

# SUCCESSSES AND FAILURES OF MODERN COMPANIES IN THE INDUSTRY 4.0

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## 1. Introduction

Under the conditions of Industry 4.0, much attention is beginning to be paid to such trends in the development of the modern economy as competitiveness, innovation, labor productivity, knowledge economy, and digital economy. Despite the globalization process, the situation in the global economy continues to become more complex. The US review of NAFTA's trade relations with Canada and Mexico and the creation of a new USMCA free trade zone (the United States-Mexico-Canada Agreement) the toll wars between the US and China, and the transition to a new round of technology development – Industry 4.0, led to changes in the rules games and world order for companies engaged in international business.

At the same time, universities are also greatly affected, which are beginning to be viewed as drivers of territorial development in three main areas: economics, science and innovations, human capital, and education is becoming one of the main factors of state competitiveness. People are beginning to be seen as creators of goods, producers of works and services and carriers of demand, and also become the core of qualitative changes and transformations in the knowledge economy and the modern digital economy.

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Therefore, the purpose of the study is to propose a model of interaction between universities and companies for the formation of their human resources, allowing them to successfully conduct business in the modern conditions of Industry 4.0.

The scientific novelty of this study is to examine the nature of the economic processes currently operating in the global economy, and to develop a number of recommendations based on the experience of companies from the Russian Federation for companies participating in international business to increase market stability, including by building up intellectual capital and building close ties with educational institutions. Research methods are system method, statistical method, graphic method, and analogy method.

## **2. Key Features of Industry 4.0**

### **Modern companies within Industry 4.0**

Industry 4.0 (Fourth Industrial Revolution) initially appeared as a project aimed at improving the competitiveness of the manufacturing industry. As part of it, it was proposed to integrate automated machines and processing centres connected to the Internet into industrial processes in order to provide the machines themselves to change production templates. At the same time, the digital approach covers all stages of the product life cycle, including design and prototyping, commissioning and maintenance of the production line, production control and optimization, as well as data obtained as a result of feedback from customers and consumers [Tarasov, 2018, p. 58].

At the same time, in the framework of Industry 4.0, not only the production process, but also the service sector associated with the manufactured products changes radically. Thus, each work object will determine for itself what work must be done for production. Such an architecture of industrial systems can be not only implemented in completely new enterprises, but also under the condition of evolutionary development through digital upgrading of existing production facilities in already existing enterprises.

Among the key principles on which Industry 4.0 is based, the following can be singled out: the interoperability of man and machine – the ability to contact directly via the Internet; transparency of information and the ability of systems to create a virtual copy of the physical world; technical assistance to human machines – combining large amounts of data and performing a number of unsafe tasks for humans; the ability of systems independently and autonomously to make decisions.

At the same time, among the main trends in the Industry 4.0 market are the following:

- growth of investments in new technologies;

- increase in the number of mergers and acquisitions and strategic alliances;
- growth in the sales of automation solutions.

Among other things, Industry 4.0 changes the working conditions of employees. The second thematic annual report “Four types of managers who will lead their companies to success in the Fourth Industrial Revolution” highlighted a number of leadership skills that leaders of the most effective innovative companies should have, including: the pursuit of public benefit, determination, long-term vision in technology, data-based decision making and an active approach to staff development [Information Portal Deloitte]. The study was based on a survey conducted by Forbes Insights in June and August 2018 among 2.042 heads of international companies from 19 countries of the world (Asia, Europe, and North and South America)<sup>4</sup>.

Also, within the framework of this study, 30% of managers among the main problem that they face when adapting a business strategy to the changing needs of their organizations, identified the lack of a managerial strategic vision. 55% of managers noted a significant gap between the skills their employees possess and the skills needed in the future. At the same time, 25% of respondents prefer to hire new workers, while 57% believe that, within the existing education system, new workers do not receive the necessary training.

Among the leading countries in the development of technology within Industry 4.0, Germany can be singled out, which annually allocates up to \$ 10 billion to implement this project [Fast Salt Times]. The goal of the Germany's Government, which is the ideological inspirer of Industry 4.0, is to maintain leadership in the industry by encouraging innovation in all sectors, provided that the government and business join forces with the country's best scientists for a new technological breakthrough in the German economy.

Thus, as Klaus Schwab (Founder and Executive Chairman, World Economic Forum) had said: «...it all comes down to people and values. We need to shape a future that works for all of us by putting people first and empowering them. ... As a complement to the best parts of human nature – creativity, empathy, stewardship – it can also lift humanity into a new collective and moral consciousness based on a shared sense of destiny» [Information Portal „World Economic Forum”].

### **Higher education institutions within Industry 4.0**

Due to the fact that in the framework of Industry 4.0, the competitive advantages associated with the abilities, capabilities and speed of self-development of countries, organizations and people come to the fore, universities are not only among the actors

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<sup>4</sup> All managers who participated in the survey are organizations with revenue of at least \$1 billion. At the same time, half of the respondents (50.1%) are heads of organizations, whose revenue exceeds \$5 billion.

in the development of an innovative economy, but also undergo changes [Wissema, 2009, p. 40] These changes are due to several reasons, among which are the following:

1. Universities are interested in continuing advanced scientific research; therefore, they are forced to look for alternative sources of funding. This is facilitated by the collaboration of universities with high-tech companies that reduce the volume of independent fundamental research in favour of cooperation with universities in the framework of projects that are important for their competitiveness. Thus, the worlds of scientific and applied research become interconnected, which allows to achieve the maximum effect in the implementation of projects.

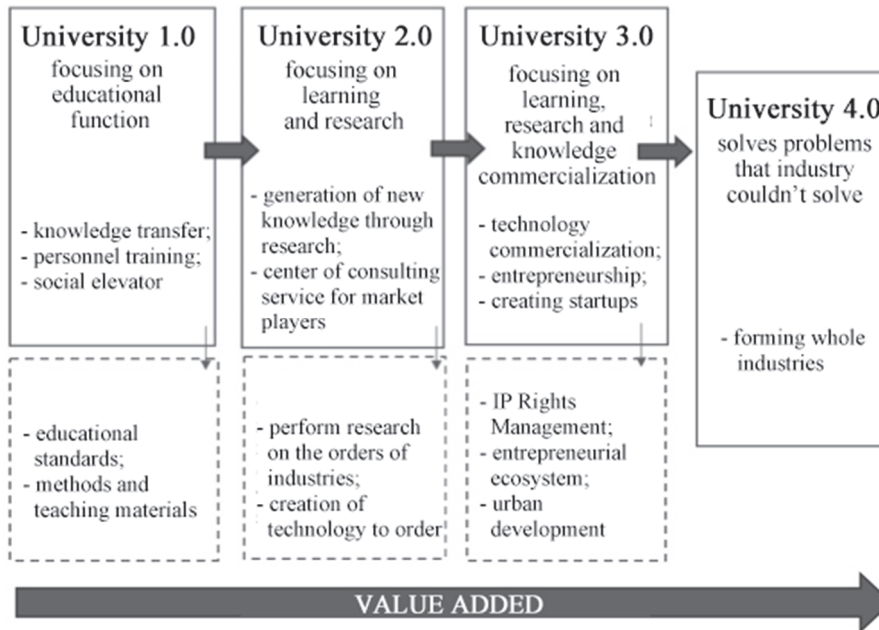
2. Increased globalization and expanding opportunities for learning and conducting research in other countries are forcing universities to compete more actively among themselves for the best students, teachers, and contracts with companies for research work. The result of this competition is an increase in the gap between the leading universities and the universities of the "second echelon". In order not only to defend their positions, but also to improve their universities, it is necessary to become a platform for the concentration of world experience, which all those involved in a particular area of knowledge are eager to attend: students, teachers, companies. Therefore, universities are beginning to actively engage in the development of projects for the introduction and commercialization of knowledge generated, which becomes one of their tasks along with education and research.

3. Changes of government policy lead to the development of the commercial component of the work of universities. This leads to the fact that in the knowledge economy, universities become one of the instruments of economic growth, playing an active role in deriving benefits from projects to create new knowledge.

4. Recently, interdisciplinary projects have been greatly developed, which has an impact on changing the form of organization of activities at the university. Thus, interdisciplinary teams focusing on solving specific problems become the most effective. Changes also affect university management. It should create new structures and positions to manage such projects and processes to benefit from the know-how gained, allowing them to adapt to the need to be most effective in the face of increasing the scale and level of complexity of the tasks facing the university.

In connection with the above reasons, in order to develop in modern economic conditions, university must have a number of characteristics, among which are the following: deriving benefit from its own know-how; conducting activities in the international highly competitive market; support of projects aimed at networking with representatives of the real sector of the economy; the prevalence in the structure of interdisciplinary research and projects; the creation of special conditions for attracting the best and most promising students and teachers; cosmopolitan activity; reducing dependence on government regulation.

This is the driving force to university transitions from models 1.0 and 2.0 to models 3.0 and 4.0, the features of which are shown in Figure 1. When universities switch to a more modern model, there is a constant increase in the level of service. University 3.0 is becoming a separate economic agent, a large company at the expense of its own competences in understanding how markets develop.



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

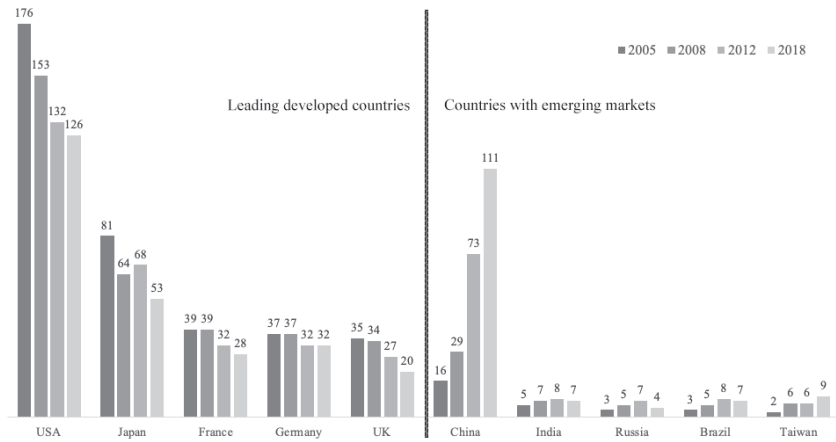
*Source: Wissema, 2009, p. 52.*

### 3. Analysis of research objects

Evaluation of the effectiveness of international companies can be carried out on various grounds, including the amount of revenue and market capitalization.

The company Fortune prepared an annual ranking of world companies in terms of revenue – Fortune Global 500 [Information Portal Fortune, Fortune Global 500]. Figure 2 presents a dynamic country analysis of the companies represented in the rating by years in the rating.

The strengthening of the positions of large economic entities from the China looks particularly impressive as can be seen from the above data. The best idea of competitiveness is given not by the cumulative indicator of the company's revenue, but by the actual profitability of its operations (profit). In 2018 Walmart took the first place in terms of revenues, and Apple took the first place in terms of profit. The data presented in Table 1.

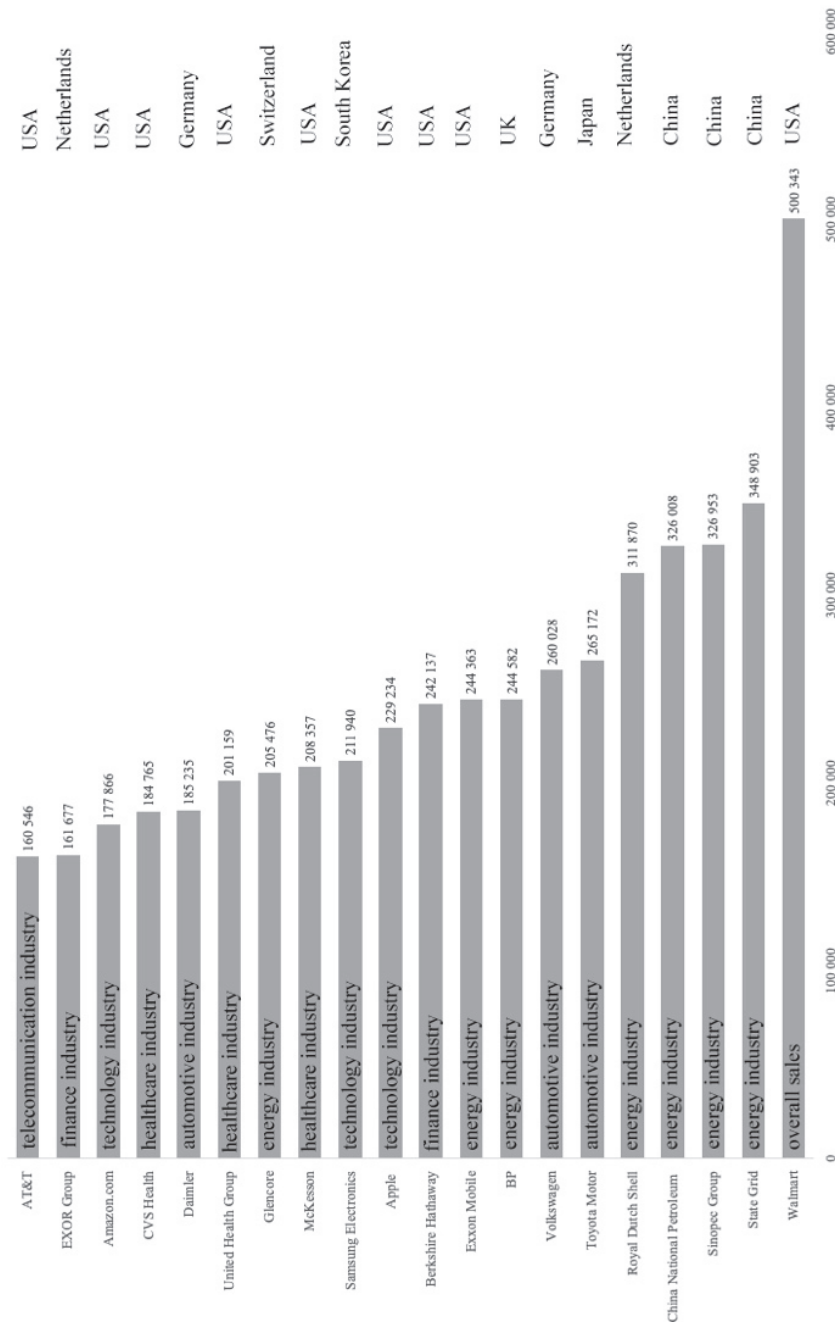


**Fig. 2.** Representation of companies from selected countries in the Fortune Global 500  
 Source: Information Portal Fortune, Fortune Global 500.

**Table 1.** The largest companies in the world in terms of profits according to the Fortune Global 500, 2018

Name of the company	Profit, million dollars	Place (profit)	Place (revenue)	Revenue, million dollars	Sales profitability, %
Apple	48 351.0	1	11	229 234	21.09%
British American Tobacco	48 327.8	2	453	26 128	<b>184.97%</b>
Berkshire Hathaway	44 940.0	3	10	242 137	18.56%
Industrial & Commercial Bank of China	42 323.7	4	26	153 021	27.66%
Samsung Electronics	36 375.4	5	12	211 940	17.16%
China Construction Bank	35 845.2	6	31	138 594	25.86%
Verizon	30 101.0	7	37	126 034	23.88%
AT&T	29 450.0	8	20	160 546	18.34%
Agricultural Bank of China	28 550.4	9	40	122 366	23.33%
Bank of China	25 509.2	10	46	115 423	22.10%
J.P. Morgan Chase	24 441.0	11	47	113 899	21.46%
Comcast	22 714.0	12	80	84 526	26.87%
Toyota Motor	22 510.1	13	6	265 172	8.49%
Wells Fargo	22 183.0	14	62	97 741	22.70%
Pfizer	21 308.0	15	187	52 546	<b>40.55%</b>
Microsoft	21 204.0	16	71	89 950	23.57%
Exxon Mobile	19 710.0	17	9	244 363	8.07%
Bank of America Corp.	18 232.0	18	60	100 264	18.18%
Facebook	15 934.0	19	274	40 653	<b>39.20%</b>
Procter & Gamble	15 326.0	20	135	66 217	23.15%

Source: Information Portal Fortune, Fortune Global 500.



**Fig. 3.** The largest companies in the world in terms of revenue, according to FG 500, 2018 (US \$ million)  
 Source: *Information Portal Fortune, Fortune Global 500.*

At the same time, as of 2012, the situation in the world was as follows: the first place in terms of income was taken by the Russian company Gazprom, the second by the company Exxon Mobil, also representing the fuel and energy sector, the third was the Industrial and Commercial Bank of China. The largest company in the world in terms of gross revenues received in 2012 was Royal Dutch Shell, second place was taken by Exxon Mobil, and Gazprom got only 15th place here. Thus, we can conclude that the financial crisis has strongly affected the fuel and energy industry, which led to a sharp drop in the performance of global companies representing it.

A study of companies in terms of market capitalization is conducted by the international firm Price Waterhouse Coopers [Information Portal Price Waterhouse Coopers, TOP-100 according to Price Waterhouse Coopers]. In 2018, the main trends in the TOP-100 rating were the following:

1. In 2018, the growth of the total market capitalization of TOP-100 companies continued and amounted to 15% compared with 2017. The greatest growth was shown by Amazon and Apple.

2. The quantitative composition of companies from different countries has changed. The data are presented in Figure 4 The largest representation of US companies (total capitalization – \$12.187 trillion).

3. 85 companies from the list of 2017 remained in the list of 2018 (in 2017 there were 91 such companies – the best indicator of stability for all the years of research). Giants such as Starbucks, Daimler, Vodafone Group, Deutsche Telekom, BASF, Bayer, etc. left the list. At the same time, 61 companies from the 2009 list remained in the 2018 list.

4. The leader of the list Apple became the first company in the world, which reached a capitalization of \$1 trillion in August 2018. [Information portal of the Interfax Information Agency]. In 2009, it was on the 32 position in the list with a capitalization of \$94 billion.

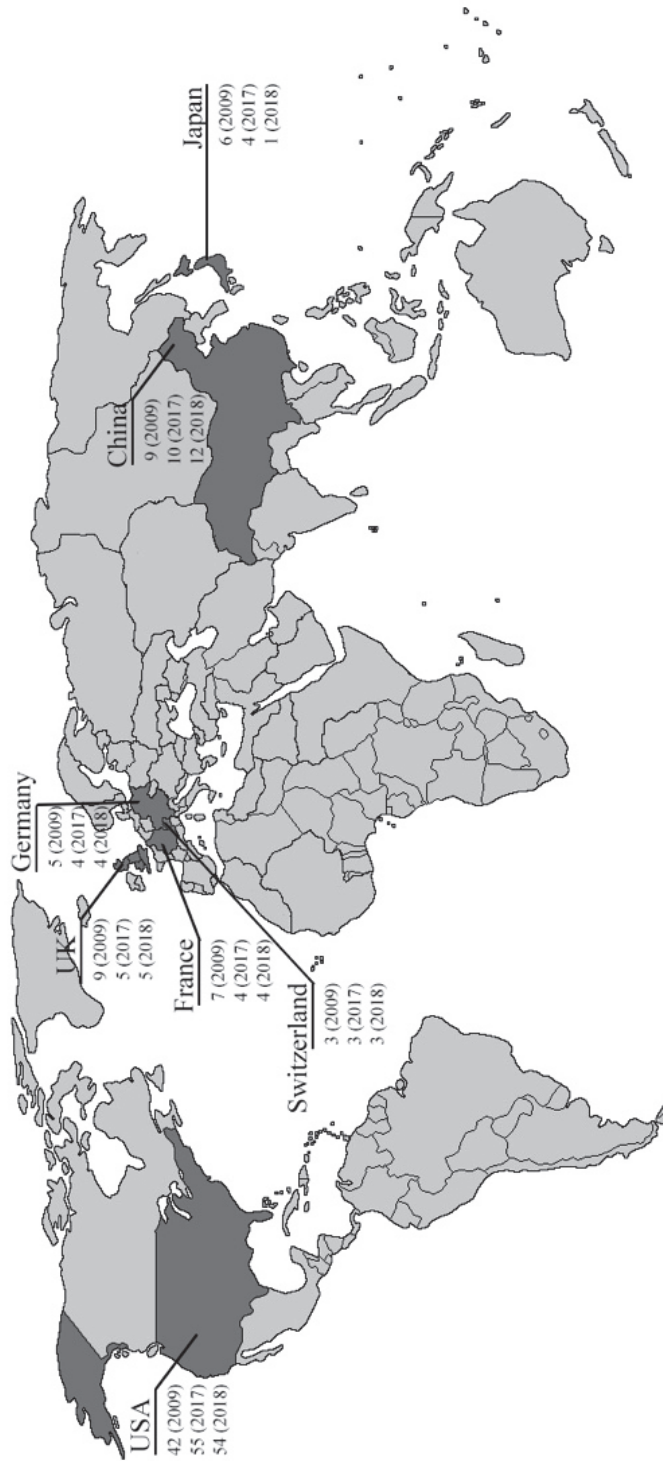
5. The maximum number of positions (77) was increased by Bank Of America (10<sup>th</sup> in the 2018 list), reaching a market capitalization of \$307 billion.

6. In the list of TOP-100 for all years of research (since 2009) there is not a single company from Russia.

At the same time, economic growth is possible mainly due to increasing the volumes of labour used, as well as improving their quality through the development of education and technology. In this regard, in recent years considerable attention has been paid to the study of the main economic resources of the national, world and global economy, namely labour and knowledge, which together constitute human capital.

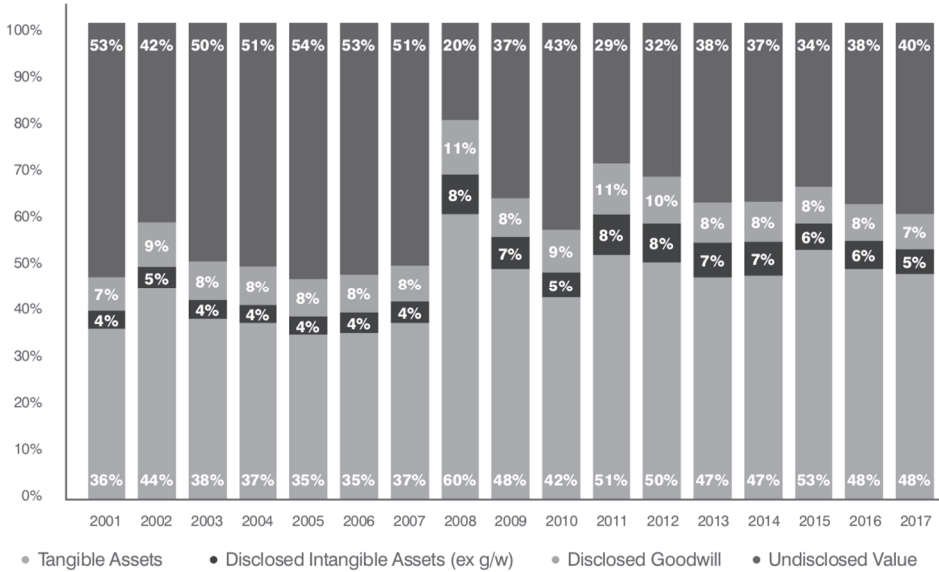
So, if previously up to 80% of the company's value was occupied by tangible assets, then in the era of the development of the digital economy and the knowledge economy [Zashchitina, 2019, p. 27], up to 80% of the company's value begins to be diverted to intangible assets [Sullivan, 2000, p. 330].





**Fig. 4.** Representation of companies from individual countries in the TOP-100 according to Price Waterhouse Coopers  
 Source: *Information Portal Price Waterhouse Coopers, TOP-100 according to Price Waterhouse Coopers.*

The global value of companies in 2017 for the first time exceeded \$100 trillion and amounted to \$109.3 trillion according to the Global Intangible Finance Tracker (GIFTTM) 2018 – an annual review of the world’s intangible value. In this value, the share of intangible assets is 40%. The data are presented in Figure 5.



**Fig. 5.** Global Enterprise Value - Relative Breakdown (%)  
 Source: Global Intangible Finance Tracker (GIFTTM) 2018.

At the same time, among the industries with the largest volume of intangible assets are: Cosmetics & Personal Care (90%), Aerospace & Defense (90%), Internet & Software (87%), Pharma (87%), Healthcare (85%), Media (84%) [Global Intangible Finance Tracker (GIFTTM) 2018].

At the end of 2017, the World Economic Forum ranked 130 countries for the development of their human capital on a scale from 0 (worst) to 100 (best), both as a whole and by individual indicators, including capacity subindex, deployment subindex development subindex, know-how subindex. The top 10 countries-leaders in the global human capital development index in 2017 are represented both by small European countries, namely Scandinavia and Switzerland, and by countries with strong global economies, such as the USA and Germany. The index leaders are countries with high incomes and a high level of education of their citizens, which contributes to greater attention to the future potential of human capital and engaging a large part of their workforce in a wide range of industries that require specialized knowledge and skills. The data presented in Table 2.

**Table 2.** Global Human Capital Index, 2017

Country	Overall index		Capacity subindex	Deployment subindex	Development subindex	Know-how subindex
	value	rank	value	value	value	value
Norway	77.12	1	80.46	73.18	82.63	72.22
Finland	77.07	2	81.05	65.09	88.51	73.62
Switzerland	76.48	3	76.36	69.12	84.87	75.75
USA	74.84	4	78.18	68.72	83.45	68.99
Denmark	74.40	5	79.37	71.41	78.65	68.18
Germany	74.30	6	76.33	69.52	79.38	71.96
New Zealand	74.14	7	78.92	72.76	80.38	64.50
Sweden	73.95	8	76.21	69.60	77.10	72.89
Slovenia	73.33	9	81.10	65.90	79.21	67.10
Austria	73.29	10	73.71	68.00	81.53	69.92
Russian Federation	72.16	16	83.19	74.33	72.97	58.14
Japan	72.05	17	80.96	66.32	73.92	67.00
UK	71.31	23	71.59	67.40	76.23	70.02
France	69.94	26	74.68	60.90	75.34	68.86
China	67.72	34	70.34	74.06	68.47	58.01

Source: Insight Report "The Global Human Capital Report 2017".

Also, as part of the work of the World Economic Forum, a new Global Competitiveness Index 4.0 was presented in this report. It allows defining a set of factors that are critical for production under the Fourth Industrial Revolution (4IR), divided into the following groups:

- Enabling Environment: Institutions, Infrastructure, ICT adoption, Macroeconomic stability;
- Markets: Product market, Labour market, Financial system, Market size;
- Human Capital: Health, Skills;
- Innovation Ecosystem: Business dynamism, Innovation capability.

Among the leaders of this index are also USA (85.6), Singapore (83.5), Germany (82.8), Switzerland (82.6), Japan (82.5), Netherlands (82.4), Hong Kong SAR (82.3), UK (82.0), Sweden (81.7), Denmark (80.6). Russian Federation with a rating of 65.6 ranks 43rd among 140 world economies [Insight Report „The Global Competitiveness Report 2018”].

Thus, we see that the countries in which the companies with the highest revenue and profits are also among the leaders in the global index of human capital and global competitiveness, which indicates a close relationship between education and business.

#### **4. Communication of companies in the real sector of the economy and institutions of higher education as an opportunity to succeed in the era of Industry 4.0 (experience of the Russian Federation)**

For the most effective integration into the existing reality of Industry 4.0, modern companies operating on the territory of the Russian Federation need to create conditions for the transition from state support of large enterprises with state participation to the development of small and medium-sized enterprises that are able to produce a technological “digging” as soon as possible.

Today it is important to join the global value chains, increase the share of value added created by national companies and the competitiveness of products, including through the placement of foreign industries in Russia and the use of imported components and technologies. Modern international cooperation is the basis of the socio-economic and scientific-technical progress of countries, the globalization of world economic relations, regional economic integration, transnationalization, and international industrial cooperation. The development of international cooperation suggests: cooperation implemented through a contract and not accompanied by the creation of any organizational structures; cooperation implemented through international business associations.

Examples of successful international cooperation are demonstrated by companies that are leaders in global aircraft manufacturing Boeing (Figure 6) and Airbus (Figure 7). It should be noted that in Russia industrial cooperation has not received such wide development as in countries with developed market economies. Among one of the obstacles to the participation of the Russian Federation in it is the raw material orientation of its economy.

To overcome this obstacle, the Agency for Strategic Initiatives autonomous non-profit organization developed a program of measures to create fundamentally new markets and create conditions for Russia's global technological leadership by 2035 (the markets for the National Technology Initiative - NTI). This program includes systemic solutions for determining key technologies, necessary changes in the field of norms and rules, working measures for financial and personnel development, mechanisms for involving and rewarding carriers of the necessary competencies. The choice of technologies is made taking into account the main trends of world development, based on the priority of network technologies centered around the person as the final consumer.

At present, 10 promising markets have been selected, represented in the matrix of the NTI, combining markets, technologies, institutions and infrastructure (Figure 8).



**Fig. 6.** Scheme of production cooperation of Airbus companies on the example of the A-320  
*Source: Information Portal Airbus.*

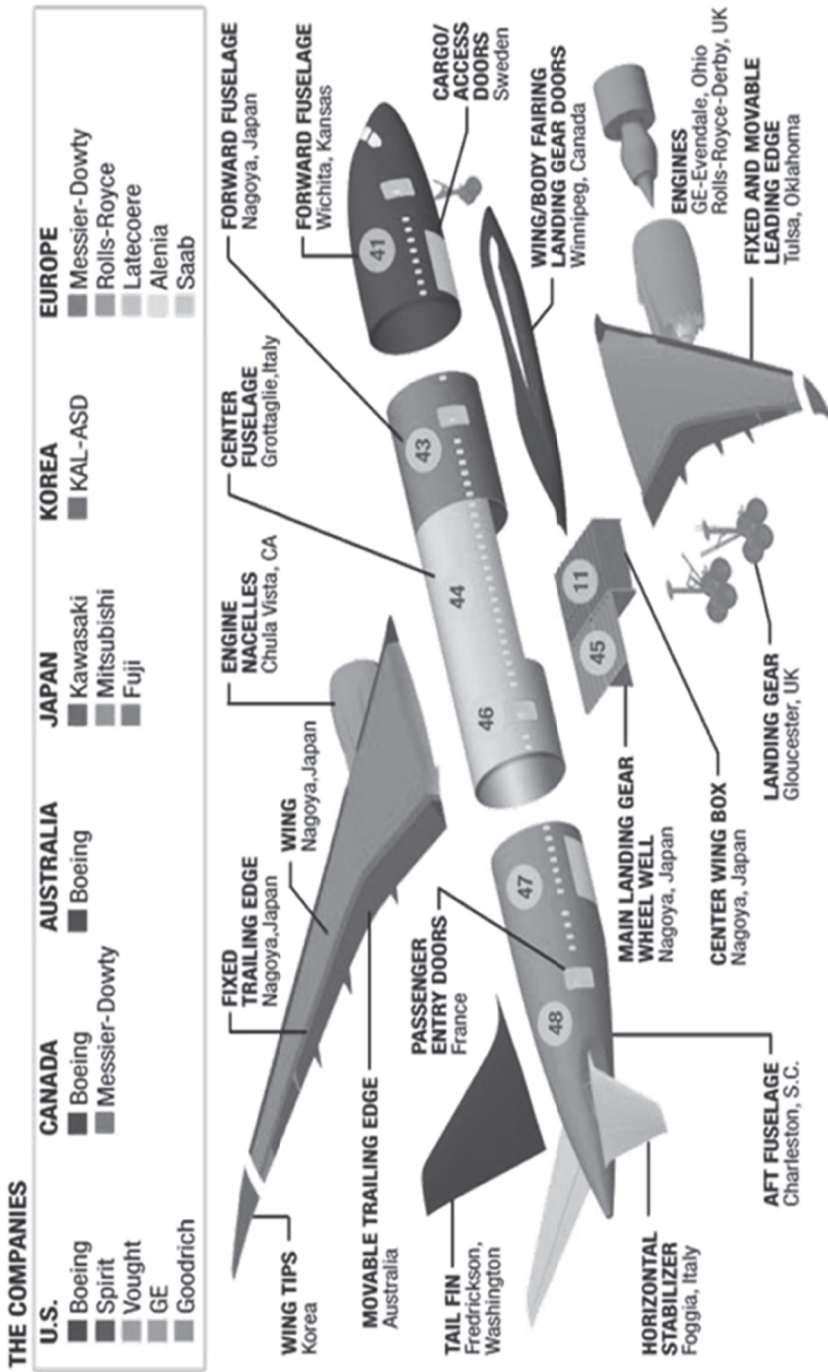
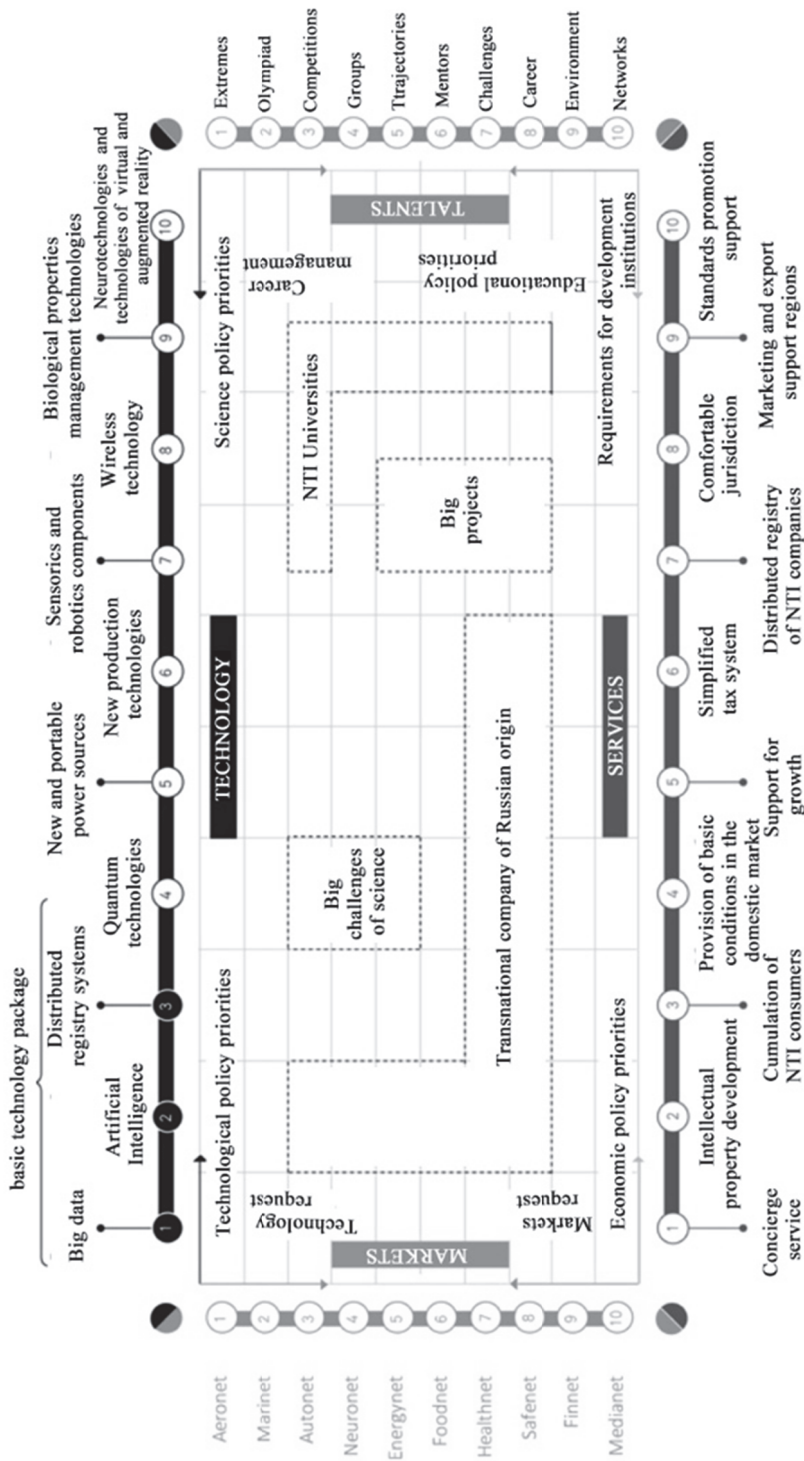


Fig. 7. Scheme of industrial cooperation of Boeing companies on the example of the aircraft B787  
 Source: *Information Portal Boeing.*



**Fig. 8.** NTI Matrix  
 Source: *Information Portal National Technology Initiative.*

In addition to the creation of NTI markets, great attention is paid in Russia to the development of human resources. Among the projects presented in this direction are the following:

1. Inclusion of the Russian Federation in an international organization that promotes professional, technical and service-oriented education and training WorldSkills. Thanks to international cooperation and the development of links between industries, governments, organizations and institutions, it is possible to show the advantages and the need for qualified specialists through holding competitions, organizing joint projects and sharing experience [Information Portal WorldSkills Russia].

Among the main projects are the following: holding championships for young professionals, the creation of specialized competence centres, the creation of advanced training centres.

2. Implementation of the project "Profstazhyki 2.0". The essence of the competition is that employers offer students to find solutions to real problems in various areas. 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 cope with the proposed task will be invited for an internship or even a job [Information Portal „Profstazhirovki”]. Among the key activities and project formats are the following:

- competition of student works "Profstazhirovki" – a new mechanism of interaction between the student, educational organization and the future employer, involving student work and internships as a social elevator for young people;
- all-Russian campaign “Days in Profession” – for schoolchildren of different age groups (grades 5-6, grades 7-8, grades 9-11) and first-year students undergo a series of one-day excursions to modern industrial and other organizations. The task of the action is to show schoolchildren and students the full range of possibilities for future professional self-realization;
- all-Russian base (aggregator) internships – thanks to the project, students can complete an internship directly in their field and receive additional employment opportunities immediately after receiving a diploma. The project allows the enterprises to participate in the preparation and training of personnel or to select graduates of educational organizations in any region of the country;
- research, monitoring, surveys;
- legislative proposals and initiatives.



3. Creating a world-class scientific and educational centers (SEC). Combining educational institutions of higher education and scientific organizations, regardless of their departmental affiliation with organizations of the real sector of the economy, conducting world-class research and development, the result of which is obtaining new competitive technologies and products and their commercialization, carrying out personnel training to address major scientific and technological tasks in the interests of the development of branches of science and technology according to the priorities of scientific and technological development Russian Federation. The SEC activity has an applied nature; therefore its key idea should be the pairing of the tasks formulated by the industrial partner, the groundwork and prospects of the scientific partner and the educational partner base, which should together provide innovative development.

Among the main goals of the project are the following:

- development and implementation of Integrated Research Programs and Integrated Scientific and Technical Programs;
- ensuring the legal protection of the management of rights to the results of intellectual activity and the protection of the results of intellectual activities obtained by the Program initiator, as well as the results of intellectual activities transferred to it for management, including abroad;
- commercialization of the results of intellectual activity, including marketing research and the search for partners to promote products to specific markets, including external ones;
- provision of the possibility for the SEC participants to use the SEC infrastructure on preferential terms;
- implementation by the initiator of the Program and participants of the SEC of educational activities, educational programs of higher education – graduate programs and programs for the training of scientific and pedagogical personnel in graduate school;
- conducting admission to targeted training in educational programs of higher education within the established target figures for admitting citizens to study at the expense of budget allocations from the federal budget, budgets of constituent entities of the Russian Federation and local budgets with a license to carry out educational activities and state accreditation of core educational programs;
- the implementation by the initiator of the Program and participants of the SEC of educational activities for the implementation of additional professional education programs with the presence of an appropriate license to carry out educational activities;

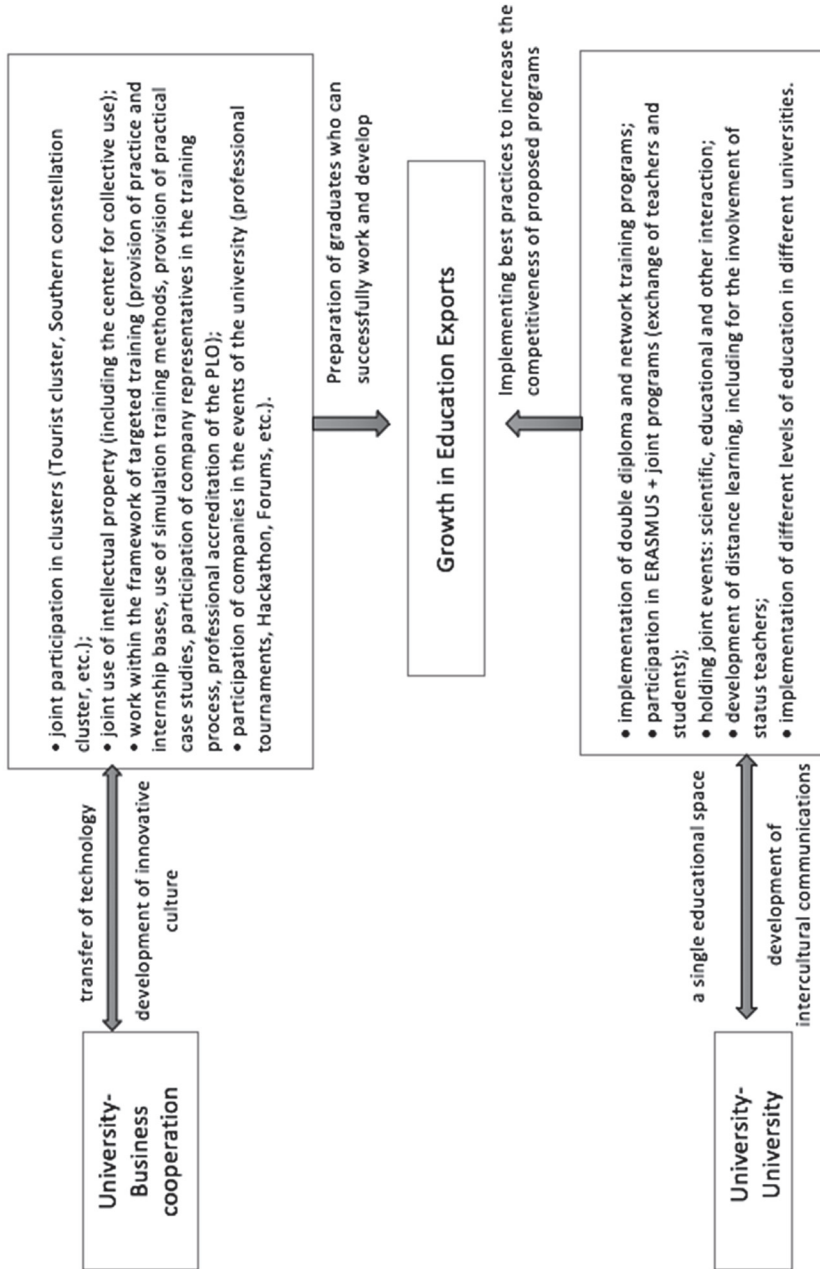
- information and consulting support on certification and standardization issues;
- provision of engineering services, including accelerated design of innovation;
- examination of the quality of innovative projects, including when making decisions on the provision of state support measures for innovative projects;
- organization of interaction with federal and regional export support centres, as well as with trade missions of the Russian Federation.

4. Intensification of interaction between institutions of higher education, scientific, commercial and non-profit enterprises. Currently, the idea of cooperation between commercial organizations and universities receives a large number of supporters, since it allows to solve many issues, including issues of demand for graduates, which is also an important aspect when choosing an educational institution. A well-developed vocational education system is needed to train well-trained and qualified personnel (Figure 9).

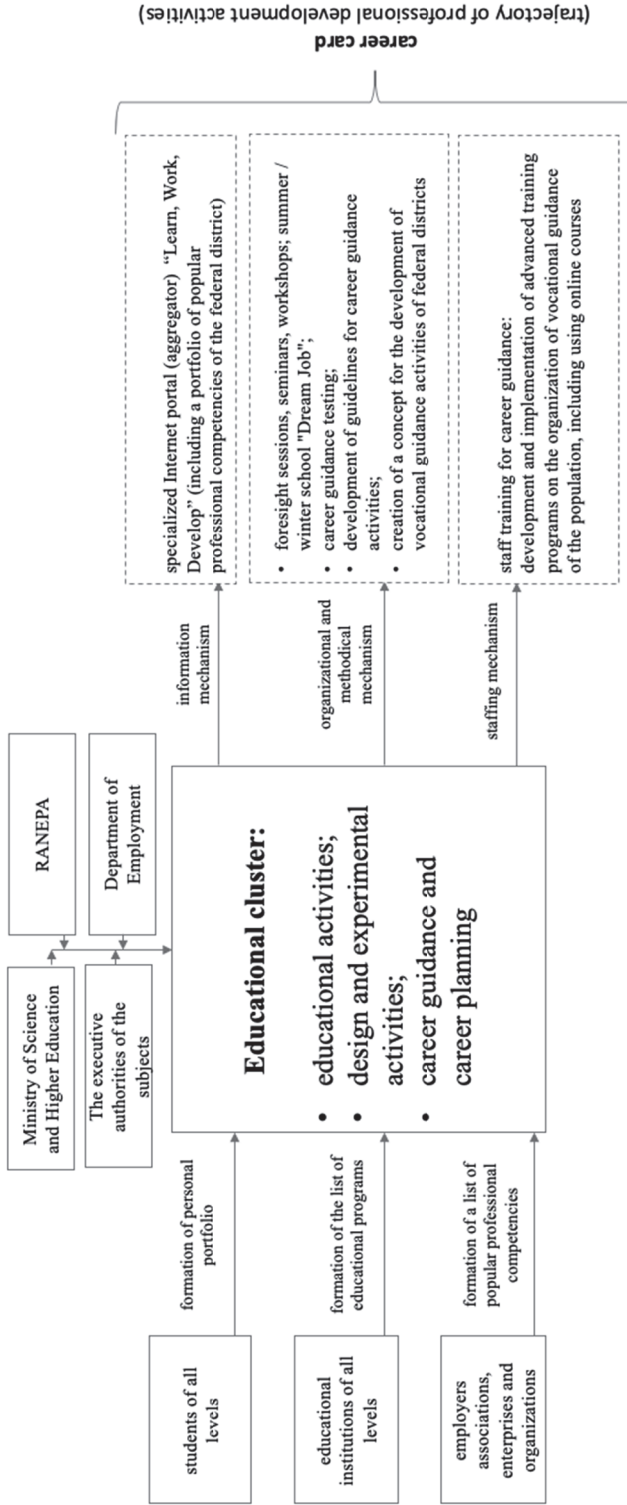
Among other things, projects aimed at educational activities, design and experimental activities, career guidance and career planning are currently gaining popularity through informational, organizational, methodical and personnel mechanisms that allow you to choose educational institutions, including on the basis of individual career maps – development trajectories professional activities, as the choice of profession is a driving factor in the subsequent selection of the country of study and the institution itself.

Figure 10 shows the model of the possible interaction of the educational cluster of federal significance and other subjects when building a career card for students.

This model will most effectively improve the regulatory, organizational and informational mechanisms for the formation and implementation of career guidance; create a comprehensive system of vocational guidance based on interagency cooperation; provide the needs of enterprises operating in the district with the necessary personnel; carry out training and professional development of human resources for the enterprises of the district; implementation of career-oriented work on the basis of socio-economic information about the prospects for the development of the district economy.



**Fig. 9.** The model of collaboration between Universities and University-Business Cooperation  
 Source: Zashchitina, Bondarev, Pavlov, Pavlov, 2018, p.187.



**Fig. 10.** Interaction model of the educational cluster of federal importance and other subjects when building a career card  
 Source: Zashchitina, 2019, p.115.

## 5. Summary and conclusions

The study showed that the unpreparedness of a number of world business leaders of the 20<sup>th</sup> century to transition to Industry 4.0 led to a change in the composition of leading companies in the global economy in the 21st century, and also had a negative impact on modern international activities of Russian companies participating in international business. Finding ways to restore the former leading positions led to their understanding of the need to change the economic and production model, the importance of participation in international industrial cooperation, the transformation of part of existing business areas and the creation of new directions in the development of network digital technologies. To implement these plans, companies need adequate staffing those universities can provide as part of the proposed model of joint cooperation within the educational cluster of federal significance.

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