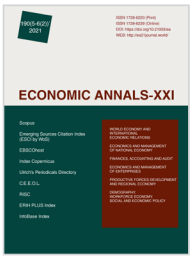

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The impact of global socio-economic changes on the regional role of universities

Abstract
Economic and regional development and rapid, often unpredictable changes across the globe in technical fields have an effect on everything, including universities, training, research and services as well. Universities must find their place in this continuously changing environment, they need to continuously reinterpret themselves and their own roles, whilst ensuring that education and knowledge transfer take priority. The pace of change is increasingly accelerating with technological novelties and innovations by high-tech industries surpassing themselves at an astounding rate. Therefore, knowledge, as the facilitator and creator of these results, plays an increasingly important role for those who wish to rank among the winners of the competition both locally and globally. Today, the primary creators of knowledge are still educational institutions, and universities are the fundamental platforms of research. However, it is not enough to be «only» a university, they must educate and research and become part of the developed world alongside participants who would like to provide scientific answers to practical problems. In our paper we address the question of breaking points along which the role of universities can be transformed in order to remain open to the needs of both their narrower and wider environment while maintaining their fundamental mission, thus becoming successful players on the global stage. The development of high-tech industries has resulted in a science-driven period when economic development is unimaginable without the scientific results and the interconnection of individual disciplines. This development will presumably lead to the deterioration of certain individual knowledge and the deepening of others. Higher education must also adapt to this with the development of an education system that strengthens digital skills and serves regional expectations. Nowadays entrepreneurial universities have emerged, which are able to operate with an entrepreneurial approach, thereby responding independently to challenges from outside. The ability to co-operate must be a key aspect of university existence, and the deepening of educational, research and business partnerships is a prerequisite for success. In order to spread management approach and create an entrepreneurial ecosystem, successful R&D work and innovation, it is also necessary to involve external, tender resources and grants, besides own resources. However, these resources need to be used well, but the lack of a pre-planned, conscious strategy results in less efficient use. Regional cooperation, common thinking, training and innovation, science workshops and science parks all contribute to the development of institutions and related regions.

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1. Introduction

The history of European universities dates back to the 11th century with the first institutions of the continent opening their doors in Italy, the United Kingdom and France. Over the past centuries

the structure, institutional system and function of higher education have significantly changed, and this transformation is still happening today. Nowadays, universities are not only the bastions of the transfer of higher knowledge, but they are also actors engaged in significant research activities, investing the acquired knowledge in further research and the creation of innovation. Knowledge itself is one of the key elements of economic development, and, if the direction of the industrial and information revolution of our days is considered, it can be seen that the impact of knowledge on economic development will be even more appreciated in the future. The selection of our topic was made for several reasons. Hungarian higher education is undergoing a powerful transformation which provides new opportunities for each institution or closes previously well-functioning paths that are not relevant any more. In this environment universities must find a place for themselves, and in addition to generating knowledge, they must turn to usable knowledge and innovations. Several studies address the role of universities in the region, but there have been far fewer studies on the impact of global changes and of the given region on higher education, at least in this context. Using this «top-down» approach, our paper examines the paths to global challenges, considered to be right by the authors. It is assumed that in higher education there is a need for structural change (providing sufficient flexibility) closely related to economical-regional development for which regional cooperation must be organized within a pre-planned framework. The analysis is primarily based on a synopsis of the opinions of the available literature. The secondary research describes the most important findings related to the topic, the models of transformation caused by the changes affecting higher education worldwide. The tables and figures are based on the latest available data. Following the definition of the findings and notions presented, the result are described that can make higher education of the future and the future of higher education a success.

2. Brief Literature Review and Research Background

According to the 1998/99 annual report about the world development (World Development Report: Knowledge for Development) published by the World Bank, there are four pillars of development which are the followings: 1) an appropriate level of economic and institutional system, 2) a strong human resource base, 3) a dynamic information structure and 4) an effective national development system. According to many experts, the basis of any system is the provision of appropriate (higher) educational institutions. To know which are the world's leading higher education institutions, we need to set an international standard.

Perhaps, the best-known rankings today are set up by the Times Higher Education and the Shanghai Jiao Tong University. According to the definition of these rankings, the title of «the best university in the world» is open to a higher education institution, which meets the high expectations of the labor market and employs the leading researchers of the scientific world, the scientists, who publish in the scientific journals with the highest quality».

«Science and technology» are the main profile of the (elite) institutions, and they are able to introduce technical innovations that are license- and marketable. Overall, the best universities in the world has three main features:

- an outstanding number of talented teachers and students;
- material background for providing a stimulating learning environment;
- convenient political background, which stimulates scientific development (strengthening of strategic thinking, high level of flexibility, openness to innovation etc.) (Rigó & Ditzendy, 2014).

Global processes leading to the transformation of higher education

The emergence of high-tech industries and the spread of new technologies render the 21st century the most science-driven period of history so far in which economic development is impossible without the interconnection of scientific results and certain disciplines. Furthermore, the pace of technological development is not projected to slow down; the appearance and emergence of new technologies are inevitable. Artificial intelligence, 5G technology or the field of autonomous vehicles cannot be ignored, as well as health care, and climate and waste management, all social problems which require complex solutions. Development includes the change of professions and of the competencies necessary for certain work phases, in some respects the degradation of individual knowledge, in others their deepening.

Competencies are crucial for national competitiveness. According to Csath (2019), in addition to the most important elements of national competitiveness (social progress and geographically

balanced development, increase of human well-being, strengthening of resilience), mobility, flexibility, constant learning (agility), the ability to make an innovation, create high added value and the ability to absorb and utilize knowledge. A matching indicator measures the proportion of 15-year-old students who do not reach level 2 («basic skills level») on the PISA scale in the three core subjects (reading, mathematics and science, Figure 1).

It is therefore clear, that globalization is transforming education systems in all parts of the world, leaving higher education untouched (Marchenko & Sydorenko, 2019). Education must also respond to global challenges and changes, which in our ever-accelerating world, with the appreciation of time, is an increasingly complex task, in close connection with theoretical and practical knowledge.

The pandemic highlighted the benefits of digitalisation especially in higher education. These tools have already been used by Hungarian higher education institutions in their educational practice, but there have been only a few training programs available exclusively online. Digital education has brought many benefits, yet we see more and more institutions are returning to frontal education despite the fact that the online world is operating in a more cost-effective way and it eliminates the distance between institutions and students around the world.

Looking back at the phases of industrial development, it can be seen that the foundations of today's development were laid by the establishment of manufactories and the creation of the division of labor. Later, the use of machines and, in this context, automation, encompassed every part of the industrial process. Today, rapid technical developments and the application of new solutions are increasingly coming to the fore. This is a two-way process in terms of individual skills and knowledge because, on the one hand, simple work phases require the employment of workers with simple expertise, on the other hand, an ever more qualified labor force is needed to operate and repair machinery.

Besides industrial production, agriculture is also considered a significant target area of technical developments in which the elements of precision farming are applied as widely as possible.

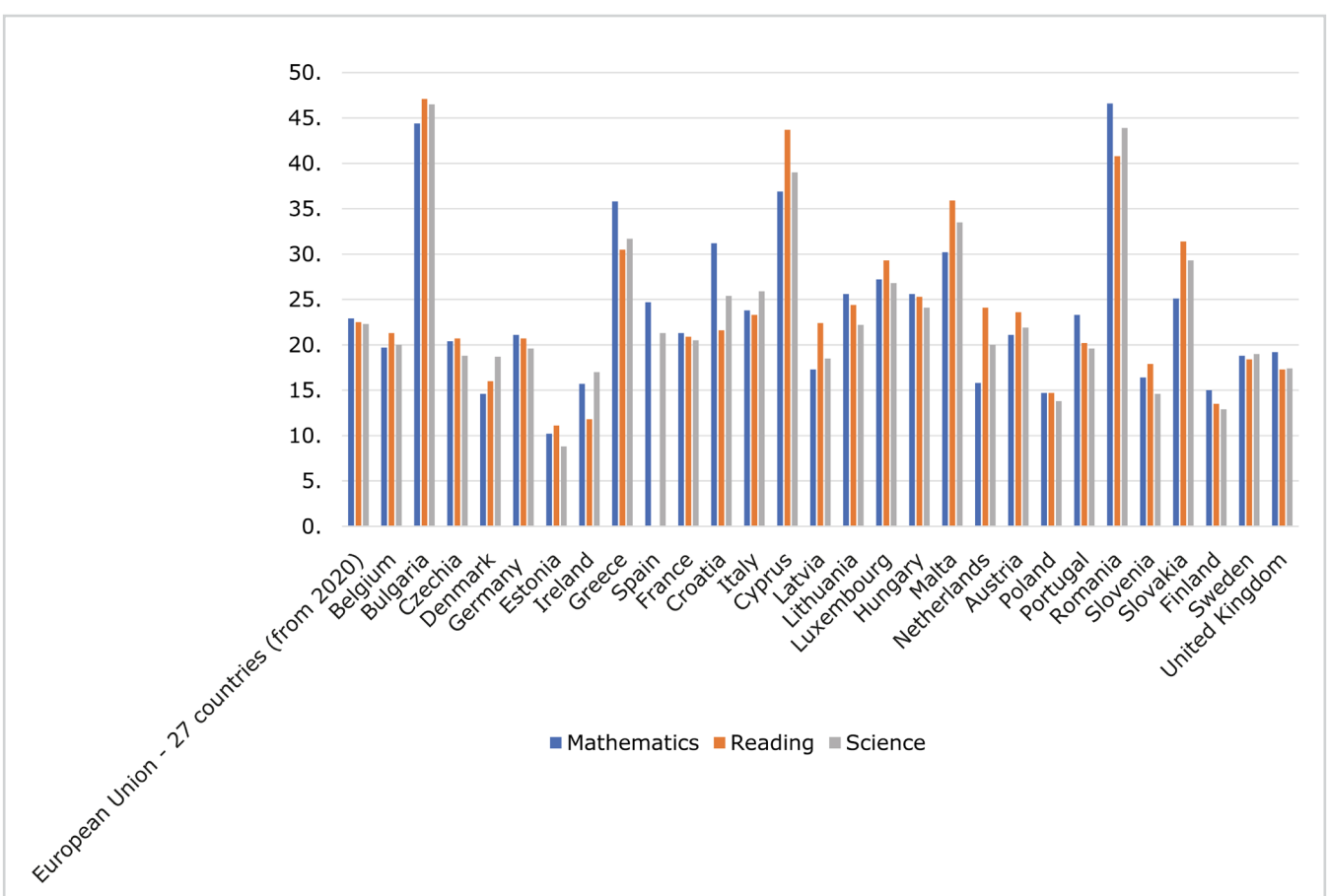

Figure 1:
Underachievement in reading, math and science, 2018
Source: Compiled by the authors based on EUROSTAT

Consequently, economic development is no longer promoted by the expansion of employment that was previously common, rather an increase in productivity contributes to increase added value and to the improvement of economic results. A different kind of knowledge requires a closer cooperation between the industrial sector and education as technical-technological changes demand the transfer of knowledge of a different nature. Therefore, it is not a question of extending the individual's knowledge quantitatively, as the required knowledge has changed fundamentally. The impact of technical-technological change can be clearly seen in the growing demand for well-qualified skilled workers whereas at the same time, an ever growing number of jobs that do not need knowledge or skills are being automated. Automation involves the transformation of occupational structure. According to a 2018 study by McKinsey&Company, automation and digitalization will result in significant changes in the composition of occupations. Mostly the number of low-income jobs will be drastically reduced, occupations which demand creativity, social skills or higher qualification are less endangered (Figure 2). However, as routine mental and manual practices are increasingly replaced by technology, employees performing such work may lose their previous jobs. Besides this, the demand for a labor force at home with digital technology and the changes this brings will increase.

Rechnitzer (2008) said that the competitive advantage of developed countries can be derived from their ability to use knowledge; it plays an important role in the development of competitiveness. For regions eager to retain their population numbers this trend will result in a new challenge. On the one hand, it means the establishment of an educational system which adapts to labor market demands; on the other hand, the development of an educational system which equally serves regional expectations and enhances digital skills.

According to Jánossy (1967) «today, technical progress requires a much more rapid structural change than earlier, being bound by a profession will become an increasingly perceivable limit of economic development. In essence, the different forms of retraining and further training are efforts towards breaking down, or at least loosening up these barriers. It should be noted that the possibility of retraining narrows with age, and this also strengthens the attachment to the profession». The transfer of knowledge from generation to generation is an essential element of knowledge, but it must not only mean the unchanged copy of the old structure - beside the dissemination of the results of advanced international standards, the high level of knowledge production is particularly important.

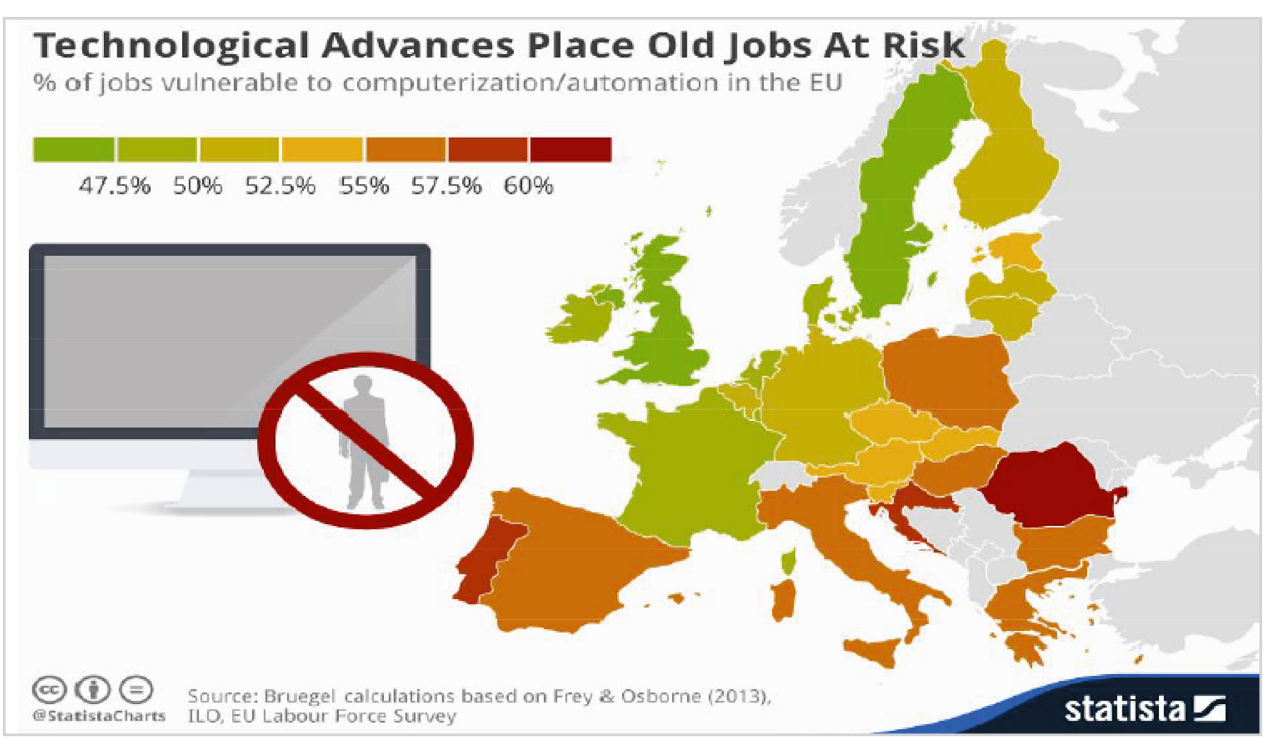

Figure 2:
Rate of old jobs threatened by technological development
Source: Mastercard: The Sharing Economy Report. Némethné (2020). Az innováció összefüggései (Contexts of innovation). Handwriting, Corvinus University of Budapest, 24.03.2020, Course

As the functions of contemporary universities change and their engagement is modified, the concept of the business university is being replaced by the entrepreneurial university model. Business universities were developed in Europe in the 1980s with much larger autonomy than had been previously characteristic. As, according to regulations, a significant part of the funding for these institutions is based on student numbers, they became interested in achieving higher performances.

In addition, governments loosened the application of budgetary resources meaning universities had more autonomy over the economic use of resources involved. Besides the primary resource secondary, indirect resources appeared in the form of tenders (in particular research tenders, although still as state resources) which provided alternative funding for the institutions. The government encouraged all universities to secure these resources, often with the involvement of economic and industrial actors. Governing bodies and departments responsible for management had to develop a new operating philosophy in order to successfully raise funds. According to the phrase used at that time, entrepreneurial universities are the universities that think about new sources of revenue such as the patents, research and projects carried out together with industrial actors (Etzkowitz, 1983).

According to Jacob (2003) an entrepreneurial university is the term used for universities disposing of a wide range of new infrastructural supporting mechanisms in order to encourage entrepreneurial knowledge within the organization, as well as to present entrepreneurial knowledge as goods. It is based on marketing (personalized further training programmes, consultancy services) and the transformation of knowledge into goods (patents, licenses or start-up enterprises launched by the students).

The entrepreneurial university is a university which is able to innovate, to recognize and create opportunities, to work in teams, and to take risks at the same time. An almost complete structural change is part of its transformation in order to be able to respond independently to emerging challenges. The entrepreneurial university is a natural incubator which provides support to teachers and students in the creation of joint ventures (Guerrero-Cano, Kirby, & Urbano, 2006; Makai & Vasa, 2020).

«The main driving force of the «entrepreneurial university» is continuous development and renewal skills, flexible adaptation to changes with a market- and business-oriented approach, finding the right balance between the traditional academic and the business organizational, management, educational, networking methods, attitude formation, breaking down bureaucratic internal obstacles which help to provide appropriate responses to expectations arising from the uncertain, risky, rapidly changing business, economic/social environment» (Mezei, 2008).

Local commitment is formulated as a basic expectation for these universities hence several institutions incorporate the strengthening of regional engagement in their own strategic documents. Besides the development of education, training and RDI (research and development and innovation) activities the strengthening of activities relating to the third mission appear (Chung et al., 2020). According to them, it is required to focus primarily on the efficient and widespread utilization of industrial relations, the participation in industrial processes, the widening of community services, and the active role in the development of the region. However, to enable universities to contribute to the economic development of their region, three activities must be realized at once. First, the education front, second, a focus on research providing successful solutions that can be used by the local economy as well, and third, the local embedding in the business sector (Lukovics & Zuti, 2014). A number of studies and analyses have been made on the impact of universities on regional competitiveness. There is still a lack of an exact understanding of how regions can take advantage of the activities of the universities operating in their regions, and the role of public policy institutions in the support of such activities is also missing (Trippl, Sinozic, & Smith, 2015). Thomas and Pugh (2020) point out that the literature lacks the study of the concept of entrepreneurial universities in a regional context, as it is essential to approach the model according to regional differences.

On the basis of surveys, it can definitely be determined that universities which recognized the strong competitive situation and are closely related to industrial operators strive for knowledge utilization, for its local application can have a positive effect on the development of their region (Lukovics & Zuti, 2014). It is worth mentioning - as an addition to the above mentioned ideas - the role of basic research in several fields, which is not marginal as success can be

achieved at a global level. This, in turn, requires the definition of focus areas and strong scientific competence. Undoubtedly this can only work successfully if it is not a one-way relationship that is established, but the region is able to utilize the established scientific results presuming naturally a collaboration of participants exists. It should also be noted that the higher education system is more often than not considered as an important part of the economy at a governmental level, thus its organic incorporation is indispensable. Many European examples show that governments are entering into a growing number of strategic cooperation with national and multinational large enterprises with the intention of laying the foundations of long-term economic development.

Effective forms of regional cooperation

While the role of first generation universities was education and knowledge transfer, in the case of second generation universities the importance of research-development activities and the creation of knowledge have also emerged besides this fundamental mission. Today, education and research-development alone are not enough for an institution to be successful; in the case of third generation - entrepreneurial universities the element of knowledge utilization is added to the two activities above (Imreh & Tóth, 2015). The university entrepreneurial eco-system that is being developed in the case of institutions operating by such principles is the result of a dynamically changing and long-term process. The model of the operation of a knowledge-based economy is provided by the cooperation of the academic-university sphere (educational pillar), industry (economic pillar) and the government (social pillar), which was first described by Etzkowitz in the 1990s. In his words, the essence of the Triple Helix concept is not only cooperation and continuous contact, but also sharing individual functions while retaining their own activities. The Triple Helix model promotes innovation, as participants complement and adopt certain activities from each other. In addition, in the knowledge-based economy the interactions among the university, industry and the government sphere encourage innovation (Leydesdorff & Etzkowitz, 1998; Etzkowitz 2002). Each of the three participants appears as equal, interdependent organizations in the cooperation. The three participants create hybrid institutions, such as incubators or spin-off enterprises, but in a non-classical sense. Jointly implemented projects can also be included here. Capellin (2002) defines the cooperation in nine dimensions: technological integration (1), labor force integration (2), production integration between companies (3), integration between producing enterprises and service providers (4), financial cooperation (5), territorial cooperation, infrastructural development (6), social and cultural cooperation (7), local institutional cooperation (8), interregional and international integration (9). These cooperation are mutually important to the participants, but are less effective in the absence of common will and willingness to cooperate. University contribution to regional development is different both at national and international levels. The reason for the difference lies in the university's profile, in the composition of university citizenship, in traditional values, in institutional management, in the operational structure and in regional factors themselves (Trippl, Sinozic, & Smith, 2015). In addition to the triple helix model, the quadruple helix model is an increasingly common approach (Carayannis & Campbell, 2009), which is complemented by actors of the innovation ecosystem as recipients of collaborations and innovation (Schütz, Heidingsfelder, & Schraudne, 2016). Quadruple helix partnerships can facilitate the implementation of joint projects, but conflicts arising from cooperation can prevent the achievement of sustainable results. The four main characteristics of successful cooperation are: the identification of common interests, the development and implementation of common strategies, and finally the evaluation of the feedback received during the monitoring (Bellandi, Donati, & Cataneo, 2021).

The cooperation practice of Hungarian university centers covers the educational, research and business cooperation. In particular, educational cooperation appears in the engagement in internship programmes and in dual training programmes, but common curriculum development cooperation can also be found, and training, development services provided by the university to the corporate sphere in the best practices. Educational cooperation is supplemented by joint re-development projects in which a significant role is given to corporate innovation and to the solution and recognition of corporate problems by researchers. It is a basic need for each university centers to prepare for the service of regionally significant industries at a local level by establishing institutions that are able to satisfy the innovation needs of knowledge-intensive industries (Rechnitzer, 2008). The establishment of innovation parks and scientific centers can

create institutes of higher educational and industrial cooperation. The mission of these centers is to increase the competitiveness of the region and the enterprises operating in the region, by providing services built on the needs of local industries (Fekete, 2015; Vasvári et al., 2020). The infrastructure of universities can provide the base of centers which must be made suitable for the realization of efficient knowledge and technology transfer.

Financing sources of the entrepreneurial universities in Hungary

In order to develop the entrepreneurial environment and entrepreneurial ecosystem in an institution, it is also necessary to involve external, tender resources and grants beside the own sources. After the accession of Hungary to the European Union in 2003, new fundings became available for the country, which provided (and still provide) new resources for higher education. The operative programmes of the I. National Development Plan (2004-2006, I. NDP), the New Hungary Development Plan (2007-2010, NHDP), the New Széchenyi Plan (2011-2013, ÚSZT), the Széchenyi 2020 (2014-2020) handled higher education in a privileged place, the strategic directions point from the training of human resources through infrastructural developments to the strengthening of the knowledge transfer role of the university knowledge base and to the deepening of international relations.

The sources of the 2021-2027 programming period will be organized around the five main objectives of the EU Cohesion Policy: a smarter, a greener and carbon free, a more connected and a more social Europe that is closer to citizens. The main development priorities are defined in the Partnership Agreements of Hungary. This document specifies the direction of the development of Hungarian higher education among the policy objectives of a social and smarter Europe. The basic goal is to channel the intellectual capacity available in higher education into the design and implementation of smart specialization strategy and local economic strategies, thus facilitating progress in global value chains. By supporting the cooperation of the actors involved in the quadruple helix model, it will be possible to stimulate the economy and develop the regions» (Hungarian Partnership Agreement 2021-2027, 15). The European Social Fund + (ESF+) will provide resources to strengthen the social and economic relevance of higher education as follows: implementation of education and training innovations, student-centered and flexible distance learning ways, institutional implementation of tools and methods for handling challenges of scientific life, smart university, support of the transition from higher education to the world of work, development of teacher training.

The European Regional Development Fund (ERDF) also provides resources to achieve RDI objectives. It focuses on the creation, support and development of organizations supporting higher education, academic and business cooperation, which undertake to focus their RDI activities on the needs of business partners by strengthening their research capacities. In addition, the energy modernization of higher education institutions is also a priority in the use of ERDF resources. (Hungarian Partnership Agreement 2021-2027) The organizational framework of the RDI development of Hungarian higher education can be provided by innovation parks as centers of the creation of innovation and centers of the flow of knowledge transfer.

Research, development and innovation (R+D+I)

Innovation is the set of scientific, technical, commercial and financial activities (transformation and new approach of an idea) which are required to develop and sell new products, utilize new production processes or equipment, or introduce a new approach to social services. According to Frascati Manual - which contains the knowledge of measuring innovation - is such a scientific, technical, organizational, financial and commercial activity, which leads to the implementation of technically advanced products and processes. R&D is one of these activities - at any stage of the innovation process. According to the Oslo Manual, innovation means the introduction of a new, or significantly improved product, service or process, new marketing or new organizational method in business practice, organization or external relations. The activity that brings innovation to the surface is research and development and technological innovation. Research and development includes basic research, applied research, and experimental development; research and development is the essence and hard core of innovation activity. There are relatively large differences among the countries of the European Union in terms of the weight of R&D activity (Figure 3) and the innovation activity (Figure 4) of the countries.

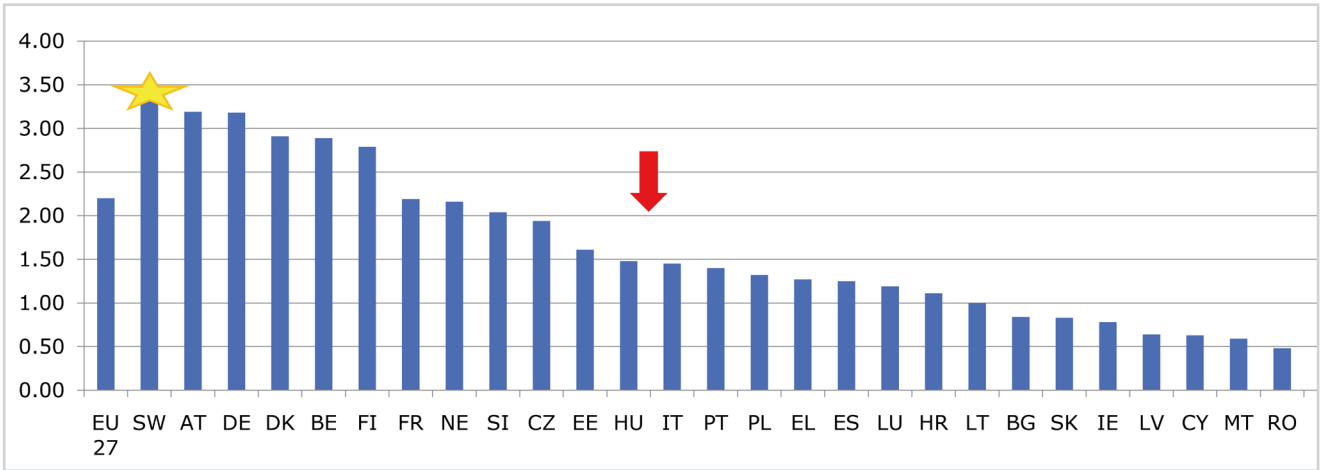

Figure 3:
Research and development expenditure, by sectors of performance, % of GDP, 2019
Source: Eurostat (2020)

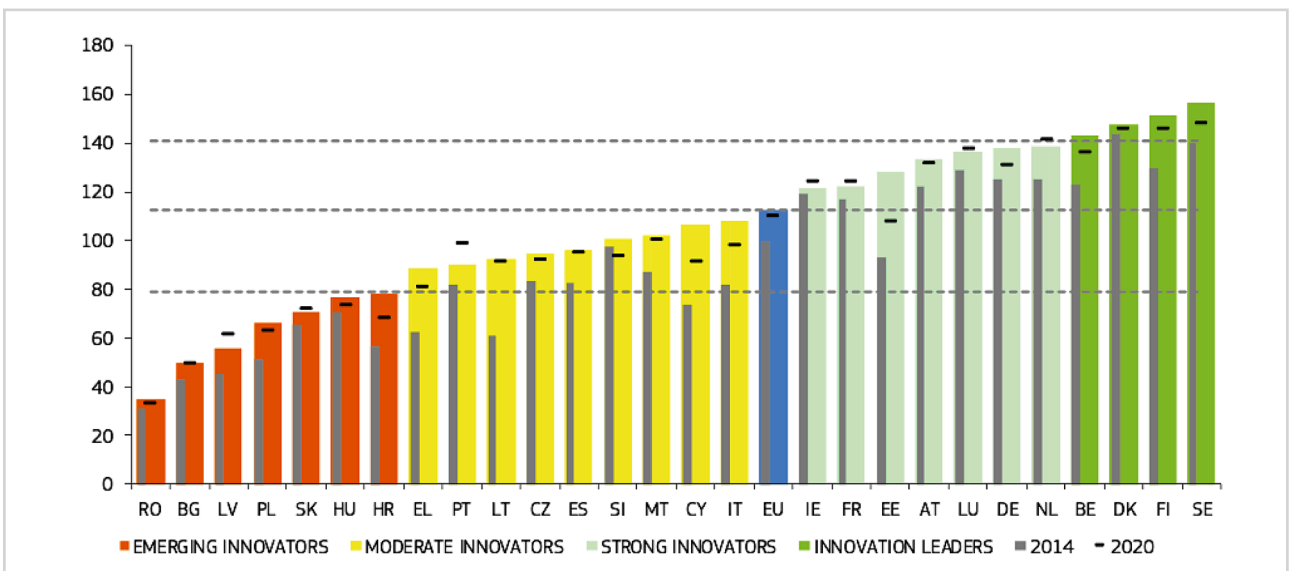

Figure 4:
The innovation performance of the EU member states, 2020
Source: European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, European Innovation Scoreboard (2021)

Intramural R&D expenditure (GERD) by source of funds

An innovative company is a company that has implemented innovation in a given period. The given period usually does not refer to one, i.e. a single year, but to a longer period (usually 3 years). However, innovation efforts are not always successful. Considering this, it is worth determining the definition of a company's innovation activity. A company is considered to be active in terms of innovation, if it had innovation activities during the survey; however the statistics also take into account ongoing and discontinued activities, whether they have been realized or not (Hoffer, 2010) (Figure 5).

Figure 6 shows the relative share of different sources in R&D. More precisely, the data mean the percent proportion of GERD (gross domestic expenditure on research and development), which are financed by industry, government, higher education and the private non-profit sector. R&D is an activity where significant reallocations of resources take place between units, organizations, sectors and countries. The importance of founding source has been recognized in one of the Barcelona objectives of the Lisbon Agenda. According to this, R&D is optimally financed in 1/3 from public funds and 2/3 from private sector.

Table 1 shows human resources in science and technology as a share of the active population. The data refer to the active population aged 25-64 year, which is classified as HRST (they have

successfully completed tertiary education or have worked in science and technology) in percent of the total active population aged 25-64 year.

Role of science parks in the development of knowledge-based economy

It is not easy to define innovation (scientific) parks (Science Parks) (Minguillo & Thelwall, 2015) as the parks are very different from each other on the basis of where they are located geographically, what their owner structure is like, what the surrounding economic environment is like, and they differ in terms of the knowledge management model that they have realized. However, their aim is always technology transfer, innovation, the development of start-up structure and the enhancement of university-business communication. The most quoted definition of innovation parks is that of the International Association of Science Parks (IASP): «science parks are organizations

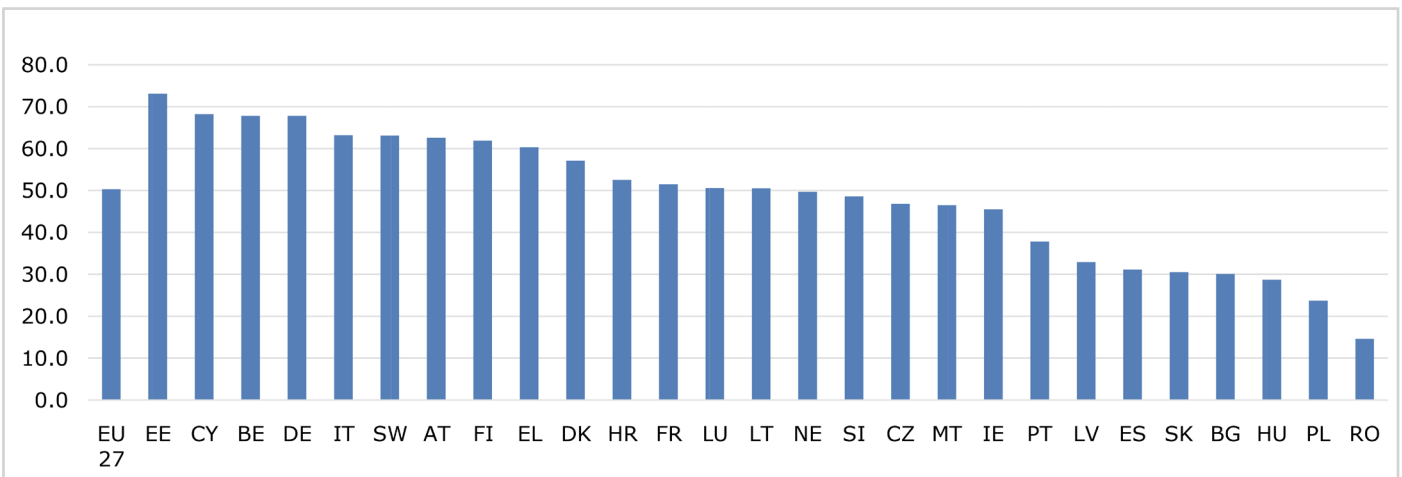

Figure 5:
Rate of innovative companies, 2018
Source: Eurostat, Community Innovation Survey

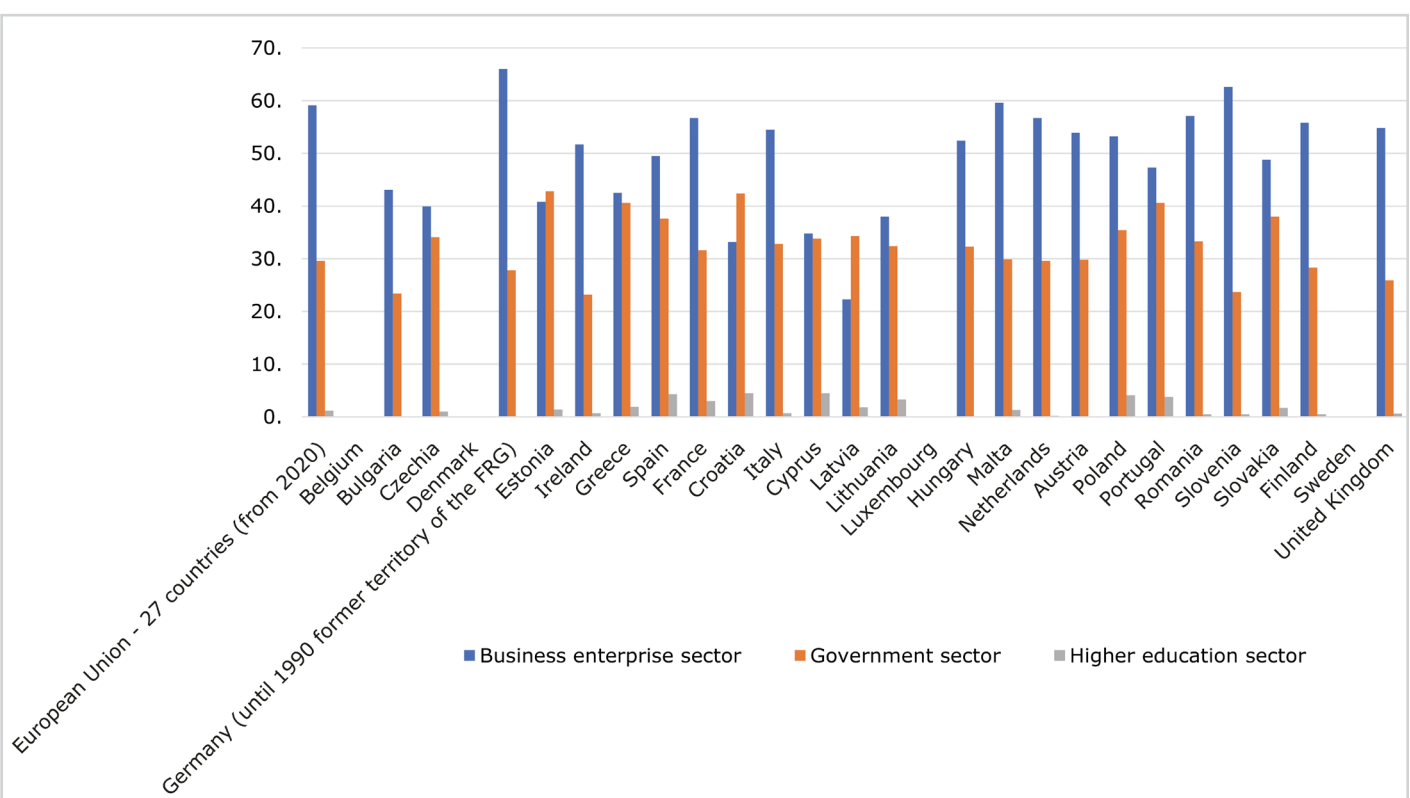

Figure 6:
Intramural R&D expenditure (GERD) by source of funds, 2018, %
Source: Compiled by the authors based on EUROSTAT (2021)

Table 1:
Human resources in science and technology (HRST), %

Time	2015	2016	2017	2018	2019	2020
European Union - 27 countries (from 2020)	43.7	44.4	45.1	46.0	46.9	49.0
Belgium	50.5	51.1	54.3	54.4	54.6	56.6
Bulgaria	36.3	36.8	36.5	36.8	36.6	38.0
Czechia	38.1	38.7	39.6	39.9	39.8	40.6
Denmark	54.6	55.4	56.9	57.7	58.4	59.3
Germany	47.7	48.4	48.7	49.3	50.3	55.7
Estonia	49.3	49.1	50.3	52.0	53.6	54.7
Ireland	54.2	54.9	56.6	57.2	58.0	60.8
Greece	36.1	37.4	38.5	39.2	39.3	40.7
Spain	42.7	43.4	44.3	45.1	46.5	47.8
France	50.0	50.6	50.9	52.2	53.5	55.2
Croatia	36.2	37.4	38.2	40.0	40.1	40.0
Italy	35.5	35.7	36.3	37.0	37.3	38.0
Cyprus	49.3	50.6	50.9	52.0	52.5	53.0
Latvia	42.4	43.3	44.4	44.4	46.8	47.7
Lithuania	48.2	49.1	49.4	50.5	51.9	52.4
Luxembourg	58.8	59.6	57.6	61.2	63.7	65.0
Hungary	36.7	36.3	36.5	37.3	38.2	39.9
Malta	40.2	40.3	42.8	46.0	47.0	47.4
Netherlands	53.6	54.6	55.3	56.9	58.7	60.8
Austria	48.6	49.1	50.1	50.4	51.1	52.2
Poland	41.6	42.8	44.0	45.2	46.0	46.6
Portugal	34.8	36.2	36.4	37.5	38.3	40.9
Romania	27.0	27.6	27.7	27.9	28.2	28.4
Slovenia	45.1	46.5	47.8	47.4	48.2	50.6
Slovakia	33.5	34.2	35.2	36.9	38.1	39.7
Finland	56.5	56.9	57.7	58.4	59.9	61.6
Sweden	56.2	57.9	58.6	59.9	60.7	61.4
United Kingdom	55.5	56.8	57.0	57.6	59.1	-

Source: Compiled by the authors based on EUROSTAT (2021)

managed by specialized professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions To enable these goals to be met, a Science Park stimulates and manages the flow of knowledge and technology amongst universities, R&D institutions, companies and markets; it facilitates the creation and growth of innovation-based companies through incubation and spin-off processes; and provides other value-added services together with high quality space and facilities» (IASP, 2012).

In the European Union, according to a study by the European Commission (2014) there are approximately 400 innovation parks in operation, which operate within different frameworks, but are still organized for the same aims. The aims are the following:

- promotion of innovation and competitiveness;
- support of local or regional economic development;
- cooperation with other knowledge centers;
- establishment of technological start-ups;
- investment in knowledge-based enterprises;
- cluster developments.

The founding institutional, research and regional economic development aims cannot be ignored when examining innovation parks. Taking these into account, Annerstedt (2006) considers that innovation parks can be divided into three main groups, first-, second-, and third generation scientific parks. First generation parks are described as «science push» institutions where the founding universities promote knowledge transfer towards marketable products, services or technologies, but the vast majority of the activities of the park are focused on R&D activities.

The second generation of innovation parks is called «market pull». They are still closely related to universities, but physical proximity and 100% ownership or control are not at all essential conditions of the operation. These organizations primarily support innovative companies with high growth potential, their goal is not only to find the «market» for university knowledge, but, the other way round, to establish university knowledge that can be linked to the market needs.

The third generation of innovation parks is closer to the «market pull» approach, although they play a key role in the local innovation economy and the community development. Open innovation and digital cooperative solutions can play an active role in daily operation. These

parks can usually be found in urban, inner city environments, and they act as local and regional catalysts.

Although only first generation parks are characterized as pure university property, higher education plays a decisive role in the case of each category. The advantages of developments based on a university-corporate-state-non-profit partnership are undisputed; moreover, they play a significant role in the development of local economy. Through the partnership of universities and research institutes, access to the knowledge base can accelerate the processes of technology transfer. The university property in itself does not guarantee efficient university-business communication. A strong and competent management background, as well as community building services are indispensable accessories of the development of the local and regional innovation eco-system (Albahari et al., 2017). The approach of McCarthy (2018), who differentiates university innovation parks by their development services and specialization, stands out from the studies dealing with the examination of innovation parks owned by universities. In this two-dimensional classification, the authors suggest four categories (matchmaker, gardener, landlord and coach) to model park strategies and their impacts (Figure 7).

In the Landlord strategy, low industrial specialization and low development services are characteristic. The management of the park does not employ strict selection criteria for the leaseholders, the businesses do not have a sector-focused portfolio. As the cooperation among the leaseholders is not supported by the management, according to this strategy the possible park resources are used less.

The Matchmaker science parks with high industrial specialization and low development services still do not offer development services for the leaseholders, as the development of innovation ecosystem does not belong to their objectives set.

The most resource-intensive strategy is the Coach with high level of development services and low industrial specialization. While it is easier to win the leaseholders, thereby to utilize the infrastructure, because of the wide scale of sectoral focus, networking and setting the park services to individual leaseholder needs mean a difficulty due to this diversity.

The Gardener strategy with an approach of high development and high industrial specialization is the priority form of the support of the local economy and the innovation ecosystem. The concentration of management resources is supported by the narrow sectoral scope, while there are certain risks and dependency against the chosen industry.

The strategy along which an innovation park operates does not affect its impact on the region. In the case of developed regions, this effect is clear, which in addition to job creation, involvement of budgetary and other external sources, is also reflected in the volume of RDI activities. Science Parks can also contribute to the development of less developed regions by attracting technology-intensive investments to the region. However, this is a double-edged weapon, because the access of scientific inputs is limited in less developed regions (Almeida, Afonso, & Silva, 2020).

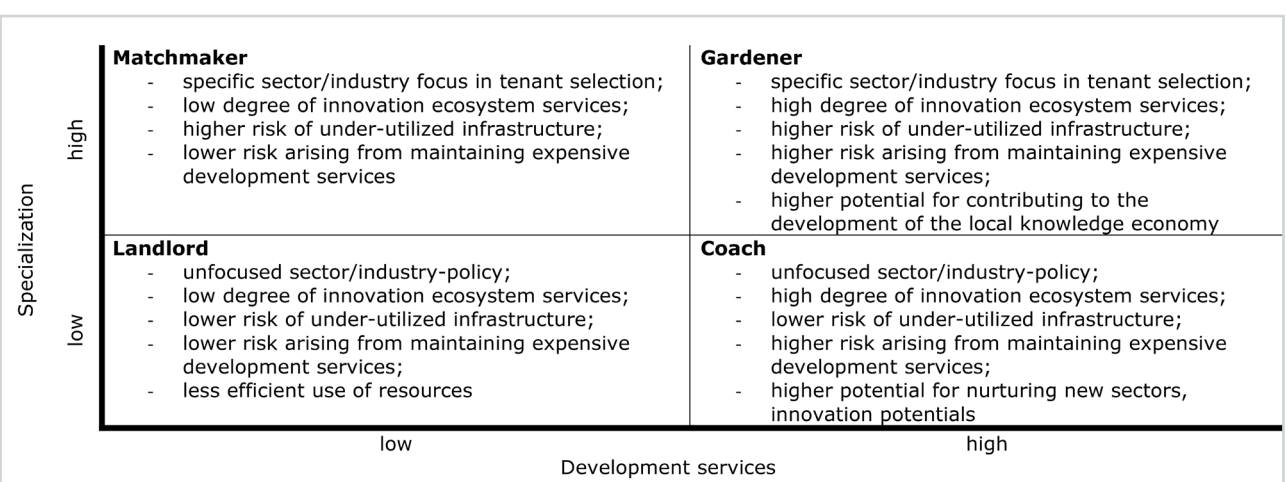

Figure 7:
Science park strategies
Source: McCarthy, Ian, Silvestre, Nordenflycht, Breznitz and Shiri:
A typology of university research park strategies: What parks do and why it matters (2018)

3. Purpose

The purpose of this article is to examine the ongoing processes in higher education today and more exactly to understand the global trends behind this transformation. Indeed, it is not only higher education that has an impact on the life of the - narrower and wider - region in which it operates, but also the region itself. Moreover, global processes force the institutions that would like to win the competition for students, research results and funding sources to undergo change. Our work focuses on understanding technological changes, serving the knowledge-based economy related to this and understanding means available for this. University roles and the change of the models of knowledge transfer induce further transformations in the university approach. The universities of the United States, which are to a large extent well ahead of the development of the cooperation models of European universities, set good examples. However, the heterogeneity of institutions makes it more difficult to do scientific research to create uniform categories and indicators to evaluate the performance of collaborations.

4. Results

Regional cooperation, common thinking, training and innovation, scientific workshops, the key role of businesses all have contributed and contribute to the development of the industry and the region. It is formulated by Blair H. Sheppard, the global strategic leader of PWC in one of his books how important coexistence was: «Before globalization became dominant and in the early stages of its spread, business success was closely linked to the success of the community or the society in which it operated. The capital was generated and primarily stayed where the workers and clients came from, even if a part of it came from sales outside the given region. A significant part of large enterprises in several fields were launched at a local level in a sense and finally became a business empire. Small- and medium size enterprises were even more important for the development of an economy. Without those who promoted the multiplication of workplaces and took innovation from one region to another, it would have been unthinkable for today strong countries to get into leading positions in the world market» (Sheppard, 2020).

All European patent applications relate to an application protection of an invention, which is either filed directly to the European Patent Office (EPO) or is filed based on the Patent Cooperation Treaty and is designates the EPO (Euro-PCT), regardless whether it has been granted or not (Table 2).

Table 2:
Patent applications to the European patent office (EPO) by priority year

	Patent applications to the European patent office (EPO) by priority year			Per million inhabitants		
Time	2015	2016	2017	2015	2016	2017
European Union - 27 countries (from 2020)	51 545.3	50 440.8	49 211.8	112.55	109.71	106.84
Belgium	1 569.72	1 589.1	1 655.44	139.69	140.49	145.83
Bulgaria	31.88	31.06	29.33	4.43	4.34	4.13
Czechia	295.4	318.67	357.38	28.03	30.19	33.78
Denmark	1 362.08	1 372.4	1 417.73	240.66	240.47	246.61
Germany (until 1990 former territory of the FRG)	21 030.44	20 138.13	18 881.7	259.00	245.06	228.81
Estonia	38.32	33.01	36.31	29.14	25.08	27.60
Ireland	382.11	361.89	371.46	81.69	76.57	77.64
Greece	97.2	92.14	90.25	8.95	8.54	8.38
Spain	1 628.73	1 641.48	1 654.56	35.06	35.35	35.56
France	9 601.54	9 555.39	9 502.67	144.48	143.19	141.85
Croatia	17.91	21.06	19.94	4.24	5.03	4.80
Italy	4 369.99	4 242.17	4 148	71.88	69.93	68.46
Cyprus	8.76	9.32	9.08	10.34	10.99	10.62
Latvia	26.17	21.64	22.26	13.18	10.99	11.41
Lithuania	24.5	19.15	21.57	8.39	6.63	7.57
Luxembourg	65.37	61.46	55.49	116.12	106.66	93.94
Hungary	205.23	201.27	196.77	20.82	20.47	20.08
Malta	7.43	6.65	6.63	16.90	14.76	14.40
Netherlands	3 500.2	3 452.44	3 477.55	207.10	203.33	203.59
Austria	2 001.61	2 025.15	2 029.62	233.15	232.76	231.35
Poland	578.38	627.33	686.64	15.22	16.52	18.08
Portugal	137.37	139.12	142.23	13.24	13.45	13.80
Romania	93.51	98.91	99.57	4.71	5.01	5.07
Slovenia	119.09	112.36	114.25	57.73	54.43	55.30
Slovakia	41.93	54.23	55.14	7.73	9.99	10.14
Finland	1 384.73	1 314.93	1 296.99	253.07	239.63	235.68
Sweden	2 925.66	2 900.34	2 833.23	300.15	294.42	283.46
United Kingdom	5 692.11	5 543.35	5 437.02	87.74	84.78	82.62

Source: Compiled by the authors based on EUROSTAT

In the future, it is not a question of whether modern corporate-entrepreneurial approach and work culture will develop beside the academic-scientific atmosphere, but it is a question of whether the participants will be to be able to exploit the benefits deriving from the new approach and to take economic advantage for themselves by responding with adequate innovation to the technological-technical changes (Figure 8). All this can only be realized through close cooperation with regional participants and the common thinking of higher education-local governments/state-businesses-non-profit sector, a possible solution of which is the establishment of innovation parks as the catalysts of the knowledge-based economy. Whatever standardization or profile an innovation park should operate in, it can generally be said that as a result of the strengthening of the innovation ecosystem based on innovation parks a third mission and entrepreneurial agenda fitting into the university profile will be established, together with a functional resources allocation strategy which supports entrepreneurial activities and innovation with the help of different incentives and horizontal support services.

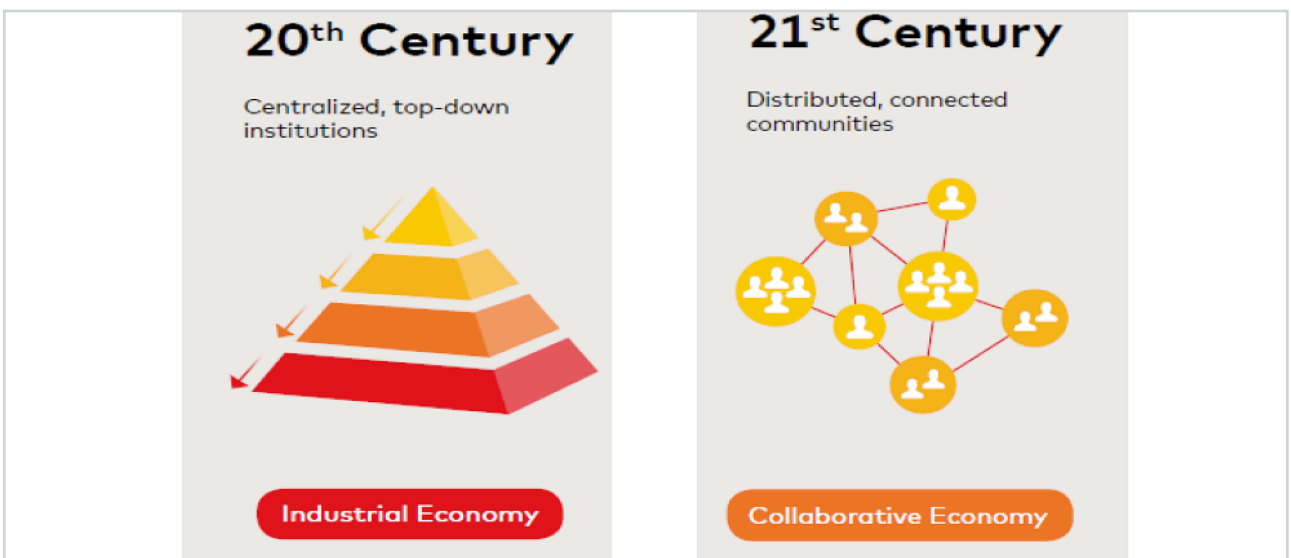

Figure 8:
The 21's century will be different…
Source: Mastercard: The Sharing Economy Report. Némethné (2020). Az innováció összefüggései (Contexts of innovation). Handwriting, Corvinus University of Budapest, 24.03.2020, Course

5. Conclusion

Nothing is permanent. In an age of globalization alongside rapid technological changes, in the field of innovation-development, business-universities and the governmental levels operate in strong synergy in the developed countries of the world.

The Ustream founder Gyula Fehér presents an example of success based on cooperation in his writing about the EU-USA-China technological war. The leading American tech companies were established by young people who started out from small garages with little capital, but later conquered the world. Today, universities provide the scientific backdrop for the sector, but it was not much different during the Second World War, except for the fact that the participants of the sector were mainly working on the projects of the American government. The success of certain projects was (and is still) measured by whether the emerging «strategic dilemma» could have been solved through some of the newly developed innovations. Development programmes never focused on further developing existing technologies; they were expected to evolve some kind of new technological solution. Of course, the best solutions were applied in practice as swiftly as possible. Several uncertain research programmes with unpredictable results were carried out in the States due to the «always innovative» nature of research. Besides the opportunity for major benefit, it necessarily resulted in a sort of uncertainty, with high financing risk, which included an excessive credit risk for the banks. The government, which assisted the rise of new developments with several grants in the 1970s, entered at this point. The incentives included the following: 2 dollars of public money was associated with every 1 dollar invested in the emerging innovative companies, or the tax rate of the profit of the funds was halved; moreover, it was made possible for pension funds to

invest a smaller part of their wealth in such funds. As a result of this support system, the American capital market was established by the late 1980s. The example illustrates well that it is cooperation among state, academic and business sectors which has contributed to the success and the technological superiority in the United States of several high-tech industries over the rest of the world today. Innovation and technology transfer are as essential elements of this system as is the participation of teachers, researchers, professors in enterprises as consultants, investors or owners.

It is the university's task (with use of the good experience of developed countries) to serve society, the economy and its environment, of which the above collaborations set a unique example. These are opportunities which are based on confidential, transparent partnership. Universities also have to adapt to their new role, and different structures and approaches and there is a need for culture change in several fields as well. Common strategies are required, development concepts, complex approaches, cooperation and bold action besides increased empathy in every field to be able to solve the difficulties caused by the Coronavirus pandemic. Universities can provide a solid foundation and partnership as illustrated, with a proactive, supportive approach.

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