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# SELECTION OF BUSINESS MODELS IN UNSTABLE CONDITIONS IN MINING COMPANIES

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**Abstract:** This paper aims to rank business models for successfully overcoming socio-economic instability through criteria using an appropriate multicriteria decision-making method (MCDM). In this paper, the AHP method was used to calculate the difficulty criteria. The literature review identified and analyzed six business models: digital business models where companies will be found, competitive advantage models, global, deglobal, market models based on new products and services and customer-built business models. The findings of this research improve the understanding of several business models on the basis of which the management of mining companies can successfully overcome the socio - economically unstable situation.

**Keywords:** Business Models, Unstable Situation, Mining Companies

## 1 INTRODUCTION

The Covid-19 pandemic and the war in Ukraine created an unstable socio-economic situation on a global level. The unstable situation has affected all branches of the economy in the world. Globalization has created an interconnectedness between all companies. The Covid 19 pandemic globally has led to a decline in and demand for many products and services, many jobs have slowed or stalled including the mining industry (Galas et al., 2021).

Unstable socio - economic situation has led to an increase in prices of products and services. The prices of precious metals have risen sharply on a global scale.

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In such a socio - economically unstable situation, it is important to identify possible business models that would bring managers safe and sustainable business in mining companies.

The AHP (Analytical Hierarchical Process) method was used to select possible business models in mining companies. The AHP method belongs to the multicriteria decision making (MCDM) methods. The calculation of the AHP method is flexible, it enables the solution of complex problems with several criteria and alternatives. The AHP method analyzes the criteria in terms of the importance of one criterion in relation to others. A further procedure is to compare each criterion with each alternative in relation to the given goal.

By selecting appropriate business models, this paper contributes to increased security during a socio-economically unstable situation in performing mining business activities.

## 2 LITERATURE REVIEW

A review of the literature shows that the identification of business models in a socially - economically unstable situation is becoming increasingly important. The term "business model" appeared in the 40 years twenty century in works on economics. But only 90 years ago, they became popular in management and economics in various fields. Business models are the forms or ways in which employees think about which methods they can use to best implement business goals while generating revenue.

Mining companies in Serbia have started cooperation with multinational companies in the world. Multinational corporations operate in accordance with the law and environmental standards of Serbia. But with the construction of certain mines in Serbia during the socio-economically unstable situation we are currently in, there is a danger of damage to the environment. Although the esteemed literature on mine management is available to managers and mining experts, the desire is to increase the safety situation in the mines.

In unstable conditions, modern business is changing globally, where there are big changes in all business segments. The form of modern business at the global level is changing in the procurement of goods and services (Bals and Turkulainen 2021); in green practice of hospitality conditions Piya et al. (2022); in circular economy (Husain et al. 2021) etc. Current changes in the global environment affect all significant factors in the postal sector (Milutinović and Popović, 2020) and other segments. Authors Husain et al. (2021) analyzed business models for the implementation of circular economy by MCDM methods, Fuzzy TOPSIS approach. Because the transition of a linear economy to a circular one requires the construction of new business models that exceed the limitations of the linear model of the economy. The analysis of the practice of green management in the hotel industry was performed using the integrated Fuzzy AHP-TOPSIS method.

Doing business in the global world is changing the way we do business due to the development of new technologies, digitalization, pandemics such as Covid-19 and wars. Digitization is increasingly becoming a priority in business circumstances. In global business, society as a whole is undergoing radical changes due to the development of digital technologies.

In mining as well as in energy, digitalization is applied, digital procedures e - mining. E-mining brings a new way of doing business: e-invoicing (electronic invoicing), e-billing, e-bookkeeping, e-postman-electronic exchange and signing of contracts and documents and much more. All the above options facilitate the implementation of the business strategy of mining in a socially - economically unstable situation.

The current socio-economic instability was produced by the Covid-19 pandemic and the war in Ukraine. These current changes in the global environment greatly affect significant factors in the mining sector - the creators of the e-mining strategy. The implementation of digital technology in the mining sector brings increased competition, customer satisfaction, profits and customer confidence in products and services (Miletić et al., 2021). While the analysis of the impact and consequences of COVID-19 on the use of non-renewable natural resources shows a decline in business volume and profitability of companies, excessive growth in gold prices and high energy uncertainty (Bogdanović and Miletić, 2021).

Unstable socio - economic situation sets new needs for users (customers), major changes in products and services, which implies the development of new business mining models.

In this paper, first of all, the criteria with which we evaluate alternatives, business models are given. The criteria were identified through the literature based on Osterwalder this business model. Alternatives were provided by sending a questionnaire to managers of mining companies using digital technology. Using the AHP method, the weight coefficients of the criteria were determined and the sustainable business model during socio - economic instability was assessed.

## 3 WORK METHODOLOGY

The methodology of the paper first defines the goal of the paper by the author in order to obtain relevant results. The aim of this paper is to choose business models in socio - economically unstable conditions in mining companies.

Hypothesis I: Built business models in socio-economic instability in mining companies can be sustainable through modeling.

Hypothesis II: Some of the built business models in socio-economic instability in mining companies cannot be sustainable.

One of the most famous in the world is the Osterwalder business model. There are 9 segments in the Osterwalder model that we use to identify the criteria. Dr. Alexander (Alex) Osterwalder is one of the world's most influential experts in business model strategy and innovation. As a lead author, entrepreneur Osterwalder gave an overview of how core companies operate and how new ventures begin.

Figure 1 shows the multidimensional hierarchical structures of the AHP method. The goal is to choose business models in mining companies.

The methodology begins with the identification of the criteria that define the business model.

Eligibility criteria:

1. Market analysis, consumer segments (C1),
2. Customer, needs satisfaction assessments (C2),
3. Method of delivery of goods to customers, sales channels (C3),
4. Customer relationship, customer attraction (C4),
5. Key resources, which resources the company has (C5),
6. Key activities to be performed (C6),
7. Important market entry partners (C7) i
8. Revenue structure (C8),
9. Finally, costs, what are the costs (whether this model is sustainable or not) (C9).

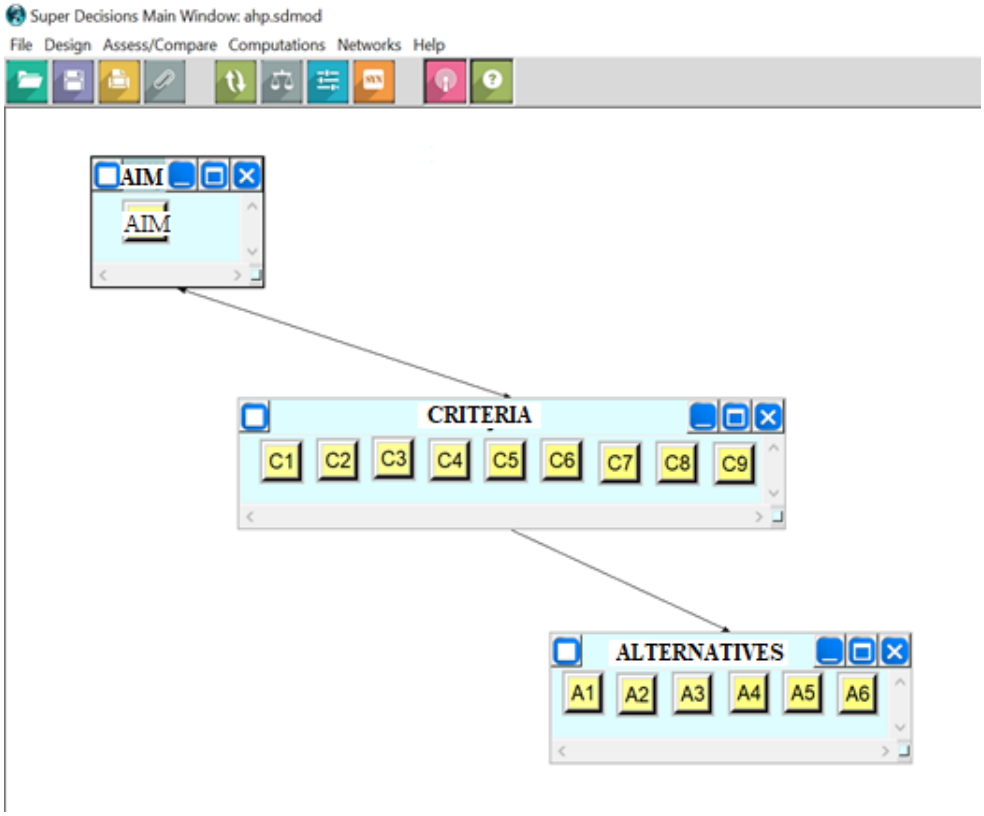


**Figure 1** Multidimensional hierarchical structure of the AHP method

The weighting coefficients of the criteria and alternatives are calculated using the AHP method using the Super Decisions software based on the Sati scale Table 1. We first evaluate the criteria with each other, defining the weight coefficients of the criteria Table 2. A further course of research is to compare the alternative with each criterion individually in relation to the given goal – Tables 3-11.

The standard AHP uses a degree of consistency (CR), its value is less than 0.1. During the analysis, a check is performed and if the degree of consistency has a higher value, the values entered in the comparison matrix are recalculated. In our case, the degree of consistency has a value of 0.05700, which means CR consistent. The results of the ranked criteria using Super Decisions software are shown in Figure 2.

**Table 1** Satie's scale for comparing two elements

$$S=\left\{\frac{1}{9},\frac{1}{8},\frac{1}{7},\frac{1}{6},\frac{1}{5},\frac{1}{4},\frac{1}{3},\frac{1}{2},1,2,3,4,5,6,7,8,9\right\}$$

| **Value ajk** | **Analysis of results** |
|---|---|
| 1 | The elements j and k are equally important |
| 3 | The element j is somewhat more important than k |
| 5 | Element j is more important than k |
| 7 | The element j is much more important than k |
| 9 | The element j is absolutely more important than k |
| 2,4,6,8 | Intermediate values between two elements |

**Table 2** Defining the weighting coefficients of the criteria

| **Criteria** | **C1** | **C2** | **C3** | **C4** | **C5** | **C6** | **C7** | **C8** | **C9** |
|---|---|---|---|---|---|---|---|---|---|
| **C1** | 1 | 1/2 | 1/2 | 1 | 1/3 | 2 | 1/2 | 1/2 | 1 |
| **C2** | | 1 | 2 | 1 | 1/2 | 1/2 | 1/2 | 1/2 | 2 |
| **C3** | | | 1 | 1/2 | 1/3 | 1 | 1/2 | 1/3 | 1/2 |
| **C4** | | | | 1 | 1/3 | 1 | 1/2 | 1/3 | 1 |
| **C5** | | | | | 1 | 3 | 3 | 2 | 2 |
| **C6** | | | | | | 1 | 1 | 1/2 | 1/2 |
| **C7** | | | | | | | 1 | 1/2 | 1/2 |
| **C8** | | | | | | | | 1 | 1 |
| **C9** | | | | | | | | | 1 |

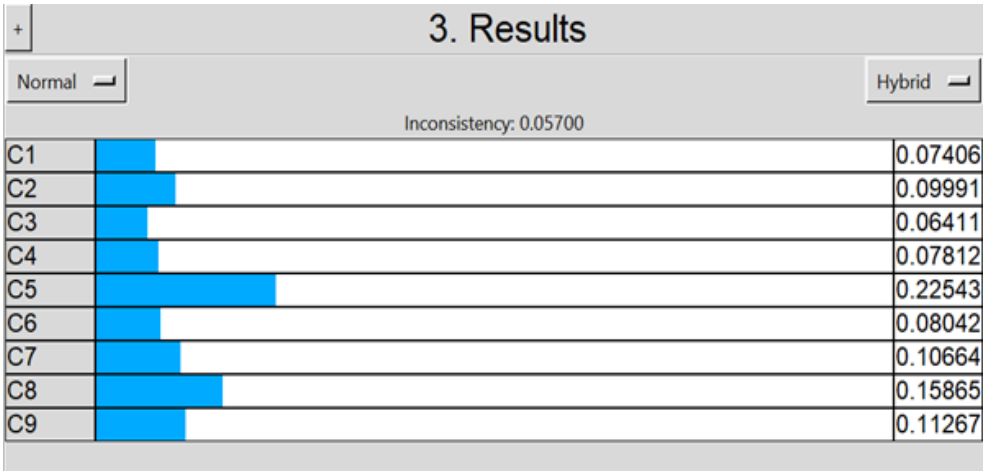


**Figure 2** Results of the ranking of criteria

Further research is the collection of data on possible business models in unstable business conditions. Data collection was done by sending a questionnaire by digitalization to managers of selected companies. Digital technology in unstable business situations serves as an aid to achieving a given goal.

Possible business models are defined by the authors together with the managers of the mining company. We evaluate defined business models using the AHP method together with managers, group decision-making with the help of Super Decisions software.

Defined business models:

1. Alternative A1 – digital business models where companies will be found,
2. Alternative A2 – competitive advantage models,
3. Alternative A3 – global,
4. Alternative A4 – deglobal,
5. Alternative A5 – market models based on new products and services and
6. Alternative A6 – business models built to customer satisfaction.

Defined business models by authors and managers are evaluated by criteria (Tables 3-11). Some modeling can always be performed until an accurate hypothesis is obtained.

The goal of authors and managers is to model business models during socio-economic instability as a way of survival and development of the company.

**Table 3** Comparison of alternatives in relation to criteria $C_1$ (Market analysis, consumer segments)

| **Alternative** | **$A_1$** | **$A_2$** | **$A_3$** | **$A_4$** | **$A_5$** | **$A_6$** |
|---|---|---|---|---|---|---|
| **$A_1$** | 1 | 1 | 1/2 | 2 | 1/2 | 1/3 |
| **$A_2$** | | 1 | 2 | 3 | 1 | 1/2 |
| **$A_3$** | | | 1 | 3 | 1/3 | 1/2 |
| **$A_4$** | | | | 1 | 1/2 | 1/3 |
| **$A_5$** | | | | | 1 | 1 |
| **$A_6$** | | | | | | 1 |

**Table 4** Comparison of alternatives in relation to criteria $C_2$ (Customer needs satisfaction assessments)

| **Alternative** | **$A_1$** | **$A_2$** | **$A_3$** | **$A_4$** | **$A_5$** | **$A_6$** |
|---|---|---|---|---|---|---|
| **$A_1$** | 1 | 1/2 | 1 | 2 | 1/3 | 1/3 |
| **$A_2$** | | 1 | 1 | 2 | 1/2 | 1/2 |
| **$A_3$** | | | 1 | 1/2 | 1/3 | 1/2 |
| **$A_4$** | | | | 1 | 1/2 | 1/2 |
| **$A_5$** | | | | | 1 | 1 |
| **$A_6$** | | | | | | 1 |

**Table 5** Comparison of alternatives in relation to criteria $C_3$ (Method of delivery of goods to customers, sales channels)

| **Alternative** | **$A_1$** | **$A_2$** | **$A_3$** | **$A_4$** | **$A_5$** | **$A_6$** |
|---|---|---|---|---|---|---|
| **$A_1$** | 1 | 2 | 1 | 2 | 1/2 | 1/2 |
| **$A_2$** | | 1 | 1/2 | 2 | 1 | 1/2 |
| **$A_3$** | | | 1 | 1/2 | 1/2 | 2 |
| **$A_4$** | | | | 1 | 1/2 | 1/2 |
| **$A_5$** | | | | | 1 | 1 |
| **$A_6$** | | | | | | 1 |

**Table 6** Comparison of alternatives in relation to criteria $C_4$ (Customer relationship, customer attraction)

| **Alternative** | **$A_1$** | **$A_2$** | **$A_3$** | **$A_4$** | **$A_5$** | **$A_6$** |
|---|---|---|---|---|---|---|
| **$A_1$** | 1 | 1/2 | 1 | 2 | 1/3 | 1/3 |
| **$A_2$** | | 1 | 2 | 2 | 1 | 1 |
| **$A_3$** | | | 1 | 1/2 | 1/2 | 1/2 |
| **$A_4$** | | | | 1 | 1/3 | 1/3 |
| **$A_5$** | | | | | 1 | 1 |
| **$A_6$** | | | | | | 1 |

**Table 7** Comparison of alternatives in relation to criteria $C_5$ (Key resources, which resources the company has)

| Alternative | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $A_6$ |
|---|---|---|---|---|---|---|
| $A_1$ | 1 | 1/2 | 1 | 2 | 1 | 1 |
| $A_2$ | | 1 | 1 | 3 | 1/2 | 1/2 |
| $A_3$ | | | 1 | 3 | 1 | 1 |
| $A_4$ | | | | 1 | 1/2 | 1/2 |
| $A_5$ | | | | | 1 | 1 |
| $A_6$ | | | | | | 1 |

**Table 8** Comparison of alternatives in relation to criteria $C_6$ (Key activities to be performed)

| Alternative | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $A_6$ |
|---|---|---|---|---|---|---|
| $A_1$ | 1 | 1/2 | 1 | 2 | 1 | 1 |
| $A_2$ | | 1 | 2 | 2 | 1/2 | 1/2 |
| $A_3$ | | | 1 | 2 | 1 | 1 |
| $A_4$ | | | | 1 | 1/2 | 1/2 |
| $A_5$ | | | | | 1 | 1/2 |
| $A_6$ | | | | | | 1 |

**Table 9** Comparison of alternatives in relation to criteria $C_7$ (Important market entry partners)

| Alternative | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $A_6$ |
|---|---|---|---|---|---|---|
| $A_1$ | 1 | 1/2 | 1/3 | 3 | 1/2 | 1 |
| $A_2$ | | 1 | 1 | 2 | 1/2 | 2 |
| $A_3$ | | | 1 | 3 | 2 | 2 |
| $A_4$ | | | | 1 | 1/3 | 1/3 |
| $A_5$ | | | | | 1 | 1/2 |
| $A_6$ | | | | | | 1 |

**Table 10** Comparison of alternatives in relation to criteria $C_8$ (Revenue structure)

| Alternative | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $A_6$ |
|---|---|---|---|---|---|---|
| $A_1$ | 1 | 2 | 1 | 3 | 1/2 | 1/2 |
| $A_2$ | | 1 | 1 | 2 | 1/2 | 1 |
| $A_3$ | | | 1 | 2 | 1 | 1 |
| $A_4$ | | | | 1 | 1/2 | 1/2 |
| $A_5$ | | | | | 1 | 1/2 |
| $A_6$ | | | | | | 1 |

**Table 11** Comparison of alternatives in relation to criteria $C_9$ (Costs, what are the costs (whether this model is sustainable or not)

| **Alternative** | **$A_1$** | **$A_2$** | **$A_3$** | **$A_4$** | **$A_5$** | **$A_6$** |
|---|---|---|---|---|---|---|
| **$A_1$** | 1 | 3 | 2 | 3 | 1 | 1/2 |
| **$A_2$** | | 1 | 1/2 | 1/3 | 1 | 1 |
| **$A_3$** | | | 1 | 2 | 1/2 | 1/3 |
| **$A_4$** | | | | 1 | 1/3 | 1/3 |
| **$A_5$** | | | | | 1 | 1 |
| **$A_6$** | | | | | | 1 |

Figure 3 shows the ranked alternatives with weighting coefficients.

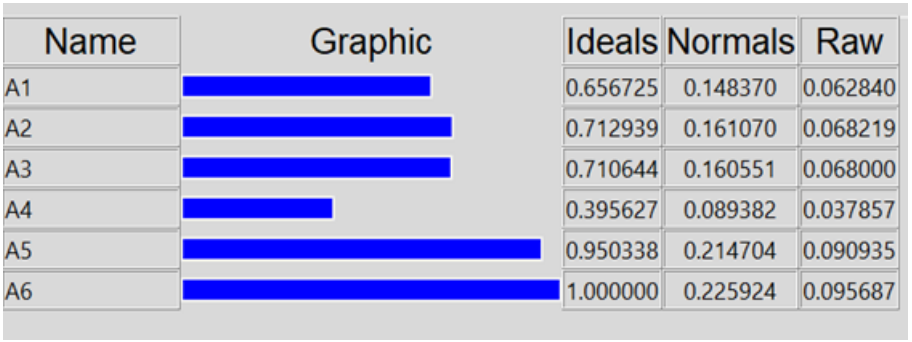


**Figure 3** Results of the ranking of the alternatives

## 4 ANALYSIS OF RESULTS

Criteria analysis: AHP calculation showed that criteria C5 – key resources, which resources the company has been the most important and because their weighting factor has the highest value of 0.22543. This means that criteria C5 has the greatest impact on determining business models because it ranks first. In an unstable socio-economic situation, it is very important that company managers have key resources in choosing business models, namely human, natural, and material resources.

Criteria C8 – the revenue structure ranks second. The weighting factor of criteria C8 is 0.15865. Revenue structure is also important when choosing business models because if there is no revenue there is no survival of the company.

Criteria C9 (costs, what are the costs, whether this model is sustainable or not), C7 (important partners for market entry) and C2 (customer satisfaction assessments) are in third place because their weighting coefficients have approximate values. The values of

the coefficient of criteria C9 is 0.12267, of criteria C7 is 0.10664 and of criteria C2 is 0.09991. When choosing business models, costs must not exceed the allowable ones, when costs increase, revenues decrease. For the companies, the business partners they work with are important, due to the conquest of the market and the assessment of the customer. Assessment and customer satisfaction with products and services is performed quarterly within the quality management system (QMS) by digital surveys.

By calculation, we get that the following criteria take the fourth place:

- C6 – Key activities to be performed with weighting factor 0,08042,
- C4 – Customer relationship, customer attraction with weighting factor 0,07812,
- C1 – Market analysis, consumer segments with weighting factor 0, 07406, i
- C3 – Method of delivery of goods to customers, sales channels with weighting factor 0,06411.

Company managers choose key activities that will bring profit to the company, carefully analyze the market, then attract customers in various ways and make decisions about the best product delivery.

Alternative analysis:

From Figure 3 we come to the conclusion that alternative A6 – business models built to customer satisfaction is the most optimal business model because its weighting factor has the highest value of 0.225924.

In second place is the alternative A5 – market models based on new products and services with a weighting factor of 0.214704.

The third place is occupied by A2 – models of competitive advantage, whose value of the weight coefficient is 0.161070.

In fourth place is the global model (A3) with a weighting factor of 0.160551.

The fifth place is taken by alternative A1 – digital business models where companies will be found, whose weight coefficient is 0.148370.

The last place is occupied by A4 – deglobal, whose value is 0.089382.

Business models built to customer satisfaction and market models based on new products and services in socio-economic instability have the greatest success of survival with mining companies. While the results show that the proposed deglobal business model is not sustainable for mining companies. Business models of competitive advantage, global and digital, can always become sustainable through modeling in unstable conditions.

Conclusion: Given Hypothesis I: Built business models in socio - economic instability in mining companies can be sustainable through modeling, namely: business models of competitive advantage, global and digital.

Hypothesis II: Some of the built business models in socio-economic instability in mining companies cannot be sustainable (business deglobal models).

## 5 CONCLUSION

The form of modern business at the global level is constantly changing, especially during socio-economic instability. The unstable business situation, COVID-19 and the war in Ukraine encouraged the authors to propose and rank business models with mining companies together with the managers of mining companies.

The aim of this paper is to evaluate the proposed business models for successfully overcoming socio-economic instability. Based on the Osterwalder of this business model, criteria were identified. Dr. Alexander (Alex) Osterwalder is one of the world's most influential experts in business model strategy and innovation. The AHP method was used to calculate the weight of the criteria and rank the alternatives.

By defining the weight coefficients of the criteria, we get:

- Criteria C5 takes the first place, key resources have the greatest influence on the choice of business models because their weight coefficient has the highest value of 0.22543;
- The second place is occupied by criteria C8 – income structure with a weighting factor of 0.15865;
- Third place is occupied by criteria C9 – costs with a weighting factor of 0.12267, criteria C7, important partners for entering the market with a weighting factor of 0.10664 and criteria C2 – the customer's estimate with a weighting factor is 0.09991;
- The fourth place is occupied by the following criteria:
    - C6 – Key activities to be performed with weighting factor 0,08042,
    - C4 – Customer relationship, customer attraction with weighting factor 0,07812,
    - C1 – Market analysis, consumer segments with weighting factor 0, 07406,
    - C3 – Method of delivery of goods to customers, sales channels with weighting factor 0,06411.

Further research showed that the selected business models A6 – built to customer satisfaction (0.225924) and A5 – market models based on new products and services

(0.214704) have the greatest success of the survival of the mining company in unstable conditions.

Business models of competitive advantage A2 (0.161070), global A3 (0.160551) and digital A1 (0.148370) after modeling and development over time can become sustainable. Business model A4, deglobal, with a value of 0.089382, is not sustainable in unstable conditions.

Authors of future research can address the question of how selected business models affect the management of mining companies.

## ACKNOWLEDGMENTS

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