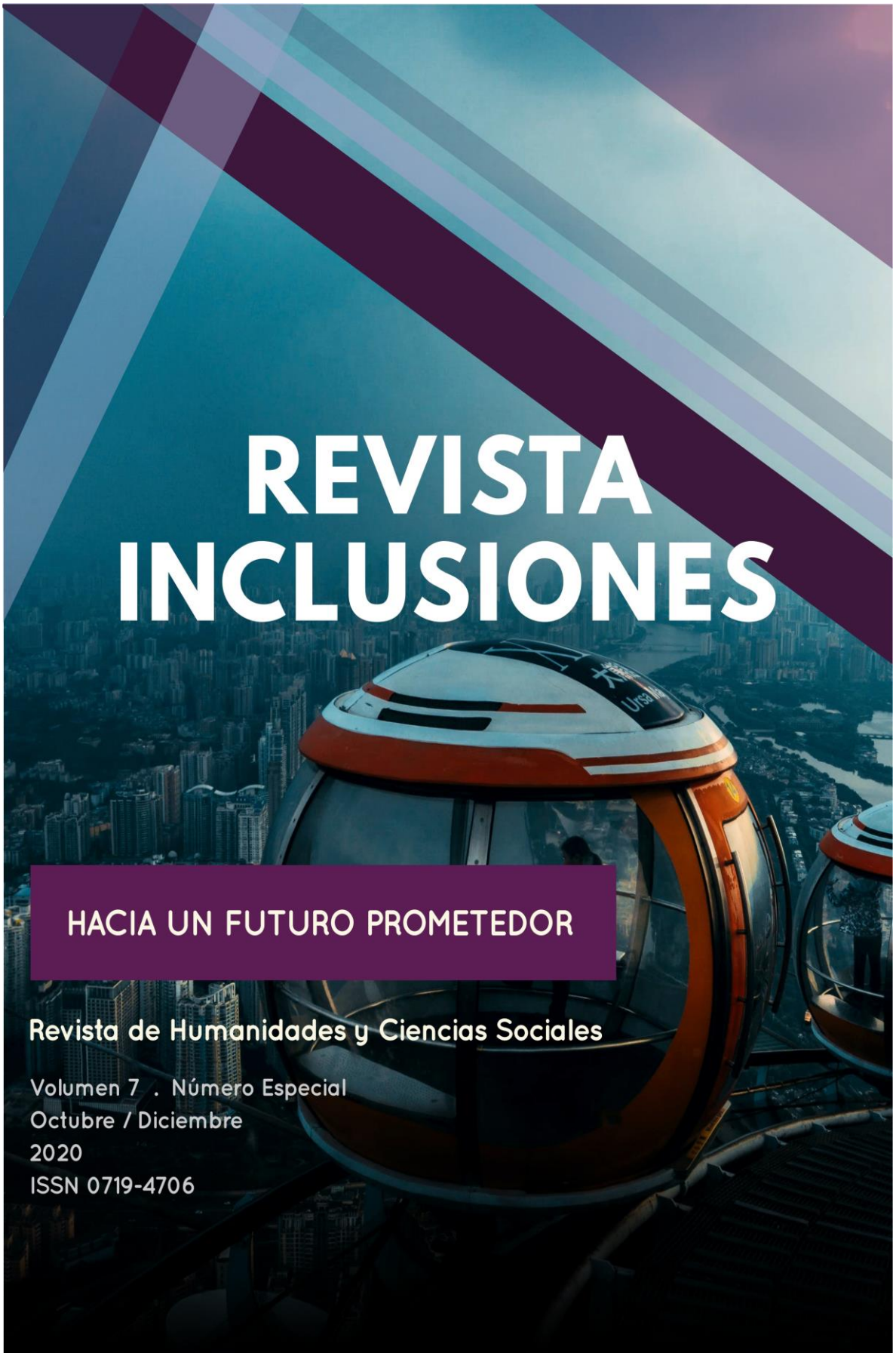

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METHOD OF QUALITATIVE ASSESSMENT OF THE HUMAN INTELLECTUAL POTENTIAL AT A DIGITAL ENTERPRISE

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Abstract

The issue of building *effective* teams capable *to* create, implement and commercialize innovative products is highly relevant for high-tech companies focused on business digitalization. The article suggests a solution based on the methodology for assessing human intellectual potential. The sensory, emotional, logical, creative, socio-cultural and economic components of intelligence are detailed and their functional interaction in the implementation of innovative team activities is described. The methods for determining the integral indicator of individual intellectual potential based on a weighted score of the structural components of intelligence are presented. The algorithm for finding the synergy coefficient as well as the human intellectual potential of the team is described. Some new areas for application of the developed methodology are suggested based on the results of testing.

Keywords

Human intellectual potential – Asessment – Innovative activities – Structure of intelligence

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Introduction

The relevance of the research topic

In view of current challenges in foreign policy, the Russian economy is in dire need of new drivers for the development of high-tech business able to accelerate the country's socio-economic growth and ensure technological updating and digitalization of the economy.

The human intellectual potential of the organization can become such a driver since enacting innovative changes is possible only with effective teams of employees capable of coming up with new ideas and making productive use of existing knowledge. Such teams are especially important for digital enterprises where contactless teamwork of employees plays a paramount role in the successful promotion of digital products on foreign markets.

As the data from the Global Competitiveness Index 2018-2019 show, Russia occupied only 38th place from 137 countries of the world due low indicators related to the human factor, in particular: Quality of the educational system – 64; Quality of management schools – 65; Reliance on professional management – 93; Country capacity to retain talent – 59; Country capacity to attract talent – 77; Reliance on professional management – 85; Cooperation in labor-employer relations – 90; Firm-level technology absorption – 72; Capacity for innovation – 65. In general, the data signalize a low ability of Russian society to effectively apply existing knowledge and create new knowledge. In this connection, the transition to a human-oriented concept of managing innovative activities in high-tech organizations focused on the development of human intellectual potential and building of effective teams of workers possessing good communication skills and intellectually complementing each other is extremely relevant.

The issues of influence of human intellectual potential on innovative development were considered from various points of view in the works of many researchers[1].

The works of J. Bruner[2], U. Neisser[3], R. Sternberg[4], H. Eysenck[5], H. Gardner[6], W. James[7], G. Kelly[8], R. Solso[9], M. Huselid et al.[10] dedicated to the psychology of intelligence

[1] W. Y. Wu; M. L. Change y C. W. Chen, “Promoting innovation through the accumulation of intellectual capital, social capital, and entrepreneurial orientation”, Journal of R&D Management Vol: 38 num 3 (2008): 265-277; S. T. T. Teo; K. K. Reed y K. Ly, “Human resource involvement in developing intellectual capital”, The Service Industries Journal Vol: 34 num 15 (2014): 1219-1233; N. Ugalde-Binda; F. Balbastre-Benavent; M. T. Canet-Giner y N. Escribá-Carda, “The Role of Intellectual Capital and Entrepreneurial Characteristics as Innovation Drivers”, INNOVAR. Revista de Ciencias Administrativas y Sociales Vol: 24 num 53 (2014): 41-60; W. M. Lu; Q. L Kweh y Ch.-L. Huang, “Intellectual capital and national innovation systems performance”, Knowledge-Based Systems Vol: 71 (2014): 201-210: C. Carraro; E. De Cian y M. Tavoni, “Human Capital, Innovation, and Climate Policy: An Integrated Assessment”, Environmental Modeling & Assessment Vol: 19 num 2 (2014): 85–89; M. A. Fedotova; V. A. Dresvyannikov; O. V. Loseva y Y. M. Tsygalov, Assessment of human capital in the innovation (Moscow: Red Star, 2014); E. L. Moreva y N. M. Abdikeev, “About culture and cognitive thinking as factors of innovative development”, Humanities num 5 (2017): 56-62 y N. M. Abdikeev, “Valuation of intellectual capital and intangible assets created based on innovative products and intellectual property”, Proceedings of the International Conference on Creativity and Innovation. Kindai University, Osaka, September 10-12, 2018. Retrieved from: http://www.icciosaka2018.net/

and cognitive psychology serve as a scientific basis for assessing the intellectual potential of an employee.

According to the human-oriented approach, the intellectual potential of a worker at high-tech digital enterprise should be considered not only as his/her ability to perceive new information, put forward competitive ideas, find solutions to non-standard problems and new ways to solve standard problems. The level of development of the above-mentioned abilities which are mainly acquired rather than genetically defined is determined by the existing level of sensory, emotional, logical, creative, socio-cultural and economic components of human intelligence.

This implies that for a comprehensive assessment of the intellectual potential of employees we need to use a proper model; its application will permit to qualitatively enhance team innovative activities and, at long last, ensure the competitiveness of high-tech organizations acting in the digital economy. A comprehensive assessment of the intellectual potential of employees may be performed through the use of a proper model; the introduction of such a model will improve the quality of team innovation and ultimately will ensure the competitiveness of high-tech organizations in the digital economy.

A distinctive feature of the model is a new intellectual potential structure that is based on selected components of the employee's intelligence, both genetically defined and acquired in the process of professional and personal development.

The definition of employee's intellectual potential structure and the objectives of research

The intellectual potential of an employee is understood as the level of intelligence possessed by an individual as well as implicit (internal) knowledge accumulated through practical experience having social and economic value and utility.

Conscious management of the human intellectual potential of the organization is required in order to transform implicit knowledge of workers into explicit knowledge and its further effective use in team interaction while carrying out innovative activities.

To achieve this, it is necessary:

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[2] J. Bruner, Psychology of knowledge. Beyond the immediate information (Moscow: Progress, 1977).
[3] U. Neisser, Cognition and Reality: Principles and Implications of Cognitive Psychology (New York: W. H. Freeman and Company, 1976).
[4] R. Sternberg, Cognitive Psychology (CA, Belmont: Wadsworth-Thomson, 2003).
[5] H. Eysenck, Paradoxes of psychology = Psychology is about people (Moscow: Eksmo-Press, 2009).
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[8] G. A. Kelly, The psychology of personal constructs and cognitive psychology (Moscow: Praym, 2007).
[9] R. Solso, Cognitive Psychology (Saint Petersburg: Peter, 2006).
[10] M. A. Huselid; B. E. Becker, R. W. Beatty, Evaluation of staff: how to manage human capital in order to implement the strategy (Moscow: Williams, 2007).

1) to identify the characteristics and properties of each type of intelligence that determine the characteristics of the employee's mental experience which affect the quality of team innovation;

2) to consider the functional interaction between intelligence structural components engaged in team innovation activities;

3) to develop a methodology for assessing human intellectual potential of a team with due allowance for the synergistic effect of employees' interaction.

Table 1 shows the types of intelligence and its substantial components (objects of assessment).

Type of intelligence and its characteristics	Practical application of the assessment	Content areas
Sensory Intelligence (psychic processes like attention, concentration, recognition of real-life objects and of self as individual (personality), their reflection and memorization)	For determining the developed level of intelligence as a faculty of adequate reality reflection, the capability to remember, keep, and reproduce information in time. It is involved in the management of mental structures	Perception (integrity, constancy, apperception, emotional coloring)
		Attention (speed, volume, duration, switching over)
		Dominating hemisphere (the right – emotional and imaginative perception /the left – logical perception)
		Memory (based on the type of receptor / based on the duration of information keeping)
		Type of representative system (visual, audio, kinesthetic, intuitive)
		Type of spatial perception
		Introversion/extraversion
Emotional Intelligence (a group of mental characteristics facilitating the realization and understanding of own emotions and emotions of others)	For determining individual specifics of emotional expression, capability to understand own emotions and to manage own emotional states	Characteristics of emotional experience (intensity, duration, depth)
		Emotions as a combination of characteristics of emotional experience (neurosis, affect, stress, feelings)
		Emotional management (mental, physical, psychotechnical)
Logical Intelligence (mental thought structures for the management of reality perception that lies in the processing and/or transformation of the perceived incoming information for the purpose of further generation of new knowledge)	For determining specifics of reflective (mental) processes of reality perception, the capacity for research activities, to think logically, to learn, to analyze, to create and introduce innovations	Overall reflection characteristics (width, depth, speed, criticism, flexibility)
		Abstract (handling of notions, judgments, conclusions, abstraction)
		Visual-image thinking
		Visual-acting thinking
		Mathematical thinking
		Spatial thinking
		Types of thinking (convergent – the ability to find the only true solution in the given context; divergent - the ability to find solutions beyond stereotypes)
Creative Intellect (it is the essence of sensory, emotional, logical, and socio-cultural intelligences fulfilling the most crucial function in	For determining individual's reflective capacity for creativity, the nature of creative potential. The development of all other types of intelligence	Creative abilities (sensitivity to problems, originality)
		Traits attributable to creativity (independence, curiosity, need for self-expression, intellectual agility, critical view on reality)

Type of intelligence and its characteristics	Practical application of the assessment	Content areas
innovative economy – the accrual of information and knowledge)	is possible, for example, the mastering of new ways of memorizing information, new ways of thinking, behavior models	Creativity types (challenge – multi-optional constructive solution of identified problems; perspective – motivated desire to create harmony, beauty, or to go beyond the limits of reality)
Socio-Cultural Intelligence (social success expressed in acceptance by the team and/or company's management and dependent on the efficiency of social relationships)	For determining the capability to remember, keep, and reproduce socially meaningful information; capability of the employee to adapt to the company and society as a social being. Assessment results are used for the distribution of roles in a team, management and self-management of social and personality development	Social memory (relates to surrounding people, to events in the social environment)
		Formal social roles (understanding of official duties and responsibilities, possible patterns of social behavior when playing job role)
		Social skills (makes assessment of own personal traits and traits of others, identifies needs, interests, motives of own behavior and the behavior of others, determines own social status and the status of others, communication skills)
Economic Intelligence (stands at the end of the chain of intellectual practices formed by other types of intelligence and ensures the individual's capability to transform his/her both internal and external real world for the purpose of economic gain)	For determining employees' capability to derive economic benefit from the use of his/her intellectual potential, the possibility to successfully build the real-world into the system of social and economic relations, the availability of practice-oriented and theoretical knowledge base to realize economic activities	Entrepreneurial thinking (ability to economic forecasting, economic foresight, progressive and innovative thinking, practical thinking and pragmatism)
		Traits (purpose-driven, strong-willed, self-confident, hard-working, responsible, and stress-resistant)
		Values (establish respect for labor outcome, expect getting economic benefit not only for the sake of life essentials, but also for the intellectual growth and/or social partnership)
		Professional and economic management knowledge

Source: compiled by the authors

Table 1

Types of Intelligence, Practical Application of the Assessment and Content Areas of Different Types of Intelligence

The functional interaction between the selected intelligence structural components involved in team innovation activities with due regard to the respective content areas is manifested in the following:

1) sensory intelligence is the basis for the development of employee's mental experience; it includes mental structures and provides information for emotional and logical intelligence;

2) emotional intelligence creates the background for sensory intelligence and participates in the development of socio-cultural intelligence which helps team workers in social adaptation and intercultural communication;

3) logical intelligence provides connection between sensory and emotional intelligence, in particular, via employee motivation. But its main purpose is to transform information with the help of mental operators;

4) creative intelligence develops tools for mental activity and contributes to generation of new knowledge by the team in view to achieve economic benefits;

5) socio-cultural intelligence determines the context of employee's activities, creates an internal mental field containing moral criteria and constrains, social values, it also participates in creating interpersonal relationships and the human intellectual potential of the team and organization;

6) economic intelligence of workers is the final link in team innovation determining its economic viability and effectiveness.

Having considered substantive characteristics of all types of intelligence and their functional interaction in performing innovative activities, we can conclude that the intellectual potential of the employee is an integral characteristic including:

1. The intellectual potential generated by the employee and being a result of internal mental activity based on perception, thinking, emotions and creativity. It is typically named "I-potential" or "pure potential" to emphasize its relative independence from teamwork potential.

2. The intellectual potential which is produced in the process of interaction and intercultural communication within a team; it is based on the socio-cultural and economic intelligence of workers. It is so-called "We are potential" or "potential for cooperation".

A right balance of these two components ensures the harmonious development of the employee as well as the effectiveness of individual and team innovation activities in the organization.

It should be noted that it is necessary to evaluate the individual components of the employee's intelligence as well as obtain integral characteristic of the intellectual potential of the employee, team, and organization as a whole.

The purpose of the study is to develop and test in practice a methodology for assessing human intellectual potential that would promote the innovative development of Russian high-tech organizations.

Research methodology

Integral indicator of the intellectual potential of the employee

Based on the structure of the intellect and the selected content areas listed in Table 1, it is suggested to determine the employee's *IPI* (Intellectual potential of an individual) by the formula (1):

$$IPI = \sum_{i=1}^{6} k_i A_i \qquad (1)$$

where A_i (i = 1..6) is the score of structural types of intelligence (sensory, emotional, logical, creative, socio-cultural and economic);

k_i ($\sum k_i$=1) is the weighting coefficient that determines the importance of a particular type of intelligence depending on the goals and objectives of the assessment of intellectual potential of the employee.

The procedures for assessing the types of individual intellectual potential A_i are based on the authors' personality questionnaires which give an initial assessment of A_i based upon reflection.

For an integrated assessment of *IPI* by formula (1), all A_i values should be in the same variation range. For this purpose, the approach used in quality statistics is applied, i.e. each type of intellectual potential A_i is described by a set of features-properties (X_j). For example, for the content area "perception" of sensory intelligence, such properties include integrity, constancy, apperception, emotional coloring (see Table 1).

To determine the quality of a feature-property set, it is necessary to establish a quality standard: it is suggested to take as such the number of quality categories. In this case, it is recommended to choose five categories that correspond to the degree of manifestation of a particular feature or property of a proper type of intelligence: "low level" - 1; "level below average" - 2; "average level" - 3, "level above average" - 4, "high level" – 5.

It is on this principle that the authors' reflection questionnaires were compiled. Each A_i value is estimated as the arithmetic mean of the values of corresponding features-properties.

$$A_i = \frac{\sum_{j=1}^{m} X_j}{m}, \qquad (2)$$

where X is the value of feature or property and m is the number of properties.

Similarly, X is evaluated as the arithmetic mean of points scored when answering test questions that determine the degree of manifestation of feature X in the test-taker:

$$X_j = \frac{\sum_{l=1}^{v} b_l}{v}, \qquad (3)$$

where b is the score of answer (from 1 to 5) and v is the number of questions describing the feature.

Therefore, all types of intellectual potential will receive a qualitative assessment in the range from 1 to 5.

The next problem that needs to be solved when calculating *IPI* by formula (1) is how to determine the values of weights k_i which are responsible for the importance of the type of intelligence.

The determination of the values of weights should be based on the goals of assessment of the intellectual potential as well as information requirements for test-takers. There can be a self-assessed individual, a leader, a personnel manager, a psychologist or a teacher-mentor. The approaches to determine the values of weights k_i are described below.

A simplified approach

A simplified approach should be applied to determine the degree of development of a particular type of intelligence A_i in case when the employee carries out self-assessment in order to evaluate himself/herself as a personality. In this case, all k_i values are taken equal to 1/6:

$$IPI = 1/6 \sum_{i=1}^{6} A_i \quad (4)$$

The emphasis is placed on a comparative analysis of components of the individual intellectual potential followed by further in-depth employee reflection in order to identify unused reserves or gaps in his/her professional development.

An expert approach

According to the expert approach the values of weights k_i are determined by a group of experts engaged in assessment of the individual or aggregate human intellectual potential.

The authors' application of this approach implies that while determining the values of weights, it is necessary to take into account the ability to control the development of intellectual potential components. The human intelligence includes physiological (F), psychological (P) and socio-economic (SE) content. It should be noted that genetically defined characteristics of perception and emotional reactions are hard to change. Moreover, it is much more difficult to develop logical or creative abilities than acquire entrepreneurial or socio-cultural skills. Taking the above into consideration, A_i were respectively ranked and corresponding values of the coefficients k_i were determined (Table 2).

No.	Type of intelligence A_i	Rank reflecting the controllability degree A_i	Weight values ($\sum k_i$=1)
1	A_1 – sensory intelligence	1	0.125
2	A_2 – emotional intelligence	1	0.125
3	A_3 –logical intelligence	2	0.175
4	A_4 – creative intelligence	2	0.175
5	A_5 – socio-cultural intelligence	3	0.2
6	A_6 – economic intelligence	3	0.2

Table 2

Weight values for different types of intelligence with reference to their controllability

As it is seen from Table 2, the higher the rank, the greater the ability to control the development of a particular type of intelligence.

The expert approach should be applied when it is needed:

– to compare characteristics of workers in terms of the developed intellectual potential;

– to determine the level of development of the human intellectual potential of the team or organization as a whole.

When building a team, an expert group determines the values of weights based on team mission in view to achieve the maximum synergy effect. In one case, the creative component of intelligence will become of the first importance, in the other case the economic component of intelligence will prevail. Of course, the socio-cultural component should always occupy a rather high rank as it promotes fruitful teamwork.

Similarly, in case of personnel changes or hiring a new employee, experts determine the importance of A_i taking into account the specifics of the position and job requirements.

Therefore, in every particular case, the components of A_i are ranked depending on the set goal and according to the principle: the greater the significance, the higher the rank, i.e. rank 3 corresponds to the most significant component; rank 2 means a rather significant component and rank 1 is the least significant component. To determine the degree of consistency of expert opinions, a qualitative assessment method is applied. The data obtained from the expert ranking are arranged as a matrix having the following general form (Table 3):

	A_1	A_2	…	A_6
E_1	x_{11}	x_{12}	…	x_{16}
E_2	x_{21}	x_{22}	…	x_{26}
…	…	…	…	…
E_m	x_{m1}	x_{m2}	…	x_{m6}

Table 3
Data Matrix obtained from Intelligence Ranking by Experts

where A_j stands for intelligence components; E_i are objects (experts);

x_{ij} is the value of the i-th row and j-th column (corresponding A_i rank);
m is the number of experts.

The multiple coefficient of concordance (consistency) has the form:

$$w = 1 - \frac{\sum_{i=1}^{m}\sum_{j=1}^{m}\sum_{k=1}^{n}\left|x_{ik} - x_{jk}\right|}{nm(m-1)(K-1)} \qquad (5)$$

where K is the number of quality categories.

For matrix 3, the coefficient *w* (0<*w*<1) is designed to solve the problem of determining the degree of consistency of opinions of two experts (pair concordance) or more experts (multiple consistency) involved in ranking the six components of intellectual potential. Only at *w*≥0.75 (good consistency) experts proceed to determine the values of weight k_i going from the number of obtained maximum and minimum ranks and the condition that $\sum k_i=1$.

Assessment of the intellectual potential of the team taking into consideration the effect of synergy

The human intellectual potential of a team is not just the sum of the intellectual potentials of its employees; it is an integral indicator that takes into consideration the effect of their interaction (synergy):

$$IPG = s \cdot \overline{IPI} \tag{6}$$

where s is the synergy coefficient;

$$\overline{IPI} = \frac{\sum_{i=1}^{n} IPI}{n} \tag{7}$$

where n is the number of group members.

The synergy coefficient *s* depends on the degree of similarity (kinship) of workers which is established by the matrix (see Table 4) using the pair concordance coefficient *w'* (8).

$$w' = 1 - \frac{\sum_{j=1}^{n} \left| a_{1j} - a_{2j} \right|}{n(K-1)} \tag{8}$$

Where *n* is the number of intelligence components selected by experts for assessment; a_{ij} is the qualitative value of the *j*-th component of intelligence for the *i*-th employee.

	A_1	A_2	…	A_n
P_1	a_{11}	a_{12}	…	a_{1n}
P_2	a_{21}	a_{22}	…	a_{2n}
…			…	
P_m	a_{m1}	a_{m2}	…	a_{mn}

Table 4
The initial matrix for determining the coefficient of pair concordance

Where P_i is a worker; A_j is the intelligence component; *i=1..m*, *j=1..n*.

Clusters are built from the aggregate of workers according to the following algorithm.

Step 1. The matrix of pairwise similarities of N-workers symmetric with respect to the main diagonal is calculated. The concordance coefficient of an object with respect to itself is equal to 1 (Table 5).

	P_1	P_2	…	P_{N-1}	P_N
P_1	1	w'_{12}		w'_{1N-1}	w'_{1N}
P_2		1		w'_{2N-1}	w'_{2N}
…			1	…	…
P_N				1	w'_{NN}
P_{N-1}					1

Table 5
The matrix of pairwise similarities

Step 2. Employees with the required degree of similarity are written out from each row of the obtained matrix of pairwise similarities of objects.

Step 3. Next, the following iterative cluster formation method is used:

1) the cluster with the largest number of objects is selected;

2) if there are several such clusters, then a cluster with the required density is selected;

3) objects of the selected cluster are deleted from the remaining clusters;

4) a new cluster table is compiled from the remaining objects;

5) items 1-4 are repeated until at least one cluster has more than two objects.

The cluster density is determined by the formula:

$$\rho = 1 - \frac{\sigma^2}{n(K-1)} \tag{9}$$

where σ^2 is dispersion.

Density levels ρ are summarized in Table 6.

ρ=1	Absolute density
0.9≤ρ<1	High density
0.8≤ρ<0.9	Average density
0.7≤ρ<0.8	Density below average
ρ<0.7	Low density

Table 6
Density levels ρ

Two principles can be used to determine the relationship between the indicators *s* and *ρ*.

1. The principle of complementarity of employees by type of intelligence A_i.

This principle assumes that all types of intelligence should be equally involved in the intellectual and innovative activities of a group (team), thus ensuring a balanced and stable teamwork.

In this case, the columns of matrix 4 will contain the values of all the components of the intellectual potential A_i, therefore, the number of columns will be equal to six. The lower the degree of similarity of the cluster employees in terms of the A_i components, the lower the cluster density and the better their complementarity, and, consequently, the higher synergy. Then the table of the quantitative relationship between the indicators *s* and *ρ* obtained by experts will look as below (Table 7).

Degree of similarity of employees	*ρ*	*s*
High similarity	0.9≤ ρ <1	1.05
Good similarity	0.8≤ ρ <0.9	1.2
Moderate similarity	0.7≤ ρ <0.8	1.35
Weak similarity	ρ <0.7	1.5

Table 7
The relationship between cluster density and synergy established on the principle of complementarity of workers

2. The principle of enhancing the importance of individual components of intellectual potential.

This principle assumes that in intellectual and innovative activities of the team one or more types of intelligence should prevail. For example, in the group engaged in the development of a new product, the creative component of intelligence comes first.

In this case, the matrix columns (Table 4) will contain those A_i components that, in an expert's opinion, have the highest rank (r = 3) or significance for this group.

The indicators *s* and *ρ* are directly proportional: the higher the cluster density, the higher the level of synergy. Table 8 shows quantitative relationship between the indicators *s* and *ρ* for the case when the principle 2 is applied.

Degree of similarity of employees	*ρ*	*s*
High similarity	0.9≤ ρ <1	1.5
Good similarity	0.8≤ ρ <0.9	1.35
Moderate similarity	0.7≤ ρ <0.8	1.2
Weak similarity	ρ <0.7	1.05

Table 8
The relationship between cluster density and synergy established on the principle of enhancing the importance of individual components of intellectual potential

The principle for determining the synergy coefficient should be chosen based on the objectives of assessment as well as on practical work experience with using the proposed methodology.

Monitoring the dynamics of integral indicators *IPI* and *IPG* is essential to achieve effective teamwork management.

Results

The proposed authors' methodology for assessing human intellectual potential has been tested to assess employees' activities at an IT multinational company. The company owns the search engine of the same name on the Internet and its Internet portals and services are available in several countries. The company occupies the most prominent position on the markets of Russia, Turkey, Belarus and Kazakhstan. It also has representative offices in Germany, Switzerland, the Netherlands and China.

The experiment was carried out in the following stages:

1. Sampling 30 employees from the company's departments engaged in the development, implementation and commercialization of innovative products.
2. Assessment of the components of intellectual potential of employees using questionnaires for reflection compiled by the authors and then compilation of Table 4.
3. Clustering workers according to the principle of complementarity by type of intelligence (the greater the degree of similarity in the six components of intelligence, the better). The formation of the first experimental group. Assessment of the synergy coefficient and human intellectual potential of the group.
4. Clustering the remaining workers according to the principle of enhancing the importance of individual components of intellectual potential, in particular of socio-cultural and economic components; formation of the second experimental group; assessment of the synergy coefficient and human intellectual potential of the group.
5. The formation the control group consisting of remaining employees; assessment of the human intellectual potential of the group.
6. Setting for the groups the task of implementing an innovative project and launching new products on the market.
7. Assessment of project implementation results obtained by the groups.
8. Assessment of the degree of satisfaction with the quality of teamwork of employees from experimental and control groups.

The achieved results covering stages 1-5 are summarized in Table 9.

Group	Number of people	$\overline{IPI} = \frac{\sum_{i=1}^{n} IPI}{n}$	Synergy coefficient (*s*)	$IPG = s \cdot \overline{IPI}$
Experimental group 1	10	4.6	1.2	5.52
Experimental group 2	8	4.3	1.35	5.81
Control group	12	4.5	-	4.5

Source: compiled by the authors on the base of experimental data.

Table 9

Data on human intellectual potential for experimental and control groups

The table shows that the second experimental group has the lowest average level of individual intellectual potential. However, due to its synergy coefficient which reflects the greatest similarity in the socio-cultural and economic components of intelligence, team intellectual potential turned out to be higher than in other groups.

The results of each group were evaluated based on the results of implementation of new products launch project. The main criteria for successful teamwork performance included the amount of profit from sales of new products in the first year of project implementation as well as the profitability of sales (the ratio of net profit from sales to sales revenue). The relevant data for the groups are given in Table 10.

Group	Number of people	$IPG = s \cdot \overline{IPI}$	Profit from sales, thousand rubles	Return on sales,%
Experimental group 1	10	5.52	245700	38
Experimental group 2	8	5.81	198450	50
Control group	12	4.5	189300	27

Source: compiled by the authors on the base of experimental data

Table 10

Data on the results of innovative project implementation for the experimental and control groups

Table 10 shows that although the first experimental group received the largest profit from sales of new products, the sales profitability indicator is the highest for the second experimental group. The control group showed the worst results as to the first and second indicators. Figures 1 and 2 show the results of surveys regarding the degree of satisfaction with team work conducted in two experimental (18 people) groups and one control group (12 people).

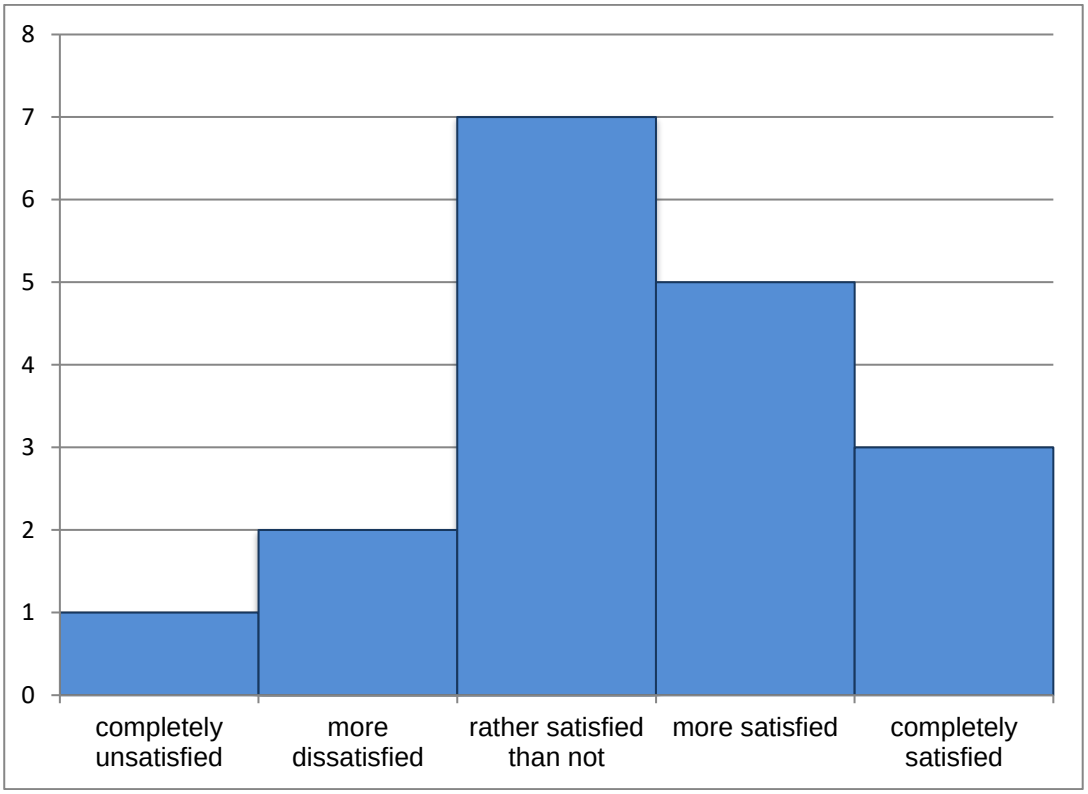

Figure 1

The results of survey regarding the degree of satisfaction with teamwork for the experimental group 1

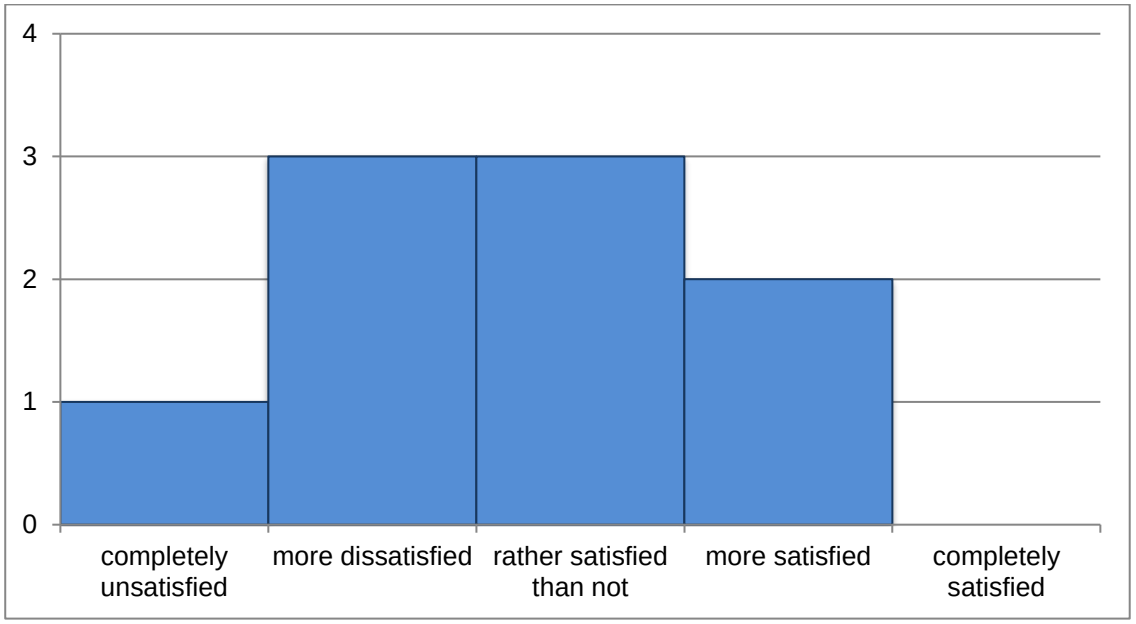

Figure 2
The results of survey regarding the degree of satisfaction with teamwork for the experimental group 2

From the figures, it is seen that the participants from the experimental groups are more satisfied with the teamwork.

Also, the participants from the experimental groups ranked the factors that, in their opinion, affect the quality of teamwork (Figs. 3, 4 and 5).

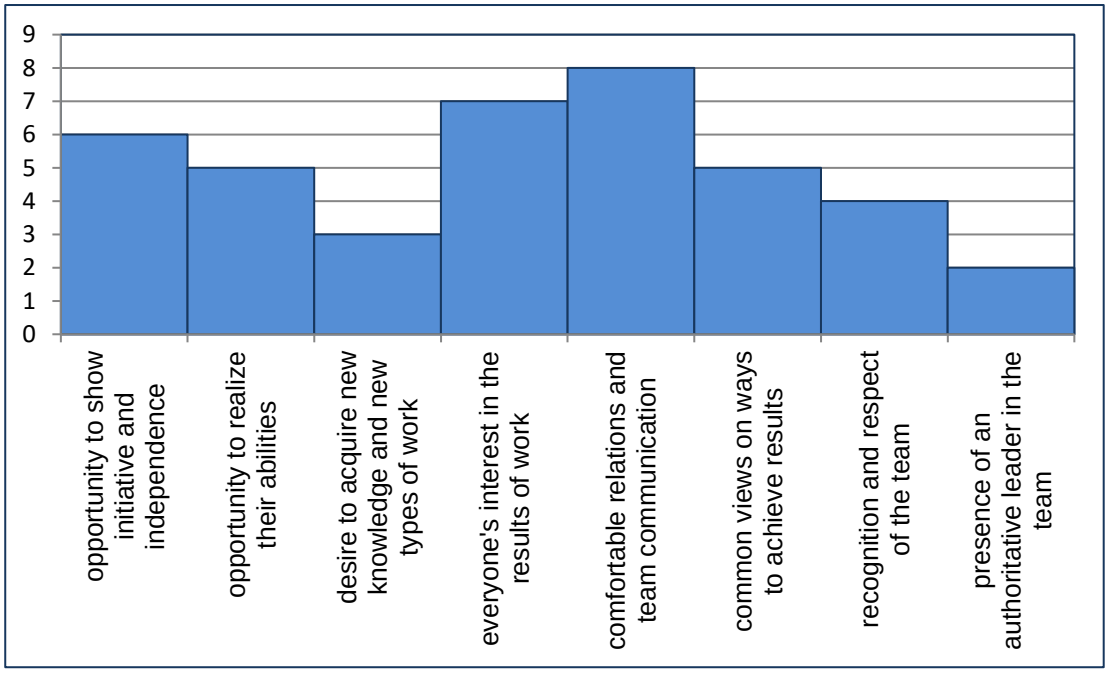

Figure 3
The distribution of factors affecting the quality of teamwork for the experimental group 1

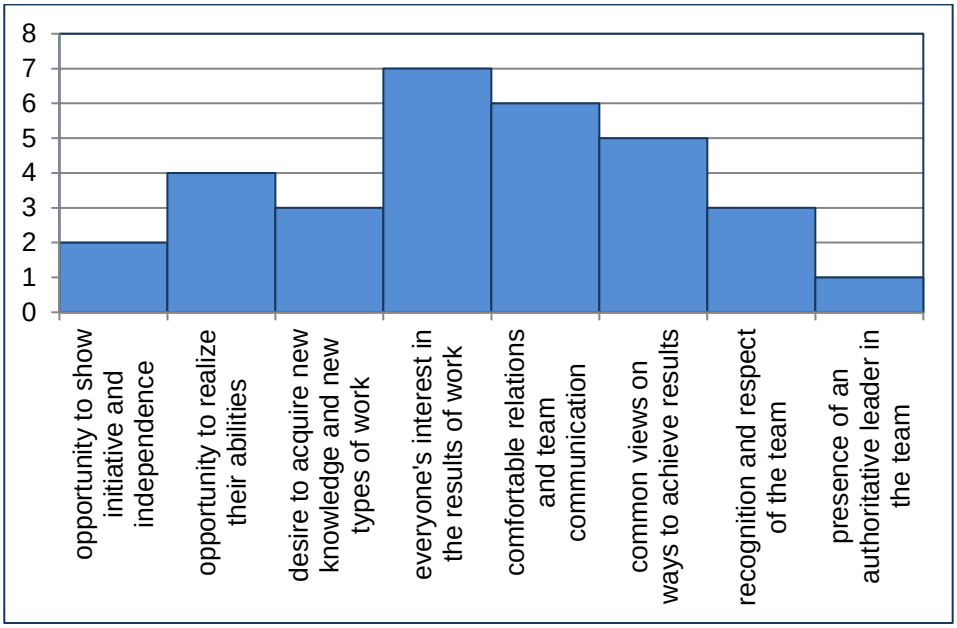

Figure 4
The distribution of factors affecting the quality of teamwork for the experimental group 2

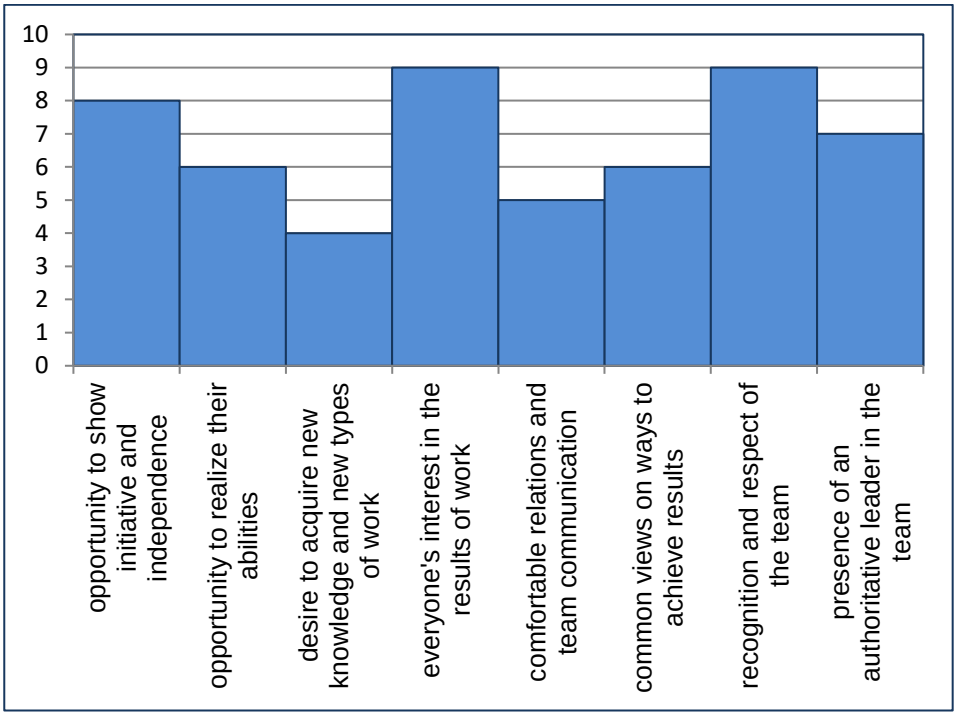

Figure 5
The distribution of factors affecting the quality of teamwork for the control group

It should be noted that the factor “everyone's interest in the results of work” maintains a leading position in all the three groups. The lowest position of the factor “desire to acquire new knowledge and new types of work” denotes a low individual innovative activity in the team. As for the differences in evaluation of factors by employees of the three groups, a more detailed analysis of the causes of the discrepancies is needed.

Discussion

It can be concluded from the analysis of Figures 3-5 that both experimental groups highly ranked the factors “everyone’s interest in the results of work” and “comfortable relations and communication in the team”, they occupy 1-st and 2-nd positions. It actually designates the fact that team unity for group members is a priority. This may explain why experimental groups are more satisfied with teamwork than the control group. The factor “common views on ways to achieve results” and “the opportunity to show initiative and independence” occupy the third place in the second group and first group, respectively. When considering the distribution of other factors, it is worth to point out that experimental group 2 built on the principle of strengthening the socio-cultural and economic components of intelligence is more focused on team interaction and achieving results than the first experimental group. Apparently, this explains the fact that it has the highest synergy coefficient and turned out to be the leader in terms of sales profitability (a key indicator of efficiency in project implementation).

The control group participants as compared to the members of the experimental groups gave greater preference to the factors “presence of an authoritative leader in the team” and “recognition and respect of the team”, thereby emphasizing the importance of self-fulfillment and the need to unite around the recognized leader of the team.

All three groups assigned a high place to the opportunity to realize their abilities, since at the first stage their individual intellectual potential was evaluated.

According to the results of the experiment, managers of innovative divisions suggested the following possible areas for applying the proposed methodology for assessing individual and team intellectual potential in a company:

1) building of target teams (for training, project development, etc.);

2) management of personnel development, building a business career;

3) management of employee motivation, first of all, formation of demands for personal development;

4) management of staff productivity and its innovative activities;

5) identification of unused reserves of intellectual potential of employees as well as structural divisions;

6) consideration of intellectual characteristics in determining the value of the employee for the organization; monetary evaluation of employee’s intellectual capital.

Positive aspects of the developed methodology are very much evident, but its complexity is a drawback which, however, can be eliminated with the automation of described evaluation procedures.

Conclusion

On the basis of the findings in this study, the following conclusions can be made.

The employee's intellectual potential based on a complex intelligence model integrating sensory, emotional, logical, creative, socio-cultural and economic components was considered as an object of assessment.

Each component of the intelligence plays a proper role in the teamwork and has its own content areas which are proposed to be evaluated using authors questionnaires for reflection.

The methodology for assessing the employee's intellectual potential has been proposed to increase the return on the employee's intellectual potential. The methodology implies the determination of the integral indicator of individual intellectual potential on the basis of a weighted score for the structural components of intelligence.

When determining weight values, it is recommended to use a simplified approach (i.e. all components of intelligence are equivalent) or an expert approach (i.e. the weight values of intelligence components depend on their importance determined by experts), it ensures the adaptation of the indicator to various assessment goals.

An algorithm for clustering workers according to their intellectual potential and its components using the pair concordance coefficient is presented. Its application allows to identify workers who are similar or different by their intellectual characteristics and further to determine the synergy coefficient in order to build more effective creative teams. The methodology was tested and confirmed through experimental study carried out at the company Yandex.

The proposals and conclusions of the study are aimed at enhancing the innovative development of socio-economic agents as they allow:

1) on the individual level:

– to increase the effectiveness of the employee's innovative activity through the purposeful and harmonious development of the selected components of the intellectual potential using methods and tools of reflective assessment;

– to enhance under the knowledge economy conditions the employee's performance and ensure its ongoing improvement through effective self-management of his/her own intellectual capital and functional interaction of the intelligence components in innovative activities;

2) on the level of company management:

– to determine the value of a particular employee; to identify areas and unused reserves for development of the individual intellectual potential;

– to build creative teams for innovative projects;

– to ensure effective management of innovative activities and improve the mechanism of motivation through monitoring of integral indicators of individual intellectual potential.

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