

TECHNOLOGY TRANSFER. COMPARATIVE ANALYSIS OF RUSSIAN, AMERICAN AND BRITISH UNIVERSITIES.

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The article analyzes the technology transfer within Russian, American and British Universities showing the statistic significance in order to accept or reject hypothesis about opportunity to use USA and UK experience in Russian universities.

Key words: *technology transfer, knowledge-based economy, Mann-Whitney criterion.*



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Introduction

The comparative analysis of technology transfer (transfer of technology) in Russia, USA and Great Britain is the research topic conducted by the Russian Engineering Education Association (REEA). "Knowledge-based economy" is that economy that is directly based on technology and further advancement and application of relevant knowledge and information [1, p. 7]. The major role in establishing this economy is innovation activities defined as R&D and further implementation of other researches. Innovation activities are all scientific, technological, organizational, financial and commercial steps which actually, or are intended to, lead to the implementation of innovations [2, p. 31]. The research community (i.e. research laboratories and higher education institutions) being generators and distributors of knowledge and performing the function of technology transfer plays a significant role in innovation activities. In the fast-moving environment the research community predominates in the generation of knowledge for technological progress and development of overall cultural principles for information exchange (swapping). However, in the case of the knowledge-based economy, the research community should be an equilibrium fulfilling the following roles of an "architect" of knowledge (research), a "distributor" of knowledge (learning) and a "transfer" of this knowledge to ensure that other social and economic institutions, including small and average businesses, are accessible to this information (knowledge transfer). By developing the interconnection between the research community and private enterprises Organization for Economic Co-operation and Development (OECD) accelerates the knowledge transfer [1, p. 7].

The development of knowledge-based economy is a challenge in Russia. The fuel-energy sector provides about 1/3 of the gross domestic product (GDP) and approximate 40% of all custom duties and taxes in the budget [3]. The energy fraction in the country's GDP is 30%, while Fuel & Energy Companies provide 52% of the federal income budget [4]. It is obvious that economy significantly depends on the export of resources.

Let's consider the key concepts used in the following article. Technology transfer – is the process of moving new information, products or processes from one organization to another for potential commercial interest [5, p.145]. "Technology – practical application of knowledge in one specific area [6]. When knowledge performs a specific function, solves one

problem then it transfers into technology. In the following research the “architect” of technology – university, while its “consumer” – enterprises of small and average businesses.

University technology transfer is vertical, i.e. technology is a step-by-step process from fundamental research to production based on this technology. Technology transfer in Russia, USA and Great Britain is quite different due to the culture diversity in universities and business, as well as, the motivation and control mode of the technology transfer management. According to American literature the technology transfer problem from university to business involves the study of indexes, for example, the ratio of patent cost to royalty [5, p.146]. The benchmark in technology transfer in USA is the adoption of the Bayh-Dole Act of 1980. Bayh-Dole permits a university to pursue ownership of an invention in preference to the government [5, p.146]. The positive result of this act was the increase of patents, i.e. less than 250 patents before 1980 to 2000 patents after 1980 [5, p.146]. This Act also influenced and furthered the cooperation between universities and enterprise representatives, where universities play an important role in the development of new technologies within modern area of knowledge [5, p.146]. According to Moveri the major effect of the Bayh-Dole Act was the fact that the universities could actively promote and commercialize the invention within the framework of the university itself. [5, p.146]. For example, for biomedical companies this is the close interconnection between new products and the university research, while for other enterprises the funding of fundamental and applied research is more effective than direct financing of a new product [5, p.146].

Due to the commercialization of university technology approximately 250 thousand workplaces were created annually [5, p.146]. Approximate 10% of new products were implemented into production as a result of the latest university research developments [5, p.146].

Traditionally, in Great Britain more attention is focused on publications than on patenting, although the British research system is the most effective one in the world today [5, p.146]. Another similar system is the so-called RAE (Research Assessment Exercise).¹ Salter [5, p.146] underlined the fact that such a focus on publications can be explained by the “conventional viewpoint” based on the idea that the research target is only information. This is the difference between British and USA, the latter of which states that the basic research target is invention patent.

During the last few years the government of GB has enforced the development of technology transfer from universities to businesses (for example, two project programs were launched on initiative of “University Challenge”: one- funding projects in the seed stage and the second- program HEROBC¹ to improve the technology transfer infrastructure in universities).

Lambert [5, p.147] identified the existing connection between universities and enterprise representatives, as well as, the future potential of these co-operations. The author considers that one of the major challenges is the lack of modern technology in universities and the general drawback of HEROBC for enterprises within GB. Hi-tech business based on Oxford and Cambridge researches increases the employment of the population within the Universities’ territories and demonstrates the “potential economic regeneration” for different regions of GB.

Planned economy in the former Soviet Union, including planned science development, promoted the development of modern military technique models, leading positions in space exploration, and some other areas. However, all in all, this did not further the improvement of the population living standards as abroad. Although the former Soviet Union was the first in fundamental sciences, it was unable to create an effective mechanism that could have implemented different innovations into the civil sphere, which, in its turn, leads to the upturn of the country itself. There did not exist those economic incentives to commercialize the inventions of not only scientific groups, but also single scientists. The result is economic lag from highly-developed countries.

¹ Higher Education Reach Out to Business and Community

V.V. Putkov [7] understands that the problem of technology transfer in RF is the insufficient development of the legislative basis in promoting innovation activities; development of stock market deficiency; intellectual property (IP) market; tools to support the innovation activities; and weak innovation infrastructure. In most cases, Russian business is not interested in implementing new Russian technology and funding research. A serious barrier in furthering innovation products into the Russian market, or even foreign market, is the 'sluggish' development of the juridical field and no defense of infringement.

L.A. Bokov, A.V. Kobzev and others underlined that the problem of technology transfer involves the disbalance of domestic science funding; research sensitivity and overall inefficiency of higher education institutions to implement serious technological projects; technology orientation towards military clients, but not market consumers [8].

Research target

M. Dexter in his investigations [5, p. 145-155], identifying the comparative technology transfer problem in universities of Russia, USA and GB, presupposed the definition of statistically important differences in the respondents' answers of these countries. Based on M. Dexter methodology questionnaire was developed and adjusted to Russian conditions.

Problem investigation of technology transfer in Russian²

Basic types of university activities

	1	2	3	4	5
New technology patenting					
Applied research					
Publication of research results					
Teaching, promotion of knowledge					
Fundamental research					
Technology transfer into business					
Upgrading intelligence level					

Dimension of organized structure coordination of the universities in technology transfer

Quite coordinated	Coordinated	Moderately coordinated	Uncoordinated	Extremely uncoordinated

Major motives for universities in technology transfer implementation

	1	2	3	4	5
Development of small innovative enterprises in accordance to FL(Federal Law)- 217					
Income diversification					
Income increase for university staff					
Business support					
Improvement of university prestige					
University staff result satisfaction of one's activities					
Shaping human resources					

Key business motives in university technology implementation

	1	2	3	4	5
Access to new ideas and technologies					
Risk decrease of technology transfer to competitors					
Expenses decrease in R & D					
Accelerated expansion into new markets					
Regular diverse cooperation with universities					

² http://aeer.ru/php/anketa_transf.php

Shaping human resources					
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Technology transfer barriers in business

	1	2	3	4	5
Inadequate evaluation of the financial result					
Interaction structure problems between universities and businesses					
No effective infrastructure for technology transfer					
Cultural differences between universities and businesses					
Insufficient number of funding sources for universities					
Lack of entrepreneurs in universities					

Accessibility of university technologies

Very accessible	Accessible	Rather inaccessible	Partially inaccessible	Practically inaccessible

Key problems of university technology accessibility for business

	1	2	3	4	5
Difficult process coordination of technology transfer					
Non-confidence of businesses to universities					
No attempts to implement technologies into business					
Prolongation of negotiations in technology transfer					
Lack of sophisticated technologies					
Insufficient funding of technology transfer					

Activity rate of technology transfer into business

High	Average	Low

Positive outcomes of technology transfer for universities

	1	2	3	4	5
Mobilization of financial resources					
Income increase of staff					
Governmental funding increase for on-demand technologies					
Realistic financial foresight for universities					
Measures in better insight of business concept execution					
Accessibility increase of financial resources					
Autonomous technology transfer structure enforcement					
Reduction of bureaucracy					
Interaction enhancement between universities and businesses					

Respondents suggest discussing and evaluating the significance of the following range of issues: basic types of university activities, major motives for universities in technology transfer implementation, technology transfer barriers in business and others. This evaluation should be conducted according to the 5-Likert (type) scale³ for all questions except activity rate of technology transfer in business which is evaluated to the 3-scale. Respondents' answers were divided into the following pairs: Russia and USA, Russia and Great Britain..

Research methodology

³ Scale showing the assumption probability of the existing fact of measurable variable as latent and indiscrete / <http://www.proresearch.ru/publish/glos30.php>

Data analysis is based on the bi-variable discrepancy test to define statistically the important differences in the respondents' answers of Russia, USA, and Great Britain in accordance to Mann-Whitney criterion [9].⁴,

$$U = n_1 n_2 + \frac{n_x(n_x + 1)}{2} - T_x \quad (1)$$

where, n_1 – first sample coverage; n_2 – second sample coverage; n_x – coverage more of n_1, n_2 coverage; T_x – more of two rank sum.

Research results

The participants of the research were the following- rectors, vice-rectors of R & D and directors of technology transfer centers of Moscow State Automobile & Road Technical University (MSARTU), Moscow State Technical University n.a. N.E. Bauman, Tusk State University, Ulyanovsk State University and other universities and members of the Russian Engineering Education Association (Table 1-9). The sample coverage for USA- 57, GB- 32 and Russia – 16. The value p1 is the statistic certainty of the zero hypothesis which shows that there is no difference between the respondent answers of USA and Russia, while p2 shows statistic certainty of the zero hypothesis. The columns Russia – USA average rank and Russia- Great Britain average rank show the relative importance of the question for the countries. For those countries with a low rank the question is more important than for those countries with a high rank.

Basic types of university activities

The question answers are marked in percents, respectively, * 90% statistic difference value in respondents' answers ** - 95%, *** - 99%.

Analysis of Russian and American respondents' answers (Table 1) indicated the following:

- similarity in answers to question 1.1 (for Russian respondents more important than for American respondents) , answers to question 1.4 (for American respondents more important than for Russian respondents); answers to question 1.6
- differences in answers to questions 1.2, 1.5, 1.7 (statistic difference value 95%), answers to question 1.3 (statistic difference value 90%).

Analysis of Russian and British respondents' answers (Table 1) indicated the following:

- similarity in answers to questions 1.3, 1.4, 1.6, 1.7 (for British respondents more important than for Russian respondents);
- differences in answers to questions 1.1, 1.2 (statistic difference value 90%); question 1.5.

Sequential comparison of the question- answers of the pairs Russia- USA and Russia- Great Britain indicated that question- answers were the following: technology transfer and teaching, promotion of knowledge – the respondents' answers were identical; question- fundamental and applied research – their opinion differed significantly. This could be explained by the fact that technology transfer and teaching are the major functions of any university, while the second answer involves the different approaches in fundamental and applied research.

Table 1. Basic types of university activities

⁴Zero hypothesis presumes that there are no significant statistic differences between the respondent answers of the country-participants.

Question	Country	1	2	3	4	5	Russia-USA average rank	Russia-GB average rank
1.1. New technology patenting $p_1=0.5552, p_2=0.0658^*$	Russia	31.21	18.75	43.75	0	6.25	34.2	19.2
	USA	12.5	32	30.5	21.5	3.5	37.8	-
	GB	3	34.5	31	22	9.5	-	27.1
1.2. Applied research $p_1=0.0033^{**}, p_2=0.0643^*$	Russia	56.25	31.25	6.25	0	6.25	23.2	19.2
	USA	17	31	38.5	9.5	4	40.9	-
	GB	26	45	19.5	6.5	3	-	27.2
1.3. Publication of research results $p_1=0.0735^*, p_2=0.5485$	Russia	50	37.5	6.25	0	6.25	45.4	26.3
	USA	82	7	5.5	2	3.5	34.6	-
	GB	61.5	26	3	6.5	3	-	23.6
1.4. Teaching, promotion of knowledge $p_1=0.2891, p_2=0.5353$	Russia	68.75	0	25	0	6.25	42	26.3
	USA	87.5	1.8	1.9	1.8	7	35.6	-
	GB	80.5	6.5	0	0	13	-	23.6
1.5. Fundamental research $p_1=0.0164^{**}, p_2=0.1074$	Russia	31.25	50	12.5	0	6.25	48.3	29.1
	USA	75	12.5	3.5	2	7	33.8	-
	GB	65.5	19	3	3	9.5	-	22.2
1.6. Technology transfer into business $p_1=0.7795, p_2=0.7949$	Russia	25	43.75	18.75	6.25	6.25	38.3	25.3
	USA	16	37.5	30.5	14	2.	36.6	-
	GB	15.5	40.5	25	9.5	9.5	-	24.1
1.7. Upgrading intelligence level $p_1=0.0466^{**}, p_2=0.5029$	Russia	18.75	25	43.75	0	12.5	46.4	26.4
	USA	36	41	12.5	7	3.5	34.4	-
	GB	25	34.5	25	3	12.5	-	23.5

Dimension of organized structure coordination of the universities in technology transfer

Analysis of Russian and American respondents' answers (Table 2) showed the absence of similar answers. Analysis of Russian and British respondents' answers showed a difference with statistic difference value of 99%. This indicates that there exists a different approach in the organized structure coordination of technology transfer in Russia, USA and Great Britain.

Table 2. Dimension of organized structure coordination of the universities in technology transfer

Country $p_1=0.2041,$ $p_2=0.0003^{***}$	Structure					Russia-USA average rank	Russia-GB average rank
	Quite coordinated	Coordinated	Moderately coordinated	Uncoordinated	Extremely uncoordinated		
Russia	0	50	50	0	0	31	14
USA	2	30	61	7	0	38.7	-
GB	0	10	40	47	3	-	29.8

Major motives for universities in technology transfer implementation

- Analysis of Russian and American respondents' answers (Table 3) indicated the following:
 - similarity in answers to questions 3.1 (for Russian respondents more important than for American respondents); answers to questions 3.2, 3.5, 3.7 (practically identical value); answers to question 3.6 (for American respondents more important than for Russian respondents); answers to question 3.7
 - differences in answers to questions 3.3, 3.4 (statistic difference value 95%).
- Analysis of Russian and British respondents' answers (Table 3) indicated:
 - similarity in answers to questions 3.2 (for British respondents more important than for Russian respondents); answers to question 3.5 (practically identical value); answers to question 3.6 (for Russian respondents more important than for British respondents),
 - differences in answers to questions 3.1, 3.4 (statistic difference value 99%); answers to questions 3.3, 3.4 (statistic difference value 95%).

Sequential comparison of the question- answers of the pairs Russia- USA and Russia- Great Britain indicated that the questions income diversification, improvement of university prestige, as well as, university staff result satisfaction of one's activities the respondents gave identical answers, while such questions as, development of small innovative enterprises, income increase for university staff and business support the respondents had different opinions. This can be explained by the fact that such factors as income diversification, improvement of university prestige, as well as, university staff result satisfaction of one's activities are acute in all of these countries. However, the development of small innovative enterprises is not so significant due to the world-wide experience of these countries (USA and GR) in this sphere. The different answers to the question income increase for university staff can be explained by the fact that the income of university staffs in the USA and GB is significantly higher than it is in Russia, so for Russian respondents this question is very important. The different answers to the question business support can be explained by the fact that the businesses in the USA and GB need the support of universities and not visa versa (the success of a large number of companies, including the most popular and expensive world brands, is based only and only on the support of different universities; for example, Google Co. was developed within the walls of the Stratford University⁵).

Table 3. Major motives for universities in technology transfer implementation

Question	Country	1	2	3	4	5	Russia-USA average rank	Russia-GB average rank
3.1. Development of small innovative enterprises in accordance to FL(Federal Law)- 217 $p_1 = 0.2187, p_2 = 0.0028^{***}$	Russia	18.75	37.5	25	12.5	6.25	31.2	15.9
	USA	11	32	24	20	13	38.6	-
	GB	0	17	26.5	30	26.5	-	28.8
3.2. Income diversification $p_1 = 0.992, p_2 = 0.4715$	Russia	18.75	31.25	37.5	6.25	6.25	36.9	26.6
	USA	16	34	37.5	11	1.5	37	-
	GB	37	20	23	13	7	-	23.5
3.3. Income increase for university staff $p_1 = 0.0324^{**}, p_2 = 0.0278^{**}$	Russia	31.25	43.75	18.75	0	6.25	26.9	18.2
	USA	14.5	28.5	41	14.5	1.5	39.8	-
	GB	7	40	30	13	10	-	27.7

⁵ <http://www.google.ru/intl/ru/about/corporate/company/history.html>

3.4. Business support $p_1=0.0188^{**}, p_2=0.003^{***}$	Russia	0	18.75	50	18.75	12.5	48	33
	USA	7	46.5	30.5	11	5	33.9	-
	GB	27.5	38	20.5	10.5	3.5	-	20.2
3.5. Improvement of university prestige $p_1=0.6745, p_2=0.992$	Russia	43.75	25	18.75	0	12.5	35	24.4
	USA	37	24	26	7.5	5.5	37.6	-
	GB	40	33.5	3.5	16.5	6.5	-	24.5
3.6. University staff result satisfaction of one's activities $p_1=0.234, p_2=0.5892$	Russia	31.25	43.75	12.5	6.25	6.25	42.6	22.9
	USA	52	27	14	3.5	3.5	35.4	-
	GB	30	27	27	6	10	-	25.3
3.7. Shaping human resources $p_1=0.8259, p_2=0.034^{**}$	Russia	25	56.25	12.5	0	6.25	35.9	18.4
	USA	34	30	21.5	12.5	2	37.3	-
	GB	13	33.5	17	23.5	13	-	27.5

Analysis of Russian and American respondents' answers (Table 4) indicated

Analysis of Russian and American respondents' answers (Table 4) indicated:

- similarity in answers to questions 4.2, 4.4 (for Russian respondents more important than for American respondents); answers to question 4.1 (for American respondents more important than for Russian respondents),
- differences in answers to question 4.5 (statistic difference value 95%), answers to question 4.3 and 4.6(statistic difference value 99%).

Analysis of Russian and British respondents' answers (Table 4) indicated:

- weak similarity in answers to questions 4.1, 4.2, 4.4 (for British respondents more important than for Russian respondents),
- strong similarity answers to question 4.5 (practically identical value),
- differences in answers to questions 4.3 and 4.6(statistic difference value 99%);

Sequential comparison of the question- answers of the pairs Russia- USA and Russia- Great Britain indicated that the questions expenses decrease in R & D, shaping human resources showed that the respondents' answers were different, while such answers to the question as regular diverse cooperation with universities were identical as those to of Russia- Great Britain.

The different answers to the question expenses decrease in R & D can be explained by the fact that there exist different approaches to research – business. The specific fraction of enterprises to R&D departments is very high in the USA and Great Britain, while in Russia this index is far from being perfect. As the respondents' answers to the question shaping human resources are quite different, it can be explained that the problem of personnel shortage in technology transfer is especially acute in Russia, while for the USA and Great Britain it has no significance.

Table 4. Key business motives in university technology implementation

Question	Country	1	2	3	4	5	Russia-USA average rank	Russia-GB average rank
4.1. Access to new ideas and technologies $p_1 = 0.1835, p_2 = 0.3077$	Russia	50	31.25	12.5	0	6.25	43.3	27.4
	USA	72	19.5	0	1.5	7	35.2	-
	GB	71.5	9.5	9.5	0	9.5	-	23
4.2. Risk decrease of technology transfer to competitors $p_1 = 0.5552, p_2 = 0.1031$	Russia	6.25	25	37.5	25	6.25	34.2	29.2
	USA	5.5	18	42	22	12.5	37.8	-
	GB	19	31	37.5	12.5	0	-	22.2
4.3. Expenses decrease in R&D $p_1 = 0.0042^{***}, p_2 = 0.0076^{***}$	Russia	6.25	18.75	56.25	18.75	-	50.4	32.2
	USA	28	44	19.5	3.5	5	33.2	-
	GB	22	50	22	3	3	-	20.7
4.4. Accelerated expansion into new markets $p_1 = 0.8103, p_2 = 0.1362$	Russia	6.25	31.25	43.75	18.75	0	38.2	28.8
	USA	18	25.5	31	18	7.5	36.7	-
	GB	25	34.5	28	9.5	3	-	22.4
4.5. Regular diverse cooperation with universities $p_1 = 0.0114^{**}, p_2 = 0.9203$	Russia	6.25	31.25	37.5	18.75	6.25	48.9	24.8
	USA	35	35	19.5	5.25	5.25	33.7	-
	GB	0	37.5	44	15.5	3	-	24.3
4.6. Shaping of human resources $p_1 = 0.0002^{***}, p_2 = 0.0001^{***}$	Russia	50	37.5	6.25	0	6.25	19.6	12.5
	USA	11	23.5	25.5	22	18	41.9	-
	GB	0	22	44	18.5	15.5	-	30.5

Technology transfer barriers in business

- Analysis of Russian and American respondents' answers (Table 5) indicated:
- similarity in answers to questions 5.1, 5.2 (for Russian respondents more important than for American respondents); answers to question 5.5 (practically identical value),
 - differences in answers to question 5.3, 5.6 (statistic difference value 90%), answers to question 5.4 (statistic difference value 99%).

- Analysis of Russian and British respondents' answers (Table 5) indicated:
- strong similarity in answers to questions 5.1, 5.2, 5.5 (practically identical value); answers to question 5.3 (for Russian respondents more important than for British respondents),
 - differences in answers to questions 5.6 (statistic difference value 90%), answers to question 5.4 (statistic difference value 90%).

Sequential comparison of the question- answers of the pairs Russia- USA and Russia- Great Britain indicated that the answers to the questions inadequate evaluation of the financial result, interaction structure problems between universities and businesses, as well as, insufficient number of funding sources for universities are of high priority for each of the country-participant. At the same time the respondents' answers of these countries were quite different to the following questions- cultural differences between universities and businesses and lack of entrepreneurs in universities. This can be explained by the fact that the cultural differences between universities and businesses in the USA and GB practically don't impede their effective interaction, in comparison to the Russian conditions where the situation is visa versa.

Table 5. Technology transfer barriers in business

Question	Country	1	2	3	4	5	Russia-USA average rank	Russia-GB average rank
5.1. Inadequate evaluation of the financial result $p_1=0.3271, p_2=0.865$	Russia	25	25	31.25	6.25	12.5	32.4	24
	USA	7	29	42	15	7	38.3	-
	GB	12.5	37.5	34.5	12.5	3	-	24.8
5.2. Interaction structure problems between universities and businesses $p_1=0.3222, p_2=0.9045$	Russia	18.75	37.5	31.25	6.25	6.25	32.3	24.9
	USA	11	33	34.5	14.5	7	38.3	-
	GB	25	31	28	9.5	6.5	-	24.3
5.3. No effective infrastructure for technology transfer $p_1=0.0949^*, p_2=0.3173$	Russia	31.25	25	31.25	12.5	0	29.1	21.6
	USA	7	31	42	11	9	39.2	-
	GB	6.5	47	31	9	6.5	-	25.9
5.4. Cultural differences between universities and businesses $p_1=0.0001^{***}, p_2=0.0023^{***}$	Russia	0	18.75	37.5	37.5	6.25	55	33.3
	USA	33	31.5	30	3.5	2	32	-
	GB	28	34.5	25	9.5	3	-	20.1
5.5. Insufficient number of funding sources for universities $p_1=0.8493, p_2=0.9045$	Russia	56.25	12.5	18.75	12.5	0	36.1	24.9
	USA	47.5	30	12	7	3.5	37.3	-
	GB	53	28	9.5	6.5	3	-	24.3
5.6. Lack of entrepreneurs in universities $p_1=0.0512^*, p_2=0.0719^*$	Russia	37.5	25	31.25	0	6.25	27.8	19.3
	USA	14	28	31.5	23	3.5	39.6	-
	GB	15.5	22	40.5	19	3	-	27.1

Accessibility of university technologies

The data analysis in Table 6 showed that there is an insignificant similarity in the question- answers of the Russian- American respondents and a moderate similarity in those of the Russian-British respondents. The conclusion is that equipment in American universities is more accessible than in Russian universities.

Table 6. Accessibility of university technologies

Country $p_1 = 0.1802,$ $p_2 = 0.4777$	Very accessible	Accessible	Rather inaccessible	Partially inaccessible	Practically inaccessible	Russia-USA average rank	Russia-GB average rank
Russia	0	37.5	50	12.5	0	43.3	22.4
USA	10.5	44	38.5	7	0	35.2	-
GB	3	17	67	10	3	-	25.5

Key problems of university technology accessibility for business

- Analysis of Russian and American respondents' answers (Table 7) indicated:
- similarity in answers to questions 7.1, 7.2, 7.3 (for Russian respondents more important than for American respondents); answers to question 7.5 (practically identical value),
 - differences in answers to question 7.4 (statistic difference value 90%), answers to question 7.6 (statistic difference value 99%).

Sequential comparison of the question- answers of the pairs Russia- USA and Russia- Great Britain showed that the respondents consider that the key problems in university technology accessibility for businesses (except in the case of negotiations and funding) is the same in these countries, i.e. prolongation of negotiations and non-confidence of businesses to universities. It should be noted that such factors as non-confidence of businesses to universities, no attempts to implement technologies into business, as well as, the lack of sophisticated technologies is common not only for Russia, but also for the USA and Great Britain.

Table 7. Key problems of university technology accessibility for business

Question	Country	1	2	3	4	5	Russia-USA average rank	Russia-GB average rank
7.1. Difficult process coordination of technology transfer $p_1 = 0.3077, p_2 = 0.4902$	Russia	6.25	25	43.75	25	0	32.2	22.5
	USA	0	21	45	24.5	9.5	38.4	-
	GB	3	12.5	59.5	22	3	-	25.5
7.2. Non-confidence of businesses to universities $p_1 = 0.3524, p_2 = 0.4777$	Russia	25	18.75	31.25	25	0	32.6	26.6
	USA	13	17	43.5	17	9.5	38.2	-
	GB	19	44	25	9	3	-	23.5
7.3. No attempts to implement technologies into business $p_1 = 0.6818, p_2 = 0.4295$	Russia	50	25	18.75	6.25	0	35.1	22.2
	USA	42.5	34.5	9.5	7.5	6	37.5	-
	GB	34.5	40.5	9.5	12.5	3	-	25.6
7.4. Prolongation of negotiations in technology transfer $p_1 = 0.0836^*, p_2 = 0.2713$	Russia	6.25	18.75	43.75	25	6.25	45.1	27.7
	USA	17	26	43.5	9.5	4	34.7	-
	GB	6.5	29	55	6.5	3	-	22.9
7.5. Lack of sophisticated technologies $p_1 = 0.8729, p_2 = 0.5687$	Russia	31.25	31.25	18.75	12.5	6.25	37.8	26.2
	USA	20	45.5	23.5	5.5	5.5	36.8	-
	GB	35.5	32.5	19.5	6.25	6.25	-	23.7
7.6. Insufficient funding of technology transfer $p_1 = 0.0034^{***}, p_2 = 0.1164$	Russia	56.25	12.5	12.5	12.5	6.25	23.2	20
	USA	4	28	39.5	19	9.5	40.9	-
	GB	19.5	35.5	26	16	3	-	26.8

Activity rate of technology transfer into business

The data analysis in Table 8 showed that there is no similarity in the question- answers of the three respondents and in this case the statistic difference value is 95% (in comparing the question answers of the Russian – American respondents the statistic difference value is 99%). It is recommended not to apply the experience of the foreign respondents. It can be stated that the activity rate of technology transfer from universities into businesses in America and Britain are rather high in comparison to Russia.

Table 8. Activity rate of technology transfer into business

Country $p_1=0.0016^{***}$, $p_2=0.0155^{**}$	High	Average	Low	Russia-USA average rank	Russia-GB average rank
Russia	6.25	50	43.75	51.8	31.4
USA	31.5	65	3.5	32.8	-
GB	17	80	3	-	21

Positive outcomes of technology transfer for universities

Analysis of Russian and American respondents’ answers (Table 9) indicated:

- similarity in answers to questions 9.3 (for Russian respondents more important than for American respondents); answers to question 9.5, 9.7 (for American respondents more important than for Russian respondents)
- differences in answers to question 9.1, 9.2, 9.4 (statistic difference value 90%), answers to questions 9.6, 9.8, 9.9 (statistic difference value 99%).

Sequential comparison of the question- answers of the pairs Russia- USA and Russia- Great Britain showed that the answers to the question autonomous technology transfer structure enforcement are identical. At the same time the respondents’ answers of these countries were quite different to the following questions - mobilization of financial resources, income increase of staff, realistic financial foresight for universities, accessibility increase of financial resources, reduction of bureaucracy and interaction enhancement between universities and businesses.

Table 9. Positive outcomes of technology transfer for universities

Question	Country	1	2	3	4	5	Russia-USA average rank	Russia-GB average rank
9.1. Mobilization of financial resources $p_1=0.0001^{***}$, $p_2=0.0001^{***}$	Russia	43.75	50	0	0	6.25	13.4	11.8
	USA	4	4	11	35	46	43.6	-
	GB	3	9.5	37.5	37.5	12.5	-	30.8
9.2. Income increase of staff $p_1=0.0001^{***}$, $p_2=0.0005^{***}$	Russia	56.25	37.5	0	0	6.25	13.2	14.5
	USA	2	9	33	29	27	43.7	-
	GB	9	34.5	37.5	19	0	-	29.5
9.3. Governmental funding increase for on-demand technologies $p_1=0.2801$, $p_2=0.1336$	Russia	37.5	31.25	18.75	6.25	6.25	31.9	28.8
	USA	21	38.5	23	5	12.5	38.4	-
	GB	56.5	34.5	6	3	0	-	22.3

9.4. Realistic financial foresight for universities $p_1=0.0003^{***}, p_2=0.0147^{**}$	Russia	25	37.5	31.25	6.25	0	20.2	17.5
	USA	8	4.5	49	20.5	18	41.7	-
	GB	3	28	41	22	6	-	28
9.5. Measures in better insight of business concept execution $p_1=0.1471, p_2=0.6892$	Russia	12.5	25	43.75	0	18.75	43.8	25.7
	USA	28	24.5	37	7	3.5	35.1	-
	GB	15.5	22	50	12.5	0	-	23.9
9.6. Accessibility increase of financial resources $p_1=0.0615^*, p_2=0.0016^{***}$	Russia	6.25	43.75	43.75	6.25	0	45.8	33.6
	USA	38.5	30	23	5	3.5	34.5	-
	GB	53	31.5	15.5	0	0	-	20
9.7. Autonomous technology transfer structure enforcement $p_1=0.4295, p_2=0.8415$	Russia	6.25	25	68.75	0	0	40.8	23.9
	USA	19.5	35	28	14	3.5	35.9	-
	GB	28	12.5	31.5	25	3	-	24.8
9.8. Reduction of bureaucracy $p_1=0.0969^*, p_2=0.131$	Russia	12.5	31.25	43.75	12.5	0	44.8	28.8
	USA	32	34	25	7	2	34.8	-
	GB	31.5	31.5	34	0	3	-	22.3
9.9. Interaction enhancement between universities and businesses $p_1=0.0588^*, p_2=0.1868$	Russia	31.25	31.25	31.25	0	6.25	45.9	28.3
	USA	56	31.5	5.5	3.5	3.5	34.5	-
	GB	34.5	59	6.5	0	0	-	22.6

The following diagram shows the comparison research analysis results (Fig.1):

Conclusions:

1. Strong similarity in Russian and American respondents' answers can be related to such questions as major motives for universities in technology transfer implementation and key problems of university technology accessibility for business.

In these two cases zero hypotheses is expectable. Thus, the major motives for universities in technology transfer implementation and key problems of university technology accessibility for business are identical for both Russian and American university representatives.

2. Strong similarity in Russian and British respondents' answers can be related to such questions as key problems of university technology accessibility for business, technology transfer barriers in business and accessibility of university technologies. In these three cases zero hypotheses is expectable. Thus, key problems of university technology accessibility for business and technology transfer barriers in business are identical for both Russian and American university representatives.

3. The average statistic value 77% (USA) and 72% (Great Britain) were determined for such questions as basic types of university activities, dimension of organized structure coordination of the universities in technology transfer, major motives for universities in technology transfer implementation and activity rate of technology transfer into business

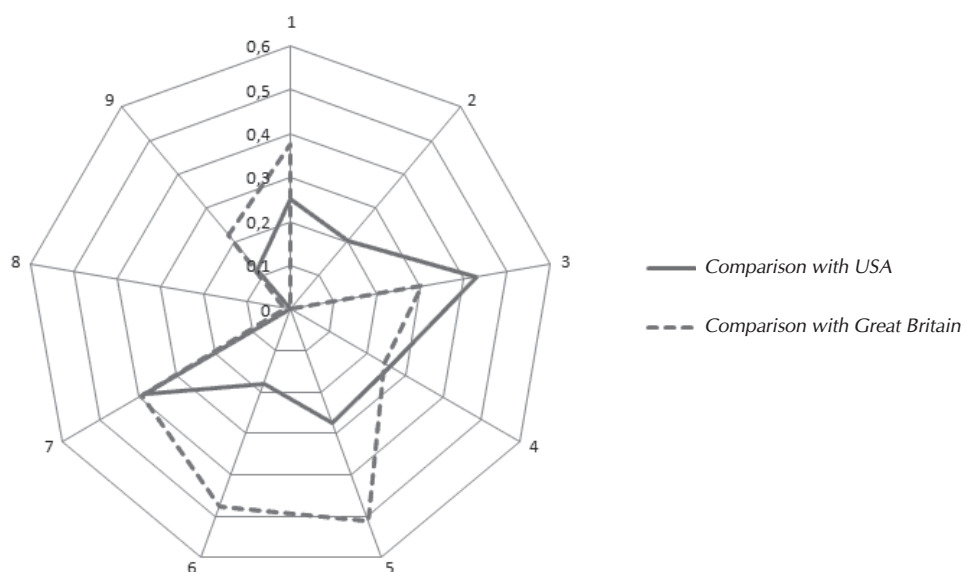
Zero hypotheses are excluded.

The research target has been achieved and the similarity evaluation including definite statistic similarity value of the respondents' answers has been conducted. It seems advisable to continue research involving the possibility of introducing foreign experience into Russian universities where priori would be the results of this research. In this case, the objective would be to prove or disprove the following hypothesis – based on the question- answers of the respondents stating a "strong similarity" - would it be possible to further the experience of USA and GB universities in technology transfer within the framework of different Russian universities.

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Fig.1. Integrated evaluation of priority problems for Russia, USA and Great Britain



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