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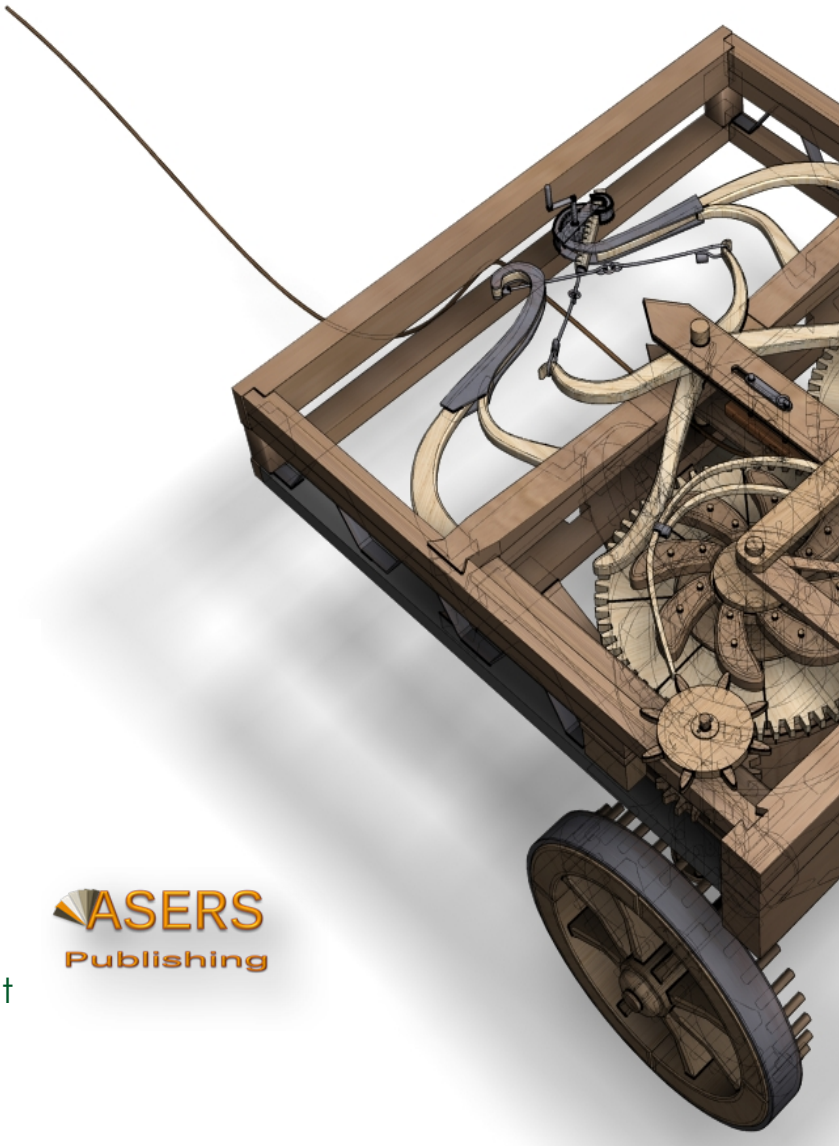

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Methodological Approaches to Evaluation and Analysis of Labor Efficiency in the Spheres of Fuel and Energy Complex

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Abstract

The article is devoted to the issues of methodological approaches to evaluation of labor efficiency in the spheres of fuel and energy complex of Russia and to the analysis of factors that influence its level. Special attention is paid to domestic and foreign approaches to quantitative evaluation of labor efficiency, used not only for a specific enterprise but for determination of its level on the whole for the groups of enterprises and spheres of industry. The authors systematize the traditional methods of evaluation of labor efficiency in view of sectorial specifics of functioning of the spheres of fuel and energy complex of Russia. Mathematical models of factor analysis of labor efficiency in the spheres of fuel and energy complex are developed which allow evaluating the influence of effectiveness of use of main capital and investment activity of enterprises.

Keywords: fuel and energy complex; labor efficiency; capital-labor ratio of labor; returns on assets; capital intensity.

JEL Classification: M21, M40, M49, G32.

Introducion

Research task setting and its connection to important scientific and practical tasks

Over the recent times, one of the key factorsof economic growth ofindustry in Russia has been high level of professional qualification of employees and technical equipment of workplace. Insufficient quantity of highly qualified personnel directly influences the reduction of labor efficiencyin the spheres of industry.

According to statistical study of the Organization for economic cooperation and development on the level of labor efficiency, Russia is ranked the last among the participating countries (OECD2014). Thus, the level of hourly average labor efficiencyin Russia constitutes $24 per capita, which is 39% of the level oflabor efficiencyin the USA and 28% - of the level oflabor efficiencyin Norway (Highly efficient jobs in regions of Russia 2013). This problem is faced by the spheres offuel and energy complexof Russia, as the level of underrun of labor efficiencyfrom the world leaders reaches 10-15 times.That's why one of the most important state tasks of the government of the Russian Federation is increase of the level of labor efficiencyin leading spheres ofindustry, including fuel and energy complex (FEC).

Taking into account that Russian FEC consists of oil and gas spheres, motor fuels production, coal industry, and electrical energetics, there's necessity for development of a unified methodological approach to evaluation of the achieved level oflabor efficiencyin the sphere on the whole and compared to foreign sectorial companies, and for analysis of factors which influence it.

1. Analysis of recent publications on the topic

Various approaches to quantitative evaluation of labor efficiencyat industrial enterprises are viewed in scientific sphere. Most of Russian economists think that efficiency characterizes ratio of result in production to costs of human labor. Most of foreign scientists stick to resource-targeted approach to evaluation oflabor efficiency. Thus, Riggs and Felix (1983) consider thatlabor efficiencyis a certain quantitative and qualitative measure of disposal of resources for execution and achievement of specific goals.In traditional understanding, evaluation of the achieved level oflabor efficiencywithin one enterprise supposes the use ofindicators determined both in natural, labor, resources, andvalue items of measurement.

However, for qualitative evaluation and analysis of labor efficiencyin the scale of the sphere or groups of enterprises, there appears difficulty in comparison of the data and receipt of integral evaluation oflabor efficiency. One of solutions of this problem is the use of international statistical standards of evaluation oflabor efficiencyon the basis of value indicators.

It's necessary to agree with the Parfenov's (2010) opinion, who considers that in modern understanding labor efficiencybecame a wider notion, as it is deemed to be the measure of evaluation of effectiveness of use of not only labor resources but other production factors (capital, raw materials, energy, land).

The most attractive from the point of view of resource approach is quantitative evaluation oflabor efficiency, based on added value which characterizes effectiveness of the use of total labor at an enterprise. A group of foreign scientists, Kaplan and Norton (1996) stick to the same approach. For the purpose of evaluation of personnel effectiveness – unlike the traditional methodology of evaluation of labor efficiency, defined as the value of the received income from production and sales of products per capita – they offer to use the indicatorof added valueper capita. This scientific position is explained in the following way.

Income per capita, being a simple and clear indicator, has a range of drawbacks. Thus, as a result of increase of income per capita, enterprise's profit may decrease when additional directions of activities are developed and the enterprise bears additional expenses. In order to evaluate labor efficiency of full-time personnel, aimed at the result and achievement of strategic goals of enterprise, it's necessary to use the indicatorof added valueper capita, excluding expenses for materials and services from the volume of income (Kaplan and Norton 1996).

Following the scientific research, the group of authors under the guidance of professor Leybert (2014, 2015) systematized methodological approaches to evaluation of labor efficiency, regarding fuel and energy complex. As a universal natural method, the reference-natural method was selected, based on the volume of issued products in the spheres of FEC, measures in tons of oil equivalent. The value method includes various variants based on application of theindicator of grossadded value, cost of supplied products, and the use of the volume of the issued products in value expression, calculated by the reference fuel.

For the purpose of evaluation ofinfluenceof factorson the change of the level of labor efficiency, Timarsuev (2015) offered a model of analysis of dynamics oflabor efficiencyon the basis of measure of index of multi-factor labor efficiency (Cobb - Douglas), which has the following form:

$$I_{TFP} = \frac{\Delta Q}{Q} - \alpha \times \frac{\Delta K}{K} - \beta \times \frac{\Delta L}{L}, \quad (1)$$

where: ΔQ/Q - dynamics of results of functioning of economy on the basis of indicator of gross domestic product;
ΔK/K - dynamics of involved capital resources on the basis ofindicatorof investments into production capital;
ΔL/L - dynamics of involved labor resources on the basis ofindicatorof the number of the employed in the economy; α, β - coefficients of elasticity for capital and labor, accordingly.

2. Formulation of the research goals

The purpose of the research is to develop a universal methodology of evaluation of influenceof factorson the change of the level oflabor efficiencyfor the spheres offuel and energy complexand for the Russian FEC on the whole, based on the generally acknowledged international provisions, and to approbate the offered methodology of evaluation of factorson the change of the level oflabor efficiencyin the FEC spheres.

Main results of the research and their substantiation

For the purpose of determination of thefactorsof change oflabor efficiency in the FEC spheres on the whole, the authors of the article developed a mathematical model of analysis of labor efficiency, which has the following form:

$$LE = CLR \times RA \quad (2)$$

where: LE – level oflabor efficiency; CLR - capital-labor ratioof labor, calculated as ratio of average annual cost of main production funds to average annual number of employees in the sphere; RA – return on assets, calculated as ratio of the volume of the issued products in value expression to average annual cost of main production funds.

Growth of labor efficiency under the influence of the factor – capital-labor ratio of labor (ΔLE_{CLR}) is calculated with the formula:

$$\Delta LE_{CLR} = \Delta CLR \times RA_0 \quad (3)$$

$$\Delta CLR = CLR_1 - CLR_0 \quad (4)$$

where: CLR_1, CLR_0 – capital-labor ratioof labor in the studied and basic periods; RA_0 – level of return on assets in the basic period.

Growth of labor efficiency under the influence of the factor – return on assets (ΔLE_{RA}) is calculated by the formula:

$$\Delta LE_{RA} = RA_1 \times \Delta RA \quad (5)$$

$$\Delta RA = RA_1 - RA_0 \quad (6)$$

Growth of labor efficiency under the influence of two factors is calculated by the formula:

$$\Delta LE = \Delta LE_{RA} + \Delta RA \quad (7)$$

Initial data for conduct of factor analysis of labor efficiency for the analyzed period of 2014-2015 is shown in Table1.

Table1 – Initial data for conduct offactor analysis of labor efficiency in the spheres of fuel and energy complex (FEC) on the whole and for FEC (2014-2015)

Indicator	Spheres of fuel and energy complex (FEC)	Item of measurement	2014	2015	Deviation (group 5)
Initial Data for Analysis					
Average annual cost of main production funds	Extraction of fuel and energy minerals	RUB million	13,987,918.00	16,660,799.50	2,672,881.5
	Oil refining industry/production of motor fuels and coke	RUB million	2,648,880.42	3,391,530.96	742,651
	Production and distribution of electrical energy, gas, and water	RUB million	10,801,712.50	12,314,500.00	1,512,788
	Total for the FEC	RUB million	27,438,510.90	32,366,830.50	4,928,320
Average annual number of employees in the sphere	Extraction of fuel and energy minerals	thousand people	803.10	798.60	-5
	Oil refining industry/production of motor fuels and coke	thousand people	119.10	122.00	3
	Production and distribution of electrical energy, gas, and water	thousand people	1,936.00	1,914.00	-22
	Total for the FEC	thousand people	2,858.20	2,834.60	-24
Initial Data for Analysis					
Volume of issued products in value expression, calculated according to data of Federal State Statistics Service	Extraction of fuel and energy minerals	RUB million	9,159,953.00	10,079,165.00	919,212
	Oil refining industry/production of motor fuels and coke	RUB million	7,304,443	7,331,444.00	27,001
	Production and distribution of electrical energy, gas, and water	RUB million	4,712,009	4,646,449.00	-65,560
	Total for the FEC	RUB million	21,176,405.00	22,057,058.00	880,653

Indicator	Spheres of fuel and energy complex (FEC)	Item of measurement	2014	2015	Deviation (group 5)
Volume of issued products in value expression, calculated according to the reference fuel	Extraction of fuel and energy minerals	RUB million	7,926,391	4,479,993.00	-3,446,398
	Oil refining industry/production of motor fuels and coke	RUB million	5,071,231	3,055,958.00	-2,015,273
	Production and distribution of electrical energy, gas, and water	RUB million	11,782,571	7,146,966.00	-4,635,606
	Total for the FEC	RUB million	24,780,194	14,682,917.00	-10,097,27
Indicators Calculated on the Basis of Data from Federal State Statistics Service					
Capital-labor ratio of labor	Extraction of fuel and energy minerals	RUB million/capita	17.42	20.86	3.00
	Oil refining industry/production of motor fuels and coke	RUB million/capita	22.24	27.80	6.00
	Production and distribution of electrical energy, gas, and water	RUB million/capita	5.58	6.43	1.00
	Total for the FEC	RUB million/capita	9.60	11.42	2.00
Return on assets	Extraction of fuel and energy minerals	RUB/RUB	0.65	0.60	-0.05
	Oil refining industry/production of motor fuels and coke	RUB/RUB	2.76	2.16	-0.60
	Production and distribution of electrical energy, gas, and water	RUB/RUB	0.44	0.38	-0.06
	Total for the FEC	RUB/RUB	0.77	0.68	-0.09
Indicators Calculated on the Basis of Data from Federal State Statistics Service					
Labor efficiency	Extraction of fuel and energy minerals	RUB million/capita	11.41	12.62	1
	Oil refining industry/production of motor fuels and coke	RUB million/capita	61.33	60.09	-1
	Production and distribution of electrical energy, gas, and water	RUB million/capita	2.43	2.43	0
	Total for the FEC	RUB million/capita	7.41	7.78	**0.37**
Indicators Calculated on the Basis of Reference Fuel					
Return on assets	Extraction of fuel and energy minerals	rub./rubles	0.57	0.27	-0.30
	Oil refining industry/production of motor fuels and coke	RUB/RUB	1.91	0.90	-1.01
	Production and distribution of electrical energy, gas, and water	RUB/RUB	1.09	0.58	-0.51
	Total for the FEC	RUB/RUB	0.90	0.45	-0.45
Labor efficiency	Extraction of fuel and energy minerals	RUB million/capita	9.87	5.61	-4
	Oil refining industry/production of motor fuels and coke	RUB million/capita	42.58	25.05	-18
	Production and distribution of electrical energy, gas, and water	RUB million/capita	6.09	3.73	-2.4
	Total for the FEC	RUB million/capita	8.67	5.18	**-3.49**

Source: according to the data of the web-site of Federal State Statistics Service (http://www.gks.ru/)

The results of analysis of influence of factors on the dynamic of labor efficiency, calculated according to two approaches, are shown in Table2.

Table 2 – Evaluation of influence of factors on dynamics of labor efficiency in 2014-2015 in the spheres of FEC and in FEC on the whole

Indicator	Spheres of fuel and energy complex (FEC)	Item of measurement	Value of influence of factor on dynamics of labor efficiency
Results of multi-factor analysis, calculated on the basis of data from Federal State Statistics Service			
Change of labor efficiency by means of influence of capital-labor ratio of labor	Extraction of fuel and energy minerals	RUB million/capita	2.26
	Oil refining industry/production of motor fuels and coke	RUB million/capita	15.33
	Production and distribution of electrical energy, gas, and water	RUB million/capita	0.37
	Total for the FEC	RUB million/capita	1.40
Change of labor efficiency by means of influence of return on assets	Extraction of fuel and energy minerals	RUB million/capita	-1.04
	Oil refining industry/production of motor fuels and coke	RUB million/capita	-16.56
	Production and distribution of electrical energy, gas, and water	RUB million/capita	-0.38
	Total for the FEC	RUB million/capita	-1.03
Total change of labor efficiency by means of influence of two factors	Extraction of fuel and energy minerals	RUB million/capita	1.22
	Oil refining industry/production of motor fuels and coke	RUB million/capita	-1.24
	Production and distribution of electrical energy, gas, and water	RUB million/capita	-0.01
	Total for the FEC	RUB million/capita	**0.37**
Results of multi-factor analysis calculated on the basis of reference fuel			
Change of labor efficiency by means of influence of capital-labor ratio of labor	Extraction of fuel and energy minerals	RUB million/capita	1.95
	Oil refining industry/production of motor fuels and coke	RUB million/capita	10.64
	Production and distribution of electrical energy, gas, and water	RUB million/capita	0.93
	Total for the FEC	RUB million/capita	1.64
Change of labor efficiency by means of influence of return on assets	Extraction of fuel and energy minerals	RUB million/capita	-6.21
	Oil refining industry/production of motor fuels and coke	RUB million/capita	-28.17
	Production and distribution of electrical energy, gas, and water	RUB million/capita	-3.28
	Total for the FEC	RUB million/capita	-5.13
Results of multi-factor analysis calculated on the basis from Federal State Statistics Service			
Total change of labor efficiency by means influence of two factors	Extraction of fuel and energy minerals	RUB million/capita	-4.26
	Oil refining industry/production of motor fuels and coke	RUB million/capita	-17.53
	Production and distribution of electrical energy, gas, and water	RUB million/capita	-2.35
	Total for the FEC	RUB million/capita	-3.49

Source: according to the data of the web-site of the Federal State Statistics Service. Available at: http://www.gks.ru/

As is seen from Table 2, using the first approach (based on the data of the Federal State Statistics Service) for FEC on the whole the level of labor efficiency in 2015, as compared to 2014, grew by 0.37 RUB million per capita. By means of influence of capital-labor ratioof labor, labor efficiency grew by 1.4 RUB million per capita. By means of return on assets, the level of labor efficiency decreased by 1.03 RUB million capita. Therefore, reduction of the level of labor efficiency on the whole for FEC was negatively influenced by reduction of effectiveness of the use of main production funds in FEC spheres and for fuel and energy complex on the whole.

During the use of the second approach to determination of the labor efficiency on the basis of reference-natural indicators, the level of labor efficiency or 2014-2015 grew by 3.49 RUB million/per capita. By means of influence of capital-labor ratioof labor, labor efficiency grew by1.64 RUB million/capita. By means of return on assets, the level oflabor efficiency decreased by 5.13 RUB million/capita. Therefore, reduction of the level of labor efficiency for FEC on the whole was negatively influenced by reduction of effectiveness of the use of main production funds in FEC spheres and in fuel and energy complex on the whole.

For the purpose of evaluation ofinfluenceof external factorson dynamics oflabor efficiency, the factor model oflabor efficiency is used, which has the following form:

$$LE = CER / CI, \quad (8)$$

$$CER = I / N, \quad (9)$$

$$CI = I / IP \quad (10)$$

where CER – capital-employment ratio, which characterizes the volume of investments per employees in the sphere; CI – capital intensity of labor, which characterized the volume of investments per 1 RUB of the issued products in the sphere; I – volume of investment of assets into FEC sphere; N – average annual number of employees in the sphere; IP – cost of issued products.

Initial data for conduct of factor analysis of labor efficiency for the second model for 2014-2015 is shown in Table3.

Table 3 – Initial data for conduct of factor analysis of labor efficiency for the second model

Indicator	Spheres of fuel and energy complex (FEC)	Unit of measurement	2014	2015	Deviation (group 5 – group 4)
Investments	Extraction of fuel and energy minerals	RUB million	1,957,100	2,463,400	506,300
	Oil refining industry/ production of motor fuels and coke	RUB million	486,500	509,600	23,100
	Production and distribution of electrical energy, gas, water	RUB million	1,186,200	990,500	-195,700
	Total for the FEC	RUB million	3,629,800	3,963,500	333,700
Average annual number of employees in the sphere	Extraction of fuel and energy minerals	thousand people	803.1	798.6	-5
	Oil refining industry/production of motor fuels and coke	thousand people	119.00	122	3
	Production and distribution of electrical energy, gas, water	thousand people	1,936	1,914	-22
	Total for the FEC	thousand people	2,858.20	2,834.6	-24
Volume of issued products in value expression, calculated according to data of Federal State Statistics Service	Extraction of fuel and energy minerals	RUB million	9,159,953	10,079,165	919,212
	Oil refining industry/production of motor fuels and coke	RUB million	7,304,443	7,331,444	27,001
	Electrical energy industry	RUB million	4,712,009	4,646,449	-65,560
	Total for the FEC	RUB million	21,176,405	22,057,058	880,653

Indicator	Spheres of fuel and energy complex (FEC)	Unit of measurement	2014	2015	Deviation (group 5 – group 4)
Volume of the issued products in value expression, calculated by reference fuel	Extraction of fuel and energy minerals	RUB million	7,926,391	4,479,993	-3,446,398
	Oil refining industry/production of motor fuels and coke	RUB million	5,071,231	3,055,958	-2,015,273
	Production and distribution of electrical energy, gas, water	RUB million	1,178,2571	7,146,966	-4,635,606
	Total for the FEC	RUB million	24,780,194	14,682,917	-10,097,277
Indicators calculated according to the data of Federal State Statistics Service					
Capital-labor ratio	Extraction of fuel and energy minerals	RUB million per capita	2.44	3.08	0.65
	Oil refining industry/production of motor fuels and coke	RUB million per capita	4.09	4.18	0.09
	Production and distribution of electrical energy, gas, water	RUB million per capita	0.61	0.52	-0.10
	Total for the FEC	RUB million per capita	1.27	1.40	0.13
Capital intensity	Extraction of fuel and energy minerals	RUB/RUB	0.21	0.24	0.03
	Oil refining industry/production of motor fuels and coke	RUB/RUB	0.07	0.07	0.00
	Production and distribution of electrical energy, gas, water	RUB/RUB	0.25	0.21	-0.04
	Total for the FEC	RUB/RUB	0.17	0.18	0.01
Labor efficiency	Extraction of fuel and energy minerals	RUB million per capita	11.41	12.62	1.22
	Oil refining industry/production of motor fuels and coke	RUB million per capita	61.38	60.09	-1.29
	Production and distribution of electrical energy, gas, water	RUB million per capita	2.43	2.43	-0.01
	Total for the FEC	RUB million per capita	7.41	7.78	**0.37**
Indicators calculated according to reference fuel					
Capital intensity	Extraction of fuel and energy minerals	RUB/RUB	0.25	0.55	0.303
	Oil refining industry/production of motor fuels and coke	RUB/RUB	0.10	0.17	0.071
	Production and distribution of electrical energy, gas, water	RUB/RUB	0.10	0.14	0.038
	Total for the FEC	RUB/RUB	0.15	0.27	0.123
Labor efficiency	Extraction of fuel and energy minerals	RUB million per capita	9.87	5.61	-4
	Oil refining industry/production of motor fuels and coke	RUB million per capita	42.62	25.05	-18

Indicator	Spheres of fuel and energy complex (FEC)	Unit of measurement	2014	2015	Deviation (group 5 – group 4)
	Production and distribution of electrical energy, gas, water	RUB million per capita	6.09	3.73	-2.4
	Total for the FEC	RUB million per capita	8.67	5.18	**-3.49**

Source: on the basis of the data of the web-site of the Federal State Statistics Service (http://www.gks.ru/)

Results of influence of factors on dynamics oflabor efficiency in FEC spheres and in FEC on the whole are shown in Table 4. The data of Table 4 shows that positive influence on dynamics of labor efficiency for the studied period of 2014 - 2015 was performed by the indicator of capital-labor ratio, which characterizes the volume of investments per one employee in the sphere by means of excess of the rates of growth of investments over the growth rate of the number of employees in the sphere, which is a positive moment. However, by means of the growth of capital intensity, the level of labor efficiency in FEC spheres and in FEC on the whole decreased, which is unfavorable factor. This primarily caused by low feedback of investments into FEC spheres per RUB 1 of the issued products.

Table 4 – Evaluation of influence factors on dynamics of labor efficiency 2014-2015 in FEC spheres and in FEC on the whole

Indicator	Fuel and Energy Complex (FEC) Spheres	Unit of measurement	Value of influence of the factor on dynamics of labor efficiency
Results of multi-factor analysis, calculated on the basis of the Federal State Statistics Service			
Change of labor efficiency by means of influence of capital-labor ratio	Extraction of fuel and energy minerals	RUB million per capita	3.03
	Oil refining industry/production of motor fuels and coke	RUB million per capita	1.33
	Production and distribution of electrical energy, gas, and water	RUB million per capita	-0.38
	Total for the FEC	RUB million per capita	0.75
Change of labor efficiency by means of influence of capital intensity	Extraction of fuel and energy minerals	RUB million per capita	-1.82
	Oil refining industry/production of motor fuels and coke	RUB million per capita	-2.62
	Production and distribution of electrical energy, gas, and water	RUB million per capita	0.37
	Total for the FEC	RUB million per capita	-0.38
Total change of labor efficiency by means of influence of two factors	Extraction of fuel and energy minerals	RUB million per capita	1.22
	Oil refining industry/production of motor fuels and coke	RUB million per capita	-1.29
	Production and distribution of electrical energy, gas, and water	RUB million per capita	-0.01
	Total for the FEC	RUB million per capita	**0.37**
Results of multi-factor analysis calculated according to reference fuel			
Change of labor efficiency by means of influence of capital-labor ratio	Extraction of fuel and energy minerals	RUB million per capita	2.62
	Oil refining industry/production of motor fuels and coke	RUB million per capita	0.93
	Production and distribution of electrical energy, gas, and water	RUB million per capita	-0.95
	Total for the FEC	RUB million per capita	0.88
Results of multi-factor analysis calculated according to reference fuel			
	Extraction of fuel and energy minerals	RUB million per capita	-1.82

Indicator	Fuel and Energy Complex (FEC) Spheres	Unit of measurement	Value of influence of the factor on dynamics of labor efficiency
Change of labor efficiency by means of influence of capital intensity	Oil refining industry/production of motor fuels and coke	RUB million per capita	-18.49
	Production and distribution of electrical energy, gas, and water	RUB million per capita	-1.41
	Total for the FEC	RUB million per capita	-4.37
Total change of labor efficiency by means of influence of two factors	Extraction of fuel and energy minerals	RUB million per capita	0.81
	Oil refining industry/production of motor fuels and coke	RUB million per capita	-17.57
	Production and distribution of electrical energy, gas, and water	RUB million per capita	-2.35
	Total for the FEC	RUB million per capita	-3.49

Conclusions

Based on the performed multi-factor analysis of labor efficiency, positive influence was done by such factor as capital-labor ratio of labor. Negative influence on dynamics of labor efficiency was done by reduction of effectiveness of use of main production funds and reduction of effectiveness of the use of investments in FEC spheres and in fuel and energy complex on the whole.

Thus, for the purpose of evaluation of the achieved level of labor efficiency in the spheres of fuel and energy complexin Russia it is offered to use value methods of evaluation on the basis of the use of added value, and conventional-natural methods on the basis of reference fuel – for comparability of the results for specific spheres of FEC. The developed mathematical models of conduct of factor analysisof labor efficiencyin the spheres offuel and energy complexwill allow evaluating the influence of effectiveness of the use of main capital and investment activities of enterprises.

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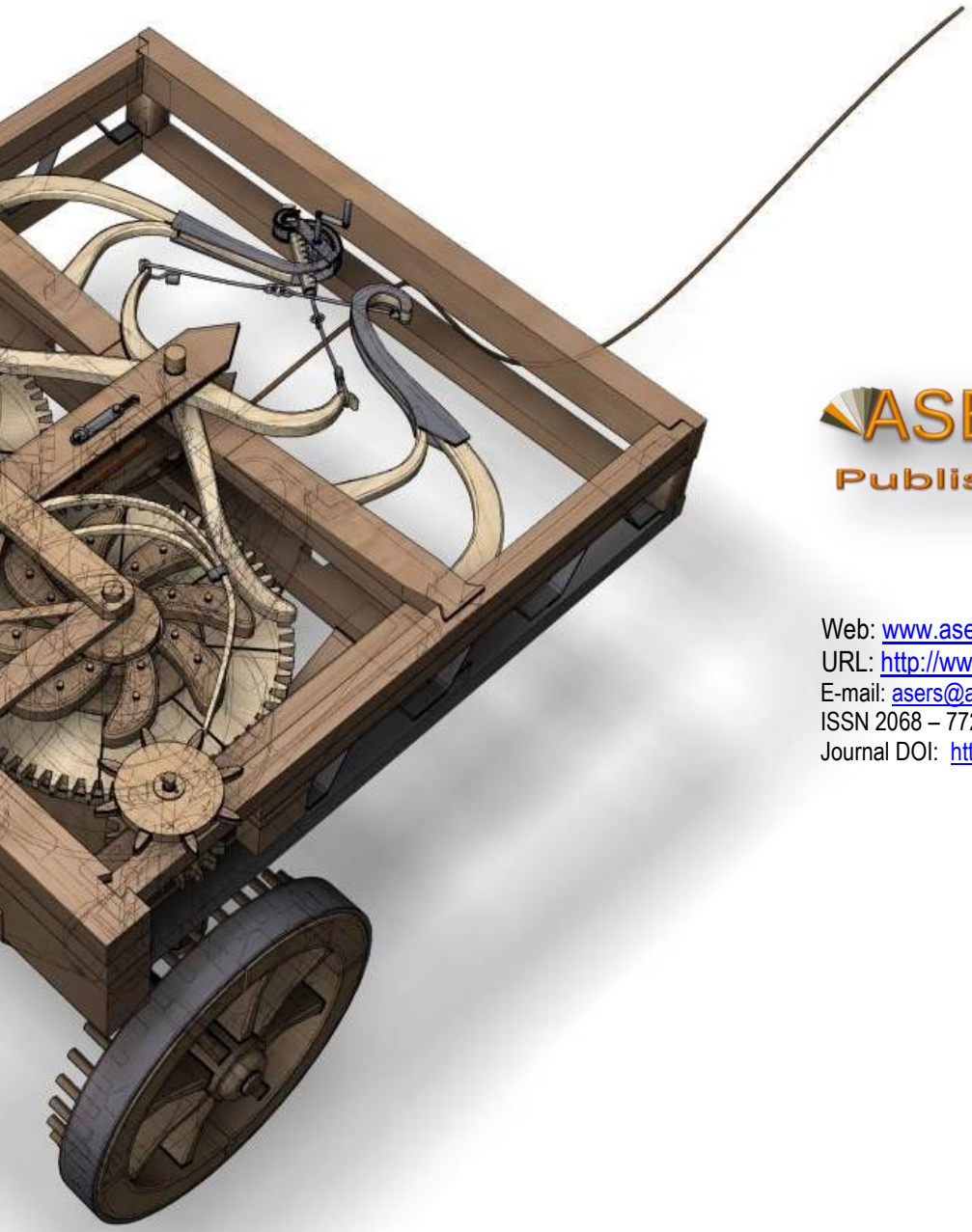

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