Strategy Planning For the Mining Industry in Semnan Province (Iran) Using A Combined SWOT-AHP Approach

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Abstract— **In today's world, the type of investment, prioritization and scheduling the extraction of mineral resources due to the constraints of resources, technologies and human resources, etc. strongly requires a strategic planning appropriated in this area. In terms of quantity and quality, the resources and mines in Semnan province would be seen among the richest mineral resources in Iran. However, due to a scarcity of compiled strategic planning in the mining industry, this prominent province plays a small role in the country's economic developments. In this regard, the exploration and evaluation of the strategic factors and a formulation of strategies seems to be vital. In this study, the analysis and formulation of the demanding strategy have been done by applying the strategic management approach SWOT (Strengths, Weaknesses, Opportunities and Threats). Then the resulting strategies have been prioritized by using a hierarchical multi-criteria decision analysis called AHP (Analytic Hierarchical Process). Three strategies: creation of industrial clusters in the field of handicraft production with raw materials of mud, clay and gypsum panels (S3), joint mineral investments with the other mines of the province (S8), and the creation of groundwork for the mineral production cooperative companies, gained the highest priorities. Three strategies: updating the existing coke-making companies and constructing small coke-making and coal-washing units (S5), forming the specialized, industrial, mining, strategic and advisory committees in the Semnan Provincial Government to facilitate the local laws and encourage investments in mining (S7), and a greater engagement of private sectors with the government (activate the role of mining engineering and a maximum participation in decision-making related to the industry of the province) gained the least priority. At last, using prioritized strategies, some systematic planning is chosen strategically to suit the current situation, and to make possible a development and utilization of the high potential capacities in the mining industry which are already provides in Semnan province.**

Index Terms— **mining industry, SWOT Analysis, Hierarchical Analysis, Semnan province.**

I. INTRODUCTION

Semnan province is an important sector located in Iran. Its capital city is named Semnan. The area of the province equals 97,491 square kilometers, which means 5.9 percent of the country's total area. In terms of area, Semnan is the seventh province of the country with a population of 636,000[1].

In terms of economy, Semnan province possesses a considerable status in the national economy. Due to the proximity with Tehran, benefiting of an advanced communication network and the railway which connects the provinces of Tehran, Khorasan, Mazandaran and the south parts of the country, and significantly the discovery of some important mineral resources, the industrial role of Semnan has been particularly important in recent years. Thanks to the geology of the area, this province profits from a large variety of rich-mineral compared with many other areas of Iran. The mines which are currently active in this area include: the mines of coal, of chromite, of gypsum, of salt, of silica, of Celestine, of sodium sulfate, of dolomite, of potash, of industrial soils, of copper, of lead, of zinc, of bauxite, of manganese, of sulfur, of phosphate, etc. [2].

According to available statistics, the distribution and diversity of the minerals in the expanse of 97,491 square kilometers is in such a way that the province lodges a tremendous amount of more than 2.5 billion tons of geological reserves, and of more than 350 million tons of proven reserves in the mines. Semnan province supply 50% of salt, 40% of gypsum, 85% of zeolite, about 100% of chromite, 20% of

Celestine and 8% of sodium sulfate of the whole country. Furthermore, 42 from the 71 known types of minerals can be found in and are provided by the province. In this province, it is annually exploited 33 types of mineral productions with an amount of over 11 million tons of minerals. All these facts bear witness to the conclusion that the contribution of the province of Semnan in Iran's reserves is a significant one [3]. However, its share in the domestic and foreign marketing is not at all considerable. The potential of the mineral reserves in Semnan province will become an actual capability just by taking into account the following enterprises: a serious attention to the exploration, a fruitful exploitation and production of the extracted minerals, a rigid investment and utilization of the modern technologies and the application of systematic strategic planning skills with an assistant of the experts and engineers.

Strategic planning is one of the topics that despite its relative antiquity is still of great importance in the field of scientific and administrative fields. One of the reasons for turning to strategic planning, of course, is the transformation and evolution occurred in today's environments of organizations [4]. One of the most appropriate techniques, under the topic of strategic planning, among others, is the technical analysis of strengths, weaknesses, opportunities and threats (SWOT). Nowadays, this approach is used as new tools of performance analysis for designers and evaluators of

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strategy. This analytical model with its systematic point of view and the correspondence it makes between indoor and outdoor sphere of organization, is one of the powerful tools aiming to construct a strategy [5].

A. Literature of Study

The SWOT analysis has already had many applications in various fields. Table (I) illustrates some examples of applications of this analytical method. In its most applications to develop strategies, SWOT analysis uses some auxiliary tool such as Analytic Hierarchy Process (AHP) and IFE-EFE matrices in order to choose the appropriate strategy.

Table I. Examples of studies in which the SWOT analysis is applied (with a combined method) in the field of Industry and Mining

Method(s)	Topic	Scholar(s)
SWOT & AHP	Utilizing the analytic hierarchy process (AHP) in SWOT analysis— a hybrid method and its application to a forest-certification case	Kurttila, M., et al, 2000 [6]
SWOT & AHP	Exploring the potential for silvopasture adoption in south-central Florida: an application of SWOT—AHP method	Shrestha, R.K., et al, 2004 [7]
SWOT	Stakeholder-based SWOT analysis for successful municipal solid waste management in Lucknow, India	Srivastava, P.K., et al, 2005 [8]
SWOT & AHP	A multi- methodological approach for shipping registry selection in maritime transportation industry	Kandakoglu, A., et al, 2009 [9]
SWOT	SWOT analyses of the national energy sector for sustainable energy development	Markovska, N., et al, 2009 [10]
SWOT	A SWOT analysis for environmental management practices in Greek Mining and Mineral Industry	Nikolaou, I.E., Evangelinos, K.I., 2010 [11]
SWOT	Feasibility assessment of recycled water use for washing machines in Australia through SWOT analysis	Mainali, B., et al, 2011 [12]
SWOT & AHP	An integrated model for prioritizing strategies of the Iranian mining sector	Fouladgar, M.M., et al, 2011 [13]
SWOT	Assessment of the biomass power generation industry in China	Zhao, Z.Y., Yan, H., 2012 [14]
SWOT & AHP	Analysis of the Turkish Consumer Electronics Firm using SWOT-AHP method	Seker, S., Ozguler, M., 2012[15]
SWOT & AHP	Application of Combined SWOT and AHP: A case Study for a Manufacturing Firm	Gorener, A., et al, 2012 [16]
SWOT & AHP	Determining proper strategies for Iran's dimensional stone mines: a SWOT-AHP analysis	Tahernejad, M.M., et al, 2013 [17]
SWOT & AHP	Use of SWOT and analytic Hierarchy process integration participatory decision making tool in watershed management	Yavuz, F., Baycan, T., 2013 [18]
SWOT & AHP	The integrated framework for analysis of electricity supply chain using an integrated SWOT-fuzzy TOPSIS methodology combined with AHP: the case of Turkey	Bas, E., 2013 [19]
SWOT & AHP	Analytical investigation of mobile NFC adaption With SWOT-AHP approach: A case of Italian Telecom	Mehmood, F., et al, 2014 [20]
SWOT & AHP	Strategic energy management in energy-intensive enterprises— quantitative analysis of relevant factors in the Austrian paper and pulp industry	
SWOT	SWOT analysis of safety and environmental regulation for China and USA: its effect and influence on sustainable development of the coal industry	Dzonzi-undi, J., Li, S. 2015 [22]
SWOT	An integration of SWOT and factor analysis to determining and prioritizing strategies: case study of a Persian food industry	Moghaddaszadeh, M., et al, 2015 [23]
SWOT	Employment of renewable energy in Jordan; Current status, SWOT and problem analysis	Jaber, J.O., et al, 2015 [24]
SWOT	SWOT analysis and strategy development for forest fuel supply chains in South East Europe	Rauch, P., et al, 2015 [25]
SWOT & AHP	Selection Strategy via Analytic Hierarchy Process: An Application for a Small Enterprise in Milk Sector	Erdil, A., Erbiyik, H., 2015 [26]
SWOT & AHP	Application of AHP method in external strategic analysis of Selected organization	Bartuskova, T., Kresta, A., 2015 [27]
SWOT	Where is the way of rare earth industry of China: An analysis via ANP-SWOT approach	Zhu, K., et al, 2016 [28]
SWOT	Energy crops for biofuel production or for food? – SWOT analysis (case study: Greece)	Paschalidou, A., et al, 2016 [29]
SWOT	The future of ASEAN energy mix: A SWOT analysis	Shi, X., 2016 [30]
SWOT	Wind energy in Poland – History ,current state, surveys, Renewable Energy Sources Act, SWOT analysis	Iglinski, B., et al, 2016 [31]
SWOT & AHP	Planning for sustainable small island management: case study of Gili Timur Island East Java Province Indonesia	Hidayah, Z., et al, 2016 [32]
SWOT & AHP	Stakeholder's perceptions on challenges and opportunities for biodiesel and bioethanol policy development in Thailand	Chanthawong, A., Dhakal, S., 2016 [33]
SWOT & AHP	Supporting policy decision makers in the establishment of forest plantations, using SWOT analysis and AHP analysis. A case study in Tocantins (Brazil)	Santopuoli, G., et al, 2016 [34]
SWOT & AHP	Comparison of methods for sustainable energy management with sewage sludge in Turkey based in SWOT-FAHP analysis	Adar, E., et al, 2016 [35]

II. METHODOLOGY OF RESEARCH

In this study, in order to identify and formulate the effective factors of the mining industry in Semnan province, eight experts, experienced in the field of mining in the province, provide us with a list of environmental factors including both the internal environmental factors (strengths and weaknesses) and the external ones (opportunities and threats). Then, we will use of the External Factor Evaluation matrix (EFE) and the Internal Factor Evaluation matrix (IFE) to evaluate strategic factors. Finally, the strategies will be prioritized by the method of Analytic Hierarchy Process (AHP).

A. Forming the Identify Matrix for External Strategic Factors

By external strategic factors (opportunities and threats), it means every events and processes in economic, social, cultural,

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ecological, environmental, political, legal, governmental, technological and competitive domains, which can be greatly beneficial or largely harmful for the organization in the future. Opportunities and threats are largely out of control of an organization; hence we are forced here to use "external" for these factors [36].

After identifying the external environmental factors in mining industry throughout Semnan province, and making a list of these factors by some consultations from the experienced experts, we reached to an identification of the Critical Success Factors (CSF). Then we attached to each factor a weight coefficient from zero (unimportant) to one (very important) so that the total sum of the weight coefficients equals one. To do this, every expert assigned to any of the factors a number between 1 and 5, then we normalized the columns in order to have a weight coefficient between zero and one for each factor, and the total sum equals one. Each coefficient indicates the relative importance of the factor.

In addition, following experts' suggestions, we assigned to each factor a score (the score of status quo) between 1 and 4 (score 4: golden opportunity, score 3: considerable opportunity, score 2: considerable threat and score 1: serious threat). These scores are determined in terms of the effectiveness of current strategies in their response to these factors. To achieve the weighted score of each factor, its weight coefficient (its degree of importance) is multiplied by its score of status quo and then each product number is recorded under a column called "weighted scores". Total weighted scores are calculated which could be at least one and at most four [37]. The final score for the identify matrix of the external strategic factors is 2.225. The identify matrix of the external factors in the mining industry in Semnan province is shown in table (II).

Table II. Matrix of the external factors in mining industry in Semnan province (EFE)

Opportunities and Treats	Weight	Score of *status quo*	Weighted Score
Utilization of the efficient and low-cost expert forces, regarding to the existence of universities, scientific and professional centers (F_1)	0.097	3	0.291
Ability to develop industries in pottery, ceramics and other mineral products (F_2)	0.097	3	0.291
Adjacency to the consumer market (F_3)	0.097	3	0.291
Situating in the heart of the main path of the country: the main iron and highway transportations; hence accessibility to the five major provinces of the country (F_4)	0.097	3	0.291
The government's new approach to non-oil sources (F_5)	0.064	3	0.192
Low-interest loans in the form of stimulus packages designed to restructure the production line (F_6)	0.064	3	0.192
Exchange rate volatility of the current currencies, especially the dollar (F_7)	0.129	1	0.129
The increase in VAT in terms of multiple economic pressures to manufacturers (F_8)	0.097	2	0.194
Problems of opening credit accounts, equipment and machinery insurances, and financial transactions with overseas companies due to the international sanctions (F_9)	0.162	1	0.162
Increased strikes and labor issues due to the problems in the payment of salaries (F_{10})	0.064	2	0.128
The occurrence of natural and unexpected incidents in the mining industry (F_{11})	0.032	2	0.064
Total sum	1	-	2.225

B. Forming the Identify Matrix for Internal Strategic Factors

Internal strategic factors (strengths, weaknesses) are among the activities which are under the control of the organization. Confronting these factors, the organization's control can be recorded in a range from the very excellent to the every weak.

One of the most important information, here, is the organization's awareness of its relative strengths and weaknesses. It is claimed that the evaluation can also be determined on the basis of the strengths and weaknesses of the company's existence and not on the basis of its performance [38]. Here, we have the similar steps outlined in forming the evaluation matrix for external factors, except that instead of "the opportunities and threats", there are "the strengths and weaknesses" to be examined. By entering the correspond factors in the evaluation matrix of internal factors and applying coefficients, the final score of 2.789 was obtained as the result of the identify matrix for internal strategic factors. In table (III), we have the matrix in details.

Table III. Matrix of the internal factors in mining industry in Semnan province (IFE)

Strengths and Weaknesses	Weight	Score of status quo	Weighted Score
Ranked first in terms of production of gypsum, salt, Celestine and zeolite (F_{12})	0.105	4	0.420
Second place in production of sodium sulfate and cyan (F_{13})	0.079	3	0.237
Ranked fifth in terms of the number of mines (F_{14})	0.105	4	0.420
Third place in production of coal and chromite (F_{15})	0.079	3	0.237
There are 45 types of mineral materials such as gypsum, sodium sulphate, zeolite, salt, Celestine, chromite, coal, limestone, gold, bauxite and other constructional granite rocks, *etc*. in the province, in the condition that the total number of known types of mineral materials throughout the country is 71. (F_{16})	0.132	4	0.528
Existing of the customs and special economic zones in order to do export formalities for mineral and industrial goods in the center of the province (F_{17})	0.079	3	0.237
Lack of liquidity in the banking system and the inability of any loan payment by them (F_{18})	0.132	1	0.132
Supply problems collaterals and guarantees for foreign exchange facilities (F_{19})	0.079	2	0.158

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Unsuitable payment of subsidies of industry and mining sector after the implementation of targeted subsidies (F_{20})	0.079	2	0.158
Lack of timely payment of the demands of the private sector from the public sector (F_{21})	0.052	2	0.104
Lack of sufficient rail routes in the transport sector (F_{22})	0.027	2	0.054
Lack of studies related to the promotion of the province's non-oil exports (F_{23})	0.052	2	0.104
Total sum	1	-	2.789

C. Forming the SWOT Matrix and Designing the Strategies

After the identification and classification of the internal and external factors, appropriate strategies are proposed. Thus, these factors enter into the sidelines of the SWOT matrix and hence the appropriate strategies are suggested in four categories: SO, WO, ST and WT. The SWOT matrix of the mining industry in Semnan province is shown in the table (IV).

Table IV. The SWOT Matrix of the Mining Industry in Semnan Province

	S (strengths)	**W (weaknesses)**
	1. Ranked first in terms of production of gypsum, salt, Celestine and zeolite. 2. Second place in production of sodium sulfate and cyan. 3. Ranked fifth in terms of the number of mines. 4. Third place in production of coal and chromite. 5. There are 45 types of mineral materials such as gypsum, sodium sulphate, zeolite, salt, Celestine, chromite, coal, limestone, gold, bauxite and other constructional granite rocks, etc. in the province, in the condition that the total number of known types of mineral materials throughout the country is 71. 6. Existing of the customs and special economic zones in order to do export formalities for mineral and industrial goods in the center of the province.	1. Lack of liquidity in the banking system and the inability of any loan payment by them. 2. Supply problems collaterals and guarantees for foreign exchange facilities. 3. Unsuitable payment of subsidies of industry and mining sector after the implementation of targeted subsidies. 4. Lack of timely payment of the demands of the private sector from the public sector. 5. Lack of sufficient rail routes in the transport sector. 6. Lack of studies related to the promotion of the province's non-oil exports.
O (opportunities)	**SO strategies**	**WO strategies**
1. Utilization of the efficient and low-cost expert forces, regarding to the existence of universities, scientific and professional centers. 2. Ability to develop industries in pottery, ceramics and other mineral products. 3. Adjacency to the consumer market. 4. Situating in the heart of the main path of the country: the main iron and highway transportations; hence accessibility to the five major provinces of the country. 5. The government's new approach to non-oil sources. 6. Low-interest loans in the form of stimulus packages designed to restructure the production line.	1. To create producing industries and improve operational capabilities to achieve salable products directly to the market (S_1, S_2, S_3, S_4, S_6, O_1, O_3, O_5). 2. To increase the production of diverse products with high quality (S_2, S_5, S_6, O_1, O_2, O_3, O_6). 3. To create some industrial clusters in the field of handicraft production (domestic and industrial) with raw materials such as mud, clay and plaster panel (S_1, S_5, S_6, O_1, O_2, O_3, O_6).	1. To provide more interaction between the government and the private sector (activate the role of mining engineering and subsequently a maximum participation in decisions related to the industry sector of the province) (W_3, W_4, W_6, O_1, O_5, O_6). 2. To form some specialized, industrial, mining, strategic and advisory committees in the Provincial Government in order to facilitate local laws and encourage the investments in mining (W_2, W_6, O_1, O_5).
T (threats)	**ST strategies**	**WT strategies**
1. Exchange rate volatility of the current currencies, especially the dollar. 2. The increase in VAT in terms of multiple economic pressures to manufacturers. 3. Problems of opening credit accounts, equipment and machinery insurances, and financial transactions with overseas companies due to the international sanctions. 4. Increased strikes and labor issues due to the problems in the payment of salaries. 5. The occurrence of natural and unexpected incidents in the mining industry.	1. To create and make basis for co-operatives to product mineral productions (S_1, S_2, S_3, S_5, T_1, T_3). 2. To update coke-making plants and to construct small units of coke-making and coal washing (S_4, S_6, T_1, T_3).	1. To contract joint mineral ventures with other mines in the province (W_1, W_3, T_1, T_3, T_5). 2. To encourage the investment companies to participate and invest in the current active mines in order to inject liquidity and capital development (W_1, W_2, W_4, T_1, T_3).

D. The Prioritization of the Strategies Relying on the AHP

Analytic Hierarchy Process (AHP) is one of the most powerful techniques for multi-criteria decisions. This technique, which is introduced by Thomas L. Saaty in 1980, is chosen for the present research, since it makes it possible to formulate a problem in a series or more precisely in a "hierarchy". Furthermore, the AHP provides the possibility to take into account both the qualitative and the quantitative criteria of a problem. Another benefit of this method is actually

to determine the amount of compatibility or inconsistency of the decision. In fact, the AHP method helps decision-makers to set their goals and their suggestions in a complex condition, and to prioritize and classify them in an unstructured and non-transparent environment [39].

In this part, the appropriate strategies developed in the previous section for the mining industry in Semnan province, will be examined to identify the priorities of them. In this way, the appeal of each strategy will be registered in the couples (one-on-one) relatively to each of the factors of strengths, weaknesses, opportunities and threats in the mining industry of Semnan province, simultaneity the strategies will be compared with each other and finally they will be prioritized. For this purpose, it seemed to us that a combination of Analytic Hierarchy Process (AHP) with the analysis of the SWOT would be the best choice.

To prioritize the strategies using a combination of the methods AHP with the SWOT, we applied the method AHP step-by-step by using the scores obtained in the analysis of SWOT. The steps for prioritize the strategies are described below.

1) Forming the Pair-wise Matrices

The Analytical Hierarchy Process (AHP) uses a kind of pair-wise comparison of decision options -with regard to every decision- to determine the relative importance of the options [40].

In this step, the strategies are compared relatively to each factor from the SWOT in a one-on-one manner of which the result would be a pair-wise matrix. The Comparisons are based on the experts' opinions gathered by questionnaires. The relative comparisons of the indexes are registered by oral judgments for "absolute", "very strong", "strong", "weak", and "the same" importance between the elements of each pair, to which the numbers 9, 7, 5, 3 and 1 are assigned respectively. And the numbers 8, 6, 4 and 2 are designated for the median opinions.

The strategies must be analyzed in a pair-wise comparison with all the 23 existing factors in the SWOT matrix. Due to the high volume of pair-wise comparisons, and the magnitude of the dimensions of matrices that can potentially cause a kind of inconsistency in comparing within matrices, we used of a structural pair (-wise) comparison (SPC) method. The method of SPC consists of two steps. In the first step, we give a score to each option and in the second we will compare the scores of the options with each other [41].

For the pair-wise comparison of the strategies, the difference between the scores functions as the superiority of one strategy over the other. Each of the pair-wise matrices forms like the one illustrated in the relation (1) [42]:

$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix} \quad (Relation\ 1)$$

In this matrix the subscript in "a_{ij}" means that the element "i" is preferred over the element "j". In the pair-wise comparison, according to the inverse conditions between entries, there exists the following relation:

$$a_{ij} = 1/a_{ji} \quad (Relation\ 2)$$

An example of a pair-wise comparison matrix of strategies is shown in the table (V). With regard to the number of strategies, the pair-wise comparisons are arranged in 9×9 matrices. In a usual method of AHP, you should also have a 23×23 matrix in order to have all comparisons. This high volume of comparisons and calculations, apart from resulting in probable errors and indubitable difficulties, not seems really necessary in our inquiry. In this part, instead of forming a kind of super-matrix and doing the high volume surveys and heavy calculations, we will use the resulting weights from the matrices EFE and IFE -fully explained in the previous section- in our calculations in the AHP method.

Table V. An example of the pair-wise comparison matrices of the strategies: regarding the factor called above "Utilization of the efficient and low-cost expert forces, regarding to the existence of universities, scientific and professional centers" (F1)

		S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	Weight
S_1	To create producing industries and improve operational capabilities to achieve salable products directly to the market	1	1	3	6	5	1	1	5	4	0.210
S_2	To increase the production of diverse products with high quality	1	1	1	3	4	1/2	3	6	4	0.179
S_3	To create some industrial clusters in the field of handicraft production (domestic and industrial) with raw materials such as mud, clay and plaster panel	1/3	1	1	2	3	1	2	4	3	0.134
S_4	To create and make basis for co-operatives to product mineral productions	1/6	1/3	1/2	1	2	1	1/2	3	2	0.073
S_5	To update coke-making plants and to construct small units of coke-making and coal washing	1/5	1/4	1/3	1/2	1	1/4	1/3	1	1	0.036
S_6	To provide more interaction between the government and the private sector (activate the role of mining engineering and subsequently a maximum participation in decisions related to the industry sector of the province)	1	2	1	1	4	1	1	1	3	0.139
S_7	To form some specialized, industrial, mining, strategic and advisory committees in the Provincial Government in order to facilitate local laws and encourage the investments in mining	1	1/3	1/2	2	3	3	1	4	4	0.147

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S_8	To contract joint mineral ventures with other mines in the province	1/5	1/6	1/4	1/3	1	1	1/4	1	1	0.042
S_9	To encourage the investment companies to participate and invest in the current active mines in order to inject liquidity and capital development	1/4	1/4	1/3	1/2	1	1/3	1/4	1	1	0.040

As we can see in table (V), the strategy S_1 has the greatest weight and the strategy S_5 has the lowest weight.

2) Calculating the Weights of the Elements and Determining the Rates of Inconsistency

After forming the pair-wise comparison matrices, the relative weights of the elements are calculated. There are different methods to calculate the relative weights in respect to the pair-wise matrices. Among them, we can mention the most important ones: the method of Least Squares (LS), the Logarithmic Least Squares Method (LLSM), the Eigenvector Method (EM) and different kinds of Approximation Methods. In this study, to determine the weights of the elements, we have utilized the Arithmetic Mean method, which is a kind of Approximation Methods. In the final step, the consistency of judgments will be checked. Since we have benefited of the views of several experts, it would not be necessary to calculate the Inconsistency Rate (IR).

3) Calculating the Final Weights and Prioritizing the Strategies

The final weight of each strategy results from the sum of the weights of the factors multiplied by the weight of the strategy. In this respect, we first introduce two matrices: first, a 1×23 matrix of the weights of factors from our SWOT analysis ($W_{factors}$), and second, a 23×9 matrix of the weights of the strategies (W_1). These two matrices are shown blow.

$$W_{factors} = [0.052 \;\; 0.027 \;\; 0.052 \;\; 0.079 \;\; 0.079 \;\; 0.132 \;\; 0.079 \;\; 0.132 \;\; 0.079 \;\; 0.105 \;\; 0.079 \;\; 0.105 \;\; 0.032 \;\; 0.064 \;\; 0.162 \;\; 0.097 \;\; 0.129 \;\; 0.064 \;\; 0.064 \;\; 0.097 \;\; 0.097 \;\; 0.097 \;\; 0.097]$$

$$W_1 = \begin{bmatrix}
0.040 & 0.042 & 0.147 & 0.139 & 0.036 & 0.073 & 0.134 & 0.179 & 0.210 \\
0.072 & 0.062 & 0.040 & 0.038 & 0.024 & 0.105 & 0.280 & 0.220 & 0.159 \\
0.066 & 0.094 & 0.047 & 0.036 & 0.127 & 0.076 & 0.136 & 0.208 & 0.210 \\
0.075 & 0.058 & 0.037 & 0.031 & 0.087 & 0.078 & 0.278 & 0.179 & 0.177 \\
0.041 & 0.034 & 0.124 & 0.120 & 0.066 & 0.054 & 0.128 & 0.182 & 0.251 \\
0.033 & 0.032 & 0.062 & 0.188 & 0.093 & 0.043 & 0.127 & 0.280 & 0.142 \\
0.304 & 0.200 & 0.078 & 0.052 & 0.119 & 0.144 & 0.038 & 0.032 & 0.033 \\
0.110 & 0.127 & 0.228 & 0.252 & 0.061 & 0.101 & 0.041 & 0.039 & 0.041 \\
0.196 & 0.269 & 0.109 & 0.064 & 0.094 & 0.162 & 0.037 & 0.035 & 0.034 \\
0.257 & 0.221 & 0.151 & 0.069 & 0.079 & 0.092 & 0.047 & 0.042 & 0.042 \\
0.122 & 0.258 & 0.077 & 0.082 & 0.070 & 0.172 & 0.069 & 0.075 & 0.075 \\
0.050 & 0.040 & 0.063 & 0.042 & 0.032 & 0.108 & 0.199 & 0.241 & 0.225 \\
0.069 & 0.061 & 0.080 & 0.036 & 0.030 & 0.166 & 0.048 & 0.250 & 0.260 \\
0.072 & 0.030 & 0.121 & 0.053 & 0.041 & 0.135 & 0.087 & 0.226 & 0.235 \\
0.072 & 0.047 & 0.097 & 0.041 & 0.255 & 0.118 & 0.029 & 0.172 & 0.169 \\
0.059 & 0.033 & 0.066 & 0.024 & 0.111 & 0.163 & 0.214 & 0.197 & 0.133 \\
0.047 & 0.027 & 0.106 & 0.084 & 0.153 & 0.054 & 0.155 & 0.189 & 0.135 \\
0.252 & 0.248 & 0.115 & 0.071 & 0.072 & 0.135 & 0.036 & 0.034 & 0.037 \\
0.227 & 0.113 & 0.296 & 0.162 & 0.053 & 0.059 & 0.030 & 0.030 & 0.030 \\
0.122 & 0.193 & 0.162 & 0.325 & 0.050 & 0.057 & 0.030 & 0.030 & 0.031 \\
0.178 & 0.117 & 0.190 & 0.320 & 0.050 & 0.055 & 0.030 & 0.030 & 0.030 \\
0.066 & 0.150 & 0.275 & 0.132 & 0.125 & 0.061 & 0.062 & 0.063 & 0.056 \\
0.044 & 0.032 & 0.250 & 0.312 & 0.060 & 0.047 & 0.060 & 0.077 & 0.118
\end{bmatrix}$$

Next, according to the relation (3), we have achieved the final weights of the strategies:

$$W_{factors} \times W_1 = W_{strategies} \qquad (relation\ 3)$$

$$W_{strategies} = [0.217561 \;\; 0.210838 \;\; 0.26296 \;\; 0.252327 \;\; 0.186594 \;\; 0.188382 \;\; 0.187489 \;\; 0.254938 \;\; 0.238911]$$

Due to the resulted weights, the prioritization of the strategies is:

$$\mathbf{S_3 > S_8 > S_4 > S_9 > S_1 > S_2 > S_6 > S_7 > S_5}$$

III. CONCLUSIONS

The importance of Semnan province in Iran, in terms of the breadth and diversity of mineral reserves, has over and over increased the requirement for an analysis to identify and prioritize the strategies and develop them in the mining industry. In fact, according to non-actualized potentials of this industry in Semnan Province, the strategy planning can be seen as an inevitable resource to overcome the problems in this

industry and to use the existing strengths and opportunities in order to become the leader industry in the domestic productions and the export of non-oil industry of Iran.

After identifying the internal and external factors and putting them in the SWOT matrix and integrating them together, we achieved a series of nine strategies: to create producing industries and improve operational capabilities to achieve salable products directly to the market (S1); to increase the production of diverse products with high quality (S2); to create some industrial clusters in the field of handicraft production (domestic and industrial) with raw materials such as mud, clay and plaster panel (S3); to create and make basis for co-operatives to product mineral productions (S4); to update coke-making plants and to construct small units of coke-making and coal washing (S5); to provide more interaction between the government and the private sector (activate the role of mining engineering and subsequently a maximum participation in decisions related to the industry sector of the province) (S6); To form some specialized, industrial, mining, strategic and advisory committees in the Provincial Government in order to facilitate local laws and encourage the investments in mining (S7); To contract joint mineral ventures with other mines in the province (S8); and to encourage the investment companies to participate and invest in the current active mines in order to inject liquidity and capital development (S9).

Then, by applying the Analytic Hierarchy Process (AHP), we prioritized the strategies resulted from the SWOT matrix. To do this, we first formed the pair-wise comparison matrices and then calculated the correspondent final weights. Therefore, based on prioritized strategies: “creating some industrial clusters in the field of handicraft production (domestic and industrial) with raw materials such as mud, clay and plaster panel” with a final weight of 0.263, “contracting joint mineral ventures with other mines in the province” with a final weight of 0.255, and “creating and making basis for co-operatives to product mineral productions” with a final weight of 0.252, are the most privileged strategies which should be taken into account seriously.

The last three prioritized strategies, which are “updating coke-making plants and constructing small units of coke-making and coal washing” with a final weight of 0.186, “forming some specialized, industrial, mining, strategic and advisory committees in the Provincial Government in order to facilitate local laws and encourage the investments in mining” with a final weight of 0.187, and “providing more interaction between the government and the private sector (activating the role of mining engineering and subsequently a maximum participation in decisions related to the industry sector of the province)” with a final weight of 0.188, despite their importance, could be taken into account after all other strategies.

Finally, it should be noticed that applying the strategic management and prioritizing the basic strategies will entail a significant contribution for the mining industry in Semnan province in Iran's both national and international markets.

REFERENCES

[1] http://semnan.mporg.ir/Portal/View/Page.aspx?PageId=e11926c6-0f3f-4dda-9813-1cd895042460 ; Management and Planning Organization of Semnan province.

[2] https://www.amar.org.ir/ ; Statistical Center of Iran.

[3] http://sem.mimt.gov.ir/ ; Semnan Organization of Industry, Mine and Trade.

[4] David, Fred R., Strategic Management: Concepts and Cases 2002, , ninth edition, The Nature of Strategic Management, ISBN 0130497940(ISBN13: 9780130497949), p. 368.

[5] Amin, S.H., Razmi, J., and Zhang. G., (2011), Supplier selection and order allocation based on fuzzy SWOT analysis and fuzzy linear programming, Exper Systems with Applications, Vol. 38, No. 1, pp. 334–342.

[6] Kurttila, M., Pesonen, M., Kangas, J., and Kajanus, M. (2000), Utilizing the analytic hierarchy process (AHP) in SWOT analysis— a hybrid method and its application to a forest-certification case, Forest Policy and Economics 1, pp. 41-52.

[7] Shrestha, R. K., Alavalapati, J. R., and Kalmbacher, R. S. (2004), Exploring the potential for silvopasture adoption in south-central Florida: an application of SWOT—AHP method, Agricultural Systems 81, pp. 185-199.

[8] Srivastava, P. K., Kulshreshtha, K., Mohanty, C. S., Pushpangadan, P., and Singh, A. (2005), Stakeholder-based SWOT analysis for successful municipal solid waste management in Lucknow, India, Waste Management 25, pp. 531–537.

[9] Kandakoglu, A., Celik, M., and Akgun, I. (2009), A multi-methodological approach for shipping registry selection in maritime transportation industry, Mathematical and Computer Modelling 49, pp. 586_597.

[10] Markovska, N., Taseska, V., and Pop-Jordanov, J. (2009), SWOT analyses of the national energy sector for sustainable energy development, Energy 34, pp. 752–756.

[11] Nikolaou, I. E., and Evangelinos, K. I. (2010), A SWOT analysis for environmental management practices in Greek Mining and Mineral Industry, Resources Policy 35, pp. 226–234.

[12] Mainali, B., Hao Ngo, H., Guo, W., Pham, T. T., and Johnston, A. (2011), Feasibility assessment of recycled water use for washing machines in Australia through SWOT analysis, Resources, Conservation and Recycling 56, pp. 87-91.

[13] Fouladgar, M. M., Yazdani-Chamzini, A., and Zavadskas, E. K. (2011), An integrated model for prioritizing strategies of the Iranian mining sector, Technological And Economic Development Of Economy, Vol. 17, No. 3, pp. 459–483.

[14] Zhao, Z. Y., and Yan, H. (2012), Assessment of the biomass power generation industry in China, Renewable Energy 37, pp. 53-60.

[15] Seker, S., and Ozguler, M. (2012), Analysis of the Turkish Consumer Electronics Firm using SWOT-AHP method, Procedia - Social and Behavioral Sciences 58, pp. 1544-1554.

[16] Gorener, A., Toker, K., and Ulucay, K. (2012), Application of Combined SWOT and AHP: A case Study for a Manufacturing Firm, Procedia - Social and Behavioral Sciences 58, pp. 1525-1534.

[17] Tahernejad, M. M, Khalokakaie, R., and Ataei, M. (2013), Determining proper strategies for Iran’s dimensional stone mines: a SWOT-AHP analysis, Arabian Journal of Geosciences, Vol. 6, No. 1, pp. 129–139.

[18] Yavuz, F., and Baycan, T. (2013), Use of SWOT and analytic Hierarchy process integration participatory decision making tool in watershed management, Procedia Technology 8, pp. 134-143.

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[19] Bas, E., (2013), The integrated framework for analysis of electricity supply chain using an integrated SWOT-fuzzy TOPSIS methodology combined with AHP: the case of Turkey, Electrical Power and Energy Systems 44, pp. 897-907.
[20] Mehmood, F., Hassannezhad, M., and Abbas, T. (2014), Analytical investigation of mobile NFC adaption With SWOT-AHP approach: A case of Italian Telecom, Procedia Technology 12, pp. 535-541.
[21] Posch, A., Brudermann, T., Braschel, N., and Gabriel, M. (2015), Strategic energy management in energy-intensive enterprises—quantitative analysis of relevant factors in the Austrian paper and pulp industry, Journal of Cleaner Production, Vol. 90, pp. 291–299.
[22] Dzonzi-Undi, J., and Li, Sh. (2015), SWOT analysis of safety and environmental regulation for China and USA: its effect and influence on sustainable development of the coal industry, Environmental Earth Sciences, Vol. 74, No. 8, pp. 6395–6406.
[23] Moghaddaszadeh, M., Sarfaraz, A. H., Komijan, A. R., et al. (2015), An integration of SWOT and factor analysis to determining and prioritizing strategies: case study of a Persian food industry, International Jornal of System Assurance Engineering and Management, Vol. 6, No. 3, pp. 297–303.
[24] Jaber, J. O., Elkarmi, F., Alasis, E., and Kostas, A. (2015), Employment of renewable energy in Jordan; Current status, SWOT and problem analysis, Renewable and Sustainable Energy Reviews 49, pp. 490-499.
[25] Rauch, P.,Wolfsmayr, U. J., Borz, S. A., et al. (2015), SWOT analysis and strategy development for forest fuel supply chains in South East Europe, Forest Policy and Economics, Vol. 61, pp. 87-94.
[26] Edril, A., and Erbiyik, H. (2015), Selection Strategy via Analytic Hierarchy Process: An Application for a Small Enterprise in Milk Sector, Procedia – Social and Behavioral Sciences 195, pp. 2618-2628.
[27] Bartuskova, T., and Kresta, A. (2015), Application of AHP method in external strategic analysis of Selected organization, Procedia Economics and Finance 30, pp. 146-154.
[28] Zhu, K., Zhao, Sh., Yang, Sh., and et al. (2016), Where is the way of rare earth industry of China: An analysis via ANP-SWOT approach, Resources Policy, Vol. 49, pp. 349–357.
[29] Psschalidou, M., Tsatiris, M., and Kitikidou, K. (2016), Energy crops for biofuel production or for food? – SWOT analysis (case study: Greece), Renewable Energy 93, pp. 636-647.
[30] Shi, X. (2016), The future of ASEAN energy mix: A SWOT analysis, Renewable and Sustainable Energy Reviews 53, pp. 672-680.
[31] Iglinski, B., Iglinska, A., Kozinski, G., and et al. (2016), Wind energy in Poland – History ,current state, surveys, Renewable Energy Sources Act, SWOT analysis, Renewable and Sustainable Energy Reviews 64, pp. 19-33.
[32] Hidayah, Z., Rosyid, D. M., and Armono, H. D. (2016), Planning for sustainable small island management: case study of Gili Timur Island East Java Province Indonesia, Procedia – Social and Behavioral Sciences 227, pp. 785-790.
[33] Chanthawong, A., and Dhakal, Sh. (2016), Stakeholder's perceptions on challenges and opportunities for biodiesel and bioethanol policy development in Thailand, Energy Policy 91, pp. 189-206.
[34] Santopuoli, G., Marchetti, M., and Giongo, M. (2016), Supporting policy decision makers in the establishment of forest plantations, using SWOT analysis and AHP analysis. A case study in Tocantins (Brazil), Land Use Policy 54, pp. 549-528.
[35] Adar, E., Karatop, B., Ince, M., and Bilgili, M. S. (2016), Comparison of methods for sustainable energy management with sewage sludge in Turkey based in SWOT-FAHP analysis, Renewable and Sustainable Energy Reviews 62, pp. 429-440.
[36] David, Fred R., Strategic Management: Concepts and Cases 2002, , ninth edition, The Nature of Strategic Management, ISBN 0130497940(ISBN13: 9780130497949), p. 368.
[37] Mosly, I. (2016), Construction Project Delivery System Selection Framework: Professional Service Firm's Perspective, Journal of Civil Engineering and Architecture 10, pp. 368-378.
[38] Banihashemi, S. A., and Rajaei, Z. (2016), Assessment of Environmental Conditions And Internal Capabilities Affecting University Strategies (IFE, EFE, SWOT and AHP Models), Vol. 6. No. 10, pp. 558 -567.
[39] Sehra, S. K., Brar, Y. S., and Kaur, N. (2012), Multi Criteria Decision Making Approach for Selecting Effort Estimation Model, International Journal of Computer Applications, Vol. 39, No. 1, pp. 10-17.
[40] Saaty, Thomas L., and Vargas, Luis G. 2012, Models, methods, concepts and Applications of the analytic heirarchy process, ISBN 978-1-4614-3597-6 (ebook).
[41] Sharifi, M. A., Boerboom, L., Shamsudin, K. B., and Veeramuthu, L. (2006). Spatial Multiple Criteria Decision Analysis in integrated Planning For Public Transport and Land Use Development Study in Klang Valley, Malaysia, ISPRS Technical II sympoisium, Vienna, pp. 85-91.
[42] Lanjewar, P. B., Rao, R. V., Kale, A. V., and Oclon, P. (2016), Evaluation and selection of energy technologies using an integrated graph theory and analytic hierarchy process methods, Decision Science Letters 5, pp. 327-348.

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