктор экономических наук, профессор, Экономический факультет
Университет прикладных наук, Эрфурт, Германия, e-mail: hofmeister@fh-erfurt.de
[2]Доктор экономических наук, профессор, Факультет международных отношений
КазНУ им.аль-Фараби, Алматы, Казахстан, e-mail: kmukhtarova@rambler.ru
[3]Профессор Национальной школы государственной политики, Академия государственного управления
при Президенте Республики Казахстан, г. Астана, Казахстан, e-mail: marta_nd@mail.ru
[4]Кандидат экономических наук, доцент, Кафедра «Менеджмент и бизнес»
Университет международного бизнеса, г. Алматы, Казахстан, e-mail: aidaerempasheva@gmail.com
[5]Кандидат юридических наук, и.о.профессора, Юридический факультет, КазНУ им.аль-Фараби,
Алматы, Казахстан, e-mail: abykenov.arhat@kaznu.kz

Экосистема технологического бизнеса: методы анализа и факторы развития

В статье рассматривается проблема инновационного предпринимательства как ключевого институционального фактора развития соответствующей экологической системы. Цель статьи – сформулировать фундаментальные теоретические и практические положения исследования, которые в значительной степени акцентируют внимание на концепции технологического предпринимательства экосистемы. Такие факторы, как трансфер технологий для обеспечения стабильной модели инноваций и бизнес-экосистемы в условиях высокого уровня риска и неопределенности во внешней среде, приобретают международное значение. В статье сформулированы понятие «экономическая экосистема», ее основополагающие принципы и факторы ее функционирования. Основные выводы исследования связаны с тем, что источниками роста инновационно-предпринимательской экосистемы являются не только внутренний потенциал системы управления, но и внешние факторы развития. К внешним факторам относятся активная инновационная политика на региональном уровне с поддержкой наукоемких производств, межрегиональные и межсекторальные экономические отношения и способность экосистемы интегрироваться в международное экономическое пространство.

Ключевые слова: инновационное предпринимательство, инновации, инновационная экосистема, концепция устойчивого развития, трансфер технологий, адаптивная институциональная среда, экосистема технологического предпринимательства, индустриальный технологический парк, инновационный коридор, теория игр, оптимальное распределение ресурсов, системный компромисс.

Introduction. Competitive economy of the twenty first century is first of all economy of high technologies. They include biomedical technologies, power engineering technologies, information and communication technologies and software that have been building up their share in the gross domestic product (GDP) for the past 15-20 years. Companies in these areas demonstrate high growth rates, dynamic development and have an increased degree of investment appeal (Kuftyryov I.G., 2013). In present-day conditions, sustainability level of development of any social and economic system is determined by its ability to generate and absorb different types of innovations. In this connection, challenges of formation and efficient operation of innovation and business ecosystems which are complex models of relations between subjects involved in the process of creation and implementation of innovations and technologies within which specific institutional environment is formed to facilitate stimulation of innovative processes gain grounds.

Literature review. Theoretical and methodological approaches in innovative ecosystems are presented by Dubina I.N., Kozhevina O.V., Chub A.A., Carayannis E.G., Barth T.D., Campbell D.F.J. and others (Dubina et al., 2016, Carayannis, 2012). Thus, for instance, Carayannis E.G., Barth T.D., Campbell D.F.J. (Carayannis et al., 2012)

fairly believe that business ecosystem incorporates knowledge factors and innovative structures based on a combination of stocks and flows of human, social and financial capitals. Further Dubina I.N., Kozhevina O.V., Chub A.A. (Dubina et al., 2016) went into the questions of economic and legal aspects of the technological entrepreneurship ecosystems, including the regional level as well in their studies. Problems of the innovation ecosystems' development of technological entrepreneurship at the international level are studied by such expert researchers as Kuftyryov I.G., Perednya S.S., Carayannis E., Campbell D. (Kuftyryov, Perednya, 2013, Carayannis et al., 2012.).

Extensive review of practical questions (in particular, game and experimental methods) for development and improvement of innovative policy is offered by Ranga M. and Etzkowitz H. (Ranga & Etzkowitz, 2013). Many experts dedicated their studies to theoretical research of forming and developing a dimensional model of the innovation and entrepreneurship ecosystem and formal methods of such economic and methodological areas as game theories, optimal resource allocation, designing and conducting managerial games (Algazin 1999, 2009; Park, 2014; Nambisan & Baron, 2012; Twiss B., 1992).

The above-mentioned authors have investigated a role of institutional factors of innovative ventures within development of ecosystems where the key role belongs to such parties as university – business – industry – state.

Prospects and opportunities to use the theory of the innovation and business ecosystems as a conceptual framework to form sources of sustainable development have not been sufficiently studied and this determines relevance of research in this area of theoretical and practical knowledge.

Material and Methods. The main descriptive part of the research is linked to existence of multi-criterion tasks where as a basis for simulation of a development process is taken a theoretical concept of a triple innovative spiral that describes interaction of such parties as science, state, and business operating within innovative activities. Experimental types of activities also include formal methods as game theory, optimal resource allocation, designing and conduct of business management games.

As one of the first conceptual models of ecosystems of technological entrepreneurship (ETE), one can consider a concept of the so-called triple innovation spiral (Triple Helix) that describes interaction of academia, government, and business within the innovation activities (Etzkowitz & Leydesdorff, 1998). According to this model, the underlying foundation is multilevel and nonlinear interaction of academia (universities), industry (enterprises) and state (government). This concept reflects a dominant side in the industrial economy – 'industry – state', enhanced role of universities and triple interaction in the spiral triad 'academia – industry – government'. It should be noted that in the concept of 'triple spiral' universities prove themselves not only as knowledge generators in classical understanding but also as innovation initiators (Ranga & Etzkowitz, 2013; Etzkowitz & Leydesdorff, 1998).

Authors of the concept of the entrepreneurship innovation ecosystem underline multilevel network interaction' and 'mixed organization'. Later, the concept of the triple spiral was expanded due to inclusion of civil society with such elements as mass media, cultural norms and values (Carayannis et al., 2012). Argument to the addition of the fourth spiral was a statement that innovative ecosystem of technological entrepreneurship is influenced by culture and values of the society as well methods of formation and translation of public opinion by mass media. As a fifth spiral, scholars have also added natural environment, which affects the ecosystem (Carayannis et al., 2012). These developments have led to the concept of N-component innovative spiral (Park, 2013).

Experimental factors should include Tobin's q as well which is defined as a ratio of market price of a company to a replacement price of its tangible assets. Gap between these parameters is explained by availability to the company of intangible assets (patents, licenses, know-how, software products) which increase its market capitalization. For high-tech companies referred to knowledge-based economy value of this coefficient can significantly exceed one, while for companies in 'traditional' sectors (machine-building industry, oil extraction and oil processing, metallurgy) it as a rule stays within one (Kuftyryov & Perednya, 2013).

The global practice also shows that economic agents are often not large companies, but instead they are representatives of small and medium-sized businesses possessing necessary intellectual (human) capital such as their employees, valuable intangible assets and also progressive and flexible marketing policy secured by high readiness for innovations and adaptation.

Leading question in analysis of innovation and business ecosystems is a question how its principal participants (universities-industry-government) can interact with each other for efficient production and

sale of new ideas through a multi-stage, constructive dialogue in order to achieve a system compromise of their interests, objectives and strategies and amid risks and uncertainty in the socio-economic environment. Answer to this question leads us to theoretical studies of formation and development of an innovation business ecosystem, in particular theory of games, optimal resource allocation, designing and conduct of business management games.

One of key moments in the ETE as a biological ecosystem is to ensure its stable balanced condition. In this context, some experts (Dubina, 2010; Dubina et al., 2016) believe it is worthwhile to resort to theoretical and methodological principles of game theory that is defined as a logical-mathematical theory of development of strategic decisions in conditions of competition, risk and uncertainty, theory of optimal and efficient rational behavior, theory of conflict resolution and searching for compromises.

Application of the game theory suggests that each player (decision maker) strives to achieve his/her own objective (for instance, maximization of profit, market share or social welfare) but along with this he takes into consideration how another player can and will act. In particular, during analysis, simulation of the ETE it is possible to use such fundamental principles of the game theory as allocentrism (McCarthy & Stadler, 2000) and Nash equilibrium (Wang, 2018).

Allocentrism marks strive of a person to put himself in the other person's shoes in order to gain a great insight into their causes and interests; this is first focusing attention and actions on other persons. Nash equilibrium is a strategic situation (configuration of strategies of players) when neither of the players is interested to withdraw, i.e. in such situation not a single player is motivated to modify a selected strategy. John Nash who was awarded a Nobel Prize in Economic Sciences in 1993 proved mathematically that any game with a finite quantity of players and finite quantity of strategies has an equilibrium with predetermined properties. From a practical point of view, this means that if we have information about motivations and other behavior determinants of players, we can define their optimal (best) strategies from viewpoint of Nash's equilibrium configuration (Dubina & Carayannis, 2014).

One among new and promising concepts of decision making that rest on the game theory is a system compromise principle. Compromise in the widest sense means an agreement based on mutual concessions that settles some conflict and to some extent satisfies all the parties. Notion and principle of system compromise were for the first time formulated (mathematically) in studies of Algazin G.I. and other scholars (Algazin, 1999; Algazin 2009; Wu et al., 2014).

Application of this principle is directed at multi-criteria solution of problems of inter-level conflicts in socioeconomic systems participants of which have at their possession incomplete and asymmetric information about sets of selection of solutions.

Distinctive feature of the approach, in contrast to the classical principles of game theory, is that along with sets of local strategic variables controlled by individual system participants, shared variables are taken into account, and none of the participants has a full right to an independent choice. Along with that, participants are asymmetrically informed about sets of shared variables and, in general, none of them has complete information in his/her possession.

Such approach calls for transfer and exchange of information at all levels of the system, expansion of multivariate cooperation and co-coordination of all participants, optimization of distribution and redistribution of their powers, resolution of both intra-level and intra-system contradictions. Based on such an approach, complex conflicts are considered when their resolution requires considerable efforts and expenses, changes in strategic paradigms and modes of operation.

Foreign scholars believe (Dubina et al., 2016) that ecosystem of innovative entrepreneurship is a system, which makes relevant application of the system compromise principle for analysis, simulation and designing of its effective operation.

As part of system compromise, a basic formal game-theoretic model of interaction between main actors of the ecosystem has been developed. It is based on the concept of triple innovation spiral with an additional inclusion of investors and direct consumers of innovations.

A relevant business game 'From Laboratory to Market' has been also developed for training, simulation and analysis of ways and possibilities of interaction between the ETE subjects through multi-level communication to achieve a systemic compromise in conditions of risk and uncertainty of the socio-economic environment.

Main objectives of creation and conduct of the game 'From Laboratory to Market':

1) Creation of a game-based training platform to understand actions of main participants of an innovation process (government, universities, business, investors, innovation consumers) who can

and should cooperate in order to reach a compromise through an effective dialogue in an entrepreneurial and innovative environment, involving risks and uncertainty;

2) Development of a tool for simulation of a decision-making process of major interested players in conditions of risk and uncertainty by analyzing possible strategies and developing new combinations of strategic decisions in the process of interaction of game participants with a view to determine optimal or suboptimal strategies of universities to promote and implement their research projects;

3) Preparation of a platform for interaction of real participants in the innovation process and development of tactics and strategies for their actions.

Participants of the business game:

– The state (project proponent, investor) – 1 group;

– Universities (project proponent, academicians and developers of technologies) – 2-4 groups;

– Entrepreneurs (groundbreakers implementing developments) – 2-4 groups;

– Investors – 2-4 groups;

– Innovation consumers (innovation consumers, investor) – 1 group.

There is a pool of innovative projects (requiring R&D, large-scale circulation and commercialization) distinguished by expected costs and profitability. Each group of participants has certain resources. The group may dispose of some portion of resources independently, another portion – subject to an agreement and in coordination with some other participants. Each group can interact with other groups. Results of such interaction determine a choice of projects and success of their implementation.

There are concurrently both cooperation and competition in this game. Goal of each group is to choose the best solution in order to satisfy their own interests, but taking into account needs and motivations of other players (game-theoretic principle of allocentrism) (Dubina et al., 2016).

With the help of this game, it is possible to analyze behavior of all the main participants of the ETE process with different sets of input data and conditions. In the end, we get a large number of possible situations and it is possible to predict results of these or those decisions of the players.

It should be noted that this game was developed at the University of Martin Luther (Halle, Germany) as part of DAAD's academic mobility program and was tested in student groups at Altai State University (Russia). The pilot game with participation of representative players was arranged and conducted with the support of IREX at the facilities of Bauman Moscow State Technical University and Moscow School of Management Skolkovo in May 2015.

The developed game can be used as an effective tool of allocentrism for better understanding of causes, interests, possible strategies and ways of interaction between participants and achievement of the system compromise.

Results and Discussion. Many scholars claim that the concepts as 'innovation ecosystem' (IES), 'ecosystem of technological entrepreneurship' (ETE), and 'innovation and business ecosystems' (IBES) are a modern 'hybrid' or 'mix' of relevant concepts from areas of such sciences as economics and biology. In addition to the main participants (actors) of such ecosystems (government, universities, and research centers, enterprises and entrepreneurs, innovation managers, investors, consumers of innovations, etc.) this concept includes a set of conditions that ensure their interaction (Dubina et al., 2016).

The mentioned notions (ETE, IES and IBES) are increasingly entering the modern scientific turnover. For example, international research database EBSCO Research has indexed 152 research articles using these terms, Web of Science – 156 articles, Scopus – 2,089 publications (2015). Given a total number of publications related to innovations and innovation development, currently these databases contain hundreds of thousands of such publications.

It is often claimed that the mentioned notions have no unanimous interpretation thus far.

It is probably true to say that, an innovation and business ecosystem is a multi-layered, multi-modal and multilateral system encompassing mutually complementary and mutually reinforcing innovation institutions and knowledge clusters that are based on human and intellectual capital formed under the influence of social capital and supported by financial capital. Its subsystems consist of 'building blocks', i.e. associations of innovative network structures and knowledge clusters. These blocks are grouped into knowledge factors and innovative structures based on a combination of stocks and flows of human, social, intellectual and financial capital (Carayannis et al., 2012.).

Strategic task of public policy must be promotion of formation of an innovation ecosystem, i.e. supportive environment that contributes to the transformation of ideas into business and without which the innovation technological entrepreneurship can not fully exist. The prefix 'eco-' in this definition is used with the meaning that not every economic system is an ecosystem. An economic ecosystem (by some analogy with a biological ecosystem) is a

self-organizing, self-regulating and self-developing economic system, built not only on formal links between its participants being the environment of their 'natural' stay. In other words, an ecosystem is not so much a configuration of the system itself, but a way of its functioning (Kuftyryov & Perednya, 2013).

From our point of view, one should not set against each other concepts of 'system' and 'ecosystem' in terms of their formal features, since from the point of view of their structure, they are similar, and they possess a similar set of interacting elements. Criteria for distinction in this case are precisely dynamic characteristics, namely self-organization, self-regulation, capability of self-development and the most important qualitative characteristic – an entrepreneur as a main element of the system.

In this sense, for example, a special economic zone (SEZ) cannot be defined as an ecosystem since it enjoys a special business treatment provided by the government. In the absence of a direct initiative from the government or in case of abolition of 'greenhouse' business conditions for its residents, the very concept of the SEZ will lose any economic sense. Business incubators and technological park are not, in our opinion, ecosystems as well because they themselves do not form closed reproduction cycles but may be part of an economic ecosystem. Thus, if the economic system is self-organizing, self-regulating and capable of self-development, then there is every reason to consider it as an ecosystem (Kuftyryov & Perednya, 2013). Foreign scholars maintain that application of the concept of innovation and business ecosystems to the level of territory (region, country) is possible through appropriate formulation of an innovation and business ecosystem as a spatial ecosystem (at the level of a country, region, enterprise, etc.). The spatial ecosystem should be defined as a complex open dynamic system within which a specific institutional environment of an adaptive type is formed taking into consideration strategic objectives of this system and contributing to activate the process of expanded reproduction of three factors as innovation (1), technology (2), and human capital (3) (Dubina & Carayannis 2014).

We will understand institutional environment (Figure 1) of an adaptive type as a set of institutions, organizations and their interrelations arranged in a certain manner that form an institutional space of innovation and business ecosystem due to influence of processes of internal integration of economic agents, exogenous factors. Incentive systems and regulatory mechanisms ensure the leveling of functional as well as informational disunity of ecosystem elements. The ecosystem is oriented towards sustainable development through the formation of incentives for the integration of organizations that are part of the research and business subsystems. It is also necessary to stimulate the innovation activities of economic actors in the ecosystem (Fig. 1):

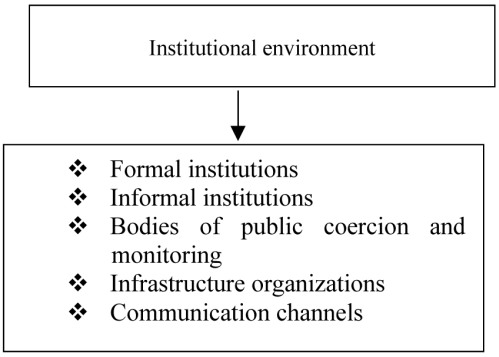

Figure 1. The institutional environment of the innovative entrepreneurship ecosystem

According to the Figure 1, it is offered to include into the institutional environment the following set:

– Formal institutions (legal norms) regulating both innovative and entrepreneurial activities;

– Informal institutions existing in the form of moral and ethical standards of behavior of citizens and business culture;

– Authorities of public coercion and monitoring provided by a judicial system, power structures and public organizations;

– Infrastructure organizations (venture companies, investment funds, etc.);

– Communication channels being real or virtual communication lines and institutional

networks via which information flows between elements of a spatial IBES (Chub A.A., 2015). According to another source (Dubina & Carayannis, 2014) institutional environment or participants of ecosystems is interpreted as economic agents (Fig. 2):

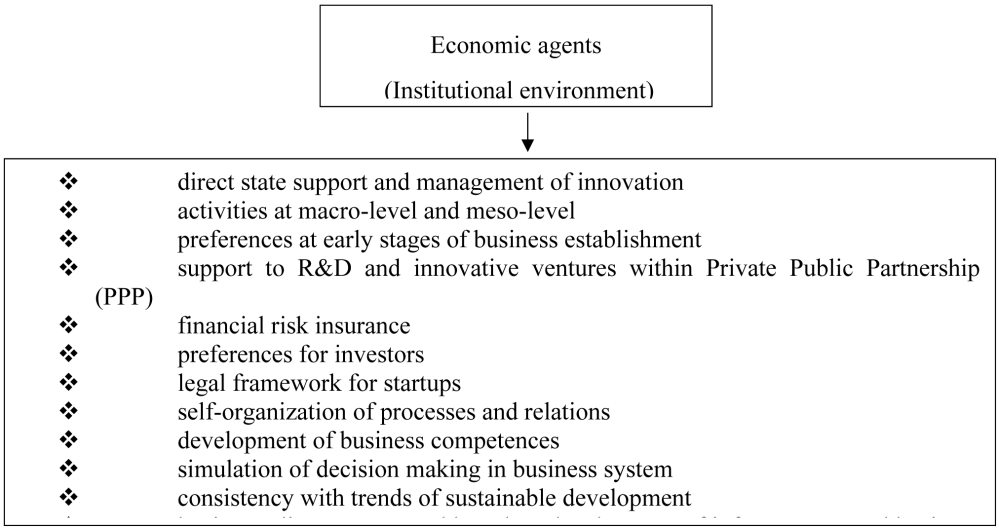

Figure 2. Factors affecting technological projects in innovation and entrepreneurship ecosystems

According to Figure 2, the government, universities and research centers, enterprises and entrepreneurs, innovation managers, investors, consumers of innovations, etc. are among economic agents operating within the framework of the ETE.

A number of economists state that innovation ecosystem rests on five basic principles (in parentheses are the so-called challenges, i.e. factors that are essential for development of the ecosystem but are not yet developed in the national context).

1. Science, engineering community and universities: they are main contributors of innovative ideas for commercialization, as well as staff which forms development teams for engineering companies and scientific and engineering expert examination (challenge: development of small innovative enterprises and institute of innovative entrepreneurship at the university) .

2. Industry of venture investments: responsible for attracting financial resources and business competencies to the ecosystem necessary for formation of innovative companies and their transformation into a full-fledged business (challenge: development of investment institutions and management consulting in the field of innovative ventures).

3. Infrastructure: creates favorable conditions for existence of innovative companies. The infrastructure can be both tangible (technological parks, business incubators, technological innovation centers, etc.) and intangible (‘soft’). The latter refers to a variety of services specifically focused on needs and specifics of innovative companies: intellectual property protection services, introduction and promotion of innovative products to foreign markets, outsourcing of ‘non-innovative’ aspects of activities, etc. (challenge: development of components of a ‘soft’ infrastructure and mechanisms for bringing innovation to global markets).

4. Stable demand for innovation: it is a key to normal functioning of the entire ecosystem as a whole. We are talking not only about the consumer market but also about demand of large businesses and other companies in the real sector for high-tech products, for technologies and for innovative companies themselves, along with all their developments and intellectual property (as promising business objects for acquisition).

5. Legislative and legal framework creates a comfortable working environment not only for innovative companies themselves but also for all participants of the ecosystem. Here should be also set convenient rules of the game allowing building a reasonable balance of interests between different market players (challenge: development of legislation in the field of innovative ventures; transformation of the state from a ‘player’ to a ‘referee’ at the innovation field).

Stable operation of the ecosystem of innovations requires not only availability of all the above-mentioned elements but also their balanced development (Kuftyryov & Perednya, 2013).

With regard to innovative entrepreneurship, there is much emphasis on a need for state support for its development. However, especially when it comes to small businesses or start-up companies, application of state measures of direct and indirect incentives becomes very problematic and difficult to apply. Thus, for example, small innovative venture is practically not an object of direct stimulation since the latter applies mainly not to business projects but to R & D and allocation of public resources (orders, grants and republican funds) between different areas of research and development (Kuftyryov & Perednya, 2013).

Therefore, when it comes to formation and development of the institute of innovative ventures, it is necessary to create a favorable innovation climate in the economy and to establish a corresponding infrastructure.

In practice, this can be achieved by taking specific steps to create such an environment, including:

– implementation of measures of state support of small and medium-sized enterprises (SMEs); support and promotion of innovative developments (for example, through creation of venture funds);

– streamlining procedures for entrepreneurs to obtain state and municipal services, for example, through introduction of 'electronic government' and similar services);

– reduction of administrative barriers for business arrangement and development of a modern and accessible information and communication infrastructure in the region (registries of innovation projects and companies, associations of innovation regions and venture entrepreneurs);

– formation and development of the innovation infrastructure of a region (business incubators, industrial parks, research consortia) (Kuftyryov & Perednya, 2013).

In this regard, we consider a role of an industrial technological park (ITP or Techno Park) in terms of the ETE development. Techno Park is an area specially organized to host new manufactures provided with utilities, infrastructure, and necessary administrative and legal conditions and managed by an ad hoc public or private company.

Several independent enterprises from the same or different industries can operate within an ITP. Multi-profile enterprises that have located their production facilities in a shared area are most often connected by shared value-added chains and share a joint infrastructure of the park and services provided by the management company. Importance of the technological park for innovative ventures is that it is a kind of a 'springboard' for promotion of new high-tech and promising businesses and a localization point for private and public venture capital (Kuftyryov & Perednya, 2013).

Development of innovative infrastructure is underlain by such factors as:

– support of innovative projects due to attraction of venture investments and subsidies from regional budgets;

– development of staff innovative potential;

– implementation of the latter of these directions can be achieved through active integration of research universities into the innovation system of the region as providers of highly qualified personnel in the field of innovative ventures.

As for our country, currently principal structural elements of the innovation system have been created and they already operate in the republic. However, it should be pointed out that tools to support innovations are weakly linked with each other; individual innovation production cycles are fragmented and poorly connected, and do not actually make a system. In the business environment, backward technological structures dominate, level of susceptibility of companies to new technological solutions remains low, in a bulk of organizations innovation activity is carried out in contingency. Moreover, offered findings of researches and developments are not used in Kazakhstan's economy due to misbalance of the national innovation system (Dubina & Carayannis, 2014).

However, all elements of the innovation system are in place and a task of their integration with each other and transformation of their interaction into the system can be achieved precisely through development of infrastructure components of the system. One of these components, implemented on an international scale, can be defined as an 'innovation corridor'. It is a mechanism for interaction of institutional elements (participants) of various innovation systems, ensuring introduction of innovative products or companies themselves into international markets.

Operation of the innovation corridor facilitates both enhancement of integration processes within innovation systems themselves and integration of systems with each other. It is noteworthy that interaction of the participants – 'builders' of the innovation corridor – can be informal and can rest on mutual interests as part of the development of their innovative tracks (Kuftyryov & Perednya, 2013).

Those innovative companies and entrepreneurs who see significant prospects for commercialization of their decisions on international technology markets must get into the innovation corridor. Role of builders of the innovation corridor can be undertaken by:

– research universities and technological clusters created on the basis of their facilities;

– structures and agencies of international development created on the basis of regional state administration bodies;

– investment consulting companies that focus on 'packaging' of innovative projects at a preincubation stage (centers for substantiation of an innovation concept);

– infrastructure participants of the innovation system: business incubators, technological parks;

– formal and informal institutions of development and financial support for activities of the corridor (regional venture investment funds and their representative offices abroad, business angels, private investors).

Leading role in building an innovation corridor can be played by a research entrepreneurial university that focuses on effective project development of its international activities and has at its disposal resources essential for operation of the corridor: promising technological solutions and backlogs, as well as qualified scientific personnel with business skills (Kuftyryov & Perednya, 2013).

Conclusion

Spatial ecosystem of technological entrepreneurship is a probabilistic dynamic system that encompasses processes of production, exchange, distribution, consumption and accumulation of innovative, technological, and human capital. Achieving a goal of sustainable development of the system is attributed to trends in the external environment and its adaptive properties as an object of management.

1. The innovation ecosystems themselves are becoming an important factor for increasing the efficiency of entrepreneurship. Entrepreneurs face a set of challenges related to a need to balance goals and priorities, where development is possible only on the basis of principles of system compromise.

2. The sources of growth of the innovation and entrepreneurial ecosystem are not only the internal potential of the management system, but also external factors of development. They are an active innovation policy at the regional level with the support of science-intensive industries, interregional and intersectoral economic relations, as well as the ability and opportunity of the ecosystem to integrate into the international economic space. Business climate formed on the basis of development of infrastructure and business culture is one of the most important conditions to attract investments for innovative development and improve competitiveness of a particular region.

3. In order successfully to balance requirements set by an innovation ecosystem with objectives of enterprises in a systemic compromise, it is important for entrepreneurs to focus on self-regulation of processes and understanding of their potential role in these processes (Nambisan & Baron, 2012).

4. Formation of an optimal institutional environment that provides for compromise implementation of conflicting goals of economic agents with different statuses and functions, acts as an adaptation mechanism for a spatial innovation and business ecosystem that functions amid environmental uncertainty, contributes to balanced development of subsystems, enhances sustainability and efficiency.

5. The concept of an entrepreneurship ecosystem has been formulated. The role of institutional environment in maintenance of the process of its sustainable development has been defined, external and internal factors that have the most significant influence on this process have been identified, mathematical tools have been chosen that allow simulating possible directions for development of the technological entrepreneurship ecosystem in conditions of risk and uncertainty.

References

Algazin, G.I. (1999). Matematicheskie modeli sistemnogo kompromissa (1st ed., p. 133). Barnaul: Altajskij gosudarstvennyj universitet.

Algazin, G.I. (2009). Modeli sistemnogo kompromissa v social'no-ehkonomicheskih issledovaniyah (1st ed., p. 239). Barnaul: Azbuka.

Carayannis, E., & Campbell, D. (2009). 'Mode 3' and 'Quadruple Helix': toward a 21st century fractal innovation ecosystem. International Journal of Technology Management, 46(3/4), 201. doi: 10.1504/ijtm.2009.023374

Carayannis, E., Barth, T., & Campbell, D. (2012). The Quintuple Helix innovation model: global warming as a challenge and driver for innovation. Journal of Innovation and Entrepreneurship, 1(1), 2. doi: 10.1186/2192-5372-1-2

Chub, A.A. (2015). Regiony Rossii: faktory ustojchivosti i institucional'nye predposylki razvitiya v usloviyah globalizacii (1st ed., p. 232). Moskva: RIOR; INFRA-M.

Dubina, I.N. (2010). Osnovy teorii ehkonomicheskih igr (1st ed., p. 208). Moskva: KnoRus.

Dubina, I.N. Kozhevina O.V., CHub A.A. (2016). Innovacionno-predprinimatel'skie ehkosistemy kak faktor ustojchivosti regional'nogo razvitiya. EHkonomicheskij Analiz: Teoriya i Praktika, 4(4), 4-19.

Dubina, I.N., Karajyanis, E. (2014). Aktivizaciya innovacionnoj deyatel'nosti v stranah s razvivayushchejsya ehkonomikoj: teoretiko-igrovye i ehksperimental'no-igrovye podhody dlya razrabotki i sovershenstvovaniya innovacionnoj politiki. Menedzhment v Rossii i Za Rubezhom, 6, 3-11.

Etzkowitz, H., & Leydesdorff, L. (1998). A Triple Helix of University—Industry—Government Relations. Industry and Higher Education, 12(4), 197-201. doi: 10.1177/095042229801200402

Kuftyryov, I.G., & Perednya, S.S. (2013). Mezhdunarodnyj innovacionnyj koridor kak infrastrukturnyj faktor razvitiya tekhnologicheskogo predprinimatel'stva. Ehkonomicheskie Nauki Vestnik Nizhegorodskogo Universiteta Im. N.I. Lobachevskogo, 3(3), 147-152.

McCarthy, J., & Stadler, H. (2000). Allocentrism and Perceptions of Helping. Journal of College Student Psychotherapy, 14(4), 57-70. doi: 10.1300/j035v14n04_07

Nambisan, S., & Baron, R. (2012). Entrepreneurship in Innovation Ecosystems: Entrepreneurs' Self-Regulatory Processes and Their Implications for New Venture Success. Entrepreneurship Theory and Practice, 37(5), 1071-1097. doi: 10.1111/j.1540-6520.2012.00519.x

Park, H. (2013). Transition from the Triple Helix to N-Tuple Helices? An interview with Elias G. Carayannis and David F. J. Campbell. Scientometrics, 99(1), 203-207. doi: 10.1007/s11192-013-1124-3

Ranga, M., & Etzkowitz, H. (2013). Triple Helix Systems: An Analytical Framework for Innovation Policy and Practice in the Knowledge Society. Industry and Higher Education, 27(4), 237-262. doi: 10.5367/ihe.2013.0165

Twiss, B. (1992). Managing Technological Innovation (1st ed.). FT PrenticeHall Press.

Wang, S. (2018). General Equilibrium vs. General Nash Equilibrium. SSRN Electronic Journal. doi: 10.2139/ssrn.3261286

Wu, J., Zhang, Q., Du, Q., & Dong, Z. (2014). Compromise principle based methods of identifying capacities in the framework of multicriteria decision analysis. Fuzzy Sets and Systems, 246, 91-106. doi: 10.1016/j.fss.2013.12.016