# Presenting the sustainable development model of mines in Iran based on tourism potentials

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## Abstract

The purpose of this research is to present mine managers with solutions for the sustainable development of mines with an emphasis on mine tourism. In the first step, identifying ways for mine sustainable development with the use of tourism potentials by studying articles on a national and global scale taken from the SID citation center, Emerald, and Science through content analysis using Nvivo software, was in order. In the second step, 12 main factors were identified and confirmed with the help of the Delphi method and 12 university and industry experts, using EXCEL software. Then, by using tourism potentials with the ISM method and the participation of experts from the previous section, the development model of mines in Iran was achieved and an interpretive structural model was extracted. Finally, in the third step, in order to check the application of the proposed model, structural equation modelling analysis was done using PLS3 software with the participation of 170 managers and supervisors of Iranian mines. The final results acknowledged 12 ways as the final methods of mine sustainable development considering tourism potentials. In the eyes of the expert, mines' innovative reconstruction based on a tourism standpoint, tourism infrastructure improvement, increase in the region's social capital, business and employment growth based on tourism as a necessity were deemed the most effective ways of sustainable development for mines using tourism potentials. Evaluation of the proposed model in the field showed that among 32 theories, only the relationship between innovative mining tourism strategies and business prosperity and job creation based on tourism, the development of mine workers human resources and the development of the region's social capital and the relationship between the development of mine workers human resources and the prosperity of business and employment based on tourism was not approved.

Keywords: Sustainable development, Sustainable development of mines, Mining tourism, Tourism potentials
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## 1 Introduction

Development is a dynamic, comprehensive and multidimensional concept which has occupied the minds of many planners, statesmen, policymakers, and other researchers and specialists to improve life circumstances and conditions, benefit us humans and enhance our capabilities however possible. Unbalanced global industrial development, threatens

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worlds with issues and challenges including poverty and hunger, inequity and injustice within and between nations, marginalization, unemployment of the youth, health problems, increased violence and terrorism, looting of natural resources and extensive environmental destruction. The existing challenges entertain the fact that without paying attention to sustainable development, it's not possible for countries to continue their healthy and optimal life [40]. In recent years, concerns about sustainable development have been addressed more and more often in many countries and industries. The United Nations World Commission on Environment and Development defined sustainable development as follows in the 1987 report "Our common future": "Development that meets today's needs without compromising future generation's abilities to fulfil their needs". There is general acceptance that sustainable development includes consideration of environmental, economic and social aspects, backed up by the foundation of good governance. After the acceptance of the sustainable development concept by the majority of facilities and governments, they began integrating various aspects of sustainable development with their activities [27].

Although mining and its related industries play a positive and valuable role in social and economic components of sustainable development through generating wealth and capital and job opportunities, however, it is criticized because of its role in sustainable development's third major component is referred to as the environment. Also, due to the increasing need of the world community for minerals, the mining industry has issues to deal with in this matter including recycling metals and minerals, environmental protection and social burden. If the components of sustainable development in growing countries, especially IRAN which is rich in minerals, are not taken into account, not only would it not command improvement, it would lead to backwardness both in economic and social aspects [36]. In mining industries, the term "Sustainable development" was first used in the early 1990s in forums such as the Rio Summit in 1992. Efforts were made by [3, 4, 5, 8, 20, 26, 28, 43, 44]. However, some researchers believe that because of the fact that mineral resources are non-renewable, mining is not part of sustainable development and that miners deplete the mine out of any mineral, which results in unstable mines and long-lasting environmental, social and economic side effects [1].

Mining geotourism is a part of every country's geotourism attractions such as; observing various stones especially precious stones, and observing mining strategies and the history of mining. Mineral tourism is a part of historical tourism which is related to history and settlement. Among the reasons for mines being included in tourism sites, we can refer to the populated interest in the environment, culture and historical heritage of extractive industries [46]. On the other hand, considering the importance of environmental preservation during the process of tourism expansion and also, exercising the fact that tourist groups will be affected by the controlled circumstances in these areas willingly or unwillingly, they are bound to express themselves and their behaviours under better appearances and social burden, and are committed to preventing any negative environmental effects from happening; in this manner, mining tourism can be listed amongst "Green Tourism" [16]. To sum it up, in its first step of Qualitative and quantitative research method and content analysis method, this study is looking to identify ways for sustainable development of mining based upon tourism potentials. Then, it seeks to achieve the sustainable development model of mines IRAN through quantitative research method (Delfi and Interpretive structural modelling), in the second step. Finally, in the last phase, with the usage of quantitative study and questionnaire, the researcher tends to analyze the application of sustainable development of mines based on tourism potentials.

## 2 Theoretical foundations and research questions

Nowadays, as a dynamic industry with various distinct and unique attributes, tourism has taken an important part in the production and economics of developed and developing countries. From its early days up to now, this industry has been in the interest of human societies and has been continuing its dynamic according to mankind's various social and economic needs which with the ever-increasing development of communications and the significant increase in the number of tourists and the income generated from them, has resulted in many benefits for societies. The increasing importance of tourism activity and its transformation to one of the great sources to obtain wealth and capital has placed many societies in the effort to make the best out of this industry throughout the world [12]. In today's world, tourism is considered to be one of the key factors in expansion and eliminating deprivation within the frame of national, regional and local spatial planning (Land-use planning). Tourism is one of the most important factors in regional development and construction; it is an activity that causes economic and social development in the region and fair distribution of income and also results in increasing employment. In fact, the income from tourism is one the biggest income sources for nations with is referred to as "Invisible export" [13]. It has been proven by experience that tourism has effects on the economy, society and environment. But despite many advantages of tourism in improving economic and social circumstances worldwide, if its development is not accompanied by policies and programs in accordance with the environmental attitude and with an emphasis on the sustainability of development, there would

be definite side effects on nature and environment which will not only destroy natural and artificial sites but ultimately leads to the reduction of the attractions of affected lands for domestic and foreign tourists [15].

Sustainable tourism tends to regulate the relationship between tourists and tourism attractions. Because this relationship can be constructive and dynamic and seeks to adjust the pressure and crisis between these elements in order to minimize the environmental and cultural damage, providing visitors with satisfaction and as well as improvements throughout the region. Therefore, sustainable tourism is a type of tourism that aims to manage renewable resources, both human and natural, in such a way that the economic, social and aesthetic needs of tourists are met and cultural integration, necessary ecological processes, ecological diversity and natural systems are preserved. In other words, sustainable tourism development emphasizes meeting the development needs of the local community, improving the supply chain of local products, encouraging local industries and professions, developing according to the local bio-environmental and social capacity and increasing the stability of tourism income [30].

Nowadays, mining tourism has become one of the booming branches of nature tourism also known as Geotourism. Mining tourism is the bridge between natural and artificial (man-made) tourism as the alterations which humans made in the natural environment of the mines, brought out a whole new and innovative landscape unique enough, to create the purest and most wonderful of experiences for any tourist who comes across these sites. Mining tourism is actually one of the sub-branches of geo-tourism that has received attention globally in the last few years and has become a source of income for countries. In fact, a mine is not only worth it because of the assets which can be extracted from it but even after being abandoned, it could be used as a source to create job opportunities and income [17]. Mining tourism is considered among the best Geotourism activities. Sites for a purposeful visit to mining exploration and digging tools and equipment from ancient times in abandoned mines to modern exploration tools in today's mines. Of course, that's not all there is to it! Because in this visit, you will be introduced to unknown things from the heart of the earth, minerals and precious stones, the activities of miners and historical heritage, and it will present the possibility to turn a mine into a destination for tourists to visit and earn a sustainable income from it at the same time. The existence of many cities and communities in the world relies on the existence of active mines [17]. According to the topics that were discussed up to now, the following question has been raised and examined, in order to achieve the purpose of this research:

What are the methods of sustainable development of mines based on tourism potentials?

What is the pattern of sustainable development of mines considering tourism potential in Iran?

How is the application of sustainable development of mines in Iran with the usage of tourism potentials in mines?

The results of data analysis in Rezayie Lori and coworkers research show that comprehensive responsibility becomes the main factor in forming a just and fair governance and on top of that, knowledge connectionism, innovation platforms and innovative actions end in sustainable development in social, economic and environmental fields. Also, tourism and mining tourism and natural resource tourism provides nations with a great opportunity for all-around improvement. The outcome of Safari and coworkers research [36], implies that upon choosing the suitable course of action on renovating the JOBEN sand mine using the FTOPSIS fuzzy multi-criteria decision-making method in order to obtain regional sustainable development, Land renovation and environmental restoration is an effective way to use land resources economically and helps harmony between people and land in the mining area. In the research, Yazdani Nasab [46] tried to examine the link between tourism and Gol Gohar mine for sustainable development. Results declared that the reconstruction operation should not be delayed or postponed after the completion of the mining operation, since the Gol Gohar mine is far from the end of its life and unanticipated assets and resources. In other words, the best decision is to simply revive the affected area at the same time as it is being used for mining purposes which not only reduce the destructive effects in all fields such as soil, water and air pollution but also, prevent the increasing erosion process.

Poor Ismaili [35] in an article entitled "Review of sustainable development evaluation methods in open-pit mines" states that mining tourism can be one of the methods of sustainable development. Ramezani and Elmi [37] in research on the subject of "sustainable development in Iran's mines", emphasize the significance of the usage of basic and vital tools to achieve sustainable development, identifying the negative effects of mining operations on the environment and providing measures and solutions, including tourism, to reduce these negative effects and reviving the ecosystem after being finished with mine operations. In the Byström research [7], the emergence of mining tourism is understood as the creation of knowledge, deeply rooted in a regional path of dependence on mining and tourism, considered as a solution for the sustainable development of mines. Therefore, mining tourism becomes a new regional tourism product which helps tourism to both sustainably develop mines and, in terms of standard tourism visits, appeal as attractive as iconic regional sites familiar to the tourists like the ice hotel. Results from research done by Jimenez-Medina and coworkers indicate, how the spatial identity model of tourism is interested in limiting the usual negative impacts associated with

tourism expansion and thus, is increasingly supported by the local population. The outcome of this study provides regional policy guidelines which lead to sustainable development in the mining region.

In their research, Dimitrovsk and Senić [11] conclude that this topic is up-to-date because it deals with a unique relationship between the local community and tourism. Mining tourism has the capacity to enhance the development of sites that are otherwise unattractive to tourists. The development of tourism will cause mines to sustainably develop and also benefits the region with lots of advantages. In research, Landorf [25] states that a better understanding of the aspects of a successful and sustainable tourism mining product will increase the effectiveness of the strategic planning process for sustainable mining development. Also, being far away from the city and other recreational attractions, regardless of other factors, is among irreversible features and killer blows. But generally speaking, tourism can be an effective attribute to improving the sustainable development of mines. Singh and Ghosh [42] state that mining tourism is a new aspect of the tourism industry that is growing rapidly worldwide, which is caused by the dual thirst of human society; first, the thirst for visiting unique and adventurous sites; second, the sustainable development of mines and the need to use a large mining land that otherwise would be left unused and abandoned after a period of time.

## 3  Methodology

The sustainable development of mines based on tourism potentials has been investigated in this research. To reach the results of this study, 3 steps were identified and set in motion. The research steps based on the research questions are as follows:

**First step:** Identifying the methods of sustainable development of mines based on tourism potentials

**Second step:** Presenting a model of sustainable development of mines in Iran with the usage of tourism potentials

**Third step:** Analyzing the application of sustainable development of mines using tourism potentials in mines

In terms of research philosophy, the research method is a study with an interpretative paradigm. This philosophy is based on an interpretative paradigm and a mentalistic approach. In the terms of purpose, this study is applied and practical. In the terms of research methods, this study follows a comparative approach. In the terms of essence, it is exploratory-analytical research. As for the research strategies, the first step follows the technique of the qualitative content analysis approach. The strategy is based on a survey approach and interpretive structural modelling for the second step, and in the third step, the strategy is the analysis of Structural equation modelling. In the first step, the statistical population includes articles on the topic of sustainable development of mines based on tourism potentials which divide into SID database (34 articles) for Persian articles, Emerald database articles published between 2015 to 2022 (13 articles), and Science database articles published in the period of 2015 to 2022 (17 articles) for international articles. Communities are limited in this section and make up to 64 articles. For the second step, industry and university experts with the condition of having a perception of sustainable development of mines are qualified as the statistical population. The statistical population for the third and final phase is formed up of Iranian mine CEOs and supervisors. The sampling method for the first step is purposive sampling. Every single one of the 64 articles was examined and among them, 37 articles were chosen. To determine the sample size in the second step, a multi-criteria decision-making method was used. Cavalli-Sforza and Ortolano [9] are in the belief that the number of experts for the multi-criteria decision-making process must be between the numbers 8 to 12, but Mullen [33] declares the number to be between 7 to 12. For the third step, the convenience method was used for the sampling process. To determine the sample size, 30 pilot questionnaires were distributed and the following formula was set in motion:

$$n = \frac{Z_{\propto/2}^2 S^2}{d^2} = \frac{(1.96)^2 \times 0.111}{(0.05)^2} = 170 \qquad (3.1)$$

170 – Indicator of sample size

0.05 - $\alpha$ - Error percentage for the optimal confidence level

0.111 – $s^2$ - Sample variance obtained from the pilot questionnaire

0.05 – d – Confidence level or optimal probable accuracy

The data-collecting technique in the first step is the desk research method. The collecting tools in this section are data extraction from various related books and articles. In the second step, questionnaires were used. As for the third step, field studies were done to collect data and questionnaires were distributed as data-collecting tools.

The analysis method in the first step is the qualitative content analysis approach. Content analysis is a documentary research method with systematic, objective, quantitative and generalizable standpoints, examining communication messages. Nvivo software was used to analyze texts in qualitative research and as well as qualitative research coding.

The second step is a two-parted process with the part operating on the Delfi method and the second part, using interpretive structural modelling. In the interpretive structural modelling section, Excel software was used. Interpretive Structural Model (ISM) design is a method to test the effects that variables have on each other. This design is a comprehensive approach to measuring communication and this design is used to develop the framework of the model to enable the general objectives of the research.

This type of design is a comprehensive approach to measuring communications and is used to develop a designated framework for the model so that the purpose of the study can be achieved. In the third step, the application of mine's sustainable development based on tourism potentials has been analyzed using structural equation modelling analysis.

## 4 Findings

### 4.1 First step: Identifying methods for sustainable development of mines based on tourism potentials

To begin, the method identification for sustainable development of mines based on tourism potentials will be examined according to domestic and international articles and then, Qualitative analysis will take place to determine a framework and a starting point for the research. Table 1 presents a qualitative analysis of the articles.

Table 1: Identifying methods for sustainable development of mines based on tourism potentials extracted from domestic and international studies

| Number | Method | Source |
|---|---|---|
| 1 | Innovative mining tourism strategies | [6, 18, 45] |
| 2 | Innovative mine renovation with tourism perspective | [7, 18, 32, 39, 45] |
| 3 | Interaction between university and industry | [2, 19, 22, 23, 29, 31, 32, 39, 42] |
| 4 | Improving entertainment factor | [6, 19, 32, 37, 45, 48, 49] |
| 5 | Improving tourism infrastructure | [6, 7, 19, 21, 32, 34, 37, 39, 42, 45, 48, 49] |
| 6 | Increase in region's social capital | [6, 7, 11, 14, 18, 19, 22, 24, 29, 34, 39] |
| 7 | Development of mine workers human sources | [19, 29, 31, 45] |
| 8 | Environmental awareness | [6, 7, 14, 18, 21, 22, 23, 24, 29, 31, 32, 34, 37, 38, 39, 42] |
| 9 | Intelligentization approach with tourism perspective | [18, 42, 45] |
| 10 | Education of community-oriented development officials and managers | [7, 11, 18, 22, 23, 24, 31, 32] |
| 11 | Cooperation between private and public sectors | [18, 21, 22, 29, 32, 41, 45] |
| 12 | Local people participation | [6, 7, 11, 14, 18, 19, 22, 24, 29, 32, 34, 37, 39, 41] |
| 13 | Access to resources | [2, 6, 18, 19, 29, 32, 38, 39, 41, 42, 45] |
| 14 | The use of natural mineral concepts in environmental designs to maximize the compatibility with the surroundings | [11, 19, 24, 37, 38, 42, 45] |
| 15 | Business growth and job creation based on tourism | [6, 14, 21, 24, 32, 34, 37, 41, 45, 48, 49] |

### 4.2 Second step, presenting the sustainable development model of mines in IRAN based on tourism potentials

This step is done in 2 parts, Delfi method at first and interpretive structural modeling for the second part.

#### 4.2.1 First part, identifying methods for sustainable development of mines in Iran based on tourism potentials

In order to screen and ensure the significance of the determined indicators and selection among them, fuzzy Delfi method has been used. To examine the importance of mentioned indicators, experts' point of view has been addressed. Various methods have been purposed to aggregate the opinions of n respondents. In fact, these aggregation methods are experimental methods presented by different researchers. As an example of a common method to sum up a set of triangular fuzzy numbers, I indicates minimum, m indicates geometric mean and u, maximum.

$$F_{AGR} = \left( \min\{l\}, \prod\{m\}, \max\{u\} \right) \tag{4.1}$$

$$F_{AGR} = \left( \min\{l\}, \{\frac{\sum m}{n}\}, \max\{u\} \right) \tag{4.2}$$

$$F_{AVE} = \left( \{\frac{\sum l}{n}\}, \{\frac{\sum m}{n}\}, \{\frac{\sum u}{n}\} \right). \tag{4.3}$$

Each triangular fuzzy number resulted from the aggregation of experts' views for J-th indicator is presented below:

$$\tau_j = (L_j, M_j, U_j) \quad L_j = \min(X_{ij}) \quad M_j = \sqrt[n]{\prod_{i=1}^{n} X_{ij}} \quad U_j = \max(X_{ij}) \tag{4.4}$$

in which, the $i$ index refers to an expert, so that;

$X_i j$: The evaluation value of the i-th expert from the j-th criterion

$L_j$: The minimum amount of evaluations for the j-th criterion

$M_j$: The geometric mean of the experts' evaluation on the performance of j-th criterion

$U_j$: The maximum number of evaluations for the j-th criterion

In this research, we have benefited from the fuzzy mean method. Usually, the summation of the average of triangular and trapezoidal fuzzy numbers can be summarized by a definite value which is the best average of the respective. This process is called defuzzification. There are multiple techniques for defuzzification. In most cases, the simple method shown below is used:

$$x_m^1 = \frac{L + M + U}{3}. \tag{4.5}$$

Another simple method for defuzzifying the mean of triangular fuzzy numbers is as follows:

$$F_{ave} = (L, M, U)$$
$$x_m^1 = \frac{L + M + U}{3}; \ x_m^2 = \frac{L + 2M + U}{4}; \ x_m^3 = \frac{L + 4M + U}{6}$$
$$\text{Crisp number} = Z* = \max(x_{max}^1, x_{max}^2, x_{max}^3). \tag{4.6}$$

The possible values of $x_{max}^i$ do not differ that much and are always close to M. M means the average resulted from the aggregation of possible values of M from different fuzzy numbers. Nonetheless, the largest crisp value of $x_{max}^i$ calculated, would be considered. In this study, to defuzzify, we use the "center of area" method as proceeded below:

$$DF_{ij} = \frac{[(u_{ij} - l_{ij}) + (m_{ij} - l_{ij})]}{3} + l_{ij}. \tag{4.7}$$

According to the results of fuzzy average and defuzzified output, any defuzzifeid value above 0.7 is acceptable whilst amounts below 7 are invalid. In this section, the designed questionnaire is responded to. The question "What are the methods of identifying the sustainable development of mines in Iran based on tourism potentials?" is stated in this questionnaire. To answer this question, the 15 methods extracted in the previous section were presented to experts via a questionnaire. To determine the consensus among experts whilst using the Delfi method, Kendall's coefficient of concordance has been used in this study. A value equal to or greater than 0.5 is considered as the measure of the correlation coefficient to examine the general agreement between experts in Kendall's coefficient of concordance (W). According to the final results in the fourth stage, by distributing the questionnaires with 4 factors among the experts, along with the average of each indicator and the score given by the expert in the third stage, the average of each factor is calculated and the difference between the averages of stage 3 and 4, shown. Factors with an average difference of 0.15 or lower, show a consensus taking place and due to this fact, are eliminated from the questionnaire distributed in the next stage.

As shown in table 3, Kendall's coefficient of concordance value in the fourth stage of Delfi is greater than 0.5 which is a suitable amount to conclude general agreement among experts. Considering the difference in the average amount of rounds 3 and 4 of experts' opinions, there is consensus on the 4 factors and in the upcoming Delfi stages, there would be no more examination on them.

Considering the results from the 4th stage of Delfi, experts were in agreement upon all of the 15 methods and there is no more need for questionnaire distribution and indicators with an average value of 3 or lower, get eliminated in this step. According to the results, 3 out of 15 methods were deleted and the other 12 are presented below in table 4, as the methods identified for sustainable development of Iranian mines based on tourism potentials.

Table 2: Results of the fourth round survey and the calculation of the average difference between the 3rd and 4th round of Delfi method

| Number | Indicator | 3rd round opinion's average | 4th round opinion's average | Difference between averages of round 3 and 4 |
|---|---|---|---|---|
| 1 | Tourism infrastructure Improvement | 3.41 | 3.51 | 0.1 |
| 2 | Development of mine worker's human resources | 3.83 | 3.71 | 0.12 |
| 3 | Environmental awareness | 3.66 | 3.69 | 0.03 |
| 4 | Education of community-oriented development officials and managers | 3.72 | 3.84 | 0.12 |

Table 3: Results of Kendall's coefficient of concordance exam in the 4th stage

| | | |
|---|---|---|
| | Amount | 12 |
| | Kendall's coefficient of concordance (W) | 0.568 |
| 4th stage of Delfi | Chi-square's exam statistics | 534.387 |
| | Degree of freedom | 3 |
| | Level of significance (sig/p-value) | 0.000 |

Table 4: Methods for sustainable development of mines In Iran based on tourism potentials

| Number | Final identified methods |
|---|---|
| 1 | Innovative mining tourism strategies |
| 2 | Innovative mine renovation with tourism perspective |
| 3 | Interaction between university and industry |
| 4 | Improving tourism infrastructure |
| 5 | Increase in region's social capital |
| 6 | Development of mine workers human sources |
| 7 | Environmental awareness |
| 8 | Education of community-oriented development officials and managers |
| 9 | Cooperation between private and public sectors |
| 10 | Local people participation |
| 11 | Access to resources |
| 12 | Business growth and job creation based on tourism |

### 4.2.2 Second part, Interpretive structural modeling

The interpretive structural modelling method begins with the identification of variables related to the discussed topic. After identifying these values, it is time to add these variables to the structural self-interaction matrix (SSIM). The group decision rule for collective agreement on the existing relationship between any pair of elements such as A and B is to be specified. The logic of Interpretive Structural Modeling (ISM) is in conformation with non-parametric methods and operates on the basis of modes in frequencies. The reachability matrix is obtained by transforming the self-interaction structural matrix into a two-valued matrix of zero and one. After forming the initial reachability matrix, its internal consistency is to be set. One of the strategies to identify paths from I to J is by accessing the T matrix. The transpose of the reachability matrix is adapted to Boolean rules presented below [47].

$$0 + 0 = 0$$
$$0 + 1 = 1; \ 1 + 0 = 1$$
$$1 + 1 = 1 \tag{4.8}$$

So, to calculate the transpose of reachability matrix (T), we proceed as shown:

$$T = (I + D)^{(n-1)}; \ t = \begin{cases} 1, & \text{if there is any paths between A and B variable;} \\ 0, & \text{otherwise.} \end{cases} \tag{4.9}$$

In order to distinguish the formulas and levelling of the criteria, the total amount of inputs and, the total amount of outputs for each criterion, are to be extracted. The set of outputs includes the criterion itself and the ones affected by it.

In the second part, the researcher has approached the experts and by distributing questionnaires, seeks to rate the 12 methods mentioned in the previous part in order to achieve the sustainable development model of mines in IRAN based on tourism potentials. To obtain the purpose of this section, questionnaires consisting of 12 identified methods with pairwise comparisons have been used, in which, the respondents are asked to clarify the relationship between

each set of 2 factors (Not related/One-sided relationship/mutual relationship) by comparing them to each other. To rate each factor, the achievable set, mutual set and pre-eminent set must be identified which is presented in table 5.

Table 5: Model significance placement

| Symbol | Factors | Achievable set | Pre-eminent set | Mutual set | Rate of significance |
|---|---|---|---|---|---|
| C1 | Innovative mining tourism strategies | 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12 | 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12 | 1, 2, 3, 5, 6, 7, 8, 10, 11, 12 | 2nd |
| C2 | Innovative mine renovation with tourism perspective | 1, 2, 3, 4, 5, 6, 8, 10, 12 | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 | 1, 2, 3, 4, 5, 6, 8, 10, 12 | 1st |
| C3 | Interaction between university and industry | 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12 | 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12 | 1, 2, 3, 4, 6, 7, 8, 10, 11, 12 | 2nd |
| C4 | Improving tourism infrastructure | 2, 3, 4, 5, 12 | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 | 2, 3, 4, 5, 12 | 1st |
| C5 | Increase in region's social capital | 1, 2, 4, 5, 6, 7, 8, 10, 11, 12 | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 | 1, 2, 4, 5, 6, 7, 8, 10, 11, 12 | 1st |
| C6 | Development of mine workers human sources | 1, 2, 3, 4, 5, 6, 8, 10, 12 | 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12 | 1, 2, 3, 5, 6, 8, 10, 12 | 2nd |
| C7 | Environmental awareness | 1, 2, 3, 4, 5, 6, 7, 8, 10, 12 | 1, 3, 5, 7, 8 | 1, 3, 5, 7, 8 | 3rd |
| C8 | Education of community-oriented development officials and managers | 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12 | 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12 | 1, 2, 3, 5, 6, 7, 8, 10, 11, 12 | 2nd |
| C9 | Cooperation between private and public sectors | 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12 | 9 | 9 | 4th |
| C10 | Local people participation | 1, 2, 3, 4, 5, 6, 8, 10, 11, 12 | 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12 | 1, 2, 3, 5, 6, 8, 10, 11, 12 | 2nd |
| C11 | Access to resources | 1, 2, 3, 4, 5, 6, 8, 10, 11, 12 | 1, 3, 5, 8, 9, 10, 11 | 1, 3, 5, 8, 10, 11 | 3rd |
| C12 | Business growth and job creation based on tourism | 1, 2, 3, 4, 5, 6, 8, 10, 12 | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 | 1, 2, 3, 4, 5, 6, 8, 10, 12 | 1st |

To draw an interpretive structural model based on table 5 factors, innovative mine renovation with a tourism perspective, improving tourism infrastructure, increase in region's social capital and business growth and job creation based on tourism, fall in tier 1 as the most impressionable factors for sustainable development of mines in Iran based on tourism potentials. Also, cooperation between private and public sectors is considered a tier 4 factor, being identified as the most influential factor for the sustainable development of mines in Iran based on tourism potentials. Besides, access to resources and environmental awareness are placed in tier 3 and innovative mining tourism strategies, the interaction between university and industry, development of mine workers human sources, education of community-oriented development officials and managers and the participation of local people form tier 2. Considering the way tiers have been set up, the interpretive structural model is drawn as Figure 1.

### 4.2.3 Third part, sustainable development of mines analysis based on tourism potentials

In this section, the confirmation of existing formulas between variables and factors has been done through confirmatory factor analysis and PLS modelling technique using the Smart PL3 software which is a variance-based path modelling technique and allows the examination of theories and metrics, simultaneously. In order to measure reliability, Cronbach's alpha, rho-A and composite reliability methods were used. Since the calculated values of Cronbach's alpha, rho-A and composite reliability for each of the research variables are more than 0.7, all variables have suitable reliability. In order to measure validity, the average variance was extracted, confirmatory factor analysis and Fornell and Larcker methods were used. According to the results, the value of this criterion for all variables is above 0.5 and this shows acceptable convergent validity. Also, based on the results of the factor analysis of the variables, all relationships are significant, because the absolute value of their significance test statistic is greater than 1.96. Also, since all factor loadings are greater than 0.4, it is an indication of items, explaining the construct well and the constructs (variables) having good factorial validity. The third validity check method in this thesis is Fornell and Larcker's method, which examines divergent validity. Based on the results, in all cases, the square of the data's extracted variance (Matrix main diameter) is greater than the numbers on its right side and below; The divergent validity of the model is confirmed. Considering the examination of the results of the associations between independent and dependent variables using the relevant coefficient, it is possible to check the significance of the effects among the research variables. To check the significance of the path coefficient or beta, the significance of the t-value for each path coefficient should be taken into account, therefore Bootstrapping method was used. According to the T-statistics and P-values for all paths except for the development of mine workers human sources to Increase in region's social capital path and Development of mine workers human sources to Business growth and job creation based on the tourism path and also, Innovative mining
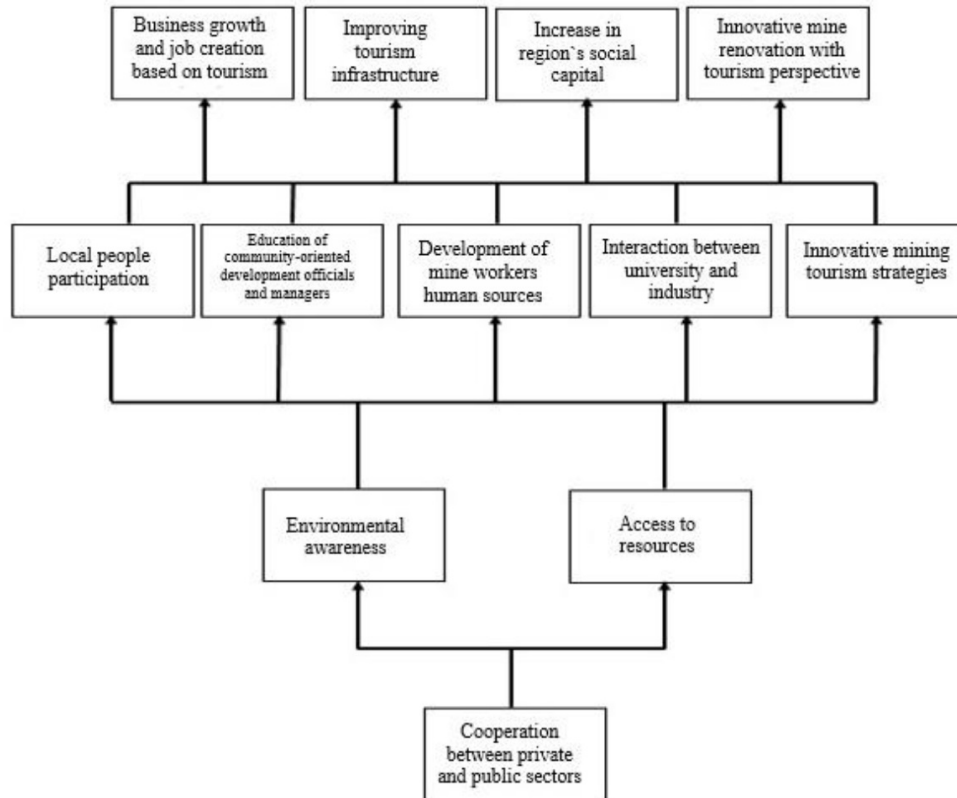
Figure 1: The final interpretive structural model

tourism strategies to Business growth and job creation based on tourism path, the T-static is greater than 1.96 and P-value smaller than 0.05 which show that at a rate of 95% confidence level, all paths except the ones mentioned above, have had the impact of significance.

We can examine the hypothesis using the inner model. By measuring the calculated P-value for each path's coefficient, we may confirm or reject the research's hypothesis. This way, If the absolute value of the T-statistic is greater than 1.96, the path coefficient comes of significance at a rate of 95%, and if the T-static is above 2.58, then the confidence level is capped at 99%.

The results indicate that T-statistic belongs to each path. To check the significance of a path's coefficient, the T-statistic of each path must be above 1.96. In this analysis, the T-statistic of every path expects the Development of mine workers and human sources to Increase in the region's social capital path and the development of mine workers human sources to Business growth and job creation based on the tourism path, and also, the Innovative mining tourism strategies to Business growth and job creation based on tourism path, has been above the value of 1.96 and has a confidence rate of 95%. Results state that the beta coefficients are the results of the regression equation between the variables, which is the path coefficient. The numbers within each circle are an indicator of the model's $R^2$ value which its predictor variables enter the circle by an arrow.

The coefficient of T's significant amount or the T-statistic of every path expects the Development of mine workers human sources to Increase in the region's social capital path and the development of mine workers human sources to Business growth and job creation based on tourism path, and also, the Innovative mining tourism strategies to Business growth and job creation based on tourism path, is above 1.96 which allows for the confirmation of the significance between association at a rate of 95% confidence level.

$R^2$ is a criterion, used to connect the measurement part and the structural part of structural equation modelling, showing the influence of an exogenous (independent) variable on an endogenous (dependent) variable. The important point is that $R^2$'s value is only measured for the dependent (endogenous) structures of the model, and in the case of exogenous structures, the value of this criterion is zero. The higher the value of $R^2$ related to the endogenous constructs of a model, the better the fit of the model. Chain 1 (1998), considers three values of 0.19, 0.33 and 0.67 as criteria for weak fit, medium fit and strong fit values of the structural part of the model by the $R^2$ criterion [10].

Table 6: Direct effects of the main models' research variables

| Path | Path coefficient | Standard error | T-statics | P-values |
|---|---|---|---|---|
| Education of community-oriented development officials and managers → Innovative mine renovation with tourism perspective | 0.174 | 0.064 | 2.743 | 0.006 |
| Education of community-oriented development officials and managers *to* Improving tourism infrastructure | 0.187 | 0.066 | 2.849 | 2.849 |
| Education of community-oriented development officials and managers → Increase in region's social capital | 0.149 | 0.073 | 2.024 | 0.043 |
| Education of community-oriented development officials and managers → Business growth and job creation based on tourism | 0.251 | 0.099 | 2.541 | 0.011 |
| Environmental awareness → Education of community-oriented development officials and managers | 0.37 | 0.071 | 5.23 | 0.000 |
| Environmental awareness → Interaction between university and industry | 0.424 | 0.059 | 7.148 | 0.000 |
| Environmental awareness → Development of mine workers human sources | 0.531 | 0.059 | 9.029 | 0.000 |
| Environmental awareness → Innovative mining tourism strategies | 0.413 | 0.076 | 5.398 | 0.000 |
| Environmental awareness → Cooperation between private and public sectors | 0.229 | 0.073 | 3.117 | 0.002 |
| Interaction between university and industry → Innovative mine renovation with tourism perspective | 0.198 | 0.082 | 2.421 | 0.016 |
| Interaction between university and industry → Improving tourism infrastructure | 0.291 | 0.07 | 4.154 | 0.000 |
| Interaction between university and industry → Increase in region's social capital | 0.312 | 0.074 | 4.207 | 0.000 |
| Interaction between university and industry → Business growth and job creation based on tourism | 0.215 | 0.099 | 2.17 | 0.030 |
| Development of mine workers human sources → Innovative mine renovation with tourism perspective | 0.308 | 0.077 | 4.001 | 0.000 |
| Development of mine workers human sources → Improving tourism infrastructure | 0.182 | 0.089 | 2.039 | 0.041 |
| Development of mine workers human sources → Increase in region's social capital | 0.054 | 0.099 | 0.542 | 0.588 |
| Development of mine workers human sources → Business growth and job creation based on tourism | 0.012 | 0.097 | 0.12 | 0.904 |
| Access to resources → Education of community-oriented development officials and managers | 0.394 | 0.066 | 5.962 | 0.000 |
| Access to resources → Interaction between university and industry | 0.443 | 0.059 | 7.483 | 0.000 |
| Access to resources → Development of mine workers human sources | 0.386 | 0.061 | 6.368 | 0.000 |
| Access to resources → Innovative mining tourism strategies | 0.33 | 0.079 | 4.202 | 0.000 |
| Access to resources → Cooperation between private and public sectors | 0.455 | 0.07 | 6.482 | 0.000 |

As shown un table 7, the variable of tourism infrastructure improvement factor with a determination coefficient value of 0.754 has the most explicability capacity and the variable of access to resources factor, has the least explicability capacity rate among all variables with the value of 0.34. According to the tests performed and the results presented, the summary of research hypotheses is obtained in the form of Table 8:

| | | | | |
|---|---|---|---|---|
| Innovative mining tourism strategies → Innovative mine renovation with tourism perspective | 0.129 | 0.057 | 2.273 | 0.023 |
| Innovative mining tourism strategies → Improving tourism infrastructure | 0.142 | 0.06 | 2.374 | 0.018 |
| Innovative mining tourism strategies → Increase in region's social capital | 0.197 | 0.058 | 3.388 | 0.001 |
| Innovative mining tourism strategies → Business growth and job creation based on tourism | 0.156 | 0.091 | 1.713 | 0.087 |
| Cooperation between private and public sectors → Innovative mine renovation with tourism perspective | 0.187 | 0.061 | 3.077 | 0.002 |
| Cooperation between private and public sectors → Improving tourism infrastructure | 0.219 | 0.076 | 2.876 | 0.004 |
| Cooperation between private and public sectors → Increase in region's social capital | 0.285 | 0.07 | 4.08 | 0.000 |
| Cooperation between private and public sectors → Business growth and job creation based on tourism | 0.203 | 0.084 | 2.414 | 0.016 |
| Cooperation between private and public sectors → Environmental awareness | 0.643 | 0.055 | 11.58 | 0.000 |
| Cooperation between private and public sectors → Access to resources | 0.581 | 0.054 | 10.674 | 0.000 |

Table 7: $R^2$'s coefficient of determination

| Structure | $R^2$ |
|---|---|
| Education of community-oriented development officials and managers | 0.432 |
| Environmental awareness | 0.413 |
| Innovative mine renovation with tourism perspective | 0.729 |
| Improving tourism infrastructure | 0.754 |
| Interaction between university and industry | 0.556 |
| Increase in region's social capital | 0.708 |
| Development of mine workers human sources | 0.627 |
| Access to resources | 0.338 |
| Innovative mining tourism strategies | 0.410 |
| Business growth and job creation based on tourism | 0.497 |
| Local people participation | 0.359 |

## 5 Conclusion

In this research, at first, we tried to examine the methods for sustainable development of mines in Iran based on tourism potentials. In the first step of the research's second act, the data desired by the experts was extracted using the Delphi method, and among the 15 methods extracted in the first step (content analysis), 3 methods whose average quorum was less than 3 were removed from the mentioned method. And 12 methods were recognized as methods of sustainable development of mines in Iran based on tourism potentials.

The results of applying the interpretive structural modelling technique show that the cooperation between the private and public sectors should be given more attention because this factor has been placed as the foundation of the interpretive structural model. In other words, this factor is important and necessary in its place, and we cannot declare that without paying special attention to this factor, it is possible to predict the proper situation of the sustainable development of mines in Iran concerning tourism potentials. Synergy and cooperation between the private sector and the public sector can lead to the sustainable development of mines and also bring the mining tourism industry to its rightful potential. The public and private sectors complement each other and the absence of one causes the inefficiency of the other. Therefore, the public sector and the private sector should each take their strategic position in order to witness the growth and prosperity of the sustainable development of mines as well as the development of mining tourism. Meanwhile, long-term and short-term planning along with strategic planning can provide the necessary infrastructure to achieve the goals. There are many mineral tourism opportunities in our country that have not been addressed so far, and the sustainable development of mines is of great importance. When it comes to the

Table 8: Summary of research hypotheses

| Hypotheses | Path coefficient | T-statics | P-value of the significance level | Conclusion |
|---|---|---|---|---|
| Cooperation between private and public sectors → Access to resources | 0.581 | 10.674 | 0.000 | Confirmed |
| Cooperation between private and public sectors → Environmental awareness | 0.643 | 11.58 | 0.000 | Confirmed |
| Access to resources → Innovative mining tourism strategies | 0.33 | 4.202 | 0.000 | Confirmed |
| Access to resources → Interaction between university and industry | 0.443 | 7.483 | 0.000 | Confirmed |
| Access to resources → Development of mine workers human sources | 0.386 | 6.368 | 0.000 | Confirmed |
| Access to resources → Education of community-oriented development officials and managers | 0.394 | 5.962 | 0.000 | Confirmed |
| Access to resources → Local people participation | 0.455 | 6.482 | 0.000 | Confirmed |
| Environmental awareness → Innovative mining tourism strategies | 0.413 | 5.398 | 0.000 | Confirmed |
| Environmental awareness → Interaction between university and industry | 0.424 | 7.148 | 0.000 | Confirmed |
| Environmental awareness → Development of mine workers human sources | 0.531 | 9.029 | 0.000 | Confirmed |
| Environmental awareness → Education of community-oriented development officials and managers | 0.37 | 5.23 | 0.000 | Confirmed |
| Environmental awareness → Local people participation | 0.229 | 3.117 | 0.002 | Confirmed |
| Innovative mining tourism strategies → Innovative mine renovation with tourism perspective | 0.129 | 2.273 | 0.023 | Confirmed |
| Innovative mining tourism strategies → Improving tourism infrastructure | 0.142 | 2.374 | 0.018 | Confirmed |
| Innovative mining tourism strategies → Increase in region's social capital | 0.197 | 3.388 | 0.001 | Confirmed |
| Innovative mining tourism strategies → Business growth and job creation based on tourism | 0.156 | 1.713 | 0.087 | Rejected |
| Interaction between university and industry → Innovative mine renovation with tourism perspective | 0.198 | 2.421 | 0.016 | Confirmed |
| Interaction between university and industry → Improving tourism infrastructure | 0.291 | 4.154 | 0.000 | Confirmed |
| Interaction between university and industry → Increase in region's social capital | 0.312 | 4.207 | 0.000 | Confirmed |
| Interaction between university and industry → Business growth and job creation based on tourism | 0.215 | 2.17 | 0.030 | Confirmed |
| Development of mine workers human sources → Innovative mine renovation with tourism perspective | 0.308 | 4.001 | 0.000 | Confirmed |
| Development of mine workers human sources → Improving tourism infrastructure | 0.182 | 2.039 | 0.041 | Confirmed |
| Development of mine workers human sources → Increase in region's social capital | 0.054 | 0.542 | 0.588 | Rejected |
| Development of mine workers human sources → Business growth and job creation based on tourism | 0.012 | 0.12 | 0.904 | Rejected |

mining and tourism industry, specialized macro management comes first and, opportunities must be identified and included in the comprehensive planning for the sustainable development of mines based on tourism potentials and

| | | | | |
|---|---|---|---|---|
| Education of community-oriented development officials and managers → Innovative mine renovation with tourism perspective | 0.174 | 2.743 | 0.006 | Confirmed |
| Education of community-oriented development officials and managers → Improving tourism infrastructure | 0.187 | 2.849 | 0.004 | Confirmed |
| Education of community-oriented development officials and managers → Increase in region's social capital | 0.149 | 2.024 | 0.043 | Confirmed |
| Education of community-oriented development officials and managers → Business growth and job creation based on tourism | 0.251 | 2.541 | 0.011 | Confirmed |
| Local people participation → Innovative mine renovation with tourism perspective | 0.187 | 3.077 | 0.002 | Confirmed |
| Local people participation → Improving tourism infrastructure | 0.219 | 2.876 | 0.004 | Confirmed |
| Local people participation → Increase in region's social capital | 0.285 | 4.08 | 0.000 | Confirmed |
| Local people participation → Business growth and job creation based on tourism | 0.203 | 2.414 | 0.016 | Confirmed |

also, the grounds for private investments in hard infrastructures such as hotels, restaurants, tourism attractions and the access to resources should be provided, and as for the government, they should expand the base for the growth of soft infrastructure to which we can point to environmental awareness, education, culture and security in our beloved country.

The factors of innovative mining reconstruction with a tourism perspective, improvement of tourism infrastructure, development of region's social capital and business bloom and job creation using tourism were identified as the most impressionable methods of sustainable development of mines in Iran based on tourism potentials. Achieving the highest degree of growth for these 4 factors can improve the state of sustainable development of mines based on tourism potentials.

Mining tourism is Among the best geo-tourism activities. There are sites of mining explorations and digging tools and equipment from ancient times in abandoned mines, and there are sites of modern area exploration methods and tools that you have targeted visiting. If elegance and tourist attractions are taken into consideration, long-term sustainable development can be imagined for mining tourism.

Business growth and job creation are one of the most important topics discussed on the matter of mine's sustainable development. The existence of many villages and cities depends on active mines. Many cities and villages have turned into a ghost town due to their population seeking to enter other cities in the area hoping to get a job whilst the preservation of their hometown was depending on mines being active which led them to abandoned mines and inhabited cities. It was here that the tourism industry came up with a solution to turn these abandoned mines into a means of livelihood for the communities, and mining tourism emerged with its help, important economic and employment issues can be solved to a great extent. An abandoned mine that has not been active for years and its workers have gone to nearby cities to secure their livelihood, or mines that are operating and have the conditions to accept tourists, can become a sustainable source of income by becoming a tourist land site. Everything in these mines can attract tourists; From the drilling methods to the type of minerals and stones extracted. Even the tools and machinery and the excavation route can be attractive to tourists.

Achieving the goals of sustainable mining development with an emphasis on mining tourism depends on the vision of tourism managers and planners as well as the existing infrastructure in this industry. In other words, it can be said that to achieve successful marketing of mining tourism and obtain a suitable competitive position in this industry, mining tourism planners must have a correct and clear understanding of the influencing variables in the choice of destination by tourists. Therefore, evaluating things like the existing tourism infrastructure and determining the level of desirability and how they relate to other effective factors in attracting mining tourists enables the managers and planners of this industry to make correct decisions in future planning.

On the other hand, one of the topics that have been relatively accepted for sustainable development and tourism researchs today is the implication and impacts of the social capital phenomenon. In today's age, we need social capital for development more than we need economic, physical and human capital; Because without social capital, other funds can't be used optimally. In a society that lacks enough social capital, other capitals are wasted. Therefore, the issue

of social capital is considered as a central principle to achieve development, and managers that could dedicate more amounts of production and growth to the community, are deemed successful.

Also, in the analysis of the independency-influence factor, it became obvious that the tourism infrastructure improvement method falls in the dependant category, which declares low powers of influence and high dependency. In general, this dimension sums up study results in which many factors are involved in their making and themselves can rarely become the basis of other variables. Environmental awareness and interaction between private and public sectors fall into the dependent category. Which dictate high powers of influence and low dependency. These variables along with the linkage variables are the key variables, creating the model infrastructure and must be paid attention to for the system to start functioning. On the other hand, innovative mining tourism strategies, innovative mining reconstruction with a tourism perspective, the interaction between industry and university, development of social capital of the region, development of human resources of mining employees, education of community-oriented development managers, local people participation, access to resources and prosperity of business and job creation Based on tourism, were placed in the linked area. That is, they are both high in influence and dependence. These variables are not stable, any changes made to them will affect them and other variables, altogether. Through analyzing the application of the sustainable development of mines based on tourism potentials, among the 32 hypotheses considered, 3 hypotheses were rejected and 29 hypotheses were confirmed in the studied statistical population.

According to the results of 3rd stage, amongst the associated formulas between the 2nd stage, only three relationships between the innovative strategies of mining tourism and the prosperity of business and job creation based on tourism, the development of human resources of mining employees and the development of the social capital of the region and the relationship between the development of human resources of mining employees and the prosperity of business and job creation based on tourism were not confirmed, and the other 29 considered hypotheses were confirmed, which indicates the overlap of experts opinions and field results. The field results showed that the relationship between private and public sector cooperation with access to resources and environmental awareness has a positive and direct relationship, and it is also approved as the basic factor of the model by the managers and supervisors of mines. Also, the confirmation of the relationship between access to resources and environmental awareness with innovative mining tourism strategies, the interaction between industry and university, the development of human resources of mining employees, education of community-oriented development managers and participation of the region's local people shows the importance of these 2 factors and the special attention that should be given to them as the 2nd most significant grade of infrastructure.

## References

[1] N. Adibi, M. Ataee-pour and M. Rahmanpour, *Integration of sustainable development concepts in open pit mine design*, J. Cleaner Product. **108** (2015), 1037–1049.

[2] H. Akbarpour Sheikh Hossein, S. Soroush Far and I. Dehedar, *General indicators of development, challenges and potentials in the development of Cheram city*, Nat. Sustain. Dev. Conf., 2015.

[3] R. Allan, *Sustainable mining in the future*, J. Geochem. Explor. **52** (1995), 1–4.

[4] H.E.K. Allen, *Mining and sustainable development: the role of the professional*, Miner. Ind. Int. **1001** (1991), 5–8.

[5] R.M. Auty and A. Warhurst, *Sustainable development in mineral exporting economies*, Resource Policy **19** (1993), no. 1, 14–29.

[6] E. Blury Fard and N.R. Kabarenzad Ghadim, *Ranking of the sub-criteria determined in the model of the impact of information technology in the development of the geotourism industry and its benefits in the sustainable development of tourism in the Persian Gulf and its coasts*, Cultural Politic Stud Persian Gulf **4** (2019), no. 11, 123–135.

[7] J. Byström, *Mining tourism in abandoned and existing mines in the Swedish Far North*, Polar Record, 58 (2022), no. E40.

[8] B. Carbon, *Sustainable development and the evolving agenda for environmental protection in the mining industry*, Ind. Environ. 20 (1997), no. 4, 10–13.

[9] V. Cavalli-Sforza and L. Ortolano, *Delphi forecasts of land use: Transportation interactions*, J. Transport. Eng. **110** (1984), no. 3, 324–339.

[10] A. Davari and A. Rezazadeh, *Structural equation modeling with PLS software*, First edition, Jihad University Publications, 2012.

[11] D. Dimitrovski and V. Senić, *Examining the support of the local community for the development of sustainable mining tourism*, Tourism Int. Sci. Conf. Vrnjačka Banja - TISC **4** (2019), no. 2, 450–468.

[12] M.R. Faraghati Gashti, *Investigation and analysis on the importance of urban green space in the development of tourism and city sustainability*, 15th Int. Conf. Manag. Econ. Dev., 2022.

[13] M.B. Ghanbari, *The effect of user-centered tourism platform on tourists' satisfaction*, 15th Int. Conf. Manag. Econ. Dev., 2022.

[14] J. Ghazi, M. Hamdollahi and M. Moazzen, *Geotourism of mining sites in Iran: An opportunity for sustainable rural development*, Int. J. Geoherit. Parks **9** (2021).

[15] S. Hasani, *Designing a new method of urban tourism for the sustainable development of the tourism industry*, Second Int. Conf. Civil Engin. Architect. Urban Dev. Approach Urban Infrastructure development, (2022).

[16] M. Hassanzadeh and H. Ebrahimi, *Mining tourism, the new field in the tourism industry*, Int. Dev. Conf. Focus. Agricul. Envir. Tourism, Tabriz, 2014.

[17] M.T. Heydari and P. Rahmati, *Stimulation, demand and market blooming with a focus on the strategic analysis of mining tourism geotourism in the context of the potential tourism capabilities of Angoran mine*, Second Int. Conf. Lut Desert with a Tourism Approach, Zahedan, 2021.

[18] P. Hronček, B. Gregorová, D. Tometzová, M. Molokáč and L. Hvizdák, *Modeling of vanished historic mining landscape features as a part of digital cultural heritage and possibilities of its use in mining tourism (case study: Gelnica town, Slovakia)*, Resources **9** (2020), no. 4, 43.

[19] A.E. Izquierdo, H.R. Grau, C.J. Navarro, E. Casagranda, M.C. Castilla and A. Grau, *Highlands in transition: urbanization, pastoralism, mining, tourism, and wildlife in the Argentinian Puna*, Mountain Res. Dev. **38** (2018), no. 4, 390–400.

[20] P.M. James, *The miner and sustainable development*, Min. Eng. **51** (1999), no. 6, 89–92.

[21] J. Jelen, *Mining heritage and mining tourism*, Czech J. Tourism **7** (2018), no. 1, 93–105.

[22] P. Jiménez-Medina, A. Artal-Tur and N. Sánchez Casado, *Tourism business, place identity, sustainable development, and urban resilience: a focus on the sociocultural dimension*, Int. Regional Sci. Rev. **44** (2020).

[23] M.R. Kayani, K. Faghani Makrani and N. Fazli, *Identifying components of performance audit in the sustainable development of the supply chain of the mining sector*, Audit Knowledge, 21 (2021), no. 84, 251–281.

[24] M. Lamparska, *Post-mining tourism in upper Silesia and Czech-Moravian country*, J. Geog. Politics Soc. **9** (2019), no. 2, 57–68.

[25] C. Landorf, *Cultural value and sustainable development: A framework for assessing the tourism potential of heritage places*, D.C. Comer and A. Willems, (eds) Feasible management of archaeological heritage sites open to tourism, Springer, Cham, 2019.

[26] D. Learmont, *Mining must show that it is sustainable*, Min. Eng. **49** (1997), no. 1, 11–12.

[27] A. Lukowik, L. Zur, R. Tomala, T.N. LamTran, A. Bouajaj, W. Strek, G.C. Righini, M. Wickleder and M. Ferrari, *Rare earth elements and urban mines: Critical strategies for sustainable development*, Ceramics Int. **46** (2020), no. 16, 26247–26250.

[28] R. Mikesell, *Sustainable development and mineral resources*, Resource Policy **20** (1994), 83–86.

[29] Z.A. Mingaleva, E. Zhulanov, N. Shaidurova, M. Molenda, A.V. Gaponenko and M. Šoltésová, *The abandoned mines rehabilitation on the basis of speleotherapy: used for sustainable development of the territory (the case study of the single-industry town of mining industry)*, Acta Montanistica Slovaca **23** (2018), no. 3, 312–324.

[30] Z. Mohammad Ghasem and A. Arbabi Sabzevari, *Evaluation of sustainable urban tourism development indicators*, Payashahr Month. **4** (2022), no. 40.

[31] S.S. Mohtasabi, A. Karimi and M. Namdari, *Forecasting and identifying the main areas of green jobs needed in*

*Iran*, J.: Mahart Amouzi **5** (2015), no. 17, 117–128.

[32] C.-L. Moyle, F. Carmignani, B. Moyle and S. Anwar, *Beyond Dutch Disease: Are there mediators of the mining–tourism nexus?*, Tourism Econ. **27** (2021), no. 4, 744–761.

[33] P.M. Mullen, *Delphi: myths and reality*, J. Health Organ. Manag. **17** (2003), no. 1, 37–52.

[34] K. Pactwa, M. Konieczna-Fuławka, K. Fuławka, P. Aro, I. Jaśkiewicz-Proć and A. Kozłowska-Woszczycka, *Second life of post-mining infrastructure in light of the circular economy and sustainable development—recent advances and perspectives*, Energies **14** (2021), no. 22, 7551.

[35] M. Poor Ismaili, *A review of sustainable development evaluation methods in open pit mines*, Second Nat. Conf. Mini. Green Min. Ind. Iran, Zanjan, 2018.

[36] R. Pourmirzai, *Investigating the role of the mining industry and mineral resources in the sustainable development of the country*, Mineral Resources Engi. **2** (2016), no. 3, 8.

[37] M.E. Ramezani and R. Elmi, *A review on sustainable development in Iran's mines*, 7th Nat. Conf. Envir. Energy Sustain. Natural Resources, Tehran, 2016.

[38] M.H. Ramsht, M. Azani and M. Nazari, *Geotopes and its role in the development of the tourism industry (case study: Dere Zanjer mine and Dastkand, Farshah-Yazd)*, Geog. Civil Urban Manag. Stud. Quart. **6** (2019), no. 2.

[39] G. Rezaei Lori, S. Selajgeh, S. Madhian and A. Nikpour, *Designing a good governance model in industry and mining in line with sustainable development with an innovative action approach*, Innov. Manag. Defense Organ. **5** (2022), no. 1, 35–58.

[40] A. Rezaei Pendri, *Designing a sustainable development policy framework with a combined ISM-IPA approach*, Parliament Strategy **27** (2019), no. 101, 223–242.

[41] M. Safari, A. Ariafar and S. Alinejad, *Choosing the right option for renovating Joben sand mine using FTOPSIS fuzzy multi-criteria decision-making method in order to create sustainable development in the region*, Environ. Technol. Sci. Quart. **22** (2019), no. 5.

[42] R. Singh and P. Ghosh, *Potential of mining tourism: a study of select coal mines of Paschim Bardhaman district, west Bengal*, Indian J. Landscape Syst. Ecol. Stud. **42** (2019), 101–114.

[43] J. Tilton, *Exhaustible resources and sustainable development*, Resource Policy **23** (1996), no. 1–2, 91–97.

[44] M.A. Von Below, *Sustainable mining development hampered by low mineral prices*, Resource Policy **19** (1993), no. 3, 177–183.

[45] K. Weis, P. Hronček, D. Tometzová, B. Gregorová, M. Přibil, M. Jesenský and V. Cech, *Analysis of notice boards (panels) as general information media in the outdoor mining tourism boards, design of boards, basic characteristics, mining site, mining tourist trail, mining tourism, mining trail Vyhne*, Acta Montanistica Slovaca **24** (2019), 269–283.

[46] Z. Yazdani Nasab, *Feasibility study of converting Gol Gohar mine in Sirjan into a tourism area*, Nat. Conf. Manag. Tourism Sustain. Dev., Tabriz, 2018.

[47] M. Yazdani Parai and L. Salimi, *Comparative comparison of media literacy curricula between Canada, Japan and Iran*, Modern Dev. Educat. Manag. (2021), no. 3, 76–100.

[48] M.A. Zanganeh Asadi, L. Goli Mokhtari and R. Saadati Far, *The role of rural tourism in the sustainable development of the southwestern slopes of Binalud*, Village Sustain. Dev. Space **1** (2019), no. 4.

[49] M.A. Zanganeh Asdi, R. Saadati Far and L. Gol Mokhtari, *Investigating the effects of geomorphosites in mountainous areas in tourism development (Case study: Northwest of Neishabur-Firuzeh city)*, Geog. Stud. Mountainous Regions **1** (2019), no. 4, 69–87.