Education and Business in the Industry 4.0

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***Abstract*— Under the conditions of Industry 4.0, much attention is beginning to be paid to such trends of the modern economy development as competitiveness, innovation, labor productivity, knowledge economy, and the digital economy. The purpose of the study is to analyze and propose the most effective mechanisms of interaction between higher education institutions and companies that would allow achieving a synergistic effect. The scientific novelty of this study consists in examining the essence of economic processes currently operating in the world economy through the prism of the features of higher education, and in developing a number of recommendations, including on building intellectual capital and building close ties between education and business that would allow on the one hand, to increase the competitiveness of enterprises, and on the other, the competitiveness of higher education institutions in the world market. The paper presents the following research methods - systemic method, statistical method, graphical method, analogy method.**

***Keywords*— human capital; education; business; Industry 4.0; world economy**

I. INTRODUCTION

Nowadays, in the era of the fourth industrial revolution, when digital technologies have transformed entire industries, social networks platforms and streaming services have changed media and entertainment, and e-commerce giants have overtaken retailers, it is especially important for companies to become more sustainable and create new, high-tech well-paid and interesting workplaces.

Within the framework of Industry 4.0, not only the production process, but also the services sector that is related to manufactured products is fundamentally changing. At the same time, people are started to be seen not only as carriers of demand and creators (manufacturers) of goods and services, but also as the core of qualitative changes and transformations in the knowledge economy and the modern digital economy.

And if during the third industrial revolution 80% of the company's value was attributable to tangible assets, now more than 80% of the value of modern companies is occupied by intangible assets, which include intellectual property, brand value and company employees (human capital) [1].

Also, the development of modern digital technologies has led to the forefront of the interoperability of man and machine (makes possible to contact via the Internet; assures transparency of information and the ability of systems to create a virtual copy of the physical world) and technical assistance of machines to man (in combining large amounts of data and performing a number of unsafe tasks for humans; the ability of systems to make decisions independently and autonomously).

II. MATERIALS AND METHODS

Comparison of modern international leading companies can be carried out according to various parameters, among which are the volumes of revenue and profits, as well as market capitalization (Table I) [2, 3].

TABLE I. TOP-10 WORLD COMPANIES BY VOLUME OF REVENUE, PROFIT AND MARKET CAPITALIZATION, MLN. USD, 2019

Company name	Country	Sector	Volume, mln. USD
BY REVENUE			
Walmart	USA	Total sales	514 405,0
Sinopec Group	China	Energetics	414 649,9
Royal Dutch Shell	Netherlands	Energetics	396 556,0
China National Petroleum	China	Energetics	392 936,6
State Grid	China	Energetics	348 903,0
Saudi Aramco	Saudi Arabia	Energetics	355 905,0
BP	Great Britain	Energetics	303 738,0
Exxon Mobile	USA	Energetics	290 212,0
Volkswagen	Germany	Automotive	278 612,0
Toyota Motor	Japan	Automotive	272 612,0
VOLUME OF PROFIT			
Saudi Aramco	Saudi Arabia	Energetics	110 974,5
Apple	USA	Technologies	59 531,0
Industrial & Commercial Bank of China	China	Finance	45 002,3
Samsung Electronics	South Korea	Technologies	39 895,2
China Construction Bank	China	Finance	38 498,4
J.P. Morgan Chase	USA	Finance	32 474,0
Alphabet	USA	Technologies	30 736,0
Agricultural Bank of China	China	Finance	30 656,5
Bank of America Corp.	USA	Finance	28 147,0
Bank of China	China	Finance	27 225,2
BY VOLUME OF MARKET CAPITALIZATION			
Microsoft	USA	Technologies	905 000,00
Apple	USA	Technologies	896 000,00
Amazon.Com	USA	Consumer Services	875 000,00
Alphabet	USA	Technologies	817 000,00
Berkshire Hathaway	USA	Finance	494 000,00
Facebook	USA	Technologies	467 000,00
Alibaba	China	Consumer Services	472 000,00
Tencent Holdings	China	Technologies	438 000,00
Johnson & Johnson	USA	Healthcare	372 000,00
Exxon Mobile	USA	Energetics	342 000,00

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In the table, one can see that while the Top-10 companies in terms of revenue are mainly representatives of the energy and automotive sectors; the top 10 companies in terms of profit there are mainly representatives of the financial and technology sectors, then the Top-10 companies in terms of market capitalization are represented by digital high-tech companies, the most striking Industry 4.0 representatives. At the same time, there are a number of companies (Saudi Aramco, Exxon Mobile, Apple, Alphabet), which are presented in several ratings at once. At the same time, the leading rating companies are registered in the member countries and partners of the Organization for Economic Cooperation and Development (OECD).

The study also revealed the following pattern – the place of most countries and OECD partners in terms of gross domestic product (GDP) by the level of gross domestic product per capita is closely related to the level of innovation and the level of education, which indicates the dependence of these indicators. In cases where these values do not coincide, in general, the largest deviation arises in terms of GDP per capita, which is possible with a heterogeneous population in OECD countries and partners (Table II) [4–6].

TABLE II. Dependence of the GDP level per capita of the population on the education level and the global innovation index

Country	Place of a country in ranking		
	GDP per capita	The level of education	Global Innovation Index
Australia	12	8	23
Austria	8	18	20
Belgium	13	15	27
United Kingdom	16	11	5
Hungary	30	31	39
Germany	11	9	9
Greece	31	35	44
Denmark	9	3	6
Israel	21	17	17
Ireland	2	12	10
Iceland	7	13	13
Spain	22	27	28
Italy	20	29	29
Canada	14	9	18
Korea	23	20	11
Latvia	32	29	33
Luxembourg	1	27	12
Mexico	35	61	58
Netherlands	6	8	3
New Zealand	19	7	21
Norway	4	5	19
Poland	29	28	38
Portugal	27	35	31
Slovakia	25	31	34
Slovenia	26	19	32
USA	5	6	4
Turkey	33	61	43
Finland	15	11	8
France	18	21	15
Czech Republic	24	22	24
Switzerland	3	8	1
Sweden	10	8	2
Estonia	28	18	25
Japan	17	19	14
Brazil	36	67	69
China	-	69	22
The Russian Federation	34	35	45

Moreover, if we consider the Top-3 clusters according to the Global Innovation Index, presented in patent and scientific activities, then of particular interest are the collaborations between clusters, universities and other companies that can achieve a synergistic effect (Table III) [7].

TABLE III. TOP-3 CLUSTERS BY GLOBAL INNOVATION INDEX VERSION REPRESENTATED IN PATENT AND SCIENTIFIC ACTIVITY, 2019.

Place	Name	Scientific publications			PCT procedure applications		
		Field	Share, %	Partnership organization	Field	Share, %	Partnership organization
1	Tokyo - Yokohama	Physics	9,22	University of Tokyo (13,82%	Electricity and equipment	9,86	Mitsubishi ectric (7,83%)
2	Shenzhen - Hong Kong	Engineering	10,81	University of Hong Kong (17,23%)	Digital communicatio ns	38,39	Huawei (25,76%)
3	Seoul	Engineering	7,53	Seoul National University (16,10%)	Digital communicatio ns	16,63	LG Electronics (18,71%)

In this regard, for successful operation of companies in the era of Industry 4.0, it is necessary not only to follow the traditional methods of production and sale of goods and services, but also to carry out the following activities [8]:

- to attract new talents and build the necessary skills and competencies for the company;
- to get practice on working with integrated contracts, create joint innovative enterprises, including with higher education institutions;
- to effectively introduce new approaches to innovation and to integrate new technologies into existing work processes;
- to develop suitable options for using digital models, as well as to apply additional technologies that will be more financially attractive;
- to study market changes and hedge risks to identify new products and services, as well as the most competitive market segments;
- to include comprehensive change management programs, flexible organizational structures and flexible working methods in its activities.

It can also be noted that the role of education and universities is growing all over the world, which are also undergoing changes:

- universities are more active in collaborating with high-tech companies, as they are forced to look for alternative sources of financing. In turn, enterprises thus reduce the volume of independent basic research in favor of cooperation with universities in the framework of projects that are important for their competitiveness;
- to increase their competitive advantages, universities are becoming a platform for the concentration of world experience, including through the development of projects for the implementation and commercialization of the knowledge created;

- to meet modern trends, universities integrate formal and non-formal education, create creative spaces and inter-university sites, and also use the project approach, personalization and digitalization in education;
- universities are gradually moving from a functioning model 1.0 to a model 4.0 (Fig. 1) [9, 10].

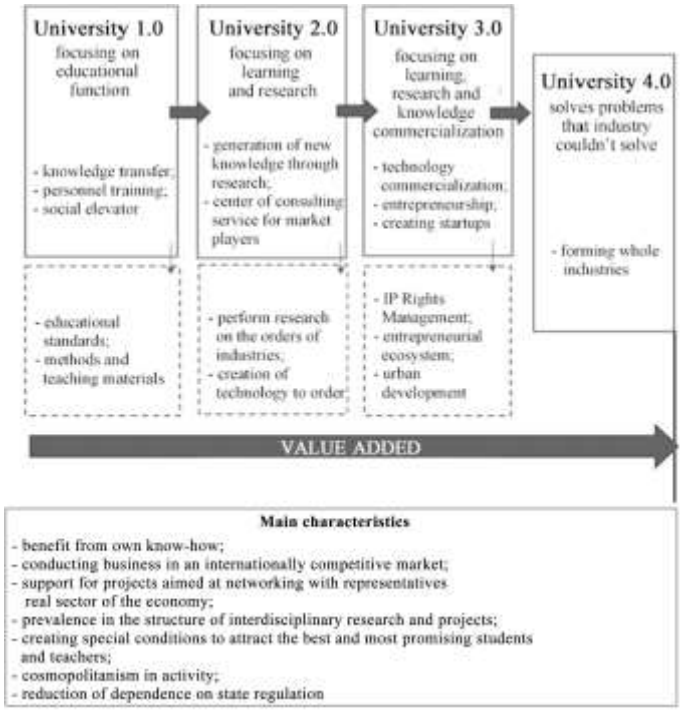

Fig. 1. Model of transition from University 1.0 to University 4.0

III. RESULTS OF RESEARCH

Due to the fact that at present it is possible to compare the duration of the technology life cycle and the duration of higher education, there is a threat of disappearance or partial changes in the professions for which training is currently being conducted. One of the problems preventing Russian universities from becoming leaders in world education is their strong conservatism, the rigidity of normative regulation of educational activities, as well as the practical lack of a student-centered approach in building curricula and personal educational routes. Among other things, there is low integration with industrial enterprises, with the exception of basic departments from enterprises that are located in a number of universities, including the Southern federal university.

In order to solve these problems, as well as for closer interaction between business and education in the era of Industry 4.0 and Russia's integration into the system of world economic relations, it is necessary to solve the following main tasks:

- to improve the system of regulatory, organizational and informational mechanisms for the formation and implementation of such integration activities;
- to create an integrated system of transition to the University 4.0 model based on interagency cooperation;
- to provide the needs of enterprises with the necessary personnel through the joint work of enterprises and universities;
- to prepare the professional development of personnel;
- to implement measures for career guidance on the basis of socio-economic information about the prospects for the development of regional economies, which will also allow for the search, selection and development of talents.

In Russia, the interaction of the University 4.0 (meaning such a university that combines consortia and clusters between higher education institutions with enterprises of the real sector of the economy) and Industry 4.0 is possible through the inclusion of the National Technological Initiative, the Agency for Strategic Initiatives, national projects, as well as national programs (for example, Digital Economics and Digital Industry).

Thus, a synergistic effect can be achieved, which will allow to develop the competitive advantages of all interacting parties (Fig. 2).

Fig. 2. Interaction between University 4.0 and Industry 4.0

Also among the projects currently available in this direction, the following can be distinguished:

1. The inclusion of the Russian Federation in an international organization that promotes vocational, technical and service-oriented education and training WorldSkills. Among the main projects, the following can be distinguished: holding championships for young specialists, creating specialized centers of competence, creating centers of advanced professional training.

2. Implementation of the project "Professional training 2.0", in this case the employers offer students to find solutions to real problems in various fields. Among them, in particular, business, tourism, education, medicine and other areas. Students, in turn, will be able to choose the direction of interest and write a scientific work. Those who

successfully complete the proposed task will be invited to an internship or even to work.

3. Creation of world-class scientific and educational centers. The union of educational institutions of higher education and scientific organizations, regardless of their departmental affiliation, with organizations of the real sector of the economy that conduct research of a world level, the result of which is the receipt of new competitive technologies and products and their commercialization, carrying out training of specialists for large-scale scientific and technological tasks in the interests of developing branches of science and technology according to the priorities of scientific and technological development of the Russian Federation.

4. Intensification of interaction between institutions of higher education, scientific, commercial and non-profit enterprises. The idea of cooperation between commercial organizations and universities receives a large number of supporters, since it allows to solve many issues, including questions of the demand for graduates, which is also an important aspect when choosing an educational institution.

To train well-educated and qualified personnel for Industry 4.0, a developed system of vocational education is necessary, based on technology transfer and the exchange of innovative culture between universities and Companies through joint participation in clusters (for example, the Tourism Cluster of Rostov Region, "Southern Constellation" cluster with the participation of Southern Federal University), the joint use of intellectual property (through the participation in the activities of the Center for Collective Use of South Federal University), work in the framework of employer-sponsored education (including the provision of practical training and internships, the use of simulation training methods, the provision of practice-oriented cases, the participation of a company representatives in the educational process, professional accreditation of educational programs, etc.), the participation of companies in university events (including professional tournaments, Hackathons, Forums) [11].

IV. CONCLUSIONS

Thus, we can conclude that in the modern global and digital world, the competitive advantages associated with the abilities, capabilities and speed of self-development of countries, organizations and people come to the fore.

In the Industry 4.0 and the transition of higher education institutions to the University 4.0 model, the role of the university is being strengthened from the position of integrator of scientific, educational and industrial environments, the boundaries between professional and academic spheres become less obvious, as well as formal and non-formal education begin to blur while personalization of education strengthens. Thus, education and business should become inseparable for this period and unite efforts to train personnel for the modern economy.

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