Increase of human capital role in sustainable development and competitiveness of companies in mineral resource management market

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Abstract. Foreign research highlights the increasing participation of human knowledge embodied in the concept of human capital and in value generation. Innovational approach to business has not yet gained comparable development within Russian mineral resource management market. A research is carried out to define the structure of human capital presented through the combination of human capabilities, intellect, health, obtained professional knowledge, motivation for continuous improvement, everything that is prerequisite for an increasing completeness throughout the transition to digital economy. The basis for the methodology is comprised of system, statistical, financial, economic, retrospective and trend analyses, as well as principles of systemacity and development. Human capital valuation tools are analyzed. Rationale is provided for human capital accounting methods and its presentation in financial reporting. The paper provides the basis for a performance index system for achievement of effect of human capital use throughout the increase of sustainable development in mineral resource management market using the example of metallurgical industry.

1 Introduction

In the works of foreign and Russian scientists, the concept of competitiveness is quite widely researched, its difference from competition at the macro and micro level is defined. Competitiveness is defined by the ability of objects and subjects to surpass the competitors under certain conditions. Importance of this problem and its practical value is stated through an increase in interest of economic re-searchers in the growing role of human capital and its main component, intellectu-al capital, in providing competitive advantages to companies in mineral resource management market and particularly its basic industry – iron and steel industry. The authors of theoretical basis of human capital have defined human role in so-cial replication. Development of human creative abilities and intellect is the most important factor of sustainable development in the age of digital platforms.

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2 Methods and materials

The transition to a new phase of economic development on the basis of innovations has formulated new qualitative requirements for the category of human capital, among which the following should be noted: national health, level of education, housing availability. These basic factors are important to every human, so they define the quality of his life as well as play part in the development of human capital.

In order to increase competitiveness of industrial companies at the current stage, the main direction for development of such innovative category as human capital should be the study and analysis of interconnections of such terms as human and intellectual capital.

Research of the category of human capital in modern economy will provide an increase in competitive advantages for industrial companies. The companies most likely to succeed are those who invest in health, education and qualification of their employees. Innovational tools based on the advances of science and education lead to an increase in profit and competitiveness. So, in order to define the ways human capital, influence the increase of competitive advantages it is necessary to study ways of its development.

The condition of mineral resource potential influences the sustainability of the development of any industrial company. Human resources (or human capital as traditionally economical term) play an increasingly significant role in sustainability and competitiveness of companies in market economy conditions.

The emergence of the category of "human capital" is explored in the works of scientists of classical political economy U. Petty, A. Smith, K. Marx, etc. The concept of human capital was formed in the 60s of the 20th century, and further developed by T. Schulz, G. Becker and a number of other scientists. First Russian research in this field was carried out by S.D. Valentei, R.I. Kapelushnikov, M.M. Kritsky, etc. In the works of these scientist human capital was seen as a combination of skills and talents that allow their possessor to produce social goods. Questions connected to innovational development are presented in the works of A.N. Dobrynin, S.A. Dyatlov, S.Y. Glaziev, B.Z. Milner, E.Y. Khsutalev, etc.

However, despite the popularization of research in this area, the issues of the influence of human capital on competitive relationship strategies and choice of first priority measures for development of competitiveness of natural resource management companies. In the practical sense it should embody a streamlined system of interconnections among economic operators directly or indirectly involved in the processes of production, distribution, exchange and consumption of resources that occur in nature [8]. Recently, the research of human capital role in sustainable development of Russian economy was carried out at a number of companies of metallurgical industry, which is a central element in the structure of natural resource complex [7]. Scientific studies were presented with the research of labor issues and the increasing role of social responsibility [6]. Insufficient attractiveness of Russian metallurgy industry for young specialist, which is driven by low wages and lack of comfortable conditions in comparison to other sectors of economy, is the main factor for outflow of professional labor, which in turn may contribute to technological inferiority and subsequent loss of competitive advantages.

Research and identification of the main patterns and trends of human capital's impact on improving the competitiveness of natural resource management market companies and their most important component – the iron and steel industry, requires the completion of the following tasks in the conditions of digital economy:

- Clarify the essence of the category of human capital in relation to the new vector of economic development - digitalization;
- Determine the relationship and differences between human and intellectual capital;
- Analysis of investment in human capital in the age of transition to digital platforms;

- Explore ways to develop the potential of company employees in the contexts of the new phase of economic development.

In addition, scientists have not sufficiently researched the questions of how to register and reflect human capital in the reporting process, as well as what tools to use to assess its effectiveness.

3 Results

Let's analyze the aforementioned development and evaluation strategies of human capital on the example of leading natural resource management complex industry – metallurgical industry. The Russian iron and steel complex includes about 290 industrial enterprises, of which 240 are iron and steel companies, of which 70% are city-forming. The number of industrial and production personnel (IPP) is more than 700,000 people, which is 60% of the number of all IPP of the entire metallurgical complex. The increase of human capital role and the increase of capital investment in its development is a necessary condition for the transfer of Russian economy to an innovational way of development [10].

Taking into account that human capital is an essential functional component of the innovative production, it is advisable to characterize it as a complex: innate human traits, health, knowledge obtained through education, professional skills, intellect, motivations for work and development, mobility, cultural and moral values, knowledge and compliance with laws and regulations. Innate human capital is developed, first of all, in the family, as well as in the system of educational institutions developed by the state programs to support young people. In the age of digitalization, competitiveness is determined by developed human capital with diverse digital and networking skills.

Intellectual capital can be interpreted as the most important component of human capital that unites thought, creative and intelligence abilities of a person, taking into account the increasing cultural and moral level in the course of the economy of the new time. Among the components of intellectual capital, it is necessary to identify the one that is most relevant to natural resource management market – intellectual capital in the field of digitization.

The world's largest manufacturing companies are undertaking digital transformation according to the Industry 4.0 Concept. The metallurgical industry is also involved in this process. Businesses are digitizing critical functions into verticalized value chain. This also involves work with partners in horizontal supply chains. Digital functions allow for a wider product portfolio that involves innovational services based on data.

It should be noted that 2018 was a successful year for the global metallurgical industry. According to Deloitte, the global production of steel amounted to 1,803 million tons in the reporting year, which is 4.9% higher than in 2017. The leading companies are Chinese, with the respective growth of 7.8%, while other global companies average at 1.9%.

In 2018, the steel smelting of Russian metallurgical companies had a volume of 71.3 million tons of steel. The industry is dominated by six vertically integrated companies, accounting for 89% of the volume: NLMK, EVRAZ, MMK, Metalloinvest and Mechel. (Table. 1).

The steel industry companies plan to invest up to 4% of annual revenue in digital production technologies over the next five years. It will be impossible for metallurgical companies to become competitive without investment in that field.

The process of automation in the metallurgical industry, together with the analysis of the data, is used to ensure flexibility and profitability of production. Algorithms are used to increase the effectiveness of labor. These algorithms allow to monitor relationships between initial physical properties of raw material and production costs as well as factors that limit the production effectiveness. There is an ongoing integration of disparate

processes, providing an opportunity to reduce heat loss, energy consumption, production time, as well as price optimization.

Table 1. Key performance indexes of leading steel companies in 2018

Key performance index	NLMK	Severstal	MMK	EVRAZ	Metalloinvest	Mechel
Production volume, million T.	17.493	12.039	12.664	13.019	5.1	3.881
Revenue, billions Usd.	12.046	8.58	8.214	8.879	7.187	4.499
Number of employees, thousands. people.	53.3	50	18	68.4	48.5	60
Productivity t. steel/person.	328	241	704	190	105	65
Net profit, billions Usd.	2.238	2.051	1.317	2.47	3.358	0.182
Investment, million Usd.	680	688	860	527	441	79

Source: Company Annual Reports Data, URL: www.nlmk.com; www.South.com; www.mmk.ru; www.evraz.com; www.metalloinvest.com; www.mechel.ru;

Magnitogorsk Iron and Steel Works (MMK) was one of the industry's first to adopt new ways of digital development to ensure long-term competitiveness. On the basis of the introduction of the corporate information system (CIS) business processes were optimized and streamlined. These actions allowed for a total saving of 500 mln. Rub as a result of use of mathematical model for optimization of supply and raw material usage. This effect was derived from improvements to the structure of the coal feed and qualitative characteristics of charred coal. The company plans to introduce 25 new digital projects in 2019.

Another flagship of the metallurgical industry Metalloinvest spent about 3 billion rubles on projects to implement and deploy an integrated management system. This investment allowed to introduce a unified corporate resource management and accountancy system based on SAP S4/HANA program product at the sites of the mining and enrichment segment of Lebedinsky and Mikhailovsky GOK. Thanks to the introduction of that digital platform, more than a hundred production and management systems have been combined, allowing more than 4,000 users to use shared information space.

The largest company of the metallurgical complex Severstal is going to spend 5.7 billion rubles in 2019 in order to improve the business processes through the introduction of digital and IT. A significant part of the projects is aimed at the introduction of end-to-end metal tracking systems. This will be based on machine mark recognition and address accounting of products by reading matrix code or radio-frequency tags.

Almost all metallurgical companies are more or less planning future implementation of projects aimed at digital transformation. The driving forces of digitalization are people and culture, and explicitly human capital, or more particularly, the capital of digitalization that needs to be developed.

In order to achieve strategic goals and strengthen competitiveness in the metallurgical industry, it is necessary to create Production systems (platforms). One example of such a platform is the production system (PS) of “NLMK” Group. The beginning of the creation of that system at NLMK dates back to 2009. Previous period allowed for development of the following production system characteristics: goal, principles and tools of the system, technical model. The production system includes all of the companies of the Group, allowing to control more than a thousand different indicators. The main tools that are

important for increased production efficiency can be identified as follows: checklist, principle of 6C, structured approach to problem solution (A3) and others (table 2).

Table 2. Key Tools of the Metallurgical Manufacturing System

Tool name	Short description	Use goal
Checklist	List of procedures for execution in strict order, highly illustrated	Eliminate the influence of the human factor: timelessness and distortion of information, lack of communication
6C	Six principles of workplace organization: 1-sort; 2- systematize; 3- keep clean; 4- create safe jobs; 5- standardize; 6-improve	Improve transparency and efficiency to ensure increased safety, level of production culture
A3	Solving a complex problem in a structured approach presented on an A3 sheet	Briefly describe the task and the algorithm for solving it
Standard Procedures & Operations (SPO)/ technological process maps (TPM)	Instructions, regulation of specific tasks	To convey in a clear form the effectiveness of the approach to solving problems to performers (stakeholders)

A new stage in “NLMK” Group Production system (PS) development started in 2016. The goal of this stage is to involve the company's staff at all levels in optimizing the process of production. The main tool of this stage are “waves” the point of which are to allocate a formed project team to a certain site for a work period of 9-10 months. During this period, the staff of the site are trained by the team in the following: using the toolkit of the PS; skills, competences and culture of production in the new conditions. After that period the team moves to a new “wave” (site) while the former project is managed by the trained site staff.

It is necessary to identify three "waves" of the development of “NLMK” PS. The first “wave” of deployment of PS was carried out in 2016-2017 at NLMK-Kaluga site. During this period, more than 1,350 initiatives were introduced, which accounted for the savings of 7.9 mln. doll. The second "wave", with 1,700 completed initiatives and net savings of 71 mln. doll. Was carried out at the Lipetsk site in agglomeration and blast-furnace production and in the factories of enrichment and lumping of Stoilensky GOK. The third "wave" started in the middle of 2018 at four leading facilities: steelmaking plant (Lipetsk site), quarry of Stoilensky GOK, charred coal production (Altai-Cox), NLMK-Ural (third processing). Finalization of the wave is planned for 2019 with an expected savings of more than 34 mln. doll.

As a result of the introduction of the "wave" toolkit of the PS all key performance indexes improved in NMLK (table 3).

Table 3. “NLMK” Group key performance index dynamics

Index	Year-over-year				
	2014	2015	2016	2017	2018
Financial performance, Million Usd.:					
Sales	10396	8008	7636	10065	12046
Net profit *	773	967	935	1450	2238
EBITDA	2381	1943	1943	2655	3589
Investments, total	563	595	559	592	680
Including staff training	4.4	3.3	3.9	4.5	6.5
Operational performance, thousand t.:					
Steel production w/o NBH	15921	15866	16438	16850	17285
Steel production w NBH	16108	16060	16641	17076	17493
Total sales of non-NBH metal products	15147	15829	15925	16469	17591
Sales of rolled metal	10223	9743	10211	10759	10762
Sales in home markets	10605	10140	10225	10650	10573
Continuous improvement indexes:					
Number of staff of NLMK group, thousands of people.	60.1	56.7	54	53.2	53.3
Productivity, i.e. steel t./person, Lipetsk site	437	463	482	502	503
LTIFR NLMK Group «Employees»	1.55	1.12	0.82	0.97	0.69
LTIFR NLMK Group «Employees» and «Subcontractors»	1.6	1.15	0.85	1.12	0.77
Polluting emissions, kg./steel t.	20.1	20.1	20.0	19.5	18.9

* - Profit per period belonging to “NLMK” shareholders

With the active development of information technology and communication tools, which can be witnessed in the enhancement and development of cloud technologies, large amounts of data, etc., new approaches to the management of the economic capital are required. An important tool for continuous improvement of employee potential are investments in social development. It is true for continuous improvement of employee qualification in the first place. Natural resource management companies, and metallurgical companies in particular, are characterized by high complexity of production processes that operate under high temperature and speed modes [5]. These companies are interested in skilled professionals of all levels in order to generate the increase in profits and competitiveness of the company. The process of transformation of employee knowledge into real financial benefits is a problematic issue that is very hard to define at scientific and practical levels. Some company leaders and analysts agree that businesses devalue the real value of employees when they try to account it to financial assets as a mean for increase in competitiveness as human capital cannot be properly quantified and measured.

The distribution of investments in social and regional development in Russia's leading metallurgical companies is carried out with the following average: health care - 43%, education - 14%, sports - 12%, culture - 5%, work with young people - 6%.

In order to achieve and maintain competitive advantage, a system of continuous multi-level education must be in place. More attention should be spent on training of labor. While training in training facilities, more hours should be given to factory practice. Following programs should be included into standard labor trainings, because workers are going to work on digital programmable equipment: “Informatics and programming”, “Informational systems and technologies”. In addition, the practice of training workers should include continuous qualification increase in the workplace, mentoring, and professional

competitions. Such training of workers should reduce unfavorable statistics of injuries and accidents, which are common for the industry.

Thus, the increase in investment in staff education in the “NLMK” Group during the period of 2014-2018 led to a decrease in the rate of injuries (LTIFR) within employees: from 1.55 (2014) to 0.69 (2018), for the group's staff and contractors from 1.66 to 0.77 for the same period (table 3).

It should be noted that in 2017, NLMK introduced an innovation laboratory, the task of which is to analyze new technology at the junction of virtual (data) and real (equipment) world and to test them in production conditions for further industrial use. The Group developed a 3D tracking system for employees in the conditions of high risk. The system is able to monitor the movement of employees at work in real time and inform them of the danger.

Metallurgical enterprises annually invest in Health and Safety of their production facilities. In 2018, the volume of investment of "Metalloinvest" company amounted to 1547 million rubles, that were distributed between five main directions of investment in Health and Safety area (table 4).

Table 4. Dynamics of investments in Health and Safety in Metalloinvest

Investment direction	Year-over-year data					2018 in % to 2014
	2014	2015	2016	2017	2018	
Training of staff and support of training systems, mln. rub.	5.1	4.3	4.0	9.7	10.0	196
Improving the quality and means of personal protection, mln. rub.	347.1	442.2	509.2	603.8	666.1	192
Improving working conditions and health and wellness activities, mln. rub.	255.4	244.7	317.0	399.8	365.2	143
Improving the technical level and efficiency of production, mln. rub.	276.6	292.8	338.7	373.0	369.3	134
Increase in fire safety, mln. rub.	114.0	121.6	118.4	112.6	136.3	120
Total	998.2	1105.6	1287.3	1498.9	1546.9	

Source: Metalloinvest's official website. URL: [www. Metalloinvest. com](http://www.Metalloinvest.com)

In general, the amount of investment in the studied period of 2014 to 2018 increased by 1.3- 1.9 times, which led to a reduction in work related injuries.

It should be noted that mineral resource management companies, including metallurgy, are enterprises with life-threatening and health-damaging working conditions. Thus, negligence to health risk factors and their role in various business levels leads to negative social-economic consequences, such as lower life expectancy, lower childbirth rate, increase in injuries, diseases, etc.

Research into the company's human capital preservation and staff health care issues deserves special attention in the company's competitive advantage system. Thus, JSC “MMK” Group has increased their spending for charity and social programs by 11% in 2018 compared to 2017. In general, expenses amounted to 2.5 billion rubles. The company's net profit in 2018 amounted to \$1,317 million and increased by 10.8% compared to previous year.

There is a direct correlation between investments in social development and financial results in metallurgical companies (table 2). The measurement process itself is very important and Russian companies are aware of the fundamental relationship between human capital and the company's financial results that affect competitiveness. Competitive

advantages should maximize the profits of an organization [9]. It should be noted that human capital is not currently reflected in the financial reports of the enterprises. The balance sheet reflects the intellectual capital presented as intangible assets. This distorts data about real market value of the companies [3]. Modern economical science highlights the necessity of evaluation of human capital and the amount of invested resources into its development.

There are currently quite a few approaches and techniques to assess the value of human capital investments. Following methods have been developed within the operational activities of science-intensive industries: an expert method, a method of estimating the cost of human capital based on cost determination, a method of determining the initial and restorative costs of labor, based on the model of E. Flamholz, etc.

It seems appropriate to keep track of the costs of training, vocational training, disease prevention, etc. - in the Account 30 of the Accounting Plan, which will allow to keep a more detailed accounting of human capital expenditures, to further determine the impact of these factors on the financial performance. The existing method of factor analysis of profits is recommended to be supplemented with the above-mentioned factors. This will strengthen control over the company's expenses on conventional operational activities [4].

There are also differing opinions on the application of indicators of efficiency assessment of human capital use: the productivity of labor and its dynamics, turnover of personnel, revenue per worker, the amount of spending on measures to improve working conditions, the cost of training and development of staff, etc. It is necessary to increase attention over quality of training of higher management staff in metallurgical industry. At present, 40% of workers in metallurgical industry have secondary professional or higher engineering education. However, there is a present issue of availability of sufficiently qualified management personnel. Last decade was characterized by the increase of median age from 30 to 45 years. Additionally, some companies do not have management that is prepared for business operation in a competitive market. Taking into account the development of digital economy technologies based on high speed of transmission of large amounts of information, human resource departments of metallurgical enterprises are recommended to be able to calculate and predict the personnel capacity ratio of the specialists with digital knowledge proficiency.

4 Discussion

The results of the study were presented for discussion at scientific and practical seminars and conferences at the Sergo Ordzhonikidze Russian State University for Geological Prospecting in presentations, oral and at-stand reports by authors at Russian and international scientific forums and conferences.

5 Conclusion

An analysis of key indicators of leading enterprises in the most important sector of natural resource management industry – metallurgy - has shown that further development of the metallurgical industry in the digital environment necessitates increased research in such a critical field as the increase of the role of human capital in sustainable development and competitiveness. All of this involves the following program of prioritized actions at the macro and micro level:

- analysis and further development of the theory of human capital, the study of the relationship between human and intellectual capital in the conditions of deployment of digital technologies;

- assessment of the effectiveness of investment in human capital in order to improve its quality and to increase the impact on growth of the competitive-ness of the enterprises;
- comparative analysis of various aspects of the education economy, health care and other factors influencing the development of human capital and increase of its role in innovative economy;
- development of methods and systems for assessing human capital in regard to industry specific features.

Gratitude should be expressed to all research scientists who have devoted their work to the study of the role of human capital in ensuring sustainable development and the competitiveness of enterprises in general and in the field of natural resource management in particular.

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