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ASSESSMENT OF RATIONALITY OF MINING INDUSTRY LOGISTIC SYSTEMS BY POINT METHOD

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Abstract

The article formulates a topical specific problem of the formation and functioning of rational integrated logistics systems of the mining industry in the Far East of the Russian Federation, criteria for the rationality of the functioning of any integrated logistics systems of the mining industry, corresponding to the interests of various entities (entrepreneurs-sellers; consumers; the population of the territory where the company is a manufacturer; the state; society of the region or the country as a whole). The following principles intended for the selection of criteria for the integral assessment of the level of social rationality of integrated logistics systems of the mining industry are presented: ensuring the completeness of the assessment; impossibility of forming a universal list; the sectoral focus of the list of criteria; taking into account all possible criteria; a collection of the most complete information; reliance on common sense; optional completeness of information on insignificant criteria; compilation of an exhaustive list of criteria for each attribute. To determine the integral assessment of the social rationality of the integrated logistics systems of the mining industry, a method of scoring is proposed. A diagram has been developed that illustrates the procedure for assigning the number of points to integrated logistics systems of the mining industry, which differ from each other in the options for the spatial location of associated industries, for each criterion of this feature. The stages of the recommended methodology for the integral assessment of integrated logistics systems of the mining industry are formulated.

1. Introduction

Despite the long-standing interest in the problems of increasing the role of the Far East of the Russian Federation in the system of international economic relations in North-East Asia (NEA) and the Asia-Pacific region (APR) in general, and on the relative growth of domestic publications touching on the efficiency of functioning and the development of individual economic sectors of this marginal Russian region in the international aspect, nevertheless, the results of the analysis of these problems are not of a theoretical, applied recommendatory and comprehensive nature about the formation of integrated logistics systems (LS) within the NEA (as the most promising sub-region of the APR) of the specified Far Eastern industries, including the mining industry.

The economy of the Far East of the Russian Federation as a problem region of the resource type (Arkhipov, 2017; Arkhipova & Vasyanovich, 2019; Bandman & Malov, 2020; Kryukov & Kradenykh, 2020; Natsionalnaya…, 2020; Volkov, 2019; Vologin & Lazarev, 2016) not only implements industrial relations and exchange goods between separate territories but also acts as a factor organizing a certain segment of the integrated world economic space and ensuring the further implementation of the international geographical division of labour. And the LS of the mining industry and other economic sectors of the Far East of the Russian Federation, in turn, are the leading factor in its international economic integration, primarily with the countries of NEA. In this regard, the subject matter of the content proposed to the reader of this article can be characterized as very relevant.

2. Problem Statement

Within the meaning of the content presented in the works (Arkhipova, 2018; Arkhipova & Bardal, 2020; Lomakina, 2020; Rasskazov & Kryukov, 2018; Sklyarova & Arkhipova, 2020) and in terms of improving the efficiency of the functioning and development of the mining complex of the Far East of the Russian Federation (FEFD) and the country as the whole, the most urgent is not a very general problem of the rational use of natural resources (mineral raw materials), but a more specific problem of the formation and functioning of rational integrated logistics systems of the mining industry (ILSGP) in this marginal Russian region, research of ways of a partial solution to which this article is offered to the reader.

3. Research Questions

The levels of the rationality of the functioning of any ILSGP can be accessed from the points of view of various subjects:

1) rational for an economic entity (firm, company) within the framework of meeting the needs of the market. The criteria for such rationality are the maximum profit, sales volume, market share, profit or sales growth, improvement of product quality, reduction of production costs, etc. (because it is a recognized indicator of the social prestige of the seller, reflecting the number of resources that are useful for society, the company processes);

2) rationale for the consumer of goods or services, the criterion for which is the minimum price or the best quality of the goods (services) purchased by him;

3) rationale for the population of the territory where the company operates; rationality criteria – the maximum of created jobs, the largest share of tax payments to the budget to maintain the life support of the territory (social sphere), minimal harm to the environment;

4) rationale for the state (federal centre and subjects of the federation); rationality criteria – full compliance with legislation (environmental, nature management, tax, etc.), minimum state support, the maximum contribution to the state budget, to the development of the national economy and social sphere, the highest level of job creation, meeting state needs and others;

5) rational for society (rational at the same time for economic entities, consumers, the population of territories and the state). The integral criterion of such rationality of the ILSGP is some compromise levels of the first four criteria.

At the same time, both firms (through the organization of these systems and the management of their work) and bodies of all branches of government (through state regulation of the processes of functioning of these systems) can directly influence the level of social rationality of the ILSGP. Whereas consumers can influence such rationality of ILSGP only indirectly (through the formation of market demand).

4. Purpose of the Study

To determine what is the generalized (integral) level of social rationality of the ILSGP for all the signs of various classifications, it is necessary not only to select the criteria and evaluate the levels of their values within each feature but also to combine them in the integral indicator. This is a rather difficult task, since, taking into account the limitations and other conditions for obtaining a generalized (integral) assessment within the boundaries of different signs, a different number of criteria for a generalized (integral) assessment of the rationality of ILSGP can be applied.

5. Research Methods

An important stage of the integral assessment of ILSGP is the choice of criteria that determine the level of social rationality of these LS for each evaluative feature included in all the above (at the first stage of the procedure for the integral assessment of the rationality of ILSGP) corresponding classifications of the second type.

Here it is necessary to take into account that the range of parameters of such a choice is limited by the generally accepted system of **principles (rules)** (Lyakishev, 2000; Mossakovskiy, 2004; Trubetskoy & Kaplunov, 2016):

- *ensuring the completeness of the assessment*. The set of criteria for social rationality of the ILSGP should provide sufficient, from the point of view of the statement of the research task, completeness of the assessment;
- the *impossibility of forming a universal (industry-wide) list*. As well as evaluative qualifications, the criteria used in the integral assessment of any of the sets of ILSGP may differ depending on its operating conditions and industry affiliation. Therefore, it is impossible to compile exhaustive lists of universal criteria for all industrial sectors of the economy;

- the *sectoral focus of the list of criteria*. It is necessary to form a list of criteria that have at least some relations to LS in a certain field (for example, to ILSGP);

- *consideration of all possible criteria*. It is better to take into account some insignificant criteria that can be excluded from the list during the selection process than to miss at least one of those that may turn out to be decisive in the assessment process;

- a *collection of the most complete information*. Great importance should be attached to the collection of information necessary for the assessment of ILSGP by the criteria for some specific classification criterion;

- *reliance on common sense*. Only the common sense of a researcher or specialist will help to decide which of the criteria are the most essential and what should be the accuracy of the data required to make such a decision;

- *optional completeness of information on non-essential criteria*. It makes no sense to spend resources to improve the quality of information related to one or another criterion that is not essential for this classification criterion for ILSGP;

- *drawing up an exhaustive list of criteria for each attribute*. This is the basis for a formal integral assessment and the simplest methods of generalized assessment of the level of rationality of ILSGP according to some separate qualification (evaluative) criterion. The obligatory fulfilment of such a condition guarantees that not a single method will be forgotten, even if difficulties arise in obtaining an initial (indicative) generalized (integral) estimate.

At this stage, first of all, it is necessary to determine the possibilities of using some of the most important qualitative criteria, which are more often than others taken into account in the integral assessment of the rationality of LS in various sectors of the economy.

Although many properties (criteria) can be quantified, there are still difficulties associated with combining them into a generalized indicator, since different properties are expressed in different units of dimension. In such a situation, you can use the well-known method of cost bridge or point estimates. It is known that in the case of an assessment by points, the dimension of some property (criterion) can be characterized by a certain number of points, for example, from 4 (maximum level) to 0 (completely absent), that is, by a 5-point scale.

The method of the scale of points makes it possible to uniformly designate the dimensions of the heterogeneous properties (criteria) of some economic systems, which is important for obtaining an approximate generalized (integral) assessment of their social rationality. It should be noted that, on the one hand, for important properties (criteria) of such systems, a numerical expression equal to 0 (zero) is practically unacceptable for use. On the other hand, the complete actualization of less important properties (criteria) of the same kind is not a very obligatory event or phenomenon.

6. Findings

The use of the method of the scale of points can be illustrated (Leontiev et al., 2020; Leontiev & Barchukov, 2021), for example, in the process of determining the generalized values of the levels of social rationality of the second-order ILSGP (LS of the mining industry plus the LS of the metallurgical industry) and ILSGP of the third-order (LS of the mining industry LS of the metallurgical industry LS of

the machine-building industry), when these LS can be compared in terms of the value and usefulness of these LS for the state, various social and social formations and society as a whole. That is, to be compared concerning the criteria belonging to the evaluative classification characteristics presented here (Table 1) below:

a) ILSGP (LS of the mining industry plus LS of the metallurgical industry) for the location of related industries of the mining and metallurgical industries;

b) ILSGP (LS of the mining industry plus LS of the metallurgical industry) for the location of related industries of the mining and manufacturing (metallurgical and machine-building) industries.

For example, someone of the many classified according to the location of the associated production facilities of the second-order ILSGP (LS of the mining industry plus LS of the metallurgical industry), belonging to the category (class, type) of foreign LS of the metallurgical industry, can (like other LS of this feature) assessed both by the criterion of nature use, and by the criterion of costs for state control over the fulfilment of relevant tax obligations, and by the degree of political and economic consequences from violation of the requirements of international treaties, etc. And this can occur about each of the three categories (classes, types) formulated above of this attribute (table 1).

Table 1. Determination of the generalized assessment of the rationality of ILSGP of the second-order according to the criteria belonging to the attribute «by the location of related industries» (point method)

Criteria	ILSGP-1	ILSGP-2	ILSGP-3
a) the maximum contribution of the territory to the federal budget	3	2	1
b) the largest share of taxes paid to the territorial and local budgets	3	2	1
c) a minimum of state support	1	2	3
d) the degree of satisfaction of state needs	3	2	1
e) minimal harm to the environment	1	2	3
f) availability of goods for business	3	2	1
g) contribution to the economy of the region	3	2	1
h) job creation	3	2	1
Generalized assessment:			
absolute (total)	20	16	12
arithmetic mean	2,5	2,0	1,5

Notation. ILSGP-1 – regional complex; ILSGP-2 – Russian metallurgical; ILSGP-3 – foreign metallurgical.

At the same time, the level of rationality according to one criterion may differ from the level of rationality according to another criterion within the same category (class, type). And the level of rationality according to some specific criterion within one category (class, type) can differ from the level of rationality according to the same criterion, but concerning LS of a different category (class, type).

Further, depending on the options for the location of mining and, for example, metallurgical industries, the Far Eastern (Russian) ILSGP of the second-order (LS of the mining industry plus LS of the metallurgical industry) should be classified in the order of their (variants) of a gradual transition from

complete regional isolation (regional autarchy) to functioning within the autarchy of the national economy and then to full openness to the economic systems of other countries, that is, as follows (see table 1):

1) regional complex, in which production for the extraction of mineral raw materials (for example, iron ore concentrate) and production of the processing industry for this raw material (for example, ferrous metallurgy) are strictly within a single region (federal district) of the country (for example, Far Eastern Federal District);

2) Russian metallurgical, in which production for the extraction of mineral raw materials (for example, iron ore concentrate) is located exclusively within a particular region (federal district) of the country (for example, the Far Eastern Federal District), and the production of an industry processing this raw material (for example, ferrous metallurgy) are located in other regions (federal districts) of the country;

3) foreign metallurgical, in which production for the extraction of mineral raw materials (for example, iron ore concentrate) is located exclusively within a particular region (federal district) of the country (in particular, the Far Eastern Federal District), and the production of the industry processing this raw material (for example, ferrous metallurgy) are in other countries.

The assignment of the number of points to ILSGP of the second-order (LS of the mining industry plus LS of the metallurgical industry), differing from each other by the options for the spatial location of associated industries, for each criterion of this feature was carried out here according to a well-known trivial scheme (see table 1).

Here (see table 1), depending on the decrease (from 3 to 1) in the number of placements in a particular region (federal district) of the country (for example, the Far Eastern Federal District) of related industries (regional complex ILSGP, Russian metallurgical ILSGP, foreign metallurgical ILSGP), respectively, decreased (from 3 to 1) point marks according to the criteria «a», «b», «d», «f», «g» and «z». Since the collected taxes decreased, the possibility of meeting state needs, the availability of mining products for entrepreneurs (business representatives), the contribution of the ILSGP to the region's economy and the number of jobs. At the same time, the total (absolute) and arithmetic mean generalized (integral) assessments of social rationality of the second-order ILSGP considered here (in table 1) (LSGP plus LSPM) decreased.

By the obtained values of the generalized assessments (see table 1), the most rational for society should be recognized as the regional complex ILSGP of the second-order (LS of the mining industry plus LS of the metallurgical industry), which received the maximum number of points (on a three-point scale, since the absence of any either criterion is not fixed in this process).

7. Conclusion

For the state, population and society as a whole (as subjects of LS evaluation), only the quality level of a product purchased by someone cannot reflect the generalized rationality (value, usefulness) of the functioning of a certain ILSGP, since for them such rationality is primarily associated with other estimates: what are the costs of the functioning of these LS associated with environmental management, state support for production, and what is its contribution to the socio-economic development of the region

and the Russian Federation as a whole (tax and customs, revenues to budgets of all levels, the number of jobs, etc.). ILSGP, which does not meet the interests of at least one group of subjects of assessment, in principle, is irrational for society, and ILSGP, which satisfies the interests of the entire set of groups of this kind, is considered socially rational.

Depending on the setting of the goal or task of the study, the procedure for determining the integrated assessment of ILSGP can be carried out by applying the method of assigning points for three different options:

a) an assessment of the irrespective level of social rationality of the ILSGP, either active, or already implemented in some past period, or planned for functioning in the coming period;

b) assessing the levels of social rationality of a real or developed and some «ideal» ILSGP with predetermined desired parameters (characteristics, requirements), and then comparing these estimates to determine the conformity of the real or developed ILSGP with the reference image characteristics of the ideal ILSGP;

c) determination of assessments of the levels of social rationality of several real and (or) developed (existing, implemented, planned for implementation) ILSGP and the subsequent selection of the optimal one.

The methodology for the integral (generalized) assessment of ILSGP should include the following stages:

1) statement of the research problem;

2) selection of evaluative features adequate to the studied ILSGP;

3) selection of significant criteria for assessing the levels of the rationality of ILSGP for each attribute;

4) determination of assessments of the levels of the rationality of ILSGP for each selected criterion within each feature;

5) determination of a generalized criterion assessment of ILSGP for each attribute;

6) determination of the integral assessment for each investigated ILSGP;

7) either the interpretation of the results (conclusions) according to the first variant of the study, or comparison of the results of the assessment of the ILSGP according to the second variant of the study, or the choice of the optimal ILSGP according to the third variant;

8) interpretation of the results (conclusions) for the second and third research options.

References

Arkhipov, G. I. (2017). *Mineralnyye resursy gornorudnoy promyshlennosti Dalnego Vostoka. Strategicheskaya otsenka vozmozhnostey osvoyeniya [Mineral resources of the mining industry of the Far East. Strategic assessment of development opportunities]*. Institut gornogo dela DVO RAN.

Arkhipova, Y. (2018). Integration of production as a way to improve the financial stability of non-ferrous metallurgy enterprises in the Far Eastern region of Russia. *VII International Scientific Conference «Problems of Complex Development of Georesources»*, 56.

Arkhipova, Y. A., & Vasyanovich, Y. A. (2019). Model otsenki investitsionnykh proyektov v gornodobyvayushchey promyshlennosti [Model for evaluating investment projects in the mining

industry]. *Gornyy informatsionno-analiticheskiy byulleten (nauchno-tekhnicheskiy zhurnal)*, *30*, 7-16.

Arkhipova, Y., & Bardal, A. (2020).Transport and economic problems of subsoil use in the Russian Far East. *VIII International Scientific Conference «Problems of Complex Development of Georesource»*, *192*.

Bandman, M. K., & Malov, V. Y. (2020). *Problemnyye regiony resursnogo tipa: programmy, proyekty i transportnyye koridory [Resource-type problem regions: programs, projects and transport corridors]*. IEiOPP SO RAN.

Kryukov, V. & Kradenykh, I. (2020). On the Geological and economic assessment of the lower Amur region (Russia). *VIII International Scientific Conference «Problems of Complex Development of Georesource»*, *192*.

Leontiev, R., & Barchukov, A., & Nemchaninova, M. (2020). Mining logistics systems: classification, identification, innovation. *VIII International Scientific Conference «Problems of Complex Development of Georesource»*, *192*.

Leontiev, R., & Barchukov, A. (2021). Axiomatical information-technology model of innovative logistics. *International Scientific Conference «AMURCON 2020»*, *111*, 105-110.

Lomakina, N. (2020). Complex exploitation of the Far East mineral resources: effects «new model» of the macroregional development. *VIII International Scientific Conference «Problems of Complex Development of Georesource»*, *192*.

Lyakishev, N. P. (2000). *Entsiklopedicheskiy slovar po metallurgii [Encyclopedic Dictionary of Metallurgy]*. Intermet Inzhiniring.

Mossakovskiy, Y. V. (2004). *Ekonomika gornoy promyshlennosti [Mining economics]*. Moskovskiy gosudarstvennyy gornyy universitet.

Natsionalnaya programma sotsialno-ekonomicheskogo razvitiya Dalnego Vostoka na period do 2024 goda i na perspektivu do 2035 goda [National program of social economic development of Far East on period untill 2024 and for perspective up to 2035] (2020). Pravitel'stvo RF.

Rasskazov, I. Y., & Kryukov, V. G. (2018). Gornaya promyshlennost' Khabarovskogo kraya: mineralno-syryevaya baza i perspektivy razvitiya [Mining industry of the Khabarovsk Territory: mineral resource base and development prospects]. *Gornoye delo*, *10*, 5-13. [in Russ.].

Sklyarova, G. F., & Arkhipova, Y. A. (2020). *Mineralno-resursnyy potentsial Dalnevostochnogo regiona (v kolichestvenno-kachestvennykh i stoimostnykh aspektakh po subyektam Dalnevostochnogo federalnogo okruga) [Mineral resource potential of the Far Eastern region (in quantitative and qualitative aspects for the subjects of the Far Eastern Federal District]*. OOO «Amurprint».

Trubetskoy, K. N., & Kaplunov, D. R. (2016). *Gornoye delo: Terminologicheskiy slovar [Mining: Terminological Dictionary]*. Gornaya kniga.

Volkov, A. V. (2019). Osnovnyye tendentsii razvitiya mineralno-syryevogo kompleksa v zone Baykalo-Amurskoy magistrali (Severnoye Zabaykalye) [The main trends in the development of the mineral resource complex in the zone of the Baikal-Amur Mainline (Northern Transbaikalia)]. *Zoloto i tekhnologii*, *4*(46), 72-88.

Vologin, V. G., & Lazarev A. V. (2016). Sostoyaniye i perspektivy razvitiya mineralno-syryevogo kompleksa Dalnevostochnogo federal'nogo okruga [The state and prospects for the development of the mineral resource complex of the Far Eastern Federal District]. *Razvedka i okhrana nedr*, *9*, 44-50.