

## Strategy of point out relevance of responsible exploitation of mineral resources

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*Mineral resources, which are necessary to be protected and responsibly used with regard to the future generations and their sustainability, are an important and also necessary condition for the continual development of any economy. These objectives can be achieved only by raw materials policy, which defines the objectives of the exploitation of domestic mineral resources in response to long-term needs of economic and social development of the society with regard to the environmental aspects of sustainable development, ranging from geological research through the exploration and exploitation of proven reserves.*

*The main content of the raw material policy should include an analysis of domestic sources of fuel and energy, ore and industrial minerals and raw materials for the production of building materials and determine the rules for the protection and prudent use of mineral resources of the state according to the principles of sustainable development. Despite the fact that Slovakia is relatively rich in certain minerals by its diverse geological structure, the last update of raw materials policy was in 2004. Now, however, a new kind of hope for its update was initialized by Ministry of Economy. The update should be not only the set of long-term goals, but also the models built on professional assessments, using appropriately chosen tools which can predict and define the future of strategic raw materials. One of the options is also described in present contribution.*

**Key words:** mineral resources, raw materials policy, model design, sustainability.

### Introduction

Raw materials and resource base are essential for the sustainable functioning of modern societies. The global importance of raw materials is also reflected in small units such as regions. Access and availability of mineral resources are crucial for the proper functioning of the national and regional economy. Sectors such as construction, chemicals, automotive, electronics, aerospace, mechanical engineering, all depend on access to raw materials. Locations of deposits within the European Union are due to the geological diversity very colourful.

Due to these reasons, but also because of the awareness of the EU's dependence on imports of most strategic raw materials as well as due to the fact that any innovations depend on mineral resources, the usability of renewable energy sources does not exist without non-renewable resources. This is the reason why it is the most important concept and at the same time priority for the EU harmonisation of national mineral policy (Madzík et al., 2016).

In addition, a strategic view has to be seen in the context of the importance of raw materials for the development of the state; development can be summarised in the term resource security (Blišťan and Blišťanová, 2011; Blišťan et al., 2015). Extremely important and necessary condition for the development of the state is the availability of resources - physical and economic. The use of own resources is the most economical and ignorance of this option would be the denial of property rights, which in the case of raw materials is rated directly in the Constitution.

This is the point of view on which many experts currently cooperate with the Ministry of Economy in the formation of raw materials policy. The main ideas, as the main conceptual tool, respect to the ideas and directions of European Union.

The main content of the raw material policy of the state is the analysis of domestic resources and determination of the rules for the protection and economical use of mineral resources of the state according to the principles of sustainable development. However, it should be noted that the EU's important step is also the circular economy.

### Process of raw materials using

Legislative norms of Slovakia, domestic raw material wealth, presents ownership of the state, while raw materials are not renewable -they must be protected and effectively used.

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Any of categorization conditions reflects exactly economical, environmental and social aspect, while factors as the level of research, geological parameters, deposit conditions, complex evaluation of balance, in this case missed during the evaluation of rationality or suitability of using of regional development with emphasis on the sustainable development (Pawliczek et al., 2015).

In 2008, the European Commission issued Raw Material Initiative (RMI), expressing the need for an integrated policy with responsibility at the EU level (Raw Materials Initiative, 2016).

The raw material policy of Slovakia as a country, rich from the view of raw materials, has in connection with the mentioned initiative considerable deficit, while its principles in present time are not adjusted towards RMI pillars.

However, after the elections, when raw materials and their use were significantly incorporated into the government declaration in Slovakia, more initiatives to formulate raw material policy were formed (Programové vyhlásenie vlády SR, 2016).

Tools of raw material policies require an integrated approach and the need for coordination with industrial activity, energy activities and trade policy and environmental policy, including employment policy (Hlavňová et al., 2014). There are mainly economic, legislative tools and area planning, as instruments for preparing raw materials policy.

From the economic instruments, the need for evaluation of mineral deposits appears as the most effective. It has the advantage of deposit assessment not in general, but in the view of the project of deposit using by the specific business entity which determines the degree of evaluation of raw materials (Surovinová politika SR pre oblasť nerastných surovín, 2003).

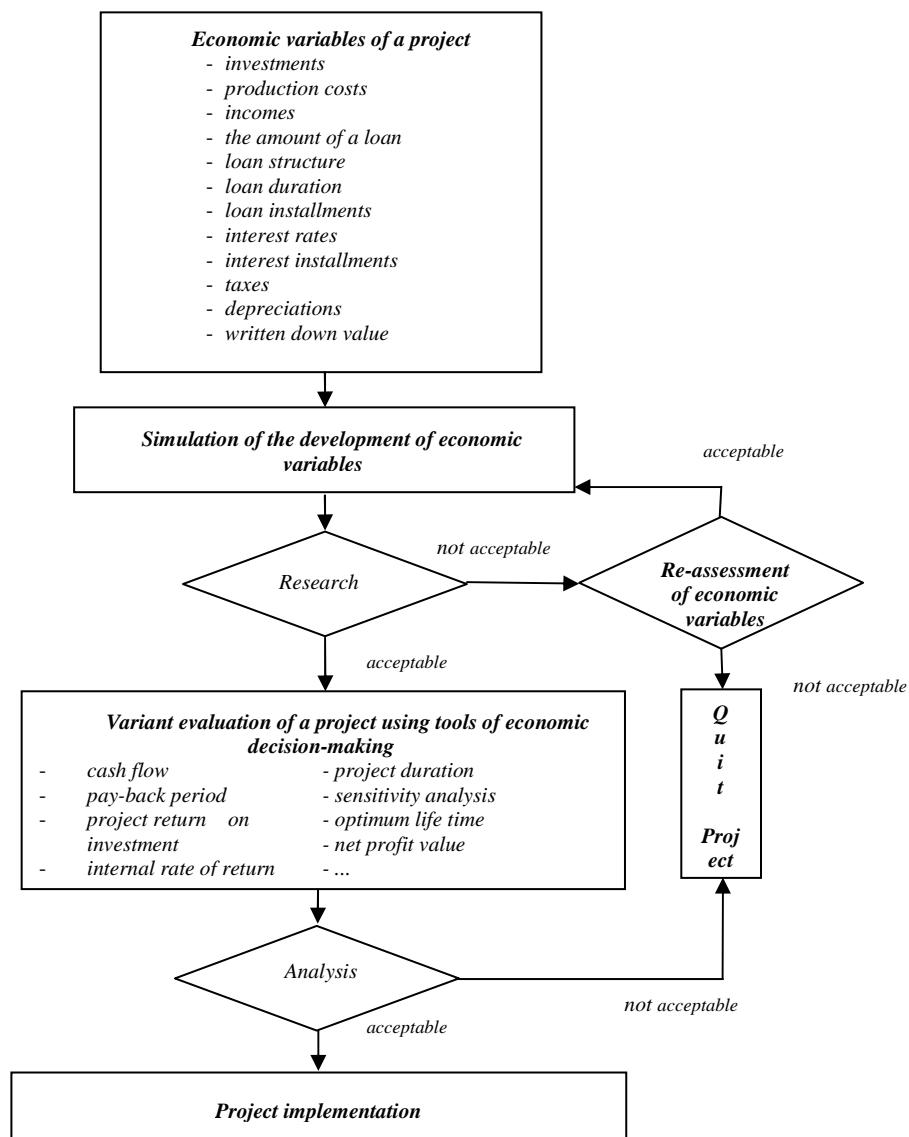


Fig. 1. The study of the complex project of the evaluation of mineral deposits (Cehlár et al., 2011).

Very important indicators are:

- prices of materials must reflect direct and indirect costs of extraction and processing as well as environmental costs associated with the subsequent elimination of environmental impact,
- payment for mining area, payment for extracted minerals and payment for storage of gases or liquids,
- payment for the removal of surface deposits from the agricultural or forest land,
- use and support of EU structural funds and the state budget (Uznesenie vlády č. 661/1995, 2003).

Given the above facts, it is necessary to know the study of the basic project, and also methods for the evaluation of mineral deposits in general (Puzder et al., 2016). According to the Figure 1, the most important parts are “the Research” and “Analysis”. In them, there are an estimate and analysis of factors as rock properties and its usability. The price of raw material, the size of the production costs, transport costs and location of the market. Comparison of production costs and the cost of purchasing raw materials with similar properties (Herman et al., 2015, Herman et al., 2016). So it is a bulky set of data to be compared, and the result is the feasibility or infeasibility of mining, thus the evaluation of mineral deposits. Being very practical in this case, data availability assessment can be drawn up in great detail (Leško et al., 2002). In the absence of specific data, it is possible to proceed analogously in similar deposits with identical commodities; it is possible to compare the corresponding raw material prices. Especially through the evaluation of mineral deposits, we can work with data that are indispensable for this purpose and available (Cehlár et al., 2011).

### Model of optimal use of the resource base

Model of the optimal use of the resource base based on mentioned facts and selected economic instruments can be divided into three parts:

- Model for the assessment of the project of geological exploration;
- Model for the assessment of the project of mining;
- Model for the assessment of the project of mining on the environment.

Model for the assessment of the project of geological exploration is an important beginning of exploring usability deposits. The whole model is a functional process of assessment of deposits while respecting the laws of behaviour of the capital, businesses and public authorities, which are regulated by the relevant legislation. The model makes possibility to assess whether it is possible to assemble a functional unit and thus evaluate the success of the geological project as a prerequisite of exploitability deposits. The role of regions, in this case, is given only by the possibility to approve or not the zoning plan. If there is no appreciation of the deposits, through the extraction and use of effects for the region, the summary of positive and negative effects for the region cannot be estimated. Thus, this model serves as an advance preparation for the evaluation of deposits, so it should have an irreplaceable role in mineral policy making.

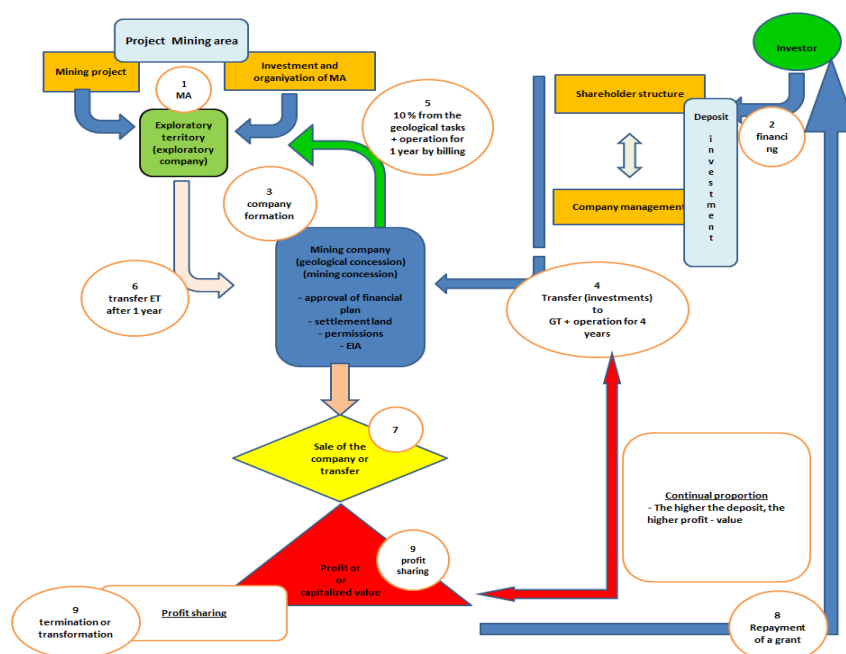


Fig. 2. Model for the assessment of the project of geological exploration [source: authors].

Model for the assessment of the project of mining is an essential part of the evaluation of deposits, their usability in terms of raw material policy-making of regions. The absence of the raw material policy of the region causes improper decisions which are often in conflict from the perspective of sustainable development, which is then reflected in all other industries and the service sector. The role of the region, in this case, is again given only by the possibility to approve or not the zoning plan for the using of deposits. A more effective tool for decision-making is the fact that regional territorial plan is then binding for smaller spatial plans. This affects the representatives of the municipalities which are parties in decision-making and allocation of mining licenses.

Then, managing conflicts of interest with contracts or sale of the land brings a strong regional charge. This task is not only indirect from the effective point of view, but there is already a recovery of the deposit by the extraction and use of effects for the region, which can be positive and negative. So, this model is essential for the evaluation of deposits and in the processing raw materials policy of the region, it should have an irreplaceable role. Both models, in combination with regional development policies materialised in the form of land-use decisions, are the basic structure for objective raw materials policy development of the region.

In contrast to the current state, the deposit is regarded as a resource, value that can only be assessed in relation to the project and its utilisation.

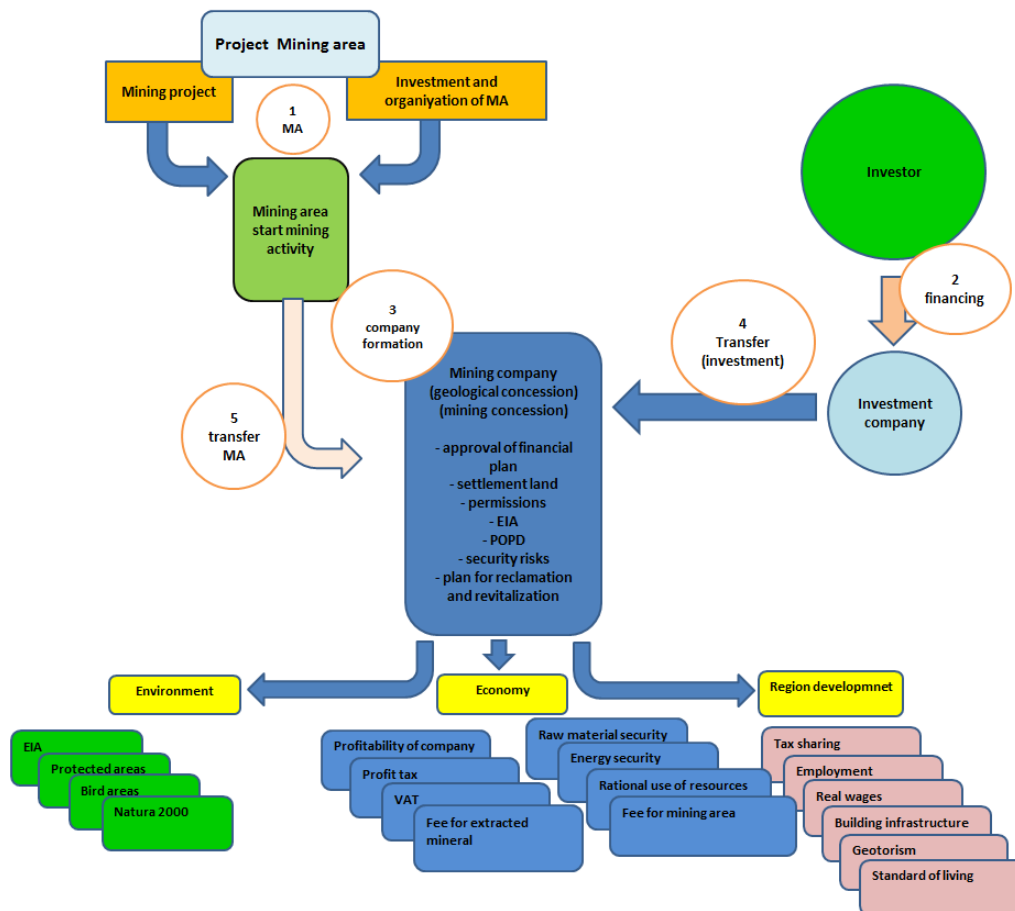


Fig. 3. Model for the assessment of the project of mining [source: authors].

The model for the assessment of the project of mining to the environment is closely linked to EIA (Environmental Impact Assessment). The purpose of EIA is to identify, describe and assess the direct and indirect impacts of the proposed mining on the environment, clarify and compare advantages and disadvantages of the proposed mining, including its variants, even compared to the zero option, identify measures to prevent pollution of the environment, mitigate pollution environment, or prevent damaging the environment, get a professional basis for the issuing of a mining permit under special regulations (Pavolová et al., 2012). Since the steps of the impact assessment of proposed activities on the environment are given by legislative framework, we will not describe them anymore in this article.

### The concept of raw materials policy of Košice region

The concept of raw materials policy of Košice region is a tool for the rational use of mineral resources and to support the development of the region while respecting sustainable development with strict respect to the environmental protection. It means to find an optimal way of using, in which the miners are technically able to mine mineral deposits, technologically process material and economically realise all the works up to the location of raw materials in the market.

The concept of the raw material policy is a model that includes:

- inputs of the concept of raw materials policy (exclusive + non-exclusive deposits),
- process of assessment factors of raw materials policy concept - legislative, economic, environmental, technological and mine-technological and autonomous skills that represent working group composed of representatives of organisations that have a real impact on the decision-making process for the authorization exploration or mining activities.
- outputs of the concept of raw materials policy:
  - a) the environmental impacts of the resource base of the Košice region,
  - b) the economic impact of the use of the resource base of the Košice region,
  - c) social impacts of the resource base of the Košice region,
  - d) development of the Košice region in a wider context.

These outputs are the main arguments for their inclusion in the process of amending and approving the zoning region plan and then to the land use plans of individual towns and villages. The model of the conception of raw material policy is a process that should occur in the sequence as indicated in the Figure. The fundamental facts are competences.

The result of objectification is essentially the division of mineral deposits on the concept of usable and unusable. Usability and unusability depend on factors that are part of the evaluation of mineral deposits: price, production costs, investment costs and resource availability by size and structure. It follows that this process needs to be updated, for what is the concept of model-making raw materials policy of the region prepared.

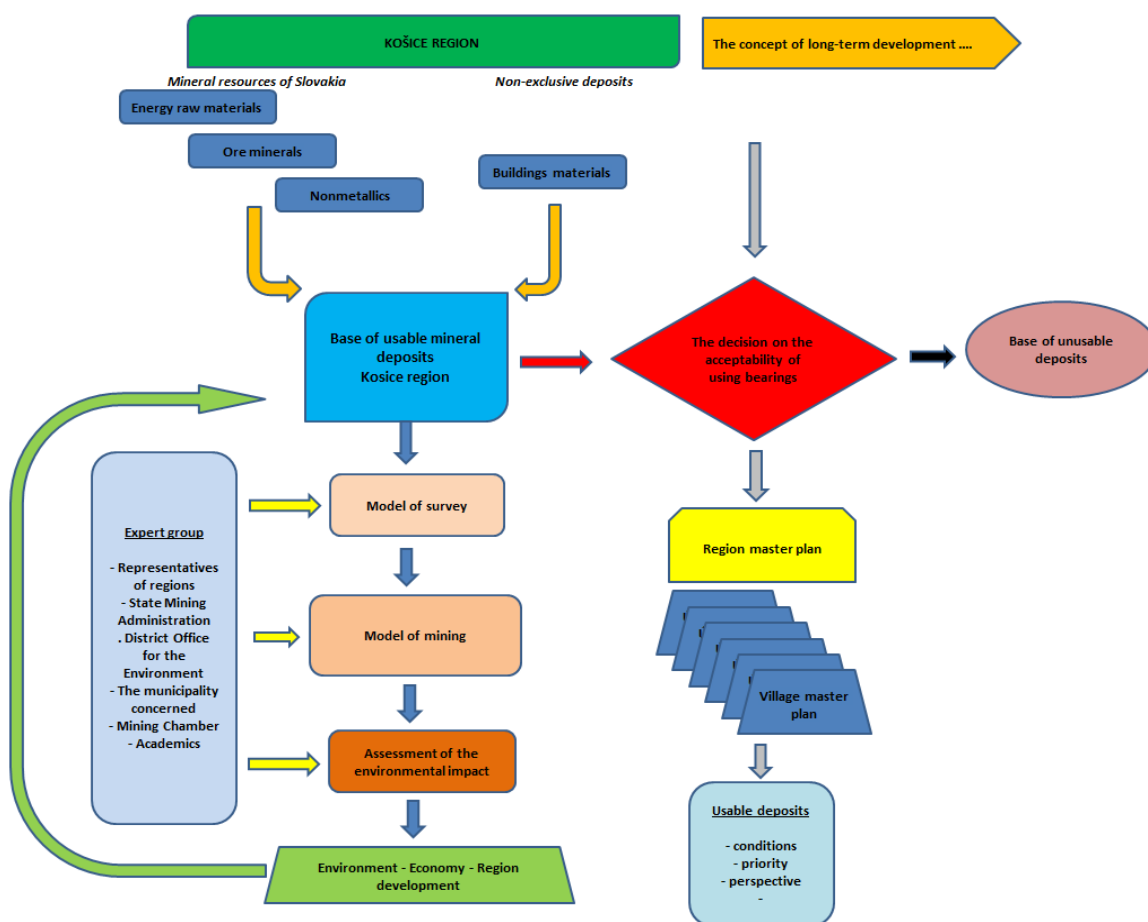


Fig. 4. The concept of raw materials policy Košice region [source: authors].

## Results and discussion

Due to the selected economic instruments, the methodology of evaluation of mineral deposits must be complex and therefore, due to the mentioned facts, also based on the quantification of the interactions of environmental and socio-economic aspects of mining of raw materials in terms of sustainable development of the regions of Slovakia. From the up-to-now empirical results and analysis of mining of mineral resources, 12 negative aspects (Tab. 1) of the extraction of mineral resources can be identified. Based on the comparison of their interaction ties, partial numerical values characterising the level of potential negative impacts on regional development were determined. The level of negativity impacts was quantified based on the subjective assignment of numerical values of 1.0 and 0.5. In the case when the impact was evaluated as more important from the view of the implementation of mining mineral deposits as the one, with which it was compared, it was assigned a value of 1. Otherwise, it was assigned a value of 0. When the compared effects were at the same level, they were assigned a value of 0.5. After evaluation of individual impacts, all values were summarised in the horizontal direction of the constructed matrix. By using the matrix, the partial level of importance of a comprehensive assessment has been determined using weights -  $\alpha_i$  (Tab. 1). Also, a generally valid condition  $\sum \alpha_i = 100\%$  has been accepted.

The matrix of negative impacts of extraction of mineral resources showed that the most significant negative impacts characterised by the risks of additional investment costs is the impact on the population. The least significant in this context is the impact of the urban complex.

Substantial negative impacts of mining and quarrying also include the impact of mining on the air, soil, climate and hydrogeological conditions (Tab. 1), according to the type of mining.

Tab. 1. Matrix of negative impacts of extraction of mineral resources on sustainable regional development [source: authors].

Indicator/Interaction	Impact on population	Impact on rock environment	Impact on earth	Impact no climatic conditions	Impact on air	Impact on hydrological conditions	Impact on fauna	Impact on flora	Impact on protected areas	Impact on TSES	Impact on the landscape	Impact on urban complex	Amount of lines	Weight in %
Impact on population	0	1	0.5	0.5	0.5	0.5	1	1	1	1	0.5	0.5	8.00	12.12
Impact on rock environment	0	0	0.5	0	0	0.5	0	0	0.5	0	0.5	1	3.00	4.55
Impact on earth	0.5	0.5	0	0.5	0.5	0.5	0.5	0.5	1	0.5	0.5	1	6.50	9.85
Impact no climatic conditions	0.5	1	0.5	0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	6.50	9.85
Impact on air	0.5	1	0.5	0.5	0	0.5	0.5	0.5	0.5	1	1	1	7.50	11.36
Impact on hydrological conditions	0.5	0.5	0.5	0.5	0.5	0	1	1	0.5	0.5	0.5	0.5	6.50	9.85
Impact on fauna	0	1	0.5	0.5	0.5	0	0	0.5	0.5	0.5	1	1	6.00	9.09
Impact on flora	0	1	0.5	0.5	0.5	0	0.5	0	0.5	0.5	1	1	6.00	9.09
Impact on protected areas	0	0.5	0	0.5	0.5	0.5	0.5	0.5	0	0.5	1	1	5.50	8.33
Impact on territorial system of ecological stability	0	1	0.5	0.5	0	0.5	0.5	0.5	0.5	0	0.5	0.5	5.00	7.58
Impact on the landscape	0.5	0.5	0.5	0.5	0	0.5	0	0	0	0.5	0	0.5	3.50	5.30
Impact on urban complex	0.5	0	0	0	0	0.5	0	0	0	0.5	0.5	0	2.00	3.03
<b>Together</b>													<b>66.00</b>	<b>100.00</b>

Also, it was necessary to construct the matrix of benefits, advantages for regional and national level by the identical methodological procedure. By the generalisation of positive impacts of extraction of mineral resources, eleven benefits that support sustainable regional development were identified (Tab. 2). The largest weight has "increased employment" and also "fostering of economic development", "increase purchasing power" and "influence on the living standards of the population." The least important benefit is expected "positive financial effect" of a company and "source of state revenue", which business pays by fees for extracted minerals.

Tab. 2. Matrix of positive impacts of extraction of mineral resources at sustainable regional development [source: authors].

Indicator/Interaction	Support of economic development	Support of social development	Increased employment	Source of state revenue	Impact to trading with RM	Increased autonomy for Slovakia	Opportunity of FDI	Support of regional development	Positive financial effect	Increase purchasing power	Influence on the living standards of the population	Amount of lines	Weight in %
Support of economic development	0	0.5	0.5	1	0.5	1	0.5	0.5	1	0.5	0.5	6.5	11.93
Support of social development	0.5	0	0	0.5	0	0.5	0	0.5	1	0.5	0.5	4.0	7.34
Increased employment	0.5	1	0	1	1	0.5	0.5	0.5	1	0.5	0.5	7.0	12.84
Source of state revenue	0	0.5	0	0	0.5	0	0.5	0.5	0.5	0	0	2.5	4.59
Impact on trading with raw materials	0.5	1	0	0.5	0	0.5	0.5	0.5	0.5	0	0	4.0	7.34
Increased autonomy for Slovakia	0	0.5	0.5	1	0.5	0	0.5	0.5	0.5	0.5	0.5	5.0	9.17
Opportunity of FDI	0	1	0.5	0.5	0.5	0.5	0	0.5	0.5	0	0.5	4.5	8.26
Support of regional development	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0	1	0.5	0.5	5.5	10.09
Positive financial effect	0	0	0	0.5	0.5	0.5	0.5	0	0	0.5	0	2.5	4.59
Increase purchasing power	0.5	0.5	0.5	1	1	0.5	1	0.5	0.5	0	0.5	6.5	11.93
Influence on the living standards of the population	0.5	0.5	0.5	1	1	0.5	0.5	0.5	1	0.5	0	6.5	11.93
<b>Together</b>												<b>54.5</b>	<b>100.00</b>

The matrices mentioned above have been synthesised into a single comprehensive matrix of evaluation usefulness of mineral deposits, pointing to the ultimate benefit of implementation in the context of sustainable socio-economic and environmental development of the regions of Slovakia.

The matrix described below was constructed based on the quantification of interaction ties of partial negative impacts and benefits of mining mineral deposits based on complex categorization usefulness. The partial numerical level of individual indicators was quantified by the identical methodological approach, with accepting the summary level of usefulness.

The matrix of comprehensive evaluation of extraction of mineral resources mentioned below (Tab. 3) shows the predominance of the negative impacts of extraction of mineral resources (54.77 %); benefits (45.23 %), with the degree of usefulness of 0.83. Also, it is pointing to an acceptable intervention by the State by inclusion in III. category "average usefulness" (Tab. 4), which predicts additional reasonable costs activated by State intervention, which does not affect the desired effect of the usefulness of extraction mineral deposits.

Tab. 3. Matrix of comprehensive evaluation of extraction of mineral resources [source: authors].

Indicator of mining of mineral deposits	Character of indicator	Usefulness of the indicator	Partial usefulness	Level of usefulness
Support of economic development	+	5.39	45.23	0.83
Support of social development	+	3.32		
Increased employment	+	5.81		
Source of state revenue	+	2.07		
Impact on trading with raw materials	+	3.32		
Increased autonomy for Slovakia	+	4.15		
Opportunity of FDI	+	3.73		
Support of regional development	+	4.56		
Positive financial effect	+	2.07		
Increase purchasing power	+	5.39		
Influence on the living standards of the population	+	5.39		
Impact on population	-	6.64	54.77	
Impact on rock environment	-	2.49		
Impact on earth	-	5.39		
Impact on climatic conditions	-	5.39		
Impact on air	-	6.22		
Impact on hydrological conditions	-	5.39		
Impact on fauna	-	4.98		
Impact on flora	-	4.98		
Impact on protected areas	-	4.56		
Impact on territorial system of ecological stability	-	4.15		
Impact on the landscape	-	2.90		
Impact on urban complex	-	1.66		

Tab. 4. The categorization of usefulness of mineral resources [source: authors].

Category of usefulness of extraction of mineral resources		Level of usefulness
<b>I. category</b>	Very high usefulness	More than 1,80
<b>II. category</b>	High usefulness	1.79 – 1.30
<b>III. category</b>	Average usefulness	1.99 – 0.80
<b>IV. category</b>	Low usefulness	0.79 – 0.30
<b>V. category</b>	Very low usefulness	0.29 and less

### Conclusion

While the Slovak Republic is permanently reliant on imports in the fuel-energy and ore resources, extraction of certain raw materials for industry and construction has a positive economic importance. Although the update of the raw material policy will not change dependency of Slovakia on imports of mineral resources, it can deliver significant conclusions and especially realistic views of the current state of mining in Slovakia. In addition, the update foresees the unification of concepts, terms and classifications of minerals with the European Union.



An important fact is an actual view of the raw materials and the formation of raw materials policy. The easiest access to the necessary data could seem through the available economic indicators, but these may lose its importance when it ignores the fact that one mining company may own several mining areas. Therefore, it is essential to collect data through mining areas separately, or by categorising the different types of raw materials.

Despite these facts, the described approach and proposed models based on economic instruments appear to be the most ideal at present, because we want to create a tool for decision making, not only to obtain general information, just by this approach. It is also necessary to note that the responsibility of the countries lies primarily in creating a relatively stable environment for the development of mining and the use of domestic raw materials with the aim to reduce dependence on the import, in the protection of mineral resources and the use of secondary raw materials, including mining and technological waste and environmental protection.

Despite the fact that Slovakia is a small country, it is relatively rich in raw materials, and also very special critical raw materials, which has special positions in the EU mainly in these days (Buijs et al., 2012). In addition to raw materials policy, it is important to define and methodologically tackled so-called deposits of public importance, which would be applicable only for specific conditions defined by countries.

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