

# EFFECTIVENESS OF ENTREPRENEURIAL UNIVERSITIES: EXPERIENCES AND CHALLENGES IN DIGITAL ERA (A SYSTEMIC APPROACH)

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## ABSTRACT

The modern world actively discusses the challenges that will lead to the Fourth Industrial Revolution. As the specialists assume, part of the jobs will be replaced by artificial intelligence. In addition, creation of completely new jobs is expected. As for the jobs that might be maintained in future, skills upgrading will be particularly important.

In such a turbulent environment of economic development, universities, and in particular entrepreneurial universities, play a significant role. We think so as these universities have special structures that promote form a university-industry-government triple helix, reskilling and commercialization of new ideas, etc. Due to the above-mentioned factors, they will neutralize the expected fluctuations in the best way. Later we will discuss the systemic links between the mutual influence of entrepreneurial universities and economy. We consider that continuous connection with such universities will enable business to adapt to the inevitable changes with minimal loss.

## KEYWORDS

fourth industrial revolution, future of jobs, entrepreneurial university, triple helix, spin-offs, system, innovative development, patents, education system, entrepreneurial ecosystem

## CLASSIFICATION

JEL: I23

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## INTRODUCTION

Since 2016 the World Economic Forum published several reports, where the main issues were connected with the Fourth Industrial Revolution. “With the 4IR, humanity has entered a new phase. The 4IR has become the lived reality for millions of people around the world, and is creating new opportunities for business, government and individuals” [1].

So facts relevant to this approach are as follows:

- “Across all industries, by 2022, growth in emerging professions is set to increase their share of employment from 16 % to 27 % (11 % growth) of the total employee base of company respondents, whereas the employment share of declining roles is set to decrease from currently 31 % to 21 % (10 % decline)” [2];
- “An estimates suggest that at least 54 % of all employees will require reskilling and upskilling by 2022. Of these, over a third will require more than six months of additional training. However, only around 30 % of employees in the jobs most exposed to technological disruption received any kind of training in the past year” [3];
- “In many industries and countries, the most in-demand occupations or specialties did not exist 10 or even five years ago, and the pace of change is set to accelerate. By one popular estimate, 65 % of children entering primary school today will ultimately end up working in completely new job types that don’t yet exist” [4];
- “The workforce transitions ahead will be enormous ... as many as 375 million workers globally (14 % of the global workforce) will likely need to transition to new occupational categories and learn new skills, in the event of rapid automation adoption. If their transition to new jobs is slow, unemployment could rise and dampen wage growth” [5]
- The global unemployment rate could rise to 24 percent (or more) in the year 2050. If we do nothing or nothing fundamental to adapt to the new realities of work, the social gap will continue to widen” [6];
- “As higher education leaders and policymakers think about how to prepare for the future of work, the educational system must be at the crux of any solution” [7].

The above-mentioned facts put on the agenda the necessity of finding the tools, which can be used to mitigate the potential challenges and apply to new opportunities. We consider entrepreneurial universities as one of these tools.

Universities have gone through several stages of development to reach their present state, with their roles and missions changing. In the late twentieth century, the term ‘entrepreneurial university’ appeared in the academic literature to describe universities that have improved various mechanisms by developing their local economy and increasing their incomes.

This article deals with the literature on entrepreneurial universities, discusses the role of the entrepreneurial universities in formation of an entrepreneurial ecosystem, analyzes the role of the universities in overcoming the challenges of the Fourth Industrial Revolution. Finally, the article schematically illustrates the systemic role of the entrepreneurial university for the development of the local economy.

## METHODOLOGY

In preparing this article, we reviewed the literature on entrepreneurial universities, studied reports and reviews by international organizations and by recognized research centers (such as

European Commission, the World Economic Forum, the OECD, McKinsey Global Institute, the University Industry Innovation Network (UIIN), European Expert Network on Economics of Education (EENEE), the Global Entrepreneurship and Development Institute – GEDI (USA), and others). The findings relate to the economies of both developed countries and developing countries.

In addition to this, literature review on entrepreneurial universities was done in two directions, in particular:

1. The literature that deal with the experience of two and more countries in the activities of entrepreneurial universities;
2. The literature that analyze the case of one university in different countries.

In studying, entrepreneurial universities one of the main methods to compare, both in time (considering research conducted on universities over several years) and in space (considering research focusing one country, on a few countries, or throughout the World). Surveys were analyzed in detail to create a clear picture of the research topic.

The investigation of entrepreneurial universities is based on the views of many authors. To test the hypotheses, we employ synthesis, analogy, description and correlation methods, as well as a systemic approach. To help the reader become acquainted with the opinions expressed in the article, we present schemes developed by ourselves and other authors. We have adopted a system that reflects the interaction and interdependence between economy and entrepreneurial universities.

To explore the topic expressed in the title of the article, we put forward a research question: are the entrepreneurial universities effective for the innovative development in the digital era?

## **ENTREPRENEURIAL UNIVERSITY: A BRIEF LITERATURE REVIEW**

At the end of the 20<sup>th</sup> century, a new term “entrepreneurial university” appeared in the scientific literature to describe universities that have improved various mechanisms to promote regional development and increase their incomes. Additionally, other terms used have been: University Technological Transfer, Innovative Universities, Business Universities and Market Universities. “The transformation of the university system is a worldwide phenomenon” [8]. “One significant European response is seen in the development, in concept and in practice, of the “Entrepreneurial University”. To find a single definition of the Entrepreneurial University which works across the European Higher Education Area is difficult and controversial” [9]. The characteristics of entrepreneurial universities are described interestingly by several authors [10-22].

In the article we shall try to analyze the scientific literature referring to the experience of different countries on entrepreneurial universities in several directions, namely:

1. The reports and reviews by international organizations and recognized research centers;
2. The literature that deal with the experience of two and more countries in the activities of entrepreneurial universities;
3. The literature that analyze the case of one university in different countries.

In the first direction of the literature review, we shall analyze government documents and state policy relevant to the topic. Studying such researches is interesting as the analysis is general, the experience of a number of countries has to be studied and global trends and expected changes are reflected.

In the Communication from the Commission is outlined, that “As centres of knowledge, expertise and learning, *higher education institutions can drive economic development in the*

*territories where they are located*” [23]. From the EENEE Analytical Report No. 18, Prepared for the European Commission we can read “Universities are encouraged to transfer their laboratory discoveries by patenting and licensing intellectual property to local firms. AUTM reported in 1999 that 82 % of firms from university licenses operated in the state where the university was located... 71 % of the entrepreneurs graduating from university start their business in the region where they were born. If the university was in the same region as they were born this probability increases to 87 %. Among those who moved to study at a university in another region, 51 % start up the business in the same region as the university. The university thus serves as a strong magnet to start-ups by alumni and breaks the otherwise very strong “home bias” that entrepreneurs have” [24].

By OECD are presented “a selection of 20 entrepreneurship education and start-up support initiatives developed by universities or their core partners in eastern Germany, Finland, the UK, Poland, South Africa, and the US. They provide useful guidance and inspiration to those in universities that are seeking to support entrepreneurship and the policy makers that are behind them” [25].

University Industry Innovation Network [26] through its publication strived to support and stimulate the development of university-industry interaction, entrepreneurial universities and collaborative innovation. As every environment is different (e.g. country, culture, stage of development, type of institution) UIIN collected good practices on various subjects and levels from 29 countries.

Table 1 shows the literature covering the cases of several countries. Conclusions provided by them are more specific. They reflect the challenges, differences and similarities of the countries being on different levels of development from cross-cultural aspect.

Table 2 shows the literature about the experience of one entrepreneurial university in different countries. Such analysis is interesting as the experience of the university is studied in details and specific conclusions are drawn.

The cases discussed in Tables 1 and 2 are from different continents of the world. This substantiates that the process of changing the university model has actively begun everywhere and in the countries at any level of development.

In general, the number of spin-offs and the duration they function in the market is one of the indicators of efficient functioning of entrepreneurial universities. “University spin-offs have remarkably strengthened the linkage between universities and industry. The number of technology patents and spin-offs coming out of university research has a significant impact on regional economic and social development” [47]. In this context, it will be interesting to consider the views of many authors [48-56].

Thus, we can conclude that, the key factors affecting efficient functioning of entrepreneurial universities are: creating entrepreneurial environment, entrepreneurial staffs as well as entrepreneurial teaching and learning; a strong entrepreneurial vision and the presence of leaders; the need of an aware environment to support spin-off creation; identifying factors that determine continuous organizational success, etc.

**Table 1.** Key findings of joint studies conducted by universities of several countries.

<b>Reference</b>	<b>Country/ countries</b>	<b>Number of Countries/ Universities</b>	<b>Key findings</b>
[27]	USA and UK	2 universities	an entrepreneurial university has the following five attributes: 1. Top-down vision, strategy and leadership; 2. Clearly defined entrepreneurship learning objectives that drive the curriculum. 3. Robust internal and external networks. 4. A culture of innovation. 5. Experiential learning and knowledge-transfer opportunities.
[28]	Austria and Germany	2 universities	the lower level of founding intentions among students in Munich and Vienna may be attributed to their less distinctive entrepreneurship education. This leaves a great deal of room for improvement [28].
[29]	Italy, Norway, and the United Kingdom	3 countries	three countries adopting differing approaches to framework conditions, to test whether national and university level initiatives have an influence on the number of spin-offs created and the quality of these spin-offs ... authors find that changes in the institutional framework conditions at both levels are conducive to the creation of more spin-offs, but that the increase in quantity is at the expense of the quality of these firms [29].
[30]	Belgium, France, Germany, Switzerland, the Netherlands, and the United Kingdom	16 case studies of universities	The article relies on 16 case studies of universities located in six European countries in order to address the pros and cons of the four types of TTOs. The results provide both a conceptual understanding and an empirical overview of how universities organize their technology transfer and intellectual property management [30].
[31]	Germany and Poland	2 countries	This article explores the development of University-Business Cooperation (UBC) both in Poland and in Germany, shining a spotlight on the various factors influencing UBC, as well as providing a comparison of the two countries [31].
[32]	Spain and Ireland	2 countries and 4 universities	Authors compare entrepreneurial universities in two European regions (Spain and Ireland) using an in-depth qualitative approach based on multiple case studies (two Spanish universities and two Irish universities) between 2006 and 2010. The findings provide organizational practices and approaches relevant to the transformation process of other regional universities seeking to become entrepreneurial [32].
[33]	Chile and Colombia	2 universities	Authors found that entrepreneurial education, the University environment, and the prior entrepreneurial exposure are mediated by the factors of the Ajzen`s model to generate entrepreneurial intention in higher education students [33].
[34]	Senegal and Spain	2 universities	Findings indicate the existence of cultural differences between both countries in the determination of entrepreneurial intention. Spain showed personal attitude as the main antecedent, whereas in Senegal, it was perceived behavioral control [34].

**Table 2.** Key findings of experience of one entrepreneurial university in different countries (continued on p.19).

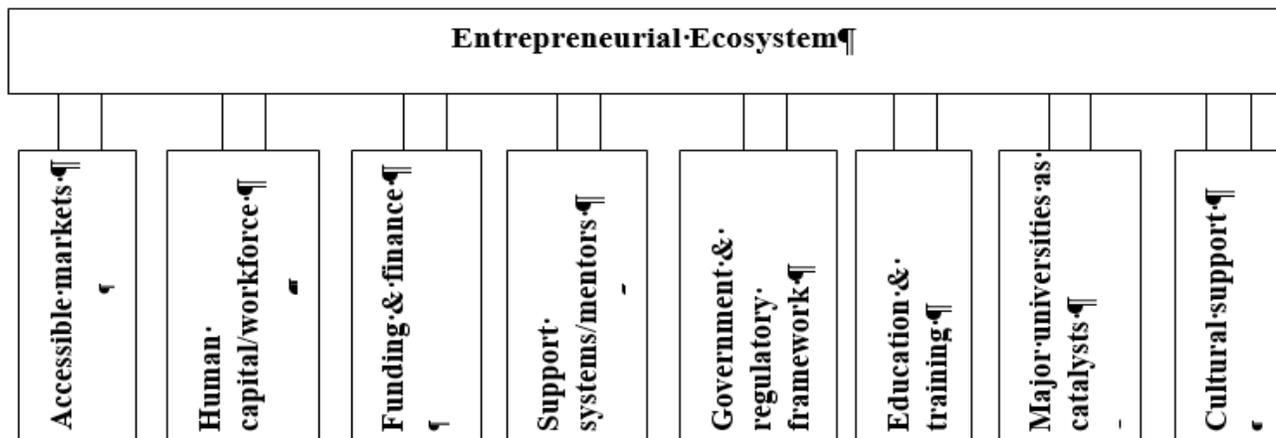
Reference	Country	University	Key findings
[35]	USA	MIT	The article presents new possibilities for entrepreneurship education from the ecosystem perspective. ...the results show educational practices that go beyond the classical model of classrooms, involving student-led activities, mentorship programs, competitions, and others. Project-based courses, experience-based activities and active-based activities are well covered in the data presented [35].
[36]	USA	University of California, Berkeley	...the presence of leaders who marry strategic thinking and capabilities development enhance the likelihood of a university's competitive fitness and long-term survival [36].
[37]	Belgium	Université Libre de Bruxelles	The government at national and regional levels supports universities. In all the Belgian regions, universities spin-offs and science parks are funded through public funds and active venture capital firms. ...On the one hand, the need of an aware environment to support spin-off creation and on the other the need of the new firm to have resources from PRIs to build a sustainable, competitive advantage [37].
[38]	Netherlands	University of Twente	...a strong entrepreneurial vision and the adoption of a different concept of knowledge may be the key for other small and peripheral European universities, in order to reach both local economic relevance and international excellence [38].
[39]	Italy	ARCA consortium (University of Palermo incubator)	...demonstrate that academic incubators play a key role in firm viability [39].
[40]	Malaysia	Universiti Teknologi MARA	... discussed the efforts of the university in creating entrepreneurial environment, entrepreneurial staffs as well as entrepreneurial teaching and learning [40].
[41]	Sweden	Chalmers University of Technology	...the difficulties in creating the entrepreneurial university: transparency; organisation of the infrastructure for entrepreneurship; integration and the commercialization of the research [41].
[42]	Croatia	J.J. Strossmayer University in Osijek	The lack of connections between individual ...components of the model is the biggest obstacle to the emergence of integrative and then entrepreneurial university. Each university needs to find its own way to transform into entrepreneurial university depending on the situation it is in, resources and environment of the university [42].
[43]	East Africa, Tanzania	Iringa University College	The results of the study show that it is possible to identify factors that determine continuous organizational success in Africa, and that managers can be offered a framework that adds focus to improvement [43].

**Table 2.** Key findings of experience of one entrepreneurial university in different countries (continuation from p.18).

Reference	Country	University	Key findings
[44]	Canada	University of Waterloo	Universities generate and disseminate knowledge as a common good. Both of these functions co-exist at University of Waterloo. Because the process of knowledge transfer into the local economic community is multi-faceted, and largely person-embodied, universities cannot be viewed in such a dualistic way [44].
[45]	China	Northeastern University in China	The pathway to an entrepreneurial university begins with government pulled industry-university collaboration, to university-industry collaboration to interaction Triple helix. This may be followed by a gradually developing “university-industry collaboration” in which companies fund academic research with potential industrial use, the beginnings of a University-pushed triple helix [45].
[46]	Indonesia	Bogor Agricultural University	... Explore university entrepreneurial transformation and emphasized that the development of entrepreneurial activity, learning and teaching processes need more attention [46].

## THE ROLE OF ENTREPRENEURIAL UNIVERSITIES IN FORMATION OF AN ENTREPRENEURIAL ECOSYSTEM

The World Economic Forum, in collaboration with Stanford University, Ernst & Young and Endeavor, surveyed over 1000 entrepreneurs from around the globe and in 2014 introduced the Report “Around the Globe and Early-Stage Company Growth Dynamics – the Entrepreneur’s Perspective”. In this report, there are given eight pillars and components of an Entrepreneurial Ecosystem [57]. This model builds on the previous work on entrepreneurial ecosystems by EY, the OECD, and Professor Daniel Isenberg (see Exhibit 1).



**Figure 1.** The eight pillars of an Entrepreneurial Ecosystem [57].

The pillars and components of an Entrepreneurial Ecosystem are [57]:

- Accessible markets (Domestic market: Large companies as customers; Small/medium-sized companies as customers; Governments as customers. Foreign market: Large companies as customers; Small/medium-sized companies as customers; Governments as customers);
- *Human capital/workforce (Management talent; Technical talent; Entrepreneurial company experience; Outsourcing availability; Access to immigrant workforce);*
- Funding and finance (Friends and family; Angel investors; Private equity; Venture capital; Access to debt);
- *Support systems/mentors (Mentors/advisers; Professional services; Incubators/accelerators; Network of entrepreneurial peers);*
- Government and regulatory framework (Ease of starting a business; Tax incentives; Business-friendly legislation/policies; Access to basic infrastructure; Access to telecommunications/broadband; Access to transport);
- *Education and training (Available workforce with pre-university education; Available workforce with university education; Entrepreneur-specific training);*
- *Major universities as catalysts (Promoting a culture of respect for entrepreneurship; Playing a key role in idea-formation for new companies; Playing a key role in providing graduates for new companies)*
- *Cultural support (Tolerance of risk and failure; Preference for self-employment; Success stories/role models; Research culture; Positive image of entrepreneurship; Celebration of innovation).*

The three strongest pillars for Europe are human capital/workforce (81 %), accessible markets (72 %) and education and training (60 %). The average percentages for ready availability across the eight pillars for region is on the first place by 86 %, US – Silicon Valley/Bay Area [57].

*It should be noted that the entrepreneurial universities have direct positive impact on 5 components of the above 8 pillars.* These components in the text are marked by the italic font. This opinion is strengthened by the fact that the region, where Stanford University is located, has the best indicator. This university is one of the most successful entrepreneurial universities in the world. Stanford alumni and faculty have created more than 39 900 companies since the 1930s.

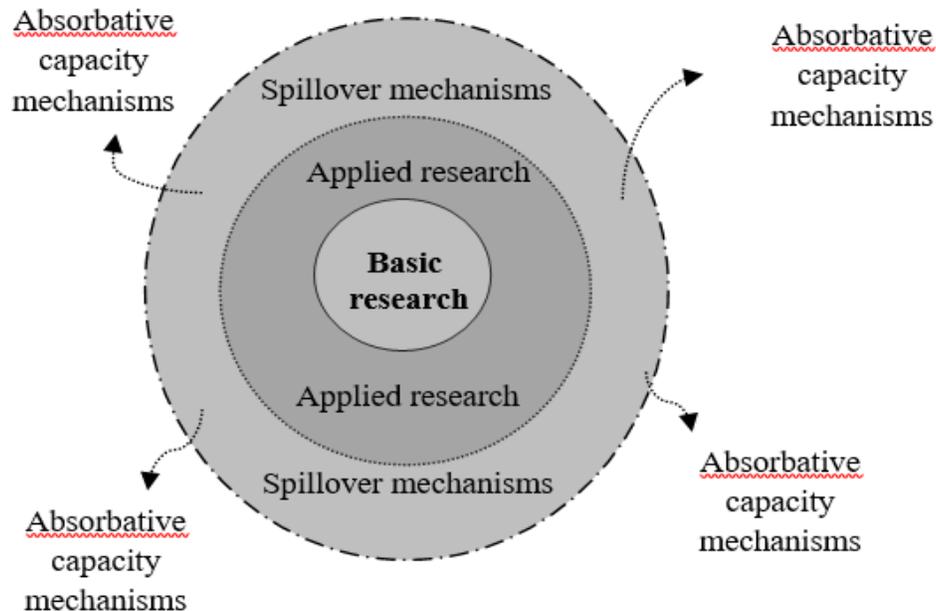
In 2017-2018 Stanford University received \$40,96 million in gross royalty revenue from 813 technologies. Fifty-three of the inventions generated \$100,000 or more in royalties. Seven inventions generated \$1 million or more. In 2017–18, the Office of Technology Licensing (OTL) concluded 150 new licenses. Stanford has 18 designated independent laboratories, centers and institutes that provide a physical and intellectual intersection between schools and disciplines.

Thus, we can conclude that entrepreneurial universities play the significant role in the formation of an entrepreneurial ecosystem.

On the other hand, we would like to discuss one more report “The Global Entrepreneurship Index 2018” by the Global Entrepreneurship and Development Institute (USA). According to this report a range of entrepreneurial framework conditions are: “government, research and development, education, infrastructure, financial sector and the corporate sector” [58]. Since entrepreneurial university combines education, research and business in one space and has an effective dialogue with the local government; we can conclude that entrepreneurial universities improve the entrepreneurial framework, too.

## ENTREPRENEURIAL UNIVERSITY – CORE SYSTEM FOR THE INNOVATIVE DEVELOPMENT OF ECONOMY

The turbulence of the economy brings about new demands on higher education systems across the world. In such environment of development, universities, and in particular entrepreneurial universities, play a significant role.



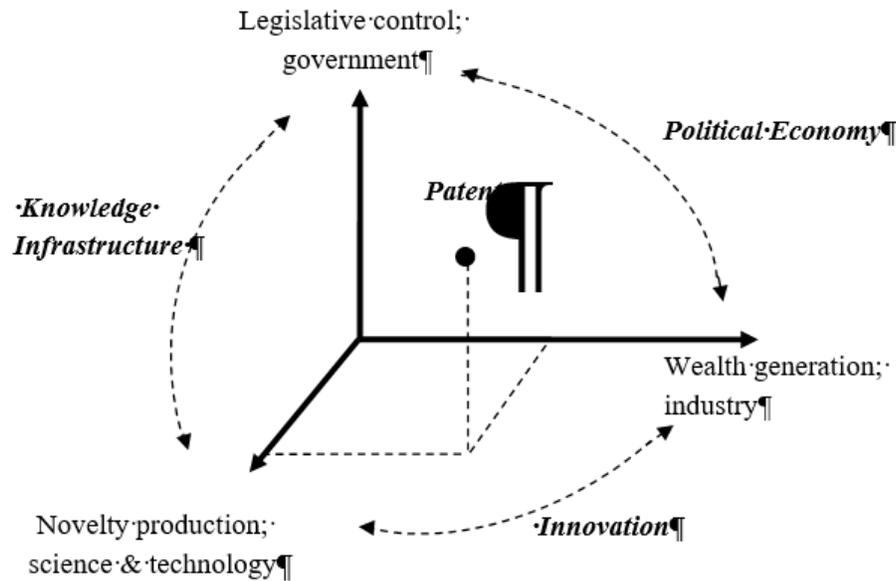
**Figure 2.** The entrepreneurial university [10].

The entrepreneurial university model is presented in Figure 1. Figure 1 shows that basic and applied research carried out at the universities requires “Third ring”, which consists of mechanisms to facilitate the spillover of knowledge from the research core and applied programs generating that knowledge to society where that knowledge would be commercialized or at least applied [10].

The outcomes of effective formation of “University-Industry-Government” (The Triple Helix) relations are the patents illustrated in Figure 2. Creation of patents in the university environment will provide businesses with the workforce equipped with all the necessary skills. The new knowledge rapidly flows into education and leads to the inspiration of new ideas.

According to Leydesdorff “patents are considered as positioned in terms of the three social coordination mechanisms of (1) wealth generation on the market by industry, (2) legislative control by government, and (3) novelty production in academia. *Whereas patents are output indicators for science and technology, they function as input into the economy*” [59]. The above factors make it clear that by creating patents entrepreneurial universities *serve as a core system and source for the innovative development of Economy* [60].

Figure 3 demonstrates the systemic impact of the entrepreneurial university on the innovative development of economy. The invention patented at entrepreneurial universities improves the possibility of starting a new business and /or functioning of existing business (this process is shown with dashed line n Figure 3). As a result, the culture of investing in research and development



**Figure 3.** Patents as events in the three-dimensional space of Triple Helix interactions [59].

is gradually developed among the business organizations. They constantly try to have links with the universities and focus on innovative development (this process is shown with green dashed lines on Figure 3). Here emerges a new wave of activities finally resulting in Trademark and Patent applications.

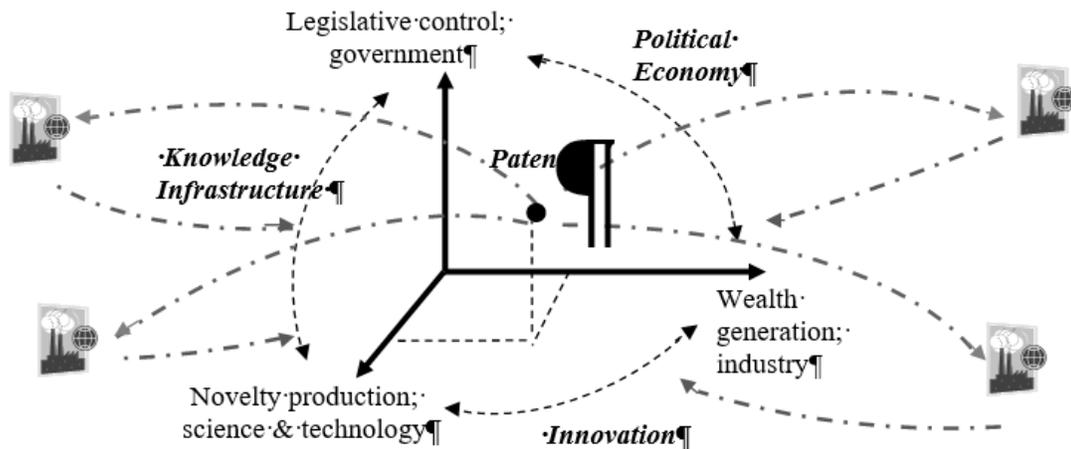
The interests of economic development make the government allocate funds for research that is helpful for both business and universities. Under such circumstances, the time required to achieve government goals is shorter than with standard policy, as incentive measures can be introduced simultaneously in many areas through the university–industry–government triple helix. “This allows direct dialogue on education, science, and business in one area, making it possible to combine private and public funds to encourage the formation of new firms, with the assistance of incubators and spin-offs to provide a properly trained workforce needed by businesses to conduct intense research and other activities” [61]. These processes promote formation of the system in which entrepreneurial university ensures innovative development of the economy.

The entrepreneurial universities create a sort of micro-system around themselves and form a cluster after a certain period.

Why this is system? The relation, given in Figure 3, has all the features characteristic of the system among entrepreneurial university and the economy, features that have been described in the works of other authors. For the purposes of this article, we provide a definition based on Ackoff’s suggestion that “a system is a set of two or more interrelated elements with the following properties:

1. Each element has an effect on the functioning of the whole.
2. Each element is affected by at least one other element in the system.
3. All possible subgroups of elements also have the first two properties” [62]. Each part of the model in Figure 3 meets all these characteristics of a system.

Systemic links, as shown in Figure 3, might not be visible in the standard approach or the study of entrepreneurial universities. Thus, the real potential systemic links cannot be identified.



**Figure 4.** Patents – output indicators for science and technology and input into the economy (developed by Gagnidze based on [59]).

## ENTREPRENEURIAL UNIVERSITY – ONE OF THE TOOLS FOR THE CHALLENGES OF THE 4<sup>TH</sup> INDUSTRIAL REVOLUTION

The World Economic Forum is introducing the new Global Competitiveness Index 4,0 as a much-needed economic compass, building on forty years of experience of benchmarking the drivers of long-term competitiveness and integrating the latest learnings about the factors of future productivity.

Table 3 presents the data of the old [63] and new [64] World Economic Forum reports for the 12<sup>th</sup> pillar. In the new Global Competitiveness Index 4,0 this Pillar includes 10 indicators (instead of previous 7). It is obvious that improvement of 9 out of these 10 indicators is supported by effective functioning of entrepreneurial universities. Due to this, the need for rethinking of the university system is one of the challenges of the modern education system. This process has actively started in developed and developing countries.

It should be noted that Schwab and Zahidi [65] identified “10 things you – and your government - should know about competitiveness in the Fourth Industrial Revolution”, namely:

1. “Competitiveness is not a luxury good;
2. Investing in people is good for social *and* economic outcomes;
3. Embracing globalization in the 4IR goes beyond free trade;
4. But open economies must also embrace social protection;
5. Creating an innovation ecosystem goes well beyond research and development;
6. Technology offers a path to economic leapfrogging but only in combination with other factors;
7. Institutions still matter;
8. As do infrastructure and the financial system;
9. In a time of constant change, there is a need for constant agility;
10. Achieving equality, sustainability and growth together is possible – but needs proactive, far-sighted leadership” [65].

The authors have also provided detailed explanation of each advice. This explanation makes it clear that entrepreneurial universities can have direct positive impact on the implementation of 7 of these 10

**Table 3.** Data of the sub-pillars of Innovation (capability) in the 2016-2018 Global Competitiveness reports of the World Economic Forum.

#	GCR 2016-2017	#	GCR 2018
	12th pillar: Innovation		12th pillar: Innovation capability
12.0 1	Capacity for innovation	12.0 1	Diversity of workforce
12.0 2	Quality of scientific research institutions	12.0 2	State of cluster development
12.0 3	Company spending on R&D	12.0 3	International co-inventions
12.0 4	University-industry collaboration in R&D	12.0 4	Multi-stakeholder collaboration
12.0 5	Government procurement of advanced tech. products	12.0 5	Scientific publications H Index
12.0 6	Availability of scientists and engineers	12.0 6	Patent applications
12.0 7	PCT patent applications	12.0 7	R&D expenditures
–	–	12.0 8	Quality of research institutions
–	–	12.0 9	Buyer sophistication
–	–	12. 10	Trademark applications

advices. Consequently, we can conclude that the model of entrepreneurial universities is effective and transition to this model is very essential in terms of expected 4<sup>th</sup> industrial revolution.

In general, the role of education is directly or indirectly critical in the leap-like development and it will continue to remain the same during the digital era.

## CONCLUSION

In the nearest 5-10 years, the world economy will face a period of sharp changes predicted by recognized research organizations. This process is called the Fourth Industrial Revolution and is evaluated in two ways. On the one hand, the expected threats (disappearance of many jobs) are discussed and on the other hand, the expected opportunities (the emergence of many new professions) are evaluated. In addition, over half of those employed will need reskilling and upskilling.

The above-mentioned facts put on the agenda the necessity of finding the tools, which can be used to mitigate the potential challenges and apply to new opportunities. We consider entrepreneurial universities as one of these tools. These universities create an entrepreneurial ecosystem and develop the local economy. After a certain period the entrepreneurial universities create a sort of micro-system around themselves and form a cluster.

The literature review in the current article revealed the main difficulties that are associated with changing the university model and the activities of the third generation universities in different countries. We have developed the schemes created by prominent scholars and schematically showed the systemic role of universities in the development of local economy.

Thus, upon the studies provided by the world-renowned organizations, the ideas of well-known scholars and the example of the best practices from the various countries, we can conclude that Entrepreneurial University model is effective and leads to the innovative consequences in digital era. At the same time it should be noted that to move the University development at this level will require significant efforts.

The key factors affecting efficient functioning of entrepreneurial universities are: creating entrepreneurial environment, entrepreneurial staffs as well as entrepreneurial teaching and learning; a strong entrepreneurial vision and the presence of leaders; the need of an aware environment to support spin-off creation; identifying factors that determine continuous organizational success, etc.

The article is partly limited as it is a desk research. It does not include research on new methods of teaching, which is desirable to develop in HEIs. These issues were beyond our scope but are nonetheless very interesting. Our future research will therefore move towards these topics.

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