Ecosystem factors contributing to innovation: A case of Latvian technological startup

Inese Ratanova
Faculty of Economics, Management and Finance
Baltic International Academy, LV1019
Lomonosova 4, Latvia
inese.r-bki@inbox.lv

Inesa Voroncuka
Faculty of Business, Management and Economics
University of Latvia, LV-1586,
Rainis Boulevard 19, Latvia
inesa.voroncuka@lu.lv

Abstract
An innovative environment boosts technological innovativeness through the implementation of new technologies. At the same time, an innovative environment draws from technological innovation knowledge, which stimulates its development. The most innovative economies exemplify the strong link between economy and science. The leading role of start-ups in EU economy is determined by a range of advantages originating from dynamic process of formation thereof, namely producing large number of new ideas, innovative projects diversification, creation of new jobs. Innovation takes place within an ecosystem of multiple factors. Any factor missing from the innovation ecosystem hinders new ideas from being generated or evolving into viable commercial products. At the same time, it should be noted that a key indicator of EU innovation leaders is the effective commercialization of their technological innovations. The purpose of this paper is to analyse a set of factors and conditions conducive to the successful development of innovative entrepreneurship environment and technology start-ups in Latvia. Results of researches show that the main drivers behind a successful innovation ecosystem are favourable administrative requirements, government supported developments, available financial resources, academic-industry collaborations, research and development, commercialization, market dynamics, entrepreneurial culture.

Keywords
Commercialization of technologies, innovation, innovation ecosystem, start-up.

1. Introduction
Latvian science, research and innovation policy (R&I) aims at launching new strategic path for the country towards the next level of ambition needed to tackle modern issue in finding Latvia’s “specialization” niche in global and European competitiveness (Eteris, 2018). Technology and knowledge, developed at universities and other research organizations, play essential role in the growth of the economy due to business activities of startups, entities, which commercialize technology and knowledge in the form of new products and services (Balkin, Gianiodis, Markman, 2005). A startup innovation ecosystem is defined as a set of regional or national structures in which start-ups, SMEs, large sized enterprises, universities, and public organizations interact on a technological, social, legal and commercial basis in order to produce knowledge, develop new technologies and new business opportunities. These interactions aim at developing and protecting new technologies, and financing and regulating new projects (Metcalfe, 2008). Investment and financial support in the knowledge-based sectors improving innovation capacity and innovation is now seen as a key approach to drive competitive advantage and improve performance of the economy of EU countries. According to the Global Startup ecosystem report 2018, the global start-up revolution continues to grow. Global venture capital investments in start-ups hit a decade high in 2017, with over $140 billion invested. Total value creation of the global start-up economy from 2015 to 2017 reached $2.3 trillion, a 25.6% increase from the 2014 to 2016 period. Underneath this continued growth, fundamental shifts are occurring. The shifts in the start-up map, both geographic and economic, according to the
Global Startup ecosystem report 2018 signal that we are heading into a new era of tech. In order for the European research and innovation sector to be successful in the coming years, the member states need funding. The EU is now considering funding and priorities for its next budget period for the EU’s research and innovation programme. Horizon Europe is the next Framework Programme for Research and Innovation that will run from 2021–2027 with a budget of 100 billion Euro allocated to three pillars: open science, global challenges and industrial competitiveness, and open innovation.

Innovation takes place within an ecosystem of multiple factors. Any factor missing from the innovation ecosystem hinders new ideas from being generated or evolving into viable commercial products. At the same time, it should be noted, that a key indicator of EU innovation leaders is the effective commercialization of their technological innovations. The purpose of this paper is to analyse a set of factors and conditions conducive to the successful development of innovative entrepreneurship environment and technology startups in Latvia. Task of the study is to define the factors and conditions of innovative entrepreneurship environment and the determinants that have significant impact on the developing of technology start-ups in Latvia. The methodological basis for the article is made up of the laws, regulations and guidelines of the Republic of Latvia, analysis of literature supplemented by national and international reports, scientific publications of foreign authors, Global Entrepreneurship Monitor (GEM) methodology, also research carried out by the authors using a survey of entrepreneurs. The authors surveyed technology commercialization startup entrepreneurs who were “born” on the platform of the “Commercialization Reactor”. The research questions that needs to be answered: what factors of the entrepreneurship innovation ecosystem are important and influence the development of the deep tech start-ups in Latvia? The study, conducted by the authors, has limitations due to the fact that a survey of 20 deep tech start-ups from one accelerator fund - Commercialization Reactor - was conducted. Furthermore, Commercialization Reactor works exclusively with science-based or deep tech startups. Commercialization Reactor is Latvia-based international technology commercialization platform that successfully solves the contradiction between entrepreneurship and science by effectively combining scientific excellence with entrepreneurial spirit. Currently there are more than 40 startups in the Commercialization Reactor based on open innovations, the technological inventions created by the scientists from different countries and scientific - research institutions. Opposed to IT or FinTech startups, deep tech start-ups can take longer - till commercialization of their results and, moreover, much more people and investments are needed for startup development. Two more acceleration funds, Overkill Ventures and Build IT, shall be studied to define how innovative entrepreneurs from these acceleration funds evaluate the factors of the startup ecosystem by their importance and influence on the development and growth of technology startups.

2. Theoretical Aspects of Innovation and Ecosystem

Joseph A. Schumpeter sees innovation as the introduction of new products or a new production method, the opening of a new market, accessing new sources of raw materials or, finally, the reorganization of economic processes (Schumpeter, 1934). However, P. F. Drucker determines innovation as a particular entrepreneurial tool by which a change is turned into an opportunity to commence new economic activity or provide a new service. He claims that innovation does not have to be technical, or even of a material nature (Drucker, 1992).

Innovation is considered a key factor for the success of firms in the marketplace (Hult, Hurley, Knight, 2004). While innovation has in the past been viewed largely as an internal function, there is now strong recognition of the importance of interactive processes among firms and with other public and private institutions (Wynarczyk, Piperopoulos, & McAdam, 2013). The innovation model that the firm uses to compete in the 21st century has evolved from being an individual process within a firm to an interactive process between firms and institutions, that is by being more reliant on collaborative idea generation and less protective of intellectual property at the domestic and foreign levels (Wynarczyk, Piperopoulos, McAdam, 2013), leading to innovation that is open to different individuals and firms. The innovation model is rapidly shifting from a manufacturer-centred to a collaborative user-centred (Von Hippel, 2006). The benefits of this shift are to gain knowledge and increase customer engagement that leads to innovation and closes the growth gaps (Selden & MacMillan, 2006). The nature of the market interaction and competition can influence the firm’s innovative capability, allowing the firm to adapt to its local market and its competition (Bao, Chen, Zhou, 2011; Martinez-Roman, Gamero, Tamayo, 2011). SMEs are crucial for a healthy dynamic market economy (Hillary, 2004). Firms of different sizes face market competition differently. Market concentration and innovation activity can either coevolve or be simultaneously determined (Salavou, Baltas, & Lioukas, 2004). The market environment, such as trading conditions and turbulence, can affect the firm’s innovative intensity and activity (Fernandez et al., 2010).

The idea of open innovation expands the scope of potential participants of the innovation process from internal actors of the R&D function to the numerous possible co-creators and co-innovators outside an organization. In this sense, ecosystem thinking comes close to what is called an open innovation. In open innovation, actors
purposively tap into the inflows and outflows of knowledge by opening up the innovation process, thus accelerating internal innovations and expanding markets for external use of it (Chesbrough, 2003).

Open innovation is a paradigm which assumes that firms can and should use external ideas as well as internal ones starting from the research stage of the innovation process and finishing with the commercialization of the product. Open innovation as a concept is most obviously associated with the work of Henry Chesbrough. He observes that valuable ideas can come from inside or out of the company and can go to the market from inside or outside the company as well. The “open innovation” places external ideas and external paths to market on the same level of importance as that reserved for internal ideas and paths in the Closed Innovation model (Table 1), (Chesbrough, 2001).

In today’s information-rich environment, companies can no longer afford to rely entirely on their own ideas to advance their business, nor can they restrict their innovations to a single path to market. As a result, the traditional model for innovation which has been largely internally focused, closed off from outside ideas and technologies has become obsolete. Emerging in its place is a new paradigm “open innovation”, which strategically leverages internal and external sources of ideas and takes them to market through multiple paths. It is necessary to constantly monitor the latest scientific achievements, invest in patents or licenses from competitors and make a company’s own unutilized solutions available, according to the concept “not all specialists work for us” (Chesbrough, 2003). The crucial element of open innovation is the previously mentioned commercialization of intellectual property rights. The main aim of patent protection is protection of the idea against its illegal application; however, Professor Chesbrough gives it an added role recognizing the subject of patent protection as a company asset. He does not perceive patents as a barrier but as a product of trade between entrepreneurs, particularly when they do not possess their own laboratories or scientific personnel (Chesbrough, 2003).

<table>
<thead>
<tr>
<th>Principles of closed innovation</th>
<th>Principles of open innovation</th>
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<tbody>
<tr>
<td>Employment of renowned specialists in their field</td>
<td>Establishment of cooperation including with specialists in a given field from outside the company</td>
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<td>In order for R&amp;D to be beneficial an innovative process has to be worked on from start to finish through own means</td>
<td>External ideas and solutions are utilized in a company, which, through research, contribute to added value</td>
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<td>In order to achieve success a product must be launched on the market before competitors</td>
<td>Launching a product on the market before competitors does not necessarily guarantee success. A business model is of far greater importance than leading the way</td>
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<tr>
<td>The aim is to introduce the highest number of best products</td>
<td>Both internal and external research and ideas are underlyng to success</td>
</tr>
<tr>
<td>To closely guard intellectual property from competitors’ access</td>
<td>Intellectual property rights are a company’s asset. Acquiring new external ideas and selling own unutilized ones</td>
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</table>

Innovation is a complex process, which indicates why there are so few innovation powerhouses in the world. It starts with the generation of ideas, some of which lead to inventions, and only a few of which are ever commercialized. Innovations enhance economic productivity only if they reach the desired markets and achieve commercial success. Innovation takes place within an ecosystem of multiple factors. Any factor missing from the innovation ecosystem can prevent new ideas from being generated or evolving into viable commercial products. The index is designed to capture this complexity and assess countries against it. Both the Innovation capability and Business dynamism pillars enable an assessment of each economy’s innovation ecosystem. Innovation capability is comprised of indicators on the ‘softer’ and less tangible aspects of idea generation, captured in the Interaction and diversity, as well as Research and development (to develop inventions) and Commercialization (the capacity to successfully bring innovation to the market).

Business dynamism is the private sector’s capacity to generate and adopt new technologies and new ways to organize work, through a culture that embraces change, risk, new business models, and administrative rules that allow firms to enter and exit the market easily. An agile and dynamic private sector increases productivity by taking business risks, testing new ideas and creating innovative products and services. In an environment characterized by frequent disruption and redefinition of businesses and sectors, successful economic systems are resilient to technological shocks and are able to constantly re-invent themselves. Innovation capability, the quantity and quality of formal research and development; the extent to which a country’s environment encourages collaboration, connectivity, creativity, diversity and confrontation across different visions and angles; and the capacity to turn ideas into new goods and services. Countries that can generate greater knowledge accumulation
and that offer better collaborative or interdisciplinary opportunities tend to have more capacity to generate innovative ideas and new business models, which are widely considered the engines of economic growth (Global Competitiveness Report 2018).

Innovations are generally discussed positively (Jalonen, 2012) and are seen as beneficial both for companies and for nations in order to survive and develop in a market environment, “create value”, and enhance competitiveness. “Ecosystem” is a term combining the words “eco” and “system”. The former has its origin in ecology and refers to the relation of living things to their environment. Innovation ecosystems can be defined as “the collaborative arrangements through which firms combine their individual offerings into a coherent (Adner, 2006), customer-facing solution”. The authors Mercan and Göktaş (Mercan & Göktaş, 2011) specify that an “innovation ecosystem consists of economic agents and economic relations as well as the non-economic parts such as technology, institutions, sociological interactions and the culture”, suggesting that an innovation ecosystem is a hybrid of different networks or systems. The collaborative arrangements, as highlighted above, might be based on local concentration of industrial specifications, but the ecosystem model has expanded the idea of local clustering, to encompass global, networked economy and various interdependent actors (Rubens, 2011).

A startup innovation ecosystem is defined as a set of regional or national structures in which start-ups, SMEs, large sized enterprises, universities, and public organizations interact on a technological, social, legal and commercial basis in order to produce knowledge, develop new technologies and new business opportunities. These interactions aim at developing and protecting new technologies, and financing and regulating new projects (Metcalfe, 2008). Table 2 describes the main components of the startup innovation ecosystem, besides members of the start-up team and corporations as partners.

Table 2. The components of a startup innovation ecosystem

<table>
<thead>
<tr>
<th>Start-up innovation ecosystem</th>
<th>Support Organizations</th>
<th>Funding Organizations</th>
<th>Government Institutions</th>
<th>Education Institutions</th>
<th>Research Institutions</th>
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<tbody>
<tr>
<td>Support Organizations</td>
<td>Accelerators and incubators have grown in popularity over the last decade. Among all the different support services they offer, mentorship has proven to be key. Mentorship has also shown its value in helping entrepreneurs to have a smooth transition into their ventures as full-time jobs.</td>
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<tr>
<td>Funding Organizations</td>
<td>Banks and Alternative Finance – these financial institutions provide support to the development of start-ups and secure their investment needs.</td>
<td>Start-up incubators and accelerators – they link technology, capital and know-how to accelerate the development of new companies and speed up exploitation of technology. Accelerators are also an important vehicle to raise investment and lead to potential exits and sales.</td>
<td>Clusters of Innovations – the important role of the cluster is to provide incentives for the entry of new companies or start-ups.</td>
<td>Angel investors – they are high net-worth, non-institutional, private equity investors who spend part of their assets in high risk, high-return entrepreneurial ventures in exchange for shares, income and capital gain.</td>
<td>Venture capital funds – venture capital (VC) is an equity investment aimed at supporting the pre-launch, launch and early-stage development phases of a company. The majority of venture capital firms intervene at a later stage of a start-up lifecycle.</td>
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<td>Government Institutions</td>
<td>Private industry is usually unwilling to take on the high levels of risk and uncertainty that characterize start-ups, therefore governments and public organizations are of key importance, in particular in ecosystems that are less developed. Government policies provide incentives that stimulate the development and sustainability of innovation environments and are aimed to yield long-term benefits.</td>
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<tr>
<td>Education Institutions</td>
<td>Universities can offer technical and business support and validation to start-ups, provide them with equipment and the associated technical expertise that is not easily available, or is available at extremely high costs in the industry, and also operate as proof-of-concept labs. In this specific context, one of the key issues for universities and their technology transfer offices (TTOs) is how to sponsor such proof of concepts, thus some of them are developing special funding and infrastructures for such activities.</td>
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<tr>
<td>Research Institutions</td>
<td>Research organizations have a huge impact on start-ups, especially in the early stages of development. One of their key roles is to connect entrepreneurs with subject matter experts.</td>
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The programmes of support, investment in research, development, innovation and skills constitutes a key policy area for the EU, as it is essential to economic growth and to the development of a knowledge-based economy. Science is part of almost every aspect of our lives. Europe has a long tradition of excellence in research and innovation, having been the birthplace of the industrial revolution.

3. EU Support Context for Development of Research and Innovation Sector

In the context of economic globalization, technology is a key factor in enhancing growth and competitiveness in business. High-tech industries are expanding most strongly in international trade and their dynamism helps to improve performance in other sectors. Research, development, science and technology have been acknowledged throughout the years since 2000 as factors of growing competitiveness, better and well-paid jobs, greater social cohesion and a smart, sustainable and inclusive economy.

The Europe 2020 Strategy sets out a vision of Europe’s social market economy for the 21st century with the 3% R&D intensity goal as one of the five headline targets to be achieved by the EU by 2020. On 17 July 2012, the Commission adopted its Communication on ‘A Reinforced European Research Area (ERA) Partnership for Excellence and Growth’. The ERA is a unified research area open to the world and based on the internal market, in which researchers, scientific knowledge and technology circulate freely. EU Member States, the Commission and research organizations need to implement the measures in the Communication to ensure completion of the ERA by 2014 as called for by the European Council (Science, technology and innovation in Europe Pocketbooks, 2013). European Innovation Partnerships (EIPs) also form part of the innovation union and are designed to act as a framework to address major societal challenges, bringing together activities and policies from basic research through to market-oriented solutions.

Innovation is considered to be one of the organization’s main business processes (Kaplan and Atkinson, 1998), and innovation management is now considered a structured process rather than a hope-based strategy (Janssen et al., 2011). Launched in 2010, the Europe 2020 strategy sets out a vision of Europe’s social market economy for the 21st century underpinned by three mutually reinforcing priorities:

- Smart growth: developing an economy based on knowledge and innovation;
- Sustainable growth: promoting a more resource-efficient, greener and more competitive economy;
- Inclusive growth: fostering a high-employment economy, delivering social and geographical cohesion.

The European Commission is further boosting the Europe 2020 strategy with seven flagship initiatives. One of these is the ‘Innovation Union’, supporting ‘smart growth’. The Innovation Union initiative aims to improve the framework for research and innovation in the EU.

The main directions for improving the innovation system in Latvia are focused on:

- Developing the scientific activity potential;
- Establishing a long-term platform for cooperation between enterprises and scientists;
- Supporting the development of innovative enterprises.

In order for the European research and innovation sector to be successful in the coming years, the member states need funding. The EU is now considering funding and priorities for its next budget period, including new financial programming or FP9, the successor to Horizon 2020, which is presently the EU’s research and innovation programme up to 2019 (Eteris E., 2018). Horizon Europe is the next Framework Programme for Research and Innovation that will run from 2021–2027 with a budget of 100 billion Euro allocated to 3 pillars (Table 3):

- Open Science;
- Global Challenges and Industrial Competitiveness;
- Open Innovation.

The disparate funding mechanisms for innovation-focused projects has now been brought together under the European Innovation Council. There will be two new key funding instruments:

- Pathfinder for Advanced Research to support scientific and technological research, proof of concept and prototypes for technology validation. It will also support transition activities to help innovators develop pathways to commercial development.
- EIC Accelerator to provide support for innovation and market deployment actions in the form of direct blended finance (grants, guarantees covering other types of financing provided by financial intermediaries, etc.)

The Horizon Europe finance support and funding open additional opportunity for commercialization of technologies and development of open innovations by start-up teams. Opportunity drives the majority of entrepreneurs in every economy, and many entrepreneurs strive to improve their lives through better income or greater independence in their work. GEM also demonstrates the impact entrepreneurs have across the world by introducing innovations into their societies, creating jobs, competing globally, and contributing to the emergence of innovation-driven growth.
and growth of industries. The level of motivation of entrepreneurs plays a significant role in increasing the number of SMEs and startups. For example, there is a distinct difference between the Europe and North America region in terms of necessity motives. In fact, necessity is nearly absent in the Netherlands and Switzerland, while ‘improvement-driven opportunity’ accounts for over two-thirds of the drivers of start-up activity in these countries (GEM, 2018).

The proportion of Total early-stage Entrepreneurial Activity (TEA) with Improvement-Driven Opportunity (IDO) motives accounts for an average of 37% of entrepreneurs in low-income economies, increasing to 42% in middle-income economies, and 51% in high-income economies. High rates in Canada and the United States are also due to IDO motives (GEM, 2018). Yet in many of the remaining countries, a lack of either motive can explain low rates. GEM National Experts’ Survey (NES) provides insights from experts in each economy on nine Entrepreneurial Framework Conditions (EFCs), i.e. factors that influence the overall climate for entrepreneurship and hence the level and nature of entrepreneurial activity.

Table 3. Horizon Europe 2021–2027: structure for research and innovation

<table>
<thead>
<tr>
<th>Open science</th>
<th>Global challenges and industrial competitiveness</th>
<th>Open innovation</th>
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<tr>
<td>€25.8 billion</td>
<td>€52.7 billion</td>
<td>€13.5 billion</td>
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<tr>
<td>Supports frontier research projects defined and driven by researchers themselves through the European Research Council (€16.6 billion).</td>
<td>Supports research relating to societal challenges, reinforces technological and industrial capacities.</td>
<td>Aims to make Europe a frontrunner in market-creating innovation via the European Innovation Council (€10 billion).</td>
</tr>
<tr>
<td>Funds fellowships and exchanges for researchers through Marie Skłodowska-Curie Actions (€6.8 billion).</td>
<td>Includes activities pursued by the Joint Research Centre (€2.2 billion) which supports EU and national policymakers with independent scientific evidence and technical support.</td>
<td>Developing of the overall European innovation landscape, including by further strengthening the European Institute of Innovation and Technology (EIT) to foster the integration of business, research, higher education and entrepreneurship (€3 billion.</td>
</tr>
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<td>Invests in world-class research infrastructures.</td>
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</table>

Each economy has its own specific entrepreneurship profile in terms of activity rates across various phases of the entrepreneurship process, characteristics of entrepreneurs and their businesses, and the attitudes and perceptions people hold toward this activity. The entrepreneurship environment in which entrepreneurs operate has its own profile, containing strengths entrepreneurs can leverage and constraints they must overcome in order to start their business. Change is an inherent feature of the economy, economics and management sciences. Traditional methods of market activities, based on a disciplined approach to planning and forecasting, and based on complex rules and forecasts, have lost their battle against the market and the chaos that currently prevails (Eisenhardt, Sull, 2001). A few decades ago, Ansoff came up with the concept of a turbulent (highly volatile and complex) environment. On the one hand he pointed out the multifaceted nature of the disturbances occurring in the business environment, on the other, the need to include such changes in strategy building (Ansoff, 1984). As already mentioned by the authors, any factor missing from the innovation ecosystem hinders new ideas from being generated or evolving into viable commercial products. At the same time, it should be noted, that a key indicator of EU innovation leaders is the effective commercialization of their technological innovations. The set of factors are creating the innovation ecosystem of the entrepreneurship. The interaction of these factors create own profile of the business ecosystem, taking into account the specific features of each country.

4. The ecosystem factors important for the development of technological startups in Latvia

The development of new businesses is an important link in the innovation system and contributes to a paradigm shift to a modern and innovative economy. For the past 3 years, the Ministry of Economics of Latvia and its subordinate institutions have been actively working on the creation of a single offer for a new ecosystem for startups. The ecosystem of Latvian start-ups has become more recognizable also in the international context. The key actors and stakeholders of a start-up ecosystem include policy makers, investors, academic institutions and business partners who are able to provide the necessary capacity and expansion opportunities (Edquist, 2006). In 2018, 3 acceleration funds were also launched (Overkill Ventures, Build IT, and Commercialization Reactor),...
where each fund has been allocated ERDF funding of 5 million EUR out of a total of EUR 15 million. To increase the potential of Latvian scientists and companies during the next European programme period, connect to innovation platforms and attract public investment, proactive action is needed to identify strategic competitiveness factors and strengthen the triple helix model.

As of January 2019, there were 418 start-up companies registered in Latvia, according to the Ministry of Economics of Latvia. Over 350 of those companies are under five years old, and over 65 start-ups are younger than seven years. Approximately 100 new business ideas are still in the development stage. Figure 1 shows Latvian start-up field by the areas in percentage of the total number of start-ups. Over the last five years, the number of startups has increased from an average of 10–15 new businesses a year before 2010 to an average of 50 new start-ups each year between 2014 and 2018. The start-up ecosystem in Latvia is developing and its economic benefits are growing, both in terms of the number of new businesses and jobs created as well as the amount of investment. Latvia’s emerging startup ecosystem has three strongest areas – fintech, deeptech and drone technology.

![Latvian startup field by the areas in % of the total number of startups](image)

Latvian startup-field includes digital technologies – 32%; energy, water, mobility, agricultural tech, manufacturing - 8%; artificial intelligence, big data and analytics – 9%; smart technologies and robotics - 9%; fintech – 7%; health and science – 6%; adtech – 5%; chemistry -4%.  

The purpose of the survey was to obtain information from CEOs of deep tech startup regarding which factors of business environment are important for technology startups, and which are less significant. The survey was conducted by the authors in January 2019. The data was obtained as a result of a survey of innovation entrepreneurs, representatives of Latvian technology start-ups who are engaged in technology commercialization projects and were created on the Commercialization Reactor platform. The technologies are to different fields of science, such as IT, Artificial Intelligence, Biotechnology, Industry & Engineering, Agriculture, Medical. The survey results demonstrate the importance of all factors of the business environment ecosystem, but, nevertheless, according to entrepreneurs, public policy and financing of entrepreneurship are the most important. It is important to remember that entrepreneurs are essentially at the centre of any start-up ecosystem. The survey was attended by the CEOs of 20 high-tech startups, which is about 50% of the 40 startups working on the Commercialization Reactor platform. Among 418 Latvian startups, there are about 70-80 (17-20%) of deep technological startups, which indicates the representativeness of the sample. Figure 2 shows the correlation among the startup ecosystem factors and in the Table 4 we can see the correlation coefficients which are calculated by the formula (1) using the software SPSS. The Pearson correlation coefficient $r$ is a measure of linear correlation between two variables X and Y.

$$r = \frac{n \sum xy - (\sum x)(\sum y)}{\sqrt{n \sum x^2 - (\sum x)^2}[n \sum y^2 - (\sum y)^2]}$$  

(1)

Figure 2 shows the correlation among the startup ecosystem factors based on the calculated coefficients of correlation (Table 4). Correlation analysis shows the relationship among variables (columns). The correlation is positive, it has a value between +0.9 and 1.
Based on the statistical analysis authors defined most important factors of the entrepreneurship innovation ecosystem that influence the development of the deep tech startups in Latvia. The survey of the CEOs of 20 high-tech startups defined factors such as entrepreneurial finance, government policies support and relevance; R&D transfer; cultural and social norms as more important for deep tech startups.

It is important to remember that entrepreneurs are essentially at the centre of any start-up ecosystem. When their companies succeed, investors get paid, economies grow, jobs are created, and communities evolve socially. Therefore, ecosystems are created where various players seek to collaborate with entrepreneurs and make them successful. In addition, entrepreneurs were asked to choose one factor, which is the most important for operating activities of a start-up CEO, after money. Among the factors in the questionnaire were the following:

- Mentoring;
- Marketing support;
- Co-working space;
- Investor meetings;
- Legal consulting;
- Access to new tech;

Table 4. The coefficients of correlation calculated by the authors using the SPSS software

<table>
<thead>
<tr>
<th>Factors</th>
<th>Entrepreneurial finance</th>
<th>Government policies support and relevance</th>
<th>Government entrepreneurship programs</th>
<th>R&amp;D transfer</th>
<th>Commercial and professional infrastructure</th>
<th>Physical Infrastructure</th>
<th>Internal market dynamics</th>
<th>Internal market burdens or entry regulation</th>
<th>Entrepreneurship education</th>
<th>Cultural and social norms</th>
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<tbody>
<tr>
<td>Entrepreneurial finance</td>
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<td>Government policies support</td>
<td>0.999345791</td>
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<td>Government entrepreneurship</td>
<td>0.997721923</td>
<td>0.9988726</td>
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<td>Programs</td>
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<td>R&amp;D transfer</td>
<td>0.994816263</td>
<td>0.9954167</td>
<td>0.997351</td>
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<td>Infrastructure</td>
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<tr>
<td>Commercial and professional</td>
<td>0.996768639</td>
<td>0.9970658</td>
<td>0.998088</td>
<td>0.9962632</td>
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<td>infrastructure</td>
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Fig. 2. The correlation among the startup ecosystem factors, calculated by the authors using the SPSS software
Only four factors out of seven are represented in figure 3. The most important factor, according to the CEOs, is mentoring. 56% of respondents indicated that this factor has a significant impact on future business success.

![Fig. 3. Single most important factor for start-up, after money](image)

It is necessary to continue a detailed and structured study of each of the factors indicated in the figure and to identify the weaknesses of the existing business environment, significant and specific components of the model, which could be deemed essential/key to Latvian startups ecosystem. Further research is also needed because technology start-ups, and all start-ups in general, are by themselves a factor of the business ecosystem. They have an impact on the innovative development of industrial sectors, businesses, and also launch processes at the level of government and education that contribute to building an economy based on knowledge. It is important to understand how the factors of entrepreneurship environment, which form the ecosystem of business environment, affect the quality of process at each stage of transfer and commercialization of technology. Moreover, a society needs entrepreneurs, who are growth-oriented, innovative, globally competitive, and or working in added-value industries. It is not enough to evaluate the effect of the external context solely on the performance of the startup. The relationship between the environment and entrepreneurship is complex, and this will provide further opportunities for research. When their companies succeed, investors get paid, economies grow, jobs are created, and communities evolve socially. Therefore, ecosystems are created where various players seek to collaborate with entrepreneurs and make them successful.

**Conclusions**

Based on the statistical analysis authors defined most important factors of the entrepreneurship innovation ecosystem that influence the development of the deep tech startups in Latvia. The survey of the CEOs of 20 high-tech startups defined factors such as entrepreneurial finance, government policies support and relevance; R&D transfer; cultural and social norms as more important for deep tech startups.

It is clear that most innovative economies exemplify the strong link between economy and science. A key indicator of EU innovation leaders is also the effective commercialization of their technology innovations. It is important to understand how the environment influences the quality of entrepreneurship. Ideally, the mix of entrepreneurs in a society should include individuals who are growth-oriented, innovative, globally competitive, and/or operating in advanced sectors.

The relationship between the environment and entrepreneurship is complex, and one that will yield promising research opportunities for years to come.

The impact of an innovation startup ecosystem is manifold. A strong innovation ecosystem allows local economies to retain top talent in their countries. International Corporations call a successful startup ecosystem a good investment. This leads to the creation of more jobs and services and boosts local economy.

**References**


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Biographies

Inese Ratanova is a PhD student of the Doctoral Programme on Management Science, sub-sector Business Management at the University of Latvia, senior lecturer at Baltic International academy. She earned bachelor professional degree in the management of entrepreneurship from the Baltic International academy, a Master degree in economics from University of Latvia. She has experience in project coordination and management. She is a team member of the FX Group startup based on the invention of Riga Technical University scientists. FX Group was born in the Reactor of Commercialization platform after Deep Tech Atelier 2018, organized by Latvian Investment and Development agency. She has Controller Diploma from joint programme of Controller Academy Group was born in the Reactor of Commercialization platform after Deep Tech Atelier 2018, organized by Latvian Investment and Development agency. She has Controller Diploma from joint programme of Controller Academy (Germany)&German Business School (Russia) and practical experience in general management and finance. The main topics of scientific researches and publications in EBSCO are in the field of project management, SMEs, controlling. Her main scientific and research interest focuses on studies in the field of innovative and sustainable development of entrepreneurship and SMEs, entrepreneurship environment ecosystem, commercialization of technologies, open innovation and start up, business management using the concept of Controlling.

Inesa Voroncuka is a Professor, Doctor of Economics Science and Director of the Doctoral Programme on Management Science, Head of the Department of Public Administration, Demography and Socio-Economic Statistics of the Faculty of Business, Management and Economics. She earned Master in Economics, University of Latvia, Post graduate studies in economics at the University of Latvia, candidate of economic science (Dr.oec.) from Moscow Statistical Institute, Russia, theme of doctor’s dissertation: Economic efficiency of information management system and Ph. D and Doctor of Economics Science from University of Latvia. The main topics of scientific researches and publications in Scopus, Web of Science, EBSCO are in the field of knowledge management in organisations and their influence on entrepreneurship, Public administration, Human Resource Management, Job Analysis and Performance Evaluation. She is member of Professional organizations such as American Society for Public Administration (ASPA, Washington, DC,20005-3885, USA); programme-manager
in Project Management Training Centre, Riga, Latvia; membership in NISPAce, Bratislava, Cheh Republic; membership in Volunteer organisation, Culver City Senior Centre 4153 Overland venue Culver City, CA,90230, USA.