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## **THE ROLE OF UNIVERSITIES IN FORMING THE INNOVATION ECOSYSTEM**

**Abstract:** The paper deals with the issue of innovation ecosystem. The aim of this paper is to highlight the role of universities in forming the innovation ecosystems at the current stage. For the purposes of this paper, the analysis of approaches to the definition of the concept of "innovation ecosystem" is presented. The characteristics of innovation ecosystem are described. The factors, which facilitate the innovation ecosystems are grouped by the following dimensions: resources, governance, strategy and leadership, organizational culture, human resources management, people, partners, technology and clustering. The main features of both types of ecosystem (industry-driven ecosystem and university-driven ecosystem) at different levels are analyzed. The peculiarities of the main interactions between industry-driven ecosystem and university-driven ecosystem are noted.

**Keywords:** University, Cluster, Ecosystem, Innovation Ecosystem, Industry-driven Ecosystem, University-driven Ecosystem

According to the current conditions the forming and development of the innovative economy is gaining a new impetus in the development of the state and the social and economic life of the society in general. It is necessary to develop the effective mechanisms for the interaction between each subjects of the market economy. It is obvious that a selective totality of industries and sectors of the economy is needed for the integrative cooperation in the composition of associations for the obtaining a cumulative economic effect.

Economic integrative associations are aimed to the achieving the set goals in order to obtain the additional benefits and benefits for each participant. The economic effect is achieved through the joint used of the integration potential of participants and their competitive advantages. In recent decades, the cluster policy acquires more popular, contributing to the competitiveness of regions and the country as a whole. This model is gaining momentum on the growth in the number and quality of clusters in many countries around the world [22].

The implementation of the cluster approach has many advantages, some of them are: attracting of foreign direct investment, changing of the structure of regions, solving of the problem of employment, cooperation in the scientific and technical sphere, training and upgrading of personnel staff, production cooperation, etc. Moreover, as the results of research (the strength of correlation) are showed, that as such instrument as clusterization is one of the more effective ways of increasing of country's' competitiveness, first of all, for the developing countries. Because the spreading of cluster development can be significantly encourage innovative activities and productivity of enterprises, as a result the increasing of added value. In this way, state of cluster development can be one of the effective sources of competitiveness for the transition and developing economies to increase an economic wealth in general, specially in the era of the 4th Industrial Revolution, where innovations become the unique instrument for their realization [10].

But we should note that in recent years, the aspect of the innovation ecosystems and their impact on the competitiveness of the economies of the world have become more actual and important.

And in this direction, through the analyzing the research papers, we should admit, that the clusters are a well defined part of the ecosystem for innovation and for sustainable, inclusive growth [7].

Taking account to the foreign experience we can see that the role of the state in the forming such innovative clusters, at the first stage, and innovation ecosystems later has significantly increased in the last decade. The directions and forms of state support differ in their diversity (education, financial support for specific projects, networking with universities, investment in infrastructure region etc).

Of course, in forming of the market model of an innovative economy requires an increasing of the role of universities in the process of updating production by commercializing the results of intellectual activity, the creation of small enterprises, and the attraction of orders for enterprises on research and consulting activities. Such an interest and importance of universities can be explained as follows: by governments of countries as one of the element of mechanism of regulation of clusterization's process, because if the state will implement an effective policy for improving the competitiveness of higher education, in result - will increase Universities' Ranking, that as a whole will lead to activation of cluster development (1 point of University Ranking to 0,34 point of Cluster Development) [11].

Considering that the previous researches were focused to the analyzing the role of universities on the level of clusterization of the country's economy, the aim of this paper is to highlight the role of universities in forming the innovation ecosystems at the current stage.

First of all, we consider it is necessary to define the essence of the concept of "innovation ecosystem".

Analyzing the existing approaches to the interpretation, one can state that the concept "ecosystem" in the economic context is used recently, but now it is a well-established concept is used by the subjects of the innovation market.

Innovation ecosystems have been described in multiple ways. According to Adner [1], innovation ecosystems can be defined as “the collaborative arrangements through which firms combine their individual offerings into acoherent, customer-facing solution”.

Mercan & Gökteş 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” [12], suggesting that an innovation ecosystem is a hybrid of different networks or systems.

It should be noted that the innovation ecosystem is distinguished by its versatility and integration among the established types of innovation systems, which are based on specific networks.

Table 1. Approaches to the definition of the concept of "innovation ecosystem"

№	Definition	Authors
1.	Innovation ecosystem is the term, which is used to describe the large number and diverse nature of participants and resources that are necessary for innovation. These include “entrepreneurs, investors, researchers, university faculty, venture capitalists as well as business development and other technical service providers such as accountants, designers, contract manufacturers and providers of skills training and professional development”	DJ. Jackson [8]
2.	innovation ecosystems—the collaborative arrangements through which firms combine their individual offerings into a coherent, customer-facing solution. Enabled by information technologies that have drastically reduced the costs of coordination, innovation ecosystems have become a core element in the growth strategies of firms in a wide range of industries.	R. Adner [1]
3.	An innovation ecosystem is a network of relationships through which information and talent flow through systems of sustained value cocreation The systems approach has been used to describe the multifaceted nature of innovation at various levels - national, regional, technological, and sectors – and to describe the processes by which research capabilities build knowledge, then transfer the knowledge to support business development in the context of the Triple Helix of business, government and academic interaction. The systems approach recognizes the interaction among the many actors and other “determinants of innovation processes . . . that influence the development and diffusion of innovations”. The ecosystem metaphor enriches the systems model with value and culture.	M. Russell [15]
4.	Innovative ecosystem is a dynamic set of organizations and institutions, a mobile community their multidimensional internalities. The innovation ecosystem approach focuses on the constantly evolving relationships between a wide spectrum of innovation partners and draws attention to how their interactions affect knowledge creation, the rate of knowledge diffusion, knowledge transformation to innovation and the expansion of that innovation. Innovation ecosystems consist of countless individuals, communities, organizations, material resources, rules and policies across large and small businesses, universities, colleges, government, research institutes and labs, and financial markets within a given region which collectively work towards enabling knowledge flows, supporting technology development, and bringing innovation to market.	A. Bramwell [3]

Consequently, the innovation ecosystem is a synergy of the state, entrepreneurial and research environment with using the organizational, normative, educational, methodological and financial resources, and the implementation of the mechanism for transferring knowledge in order to the transform into the innovative products.

The notion of “ecosystems” offers an attractive metaphor to explore a variety of interactions and inter-linkages between multiple organizations in innovation [2]. The metaphor emphasizes that the relationships are constantly co-evolving through actions and interactions of involved actors [14].

Moreover, an innovation ecosystem is the place where the relationships formed between the actors or entities are reflected, and whose functional purpose is to allow technological development and innovation, integrating the above two types of ecosystems: exploration (knowledge) and exploitation (business). Thus, innovation policymakers, local intermediators, innovation brokers, and funding organizations (such as venture capitalists or public funding agencies) are salient actors in innovation ecosystems [21].

Table 2 shows some characteristics of innovation ecosystem, such as: their outcomes, interactions, actor roles, and logic of action.

Table 2. Characteristics of innovation ecosystem

Peculiarities	Definition
Baseline of Ecosystem	Co-creation of innovation
Relationships and Connectivity	Geographically clustered actors, different levels of collaboration and openness
Actors and Roles	Innovation policymakers, local intermediators, innovation brokers, and funding organizations
Logic of Action	Geographically proximate actors interacting around hubs facilitate by intermediating actors

Source: based on [21]

So, innovation ecosystems occur as an integrating mechanism between the exploration of new knowledge and its exploitation for value co-creation in business ecosystems. Thus, innovation policymakers, local intermediators, innovation brokers, and funding organizations (such as venture capitalists or public funding agencies) are salient actors in innovation ecosystems.

The success factors for implementing an innovation ecosystem are in the areas of resources, governance, strategy and leadership, organizational culture, human resources management, employees, partners, technology and grouping in clusters or networks. Table 3 indicates the factors seemingly facilitating innovation ecosystems as reported in the papers reviewed. The factors can be grouped based on the following dimensions: resources, governance, strategy and leadership, organizational culture, human resources management, people, partners, technology and clustering.

Table 3. Overview of success factors facilitating innovation ecosystems

Factors supporting innovation ecosystems	Studies
<b>Resources</b>	
Resource management	Watanabe & Fukuda (2006)
Resource allocation	Adner (2006)
Resource availability	Tassey (2010)
Availability of different funding possibilities (private and public)	Tassey (2010); Samila & Sorenson (2010)
<b>Governance</b>	
Continuous investments in infrastructure	Iyer & Davenport (2006); Tassey (2010)
Architectural control	Iyer & Davenport (2006)
Rigorous decision making facilitated by data	Iyer & Davenport (2006)
Timing referring to all partners involved	Adner (2006); Watanabe & Fukuda (2006)
Systematic risk assessment	Adner (2006)
Democracy	Carayannis & Campbell (2009)
Own organizational structure	Rohrbeck et al. (2009)
Use of internet platforms to support and foster interaction between partners	Rohrbeck et al. (2009)
Flexible system that allows integration and expansion	Rohrbeck et al. (2009)
Clear role assignment	Tassey (2010)
<b>Strategy and Leadership</b>	
Patience	Iyer & Davenport (2006)

Clarity of purpose and attention to detail	Iyer & Davenport (2006)
Distant and distanced view on innovation	Mezzourh & Nakara (2012)
<b>Organizational culture</b>	
Open to failure and chaos	Iyer & Davenport (2006)
Innovation culture	Mercan & Göktas (2011)
<b>Human resources management</b>	
Innovation as integral part of job descriptions	Iyer & Davenport (2006)
<b>People</b>	
Involving post-doctoral researchers to get access to worldwide R&D community	Rohrbeck et al. (2009)
<b>Technology</b>	
Technology	Carayannis & Campbell (2009)
<b>Partners</b>	
Pluralism of a diversity of agents, actors and organizations	Carayannis & Campbell (2009)
Use of a variety of partners	Rohrbeck et al. (2009)
University - industry collaboration	Mercan & Göktas (2011)
<b>Clustering</b>	
Foster interactions	Mercan & Göktas (2011)

The table 3 indicates that especially the governance dimension plays a central role in innovation ecosystems which is easily comprehensible given the different actors and thus communication challenges that need to be coped with in such a system. Thereby the factor addresses areas such as control, structural and technological aspects, data management, data analysis and data processing. Moreover, issues related to flexibility as well as the form of governance are highlighted.

Additionally, strategy and leadership, organizational culture and partners are viewed as critical aspects that need to be carefully handled to increase the success of innovation ecosystems.

In the Ecosystem a triple flow (exchange) to occur:

1. Goods and services, including transactions relating to contracts and invoices, receipt of orders, requests for proposals, confirmations or receipts and payments.
2. Knowledge, exchange of strategic information planning, process knowledge, expertise, collaborative design, policy development, etc.
3. Intangible Benefits, exchanges of value and benefits that go beyond the actual service and are not counted by traditional financial measures such as community spirit, loyalty, image enhancement, etc.

So, an innovation ecosystem is a hybrid of different networks or partnerships linked with agreements and based on industrial local concentration [16] and global, networked with interdependent actors [17], system in which the idea of open innovation broadens the scope of potential participants in the innovation process of internal actors function I + D + many possible co-creators anywhere in the network.

In this sense, and from the point of view of knowledge management, the ecosystem fosters community building intended for professional development and innovation in which the actors deliberately exploit the inputs and outputs of internal knowledge by opening the innovation process, thus accelerating innovations and expanding markets for external use of the same [6].

The focus of (economic) national innovation system can also be viewed as a Quintuple Helix [5] in which five actors converge:

- Academy/ Science & Arts/Research
- Companies/Industry/Economy & Creative Industries
- Environment and interaction between society and nature/Social Ecology
- Media/Culture/Society
- Government/Policies

The innovation ecosystem includes and interrelates two different economies, but largely separate, the knowledge economy, which is driven by fundamental research (university-driven) and the commercial economy that is market-driven (industry-driven).

Then, we are analyzing the main features of both types of ecosystem (industry-driven ecosystem and university-driven ecosystem) at different levels (table 4).

Table 4. Main features of both types of ecosystem (industry-driven ecosystem and university-driven ecosystem) at different levels

Main feature	Eco-system level	Industry-driven ecosystem	University-driven ecosystem
Type of innovation	Macro-level	Technology innovation	Open innovation

supported			
Economic impact on the territory	Macro-level	Global or regional	Regional (State-based)
Drivers of public support	Macro-level	Regional or national authorities	Channelled through the university funds
Geographical focus	Macro-level	Industrial interest with public-private agreements	Pre-existing university Campus
Internationalisation	Macro-level	Networking in several geographical areas	Weak alliances
Leadership	Meso-level	Industrial excellence driven by a multinational high-tech industry (or group of related industries)	Academic excellence driven by a technologically-based research university campus
Main actors	Meso-level	SMES, start-ups, research centres, universities, venture capital	Spin-offs, (joint) research centres, high-tech industries, business angels
Sectorial or thematic focus	Meso-level	Linked to the main sector of the lead industry	Multi-sector by emphasising inter-disciplinary work
Type of activities and instruments	Meso-level	Project-based	Project-based and educational programmes
IPRs	Meso-level	Patent cross-licensing agreements controlled by larger companies	Open licenses (based on non exclusivity) Diffusion of academic publications
Cultural bias for evolution	Meso-level	Mergers and acquisitions	Entrepreneurship
Attractiveness for location of actors	Meso-level	Access to contracts and venture capital funds	Access to ideas and seed capital funds
Governance schemes	Meso-level	Based on bilateral or multilateral contracts	Advisory Boards
Recruitment of key personnel	Micro-level	Doctorate, technicians	Engineers, technicians
Research projects	Micro-level	Company decision	Research groups decision
Technology transfer offices	Micro-level	Large departments in companies	University offices Specialised companies

Source: [9]

Comparing the figure 1a with figure 1b we can note, that figure 1a gives a schematic view of the concept in the case of an industrial-driven ecosystem. Bubble colours represent different types of actor (universities, start-ups, research centres, etc.); some of them can appear and disappear over time due to the dynamic character of the membership. In fact, the stability of the ecosystem is very important and this is the reason for thinking about “partnerships” and not only about “relationships” which could be shorter.

Figure 1a also represents three proximity circles to the core activity of the industry. Even if partnership occurs in all of them, entities in the outer circles have more freedom to contribute to future innovations because they are less linked to product development. For this reason, it is more frequent that open innovation initiatives occur with entities located in the external circle.

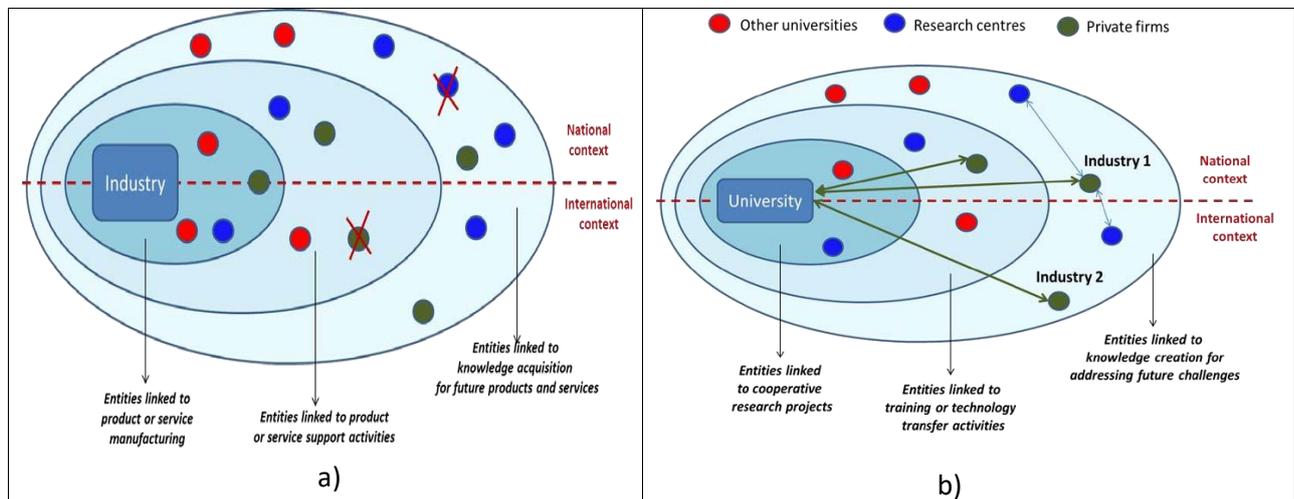


Figure 1. Main interactions between industry-driven ecosystem and university-driven ecosystem [9]

Figure 1b shows the specific partnerships with different industries located at different levels of proximity (both at the national and international contexts). The rationale is to distinguish between university-industry partnerships to commercialize or to integrate research results obtained by the university (playing the role of brokers) and university-industry partnerships where the main goal is to contribute to knowledge creation in some areas jointly proposed for addressing future challenges. Both types of partnership complement each other.

Unfortunately, only a few set of universities have created rich ecosystems around them. Only two elements become decisive to ensure the stability of these university-driven ecosystems: 1) the existence of a strong internal institutional positioning towards supporting innovation and 2) it is also necessary to establish rich interactions with the external environment [9].

Thus, in current conditions of development of knowledge-based economy, the universities are seeking ways to play a more proactive role in the transfer of knowledge from university to industry and to create the opportunities for direct collaboration in innovation activities with diverse stakeholders.

In such way, the concept of an "innovation ecosystem" helps for the universities to play a driving role in creating such opportunities and realizing the broader outcomes, which are not possible under traditional models of university-industry interactions. The origins of the innovation ecosystem indicate how universities can play a driving role in future collaborations toward outcomes of the common interest of these activities.

As for considering the prospects of forming the innovation ecosystems in "transition economies", we should note about the existing problems which hinder their development, in particular, first of all, the lack of proper state regulation and evaluation of the innovation environment. However, undoubtedly, the main precondition for the forming of such systems is the presence of highly educated human capital, which indicate a high potential for a technological breakthrough in the future. That is why the universities, which combine the students, professors, staff and graduates, are the driving force behind the forming of innovation ecosystems, are the main source of needed talent for these ecosystems, are capable for the supporting of start-ups and high-growth companies. Moreover, universities are able to accelerate the development of the innovation ecosystems, to bring together the different actors within the ecosystem and teach the skills of more deep collaboration.

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