

Economic and management analysis of the impact of human capital on the development of machinery-building in Bulgaria

Mariana Petrova^{1*}, Milena Tepavicharova² and Lyudmila Dikova³

¹ St. Cyril and St. Methodius University of Veliko Tarnovo, Veliko Tarnovo, Bulgaria

² Higher School of Security and Economics – Plovdiv, 13 Kuklensko Shose Blvd., 4004 Plovdiv

³ Higher School of Security and Economics – Plovdiv, 13 Kuklensko Shose Blvd., 4004 Plovdiv

Abstract. At present, foreign markets and, above all, the EU market are decisive for the development of the Bulgarian machine-building sector. In the majority of cases, the presence of European and other foreign markets remains at the level of inter-company trading relationships. One reason for this is the absence of strong national scientific, technical and production structures (science-technology-production) which are able to integrate themselves into large production chains. The lack of adequate human capital management, as well as the low level of professional knowledge, skills and competencies, have a negative impact on the economic performance of the sector. Therefore, it is necessary to carry out an economic and managerial analysis of the state of human capital, revealing the possibilities for its effective utilization and management. The purpose of this article is to examine the state of the human capital by analyzing its impact on the development of the machine building sector in Bulgaria.

1. Introduction

The membership of Bulgaria in the EU and the access to the European market are crucial for shaping the production, the product structure and the market policy of Bulgarian machine-building enterprises. In recent years, more than 80% of machine-building production is being realized on the European market. The foreign markets and, above all, the EU market, are decisive for the development of the Bulgarian machine-building sector. In the majority of cases, the presence of European and other foreign markets remains at the level of inter-company trading relationships [1]. At this stage, it is difficult to talk about the integration of Bulgarian machine building in cross-border co-operative production chains, which create scientifically demanding products with high added value. One reason for this is the absence of strong national scientific, technical and production structures (science-technology-production) which are able to integrate themselves into large production chains[2]. Under these conditions, the use of internal reserves is an important resource to sustain production. Along with cost optimization, company innovativeness [3], the main reserve is the use of working capital. Development opportunities depend not only on the

* Corresponding author: m.petrova@ts.uni-vt.bg

level of equipment and technology, but also on the added value of the participants in the process - managers, specialists, workers. The bottom line should be the understanding that working capital is not only a fundamental production factor, but also an important source of income for the company, especially for small and medium enterprises [4-6].

The lack of adequate human capital management, as well as the low level of professional knowledge, skills and competencies, have a negative impact on the economic performance of the sector [7,8]. Therefore, it is necessary to carry out an economic and managerial analysis of the state of human capital, revealing the possibilities for its effective utilization and management.[9-11]

The purpose of this article is to examine the state of the human capital by analyzing its impact on the development of the machine building sector in Bulgaria.

2. Materials and methods

Four groups of criteria with their respective indicators were used to reveal the impact of the human capital on the development of machine building. (Table 1). Based on the specifics of the sector, the following groups of criteria were included for the analysis in this study: Number, Structure and Professional Experience of the Employed, Educational and Professional Qualification Profile, Efficiency of the Use of the Employed and Remuneration and Material Stimulus of Labor. Each criterion contains the corresponding indicators which reveal in depth the impact of the human capital. In this sense, we used indicators for revealing the age and gender structure, length of service, education and professional qualification profile, labor productivity, level of basic and extra pay according to the Labor Code and the internal regulations in the machine building enterprises.

Table 1. Criteria and indicators for analyzing the impact of the human capital on the development of machine building

Criteria	Indicators	
I. Number, structure and professional experience of the employees	1. <i>Number of employees in the organization;</i>	3. <i>Gender</i>
	a / Incl. management staff;	a/ Men; b/ Women;
	b / Permanent subordinate staff;	
	c/ Temporary staff.	4. <i>Work experience</i>
	2. <i>Age structure</i>	a/ up to 15 yrs.;
	a/ from 15 to 35 years old;	b/ from 16 to 35 yrs.;
	b/ 36 to 55; c/ above 56;	c/ 36 and over
II. Educational and professional-qualification profile	1. <i>Education</i>	Concerning only the managers:
	a / elementary educational level	3. <i>Professional specialization</i>
	b / basic educational leve;	a/ at home;
	c / secondary general level;	b/ abroad;
	d / vocational secondary education;	
	e / higher education - bachelor's;	4. <i>Learning and use of foreign languages</i>
	f / higher education – master's;	a / English;
2. <i>Professional experience;</i>	b / French;	
a/ up to 15 yrs.	c / German;	
b/ from 16 to 35 yrs.;	d / Russian;	
c/ above 36 yrs.	e / other languages.	
III. Employees' efficiency	1. <i>Produced output / BGN;</i>	
	2. <i>Produced output per employee / BGN.</i>	
	3. <i>Produced output per one person / BGN.</i>	
	4. <i>Produced output of a person-day of the subordinate /managerial/ staff</i>	
IV. Remuneration and material stimulus of labor	1. <i>Basic salary and social security BGN/ month.</i>	
	2. <i>Social co-payments BGN/ month.</i>	
	3. <i>Additional incentives BGN/ month.</i>	

For the purposes of the study on the impact of the human capital on the development of the machine-building in Bulgaria, 68 business organizations from the sector were studied, which were divided into two groups. The first group refers to companies which made a profit. Group 2 includes non-profit entities which account for economic loss for the period under review. The economic result is measured by the level of their profit.

The survey covers the period between 2016-2018. The data and information are collected through direct contacts, completing special reports, tables, company documentation, etc. developed for the purpose of the analysis. The SPSS software used for data processing was used to process the data.

3. Results and discussion

Analysis of the criterion Number, Structure and Professional Experience of the Employed

In the analysis of the criterion Number, Structure and Professional Experience of the Employed in the machine-building sector the indicators related to the number of employees in the enterprises, their age and gender structure, as well as the length of their service are examined. (Table 2.). The data presented show that the share of the managerial staff in the machine-building enterprises, which made a profit, is 19.05% out of all employees.

Table 2. Human capital status according to the criterion Number, Structure and Professional Experience of the Employed in the machine-building sector

Indicators	Companies which made a profit		Companies which declared a loss		Deviation from loss-to profit-making companies
	Number, \bar{x}	%	Number, \bar{x}	%	%
Management staff					
1. Number of employees in the organization	66.50	100	7.67	100	11.53
2. Incl. management staff	12.67	19.05	2.33	30.43	18.39
3. At the age from 15 to 35 years old;	3.58	28.3	0.00	0.00	0.00
4. At the age from 16 to 55 years old;	4.76	37.5	1.33	57.1	27.94
5. At the age from above 56;	4.33	34.2	1.00	42.9	23.09
6. Men;	8.08	63.8	1.67	71.4	20.67
7. Women;	4.59	36.2	0.66	28.6	14.38
8. Work experience up to 15 yrs.;	3.17	25.0	0.33	14.2	10.41
9. Work experience from 16 to 35;	4.83	38.2	1.00	42.9	20.70
10. Work experience 36 and over.	4.67	36.8	1.00	42.9	21.41
Executive staff					
11. Executive staff;	53.83	80.95	5.34	69.57	9.92
12. Permanent subordinate staff;	49.83	74.94	5.00	60.22	10.03
13. Temporary staff.	4.00	6.01	0.34	9.35	8.50
14. At the age from 15 to 35 years;	15.00	27.86	0.67	12.5	4.46
15. At the age from 16 to 55 years;	27.08	50.31	2.00	37.5	7.38
16. At the age from above 56;	11.75	21.83	2.67	50.0	22.72
17. Men;	29.17	54.18	3.00	56.3	10.11
18. Women;	24.67	45.82	2.34	43.7	9.48
19. Work experience up to 15 yrs.;	10.08	18.73	0.34	6.3	3.37
20. Work experience from 16 to 35;	28.83	53.56	2.67	50.0	9.26
21. Work experience 36 and over.	14.82	27.71	2.33	43.7	15.72

Source: Own calculations

With respect to this indicator, the share of management personnel in the companies with negative economic outcome is significantly higher - 30.43%. This reveals that a higher share of managers is not a guarantee for the efficient management. Achieving a balance between the share of managerial and subordinate staff is a key to ensure the optimal use of the human resources, which helps to increase the production and economic results.

After analyzing the age structure of the management staff, it was established that the aging of the managers is one of the main problems for the machine-building industry in Bulgaria. The survey data show that this problem is more pronounced in loss-making enterprises. In them, management personnel aged 15 to 35 years is missing, while the share of managers over the age of 56 is significant - 42.90%. In organizations with positive economic outcome, there is a more even distribution among the age groups. The share of managers over the age of 56 is 34.20% and management personnel aged between 15 and 35 - 28.30%. These data are evidence that managers of up to 35 are the main drivers of positive economic performance in the machine manufacturing sector. A rejuvenation of the management staff with high priority will also provide for continuity between different age groups.

With respect to the Gender indicator in the surveyed companies, there is a certain prevalence of men over women. This is noticeable both for profitable enterprises and for those which have incurred loss for the research period. The equity ratios between women and men in both groups are almost equal. The analysis of these data shows that the gender of the managers does not directly affect the development and the economic condition of the machine-building enterprises in Bulgaria.

From the average length of work experience of the managers, one can judge about the level of knowledge and skills acquired in practice. With regard to this indicator in the companies in focus, the proportions are similar to those to the age groups.

The practical implementation of the management decisions is done by the workers and employees on whose personal qualities and professional training depends the achievement of the desired result. Therefore, the analysis of the condition, development and problems of the subordinate staff will assist managers in a more effective management and achievement of good economic status in the machinery industry.

Regarding the companies, which declared loss during the survey period, a significant imbalance in the distribution of the different staff groups is observed. The share of managers is significantly higher - 30.43%. The share of temporary staff is also increased - to 9.35%. By contrast, the permanent staff is only 60.22%. The priority recruitment of permanent subordinate personnel provides the basic prerequisites for increase in the motivation of the human capital and for achieving better performance of the labor tasks.

With regards to the age structure in the enterprises which have achieved positive economic results, the basic labor energy is carried by the workers aged 36 to 55 (50.31%). The share of the subordinate staff aged between 15 and 35 is 27.86% and that of the 56 years-olds and over is 23.83%. A positive trend in the group of these enterprises is the prioritized rejuvenation of the subordinate staff.

The age structure of the subordinate staff in companies with negative economic outcome shows a different share distribution. The main group of employees is over 56 years of age (50.00%), as for the share of workers aged 15 to 35 is only 12.50%. The aging of the subordinate personnel can also be identified as a major problem in this group of enterprises.

The analysis of the gender structure of the subordinate staff in the enterprises with a profit discloses similar shares of the distribution between women and men in them. The ratio in the enterprises declaring loss is similar, too. Consequently, the achievement of positive economic performance cannot be gender-sensitive as for the subordinate staff. The selection of employees for this indicator in the machine building depends mainly on the specifics of the production activity and the work technology in them.

The analysis of the first criterion reveals that the optimal selection of the managerial and subordinate staff, consistent with the age structure and experience acquired over the years, has a positive impact on the economic situation and the development of the enterprises in the machine engineering sector. The managers of up to 55 years of age are the carriers of the main charge for achieving positive economic results in them. The prioritized rejuvenation of the management staff also provides an opportunity for continuity between different age groups.

Analysis of the criterion Educational and Professional Qualification Profile of the Employed

According to the Educational and Professional Qualification Profile of the Employed in the machine-building industry in Bulgaria, the acquired educational level, the professional experience and the opportunities for improving the professional qualification are analyzed.

Survey data demonstrates that in the enterprises with positive economic outcome, managers having higher education are just above the half - 53.30% (Table 3.) Of them, 38.20% hold a Master's degree and 15.10% - Bachelor's. The managers with secondary education are 46.70%, of which only 21.10% have secondary specialized such.

Table 3. Educational and Professional Qualification Profile of the Employed in the enterprises of the mechanical engineering sector

Indicators	Companies which made a profit		Companies which declared a loss		Deviation from loss- to profit-making companies
	Number, \bar{x}	%	Number, \bar{x}	%	%
<i>Management staff</i>					
1. Higher education – master's;	4.83	38.2	0.67	28.6	13.87
2. Higher education – bachelor's;	1.92	15.1	0.33	14.3	17.19
3. Vocational secondary education;	2.67	21.1	0.00	0.00	0.00
4. Secondary general level;	3.25	25.6	1.33	57.1	40.92
5. Professional experience up to 15 yrs.	3.67	29.0	0.33	14.2	8.99
6. Professional experience from 16 to 35	5.42	42.8	1.00	42.9	18.45
7. Professional experience above 36 yrs.	3.58	28.2	1.00	42.9	27.93
8. Professional specialization at home;	1.59	12.5	0.00	0.00	0.00
abroad.	0.92	57.9	0.00	0.00	0.00
10. Learning and use of foreign languages	0.67	42.1	0.00	0.00	0.00
English;	6.50	51.3	0.33	14.3	5.08
French;	2.17	33.3	0.33	100	15.21
German;	0.58	9.00	0.00	0.00	0.00
Russian;	0.50	7.70	0.00	0.00	0.00
other languages.	1.42	21.8	0.00	0.00	0.00
1.83	28.2	0.00	0.00	0.00	0.00
<i>Executive staff</i>					
11. Higher education;	0.67	1.3	0.00	0.00	0.00
12. Vocational secondary education;	10.08	18.7	0.34	6.30	3.37
13. Secondary general level;	33.33	61.9	2.33	43.7	6.99
14. Basic educational level;	8.42	15.6	2.00	37.5	23.75
15. Elementary educational level;	1.33	2.5	0.67	12.5	50.38
16. Professional experience up to 15 yrs	12.33	22.9	0.67	12.5	5.43
17. Professional experience from 16 to 35 yrs.;	28.83	53.6	3.00	56.3	10.41
18. Professional experience above 36 yrs.	12.67	23.5	1.67	31.2	13.18

Source: Own calculations

The heavy working conditions and not particularly high remuneration make this sector not very attractive to managers with a higher level of education. This is especially true for businesses which declared loss for the period of the survey. In addition, half of their managers have a secondary general education (57.10%). These data show that the level of education of the management personnel in the enterprises which made a loss is significantly lower than that in the profitable companies during the research period. Therefore, for the achievement of positive economic results, the higher educational and professional training of the management staff is of particular importance.

The analysis of the indicator Work Experience reveals the level of professional knowledge and experience gained through practice. Longer experience in the specific position implies the higher quantity and quality of the acquired knowledge and practice.

42.80% of the managers possess between 16 and 35-year experience in the machine-building companies which achieved positive economic results. The data from the other two groups are relatively similar. The managers with professional experience of over 36 years are 28.20% and those with experience in the specialty of up to 15 years – 29.00%. This share distribution helps to achieve some continuity in transfer of knowledge and skills during practice.

In the case of loss-making enterprises, the managers with experience in the specialty of over 36 years have a relatively high share - 42.90%. Same refers to the managers with professional experience from 16 to 35 years (42.90%). This implies the existence of management staff with extensive experience and professional competence. The reason for the negative results should be sought rather in the inefficient use of the managerial staff's capacity and potential, which directly affects the economic situation of these companies.

Research data demonstrates that a relatively small proportion of the management personnel in the surveyed enterprises have specialized in the country and/ or abroad. In the companies which made a profit, 12.50% of the managers have additional specialization. Nearly two-thirds of them acquired it in the country (57.90%), and the share of those specialized abroad is 42.10%. The survey of enterprises with negative economic results shows a lack of specialists. In recent years, the importance of this indicator has been steadily increasing. After Bulgaria's accession to the European Union, the requirements for manufactured products in machine-building have increased significantly after the introduction of the new European standards. To meet these requirements, the management staff must continuously improve their qualifications through additional forms of training and specialization.

Applying European standards and enhancing the professional qualification of the management staff requires free communication and use of foreign languages. In this sense, the current survey shows that in the enterprises which made a profit, more than half of the managers (51.30%) can freely use different foreign languages. Of these, 33.30% are English speakers, French and German is used by 16.70%, free communication in Russian can do 21.80% of them, and the remaining 28.20% can use other languages. For enterprises with negative economic performance, foreign-language speaking managers account for only 14.30% of management staff. The use of foreign languages enables easy access to international scientific achievements in the field of mechanical engineering. This helps to continually update managers' knowledge and master the most advanced techniques and technologies in production. Their implementation in practice ensures higher efficiency of production activity and increased economic performance.

A major problem with the subordinate staff in the machine-building enterprises is the low level of education. It is particularly significant in those which have made a loss, where 50% of the subordinates have lower than secondary education. Of these, primary education have 12.50%, and elementary - 37.50%. In the enterprises that made a profit, the share of workers with lower than secondary education is also high - 18.1%. While in the enterprises

which made a profit during the survey period, the subordinate staff with secondary vocational education are 18.7%, in those which declared loss it is only 6.3%. The presented data show that the higher level of education of the subordinate personnel in the machine-building enterprises is a prerequisite for achieving high production-economic results. The low-skilled worker does not possess the potential to work with up-to-date techniques and technologies.

The analysis of the second criterion shows that the level of education of the employed in all the studied enterprises in the machine-building sector is comparatively low. In enterprises with negative economic outcome, the most of the managers have only secondary education. The low educational level is one of the prerequisites for low production-economic results in them. The increase of the qualification and the sophistication of the knowledge and experience through specialized training in the country and/ or abroad has a great positive impact on the economic condition of the companies. The use of foreign languages enables easy access to international scientific achievements. In this way, continuous updating and improvement of the managers' knowledge and positive impact on the work of the employees of the sector are achieved.

Analysis of the Employee Efficiency Criterion

Employee efficiency, as a key factor in analyzing the impact of the human capital in machine building, combines the level and quality of knowledge and skills and their application to the human capital in the production process. The study of labor productivity in machine building allows us to understand how and to what extent the level of staff qualification affects the final economic result.

The averages for the criterion Employee Efficiency during the survey period in the studied machine-building enterprises are presented in Table 4.

Table 4. Human Capital Condition by Employee Efficiency criterion in the Machinery Sector

Indicators	Companies which made a profit		Companies which declared a loss		Deviation from loss-to profit-making companies
	Number, \bar{x}	μ	Number, \bar{x}	μ	%
1. Produced output / BGN.	661965.6	21137.4	66417.29	5721.3	10.03
2. Produced output per employee / BGN.	12071.84	1664.67	2331.14	560.53	19.31
3. Produced output per one person / BGN.	216.41	38.19	37.08	11.26	17.13
4. Produced output of a person-day of the subordinate /managerial/ staff	66.76	8.77	14.55	4.54	21.79

Source: Own calculations

The survey of machine engineering enterprises reveals that the output/ BGN in the companies which made a loss, is only 10.03% of the same output in those which made a profit. The ratio of the output per person-day for the management personnel/ BGN in companies with a negative economic outcome is 17.13% of that in the enterprises with profit. The reported low productivity is largely due to inefficient management, which also directly affects the economic situation.

The ratio of the output per person-day of the subordinate staff/ BGN in the enterprises which made a loss to the same indicator in those which made a profit is only 21.79%. Relative ratios are also observed in the other indicators surveyed.

The significantly lower production results in enterprises which declared loss during the survey period are mainly due to the high share of aging subordinate staff in them and their low level of education. These characteristics indicate that the subordinate staff in companies with negative economic outcome do not have the necessary knowledge and professional competence to work with new techniques and technologies in the production and its marketing. All the above leads to low production-economic results in these enterprises.

Analysis of the criterion Remuneration and Material Stimulus of Labor of the Employed

The adequate remuneration is a measure and an incentive for the effective work performance. Financial incentives to a large extent attract more and better human capital in the enterprises.

The analysis of the criterion Remuneration and Material Stimulus of Labor discloses that the basic salary and insurance contributions of the management personnel in the loss-making enterprises is 88.42% of that of the managers' salaries in the companies with positive economic outcome (Table 5). For the other two indicators are similar ratios also observed. From these data it can be concluded that the system for payment and material stimulation of the managers in machine building is not bound to the efficiency of the management work.

Table 5. Human capital status according to the criterion Remuneration and Material Stimulus of Labor of the Employed in the enterprises of the machine-building sector

Indicators	Companies which made a profit		Companies which declared a loss		Deviation from loss to profit-making companies %
	Number, \bar{x}	μ	Number, \bar{x}	μ	
Management staff (BGN/ month)					
1. Basic salary and social security	678.57	26.41	600	50	88.42
2. Social co-payments BGN/ month.	22.86	8.65	15	8.93	65.62
3. Additional incentives BGN/ month.	111.43	16.83	90	10.34	80.77
Executive staff					
4. Basic salary and social security of employees in the BGN / Month.	431.67	11.92	390	0	90.35
5. Social co-payments BGN/ month	50	5	40	6.16	80.0
6. Additional incentives BGN / month	123.33	7.21	33.33	8.39	27.03
7. Temporary hired / number of months per year	1.5	0.41	1.33	0.66	88.67
8. Basic salary and benefits of temporary workers in the BGN / month	218.33	55.77	116.67	17.68	53.44
9. Social co-payments of temporary BGN/month	0	0	0	0	0
10. Additional incentives of temporary BGN/ month	77.5	12.37	33.33	11.36	43.01

Source: Own calculations

The remuneration and material incentives of the subordinate staff are quite low against the backdrop of the overall pay level in the country. There are no significant differences in the basic salary and the social contributions of the permanent staff in respect of the enterprises – those with a loss, compared to those which made profit for the period.

The social co-payments in companies with negative economic outcome are significantly higher than those in profitable companies. On the other hand, the deviation in additional incentives in the enterprises which made a loss compared to those which achieved good financial stability is 37.49%.

The remuneration for the temporary staff is considerably lower than that of the permanent staff. This pattern is observed both in enterprises with positive economic outcome and in those with a negative such. Temporary hiring of subordinate staff in the mechanical engineering is usually for a short period of time (less than a month). The significant pay gap between temporary staff and permanent staff is due precisely to this fact.

4 Conclusions

The performed analysis of the impact of the human capital on the state and the development of the machine-building sector in Bulgaria highlights the following conclusions:

- One of the most pressing problems in the machine-building enterprises is the aging of managerial and subordinate staff. Prioritized rejuvenation will increase the capacity to deploy innovative techniques and technologies, as well as the implementation of highly efficient activities, which will become a prerequisite for better economic performance.
- High educational and vocational training is particularly important for achieving positive economic results. Enhancing the qualification and improvement of knowledge and experience with additional specializations in the country and/ or abroad of the management staff should become a mandatory practice in machine-building enterprises. This is a key factor in achieving effective management and positive production-economic performance.
- The low level of education of the subordinate staff is one of the main reasons for the low productivity of labor and hence low economic performance. Improving the vocational training and qualification of the employees in the machinery industry can lead to an increase in labor productivity and the provision of more stable and guaranteed income. From this point of view, the investment in human capital will increase the individual productivity of labor and, hence, the economic performance of the enterprises in the machinery sector.
- The system for payment and material stimulation of labor in the machine-building enterprises is obsolete and inefficient. It is necessary to build a new pay system that links wages to labor and economic performance. The higher productivity must reflect on rising labor remuneration to motivate and retain staff in the businesses.

References

1. Nikolova-Alexieva V. (2012). Exploring the state of business processes management in the Bulgarian Enterprises, *PROCEDIA – SOCIAL AND BEHAVIORAL SCIENCES*, Vol. 62, Pages 1350-1354, www.sciencedirect.com, ISSN: 1877-0428, Published by ELSEVIER, <https://doi.org/10.1016/j.sbspro.2012.09.230>
2. Bencheva, N., M. Tepavicharova (2011). Autodidactic instruments for increasing the expertise of managers and staff. Conference “Learning from the crisis – lessons learned, recommendations and strategies”, CEA, 13 may 2011, p. 155 – 167

3. Pukala, R., (2016), Use of neural networks in risk assessment and optimization of insurance cover in innovative enterprises, *Engineering Management in Production and Services*, Volume 8, Issue 3, p.43-56.
4. Pukala, R., (2013), Efficient insurance protection management as a determinant of micro and small enterprises operational risk limiting, *Economic Annals-XXI*, Nr 9-10, p.67-70.
5. Tepavicharova, M., (2013). Organizing the Work and Optimizing the Use of Human Resources in Economic Organizations. In: Yearbook Kia, vol. X, "Auto Print", Plovdiv, pp. 40 - 47, ISSN 1313-8472
6. Vachkova, E., (2007). Human Resource Management - Bulgarian and World Experience, International Business School TRANSBUSINESS E, Sofia
7. Peeva, R., M. Tepavicharova, (2014): Analysis of the specific needs of employers by qualified labor force in the region of Plovdiv. Scientific conference on "Main trends in the development of human resources" KIA, May 29, 2014, pp. 89-111
8. Todorov, I., K. Kolev (2012), "Sectoral Analysis of Labor Force Competencies in the Mechanical Engineering Sector", Project "Development and Implementation of an Information System for Assessment of Competences of the Labor Force by Branches and Regions", http://www.aeaweb.org/journal/jel_class_system.php.
9. Petrova M., Dekhtyar N., Klok O. & Olha Loseva. Regional tourism infrastructure development in the state strategies. *Problems and Perspectives in Management*, 16(4), 259-274. doi:10.21511/ppm.16(4).2018.22
10. Dyachenko Y., Nenkov N., Petrova M., Skarga-Bandurova I. & Oleg Soloviov. (2018) Approaches to Cognitive Architecture of Autonomous Intelligent Agent. *Biologically Inspired Cognitive Architectures*, Elsevier, Volume 26, 2018, p. 130-135
11. Petrova M., Buzko I., Dyachenko Y. *Cognitive, Intelligence Technologies and Economical Foundations of Teaching of International Economical Relations and Tourism*. 17th International Scientific Conference Engineering for Rural Development, 23.-25.05.2018. pp. 1102-1106, DOI: 10.22616/ERDev2018.17.N170, Jelgava, Latvia