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REAL OPTIONS IN THE PROJECT MANAGEMENT OF DIVERSIFICATION PROGRAM (A CASE STUDY OF MONGOLIAN-RUSSIAN COMPANY CCW "ERDENET")

Summary. This article is devoted to the question of applying real options method for estimating investment efficiency of projects. Two main approaches to understand the concept of the real options have been considered in this article. The conditions of the project diversification program developed by the mining company CCW «Erdenet» have been analyzed and the «decision tree» has been made for project of cathode copper production. Several of the real options have been found throughout this research: waiting and expansion options. The estimation of investment efficiency has shown that using waiting real option increase project revenue by \$9.85 mln., when compared to the alternative proposed by the company. By using expansion real option company can borrow funds at a higher interest rate and increase financial stability. Using the real options method makes it possible to choose the most effective alternative after the necessary information about external environment has been received.

Keywords: real options, project, project management, investment efficiency.

OPCJE REALNE W ZARZĄDZANIU PROJEKTAMI DYWERSYFIKACJI (STUDIUM PRZYPADKU MONGOLSKO-ROSYJSKIEGO PRZEDSIĘBIORSTWA CCW „ERDENET”)

Streszczenie. W niniejszym artykule poruszono kwestię wykorzystania metody opcji realnych w rachunku efektywności inwestycji. Rozważono w tym zakresie dwa główne podejścia. Ustalono także warunki programu dywersyfikacji w przedsiębiorstwie górniczym CCW „Erdenet”, które zostały wnikliwie

przeanalizowane, a na podstawie otrzymanych wniosków stworzono „drzewo decyzyjne” dla projektu produkcji katod miedzianych. Niektóre z opcji realnych zostały zauważone podczas przeprowadzania badania, w tym: opcje oczekiwania i opcje ekspansji. Rachunek efektywności inwestycji wykazał, że użycie opcji realnych podwyższa przychody z projektu o 9,85 mln dolarów w odniesieniu do alternatywy zaproponowanej przez przedsiębiorstwo. Przy wykorzystaniu opcji realnych przedsiębiorstwo może pożyczyć środki przy wyższej stopie procentowej i zwiększyć stabilność finansową. Zastosowanie metody opcji realnych pozwala także wybrać najbardziej efektywną alternatywę po uzyskaniu niezbędnych informacji na temat otoczenia zewnętrznego.

Słowa kluczowe: opcje realne, projekt, zarządzanie projektem, efektywność inwestycji.

1. Introduction

In project management the methodology of investment efficiency estimation substantially influence the way of making management decisions. Usually the traditional methods of investment efficiency estimation are used in companies. These methods are based on an evaluation of discount cash flows and forecasts. But in these methods of estimation of the project economic value opportunities for changing management decisions due to the new information are not taken into consideration.

Nowadays projects of mineral resources complex are influenced by a wide range of different factors of external environment such as:

- decrease of product price
- volatility of national currency
- deterioration of mineral resources
- necessity of extraction the hard-to-recover reserves
- initiation and development of innovative technologies

External environment changes and deterioration require improvement of methods of an estimation of investment projects efficiency in conditions of uncertainty.

One of the perspective methods of project evaluation, taking into account changes of conditions of realization and the choice of decisions at various stages, is the method of real options analysis (ROA).

The purpose of this science project is using the real options method for increasing the efficiency of the strategic program of «Erdenet»

Objectives:

- Analysis of practices of the real options method application in the companies of mineral resource complex
- Analysis of conditions of projects implementation

- Identification and evaluation of real options in projects for improving the program efficiency and analysis of expediency of their application

Subject: real options method.

Object: strategic program of «Erdenet», that consists of three general and one infrastructure project.

Despite the fact that the term "real option" was used by a major American expert on the theory of Finance S. Myers over 25 years ago, today in the world there is no acknowledged point of view, what a real option is.

There are two main approaches to understand the concept of the real options.

According to the first one real option is the application of the theory of financial options for the real assets. According to the second one real option is the possibility of making flexible decisions in conditions of uncertainty¹.

But it is important to understand that the real options are not any possibilities of external environment. Besides the essential knowledge real option method requires making certain actions and investment for opportunity to choose the most effective alternative after receiving information about changes of the main factors, influencing the project.

Using real option method is possible after taking into consideration and verifying the necessary conditions²:

- Possibility of making financial model.
- An availability of uncertainty of the main factors. Also external uncertainty must have a decisive influence.
- Management is able to make a decision and influence the project realization.
- Management requires essential knowledge and trust by stakeholders.

2. Increase of efficiency of the strategic program

The object of this science project is the strategic program of «Erdenet», CCW. Mongolian-Russian Erdenet Mining Corporation that is one of the biggest Ore mining and Ore processing factory in Asia.

Erdenet started its operation in 1978. Today this company is a large complex that process 26 million tons of ore per year and producing 530.0 thousand tons of copper concentrate and around 4.5 thousand tons of molybdenum concentrates annually. Erdenet cooperate with leading mining experts from Phelps Dodge, Inc.; Outokumpu Oyj, Finland; Bateman Engineering Ltd., Australia; Pacific Ore Technology Ltd., Australia; Brook Hunt &

¹ Source [2].

² Source [8].

Associates Ltd., UK; KDEngineering, USA; Samsung Corp., South Korea and the world's other mining leaders. The strategic plans for Erdenet until 2020 are: to improve the equipment of the plant, to extend the ore processing capacity up to 35 million tons per a year, to reduce cost of unit product, to produce a final product with added value by introducing new techniques and technologies, which are environmentally-friendly and energy saving³.

So the effective realization of diversification program is one of the most important and difficult challenges for company at this moment.

This strategic program of «Erdenet», CCW consists of three general and one infrastructure project:

- Constriction of the plant for molybdenum production,
- Constriction of the plant for cathode copper production,
- Constriction of the plant for copper wire rod production,
- Reconstruction of the thermal power plant.

All necessary for using real options method conditions have been verified according to the strategic program (table 1).

Table 1

Verifying conditions of using the real options method

Conditions of application of the real options method	Conditions of realization of program projects
Possibility of making financial model	The financial models of projects have been made.
Availability of uncertainty of the main factors. External uncertainty has a decisive influence.	<ul style="list-style-type: none"> • The difficulty of forecasting the price of copper and concentrates. • The availability of uncertainty regarding the copper content in the ore. • The lack of industrial trials, confirming the efficiency of processing technologies.
Management is able to make a decision and influence the project realization.	Company has essential infrastructure, technologies, investment and knowledge.
Management requires essential knowledge and trust by stakeholders.	The high level of competences of partner companies conducting R&d. The consistency of the views of key participants in making investment decisions.

Source: The report of „Erdenet”, CCW project.

³ Source [14].

Making forecast for project efficiency estimation is very difficult even with using statistic data (fig. 1) and government forecasts (fig. 2).

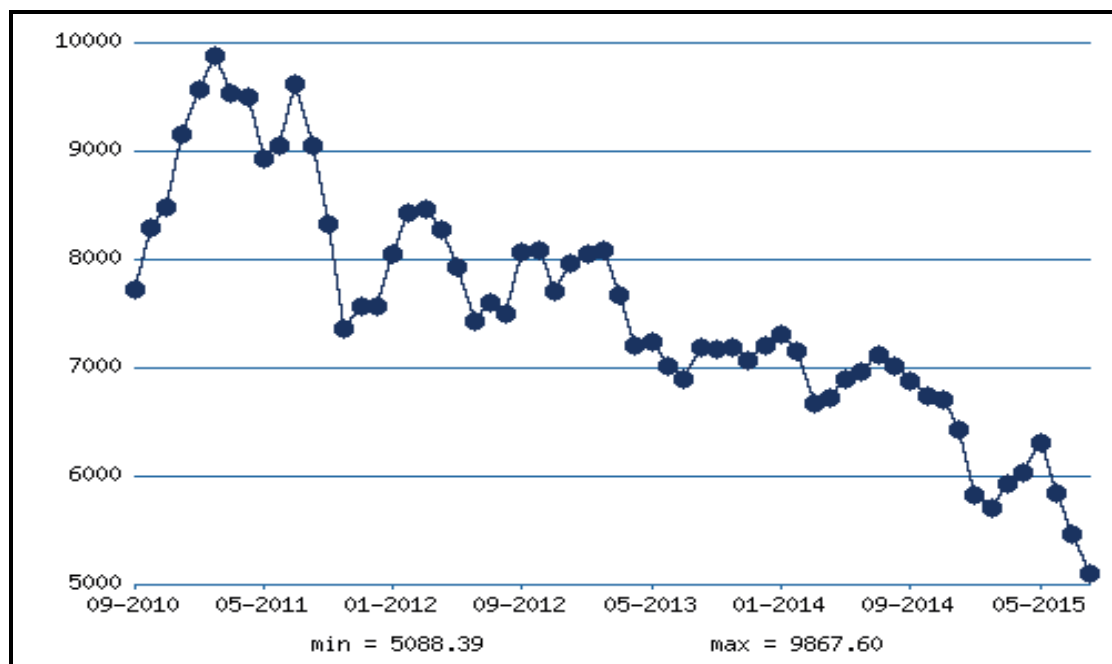


Fig. 1. Dynamics of copper price 2010-2015
Rys. 1. Rozwój cen miedzi w latach 2010-2015
Source: London Metal Exchange.

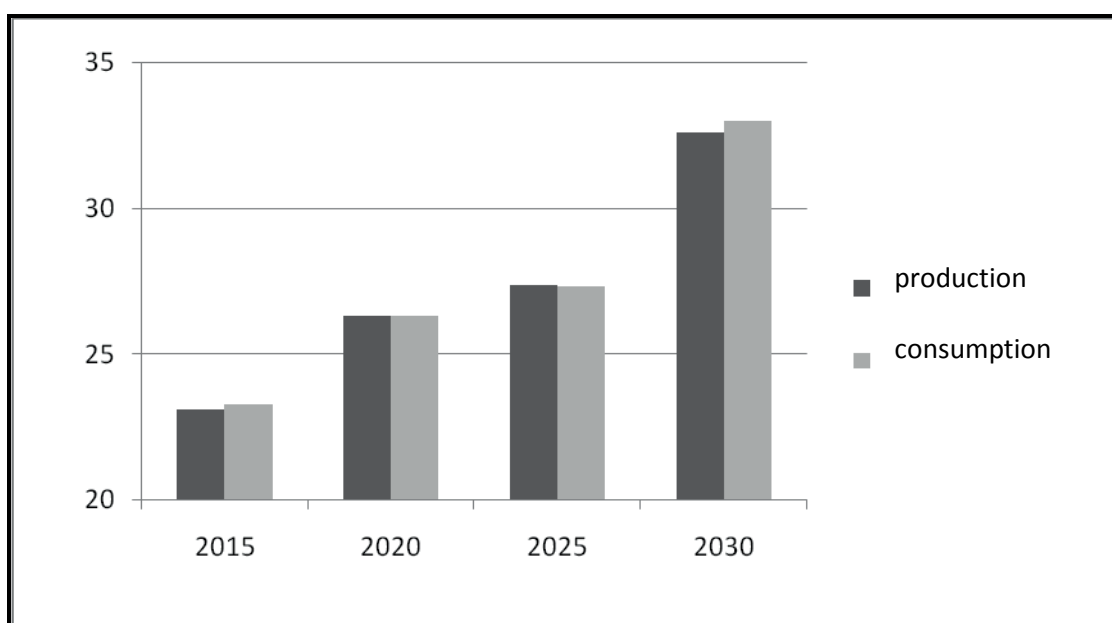


Fig. 2. Forecast of production and consumption of copper 2030
Rys. 2. Prognoza produkcji i zużycia miedzi do 2030 roku
Source: The strategy of development of Russian nonferrous metal industry 2014-2020 and by 2030.

That is why it is so important to use other methods of project estimation with taking into account changes of external environment.

We decided to analyze the reasonableness of management decisions and using traditional method of project estimation.

In 1994-1996 the Company made R&D of SX-EW technology of cathode copper production. In 1996 company built the small plant Erdmin (3 000 t.) for testing Dump Leaching – SX-EW technology of cathode copper production. In 2001-2005 joint venture made another R&D of processing technologies with other special-purpose companies in order to change the processing technology. The investment for these R&D was \$4 mln.

Now the purpose of project is building a new factory (30 000 t.) for:

- Heap leaching of oxidized ore for cathode copper production, using Dump Leaching-SX/EW technology
- Processing the part of sulfide enriched ore, using autoclave technology for production cathode copper and sulfuric acid

It is important to mention that management of the company could make the wide range of different decisions and identify the real options. Each management decision requires certain investment in the certain period of time and ensures receiving different revenue. We have found seven different possible alternatives of project realization and make a decision tree (fig. 3).

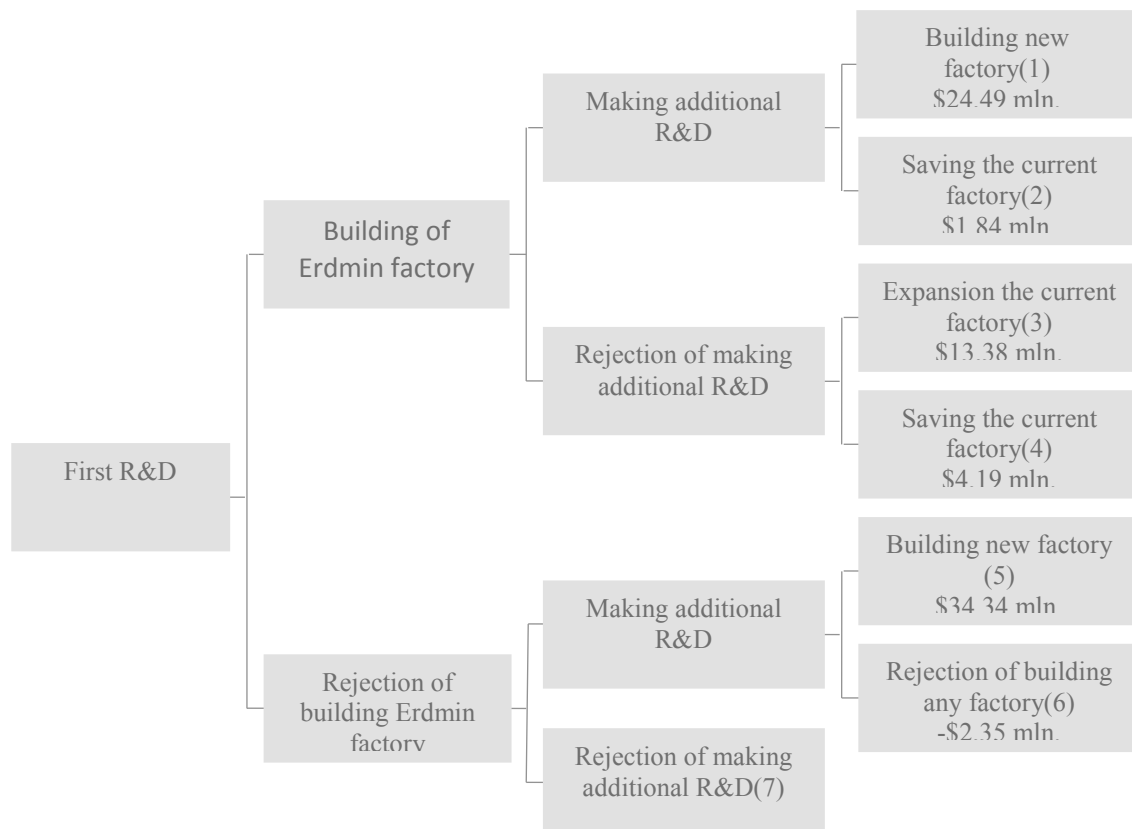


Fig. 3. Decision tree of cathode copper production project
Rys. 3. Drzewo decyzyjne projektu produkcji miedzi katodowej
Source: Made by the authors.

First alternative – it is the current decision of company management, according to which the company was building the small plant Erdmin (small capacity 3000 t) for testing

technology of cathode copper production while making the joint R&D with other special-purpose companies in order to change the processing technology. As a result, the company management has decided to build a new plant for 30 000 t., with using new technologies.

According to the second alternative the small plant Erdmin (small capacity 3000 t) for testing technology of cathode copper production could be built while company was making the joint R&D with other special-purpose companies in order to change the processing technology. In this case if new technologies had not been effective, company would have used existing small plant.

According to the third alternative the company could build the small plant Erdmin (small capacity 3000 t) for testing technology of cathode copper production but additional R&D would not be made. In this case if Erdmin had been effective, company would have increase its capacity to 30 000t.

According to the fourth alternative the company could build the small plant Erdmin (small capacity 3000 t) for testing technology of cathode copper production but additional R&D would not be made. In this case if Erdmin had not been effective, company would have used existing small plant.

According to the fifth alternative the company could not build the small plant Erdmin (small capacity 3000 t) for testing technology of cathode copper production and could make only additional R&D with other companies. In this case if new technologies had been effective, company would have build big plant (30 000t. capacity).

According to the sixth alternative the company could not build the small plant Erdmin (small capacity 3000 t) for testing technology of cathode copper production and could make only additional R&D with other companies. In this case if new technologies had not been effective, company would have not build any plant.

According to the seventh alternative the company could not build the small plant Erdmin (small capacity 3000 t) for testing technology of cathode copper production and could not make any additional R&D with other companies. In this case company would not realize the project of cathode copper production.

We have estimated the investment efficiency of all these alternatives.

Assumptions in the calculation:

- price of cathode copper: \$3 th./t.
- the copper content in the ore 0,34%.
- consideration of inflation: no

Also the necessary investment for small plant Erdmin construction (\$10 mln.), expansion of Erdmin (\$60 mln.) and building absolutely new plant (\$100 mln.) have been taken into account.

The most effective alternatives are: 1,3 and 5. The first one is the current decision of «Erdenet» management, the third one is the real option of expansion and the fifth is the real option of waiting.

We have compared these three alternatives according to the different criterions: capacity of the plant, investment, «Erdenet» share, dividends, NPV and IRR (table 2).

Table 2

Comparison of alternatives

Alternatives	Management decision	Option of expansion		Option of waiting
Capacity, t.	30 000	30 000	30 000	30 000
Investment, mln.\$	57,6	18	32	55
«Erdenet» share, %	51	25,7	49	51
Dividends, mln.\$	Year 1-9: 0,6 Year 13-32: – 12	Year 1-9: 0,6 Year 13-32: – 4.8	Year 1-9: 0,6 Year 13-32: – 9.11	Year 8 - 27: 12
NPV, mln.\$	24,49	13,38	24,49	34,34
IRR, %	17,777	22,257	23,438	17,778

Source: Made by the authors.

The most effective alternative is the fifth.

The real option of waiting let management postpone the moment of making decision. Due to this fact it is possible to decrease the amount of investment because of discount factor. Also it is possible to reduce the period of project realization, it is not necessary to build a testing plant and company could immediately build a big plant and receive the essential income by production 30 000t. of cathode copper.

The second most effective alternative is the current management decision. But the income that is generated by this alternative is less than \$9.85 mln.

The third most effective alternative is the real option of expansion.

But in the case of implementation this option and effectiveness of new technologies of cathode copper production it is necessary to increase the share of «Erdenet», CCW at least to 49% instead of 25,7% as in the case of small plant construction. If the «Erdenet», CCW share of the big plant (30 000t.) is 49% the income of this alternative is the same as the income of the current management decision.

The IRR of all alternatives were estimated: 17,777%, 13,793%, 22,257%, 23,438%, 17,778.

Comparison of IRR showed that the real option of expansion let borrow credit funds for a higher interest.

Therefore the using real option of waiting let increase the income of the project, while the using of the real option of expansion increase financial stability. Consequently implementation of the real options is worth being made.

3. Conclusions

In result of the research the following conclusions were made:

- Using only DCF for estimation of investment project efficiency is not enough in conditions of uncertainty.
- Real options method gives an opportunity to choose the most effective alternative after receiving the essential information about changes of the main factors (price, demand, profitability of technology etc.)
- Real options were identified in the strategic program.
- The decision tree was made for the project of production cathode copper.
- The efficiency of current management decision, real option of expansion and real option of waiting have been compared.
- Using real option of expansion is effective if the share of «Erdenet» is not less than 49%.
- Comparison of IRR showed that the real option of expansion let raise credit funds for a higher interest.
- Using of real option of waiting let increase the income by 9,85 mln.\$

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Omówienie

W artykule przedstawiono możliwość zastosowania metody opcji realnych do zarządzania programem dywersyfikacji przedsiębiorstwa górniczego. Przeanalizowano różne metody opcji realnych. Warunki programu projektu zostały zbadane i stworzono „drzewo decyzyjne” dla projektu produkcji katod miedzianych. Rachunek efektywności inwestycji dla analizowanych alternatyw pokazuje, że warto wykorzystać metodę opcji realnych w zarządzaniu projektami.