SUSTAINABILITY ROLL AND REVENUE-COST OPTIMIZATION UNDER SUSTAINABLE DEVELOPMENT (FOR MINING COMPANIES ADOPTION)

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Abstract: Anchoring practical mechanisms and instruments by mining companies in transitive economies based on natural resources trade is of great importance. How to make sustainable development attractive for investors and mining magnates remains a topical issue. There is a fundamental difference in the postulates of the market economy and the view prevailing among business persons and managers about the importance and necessity of implementing socially and environmentally effective projects. This is reflexively expressed in their personal attitude to these projects in the past and positioning them within the hierarchy of priorities designed for a company to be developed in the long-run perspective. In other words, the process of sustainable development, as it is seen by the leaders, has a high level of cost and a low level of profitability. At the same time, the company operates under the rules of the market economy – that is, the company is oriented on financial benefits gained as a result of the implementation of environmental and social projects. Among such projects are rendered public services (education, health, culture and recreation), which do not bring direct financial benefits to the enterprise in the form of revenue.

Keywords: sustainability roll, revenue-cost optimization, sustainable development, mining company.

Introduction
Lack of indicators to measure a company’s image enhanced due to socially responsible policy leads to an unclear and vague evaluations of sustainable development efficiency. Increasing market value of a sustainably developing enterprise, its improving position in the rankings on sustainable development are relevant to the case if the company has a public form of ownership, is preparing for being sold, meets a number of financial indicators and indicators of scale to participate in the process of rating. Otherwise, the implementation of social and environmental projects now requires incurring additional costs and cuttings of net profit. In this case, the opportunity cost calculated as the effect of other possible projects, which could have been implemented if these costs would have been incurred for other projects, may exceed the resulting non-economic social and environmental effect of sustainable development estimated by experts.

All this increases the risk that an enterprise will refuse to implement social and environmental sustainable development projects especially under conditions of changed owners or top managers, and without possible grants from public authorities.

Therefore, the conceptual platform of the sustainable development of mining companies must be integrated into the free market model so that a company may be profitable and follow the principles of economic, social and environmental sustainability and this benefit may be measured in monetary units.

Results
At the global level, a similar example is an artificially created world market of quotas for CO₂ emissions under the Kyoto Protocol. A company introducing innovative green technology, can sell in the global market the excess over reduced emissions but under allowed emissions, which actually had been received due to these technologies. In this case, a company not only compensates costs of innovations, but also gets additional benefit.

It was found that a mining company by its nature violates the principles of sustainable development not only during active operation stage of its life cycle, but also after its liquidation as an economic entity.

Then a dilemma arises. It is proposed to think it as a dilemma of transitioned stability roll in the development of the mining company (Sustainability Roll in Transitive Mining) (Fig. 1).
The economic essence of sustainability roll observed during the development of the mining enterprise can be determined as a concentration of resources to perform more tasks in one or two areas – that is, economic, social and environmental. It accordingly allows satisfying the interests of certain groups of stakeholders to a greater extent than others. If a mining company is active in the economic area, then its standing could not be called absolutely sustainable due to the significant ecosystem disruption (social and economic sustainability roll). In turn, the termination of the process of destroying the ecosystem causes social and economic shocks in the territorial development (environmental sustainability roll). Therefore, in this regard, it can be concluded that both the actual mining activities and its termination shall not contribute to the achievement of sustainable development of internal and external environments of the company. This precedes the question of the possibility to ensure sustainable development of a mining company even after its liquidation, as an economic entity.

Sustainability roll is a dynamic characteristic of the mining enterprise development, which is explained by its shift and especially clearly observed in the transition from active mining enterprise economic activity to its termination. This suggests that the roll of the enterprise agile in time. At different points of time, at different stages of development of the enterprise we can see deterioration in the economic, social or environmental internal and external subsystems of the company due to a specific variant of the reallocation of resources.

Taking into consideration all said above, we can formulate the following provision to complement existing theoretical foundations for sustainable development of the mining enterprises. Sustainability in the development of the mining company does not disappear or appear as a permanent feature because the company always has internal economic, social and environmental impact and is always integrated into external upper system. However, the efficiency and effectiveness of sustainable development of the mining enterprise depends on the harmonious interaction of these areas. It is reflected in the roll of sustainability of
mining enterprise that is changing in the transitional stages of its operations. Mining company after termination of economic activity also has a roll of its sustainable development at a post-termination stage.

The area of the sustainable development of the mining enterprise in enlarged form is illustrated for better understanding the principal of calculating sustainable position of a company (Figure 2.). We define the coordinates of points limiting the area. They are the general solution of the equation system of three pairs of circles describing the economic, social and environmental clusters. In this case, it is obvious that these decisions imply only positive roots. Equation of a circle with a radius and a center coordinates 

\[ A_i \left( x_{1i}, x_{2i} \right) \] 

in the general form is written as 

\[ R^2 = (x_1 - x_{1i})^2 + (x_2 - x_{2i})^2 \]

where \( (x_1; x_2) \) are the coordinates of the desired point in the coordinate plane. Form a system of equations of circles, describing the economic and social cluster. Figure 2 shows that a positive solution of this system will point coordinates of \( F \), \( G \), \( H \).

Fig. 2. A Zone of Relatively Sustainable Development of a Company

*Source: developed by authors*

Then, the final optimization model for finding a zone where an enterprise develops sustainably will be as follows:

\[
P = K_{EC} \cdot \sum_{i=1}^{n_i} (x_{1ECi} - x_{2ECi}) + K_{SS} \cdot \sum_{i=1}^{n_i} (x_{1SSI} - x_{2SSI}) + \\
+ K_{EL} \cdot \sum_{i=1}^{n_i} (x_{1ELi} - x_{2ELi}) \rightarrow \max \\
0 \leq K_j \leq 1; \quad \sum_{j=1}^{3} K_j = 1, \\
x_{1,2j} \geq 0, \\
\text{min}(x_{1H} ; x_{1G}) \leq x_{1j} \leq \text{max}(x_{1F} ; x_{1G}), \\
\text{min}(x_{2H} ; x_{2F}) \leq x_{2j} \leq \text{max}(x_{2F} ; x_{2G}), \\
\lambda_{EC} \cdot \sum_{i=1}^{n_i} (x_{1ECi} - x_{2ECi}) \geq \sum_{i=1}^{n_i} x_{2ELi} + x_{2S1} + x_{2S3}, \quad 0 \leq \lambda_{EC} \leq 1
\]
where \(x_1EC_i, x_1Si, x_1EL_i\) - incomes of \(i\) - object belonged to economic, social and environmental areas of a company; \(x_2EC_i, x_2Si, x_2EL_i\) - costs of \(i\) - object belonged to economic, social and environmental areas of a company; \(m_{EC}, m_S, m_{EL}\) - a number of objects in economic, social and environmental areas of a company; \(K_{EC}, K_S, K_{EL}\) - coefficients of importance of economic, social and environmental areas of a company; \(x_1H, x_1G, x_1F\) - incomes at points \(H, G, F\), restricting a zone of a company’s sustainable development; \(x_2H, x_2F, x_2G\) - costs at points \(H, F, G\); \(\lambda_{EC}\) - retained profit gained in economic area and distributed to social and environment areas; \(x_2'EL_i\) - costs of unprofitable social and environmental projects of a company.

**Discussion**

By analyzing clusters, values of revenues and costs of economic objects of the mining companies relating to internal and external parts of the relevant economic, social and environmental systems can be determined. Then, the development of the company will be characterized by a roll of sustainability regarding relative or absolute stability. As a result, the approach to mathematical formalization of sustainable development of mining enterprises and to efficient resource allocation and processes management to achieve economic stability was approved. It is proved that the point of sustainable development of the enterprise is characterized with objects regardless of the system to which they belong that generate the same amount of revenue and are maintained by the same amount costs. However, the methodology used in the research can be regarded as disputable given the huge amount of methods and techniques employed for determining sustainable development of a company.

**References**


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