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MARKETING STRATEGY OF QUALITY MANAGEMENT DURING REORGANIZATION OF REGIONAL UNIVERSITIES IN THE PROCESS OF MODERNIZATION OF EDUCATION IN THE CONDITIONS OF REGION'S TRANSITION TO INDUSTRY 4.0

Abstract: *The purpose of the research is to study the modern Russian practice of quality management during reorganization of regional universities in the process of modernization of education in the conditions of region's transition to Industry 4.0 and to develop a marketing strategy of quality management during this reorganization, which would allow improving the existing practice and ensuring the quick transition of Russia's regions to Industry 4.0. In order to determine the consequences of reorganization of regional universities in this process of modernization of education in Russia's regions, the authors use a specially developed method, as well as the methods of trend, correlation, and factor analysis. As a result it is substantiated that the issues of marketing management of quality during reorganization of regional universities in the process of their modernization in modern Russia are not studied sufficiently – which hinders the transition of regions to Industry 4.0. This is proved by reduction of the number of universities (tendency of monopolization of the regional markets of educational services) and growth of the volume of state financing of reorganized (regional flagship) universities during insignificant implementation of the leading digital technologies and insufficient training of digital personnel for Russia's regions. It is shown that marketing management stimulates the increase of quality of education in the process of universities' reorganization. The authors develop a marketing strategy of quality management during reorganization of regional universities in mentioned process.*

Key words: *Marketing strategy; Reorganization management; Regional universities; Modernization of education; Region's transition to Industry 4.0; Quality management.*

1. Introduction

Recently, due to formation of "knowledge economy" in modern Russia, the issues of education's development have been paid a lot of attention in modern Russia. One of the key tools of modernization of education is reorganization of regional universities. Serious changes, which take place in activities of regional universities due to their reorganization, and new opportunities, which appear due to this, lead to the necessity for

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marketing support for this process.

Firstly, intellectual capital of has a key role in functioning and development of modern universities. Modernization of education is to increase the intellectual capital of universities. Marketing is to strengthen the university's reputation in the region as a responsible and popular employer for attraction of the best professors and lecturers. Secondly, marketing allows expanding sales markets for universities, thus increasing their global competitiveness and attracting more foreign students from different countries.

Thirdly, against the background of reduction of high school graduates in Russia from 2,541,500 in 2010/2011 to 914,200 in 2017/2018 (Federal State Statistics Service, 2019), competition between educational establishments, including universities, grows, and marketing allows attracting the best students and in sufficient numbers for full load of production capacities of universities. Fourthly, marketing allows promoting the educational innovations that are implemented by the universities for increasing their effectiveness. Fifthly, marketing strategies are one of the top-priority directions of development of agglomerations and, therefore, of activation of the markets of educational services (Kataeva et al., 2017), (Loginov, 2017), (Saenko at al., 2016), (Saveleva at al., 2017).

In the conditions of transition of modern Russia's regions to Industry 4.0 within the implementation of the Federal Program "Digital economy of the Russian Federation", adopted by the Decree of the Government of the RF dated July 28, 2017, No. 1632-r, requirements to regional universities will grow, which will lead to a new wave of their reorganization in the interests of bringing them in accordance with new educational standards and increasing their global competitiveness.

This requires a marketing strategy that allows for systematization and coordination of marketing measures.

Reorganization in any sphere of economy usually leads to a problem of reduction of quality of products (and/or services) due to loss of a part of assets (material and non-material – employees, corporate knowledge, and information), destruction of the integrity of the organizational structure, violation of the new organizational culture, and other reasons, which are determined by the context. In the sphere of education, reduction of quality is inadmissible, as instead of expected stimulation reorganization of regional universities will hinder the regions' transition to Industry 4.0.

Increase of quality of higher educational services is the priority of modernization of education in the conditions of region's transition to Industry 4.0. We offer hypothesis H_1 – the issues of marketing management of quality of during reorganization of regional universities in the process of their modernization are not studied sufficiently, which hinders Russia's regions' transition to Industry 4.0; and hypothesis H_2 – strategic marketing management allows raising the quality of during reorganization of regional universities and thus should be mandatory in the process of modernization of education in the interests of the region's transition to Industry 4.0.

The purpose of the research is to study the modern Russian practice of quality management during reorganization of regional universities in the process of modernization of education in the conditions of region's transition to Industry 4.0 and to develop a marketing strategy of quality management during reorganization of regional universities in the process of modernization of education, which would allow improving the existing practice and ensuring quick transition of Russia's regions to Industry 4.0.

2. Literature review

The authors of this research use the materials of works of the modern authors on the issues

of marketing management of regional universities' reorganization during modernization of education. Rahman and Lambkin (2015) note that reorganization (mergers and acquisitions) of universities could lead to creation and loss of value – the risks of this process could be reduced by marketing management. Sinkovics et al. (2015) provide the practical examples of successful reorganization of universities in Malaysia and Indonesia due to marketing management. The concepts and tools of marketing management of universities' reorganization are offered in the works Sozinova (2018a), Sozinova (2018b) and Sozinova et al. (2017).

We also use the modern authors' materials on the issues of modernization of education in the conditions of regional economy's transition to Industry 4.0. Gubareva et al. (2019) emphasize the expedience of modernization of higher education in the conditions of formation of the "knowledge economy". Lebedev (2019) writes that modernization of the marketing conditions of provision and promotion of universities' educational services universities takes place at the same time.

Popkova (2019) thinks that in the conditions of the "knowledge economy" and in the process of transition to Industry 4.0 the role of universities consists in educational support for economy's modernization. Steele (2019) shows successful experience of modernization of the system of higher education in Iran. Tarhan et al. (2018) substantiates - by the example of Turkey – the necessity for modernizing higher education in the conditions of globalization. Vodenko et al. (2019) think that during modernization of the system of higher education in the modern economy it is necessary to adopt the standard of education and train digital personnel for Industry 4.0.

Also, the materials on the issues of marketing management of services' quality in the sphere of higher education are used in this paper. Ogunnaike et al. (2018) provide a set of data on quality of interactive services in marketing of higher education. Polkinghorne et al. (2017) considers marketing of higher education and notes the level of students' involvement in the educational process as the key indicator of education's quality. Clark et al. (2017) points out the important role of social media in marketing management of quality of higher education. Safi et al. (2015) substantiate that marketing efforts influence the quality of services in the sphere of higher education (by the example of Pakistan).

Ogunnaike et al. (2014) shows that quality is very important for development of universities in the conditions of Industry 4.0 and it could be managed with the help of marketing. Osman et al. (2018) study the intermediary's role of institutional image with the help of full modeling of structural equations in the sphere of higher education. Pedro et al. (2018) thinks that perceived quality of services and students' satisfaction in higher education are influenced by the training methods. Sharok (2018) substantiates the important role of social and psychological factors of satisfaction with education in evaluation of the quality of services that are provided by the universities. Vučijak et al. (2018) describe the practice of teaching entrepreneurship in Eastern Europe and Russia and come to the conclusion on importance of marketing.

As a result of the literature overview, a conclusion could be made that the problem of the research has been studied only fragmentarily. The components of this problem (marketing management of reorganization, modernization of education, and marketing of quality management of higher education) are studied separately, which hinders the formation of a comprehensive idea of organization of strategic marketing of quality management during reorganization of regional universities in the process of modernization of education in the conditions of region's transition to Industry 4.0.

In particular, the current role of quality management in the system of marketing support for reorganization of regional universities in the process of modernization of education in the conditions of region's transition to Industry 4.0 (from the positions of positive economics) remains unclear. The issue of organization of strategic marketing of quality management during reorganization of regional universities in the process of modernization of education in the conditions of region's transition to Industry 4.0 (from the positions of normative economics) also remains open. These gaps are to be filled by the presented paper.

3. Materials and method

To determine the consequences of reorganization of regional universities in the process of modernization of education in the conditions of region's transition to Industry 4.0 for quality of higher education in regions of Russia, the authors use a specially developed method. It is aimed at measuring the quality of services in the sphere of higher education and analyzing its changes in the dynamics of time. For achieving the highest precision, objectivity, and correctness during assessment of quality of education within the developed method, we use the information materials as a result of monitoring of effectiveness of the activities of educational organizations of higher education in 2018, which contain the quantitative values of the indicators of the official Russian statistics in the sphere of higher education, in view of regional universities.

The research is performed in three consecutive states. 1st stage – evauation of quality of higher educational services that are provided by regional universities, in two time periods:

- before the reorganization (in Russia – 2015) – t_0:
- after the reorganization in the process of modernization of education in the conditions of regions' transition to Industry 4.0 (at present - 2019) – t_1.

The following formula is used:

$$Q_t=(H_t/H_{thresh}+I_t/I_{thresh}+T_t/T_{thresh}+K_t/K_{thresh})/4, \quad (1)$$

where Q_t – integral quality of educational services provided by the university, shares of 1;

H_t – indicator that characterizes the research activities in the university, number of publications;

H_{thresh} – threshold value of the indicator of research activities, number of publications;

I_t – indicator that characterizes the infrastructure of provision of educational services in the university, share of assets (%);

I_{thresh} – threshold value of the infrastructure indicator, share of assets (%);

T_t – indicator that characterizes the employment of the university's graduates by the specialty, % of employment;

T_{thresh} – threshold value of the indicator of employment of graduates, % of employment;

K_t – indicator that characterizes the university's personnel structure, share of academic staff (%);

K_{thresh} – threshold value of the indicator of personnel structure, share of academic staff (%).

As is seen from Formula (1), for provision of compatibility of the data we use ratio of the indicators for the universities to the threshold values. The threshold values of the indicators are set by the state (ministry of Education and Science of the Russian Federation) based on calculation of average values for all universities of the country. The higher the ratio the higher the separate (within the studied characteristics) and integral quality of educational services that are provided by the university.

Based on the performed calculations we determine the growth of integral quality as a result of reorganization of the university in the process of modernization of education in the conditions of regions' transition to Industry 4.0. The following formula (trend analysis) is used:

$$\Delta Q=Q_{t1}/Q_{t0}, \quad (2)$$

where ΔQ – growth of quality as a result of university's reorganization.

The obtained values determine the selection of the values of the dependent variable (y). Regression analysis is used for determining the influence of independent variable (x) – share of expenditures for marketing in the structure of aggregate expenditures of the university. A model of paired linear regression of the type y=a+b*x is compiled and its expanded analysis is provided. The presence of close (determination coefficient - R2>0.9), direct (value b>0 – i.e., with the "+" sign) and statistically significant (according to F-criterion) interconnection proves the offered hypothesis H_2.

Hypothesis H_1 is proved with the help of trend analysis. In case of insignificant (below 25% - i.e., ΔQ<1.25) average growth of integral quality of educational services for the selection and reduction of quality in certain universities (ΔQ<1), hypothesis H_1 is deemed to be proved. Also, the method of factor analysis is used for determining the contribution of each factor (characteristics of quality: research activities in the university, infrastructure of provision of educational services, employment of graduates, and personnel structure of the university) and the change of integral quality of educational services that are provided by the universities from the selection (on average) as a result of reorganization in the process of modernization of education in the conditions of regions' transition to Industry 4.0. The following formulas are used:

$$\Delta Q(H)=(H_{t1}/ H_{thresh} + I_{t\,0}/I_{thresh}+T_{t0}/ T_{thresh} +K_{t0}/ K_{thresh})/4-Q_{t0}, \quad (3)$$

where ΔQ(H) – growth of integral quality by means of the change of research activities.

$$\Delta Q(I)=(H_{t0}/ H_{thresh} + I_{t\,1}/ I_{thresh} +T_{t0}/ T_{thresh} +K_{t0}/ K_{thresh})/4-Q_{t0}, \quad (4)$$

where ΔQ(I) – growth of integral quality by means of the change of infrastructure of provision of educational services.

$$\Delta Q(T)=(H_{t0}/ H_{thresh} + I_{t\,0}/ I_{thresh} +T_{t1}/ T_{thresh} +K_{t0}/ K_{thresh})/4-Q_{t0}, \quad (5)$$

where ΔQ(T) – growth of integral quality by means of the change of employment of graduates.

$$\Delta Q(K)=(H_{t0}/ H_{thresh} + I_{t\,0}/ I_{thresh} +T_{t0}/ T_{thresh} +K_{t1}/ K_{thresh})/4-Q_{t0}, \quad (6)$$

where ΔQ(K) – growth of integral quality by means of the change of personnel structure of universities.

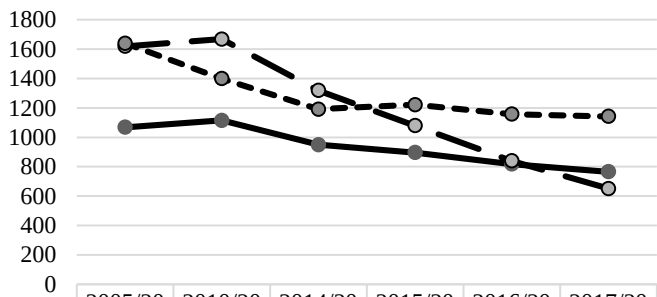
The results of factor analysis are used for qualitative treatment of causal connections of quality management during reorganization of regional universities in the process of modernization of education in the conditions of region's transition to Industry 4.0.

4. Results

4.1. The modern Russian practice of quality management during reorganization of regional universities in the process of modernization of education in the conditions of region's transition to Industry 4.0

Though specific sectorial statistics of reorganization of universities are not available in modern Russia, an obvious sign of this tendency is reduction of the number of universities with stable number of students against the background of full load of production capacities (Figure 1).

Based on the data of Figure 1, we calculate the growth rate of the studied indicators. The number of universities in Russia in 2017/2018 reduced, as compared to 2010/2011 by 31.3%; the number of branches of universities – by 60.97%; and the number of accepted students of universities – by 18.39%. Therefore, universities and their branches were not liquidated but reorganized (through mergers and acquisitions).



	2005/2006	2010/2011	2014/2015	2015/2016	2016/2017	2017/2018
Число вузов, шт.	1068	1115	950	896	818	766
• Число филиалов вузов, шт.	1619	1668	1319	1079	840	651
Прием на обучение студентов вузов, тыс. чел.	1640.5	1399.5	1191.7	1221.8	1157.8	1142

Figure 1. Dynamics of the number of universities, their branches, and number of accepted students in Russia in 2005/2006-2017/2018 academic years
Source: compiled by the authors based on (Federal State Statistics Service, 2019)

Reorganization of universities in the process of modernization of education in modern Russia often acquires a form of creation of regional flagship universities, which unify two and more previously independent universities. As of early 2019, Russia had 51 regional flagship universities, according to the Ministry of Education and Science of the Russian Federation (2019a).

We also determined the following signs of insufficient marketing support for the process of reorganization of universities in modern Russia:

- reduction of academic staff of the Russian universities from 348,160 in 2010/2011 to 245,078 in 2017/2018 (Federal State Statistics Service, 2019) – i.e., by 29.61%;
- remaining deficit of digital personnel in the Russian economy, which shows failure to achieve the most important goal of reorganization of universities, which is connected to their training;

- reduction of the number of PC that are used for educational purposes by the Russian universities reduced from 261 per 1,000 students in 2016/2017 to 229 per 1,000 students in 2017/2018 (Federal State Statistics Service, 2019) – i.e., by 12.26% instead of expected increase;
- small increase of the number of foreign students, who study in the Russian universities, from 212,431 (175,412 in state-funded universities and 37,019 in private universities) in 2016/2017 to 228,902 (198,295 in state-funded universities and 30,607 in private universities) in 2017/2018 (Federal State Statistics Service, 2019) – i.e., by 7.75% instead of expected large increase.

4.2. Consequences of reorganization of regional universities in the process of modernization of education in the conditions of region's transition to Industry 4.0 for quality of higher education in regions of Russia

For the research we selected 10 universities from the ones that performed reorganization in the process of modernization of education in the conditions of Russia's regions' transition to Industry 4.0 and became the regional flagship universities. This allowed covering the regions from different federal districts of the Russian Federation and ensuring the representative character of the research and its results. The selection includes the following universities:

1. Altai State University (Barnaul;
2. Belgorod State Technological University (Belgorod);
3. Vladimir State University (Vladimir);
4. Volgograd State Technical University (Volgograd;
5. Voronezh State Technical University (Voronezh);
6. Vyatka State University (Kirov);
7. Don State Technical University (Rostov-on-Don);
8. Kalmyk State University (Elista);
9. Kemerovo State University (Kemerovo);
10. Kostroma State University (Kostroma).

The initial values of the indicators of quality of educational services that are provided by the universities from the selection before the reorganization (2015) and their analysis through the prism of ratio to the threshold values (equal in periods t_0 and t_1) are presented in Table 1.

As is seen from Table 1, Altai State University showed very high results in research activities (3.89) and good results in other indicators of quality of the provided educational services in 2015: infrastructure – 1.39, employment – 1.07, and personnel structure – 1.08. Belgorod State Technological University showed prominent results in research activities (6.52) and good results in employment (1.21), but low results in infrastructure (0.88) and personnel structure (0.94).

Vladimir State University showed high results in research activities (3.37) and goods results in employment (1.14), but very low results in infrastructure (0.68) and personnel structure (0.86). Volgograd State Technical University showed prominent results in research activities (10.41), moderate results in infrastructure (1.05) and employment (1.00), and low result in personnel structure (0.98).

Voronezh State Technical University showed high results in research activities (3.05) and good results in employment (1.14), but low results in infrastructure (0.88) and personnel structure (0.97). Vyatka State University showed good results in all indicators of the quality of provided educational services: 1.37 in research activities, 1.13 in infrastructure, 1.29 in employment, and 1.17 in personnel structure.

Don State Technical University showed good results in research activities (1.59) and moderate results in employment (1.07), but low results in infrastructure (0.87) and personnel structure (0.90). Kalmyk State University showed high results in research activities (1.83) and infrastructure (1.63), but low results in employment (0.93) and personnel structure (0.94). Kemerovo State University showed high results in research activities (1.45) and employment (1.14), but low results in infrastructure (0.86) and personnel structure (0.99). Kostroma State University showed high results in research activities (1.32), employment (1.21) and personnel structure (1.11), but critically low results in infrastructure (0.34).

Table 1. Indicators of quality of regional universities before the reorganization (2015)

University	Indicator	Research activities (H)	Infrastructure (I)	Employment (T)	Personnel structure (K)
Threshold value (threshold)		51.28	50.00	70.00	60.00
Altai State University	value	199.44	69.67	75.00	64.70
	ratio to threshold	3.89	1.39	1.07	1.08
Belgorod State Technological University	value	334.12	44.21	85.00	56.43
	ratio to threshold	6.52	0.88	1.21	0.94
Vladimir State University	value	172.92	34.23	80.00	51.71
	ratio to threshold	3.37	0.68	1.14	0.86
Volgograd State Technical University	value	533.68	52.48	70.00	59.08
	ratio to threshold	10.41	1.05	1.00	0.98
Voronezh State Technical University	value	156.57	43.89	80.00	58.45
	ratio to threshold	3.05	0.88	1.14	0.97
Vyatka State University	value	70.30	56.69	90.00	69.92
	ratio to threshold	1.37	1.13	1.29	1.17
Don State Technical University	value	81.44	43.34	75.00	54.01
	ratio to threshold	1.59	0.87	1.07	0.90
Kalmyk State University	value	93.75	81.68	65.00	56.32
	ratio to threshold	1.83	1.63	0.93	0.94
Kemerovo State University	value	74.46	43.16	80.00	59.59
	ratio to threshold	1.45	0.86	1.14	0.99
Kostroma State University	value	67.88	16.79	85.00	66.32
	ratio to threshold	1.32	0.34	1.21	1.11

Source: compiled by the authors based on Ministry of Education and Science of the Russian Federation (2019)

Let us present the examples of calculations from Table 1. Value of the indicator that characterizes research activities in Vyatka State University (H_{t0}) constituted 70.30 publications, and the threshold value of the indicator of research activities constituted 51.28 publications.

Thus, $H_{t0}/H_{thresh}=70.30/51.28=1.37$.

Value of the indicator that characterizes infrastructure of provision of educational services in Vyatka State University (I_{t0}) constituted 56.69%, and the threshold value of the indicator of infrastructure constituted 50.00% publications.

Thus, I_{t0}/I_{thresh} =56.69/50.00=1.13.

Value of the indicator that characterizes employment of the graduates of Vyatka State University (T_{t0}) constituted 90.00%, and the threshold value of the indicator of employment of graduates constituted 70.00%.

Thus, T_{t0}/T_{thresh}=90.00/70.00=1.29.

Value of the indicator that characterizes personnel structure of Vyatka State University (K_{t0}) constituted 69.92% publications, and the threshold value of the indicator of personnel structure constituted 60.00%.

Thus, K_{t0}/K_{thresh} =69.92/60.00=1.17.

Thus, integral quality of educational services that are provided by the university constituted Q_{t0}=(1.37+1.13+1.29+1.17)/4=1.24 (high). In Altai State University, integral quality of educational services constituted Q_{t0}=(3.89+1.39+1.07+1.08)/4=1.86 (very high).

In Belgorod State Technological University, integral quality of educational services constituted Q_{t0}=(6.52+0.88+1.21+0.94)/4=2.39 (very high). In Vladimir State University, integral quality of educational services constituted Q_{t0}=(3.37+0.68+1.14+0.86)/4=1.52 (high). In Volgograd State Technical University, integral quality of educational services constituted Q_{t0}=(10.41+1.05+1.00+0.98)/4=3.36 (very high).

In Voronezh State Technical University, integral quality of educational services constituted Q_{t0}=(3.05+0.88+1.14+0.97)/4=1.51 (high). In Don State Technical University, integral quality of educational services constituted Q_{t0}=(1.59+0.87+1.07+0.90)/4=1.11 (moderate). In Kalmyk State University, integral quality of educational services constituted Q_{t0}=(1.83+1.63+0.93+0.94)/4=1.33 (high). In Kemerovo State University, integral quality of educational services constituted Q_{t0}=(1.45+0.86+1.4+0.99)/4=1.11 (moderate). In Kostroma State University, integral quality of educational services constituted Q_{t0}=(1.32+0.34+1.21+1.11)/4=0.99 (low).

Direct average (for the selection) of the indicators of quality of regional universities before the reorganization (2015) is shown in Figure 2.

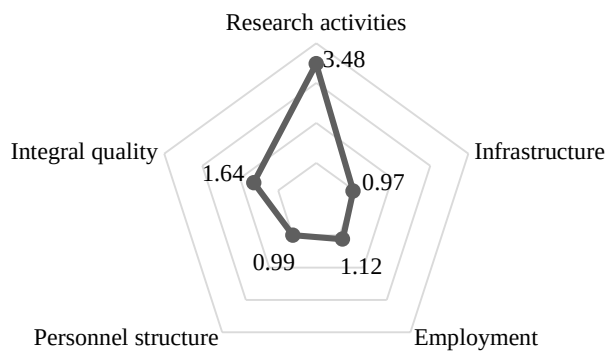


Figure 2. Direct average (for the selection) of the indicators of quality of regional universities before the reorganization (2015)
Source: calculated and compiled by the authors

As is seen from Figure 2, quality of the regional universities before the reorganization was based on research activities (3.48). Employment of the graduates is statistically average (1.12), and infrastructure (0.97) and personnel structure (0.99) are low. Direct average of integral quality of educational services that are provided by Russian regional universities before the reorganization (in 2015) constituted 1.64 (high).

The initial values of the indicators of quality of the educational services that are provided by the universities from the selection after the reorganization, in the process of modernization of education in the conditions of regions' transition to Industry 4.0 (2019), and their analysis through the prism of ratio to the threshold values (equal in periods t_0 and t_1) are shown in Table 2.

Table 2. Indicators of quality of regional universities after the reorganization, in the process of modernization of education in the conditions of regions' transition to Industry 4.0 (2019)

University	Indicator	Research activities (H)	Infrastructure (I)	Employment (T)	Personnel structure (K)
Threshold value (threshold)		51.28	50.00	70.00	60.00
Altai State University	value	316.77	66.15	65.00	63.90
	ratio to threshold	6.18	1.32	0.93	1.07
Belgorod State Technological University	value	295.23	42.78	75.00	60.33
	ratio to threshold	5.76	0.86	1.07	1.01
Vladimir State University	value	180.17	21.88	80.00	57.96
	ratio to threshold	3.51	0.44	1.14	0.97
Volgograd State Technical University	value	514.05	42.53	70.00	60.11
	ratio to threshold	10.02	0.85	1.00	1.00
Voronezh State Technical University	value	233.15	52.71	75.00	64.99
	ratio to threshold	4.55	1.05	1.07	1.08
Vyatka State University	value	108.25	49.90	75.00	66.21
	ratio to threshold	2.11	1.00	1.07	1.10
Don State Technical University	value	117.17	17.39	65.00	55.84
	ratio to threshold	2.28	0.35	0.93	0.93
Kalmyk State University	value	77.77	49.26	50.00	58.94
	ratio to threshold	1.52	0.99	0.71	0.98
Kemerovo State University	value	195.00	19.90	70.00	63.45
	ratio to threshold	3.80	0.40	1.00	1.06
Kostroma State University	value	166.41	35.29	70.00	62.11
	ratio to threshold	3.25	0.71	1.00	1.04

Source: compiled by the authors based on Ministry of Education and Science of the Russian Federation (2019b)

As is seen from Table 2, Altai State University 2019 showed prominent results in research activities (6.18) and good results in infrastructure – 1.32 and in personnel structure – 1.07, but low results in employment (0.93) in 2019.

Belgorod State Technological University showed prominent results in research activities (5.76) and good results in employment (1.07), but low results in infrastructure (0.86) and personnel structure (1.01).

Vladimir State University showed high results in research activities (3.51) and good results in employment (1.14), but very low results in infrastructure (0.44) and personnel structure (0.97). Volgograd State Technical University showed prominent results in research activities (10.02), moderate results in infrastructure (1.00) and employment (1.00) and low results in personnel structure (0.85).

Voronezh State Technical University showed high results in research activities (4.55) and good results in other indicators of quality: in infrastructure (1.05), employment (1.07), and personnel structure (1.08). Vyatka State University showed good results in all indicators of the quality of provided educational services: 2.11 in research activities, 1.00 in infrastructure, 1.07 in employment, and 1.0 in personnel structure.

Don State Technical University showed good results in research activities (2.28) and low results in infrastructure (0.35), employment (0.93), and personnel structure (0.93). Kalmyk State University showed high results in research activities (1.52), but low results in infrastructure (0.99), employment (0.71), and personnel structure (0.98).

Kemerovo State University showed high results in research activities (3.80), moderate results in personnel structure (1.06) and employment (1.00) and low results in infrastructure (0.40). Kostroma State University showed high results in research activities (3.25) and personnel structure (1.04), but critically low results in infrastructure (0.71) and low results in employment (1.00).

Let us present examples of calculations. Value of the indicator that characterizes research activities in Vyatka State University (H_{t0}) constituted 108.25 publications, and threshold value of the indicator of research activities constituted 51.28 publications. Thus, $H_{t0}/ H_{thresh}=108.25/51.28=2.11$. Value of the indicator that characterizes infrastructure of provision of educational services in Vyatka State University (I_{t0}) constituted 49.90%, and threshold value of the indicator of infrastructure constituted 50.00% publications.

Thus, $I_{t\,0}/I_{thresh}=49.90/50.00=1.00$.

Value of the indicator that characterizes employment of the graduates of Vyatka State University (T_{t0}) constituted 75.00%, and threshold value of the indicator of employment of graduates constituted 70.00%.

Thus, $T_{t0}/T_{thresh}=75.00/70.00=1.07$.

Value of the indicator that characterizes personnel structure of Vyatka State University (K_{t0}) constituted 66.21% publications, and threshold value of the indicator of personnel structure constituted 60.00%.

Thus, $K_{t0}/K_{thresh}=66.21/60.00=1.10$.

Thus, integral quality of educational services that are provided by the university constituted $Q_{t0}=(2.11+1.00+1.07+1.10)/4=1.32$ (growth as compared to 2015). In Altai State University, integral quality of educational services constituted $Q_{t0}=(6.18+1.32+0.93+1.07)/4=2.37$ (very high; growth as compared to 2015).

In Belgorod State Technological University, integral quality of educational services constituted $Q_{t0}=(5.76+0.86+1.07+1.01)/4=2.17$ (very high; decrease as compared to 2015). In Vladimir State University, integral quality of educational services constituted $Q_{t0}=(3.51+0.44+1.14+0.97)/4=1.51$ (high, but reduced as compared to 2015). In Volgograd State Technical University,

integral quality of educational services constituted Q_{t0}=(10.02+0.85+1.00+1.00)/4=3.22 (very high, but reduced as compared to 2015).

In Voronezh State Technical University, integral quality of educational services constituted Q_{t0}=(4.55+1.05+1.07+1.08)/4=1.94 (high; growth as compared to 2015). In Don State Technical University, integral quality of educational services constituted Q_{t0}=(2.28+0.35+0.93+0.93)/4=1.12 (moderate, at the level of 2015). In Kalmyk State University, integral quality of educational services constituted Q_{t0}=(1.52+0.99+0.71+0.98)/4=1.05 (high, but reduced as compared to 2015.). In Kemerovo State University, integral quality of educational services constituted Q_{t0}=(3.80+0.40+1.00+1.06)/4=1.56 (high; growth as compared to 2015). In Kostroma State University, integral quality of educational services constituted Q_{t0}=(3.25+0.71+1.00+1.04)/4=1.50 (high; growth as compared to 2015).

Direct average (for the selection) of the indicators of quality of regional universities after the reorganization in the process of modernization of education in the conditions of regions' transition to Industry 4.0 (2019) is shown in Figure 3.

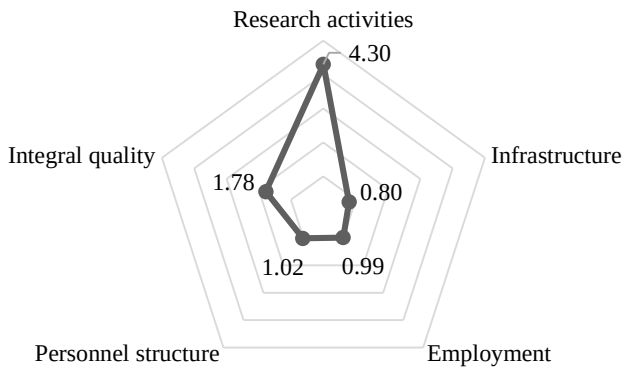


Figure 3. Direct average (for the selection)of the indicators of quality of regional universities after the reorganization in the process of modernization of education in the conditions of regions' transition to Industry 4.0 (2019)
Source: calculated and compiled by the authors

As is seen from Figure 3, quality of the regional universities after the reorganization in the process of modernization of education in the conditions of regions' transition to Industry 4.0 (2019) is still based on active research activities (4.30). Personnel structure is statistically average (1.02), and employment of graduates (0.99) and personnel structure (0.80) are low. Direct average of integral quality of the educational services provided by the regional universities of Russia before the reorganization (in 2015) constituted 1.70 (high).

Calculation of growth of integral quality of Russian universities as a result of reorganization in the process of modernization of education in the conditions of regions' transition to Industry 4.0 (2019) and the data on their expenditures for marketing (i.e., data for regression analysis) are shown in Table 3.

Table 3. Data for regression analysis

University	Integral quality of education		Growth of quality ($\Delta Q=Q_{t1}/Qt_0$): y	Expenditures for marketing, share of aggregate expenditures (%): x
	2015 (Q_{t0})	2019 (Q_{t1})		
Altai State University	1.86	2.37	1.28	3.76
Belgorod State Technological University	2.39	2.17	0.91	2.68
Vladimir State University	1.52	1.51	1.00	2.94
Volgograd State Technical University	3.36	3.22	0.96	2.82
Voronezh State Technical University	1.51	1.94	1.28	3.77
Vyatka State University	1.24	1.32	1.07	3.14
Don State Technical University	1.11	1.12	1.01	2.97
Kalmyk State University	1.33	1.05	0.79	2.32
Kemerovo State University	1.11	1.56	1.41	4.59
Kostroma State University	0.99	1.50	1.50	4.43

Source: calculated and compiled by the authors based on Ministry of Education and Science of the Russian Federation (2019b)

Let us consider an example of calculating the growth of quality of educational services of Russian universities as a result of reorganization in the process of modernization of education in the conditions of regions' transition to Industry 4.0 (2019). In Vyatka State University, quality of educational services in 2015 (Q_{t0}) constituted 1.24, and in 2019 (Q_{t1}) – 1.32. Thus, growth of quality is calculated in the following way: $\Delta Q=1.32/1.24=1.07$ (moderate). The data on growth of quality of educational services of all studied Russian universities as a result of reorganization in the process of modernization of education in the conditions of regions' transition to Industry 4.0 and their direct average are shown in Figure 4.

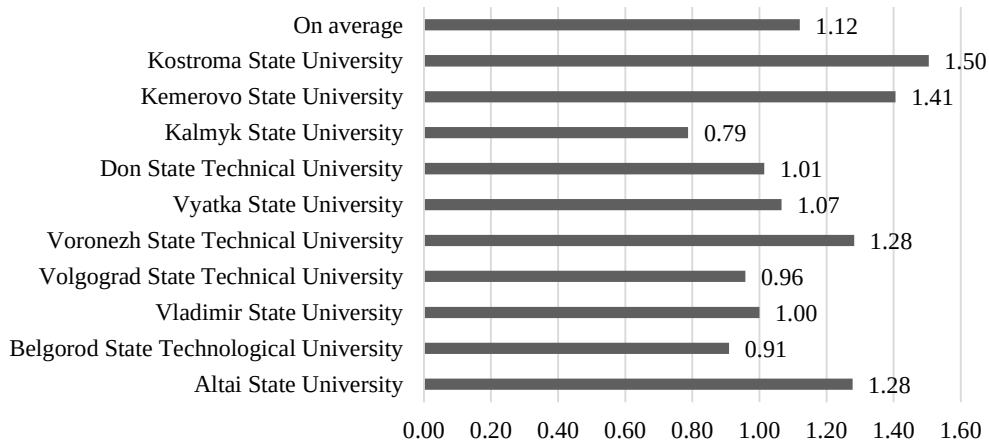


Figure 4. Quality of educational services of the Russian universities as a result of reorganization in the process of modernization of education in the conditions of regions' transition to Industry 4.0

Source: calculated and compiled by the authors

As is seen from Figure 4, quality grew by 1.12 times on average. The most vivid growth of quality is observed in Kostroma State University (1.50) and Kemerovo State University (1.41), and reduction of quality is observed in Kalmyk State University (0.79), Volgograd State Technical University (0.96), and Belgorod State Technological University (0.91). This confirms the offered hypothesis H_1.

As a result of the regression analysis, the following model of paired linear regression is compiled: y=0.1093+0.3026*x. Therefore, increase of the share of expenditures for marketing by 1% in the structure of aggregate expenditures of universities leads to growth of quality of the provided educational services as a result of reorganization by 0.3026 – the connection between the indicators is direct and strong (R^2=0.9710). The table value of F-criterion constituted 5.32 (with significance level α=0.05, number of variables m=1=k1, and the number of observations: 10, k2=10-1-1=8), and estimate value – 267.4042. As the estimate value exceeds the table value (267.4042>5.32), the regression equation is statistically significant according to F-criterion. This confirms the offered hypothesis H_2.

The performed factor analysis of the contribution of each factor into the change of integral quality of the provided educational services (of the universities from the selection on average) as a result of the reorganization in the process of modernization of education in the conditions of regions' transition to Industry 4.0, led to the following results:

- ΔQ(H)=(4.30+0.97+1.12+0.99)/4-1.64=0.21. Therefore, growth of integral quality by means of the change of research activities constituted 0.21;
- ΔQ(I)=(3.48+0.80+1.12+0.99)/4-1.64=-0.04. Therefore, growth of integral quality by means of the change of infrastructure of provision of educational services is negative – decrease constitutes 0.04;
- ΔQ(T)=(3.48+0.97+0.99+0.99)/4-1.64=-0.03. Therefore, growth of integral quality by means of the change of employment of graduates is negative – decrease constitutes 0.03;
- ΔQ(K)=(3.48+0.97+1.12+1.02)/4-1.64=0.01. Therefore, growth of integral quality by means of the change of personnel structure of universities constituted 0.01.

The sum of growth of quality by means of all factors constituted 0.21+0.04+0.03+0.01=0.14. Difference between integral quality in 2019 (1.78) and 2015 (1.64) constitutes: 1.78-1.64=0.14 – the calculations are correct. Thus, research activities of universities are the key factor of the growth of quality of provided educational services. Thus, during marketing of quality management during reorganization of universities it is recommended to pay a lot of attention to research activities.

4.3. Marketing strategy of quality management during reorganization of regional universities in the process of modernization of education in the interests of quick transition of regions to Industry 4.0

The following marketing strategy of managing the quality during reorganization of regional universities in the process of modernization of education in the conditions of region's transition to Industry 4.0 is offered (Figure 2).

Figure 5. Marketing strategy of quality management during reorganization of regional universities in the process of modernization of education in the conditions of region's transition to Industry 4.0
Source: compiled by the authors

As is seen from Figure 5, the purpose of the developed strategy is to increase quality during reorganization of regional universities in the process of modernization of education in the conditions of region's transition to Industry 4.0. The logic of the goal is that at present reorganization of regional universities during modernization of education, which is to ensure training of digital personnel for regions of Russia and to increase the quality of provision of educational services due to implementation of the newest digital technologies, often leads – instead of achievement of these goals – to monopolization of regional markets of educational services and lobbying of interests of the reorganized universities for obtaining the state financing.

For example, in Kirov Oblast in 2014 out of 24 regional universities only 5 were in the process of reorganization. In 2015, 6 more universities of Kirov Oblast underwent reorganization, and the total number of the region's universities decreased to 17. In 2016, the reorganization processes in Kirov Oblast were finished, and the total number of universities decreased to 12. In 2017 and 2018, there were 9 universities in Kirov Oblast, according to the monitoring of effectiveness of activities of educational organizations of higher education (Ministry of Education and Science of the RF, 2019b).

In 2018, regional flagship universities in Russia received additional funding of RUB 13 billion – 2.39% of total state expenditure for higher education (RUB 54,195.05 billion) (Ministry of Education and Science of the RF, 2019a). However, according to the materials of autonomous non-profit organizations "Digital economy", created by the leading hi-tech companies of Russia with support from the Administration of the President of the RF and the Government of the RF for implementing the national program "Digital

economy of the RF", adopted by the Decree of the Government of the RF dated July 28, 2017, No. 1632-r, as of early 2019 Russia has not achieved significant results in training of digital personnel, which leads to their deficit, including in the top-priority spheres (e.g., extracting industry, agriculture, etc.) (Digital economy, 2019).

The above statistical and analytical data show low effectiveness of managing the reorganization of regional universities during modernization of education in the conditions of transition of the Russian regions to Industry 4.0. The strategy is to increase the effectiveness of this management on the basis of implementation of four directions of marketing of universities during reorganization. 1st direction: HR marketing. Within this direction, it is recommended to provide information support for personnel regarding the reorganization and to have group discussion and making of personnel decisions. This will allow reducing uncertainty and simplifying social adaptation to reorganization, as well as preserving the most valuable personnel.

2nd direction: product marketing. Within this direction, it is offered to start new educational programs and directions of training of digital personnel during reorganization. 3rd direction: marketing of innovations. Within this direction, it is recommended to implement the leading educational technologies during reorganization. 4th direction: branding of university and the process of reorganization. This direction envisages advertising and PR of reorganization.

The expected results of practical implementation of the presented marketing strategy of managing the reorganization of regional universities during modernization of education in the conditions of the region's transition to Industry 4.0 ensure the increase of quality of education and include preservation and increase of intellectual capital, digital modernization, and increase of competitiveness of regional universities.

5. Conclusion

Thus, the offered hypotheses have been proved. It is substantiated that the issues of marketing of quality management during reorganization of regional universities during their modernization in modern Russia are not paid sufficient attention, which reduces the effectiveness of this process. This is shown by reduction of the number of universities (the tendency of monopolization of the regional market of educational services) and growth of the volume of state financing of reorganized (regional flagship) universities with slight implementation of the leading digital technologies and insufficient training of digital personnel for regions of Russia.

The developed marketing strategy of quality management of reorganization of regional universities during modernization of education in the conditions of transition of modern Russia's regions to Industry 4.0 allows solving this problem, as (proved in the paper) marketing of management stimulates the increase of quality of education in the process of universities' reorganization. The subject of management of reorganization in this strategy is universities, not the state – which allows reducing the dependence of the universities on state financing. Implementation of markets measures in the four directions – HR marketing, product marketing, marketing of innovations, and branding of university and reorganization – will allow preserving and increasing the intellectual capital of universities during their reorganization, ensuring their digital modernization, and increasing their competitiveness.

It should be concluded that though organizational & economic and managerial issues are successfully studied and solved in this work, the regulatory issues remained outside the limits of this research. In particular, the mechanism of the shift of responsibility and initiatives from the state to reorganized universities, which strive for strengthening of market positions and

additional state support and are not inclined to showing high marketing activity. That's why the problem of state stimulation of marketing activity of reorganized regional universities as (proved in the paper) marketing of management stimulates the increase of quality of education in the process of universities' reorganization. The process of modernization of education in the conditions of region's transition to Industry 4.0 should be studied in further works.

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