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Research Insights
Изследователски проникновения

EDUCATION 4.0 – THE CHANGE OF HIGHER EDUCATION INSTITUTIONS AND THE LABOUR MARKET

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Abstract. Globalization and digitalization under the influence of the Fourth Industrial Revolution led to a change in all key sectors. The connection between education and the labour market under the influence of Education 4.0 is especially relevant. Changes in structural employment have brought to the fore the need for new skills. In this regard, the impact of globalization and digitalization on higher education institutions, their transformation under the influence of Education 4.0 and the impact on the labour market are considered. All this leads to the conclusion that the share employment by sectors is changing and education has to adapt to the needs of the labour market.

Keywords: Education 4.0; HEI's; labour market; globalization; technological progress; labor force

Introduction

The currently observed processes of globalization and digitalization set a series of challenges, presupposing the need for strategic reorientation of a number of industrial sectors, in relation to their competitive positioning in the newly created macroeconomic environment and the emerging "new economic model". With a focus on high technology and digitalization, the Fourth Industrial Revolution (Kagermann et al. 2011; Burganov & Bystrov 2014; Schwab 2015; Lu 2017) is perceived as a new paradigm, outlining the transition from "centralized" to "decentralized" smart manufacturing and a focus on „innovative research" (Shvertner & Ilieva 2020).

Viewed through the prism of the systems approach, Industry 4.0 emerges as a platform of interconnected components, "smart factories" (Frank & Dalenogare 2019) of people, machines, products which directly interact in cyberphysical systems (Li Da Xu, L. et al. 2018), including interfaces, intelligent sensors, mobile applications, cloud technologies and the Internet of Things (Lu 2017), virtual

reality, 3D printers, Big Data, etc. The integration processes, which stand out from the interaction between the elements of the system and the so formed connections (horizontally and vertically), situate them in conditions of collaboration and coordinated cooperation, in search of opportunities and potential for "sustainable innovative growth"[1)] and competitiveness.

The ongoing processes find their projection on the labour market, which reflects on the overall management of the work processes and activities of the business entities, and in connection with the need for staff with the necessary qualifications, qualities, skills and competencies. This is also evident in the derived development priorities (Kagermann et al. 2011), some of which are related to the selection, training and professional development of the staff.

In the context of the above-stated and in connection with the focus placed on the systematic approach, attention is paid to taking into account the importance of interaction and cooperation between HEIs (as an educational institution and knowledge producer) and the labour market (as its user) in relation to training and the realization of the graduating students.

The main goal of the study is to outline the challenges which the HEIs face, along with the emerging new shapes and approaches of education, typical for Education 4.0, in response to the needs and requirements of the labour market, determined by the current processes of globalization and digitalization.

Methodology

The study is based on: analysis and synthesis, analysis of secondary data, content analysis, situational and comparative analyses.

The data are processed with IBM SPSS Statistics, and the static methods implemented are: descriptive and factor analysis.

The approaches applied are: integration, system and network approaches.

Its object is the dynamics of the labour market under the influence of modern necessities, and the subject is the role of HEIs and their relationship with the labour market, outlined through the prism of the processes of globalization and digitalization.

In order to achieve the research goal, the following tasks have been set:

– Impact of the macroeconomic changes caused by the processes of globalization and Industry 4.0 on the higher education institutions (HEIs) and the labour market.

– Outlining of some basic aspects of the cooperation between HEIs and the labour market, as a strategic orientation for dealing with the challenges of Industry 4.0.

– Outlining of the skills necessary for adaptation to the new realities of the labour market and the role of HEIs.

Outlining of the influence and role of HEIs and globalization on the labour market in Bulgaria and the EU through a comparative analysis of temporary employment at the sectoral level.

Findings

A) Globalization – impact on innovation, higher education and the labour market

A large-scale analysis has been carried out on globalization and technological progress, and in particular innovation, as well as their impact on the labour market and the emerging need for new competencies and the remodelling of HEIs under this influence.

Globalization and its associated consequences, such as technological advance and market liberalization, are a source of new opportunities and challenges for the development of economic, demographic and political life. The various aspects of globalization also show their side effects, which are unevenly distributed among regions, markets and citizens and which lead to polarization between them. For example, the labour market and the nature of jobs are also affected by globalization and the resulting factors, the combined effect of which is becoming even more significant. All this requires a reconsideration of current practices and the need to implement programs and measures tailored to the requirements of modern times, namely that they are aimed at achieving growing, sustainable and inclusive economies. The driving force for achieving long-term economic growth is the effective integration of the factors of production, labor and capital, which is made possible by the use of technology. Innovation is a key element of technological progress worldwide.

The aftermath of technological change on all spheres of social and economic life and the very scale of change lead to the emergence of the so-called Fourth Industrial Revolution or Industry 4.0, which include "technological developments aimed mainly at improving augmented reality interfaces, the development of large-scale data analysis through machine learning, the creation of intelligent computer programs with a high degree of autonomy and especially their connection with other digital and physical systems"[2].

In the era of the Fourth Industrial Revolution, in which technology and innovation are the driving force, there is a restructuring of the world market, in which countries like China are transforming their production from low-cost and labour-intensive to highly skilled, technological production. Technological progress and innovation leave an indisputable imprint on the work process, organizational forms and structure of jobs. The professional profile structure is changing, as professions related to the industry are dying out, and new professions are emerging, the profile of which includes key qualifications in the field of information technology; language, communication skills, etc. These modern challenges for the design of professions require greater flexibility and adaptability. The significant modification in the structure of jobs redirects labour to development activities. This also leads to a change in the educational process. It does not end with obtaining an educational degree, but on the contrary - begins with starting work, precisely because of the dynamics of jobs. For this reason, the role of lifelong learning policies, which make it possible to adapt the workforce to shifts in

the labor market and to the needs of the economy, is growing. All this requires a better understanding of technology and innovation, which is why it is necessary to clarify the essence of the very concepts themselves.

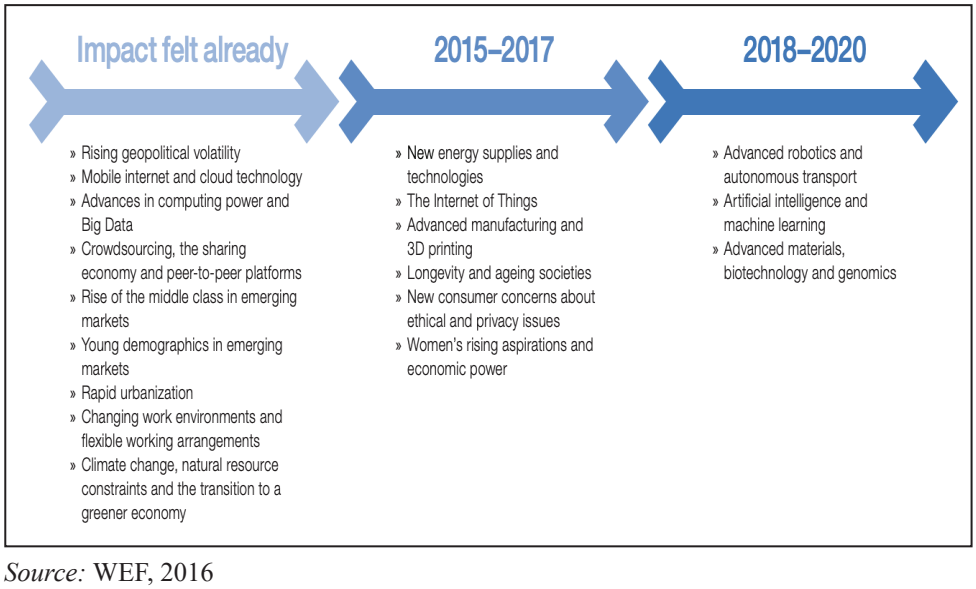
Innovation can be seen as both a dependent and an independent variable. Some of the elements of the analysis can be both a factor for and a result of innovation. For example, high quality along with the development of human capital is the reason for creating innovation, but at the same time it can be a consequence of innovation. This makes it difficult to clearly distinguish between the causes of innovation and its consequences. Another conclusion from the analysis is that innovation can have both positive and negative effects, and this largely depends on how the distribution of innovation is managed. On the one hand, innovation creates the preconditions for creating new jobs and employment. On the other hand, innovation can destroy existing jobs, which can be replaced by new jobs that are fully automated. In addition to the positive economic and social effects on society related to economic growth, employment, improved welfare, efficient public services, etc., innovation also has a negative impact on society: Some of the effects of globalization and technological progress, and namely, economic change, market restructuring, the imposition of new models of income distribution, modern employment models, lead to social and economic polarization, which undermines social cohesion.

The conclusions point that globalization, technological progress and demographic change are the factors that have a profound impact on the competencies associated with new jobs. These megatrends affect the number and quality of positions available, as well as the skills which workers will need in the future to succeed in an increasingly competitive environment. An OECD study[2)] reveals that the nature and intensity of the skills required by the companies can vary considerably from country to country depending on the productive structure of each economy or technological progress. Among OECD[3)] countries, the work skills analysed show that more than 5 out of 10 positions that are difficult to fill (i.e. are in short supply) are found in highly skilled professions. These jobs range from management positions to highly qualified professionals in the fields of healthcare, teaching or ICT. They are less in low-skilled positions. On average in the OECD, the shortage is strongest in computer and electronics jobs (i.e. knowledge of hardware and software, programming and applications), followed by a significant demand for decision-making, communication and verbal skills, abilities related to the acquisition and application of information in problem solving. The focus is already shifting to the search for completely new skills and key competencies. Moreover, the development of technology (evident from the hereby offered research) requires a remodelling in the labour market, namely – the growing demand for highly specialized workers. Employees are increasingly educated, as significant educational progress has been made in the EU for decades. In all Member States, young groups are better educated than the previous generation.

B) Digitalisation – impact on HEIs and the labour market

Each one of the stages in industrial development can be considered through the prism of the specifics of production and their impact on the business environment and the activities of industrial sectors. While Industry 1.0 focuses on the mechanization of production processes, Industry 2.0 brings out the processes of electrification, and Industry 3.0 is related to the automation of production, then Industry 4.0 is focused on high-tech development and the processes of digitalisation of the economy. Technological progress and digitalisation inevitably leave an impact on the labor market as well. A number of international studies take into account the observed and expected (forecast) changes in occupations and jobs. These include both the emergence of new "types of work", with their corresponding current and „future requirements" for qualifications and skills[1)], along with the shift in the very way people work[4)]. According to the Institute of the Future, "85% of occupations of 2030 do not yet exist"[5)], and citing its own sources, the World Economic Forum states that 65% of children who start school today will be employed professionally in new types of professions that are non-existent today[1)].

In 2016, the Forum presents its Report The Futures of Jobs, which sets out forecasts predicting the closure of millions of work positions, mainly administrative and office positions and the opening of new ones - with a focus on computer, mathematics, engineering, etc. professional profiles. The periodization of the changes shaped in the Report is determined by a number of prerequisites (Fig. 1) and their impact on



Source: WEF, 2016

Figure 1. Timeframe to impact industries, business models

the quality of life and economic development of nations, as a consequence of the formation of "new business models". This is an indicator of a change in demand and the need for the formation of relevant skills, which in turn is an indicator of the need for modification and innovation in the educational process in response to the anticipated (and observed) requirements of the work environment.

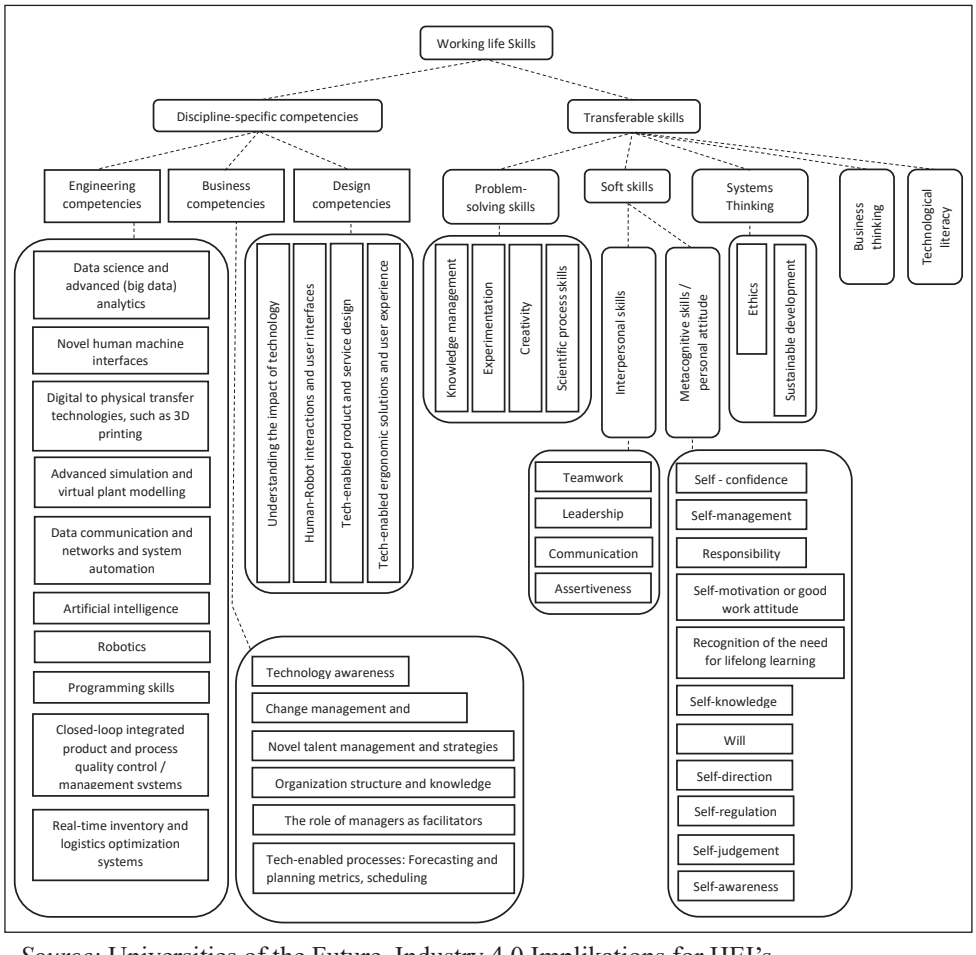
There is an evident necessity for a strategic reorientation of the Universities to meet the digital challenges, defending their leading role, defined by the transition of the European economy to a "knowledge economy", in line with the three "mutually reinforcing priorities" set out in the Europe 2020 Strategy – for smart, sustainable and inclusive growth[6]. This, on the one hand, draws attention to Education 4.0 and the future-oriented education, and on the other hand, derives the importance of the university-business interaction in relation to "building structures", "ecosystems" (including educational such) to accelerate the "global transfer of know-how, by identifying, developing and adapting already proven good practices and formats" (Stanimirov 2020).

C) Education 4.0 – transformation of HEIs

The alterations in the macroeconomic environment pose higher education institutions (HEIs) in a number of challenges, which in the context of Education 4.0 (Laptev & Efimov 2016; Todorov & Kamberov 2018; Salmon 2019; Stanimirov 2020) raise the need to transform the education system and adopt a different approach to learning, enabling students to acquire professional skills and qualifications adequate to the "requirements of the workplace" (Stanimirov 2020) and the needs of the labor market.

Universities 4.0 are expected to become an "infrastructure platform" (Laptev & Efimov 2016) for various activities, a "cognitive society" (Laptev & Efimov 2016, 269) consisting of hybrid technologies and collective intelligence (Efimov & Lapteva 2017), a set of and intersection points for multiple cooperation networks and knowledge transfer.

This puts a focus on modern forms of education which enable the students to be involved in project activities and field work, as a way to build the skills and competencies so necessary for their professional realization. The emphasis is on the acquisition of interdisciplinary competence, ability to make informed decisions and manage people, skills to take on multifunctional and complex tasks, teamwork, forecasting, skills to work in strategic and complex areas and the use of technological products (computers, tablets, etc.), internet and mobile applications, etc. HEIs become "living laboratories" (Verhoef & Bossert 2019), in which the method of "learning by doing" helps to form in students the so-called "transferable skills"[4] or "21st century skills" (Fig. 2), which include both personal qualities and educational qualifications, as well as "key competences" and "soft skills" necessary for their professional realization, such as creativity, flexibility, adaptability, analyticalness, abstract thinking, communicativeness, etc.



Source: Universities of the Future, Industry 4.0 Implikations for HEI's

Figure 2. Working life skills

An essential moment in the overall educational process is the relationship between HEIs and the labor market, which functions in both directions. In order for HEIs to meet the need for staff with specific knowledge and skills, businesses are expected to actively participate in the process through: offering traineeships and internships, participation in scientific forums, round tables and commissions to update curricula, in the opening of new specialties, including those which provide the necessary digital competencies, becoming an imperative of the emerging new business models, etc. According to a statement of the World Bank[7], analyzed by the authors, the changing nature of work makes higher education more attractive in three aspects. Firstly,

technology and integration increase the demand for higher-level common cognitive skills - such as problem solving, critical thinking and advanced communication, which are essential for new positions but cannot be acquired through training alone but through education, too. The growing demand for these skills leads to increased salaries for higher education graduates, while the demand for less educated workers decreases Secondly, higher education increases the demand for lifelong learning policies. Workers are expected to have multiple careers, not just a few throughout their lives. Higher education, with a wide range of courses, offers also flexible acquisition models such as online learning and open universities, meets this growing demand. Thirdly, higher education – particularly universities – is becoming more attractive in a shifting world, serving as a platform for innovation. The importance of higher education systems for the future of work depends on how well they cope with these three areas.

D) Labour market

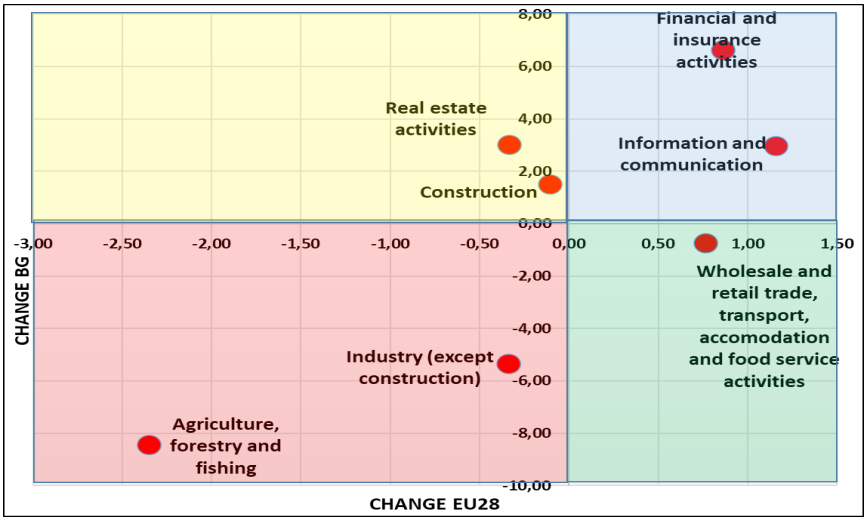
Labour markets are changing rapidly and employees need to be prepared to change careers or even sectors of activity, as innovation is likely to affect skills demands and, as such, demand for workers. Therefore, developing skills which facilitate labour market transitions become paramount. In addition, motivation largely determines efficiency and effectiveness, as this process is a significant factor in the formation and development of the human capital in organizations. The creation of a skilled workforce for future work is based on the growing demand for advanced cognitive skills, socio-behavioural skills and adaptability. The ability of an employee to adapt quickly to change is increasingly appreciated by the labour market. The desired trait is adaptability – the ability to react to unexpected circumstances and quickly unlearn and learn again. This competence requires a combination of certain cognitive skills (critical thinking, problems) and socio-behavioural skills (curiosity, creativity). The OECD concludes[2)] that high-level cognitive skills and the crossroads between technology and the humanities are the future. While the intensive search for a high level of cognitive skills may not be surprising, the observed shortage in some knowledge related to the humanities, such as psychology or therapy and counselling, may be the entry of new technologies and digital products. More than ever, it is intertwined with the need to understand consumers' preferences, desires and habits and their “human” answers to the question of why they consume. These are all aspects which require well-developed knowledge of how society and human social behaviour function.

Results and discussion

Based on the empirical study, Figure 3 presents in a comparative perspective the change in the share of employment by economic sectors in Bulgaria and the EU28 in 2018 compared to 2009, in percentage points of the employed in part-time

employment. The conclusions from the presented figure, presenting the alterations in the share employment of the part-time employees are as follows:

– *The Agriculture, forestry and fishing sector* reduces its share employment in both Bulgaria and the EU, with a stronger change in Bulgaria - b– as much as 8.46 percentage points against 2.35 in EU;



part time employment	total	
Sectors	EU28	Bulgaria
Agriculture, forestry and fishing	-2,35	-8,46
Industry (except construction)	-0,34	-5,36
Construction	-0,10	1,49
Wholesale and retail trade, transport, accomodation and food service activities	0,77	-0,76
Information and communication	0,03	
Financial and insurance activities	-0,17	
Real estate activities	-0,01	
Professional, scientific and technical activities; administrative and support service ac	1,16	2,96
Public administration, defence, education, human health and social work activities	0,86	6,60
Arts, entertainment and recreation; other service activities; activities of household an	-0,33	2,99
No response	0,47	

Figure 3. Change in the share employment by economic sectors of the part-time employees in Bulgaria and the EU28 in percentage points in 2018 compared to 2009

– *Sector Professional, scientific and technical activities, administrative and support services* increases its share employment in both Bulgaria and the EU, with a larger shift in Bulgaria – by just over 2.9 percentage points against 1.16 in the EU;

– *Sector Public administration, defense, education, human health and social work* increases its share employment in both Bulgaria and the EU, with stronger change in Bulgaria – by as much as 6.6 percentage points against 0.86 in the EU.

– *Sector Arts, entertainment, and recreation, other service activities, activities of household repairs and other activities* raises its share employment in Bulgaria – by almost 3 percentage points, but decreases it in the EU by 0.33 percentage points.

– The share of respondents who indicated „no response" from the represented sectors increased by 0.47 percentage points in the EU.

Summary

1. In balance, in Bulgaria in 2018 compared to 2009 there is a decrease in the share employment of 3 sectors, with the largest negative change in the Agriculture, Forestry and Fishing Sector by (-8.46) percentage points. In four sectors there is an increase in share employment, which is strongest in the Sector public administration, defence, education, human health and social work by (+6.6) percentage points. There is lack of data for three sectors;

2. In brief, in the EU28 in 2018 compared to 2009 there is a decrease in the share employment of six sectors, with the largest negative change in the Agriculture, Forestry and Fishing Sector by (-2.35) percentage points. In the other four sectors there is an increase in the share employment, which is the strongest in the Sector Professional, scientific and technical activities, administrative and support services by (+1,16) percentage points.

3. Comparing the EU and Bulgaria we can conclude that:

– there are two common sectors in which there is a reduction in share employment: Agriculture, forestry and fishing and Industry (excluding construction);

– there are two common sectors in which there is an increase in share employment: Professional, scientific and technical activities, administrative and support services and Public administration, defence, education, human health and social work;

– there are three sectors in which the dynamics diverge and suggest the presence of specific factors that have different influences in Bulgaria and the EU and should be studied: Construction, Wholesale and retail trade, transport, accommodation and food services and Arts, entertainment, and recreation, other service activities, activities of household repairs and other activities.

Table 1 presents an analysis of the economic sectors in the EU and Bulgaria in part-time employment for the period 2009 – 2018, by main statistical indicators.

Descriptive statistics for the EU (above) and Bulgaria (below) for share employment by economic activities in the period 2009 – 2018 for part-time employment.

Table 1. Analysis of the economic sectors in the EU and Bulgaria (in part-time employment) for the period 2009 – 2018 (by main statistical indicators)

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
Agriculture, forestry and fishing	10	2,35	3,76	6,11	4,991	,85381	,729
Industry (except construction)	10	,40	6,35	6,75	6,457	,11621	,014
Construction	10	,17	2,61	2,79	2,706	,05470	,003
Wholesale and retail trade, transport, accomodation and food service activities	10	1,09	25,98	27,07	26,51	,37299	,139
Information and communication	10	,18	1,95	2,13	2,019	,05379	,003
Financial and insurance activities	10	,17	2,01	2,18	2,060	,05283	,003
Real estate activities	10	,05	,86	,91	,8921	,01505	,000
Professional, scientific and technical activities; administrative and support service activities	10	1,20	10,67	11,87	11,32	,48668	,237
Public administration, defence, education, human health and social work activities	10	,91	31,43	32,34	31,82	,31391	,099
Arts, entertainment and recreation; other service activities; activities of household and extra-territorial organizations and bodies	10	,42	9,76	10,18	9,976	,17935	,032
Valid N (listwise)	10						

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
Agriculture, forestry and fishing	10	11,97	14,91	26,88	19,34	3,49908	12,24
Industry (except construction)	10	6,49	4,45	10,94	7,747	1,83127	3,354
Construction	9	3,84	5,01	8,85	6,541	1,05296	1,109
Wholesale and retail trade, transport, accomodation and food service activities	10	7,41	19,85	27,26	22,86	2,25754	5,096
Information and communication	0						
Financial and insurance activities	0						
Real estate activities	0						
Professional, scientific and technical activities; administrative and support service activities	10	6,96	8,90	15,86	12,43	2,60081	6,764
Public administration, defence, education, human health and social work activities	10	8,24	11,20	19,44	15,50	2,66830	7,120
Arts, entertainment and recreation; other service activities; activities of household and extra-territorial organizations and bodies	10	6,59	7,67	14,27	10,84	2,24595	5,044
Valid N (listwise)	0						

The following main points can be indicated from the presented table:

1. The conclusions from the graphical analysis are confirmed that the largest changes in the share employment in percentage points are in Bulgaria, while in the EU the changes are more limited. All sectors in Bulgaria have a much larger scope and, accordingly, variations in values compared to the EU28.

2. In comparison with the values of the scale and respectively of the strength of the change in the share employment of the economic sectors in Bulgaria concerning full employment, here these values are many times higher. It should be highlighted that the factors leading to a change in employment among the sectors are most strongly reflected in part-time employment.

The following results for Bulgaria can be deduced as a conclusion from the conducted empirical research:

The sectors which undergo the weakest change in the share employment and respectively showing the most stable share employment during the studied 10-year period in comparison are: the Construction Sector – with a value of the scope below 4 percentage points.

The sectors with the largest modifications are: Agriculture, forestry and fishing, Wholesale and retail trade, transport, accommodation and food services and Public administration, defense, education, human health and social work - by more than 7 percentage points. The change can be clearly explained by the size of the share employment of the sectors.

The results for the EU are as follows:

– the sectors that have undergone the weakest change in share employment and, accordingly, showing the most stable share employment during the surveyed 10-year period are: Construction, Real estate activities, Financial and insurance activities, and Information and communication – by less than 0.2 percentage points;

– the sectors with the largest changes are: Agriculture, forestry and fishing, Professional, scientific and technical activities, administrative and support services and Wholesale and retail trade, transport, accommodation and food services – by more than 1.2 percentage points. A courious point raises the sector with the greatest change – Agriculture, forestry and fishing – with only 6 percentage points of share employment. That should be explained by the strong influence of factors specifically in these sectors in the last 10 years.

There are still significant differences in the development of the labor market between the EU and Bulgaria, which need to be compensated.

Conclusion

The fourth industrial revolution remodeled the labor market and the skills needed. HEIs need to adapt quickly and meet the needs of the business. Significant differences in the development of the labor market in Bulgaria and the EU are still present, which puts our country in a position to catch up with the new realities, which

are already a fact under the influence of globalization, digitalization, innovation and demographic change. This can happen through the strategic reorientation of HEIs (including through their transition to research universities) and their adaptation to Education 4.0, which is an inevitable process.

NOTES

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