

## ENSURING THE COMPETITIVENESS OF HIGH-TECH INDUSTRIAL ENTERPRISES AND THEIR ROLE IN THE INNOVATION ECONOMY

**Natalia POLZUNOVA**

Vladimir State University  
79 Gorkogo Street, Vladimir, Russia  
natalya.polzunowa@yandex.ru

**Tatiana STARIKOVA**

Vladimir Branch of the Russian Presidential Academy  
of National Economy and Public Administration  
59a Gorkogo Street, Vladimir, Russia  
startv008@rambler.ru

**Abstract.** *The innovative trajectory of the country development requires a competitive sector of high-tech industrial enterprises. Competitiveness is seen as an essential emergent property of the high-tech industry and depends on many external and internal factors. Being aware of the combination of the most effective factors for competitiveness in certain economic conditions and the mechanism of their influence, one can make rational management decisions. An indispensable condition for the knowledge of the socio-economic reality and the most important factor for the effectiveness of the decisions in the field of competitiveness of high-tech enterprises is the assessment. The purpose of the study is the definition of the vector to ensure the competitive development of high-tech industrial enterprises. To evaluate the level of competitiveness of high-tech industrial enterprises the author used the method based on Harrington desirability function. The degree of importance of the functional areas of competitiveness of high-tech enterprises was determined through the ranking method. The ranks were marked by contractors and managers of different levels of high-tech industrial enterprises of Central Federal District of Russia. The reliability of ratings of importance was confirmed through Pearson goodness-of-fit test, the use of which allowed claiming that the consistency in the opinion of the experts surveyed is not accidental and is 90%. The research produced the following results: we defined levels of functional components of the competitive superiority of high-tech enterprises, namely production and technological competitiveness; scientific and technological competitiveness; environmental competitiveness; human resources competitiveness; financial competitiveness; economic competitiveness; market competitiveness; management system competitiveness; social competitiveness; competitiveness of manufactured products, which are eventually integrated into the final evaluation of the quantitative level of competitiveness. It was revealed that the competitiveness primarily depends on the competitiveness of the enterprise management system and, secondly, on the scientific and technological and the production and technological competitiveness. The most important factor in the competitiveness of high-tech enterprises is the level and potential of innovative activities.*

**Keywords:** *competitiveness; high-tech industrial enterprises; factors; competitive sustainability.*

## Introduction

The only possible way of society development is an innovational course which provides economic growth and well-being of the population. An innovative model of economic development doesn't only mean producing new knowledge translated into technologies and products with new and improved consumer characteristics (Morris, Schindehutte & Allen, 2005), but also introducing it into production effectively using corresponding new types of machinery, which in its turn suggests that there are highly developed industrial facilities.

There are several ways to implement the innovative model of economic development:

- Forced integration in the global economy with the implementation of the post-industrial development model.
- The gradual build-up of innovative development potential.

Each of these scenarios suggests that there are competitive industrial enterprises, most of which have an objective propensity for innovative activity; the commercial orientation of innovative activity; innovative susceptibility; high sensitivity to any kind of interactions.

The current stage of world economic development is characterized by the emphasis on industrial development. Unfortunately, at present, the industrial sector in the economy is not the primary generator of technological innovation. The proportion of organizations implementing technological innovation, is 9.8% according to 2013, compared to Germany – 55%, Norway – 31.2%, Poland – 16.1% (Ditkovsky & Fridlyanova, 2015, p.301). It is also necessary to focus attention on the role that high-tech industrial exports of Russian companies play in the world's industrial exports. Now it is 0.5%, it is less than in the USA, Germany, Japan, China, France, Italy (UNIDO, 2013, 2016) etc.

The reason why Russian industrial enterprises have a small share in the markets of high-tech products is to be found in their low competitiveness. Therefore, boosting the competitiveness of industrial enterprises is a very important and urgent task.

Competitive development of industrial enterprises, including high-tech enterprises, as well as factors influencing competitive advantage got scientific coverage in many works that are associated with the names of such scholars as Batkovsky (2013), Borisov and Pochukaeva (2011), Esser (2013), Godin (2004), Kutin (2009), Polenske (2004), and others.

The purpose of this article is to define conditions and factors for the competitive development of high- competitiveness tech industries. The paper also considers the development of methodological tools to assess their competitiveness.

## Research methods

The study was carried out in three stages:

- The first stage involved identification of the most important factors and conditions to ensure competitive high-tech industries;

- The second stage involved evaluation of competitiveness of high-tech industries;
- The third stage was aimed at assessing the stability of competitiveness / un-competitiveness of high-tech industries and its factors.

The findings of the research are based on the official statistics of the Russian Federation for the period 2007-2014 as well as financial reports of the Russian industrial high-tech joint-stock companies. The financial reports are publicly available and taken from Interfax disclosure system.

Analyzing the official statistics, we used such criteria as net financial result, gross value added, depreciation of fixed assets, and investment in the economic activities of enterprises. To evaluate the competitiveness of high-tech industrial enterprises Harrington's desirability function was used. The initial data included a system of 75 indicators characterizing the performance of high-tech industrial enterprises of Vladimir region. The observation period lasted 7 years from 2007 to 2013.

We chose functional areas of competitive advantage of high-tech enterprises and defined their roles in developing competitiveness by means of the ranking method. Experts and managers of high-tech industrial enterprises of the Central Federal District of Russia ranked these areas. The number of experts was calculated according to the formula:

$$H_{\text{min}} = 0,5 \cdot \left( \frac{3}{\mu} + 5 \right),$$

where  $\mu$  is a probable error in the expert's appraisal, %;  $\mu \in [0,100]$ .

The main criterion in the selection of experts was his/her professional competence. Fifty-five experts working at high-tech industrial enterprises and regional authorities were interviewed. Then we compared the consistency of expert opinions. For that, we used the coefficient of concordance. The data validation of the ratings was performed with Pearson fitting criterion with the significance level of 0.95, characterizing the maximum probability of 5% incorrect results in the expert's appraisal.

Measurement of sustainable competitiveness of high-tech industries was carried out by calculation of the individual indices and sustainable competitive development of high-tech industries - by means of calculation of the Spearman coefficient.

Scientific and analytical papers, research reports were another source of information on the relevant factors and conditions ensuring competitive advantages of high-tech industrial enterprises.

## Results of the study

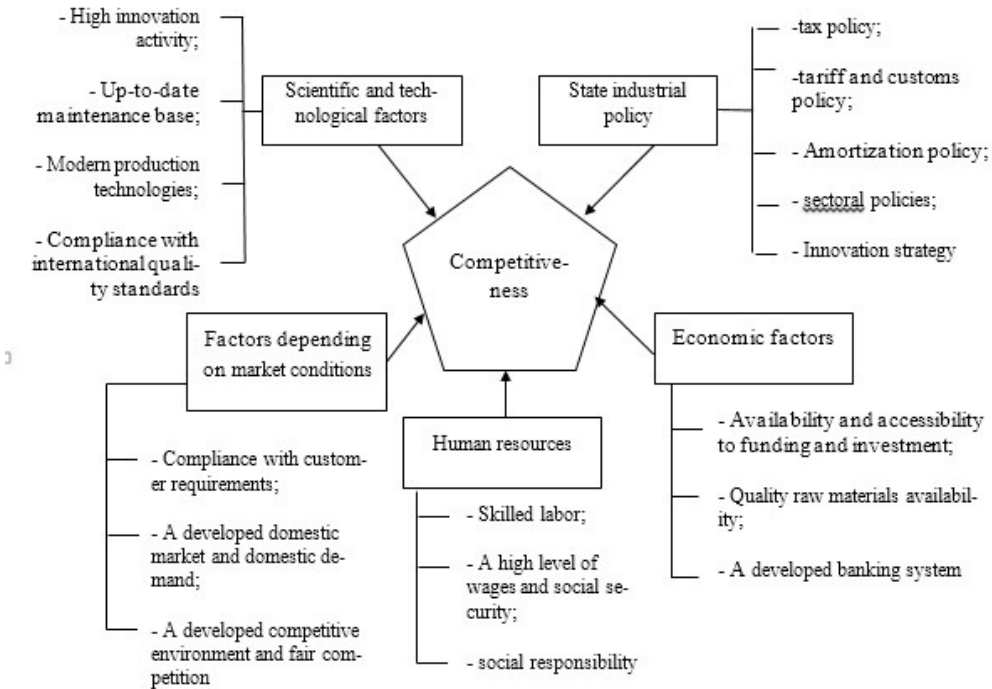
Critical analysis of current information sources on the competitiveness of industrial enterprises allows us to say that at present there is no generally accepted definition of competitiveness. High polysemy in the interpretation of competitiveness can be explained by the complexity of this category, a great variety of competitive objects, the different personal perception of the object and its competitiveness etc.

Our study of competitiveness as an economic category is based on the following principles:

- Competitiveness can only occur in a free market, which is non-stationary and non-deficient, non-equilibrium;
- Competitiveness can be considered concerning objects of market relations (goods and services) and subjects of market relations (producer, intermediary, customer), as well as conditions of the market economy;
- Competitiveness is a relative concept that requires specification in terms of its formation segment, thus, the geographic factor becomes obvious;
- Competitiveness takes into account quality, both on the part of the producer and on the part of the customer;
- Defining competitiveness requires taking into account the level of effective demand;
- Competitiveness of a producer is defined by economic, technological and other parameters, as well as its share in a free market;
- Competitiveness of goods and services has a dynamic, constantly adjusting character; therefore, it makes sense to consider it at a particular point in time, take into account changes in market conditions;
- Only competition formed in one of the free commodity markets controls competitiveness of goods and enterprises;
- It makes sense to consider competitiveness only among existing high-tech industrial enterprises that already have a certain market share. For further evaluation, this prehistory, i.e. the market share of companies in the previous period, has some influence.

The competitiveness of high-tech industrial enterprises in modern conditions is a complex concept. It is under the impact of a combination of factors, as shown in Figure 1. It also includes several levels of competitive advantage. All presented in Figure 1 factors have a diverse effect on the competitiveness of high-tech industrial enterprises. The impact of production and technological factors on competitiveness is described in detail in another article (Filimonova, Polzunova & Malkerov, 2013). This issue is also addressed by Brandão Santana, Rebelatto, Périco, Moralles and Leal Filho (2015). Scientific and technological factors besides production and technological ones include scientific and production factors; their structure and impact are set out in detail in Fedosova and Heifits (2013) article. Assessing the impact of state industrial policy on the competitiveness of the industrial enterprises produced the works Carayannis and Grigoroudis (2014), and Galbraith (2015). Enterprise competitiveness also depends on the market and market factors (Sung, 2012) and human potential of the enterprise (Sabadie, 2014).

Due to the experts' appraisal, the following areas of competitive advantage have been selected, industrial and technological competitiveness; scientific and technological competitiveness; environmental competitiveness; HR competitiveness; financial competitiveness; economic competitiveness; marketing competitiveness; competitive management system; social competitiveness; product competitiveness.



**Figure 1. Factors influencing the competitiveness of high-tech industries**

After processing the results, we got final functional areas of enterprise competitiveness (Table 1) with the consistency of experts' opinions 0.8 (Table 1). The data validation is 90%. The value of the indicator on the consistency of experts' opinions proves that the experts' consistency in their opinions is nonrandom and thus their appraisal can be trusted. The ranks are presented in descending order of importance.

**Table 1. Importance evaluation of functional areas of high-tech industrial enterprise competitiveness**

	Functional areas of enterprise competitiveness									
	Scientific and technological	Production and technological	Ecological	Personnel	Economic	Financial	Marketing	Social	Product competitiveness	Management system competitiveness
Ranks of importance	3	2	10	4	8	7	6	9	5	1

These estimates indicate that at the present stage of development the competitiveness of high-tech industrial enterprise primarily depends on the competitiveness of the management system of the enterprise and, secondly, on the scientific-technological and production-technological competitiveness.

Several ways to assess the competitiveness of enterprises have been analyzed because of solving the problem of determining the level of competitiveness of high-tech industrial enterprises. All of them can be combined into four groups: approaches based on the definition of the composite indicator; approaches based on the calculation of single indicators; approaches based on the use of expert methods of assessment and matrix approaches (Shchepakina, Krivosheya & Tretyakov, 2012). Yet there is no univocal approach to evaluating the competitiveness of high-tech industrial enterprises. The multiplicity of approaches in estimating the competitiveness of high-tech industrial enterprises can be explained by the characteristics of the competitive environment and involvement in this process of internal factors, and by the fact that, on the one hand, there is close relationship between competitive advantages of different levels, and on the other hand, there are significant differences.

The analysis of enterprise competitiveness level estimation methods has made it possible to find out that the methods where group indicators are focused on the determination of a certain integral parameter, and which are reduced to identifying the most significant numerical indicators and their integration, are more preferable. When using these methods, one should take into account the non-additive nature of competitiveness, which is a consequence of the fact that it is an emergent property of the enterprise, and determines the impossibility to apply the operation of addition of a variety of measures. Competitiveness refers to latent variables, the measurement of which is a complex creative task (Yakupova & Yarullina, 2009), and implies that the measurement of high-tech industrial enterprise competitiveness level through one indicator, is a priori impossible and suggests the use of indirect assessment method through the measurement of aggregate indicators.

Therefore, the evaluation of high-tech industrial enterprise competitiveness level should be based on the principles, the main of which are: the principle of consistency, the principle of concurrence, the principle of common approaches, the principle of assessment continuity, the principle of inductiveness, the variance principle, the principle of individuality, the principle of adaptability. The principles can be combined into two interrelated groups, the first of which reveals the requirements to the assessment technology organization, and the second group defines the essential side of assessment (Fedotova, Dresvyannikov, Loseva & Tsygalov, 2014).

One of the integral methods of high-tech industrial enterprise  $f_i = \frac{1}{e^x \sqrt{e}}$ ,

Where  $f_i$  – is competitiveness level in  $i$ - a functional area of competitive edge.

$e$  – is the base of the natural logarithm;

$x$  – is the adjusted value of the experimental variable.

The following arguments support the use of this method: firstly, it allows to assess the level of high-tech industrial enterprise competitiveness thoroughly; to use only analytical dependence, making it possible to reduce the level of subjectivity of the subject of evaluation greatly; to apply different-sized quantitative measures as a criterion for competitiveness; to use qualitative measures as a criterion for competitiveness, and translate them into quantitative estimates; to use comparative and dynamic approach in the process of assessment of high-tech industrial enterprise competitiveness. The absence of any basis for comparison (a standard of measure, a perfect condition) is a significant positive argument.

At the bottom of Harrington's function is the idea of transforming the natural values of particular indicators characterizing the level of enterprise competitiveness, into a non-dimensional scale of desirability. Therefore, an important step is the formation of a system of analytical indicators.

The system of analytical indicators is to meet a number of requirements, among which the most important are:

- firstly, it is supposed to provide multi-dimensional measurement and take into account structural features of the competitive edge areas;
- secondly, to adequately reflect the situation and main trends in high-tech industrial enterprise competitive development, that is the reliability of the indicators. At the same time, indicator calculation methods should not cause significant difficulties;
- thirdly, one of the main requirements from the point of view of high-tech industrial enterprise competitive development is interpretability of the indicators. It means that each indicator is designed to a greater or lesser extent to illustrate and characterize one of the functional areas of competitiveness;
- fourthly, to provide the accessibility of information sources, the simplicity of performance measurability, the possibility of matching (comparison).

In addition to these requirements, there are generally accepted principles such as the principle of scientific character of the indicators, their objectivity, criteria specificity, etc. that are also to be taken into account.

Based on the above material and results of research undertaken by the author and other experts, one can form a system of parameters characterizing the competitiveness of the whole enterprise and its functional areas. Its construction and use are complicated by several circumstances:

- by a large number of parameters and constraints that determine the operation of high-tech industrial enterprises and formation of their competitiveness;
- by the complex nature of the relationships between variables that determine the state and dynamics of high-tech industrial enterprise level ;
- by the merge of random factors, without taking into account a set of parameters;
- by the lack of quantitative assessment of a number of indicators.

In determining the level of high-tech industrial enterprise competitiveness and the level of use of its potential capacity in this study we will take into consideration the following restrictions and conditions:

- we use only indicators available in all types of reports of the enterprise;
- we reasonably limit the number of indicators used in the study. In scientific and practical studies (Frolova & Kashintseva, 2006) it is believed that the number of indicators should be minimal. In addition, it is appropriate with the competitiveness being estimated for internal purposes of the organization. In addition, when it comes to fostering the competitive development of high-tech industrial enterprises on the part of authorities or to the formation of entities of cluster type on an arranged territory, the number of indicators increases. Moreover, the purpose of such increase is a comprehensive diagnosis of the static level of competitiveness, estimating reserves of the use of competitiveness potential and identifying the sustainability of the calculated level.

In spite of these characteristics, the use of the constructed system of indicators of enterprise competitiveness is fraught with some difficulties. The most significant include:

- the lack of regular information on production and technological competitiveness of the enterprise. Especially because, as it has already been noted in other studies (Arkhipova & Golichenko, 2007), nobody keeps records of the creation and use of advanced production and information technologies by small and medium enterprises;
- a complete lack of aggregated information about the level of cooperation activity of the enterprise and its effectiveness;
- difficulty in assessing the state of partnership relations between government and business that affects the reflection of this side of competitiveness. In the proposed system of indicators, this aspect is assessed in an indirect way.

The evaluation process was based on an iterative algorithm designed to estimate the level of competitiveness of high-tech industrial enterprises, consisting of the following stages:

- Setting goals and objectives of the evaluation.
- Making a list of indicators characterizing the level of competitiveness of the enterprise subject to evaluation.
- Determining boundary values of the desirability function and calculating for them adjusted values of the experimental variable ( $x$ ).
- Calculating coefficients of approximating functions for each variable and making equations. Linear functions are used as approximating functions. Approximation coefficients, in this case, are found through the method of least squares.
- Calculating reduced parameter value for specific values of the estimated variable.
- Calculating the level of competitiveness of each functional area using desirability function.

The final stage of the iterative algorithm is the calculation of the integral index of competitiveness of high-tech industrial enterprises, defined by the model:

$$F = \begin{cases} \sqrt[7]{f_{\text{HTK}} \cdot f_{\text{HTK}} \cdot f_{\text{ЭК}} \cdot f_{\text{К}} \cdot f_{\text{Э}} \cdot f_{\text{Ф}} \cdot f_{\text{С}} \cdot f_{\text{СЭУ}} \cdot f_{\text{МП}} \cdot f_{\text{М}}} & \text{if } f_i \neq 0 \\ 0,15 \cdot f_{\text{HTK}} + 0,16 \cdot f_{\text{HTK}} + 0,02 \cdot f_{\text{ЭК}} + 0,13 \cdot f_{\text{К}} + 0,05 \cdot f_{\text{Э}} + \\ \quad + 0,07 \cdot f_{\text{Ф}} + 0,04 \cdot f_{\text{С}} + 0,18 \cdot f_{\text{СЭУ}} + \\ \quad + 0,11 \cdot f_{\text{МП}} + 0,09 \cdot f_{\text{М}}, & \text{if at least one } f_i = 0 \end{cases}$$

where  $f_{\text{HTK}}$  – production and technological competitiveness;  $f_{\text{HTK}}$  – scientific and technological competitiveness;  $f_{\text{ЭК}}$  – ecological competitiveness;  $f_{\text{К}}$  – personnel competitiveness;  $f_{\text{Ф}}$  – financial competitiveness;  $f_{\text{Э}}$  – economic competitiveness;  $f_{\text{М}}$  – marketing competitiveness;  $f_{\text{СЭУ}}$  – management system competitiveness;  $f_{\text{С}}$  – social competitiveness;  $f_{\text{МП}}$  – product competitiveness.

The numbers in the formula (2) – are the weight coefficients calculated based on the importance rating of each allocated functional area of competitiveness. For determination of relative importance of the criteria ( $K_i$ ) the normalized iterated force is used:

$$K_i(q) = \frac{P_i(q)}{\sum_1^n P_i(q)}$$



where  $P_i(q)$  - the iterated order  $q$ - force,

$$P_i(q) = B \cdot P(q - 1)$$

where the  $B$ -square matrix of estimates

$$B = |b_{ij}|$$

By drawing up a matrix "the return symmetry" is realized:

$$b_{ji} = \frac{1}{b_{ij}}$$

$$b_{ij} = \sum_{i=1}^M a_{ij}$$

where  $a_{ij}$  - estimates of experts;

$M$  - total of experts;

$i=j=n$

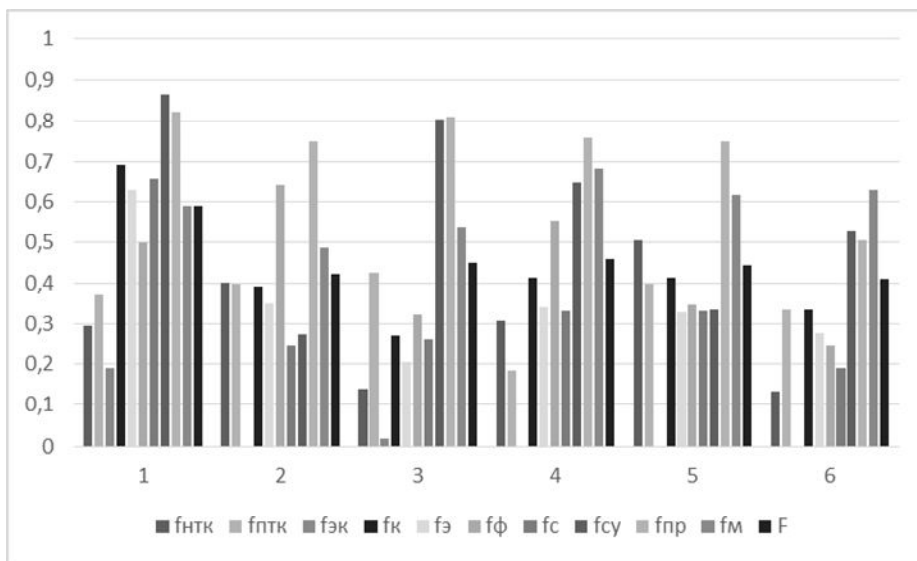
Each calculated value of the competitiveness level, according to the formula of the function of desirability, is given a specific economic meaning. Moreover, the value function of desirability, equal to 0, corresponds to the unacceptable level parameter; the value of desirability function, equal to 1.00, corresponds to a completely acceptable level parameter or such a parameter value at which further improvement in the solution of specified tasks is impractical or impossible. Intermediate values of the desirability function, their economic characteristics regarding the competitiveness of enterprises are given in Table 2.

**Table 2. The economic interpretation of the parameters of the desirability function**

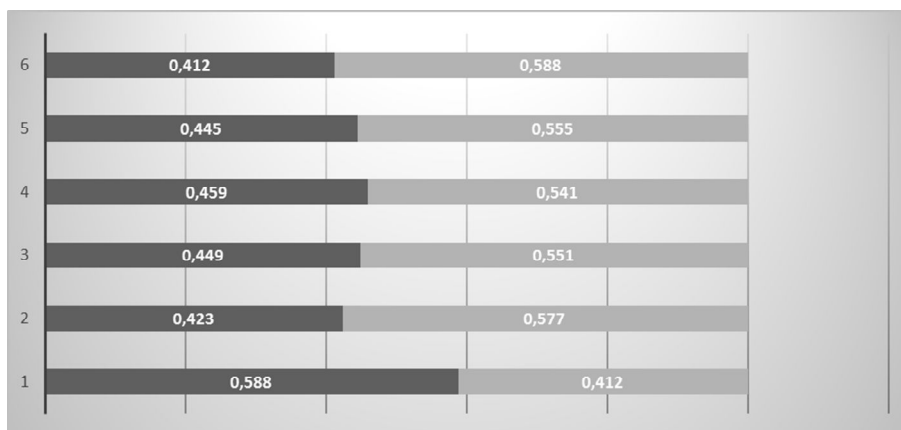
Standard values of the desirability function	Characteristics of the level of competitiveness of enterprises
1.00	Corresponds to the best use of the factor of competitiveness (Best (optimal) level of competitiveness of the enterprise).
1.00-0.80	A high level of competitiveness of the enterprise, but there are insignificant reserves of its improvement.
0.80 - 0.63	A sufficient level of competitiveness of the enterprise, allowing it to function effectively.
0.63	An average level of competitiveness that does not cause it to be an outsider but does not permit it to get the position of a leader.
0.63 - 0.37	A satisfactory level of competitiveness of the enterprise.
0.37	A minimum acceptable level of competitiveness that makes the company to function and operates in the market as an outsider.
0.37 - 0.20	.The low level of competitiveness of the company preventing it from the realization of its goals.
0.00	Totally unacceptable level of competitiveness usage of the enterprise. The company is completely uncompetitive.

By using this algorithm the assessment of the competitiveness of high-tech industrial enterprises operating on the territory of Vladimir region of the Russian Federation is made. The assessment results for each functional area and the total level of competitiveness of the enterprises represented in Figure 2.

The results of the assessment make it possible to conclude that there is not a large scale in the levels of competitiveness of the considered enterprises. Thus, the maximum level of competitiveness among enterprises is estimated as 0.588, and the minimum level of competitiveness - 0.412 (Figure 3).



**Figure 2. A fragment of the assessment results of level of competitiveness of high-tech industrial enterprises of the Vladimir region**



**Figure 3. A fragment of assessment of competitiveness potential of high-tech industrial regional enterprises**

The contribution of each functional area of competitive superiority in the total level of competitiveness is presented in Table 3 for the best and the worst company.

Thus, in all areas of competitive superiority aside from marketing competitiveness one can see an exceeding level of parameters of one company over another. Therefore, according to scientific-technical, personnel, economic, financial, and social areas, there is the superiority of more than 2 times.

Beside this, in the course of the study the task was set and the results were received on the calculation of the average private coefficients of elasticity showing the average percent of change of level of competitiveness at change for 1% of the level of competitiveness of functional area.

For this, the regression analysis was used combined with the use of Excel. The assessment of the statistical significance of the coefficients of the regression equation showed that only three indicators remain significant - the competitiveness of the system of management, scientific and technical and production and technical competitiveness. For these factors, the average private elasticity is respectively 0.248; 0.113 and 0.114.

**Table 3. The contribution of the functional areas of competitive edge of enterprises into the final level of its competitiveness**

Functional area of competitive edge	Kinds of functional region competitiveness	
	The company with the highest level of competitiveness	The company with the lowest level of competitiveness
Scientific and technical	0.297	0.133
Production and technical	0.372	0.335
Ecological	0.19	0
Professional	0.691	0.334
Economical	0.627	0.277
Financial	0.497	0.248
Social	0.656	0.19
Management system	0.864	0.528
Product	0.822	0.503
Marketing	0.588	0.627
Total level of competitiveness	0.588	0.412

From our point of view, the assessment of the level of competitiveness of high-tech industrial enterprises cannot be completed, if the level of its stability is not defined.

Stability of competitiveness implies dynamic stability of characteristics of the basic economic condition of the company and may be reflected by formulating specific targets, which are expressed by reordering some of the indicators of its economic condition. It should be kept in mind that stability is a property of high-tech industrial enterprises, which preserves the specific quality within the observed period, allows withstanding external shocks.

In this study 'competitiveness stability of the high-tech industrial enterprises' refers to the ability to remain competitive having the minimal fluctuations of this criterion in comparison to this tendency.

Such interpretation of competitiveness involves the use of it as the statistical characteristics of dynamic series.

With this approach to competitiveness, the following conditions must be satisfied:

- minimization of fluctuations of the levels of competitiveness in the dynamics;
- a certain tendency of changing functional areas of competitiveness of high-tech industrial enterprises which is necessary for the region, society, companies.

These conditions underlie the assessment of competitiveness and are transformed for describing of the two following problems.

*First: Assessing the sustainability of competitiveness levels of the enterprises in the dynamics.* The solution to this problem is possible on the basis of calculations of

individual sustainability indexes ( $i_y$ ), which correspond to the ratio of the average level of the levels above trend (the average level of competitiveness for favorable periods of time  $\overline{F_{\delta n}}$ ) and the average level of the levels below trend (the average level of competitiveness during the adverse periods of time  $\overline{F_{\text{не}\delta n}}$ ), which is expressed as the formula:

$$i_y = \frac{\overline{F_{\delta n}}}{\overline{F_{\text{не}\delta n}}},$$

The closer the value of individual indices to unity, the less variability is and the higher resistance there is.

Concerning the facts mentioned above, it can be stated that the optimal value of this indicator is equal to one.

The state when the high-tech industrial enterprises have had the level of competitiveness equal to one for a long period of time is called 'hyperstability'. However, it should be noted that the company, which has been hyper stable for a long time, is incapable of developing due to the fact that all deviations from the balanced state in such an enterprise are leveled. It turns out that for the transition to a new qualitative state the high-tech industrial enterprises has for some time not only lose strength but also to acquire the ability of irreversibility in the old ruined condition.

*Second: Estimation of the competitiveness stability of the high-tech industrial enterprises can be based on the calculation of the Spearman coefficient (Aghanbegyan, 2014):*

$$K_{ycm} = 1 - \frac{6 \cdot \sum_{i=1}^n d^2}{n^3 - n},$$

where  $n$  is the number of monitoring periods;

$d$ —the difference between ranks of levels of competitiveness by years and grades of number periods.

Interpretation of the Spearman coefficient is as follows: if each following level of competitiveness is higher than the previous one, the grades of these levels and the numbers of the periods coincide, i.e.,  $K_{ycm} = +1$ .

This algorithm made it possible to estimate the sustainability of the levels of competitiveness of enterprises operating on the territory of Vladimir region of the Russian Federation. The results of the assessment are shown in Table 4.

**Table 4. A fragment of assessing the level of competitiveness of high-tech industrial enterprises**

Enterprise	Individual indices of the stability of levels of competitiveness of enterprises ( $i_y$ )	the Spearman coefficient
1	1.02	1
2	1.09	-0.8
3	1.52	1
4	1.104	1
5	1.01	-0.8
6	1.02	0.6

## Conclusions

We conducted a study in which we identified factors ensuring the competitiveness of high-tech industrial enterprises to evaluate their contribution to the final level of competitiveness of the enterprise. As a result, we have highlighted two factors that have the greatest impact: the state of the enterprise management system, scientific and technological factor.

Analysis and evaluation of factors made it possible to calculate the level of competitiveness of the enterprise. For this purpose, we used Harrington desirability function.

The method of estimating the level of competitiveness of high-tech enterprises to determine the static level of competitive advantage presented in the article tracks its changes over time, compares it with the level of competitiveness of other enterprises.

The proposed method is assessing the level of competitiveness to evaluate the degree of sustainability.

The results are aimed at finding the most powerful factors of competitiveness, improvement of the level of a technology assessment of the competitiveness of high-tech enterprises, with the result that will allow adjusting the high-tech enterprise's competitive strategy of its development.

The results of this study are derived from the study of Russian high-tech industry. Further research of the authors will be associated with the assessment procedure provided for greater competitiveness combination of domestic and foreign high-tech industrial enterprises in order to identify patterns and trends of the competitive development.

## References

- Aghanbegyan, A.G. (2014). Socio - economic development of Russia: Analysis and Forecast. *Problems of Forecasting*, 4(1), 3-16.
- Arkipova, M.Y., & Golichenko, O.G. (2007). Cooperation in the innovation processes of the manufacturing industry of Russia. *Economic Science of Modern Russia*, 1(1), 44-57.

- Batkovskij, A.M. (2013). *The development of the theory and practice of enterprise management of complex high-tech*. Moscow: MESI.
- Borisov, V.N., & Pochukaeva, O.V. (2011). Modernizations of Russian manufacturing on the basis of the sustainable development of domestic machine building Studies on. *Russian Economic Development*, 2(22), 142–147.
- Brandão Santana, N., Rebelatto, D.A.D.N., Périco, A.E., Moralles, H.F., & Leal Filho, W. (2015). Technological innovation for sustainable development: an analysis of different types of impacts for countries in the BRICS and G7 groups. *International Journal of Sustainable Development & World Ecology*, 22(5), 425–436.
- Carayannis, E., & Grigoroudis, E. (2014). Linking innovation, productivity, and competitiveness: implications for policy and practice. *Journal of Technology Transfer*, 39(2), 199–218.
- Ditkovsky, K., & Fridlyanova, S. (2015). Indicators of Innovation in the Russian Federation: 2015. Data Book. Retrieved from [https://www.hse.ru/data/2016/02/08/1140135302/Innov\\_2015e\\_c%D0%B0%D0%B9%D1%82.pdf](https://www.hse.ru/data/2016/02/08/1140135302/Innov_2015e_c%D0%B0%D0%B9%D1%82.pdf).
- Esser, K., Hillebrand, W., Messner, D., & Meyer-Stamer, J. (2013). *Systemic competitiveness: new governance patterns for industrial development*. London: Routledge.
- Fedotova, M.A., Dresvyannikov, V.A., Loseva, O.V., & Tsygalov, Y.M. (2014). The intellectual capital of the organization: management and assessment. Financial University under the Government of the Russian Federation.
- Filimonova, N.M., Polzunova, N.N., & Malkerov, M.U. (2013). Hi-tech entrepreneurial structure upgrade project. *Investment Management and Financial Innovations*, 10(4), 166–170.
- Frolova, N.I., & Kashintseva, E.V. (2006). Methods of analysis of the competitiveness of the commercial organizations. *Economic Analysis*, 20(1), 55–60.
- Galbraith, J.K. (2015). *The new industrial state*. Princeton, NJ: Princeton University Press.
- Godin, B. (2004). The obsession for competitiveness and its impact on statistics: the construction of high. *Research Policy*, 33(4), 1214–1229.
- Kutin, A.A., & Kornienko, A.A. (2009). Modern Trends and Conception of Native Machine tool Products Competitiveness. *Vestnik MSTU "Stankin"*, 2(6), 68–72.
- Morris, M., Schindehutte, M., & Allen, J. (2005). The entrepreneur's business model: toward a unified perspective. *Journal of Business Research*, 58(6), 726–735.
- Polenske, K.R. (2004). Competition, Collaboration, and Cooperation: An Uneasy Triangle in Networks of Firms and Regions. *Regional Studies*, 38(9), 1021–1035.
- Sabadie, J.A. (2014). Technological innovation, human capital and social change for sustainability. Lessons learned from the Industrial Technologies Theme of the EU's Research Framework Programme. *Science of the Total Environment*, 481(3), 668–673
- Sung, T.K. (2012). Technology Marketing as a Tool of Commercialization: Definition, Strategy, and Process. *Journal of Intellectual Property*, 7(3), 101–129.
- Shchepakina, M.B., Krivosheya, E.V., & Tretyakov, R.M. (2012). Methodical approach to the development of the estimated enterprise's competitiveness in its marketing orientation. *Scientific Journal of KubSAU*, 81(7), 967–982.
- UNIDO (2013). Sustaining Employment Growth: The Role of Manufacturing and Structural Change. Industrial Development Report. Retrieved from [https://www.unido.org/fileadmin/user\\_media/Re](https://www.unido.org/fileadmin/user_media/Re)

search\_and\_Statistics/UNIDO\_IDR\_2013\_main\_report.pdf

UNIDO (2016). The Role of Technology and Innovation in Inclusive and Sustainable Industrial. Development:Industrial Development Report. Retrieved from [https://www.unido.org/fileadmin/user\\_media\\_upgrade/Resources/Publications/EBOOK\\_IDR2016\\_FULLREPORT.pdf](https://www.unido.org/fileadmin/user_media_upgrade/Resources/Publications/EBOOK_IDR2016_FULLREPORT.pdf)

Yakupov, N.M., & Yarullina, G.R. (2009). A conceptual framework for the assessment of investment attractiveness of enterprise. *Economic Science*, 9(2), 165–169.