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PRACTICAL APPLICATION OF INDICATORS OF THE ECONOMIC EVALUATION OF MINERAL RESERVES IN BUSINESS OPERATIONS OF THE MINERAL SECTORCOMPANIES

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Abstract: *The complexity of the business conditions of the mineral sector companies requires the application of various data and information dominantly related to geological, mining, technological and economic aspects of operations. The special complexity is reflected in the interrelation between the mentioned aspects, which appears in the geological-economic analysis of the conditions and method of utilization of mineral reserves from the deposit and the perception of the profitability of such work. A significant part of the analyzed factors and indicators of the economic evaluation of the deposits by the analytical basis is related to the variability of the qualitative and quantitative characteristics of the mineral reserves, which has significant consequences on the balance of reserves and the degree of economic viability of their valorization. The complete coverage of relevant factor and indicator information is carried out through the appropriate method of geological and economic analysis, the final expression of which is the economic evaluation of mineral reserves. These data and information are particularly relevant for making appropriate business decisions in the operations of the mineral sector companies.*

Keywords: *economic evaluation, mineral reserves, mineral deposit, mineral sector.*

1. INTRODUCTION

The work and functioning of the mineral sector companies in modern business conditions are partly related to the standard influencing factors of production, as well as to enterprises in other economic activities, and partly to specific factors related to mineral raw materials and the specificity of the functioning of the mineral economy. Under the influence of the process of globalization, informatics and digitization, a more complete analysis of the factors of production, apart from natural resources, labor and capital, according to the classical economic approach, as a condition for the competitiveness of enterprises in modern business conditions, enables the separation of all separate factors: (a) information and (b) necessary knowledge. Having said that, there is a particular specific factual effect of various information in the process of geological exploration and geological-economic definition of deposits of mineral raw materials, as basic economic facilities, is particularly specific (Tošović, 2003, 2017a). The subject matter is especially related to the qualitative and quantitative characteristics of the metallic, non-metallic and energy mineral raw materials, which are explored as a subject of future market valuation (Tošović, 2016).

In relation to the performance of enterprises of other industries, in the mineral sector, success is directly linked to mineral reserves and their qualitative-quantitative definition, which

ultimately results in economic definition through a geological-economic evaluation. Defining the quality of the mineral resource is important not only in terms of the content of the basic useful components (eg copper), but also the accompanying useful components (eg gold, selenium, telur etc.), which can have very significant economic effects in market valorization, but also harmful and undesirable components (eg sulfur, arsenic, mercury, etc.), which hinder or completely prevent the use of mineral raw materials (Tošović, 2011). Defining the quantity of mineral resources and/or mineral reserves, except for encompassing the quantities involved, requires the separation of geological reserves as total explored reserves, then the balance, ie economically profitable reserves, as well as the exploitation ones, as the total usable reserves from the deposit area.

Adopting appropriate business decisions in mineral enterprises is partly related to the standard set of information in the company, and the second part to a specific set of information related to mineral reserves (Tošović, 2003, 2017a) and the operating economic principles of the mineral economy. Part of the first, and especially the second set of information, is an integral part of the economic evaluation of the deposit, and as such can be successfully applied directly in the company's operations. In modern conditions of business in the mineral sector, the place, role and importance of economic evaluation in the obligatory, consistent and systematic application of the concept of sustainable development and its principles, as well as the management of mineral resources, as a non-renewable and exhaustive part of the country's natural resources is particularly important (Tošović, 2017b). Hence the application of the method of geological and economic evaluation, and its final expression in the form of economic evaluation of deposits, provides a more reliable basis for the preparation, adoption and implementation of appropriate business decisions in mineral enterprises. Based on current expert opinions in the field of economic evaluation of mineral resources, as well as appropriate analytical-synthetic, inductive-deductive and complex scientific and research activities (Tošović 2006; Janković & Milovanović, 1985; Guarnera & Martin 1992; Rudenno, 2012; Rundge, 1998; Wellmer, Dalheimer & Wagner, 2010), this paper provides a preliminary analysis of the functional position of the relevant data obtained from the factors and in particular the indicators of the economic evaluation in the context of the possibility of application in the relevant segments of the operations of the mineral sector companies.

2. Economic evaluation of mineral deposits

Modern evaluation of mineral reserves, in the global mineral economy practice, includes different types of grades, which allow evaluation from different aspects, different degrees of complexity and final expression of the estimation (Tošović, 2017s, Rudenno, 2012). As the most commonly applied, the following types of grades can be listed: Geological assessment, Geological and Economic evaluation, Technical-economic evaluation, Economic evaluation, Technology assessment, Industrial assessment, Admissibility study, Feasibility studies, Mining report, Geoecological assessment etc., A complex and comprehensive geological and economic evaluation has been developed in the domestic conditions of the decades-long development of mineral economy and the functioning of the mineral sector of Serbia, as part of the famous Belgrade School of Economic Geology (Tošović, 2006). This type of integral evaluation represents a specific evaluation, which combines the basic geological sphere of knowledge of mineral deposits with the economic sphere, as a market valuation of the subject mineral resources. In the final result of the integrative linking of different data and information from the first phase of geological exploration, through exploitation, technological preparation and processing, until the final market product is produced in the form of rolled ore, refined concentrate, molten metal or finished mineral product, an economic estimate is obtained as a measure of profit which can be realized from the same.

The geological and economic evaluationof the individual deposit of mineral raw materials practically represents a special type of managerial tool for making the necessary expert and managerial decisions important for the operations of the mineral sector companies. In doing so, they can be singled out separately; (a) analytical data obtained from the factors; and (b) analytical data obtained from the indicators of the geological and economic evaluation of mineral deposits. In the following, illustrative views of individual factors and indicators are given in order to show a wide range of data useful in the operations of the mineral sector enterprises and to successfully explore, exploit, prepare, process and evaluate metallic, non-metallic and energy mineral raw materials in order to show the breadth of their display and content. in Serbia.

3. Analytical data on the factors of economic evaluation in the company's business

The geological and economic evaluation of mineral resources, through a systematic-analytical approach, can be presented as the hierarchical

highest system, consisting of subsystems expressed through concrete factors, which are (Tošović 2006; Janković & Milovanović, 1985): (1) Metalogenetical; (2) Geological; (3) Technical-exploitation; (4) Technological; (5) Market; (6) Regional; (7) Socio-political-economic-strategic; (8) Geoecological and (9) Legislative and legal factors. These factors provide the possibility of a complete analysis of the relevant data relevant for the business of the enterprise, which carries out the valorization of mineral raw materials by the breadth of the range of factorial analysis of the data on the individual mineral deposit. Due to the scope of this, mainly descriptive factor analysis and objective constraints in this paper, the subject of further presentation will be indicators, which, as concrete values, derive from the factors involved.

4. Analytical data on indicators of economic evaluation in the company's business

After the first step of the geological-economic analytical activity, through which the mentioned factors of the geological-economic evaluationare processed, the second higher and more explicit analytical step follows. From the basic expert analysis of each of the specified specific factors from the respective groups, the individual indicators of the evaluation are presented as elements that are important for the completeness of the representation of these factor subsystems, and comprise three bases of the set of indicators, namely (Tošović 2006; Janković & Milovanović, 1985): (1) Set of natural; (2) Set of value and (3) Set of synthetic indicators. Valuable and synthetic indicators are particularly significant in the market, since they, together with the natural ones, are decisive in determining the possibility of viable / profitable use of mineral resources, or an appropriate result of geological exploration of metallic, non-metallic and energy mineral raw materials.

4.1. Set of natural indicators

Natural indicators are expressed in physical, or natural units of measure (eg percentages, meters, tons, years, etc.). Two sub-sets of natural indicators are distinguished: (Tošović 2006; Janković & Milovanović, 1985): (a) a subset of natural indicators in the narrow sense; and (b) a subset of natural indicators in a wider sense. The former are simpler, easier to calculate or measure. The latter are more complex and are often calculated by combining natural indicators in the narrow sense and value indicators, and are significantly more numerous.

Among natural indicators, in the narrower sense, the most important ones are: (1) Geological reserves (ores and useful components); (2) The mean content of the useful component; (3) The mean content of harmful and undesirable components; (4) The middle thickness of the ore body; and (5) The mean thickness of the empty sublayers.

Among natural indicators in the broader sense, the most important ones are: (1) Minimum economic content of the useful component; (2) Minimum excavation content (boundary content); (3) Minimum geological reserves in the deposit and individual ore bodies; (4) Minimum thickness of ore bodies and deposits; (5) Minimum thickness of defective forward and off-balance parts; (6) Optimum and maximum depth of exploitation of the bearing; (7) Coefficient of Mining; (8) Maximum content of harmful and undesirable components; (9) Minimum content of usable complementary components; (10) Losses in exploitation, preparation and primary processing of mineral raw materials; (11) Diluting the useful component in exploitation; (12) Exploitation reserves, or useful components; (13) Capacity of mines, preparation plants and processing plants; (14) Age of exploitation of deposits; (15) The content of useful and harmful components in the concentrate; (16) The content of useful and harmful components in the primary final product; (17) Degree of utilization in the preparation of ore and processing of ore / concentrate; (18) Consumption of ore per 1 tonne of concentrate; (19) Consumption of concentrate for 1 t of primary (final) product; (20) Reimbursement (re-accumulation) of invested funds; (21) The mean and boundary coefficient of discrepancy; and (22) The profitability rate in relation to the mine, the plant for preparation and primary processing.

Among the above indicators of special importance for making appropriate business decisions are the reserves of mineral raw materials, the quality of mineral raw materials, the production capacity and the life of exploitation. It should be borne in mind, in particular, that for different metallic, non-metallic and energy mineral raw materials, the relevant indicators have their specificities and, according to these specifics, the need to display individual indicators of the complete set.

The above can be illustrated on the example of a concrete deposit of brick raw material, which is used for the production of brick products (Tošović, 2018). Among the practical and operational most important natural indicators and their values, the following can be stated: (a) Geological reserves of 254.762 m^3; (b) balance reserves of 248,632 m^3; (v) Exploitation reserves of 241.173 m^3; (g) Mean ore body thickness of 6,2 m; (d) quantity of

tailings 1.740 m^3; (f) Reversal coefficient 0.0072 m^3 / m^3; (e) mineral fertilizer losses of 3% or 7,459 m^3; (f) Annual production capacity 10,000 m^3; and (z) life span of about 24 years. Based on the above mentioned natural indicators, the appropriate natural planning elements for the production of brick raw materials in the business year can be planned, monitored and realized, and the necessary business decisions can be planned and made.

4.2. Set of value indicators

Value indicators are expressed in value or money units, and the most important ones are as follows: (1) Geological survey costs: 1 t of reserves of certain categories and total research costs; (2) Total required and invested investments in research, construction of mines, plant for preparation and plants for primary processing; (3) Specific investments per 1 ton of ore, concentrate and final product; (4) Cost of 1 t ore, concentrate and final product; (5) Market price of ore, concentrate and final product (current and forecast); (6) Accumulation, ie profit per 1 ton of ore, concentrate or final product; (7) Transport costs; and (8) Profitability. Among the above indicators, apart from cost and investment indicators, we can extract the cost price as a particularly practically applicable indicator. It includes a detailed calculation with all the necessary cost elements in various stages of treating mineral raw materials. In relation to the market price, it can enable the planning of the economic effect of production and a more complete definition of the degree of profitability and economy of the subject production of mineral raw materials in the enterprise.

Among the practically and operatively most important value indicators and their individual values, we can mention the example of a specific deposit of brick raw material (Tošović, 2018), the following can be stated: (a) The total required investments for the procurement of equipment for exploitation are 4.200.000 dinars, as the amount of credit indebtedness commercial banks at 5 years with 8% interest; (b) Depreciation costs 700,000 din / year or 70,00 din / m^3 (0,58 EUR / m^3); (v) Cost of investment maintenance 3% on the purchase value of fixed assets 126,000 din / year or 12,60 din / m^3 (0,11 EUR / m^3); (g) Insurance costs 2% on the cost of fixed assets, ie 84,000 din / year or 8.40 din / m^3 (0,07 EUR / m^3); (d) Material costs 1.804.742,50 din / year or 180.47 din / m^3 (1.50 EUR / m3); (f) Costs of third party services 3% of material costs 54,142.27 din / year or 5.41 din / m^3 (0,05 EUR / m^3); (e) The costs of preserving and improving the environment in the amount of 2.5% of material costs, or 45.118,56 din / year or 4.51 din / m^3 (0,04 EUR / m3); (f) Cost of geological exploration 1.150.000 din or 4.77 din / m^3 (0,04 EUR / m3); (z) Labor costs 2.925.000 din / year or 292.50 din / m^3 (2.44 EUR / m^3); (i) Costs for the use of mineral resources 324,700 din / year or 32,47 din / m^3 (0,27 EUR / m3); (j) Small inventory costs 20,000 din / year or 2,00 din / m^3 (0,02 EUR / m^3); (k) Other costs 200,000 din / year or 20,00 din / m^3 (0,17 EUR / m^3); (l) The cost of production of the unit of products is 6.725.903 din / year or 672.59 din / m^3 (5.60 EUR / m^3); (lj) Average selling price 864,95 din / m^3 (7,21 EUR / m^3); (m) Income tax (at a rate of 15%) 28,85 din / m^3 (0,24 EUR / m^3); (n) Average production price 701,44 din / m^3 (5,85 EUR / m^3); (nj) Total revenues 8,649,500 din / yr (72,079.17 EUR / m^3); (o) Total expenditures 7,014,400 din / yr (58,453.33 EUR / m^3); (p) Rate of return 23,31%; and (r) Economy rate 123.31%. On the basis of the above mentioned values, they can plan, monitor and realize the appropriate value or financial planning elements for the production of brick raw materials in the business year and plan and make the necessary business decisions.

4.3. Set of synthetic indicators

Synthetic indicators are the most complex indicators, which are often expressed by the indicator system. They cover higher order indicators, the determination of which includes predefined natural and value indicators, and the most important ones are as follows: (1) Value of deposits and reserves without taking a time factor into consideration; (2) Economic classes of reserves on the basis of potential profit (economic classification of reserves); (3) Bearing value determined by dynamic estimation methods (taking a time factor into account) - indicators obtained by the NPV and IRR budget, and derived indicators; and (4) Cost of 1 t of explored reserves. Among the above indicators, the value of deposits is particularly important in terms of investment and planning, which express the amount of net profit, that is, the net profit, which can be realized in the company's operations, based on the total existing mining reserves. In the domestic practice of the mineral economy in Serbia, for each deposit of mineral raw materials, the determination of the value of the deposit with and without taking the time factor is taken into account, with particularly economically relevant value being determined by the NPV and IRR method, especially in the case of a longer exploitation of the relevant mineral reserves .

Among the practically and most operatively important synthetic indicators and their individual values on the example of a specific deposit of

brick raw material (Tošović, 2018), the following can be stated: (a) The value of the deposit without taking a time factor into account 39,434,197 dinars (328,618.31 EUR); (b) Unit unit value 163,51 din / m^3 (1,36 EUR / m^3); (v) Net present value of deposit, ie NPV (with a discount rate of 10%) 7,926,358 dinars (66,052.98 EUR); and (g) Internal Return Rate, or IRR 12.44%. On the basis of the above mentioned values, the total value or financial effects of the production of brick raw materials in the company's business, which is engaged in its exploration, exploitation and market valuation, can be considered and planned and necessary business decisions can be made.

CONCLUSION

The work and functioning of the mineral sector companies in modern business conditions are partly related to the standard influencing factors of production, as well as to enterprises in other economic activities, and partly to specific factors related to mineral resources and the specific features of the functioning of the mineral economy. In relation to the performance of enterprises of other industries, in the mineral sector, success is directly linked to mineral reserves and their qualitative-quantitative definition, which ultimately results in economic definition through a geological-economic evaluation.

The geological and economic evaluationof the individual deposit of mineral raw materials practically represents a special type of managerial tool for making the necessary expert and managerial decisions important for the operations of the mineral sector companies. In particular, the following may be distinguished: (a) analytical data obtained from the factor; and (b) analytical data obtained from the indicators of the geological and economic evaluation of mineral deposits. Analytical data on factors of economic evaluation relevant to the company's operations include data obtained through a system-analytical approach and analysis of subsystems expressed through concrete factors, which are: (1) Metalogenetic; (2) Geological; (3) technical-exploitation; (4) Technological; (5) Market; (6) Regional; (7) Socio-political-economic-strategic; (8) Geoecological and (9) Legislative and legal factors. Analytical data on indicators of economic evaluation relevant to the business operations of the company are obtained after a basic expert analysis of each of the specified specific factors, and include data from the three basic set of indicators, namely: (1) A set of natural; (2) A set of values and (3) A set of synthetic indicators.

Individual data in the case of each specific deposit of metallic, non-metallic and energy mineral raw materials have a special professional and economic functional role for three important reasons: (a) determining the value of mineral reserves; (b) determining the position of the target mineral deposit in the mineral-raw material base and the mineral economy of the country; and (v) identifying key production elements in the planning and realization of production in the enterprise. A particular specificity of the economic evaluationis a temporary character based on a time-out of the validity of the subject factors and indicators of the economic evaluationof the deposit, which requires the need for special professional and economic monitoring, which can cause significant changes especially in the economic and financial segment of the company's operations.

A comprehensive and complex author's activity that has been started on the study of practical aspects of the application of factors and indicators of the economic evaluation of mineral deposits has been initiated as part of further active scientific research and applied work. Particular attention will be given to a more detailed analysis of the application of each individual group of factors and set of indicators to the adoption of appropriate expert, managerial and business decisions, in order to create expert bases for the successful functioning and operation of the miner sector, and apply the appropriate basic knowledge of economic geology in improving the mineral economy of Serbia.

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SUMMARY

The work and functioning of the mineral sector companies in modern business conditions are partly related to the standard influencing factors of production, as well as to enterprises in other economic activities, and partly to specific factors related to mineral resources and the specific features of the functioning of the mineral economy. In relation to the performance of enterprises of other industries, in the mineral sector, success is directly linked to mineral reserves and their qualitative-quantitative definition, which ultimately results in economic definition through a geological-economic evaluation. The geological and economic evaluation of the individual deposit of mineral raw materials practically represents a special type of managerial tool for making the necessary expert and managerial decisions important for the operations of the mineral sector companies. In particular, the following may be distinguished: (a) analytical data obtained from the factor; and (b) analytical data obtained from the indicators of the geological and economic evaluation of mineral deposits. Analytical data on economic evaluation factors relevant to the business operations of a company include data obtained through the system-analytical approach and the analysis of subsystems expressed through specific factors, which are: (1) Metalogenetic; (2) Geological; (3) technical-exploitation; (4) Technological; (5) Market; (6) Regional; (7) Socio-political-economic-strategic; (8) Geoecological and (9) Legislative and legal factors. Analytical data on indicators of economic evaluation relevant to the business operations of the company are obtained after a basic expert analysis of each of the specified specific factors, and include data from the three basic set of indicators, namely: (1) A set of natural; (2) A set of values and (3) A set of synthetic indicators. Individual data in the case of each concrete deposit of metallic, non-metallic and energy mineral raw materials have a special professional and economic functional role, for three important reasons: (a) determining the value of mineral reserves; (b) determining the position of the target mineral deposit in the mineral-raw material base and the mineral economy of the country; and (v) identifying key production elements in the planning and realization of production in the enterprise. The specific characteristic of the economic evaluation is a temporary character based on a time-overdrafted validity of the subject factors and indicators of the economic evaluation of the deposit, which requires the need for special expert and economic monitoring, which can cause significant changes especially in the economic and financial segment of the company's operations.
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