

Innovative business development and the startup ecosystem in the era of the fourth industrial revolution

Galyna Zhavoronkova, Vladimir Zhavoronkov, Vusala Nagieva,
National Aviation University,
Kyiv, Ukraine
zhavor@ukr.net

Annotation. The study of the theoretical aspects of the development of innovative business has proved that the most effective form of innovative business, which can create and implement the final product, is a startup. The environment and infrastructure of a startup form its ecosystem. An innovation ecosystem includes economic agents, as well as an innovation environment consisting of ideas, rules of the game, social interactions, and culture. The state of the innovative business and the startup ecosystem of Ukraine behind its main components and institutions are analyzed, and the factors of the development of the startup ecosystem for its competitiveness among the world are determined. Government measures and initiatives should promote the emergence of a community of startup founders who will work closely with other actors in the private sector of the economy and the public sector. At the same time, the state should not assume the role of a leader, but only an initiator.

KEYWORDS: INNOVATIVE BUSINESS, MODEL, STARTUP, ECOSYSTEM, DEVELOPMENT FACTORS.

1. Introduction

The fourth industrial revolution means more and more automation of absolutely all processes and stages of production: from digital product design, creating a virtual copy of it – to remote configuration of equipment in production under the technical requirements for the release of a specific "smart" product. This revolution is unique in terms of the pace, dimension, and consistency of transformations. It was driven by digitalization and networking. It blurs the boundaries between the physical, digital, and biological spheres while changing entire systems, basic concepts (money, power, partnership, property, identity) [1].

Innovative business is based on the constancy of the external environment, understanding it as a necessary condition for a stable organization and effective functioning of the economic system as a whole. It should be noted that most countries face the problem of lack of investment resources necessary for the development of innovative business, there is a structural imbalance between supply and demand in the field of financing innovative projects.

In the economic context, the concept of "ecosystem" is considered as a concept that describes the evolution of the nature of the interactions of economic agents, the models of their innovative activity, and their relationship with the operating environment [2]. The innovation ecosystem includes economic agents, as well as an innovative environment consisting of ideas, rules of the game, social interactions, and culture [3].

Consequently, innovative business turns into a strategic growth factor, affects the structure of social production, changes the economic organization of society, and stabilizes the social situation in the country.

2. The model of the startup ecosystem in innovative business

A distinctive feature of the startup ecosystem from the environments for other types of business is the close relationship with applied science. Naturally, in regions where leading universities, research institutes, scientific and technological parks operate, innovation ecosystems are more developed, which increases the success of the startup implementation [4]. The size and maturity of the startup ecosystem are determined by its ability to provide opportunities for the launch, development, and successful implementation of startup projects, as well as the further development of innovative companies.

A startup ecosystem (hereinafter referred to as SE) is an innovative and developed region where a set of institutions operates, in particular research institutes, the best technical universities, technology parks, giant firms in the field of information and communication technologies, organizations whose activities are aimed at supporting business initiatives in the technology and innovation sector. The basis for the functioning of

the SE is the movement of venture capital, intellectual and human resources, the purpose of which is to introduce innovations [5]. The peculiarity of the organized SE is that the resources necessary for the introduction of innovations should be supplemented from the commercial sector [6].

The first and most developed ecosystem is considered to be Silicon Valley in California, whose progress is stimulated by giant IT firms, as well as advanced universities. Boston and Berlin are also considered the most progressive SE, where one of the largest technoparks WISTA is located, where numerous enterprises in the field of creative industries and innovative business also operate [7].

PHASE #1. OCCURRENCE	PHASE #3.1. NATIONAL INTEGRATION
<p>Characteristics: accumulating resources; founding the first startups; the emergence of a community of innovative entrepreneurs</p> <p>Initiatives: organization of conferences and meetings</p>	<p>Characteristics: implementation of a significant number of startups – the rapid growth of CE capitalization; active receipt of foreign resources; increasing CE competitiveness; the emergence of an innovative brand in the country; strengthening the relationship between research institutes and businesses</p> <p>Initiatives: reducing tax pressure on venture projects</p>
PHASE #2: ACTIVATION	PHASE #3.2. GLOBAL INTEGRATION
<p>Characteristics: combining the efforts of startup leaders and authorities to raise capital and strengthen interregional ties; adapting fo-foreign experience; increase productivity by using resources in the work of start-up teams.</p> <p>Initiatives: state support programs, establishing ties with global SE.</p>	<p>Characteristics: implementation of large projects (more than \$ 500 million); the startups-the primary engine of the economy; active immigration: personnel, entrepreneurs; fixing the connection with other CE; SE is the main business platform in the country.</p> <p>Initiative: flexible immigration policies, the content of the low cost of living</p>
PHASE # 4: MATURITY	
<p>Characteristics: slowing growth rates; balancing all areas; strengthening business and research links at the global level; expanding the differentiation of areas in the startup sector.</p> <p>Initiatives: active investment in R & D, development of effective implementation practices</p>	

Figure 1. Startup ecosystem lifecycle

The startup ecosystem evolves at the macro level, overcoming certain phases. The Startup Genome organization, which studies the evolution of dozens of startup ecosystems over several years and publishes annual reports on the state of the SE of

mainly developed countries, has proposed a model for the development of an ecosystem consisting of four phases (Fig.1).

To determine the phase of SE development, the organization uses a set of metrics that allow assessing the pace of ecosystem development, their relationships at all levels, the state of funding, state support, infrastructure, etc. The phases of ecosystem development do not have clearly defined timelines. For example, for almost 30 years, the Israeli SE has reached the last phase, while the Berlin one is in "world integration", and the Hong Kong one is only "activation".

Advanced organizations and institutions offer various models of CE, but, according to the author, the most complete model is that proposed by the Netherlands accelerator and its research institute Startup Delta [7] (Fig. 2). The region in which all these elements and institutions are present is considered a "strong" or full-fledged CE. The complex infrastructure of a startup provides its comprehensive support at all stages of development.

Networks		Expertise	Education
Support in entering the local market	Competitions	Transfer of knowledge and technologies	Innovation Business Centers
Cooperation	Co-working space	Industry development	Support for student entrepreneurship
Events	Startup-media	Education	Science parks, research institutes
Capital		Support	
Investing at the pre-seed stage	Alternative financing	State	Incubators& Accelerators
Angels	Government funding	Development of the concept	Organizations that exercise social influence
Corporate and venture capital	Private and venture capital funds	Scaling a startup	Developing a venture business

Figure 2. Startup ecosystem model based on the startup Delta Institute

The state of the spheres in these five categories (networks, expertise, etc.) is studied based on the analysis of the state of commercial and non-commercial structures operating in these spheres.

1. Science parks. The main function of science parks is a mechanism for commercializing R & D results. A science park is defined as an organization established by a VSO or research institute based on a Cooperation agreement to transfer scientific knowledge to commercial structures.

2. Technology transfer. This is the process of transferring scientific achievements/discoveries from one organization to another for further development and commercialization. The sequence of the provision of technology transfer services can be considered as its life cycle.

3. Venture capital. The venture capital market is defined as a set of economic relations between buyers (innovative enterprises) and sellers (venture capitalists) regarding the movement of venture capital, reflecting the economic interests of market participants and ensuring the exchange of innovative products [8].

4. Business incubators are defined as structures that help projects at the initial stages to develop their idea, identify the target audience, build a team, get customers and feedback from them. **Accelerators** invest in startups by providing mentoring support and charge for their services, not money, but a share in the project [9].

5. State support. State support plays an important role in the creation of the SE. Examples of effective state support for innovative enterprises are the Netherlands and Ireland, which is a relatively short period have caught up with large countries thanks to the active policy of the state in this direction [10].

3. State of innovative business in Ukraine

In most cases, the activities of most science parks in Ukraine do not meet either the set priorities or the needs of the market, so these structures do not bring sufficient economic results. The state of science parks, research institutes, Western military districts and other institutions related to scientific activities has a steady tendency to decline (table. 1). There is a turnover of scientific personnel, a decrease in spending on science and innovation, a reduction in the share of innovative products, and R & D in GDP.

Table 1. State of Science, Technology, and innovation in Ukraine 2010-2017

Year	Number of organizations in the field of research and development	Number of scientists	Total innovation costs, mln UAH	Share of enterprises engaged in innovation, %	Share of innovative products sold in industry, %	Share of R&D GDP, %
2010	1303	89564	8045,5	13,8	3,8	0,90
2011	1255	84969	14333,9	16,2	3,8	0,79
2012	1208	82032	11480,6	17,4	3,3	0,80
2013	1143	77853	9562,6	16,8	3,3	0,80
2014	999	69404	7695,9	16,1	2,5	0,69
2015	978	63864	13813,7	17,3	1,4	0,64
2016	23229,5	18,9	...	0,48
2017	9117,5	16,2	0,7	0,45

Due to the weak interaction of Science and business, technology transfer has not found its development in Ukraine, which is due to the peculiarities of the state's economic development and legal aspects of intellectual property protection [12]. Nevertheless, since 2015, there has been a jump in the commercialization of R & D in Ukraine (fig. 3-4). The graphs show a tendency for technology imports to prevail over exports, especially until 2015, which indicates a relatively low competitiveness of the innovation sector of the Ukrainian economy. In Ukraine, the total amount of venture capital as of 30.06.2016 amounted to UAH 235.46 billion, which is 4.4% (or UAH 9.92 billion) more than in 2015.

Ukrainian investors and funds invested. 68 million in startup projects in 2015. This is three times more than in 2014 and 25% more than in 2013. The share of funds of Ukrainian investors during 2013-15 consistently exceeded the share of foreign investors, and in comparison with 2010 it increased more than 5 times (from 10% to 52%) (Fig. 5) [13].

During 2010-15, the IT sector showed a positive average annual growth trend of 80%, despite the decline in investment activity in 2014 (-55% compared to 2013). According to a study by the Ukrainian capital and private equity Association (UVCA), there are currently 17 active venture funds, 6 private equity funds and 1 corporate fund (HP Tech Ventures) operating in Ukraine. The portfolio of funds averages 20 companies; funds provide from 20 thousand to several million dollars; 16 funds are ready to invest in startups at the sowing stage, 10 funds at Rounds A and B, and 7 each at the pre-sowing growth stage, respectively [14].

Most incubators and accelerators have been operating in Ukraine since 2012 (foreign or domestic branches), which has led to a sharp increase in the number of startups launched and successfully implemented. The volume of attracted investments for the year of operation ranged from 500 thousand hryvnias (Polyteco) to 15.5 million US dollars (GrowthUP). The largest institution among the accelerators and incubators available in Ukraine is GrowthUP, which has been operating since 2007, accepting from 200 to 600 startup projects per year. The amount of funding for the project in these institutions ranges from several to 50 thousand dollars (most of the funds are provided by GrowthUP) [15]. Incubation and acceleration conditions in Ukraine differ somewhat from organization to organization, although they are similar in some

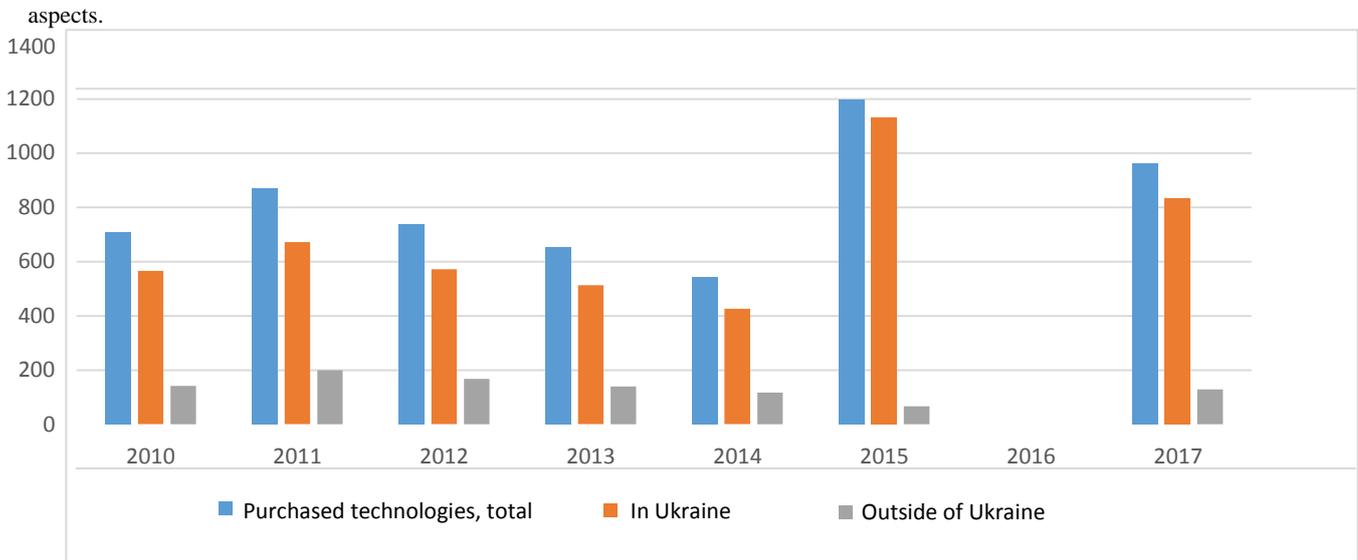


Figure 3 Dynamics of the number of purchased technologies in Ukraine (unit)

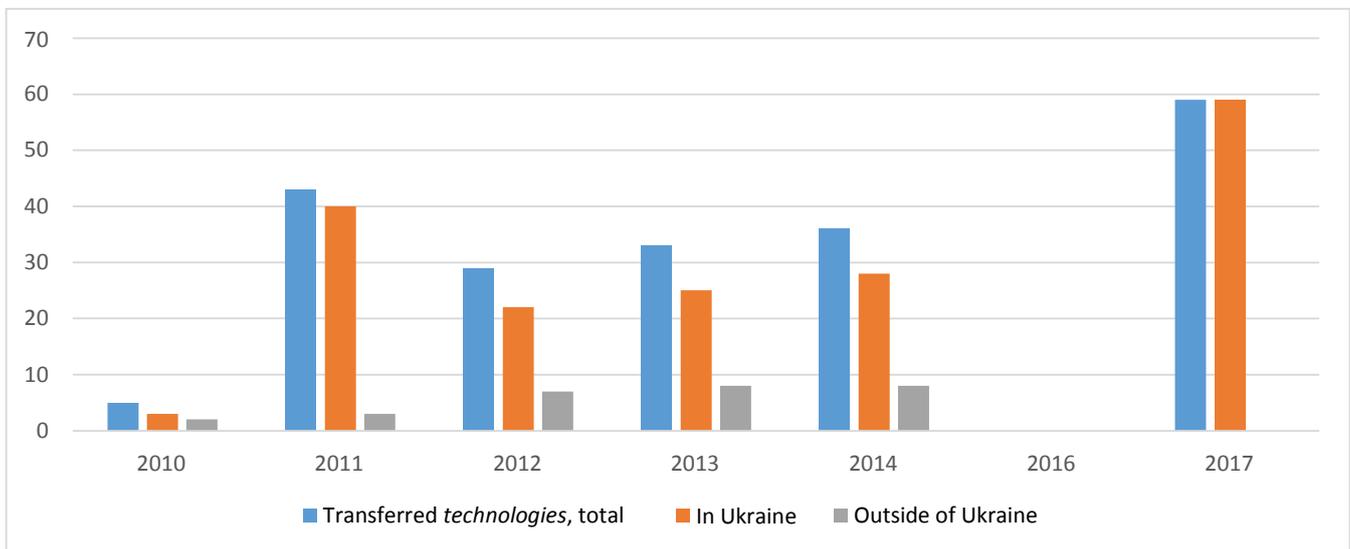


Figure 4. Dynamics of technologies transferred in Ukraine and abroad (unit)

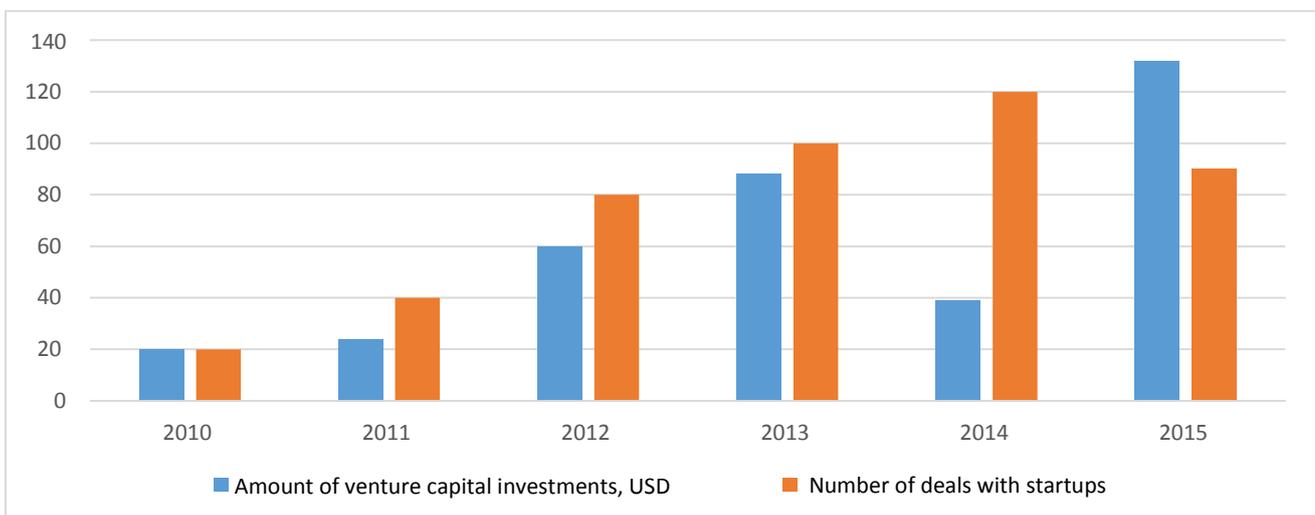


Figure 5. Dynamics of venture capital investments in Ukraine (unit)

The state policy in the field of innovation in Ukraine is regulated by the Law "On Innovation Activity". For the systematic development of the innovative sector of the economy, several state measures are envisaged, which, in particular, include: financial support for innovative projects and the establishment of preferential taxation of innovation entities. To provide financial support for the innovative activities of business entities of various forms of ownership, the Cabinet of Ministers of Ukraine established a State Innovative Financial and Credit Institution to provide repayable or non-repayable loans under certain conditions.

4. Assessment of the attractiveness of the Ukrainian SE.

At the moment, there are several methods for evaluating the startup ecosystem in the world. The assessment of the ecosystem, by main components, industries, categories, is carried out to determine its state, phase, level of development and develop a strategy or program for the development of the SE. The need for startups, large firms, and the state to focus on the market of innovative business in the conditions of its dynamic development, determines the importance of conducting analysis and a comprehensive assessment of the startup ecosystem. To determine the appropriate approach for assessing the Ukrainian SE, the existing methods were considered (Table 2).

Table 2. Methods for evaluating the startup ecosystem

Methodology	Sequence of actions	Result
I. Methodology of the American startup accelerator Founder Institute	1. Choosing the optimal model for CE. 2. Collecting data on institutions in relevant industries. 3. Creating a complete CE structure of institutions in stages.	The complete structure of the national or regional SE.
II. Startup Genome organization methodology	1. Collect data by Category (productivity, State of industries, knowledge and talent base, funding, etc.). 2. Statistical analysis of data by Category. 3. Determining the development phase	The phase of CE development is defined.
III. Global Innovation Index	1. Collection of statistical data on 80 indicators of various categories (state institutions, infrastructure, human capital, and research, etc.). 2. Normalization of indicator values on a 100-point scale. 3. Aggregation of normalized values	The index that reflects the state and level of development of the country's innovation sector
IV. Startup Friendliness Index	1. Collect statistics related to categories. 2. Normalization of indicator values on a 100-point scale. 3. Aggregation of normalized values	The index that reflects the attractiveness of the ecosystem

Therefore, the existing methods for evaluating startup ecosystems are fragmentary, since they study ecosystems only from separate positions. Based on the considered methods and features of the Ukrainian economy, the following methodology for the assessment of the SE is proposed (Table 3).

The selection of indicators by categories and spheres was carried out, the normalization and aggregation of indicators were carried out according to the formulas (Table 4).

Table 3. A comprehensive methodology for assessing SE

	Sequence of actions
1. Determining the phase of SE development	1. Collection of data on relevant indicators for Ukraine and, for comparison, other ecosystems in different stages of development. 2. Comparative data analysis and conclusion.
2. Evaluating the attractiveness of the SE	1. Selection of indicators by category and area. 2. Normalization of indicator values. 3. Calculation of the SE score. 4. Comparison of ecosystems and innovation sectors of countries to determine Ukraine's position on the global innovation market.
3.1 Research of the state of science, science parks	1. Collecting data on indicators for recent years 2. Analysis and conclusion regarding the dynamics of indicator values.
3.2 Technology transfer	1. Data collection on technology transfer. 2. Analysis and conclusion regarding the dynamics of indicator values.
3.3 Venture capital	1. Collecting data on the state of venture fund assets, the number of transactions and investment volumes, and key internet segments. 2. Analysis and conclusions.
3.4 Incubation	1. Comparative analysis of programs.
3.5 State influence	1. List of the main state measures in this area.
3.6 Generalizations and conclusions	

Table 4. Normalized indicators by category and area

Scope/category	0-100	Scope/category	0-100
1. MARKET	34,9	4. INFRASTRUCTURE	36,9
1.1 Performance	30,6	4.1 Transport	30,6
1.2 Attractiveness	39,3	4.2 Energy and ecology	39,9
2. FINANCE	32,3	4.3 Information and communication technologies	40,2
2.1 Resources	23,2	5. HUMAN CAPITAL	41,6
2.2 System	41,4	5.1 Education and standard of living	32,7
3. "SPACE" FOR STARTUP DEVELOPMENT	32,1	5.2 Labor market	50,5
		6. STATE INFLUENCE	24,8
3.1 technology and science	32,1	6.1 Policy aspects	27,3
3.2 Business environment	32,1	6.2 Crime	22,3

On a 100-point scale, the overall attractiveness of the startup ecosystem in Ukraine is 33.7 / 100, inferior to most ecosystems in the world. It can also be noted that in countries with a high level of development of the innovation sector, SE is also more formed and stable.

4. Factors of development of the startup ecosystem in Ukraine.

The creation of a competitive SE is associated with many political and economic aspects. The formation of an appropriate environment for the development of startups should be part of an integrated long-term strategy for economic development and be based on the strengths and prospects of the Ukrainian economy, the scientific environment, the fiscal and educational systems [16]. Planning the development strategy of the Ukrainian SE can be based on the experience of successful countries in this aspect and should take into account the combination of the most influential factors (Table 5).

Table 5. Factors in the development of SE in different categories

Factors by level	The factors that determine the success (advanced) SE	Basic concepts for the development of SE
Level 1. Contextual factors: a) political and legislative, b) cultural and institutional; c) national and regional Level 2. Government support for research, funding, industry; personal support and support for organizations	- availability of the right personnel in the labor market; advanced technologies; access to capital; high-quality services of incubators and accelerators; corporations with open innovations; - culture of entrepreneurship; - promotion of business development; - well-established intellectual property mechanisms; - access to the markets on an international scale and connectedness.	1) the concept of state impact: the availability of specialized; 2) the concept of free development

The promotion of systemic changes by the public sector in the organization of a competitive ecosystem should take place by international practice, and either the state or, by agreement, a set of private structures should initiate the formation of the SE. Most of the world's ecosystems have developed both under the influence of the state (especially in the phase of emergence) and based on entrepreneurial initiatives. At the same time, the absolute majority of ecosystems (including Silicon Valley, the ecosystems of Beijing, Tel Aviv, Berlin, Stockholm, Moscow, etc.) began to form on the state initiative [17].

Government measures and initiatives should promote the emergence of a community of startup founders who will work closely with other actors in the private sector of the economy and the public sector. At the same time, the state should not assume the role of a leader, but only an initiator. In Ukraine, the government has developed some initiatives to support startups, but they do not perform their functions properly. To bring coherence, organization, and transparency to the SE of Ukraine, the state should identify target groups and direct the available tools and possible measures to stimulate their development.

6. Conclusions

A startup can be started, but it cannot be implemented without the necessary infrastructure and comprehensive support at all stages of development. In Ukraine, the innovation sector is stagnating, but the startup ecosystem in the private sector of the economy is gradually growing.

The directions of stimulating the development of the startup ecosystem should be on the state initiative, which provides for a set of measures for five components. As a result of their implementation, a well-formed and controlled network of commercial and non-commercial structures that form the ecosystem of startups in Ukraine will be formed. In turn, this will allow the state to cooperate in a coordinated and effective manner with these structures, which will contribute to raising the Domestic SE to a new level of development.

7. References

1. Schwab k. The Fourth industrial revolution: K. Shvab. - M.: Publishing House "E", 2017 – 208 p.
2. Mercan B, Gortas D. Components of Innovation Ecosystems: A Cross-Country Study // International Research Journal of Finance and Economics, Vol. 76, 2011.
3. Smorodinskaya N. V. Network innovation ecosystems and their role in the dynamization of economic growth // Innovation. - 2014. - No. 7. - pp. 27-33.

4. Launchpedia financial direction web portal / launch of lifecycle financing. [Electronic resource]. - Access mode: <https://fundingsage.com/startup-financing-tour-and-zhyt'yevogo-life-cycle-financing/seed-stages/>

5. Official web portal of the international research organization in the field of innovation Startup Genome. [Electronic resource]. - Access mode: <https://www.startupgenome.com/>

6. The official web portal of the international research organization in the field of startup innovation is flashing. [Electronic resource]. - Access mode: <https://www.startupblink.com/>

7. Web portal of the Dutch Research Institute and accelerator startup Delta. [Electronic resource]. - Access mode: <https://www.startupdelta.org/>

8. Pilipenko B. venture capital as a source of financing for innovation processes. / B. Pilipenko-Kiev, 2015. - 273 P.

9. Web portal of a media resource Hubs.ua by business direction / Accelerator vs business incubator. [Electronic resource]. - Access mode: <http://hubs.ua/starter/akselerator-vs-biznes-inkubator-21224.html>

10. Official web portal of the state program of support for the development of startups of the Republic of Ireland Enterprises Ireland / support for startups from the Enterprise Ireland. [Electronic resource]. - Access mode: <https://www.enterpriseireland.com/en/Start-a-Business-in-Ireland/Startups-from-Outside-Ireland/Funding-and-support-for-startups-in-Ireland/government-support-through-enterprises-Ireland.html>

11. Official web portal of the state statistics service of Ukraine. [Electronic resource]. - Access mode: <http://www.ukrstat.gov.ua/>

12. Zhavoronkova G. V. Tekhnologicheskaya bezopasnost Ukrainy I mirnoe Rynok tekhnologii [technological security of Ukraine and the world market of technologies]. – №4 (32). 2011 pp. 3-7.

13. Kvasova O. Razvitie Ven'churny bankovy investitsii V Ukrainy [development of venture banking investment in Ukraine]. – 2014. – №1 (66). - P.107

14. Web portal of the economic media resource Ekonomicheskaya Pravda Ukrainka Pravda / the first catalog of investors in Ukraine has been published [Electronic resource]. - Access mode: <https://www.epravda.com.ua/rus/news/2017/04/5/623518/>

15. Web portal of a media resource Ain.ua / Ukrainian startup incubators: what do they represent and what do they want in return? [Electronic resource]. - Access mode: <https://ain.ua/2013/01/29/ukrainskie-startap-inkubatory-cto-predostavlyayut-i-cto-xotyat-vzamen/>

16. Web portal of the American accelerator Found Institute/how to build your Local Startup Ecosystem. [Electronic resource]. - Access mode: <https://fi.co/insight/how-to-build-your-local-startup-ecosystem>

17. Official web portal of the European Union Innovation Support Program Horizon 2020. - Access mode: <https://ec.europa.eu/programmes/horizon2020/en>