DOI 10.52260/2304-7216.2025.3(60).15
UDC 331.108
SRSTI 06.81.65

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DEVELOPMENT OF HUMAN CAPITAL IN THE METALLURGICAL COMPLEX: BIBLIOMETRIC ANALYSIS OF THEMATIC PUBLICATIONS

This research presents an interpretation of the materials from bibliometric analysis, created within thematic scientific field "human capital in the metallurgical industry" and obtained by analysis of interrelationships between publications on this topic. The purpose of presented research is to describe and review the publication trends of scientific papers, written within the framework of researching field to the "Human capital in metallurgy" topic, based on the keyword map of analyzed articles, which one was modeled by the method of bibliometric relationships. This study is presented as part of analysis for scientific works of authors, specializing in this field, which are also relevant to modern economic thought. The nature of their researches is considered, as well as the trends, investigated in this thematic area. The bibliometric analysis method was used by VOSviewer program to achieve the goal of this research and describe analysis of its results, it also includes a network analysis of literary relationships. In addition, there were presented some following indirect methods: comparison of statistical indicators, expert assessments, classification and typology. The bibliometric analysis of this work illustrated us very low interest from scientific community to this topic of both developed and developing countries, especially for human capital development researching into metallurgical industry. Article describes the causes of this phenomenon in details, while it is based on specifics of this industry development in various countries from the entire world, over the last 50 years.

Keywords: *human capital, metallurgical industry, bibliometric analysis, relationship map, social issues, labor process, development potential, economic feasibility.*

Кілт сөздер*: адами капитал, металлургия индустриясы, библиометриялық талдау, қатынастар картасы, әлеуметтік проблемалар, еңбек процесі, даму әлеуеті, экономикалық орындылық.*

Ключевые слова*: человеческий капитал, металлургическая индустрия, библиометрический анализ, карта взаимосвязей, социальная проблематика, трудовой процесс, потенциал развития, экономическая целесообразность.*

JEL Classification: J24, J28, J81

Introduction. The mining and metallurgical complex (MMC) still remains to this day as one of the fundamental and priority areas of national economy of the Republic of Kazakhstan. Despite the fact that the country is currently not among the top 15 leaders of the metallurgical industry (in both areas of metallurgy: non-ferrous and ferrous), this sphere of management is important for Kazakhstan [1]. This statement based on four factors:

1. The metallurgical industry, in fact, is one of the foundations of Kazakhstani national economy. It occupies a share of 14.1% in the GDP of the Republic of Kazakhstan, 17.5% of the country's exports are accounted for by the mining industry and its industry enterprises provide jobs for more than 300 thousand people;

2. Kazakhstan stays in ranking of the top 10 countries in terms of reserves of various non-ferrous metals, and besides them, there are enough iron ores in its bowels to produce steel for export. The foreign trade balance reflected the revenue brought to the country in amount of $ 9 billion in 2023 for this industry. Therefore, the deterioration of the MMC development will lead to an immediate decrease in economic growth in the Kazakhstani industry;

3. The investment climate in this industry also confirms its profitability: there was a steady increase in investments to MMC between 2012 and 2019, reaching 1,060 billion tenge by its peak in 2019 (not including investments in coal mining) [2];

4. However, what is most important is the fact that the metallurgical industry accounts for about 21.2% of the volume of Kazakhstan's manufacturing and extractive industries. In the aspect of the manufacturing industry (the result of which is the production of products with higher added value), it still accounts for almost half of the share of the volume of the national manufacturing industry – about 43.5% [3].

It is quite natural that the MMC is one of the most important branches of the country's economy, especially from the point of view of processing metallurgical enterprises: both from the standpoint of purely economic profitability and from a socio-economic position in terms of providing jobs for a significant proportion of residents of Kazakhstan.

However, the main problem of this industry is physical and moral deterioration of fixed assets of mining and metallurgical enterprises, which can be prevented not only by purchasing new equipment and by repairing production facilities of workshops. The most important thing in the production renewal and its processes is the creation of investment sphere and work environment, which going to be conducive to the work of the production team at the stage of severe transformation of mining and metallurgical enterprises within the framework of updating production processes.

The effectiveness in the formation of such an environment, for the first point, depends on the state of human capital in the enterprise and the potential for its improvement for each individual employee within this system, which needs to be directed to the harmonious and dynamic development of the enterprise as a whole. After all, the updated equipment will not function without skilled workers, and even the most advanced management concepts and strategies will not work without an appropriate level of training for engineering and administrative personnel.

Therefore, the development of human capital should primarily be expressed in high-quality industrial training and retraining of workers, and for the administration in obtaining skills in managing production facilities, investment activities and the formation of appropriate competencies to create an effective and motivating work environment to improve production performance.

Nevertheless, has the methodology of improving human capital in metallurgy been sufficiently studied in modern science, or has this area not been fully disclosed? After all, before applying any approaches to improve the Kazakhstani metallurgical segment, it would be worth considering the study of this topic in the context of the world experience in scientific studying human capital for this production sector.

This research is written as a bibliographic part of the first section of the doctoral thesis on the next topic theme: “Improving the quality of human capital in the mining and metallurgical industry: the main directions and mechanisms of implementation”. Its significance lies in determining of its researching level for this topic in the world scientific literature, in order to determine the need to use foreign experience in Kazakhstani domestic realities.

In this context, it would be reasonable to formulate the following question for this research: What is the current state of scrutiny level about the issues of human capital development in the metallurgical industry, based on the analysis of international publications, and what kind of such bibliometric gaps exist for application of foreign experience in Kazakhstan?

The following research hypothesis forms here to answer this question: Modern scientific literature does not fully reflect the relationship between the development of human capital and metallurgical industry’s conditions. This fact creates the need for additional research and adaptation of foreign approaches in the context of this theme for Kazakhstan.

Literature review. If we consider a literary review on the topic of human capital development in metallurgy without a specialized methodology, it will turn out to be extremely modest and would not be informative at all.

The reason for this situation is the difference in understanding the priority of aspects in the interaction of the concept of human capital and the metallurgical industry. The metallurgical industry is a negative environment that undermines one of the foundations of human capital – healthcare for biggest part of Western European countries. On the other hand, for newly industrialized countries, as well as developing ones, this industry is an instrument of social realization and a source of income for unlocking the potential of their economies, especially when they are traditionally rich in minerals and human resources for its implementation in life.

The search for such sources by the keywords “human capital” and “metallurgy” in the Scopus database yields is too small and has a sample of articles: only 51. In each of them, authors consider these processes and their relationship within completely different contexts.

For example, if in the Western scientific literature the issue of human capital development in metallurgical industries is extremely narrowly considering in a relatively small volume of submitted works. For example, they are presented in the aspect of preserving sustainable development with a focus on environmental issues, considering the impact of individual technological changes on aspects of human capital) [4]. Otherwise, in the works of authors of developing countries, due to the more acute social nature of the area under consideration, these issues are raised much more often in environmental aspects [5; 6]. They also show socio-economic aspects of human capital in metallurgy [7; 8].

Main part. When we start our main part of bibliometric analysis, it is possible to deduce: this information is justified by the pie chart, presented below, what is reflecting the territorial ratio of publications on the development of human capital in metallurgy, what based on Scopus database for the 3rd quarter of 2024 (figure 1):

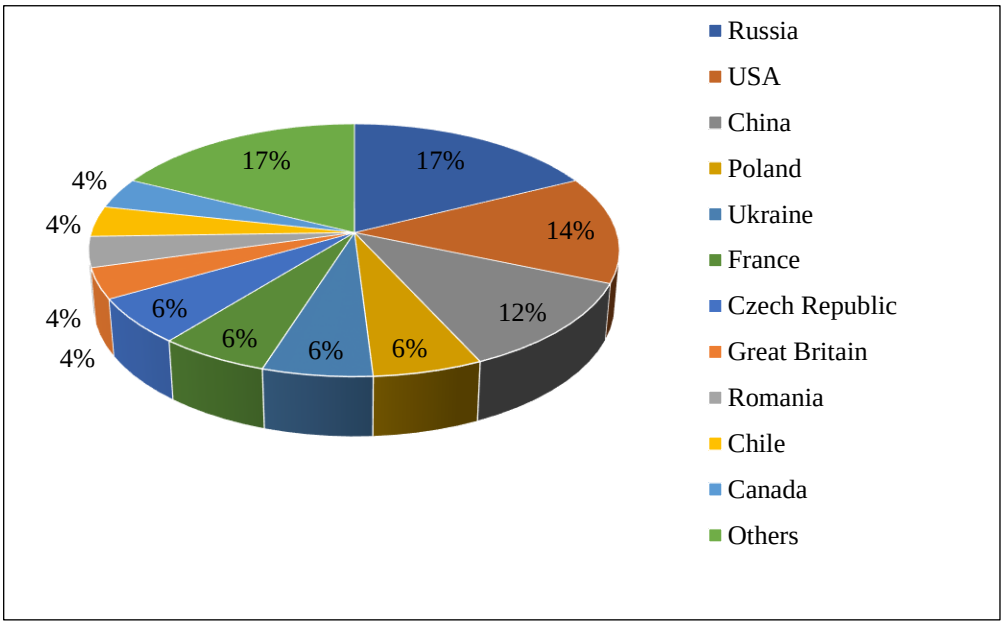

Figure –1. **The territorial ratio of publications on the development of human capital in metallurgy based on Scopus for the 3rd quarter of 2024***

**compiled by the authors according to the sources [4; 5; 6; 7; 8]*

As we can observe on the basement of the information, presented in figure 1, the USA, France, Great Britain and Canada account in the total only 28% from all submitted publications (and then only by the reason that metallurgy sector of these countries has a long history of development and traditionally extensive technological capacities), while the lion's share of these publications is represented by authors from developing countries.

This fact is quite understandable. The development of human capital theory in the West fell on the mid-60s, at a time when Western countries were transferring production capacities to developing countries in order to reduce emissions into the environment and maximize profits for cheap labor in peripheral states.

The popularization of the human capital concept in developing countries took place already at the beginning of the XXI century, and metallurgy was affected by this concept precisely at this time. This turn is confirmed by the dynamic graph of the increment of publication activity of authors on this topic precisely in these years (figure 2):

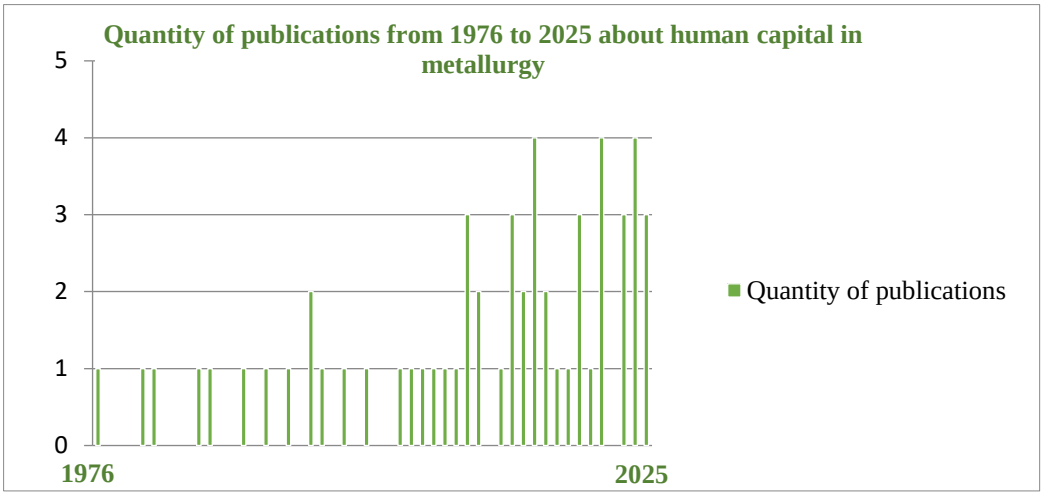

Figure –2. **Activation of publication activity in the researching direction of human capital in metallurgy***

** compiled by the authors according to the sources [4; 5; 6; 7; 8]*

However, despite the intensification of this research area at the beginning of the XXI century (presented in the form of a dynamic diagram in figure 2) it can be argued, that it was popularized only in the middle of the second decade of the XXI century, starting only in 2015. Why did the importance of human capital development for such a priority and important business sector begins to be described so late? Why has so little attention been paid to the issue of human capital in such risky work?

Results. In order to answer these questions, as well as to consider in more depth the development of human capital in metallurgy in the works of modern economic thought, it is necessary to apply the method of bibliometric analysis.

To research two interacting, but at the same time different scientific fields of economics, in the form of a field of “human capital” and a field of “specifics of metallurgical management”, the best method for building any connections is the method of scientific networks. This method should be expressed in the creation of visual maps of the relationships of keywords and subsequent network analysis of these relationships in terms of their interpretation in the real development conditions of this knowledge field under consideration. And the best way to implement this method, in our opinion, is the VOSviewer program [9; 10].

The task of any researcher (in creation of bibliometric maps) is related to obtaining information about the device of the created network, based on processing data from uploads of the keywords in question on the topic, within the framework of an illustrated bibliometric network on the following issues:

1) What are the research directions within the scientific field or the intersection of fields?

2) What is the relationship of these directions with each other and what does it mean?

3) How the problems of the scientific field have developed over time (trends, time contexts, their inherent concepts and changes in their dynamics in different periods) [11]?

Maps of bibliometric relationships of keywords can be built in two stages:

- The first stage is the selection of articles by keywords (“human capital” and “metallurgy”) in a scientific metric database (in this case, it is the Scopus database) and uploading it to Excel format;

- The second stage is map’s creation, based on the processing of this upload in the VOSviewer program using the creation algorithm.

As a result of these operations, we can get a map of relationships, which is presented in three types:

- full cluster map;

- selected cluster map (for one specified cluster);

- temporal (retrospective) map.

In presenting these types of maps of the interrelationships of our keywords on the presented research topic (human capital in metallurgy), as each map is visualized, the essence of the methodology of each type will be explained, as well as demonstrated by the example of the specifics and topics of the research context presented in this paper.

Visualization of cluster maps is presented in form of screenshots, because it is a result of bibiliometric relations modeling within VOSviewer program complex. These figures are not drawn by hand: there is a

need to get a well-processed and verified visual result. It is worth starting with the first type – a cluster map of these concepts, shown below (figure 3):

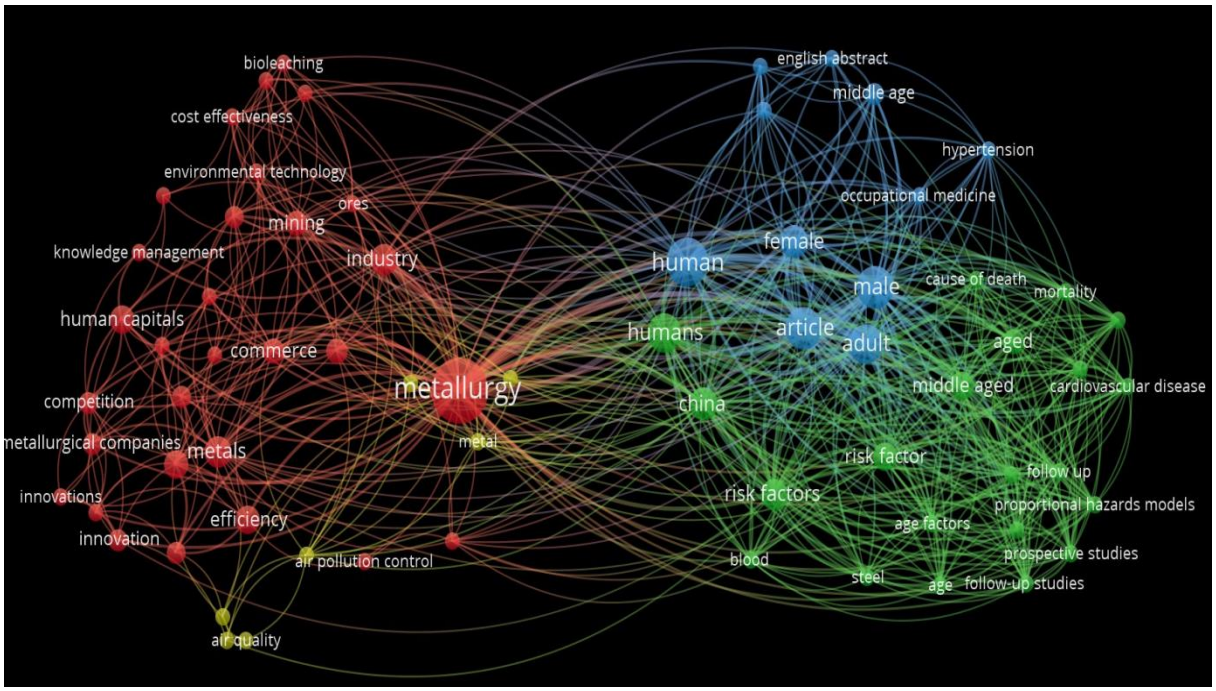

Figure –3. **Screenshot of cluster map for the keywords relationships in direction of research about human capital development in metallurgical industry***

**compiled by the authors in VOSviewer and based on the sources [4; 5; 6; 7; 8]*

The color decisions (for schemes) in the VOSviewer program mean separated thematic connections between keywords and concepts, found in the texts of scientific publications. There are usually two or more different thematic clusters on each map, presented in various color variations. For example, in figure 3, we can identify 4 main clusters, according to the context of the words encountered in the cluster of each color:

1) "Red" cluster contains words like "industry", "innovation", "commerce", "metallurgical companies", "cost effectiveness", "competition", "knowledge management", "mining", "metallurgy". The context of these keywords allows us to call this thematic cluster as the "corporate cluster" of the topic under consideration;

2) "Blue" cluster has words "human", "female", "adult", "middle age", «medicine». The context of this cluster allows us to call it a "human data cluster";

3) "Yellow" cluster includes some words like "environmental pollution", "metal", 'pollution", "air quality", "human health". The context of this cluster allows us to call it as the "cluster of environmental problems";

4) We have different word within "Green" cluster: "risk factor", "blood", "cause of dead", "mortality", "diseases", "hazard model", "follow up". This cluster can be named as the "industrial employment risk cluster".

As we can see, all the presented contexts quite logically harmonize with each other in various socio-economic publications devoted to the problems of the development of the industrial economy. However, in addition to this, the information presented below also inspires some reasons for concern (figure 4):

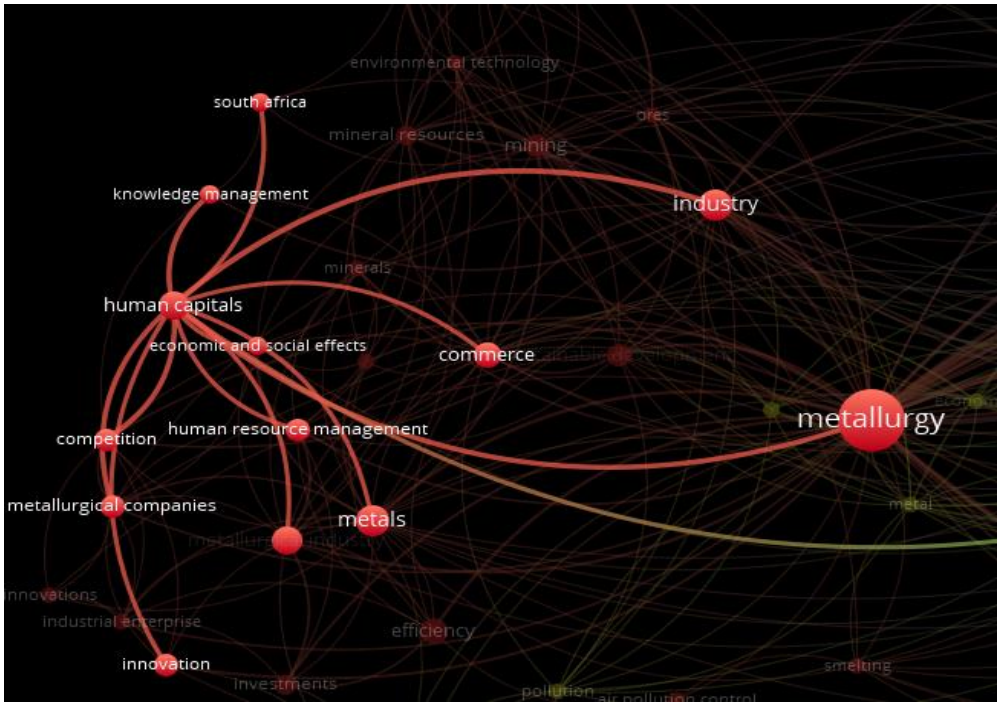

Figure – 4. **Screenshot of internal cluster relationships for the «human capital» and «metallurgy» keywords***

**compiled by the authors in VOSviewer and based on the sources [4; 5; 6; 7; 8]*

Foremost, figure 4 illustrates us the fact, that human capital is really often considered by the authors in a corporate context (since both concepts are highlighted in red for the cluster of the same name).

This is not a good thing, since risk factors and human health are ignored in the totality of elements, which affecting human capital, and these factors just affect the quality of human capital from the standpoint of deterioration (for both existing and potential employees of metallurgical enterprises).

At large, underestimating the associated risks is the main problem in the development of human capital in metallurgy, both from the practical side – for company management, and from the theoretical side – for authors who poorly study this area in principle and the relationship between the block of risks and human capital in particular.

This thesis confirms itself by the temporal view of the map presented above, namely, the map of the interrelationships of these publications in the historical context, shown in Figure 5:

The retrospective (temporal) map in figure 5 demonstrates the trend towards popularization of the study and research of human capital issues in metallurgical enterprises, clearly reflects that this process has been updated in the scientific literature only recently, as described above (let us see confirmation in figure 2).

The thickness of the lines (in VOSviewer program) between keywords and the proximity of the location of keywords on the relationship map from each other just emphasize the strength of this relationship between them, explored in the scientific papers under consideration.

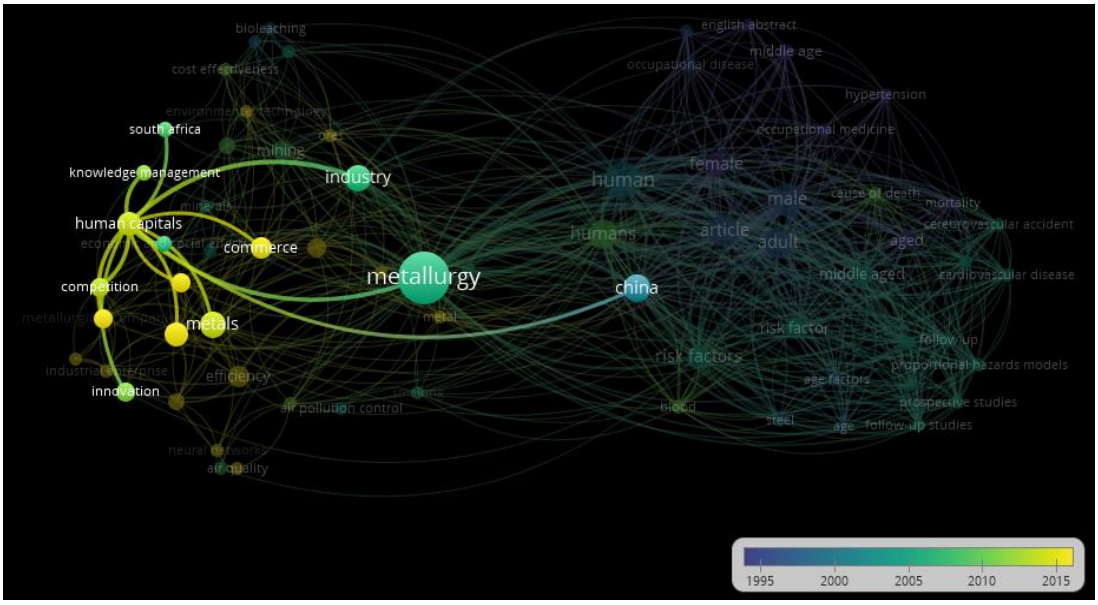

Figure –5. **Screenshot of retrospective map for the keywords relationships in research direction about human capital development in metallurgical industry***

**compiled by the authors in VOSviewer and based on the sources [4; 5; 6; 7; 8]*

In figures 4 and 5, we can clearly see how the concepts of «innovations», “industry”, “commerce” and “metallurgy” are equally removed at most from the phrase “human capital”. It gives an understanding that not only the owners and administration of metallurgical industries do not put human capital at the forefront of the industry, but even economic researchers do not give any chance for interrelationships of these concepts in the proper level of mutual importance.

In that way, the following conclusions can be drawn by summing up the above-described provisions, considered in the main part of the study:

1) The problem of the importance of human capital for metallurgical industry development plays a small and secondary role, among various indirect problems, according to economic scientists;

2) The problem of the mutual influence of human capital factors and the metallurgical industry for employment has become more intensively studied only recently;

3) The development of human capital in the modern scientific literature does not take into account the block of risks at all, and therefore it is difficult to find any practice-oriented methods for reducing them in the metallurgical industry, which would motivate the labor personnel of this industry to maintain their employment in it or attract additional (potential) labor resources to the industry for its management;

4) In opinion of the scientific community, human capital, only remotely affects commercial results, efficiency, industry, is a term, what is very remote from the innovation process.

Although, if we compare the results of this study on most of the materials considered here, on this topic, we can see, that the topics raised in them and their significance are poorly aligned with the practical problems of human capital in the metallurgical industry, which are described by the authors-economists dealing with the profile of social problems in manufacturing industries (these scientists do not publish materials in indexed databases, because they represent them mostly in industry collections or reports, the format of which is not suitable for journal publications due to their thematic and technical limitations), such as Professor I.A. Budanov with his publication “Social Priorities of Metallurgy”.

But, problems of human capital in metallurgy, which were raised in this paper, were taken directly from the practice of industry development within the national economy:

1) The problem 1 is the urgent need to minimize the risks and threats to the health of workers related to industrial safety;

2) The problems of motivational actions for a new generation of potential employees, in terms of attracting them as new workers and administrative staff to manage an enterprise in modern conditions;

3) The problem with salary level determining, that fairly corresponds to the experience, length of service, as well as the indicators of labor efficiency of employees;

4) The problem of social guarantees providing that can have an effective impact on retaining existing employees and attracting new ones;

5) The adoption of external measures to improve the human capital of residents of single-industry towns, where metallurgical production is mainly concentrated in the territories of the CIS countries [12].

All these problems of human capital development are presented as primary for the metallurgical industry and above-described representation for them in the context of reviewing the publications of the Scopus database is very surprising and does not quite correspond to reality in practical terms.

Summarizing all results above, it can be concluded that more than 65% of publications (about the development of human capital in metallurgy) were written in developing countries, since it is important only for them to preserve human resources to work at enterprises in the structure of their national economies.

Companies and the scientific community of developed countries, which move their manufacturing facilities to developing economies, are not interested in this topic. In addition, the biggest part of researches about human capital in metallurgy has intensified only over the past 10 years. This means that t human capital of the metallurgical sector has not received serious consideration from the scientific and expert community: neither during the remaining 40 years in the 20th century (since the creation of the theory of "human capital"), nor during the first 15 years in the 21st century. This factor explains many of serious human capital problems that have accumulated in metallurgy today:

- The lack of a globally accepted standardization for labor processes in metallurgy, lack of united standards and requirements for labor relations regulation in the industry, which could be developed by the scientific and expert community;
- The high level of injuries and deaths for manufacturing personnel of metallurgical enterprises, which is observed against the background of increasing steel production rates in the global economy. No socio-economic solutions have been found for that problem;
- The indifferent attitude of employers and the expert community to the urgent problems from human capital's quality in metallurgical industry. These problems are expressed in the dissatisfaction of employees with wages' amount; the level of social guarantees; deteriorating working conditions with increasing production plans for products manufacturing that negatively affect the health of employees;
- The consequence of this dissatisfaction is the deprivation of qualified personnel in the industry and disruption of labor continuity among manufacturing personnel. These aspects either force companies to spend enormous financial resources for automation of production, or to close metallurgical enterprises due to their absence.

Conclusion. Summing up the above, it is necessary to highlight the main conclusions, concerning the aspect of literary consideration of the issue of human capital development in the metallurgical sector.

Firstly, our hypothesis was approved. The bibliometric analysis revealed that the number of publications with keywords as "human capital" and "metallurgy" in the Scopus database is extremely limited (51 articles) and their content is fragmentary. Greater part of the works is devoted to environmental aspects of metallurgy or narrow issues of corporate governance, while the issue of human capital development is considered in secondary order. The lack of systematic research and practice-oriented methods confirms the correctness of formed hypothesis about the lack of study for this topic.

Secondly, the subject of this area is extremely poorly studied in the Western scientific literature, since Western countries did not need it and it is unlikely that most of these states (with the possible exception of the United States) would want to reindustrialize and localize back metallurgical production facilities in their territories. As before, especially in the context of the "green agenda", these states will continue to develop metallurgical production facilities in developing countries, trying to protect their environment, and completely ignoring the development of human capital of the population of foreign citizens. The experience of studying human capital in metallurgy has only been gaining power since the second half of the last decade in developing countries.

For this reason, Kazakhstan will not have previously known and qualitatively verified methodologies for correcting the current situation with human capital in its metallurgical industry. Domestic economic scientific thought will have to focus either on the experience of neighboring countries in the CIS, or to develop its own successful approaches.

At the third point, bibliometric analysis of this work has shown that the topic of "human capital in metallurgy" is poorly represented not only in developed countries, but also in developing countries. Such a small number of publications can give a suggestion, that this topic is very poorly covered in scientific

papers, and there is no need to talk about detailed consideration at all. There are only several publications among the works, indexed in the Scopus database from such leading metallurgical powers of the world as China, India and Russia. There was none of such publications for theme about Kazakhstani metallurgical industry.

For the fourth point, despite such conditions, bibliometric analysis has shown that presented publications have semantic interrelations, affecting the most priority substantive aspects of this topic. This thesis is confirmed by presence of thematic clusters in the main part of the research. The presence of such clustering and the interrelationships of each cluster with others, indicates the proper level of perception about human capital in metallurgy as a comprehensive concept.

Prospects and significance of such a bibliometric analysis opens up in further research on the subject of human capital in metallurgy. It would be shown in the following aspects:

1) This analysis gives for researchers a real idea about the level of knowledge and consideration for the topic of human capital in the metallurgical industry;

2) It identifies trends and specific clusters, focusing the researcher's attention on 4 main areas about the problem of this aspect (shown in clusters' names);

3) It reflects all possible aspects of these clusters, allowing for researchers to understand which of them have been researched at least once, and which have not been considered in general;

4) The temporal (retrospective map) gives a clear idea about the trends of researches in human capital for the metallurgical industry of the modern period (todays). Based on its data, it can be concluded that the latest research on this topic is provided in the context of knowledge economy's influence and the innovation process to the results and commercialization of metallurgical activities.

For example, this bibliometric analysis helped us to determine the context of modern research for this theme, as well as to identify aspects that had not previously been touched by other authors.

Obtaining the problems of the previous paragraph, the economic block of Kazakhstan needs to maintain control over the processes of developing the human capital within the metallurgical industry at the main strategic facilities of this type of activity, since these enterprises are the flagships of changing approaches in the management of this industry, also including its workforce.

Large metallurgical corporations around the world (both in developed and developing countries) do not consider the development of human capital as a priority of their business processes, mercilessly reducing the number of production and administrative personnel and using this policy as a cost optimization tool.

It is not profitable to describe the problems of human capital for science, whose research on this topic in the West is funded by the same metallurgical companies, as for developed countries and for countries where developed countries transfer their production powers. Money saving on human labor and on accompanying social support is one of the main foundations for optimizing the costs of modern metallurgical industry.

However, today's practice shows, in the knowledge economy, human is main engine of innovation, and therefore of economic progress. This applies to absolutely all types of technological industries, including metallurgy. Therefore, the usage of comprador approaches to the management of human capital of enterprises, what is acceptable for this sphere at this stage of industrial development, will become a negative rather than a positive factor in optimizing the costs of metallurgical enterprises soon.

The scientific environment and manufacturing corporations should prepared for these changes and they should start their preparing right now, so as not to lose such a fundamental industry in the national economy. Which one (moreover, in Kazakhstan) is the main industry area with deep processing of raw materials into a final product, which allows not only to sell raw materials to the foreign market as typical "resource appendage country", but independently process and produce it into a commodity with high added value.

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МЕТАЛЛУРГИЯ КЕШЕНІНДЕГІ АДАМИ КАПИТАЛДЫ ДАМЫТУ: ТАҚЫРЫПТЫҚ БАСЫЛЫМДАРДЫ БИБЛИОМЕТРИЯЛЫҚ ТАЛДАУ

Аңдатпа

Мақалада осы тақырып бойынша жарияланымдар арасындағы байланыстарды талдау нәтижесінде алынған «Металлургия өнеркәсібіндегі адам капиталы» тақырыптық ғылыми бағыты бойынша жүргізілген библиометриялық талдау материалдарының интерпретациясы берілген. Ұсынылған зерттеудің мақсаты библиометриялық байланыстар әдісімен модельденген талданатын мақалалардың түйінді сөздерінің картасына сүйене отырып, «Металлургиядағы адами капитал» тақырыбына зерттеу саласында жазылған ғылыми еңбектердің жариялану тенденцияларын сипаттау және зерттеу болып табылады. Бұл зерттеу осы салаға маманданған авторлардың қазіргі экономикалық ойға қатысты еңбектерін талдау аясында жүргізілді. Олардың зерттеу сипаты, сондай-ақ осы тақырыптық саладағы зерттелген тенденциялар қарастырылады. Зерттеудің қойылған мақсатына жету және оның нәтижелерін талдауды сипаттау үшін VOSviewer бағдарламасында библиометриялық талдау әдісі, оның ішінде әдеби байланыстарды желілік талдау қолданылды. Бұдан басқа жанама әдістер ретінде келесілер ұсынылды: статистикалық көрсеткіштерді салыстыру, сараптамалық бағалау, жіктеу және типология. Бұл жұмыстың библиометриялық талдауы дамыған және дамушы елдердегі ғылыми қоғамдастықтың металлургия өнеркәсібіндегі адам капиталының дамуын зерттеуге өте төмен қызығушылық танытты. Мақалада соңғы 50 жылдағы әлемнің әртүрлі елдеріндегі экономикалық қызметтің осы саласының даму ерекшеліктеріне сүйене отырып, бұл құбылыстың себептері егжей-тегжейлі сипатталған.

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РАЗВИТИЕ ЧЕЛОВЕЧЕСКОГО КАПИТАЛА В МЕТАЛЛУРГИЧЕСКОМ КОМПЛЕКСЕ: БИБЛИОМЕТРИЧЕСКИЙ АНАЛИЗ ТЕМАТИЧЕСКИХ ПУБЛИКАЦИЙ

Аннотация

В статье представлена интерпретация материалов проведенного библиометрического анализа по тематическому научному направлению «человеческий капитал в металлургической отрасли», полученная посредством анализа взаимосвязей публикаций по данной тематике. Цель представленного исследования заключается в описании и рассмотрении публикационных трендов научных трудов, написанных в рамках исследовательского поля по теме «Человеческий капитал в металлургии», на основании карты ключевых слов анализируемых статей, смоделированной методом библиометрических взаимосвязей. Данное исследование проводилось в рамках анализа трудов специализирующихся на данном направлении авторов, актуальных для современной экономической мысли. Рассматривается характер их исследований, а также изучаемых трендов данного тематического направления. Для реализации поставленной цели исследования и описания анализа его результатов, использовался метод библиометрического анализа в программе VOSviewer, включающий в себя сетевой анализ литературных взаимосвязей. Помимо него, в качестве косвенных методов были представлены следующие: сравнение статистических показателей, экспертные оценки, классификация и типология. Библиометрический анализ данной работы проиллюстрировал весьма низкий интерес научного сообщества как развитых, так и развивающихся стран к изучению развития человеческого капитала в металлургической отрасли. В статье были подробно описаны причины данного явления, исходя из специфики развития данной отрасли хозяйствования в различных странах мира, за период последних 50 лет.