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# APPLICATION OF THE PROJECT APPROACH TO THE MANAGEMENT OF MINING WASTE

**Summary.** One of the problems of the mining sector is a significant waste of extraction and processing. From the total mass of waste is used less than half, and the remaining part is placed in dumps, tailings, forming a anthropogenic objects, mostly intended for the remediation and disp0osal. Despite a number of reasons (environmental, organizational, economic, institutional and technological), which lead to the accumulation of waste and negative impacts of their savings, the solution to this problem lies in identifying opportunities for the involvement of waste into the economy as a source of raw materials and energy. Foreign experience shows that the mining companies the opportunity is created through the use of tools of the project approach - as a the new format to solve the problem of accumulated waste in a constantly changing environment. Application for the methodology of the project approach to waste management for companies of the mining sector can be implemented, according to the authors opinion, when their projects are included in the program of strategic development of the company.

**Keywords:** waste, mining operations, technological deposits, project management, diversification strategy.

# ZASTOSOWANIE PODEJŚCIA PROJEKTOWEGO DO ZARZĄDZANIA ODPADAMI GÓRNICZYMI

**Streszczenie.** Jednym z problemów sektora górniczego jest duża liczba odpadów, powstających w trakcie wydobycia i przetwarzania. Z ogólnej masy odpadów, które powstają w górnictwie, wykorzystywana jest mniej niż połowa, a pozostała część jest składowana na wysypiskach lub hałdach, tworząc

antropogeniczne obiekty, głównie przeznaczone do rekultywacji i usunięcia. Mimo wielu przyczyn (środowiskowych, organizacyjnych, ekonomicznych, instytucjonalnych i technologicznych), które powodują akumulację odpadów, problem ten można rozwiązać traktując znaczną część odpadów jako wtórne źródło materiałów i energii. Z doświadczeń zagranicznych jednoznacznie wynika, że w rozwiązaniu problemu odpadów górniczych w warunkach zmiennego otoczenia można wykorzystać podejście projektowe. Niemniej jednak – zdaniem autorów − wykorzystanie metodologii podejścia projektowego w gospodarce odpadami w przedsiębiorstwach z sektora górniczego może zostać wdrożone jedynie wtedy, gdy projekty zostaną uwzględnione w programie strategicznego rozwoju przedsiębiorstwa.

**Słowa kluczowe:** odpady, działania górnicze, zarządzanie projektami, strategia dywersyfikacji**.**

## 1. Introduction

Annually in the Russian Federation forms more than 4 billion tons production and consumption wastes. 90% of these wastes are wastes of mining. About half of all waste is used or disposed, and the other is placed in dumps. During 10 years, more than 20 billion tons of mining waste has been accumulated.

For the period 2005-2014, more than 18 billion tons of waste accumulated in dumps and tailing ponds. If we consider the last period, more than 100 billion tons of mining tailings already accumulated. The rate of waste generation exceeds the growth of industrial production in the mining sector several times.

Forecasts of reducing the quality of the mineral resource base, deterioration of mining and geological conditions of conducting works, lead to the conclusion about the growth of the waste mass in the long term. It should be noted that the trend towards to extensive use of subsoil resources is maintained.

Another important factor is the market low motivation, lack of incentives for the use of industrial waste by mining companies and non-availability of coherent state policy in this sphere of activity. The waste, formed in the process of mining and recycling of minerals, as a rule, are the result of imperfections in the process and the lack of reasonable project development in natural deposits production.

The reasons for this situation are: the decline in the quality of the mineral resource base, the deterioration of mining and geological conditions, low market motivation of mining companies for processing the waste, problems of legislative regulation in this sphere. About this problem we spoke last year at the webinar.

As practical experience shows that 70% of all waste, formed at the mining enterprises cannot be recycled within the existing technologies[1].

Therefore, to solve the problem we need new technologies, institutional mechanisms and schemes, allowing to involve the waste in the production process.

In our opinion, These are the main tasks of waste management, the solution of which is impossible without the implementation of projects.

The authors are aware that a comprehensive solution to the problem of waste in mining production is impossible to solve without the state participation, changes in legislation and certain institutional transformations.

Therefore, we are limited in the range of issues aimed at addressing the waste problem at the level of primary economic link – which is a mining company.

We use for this purpose, validated and promising tools of project management.

1. We are dealing only with waste from extraction and primary processing of minerals.
2. We consider the waste, the use of which is not stipulated by the project of mining of the field.
3. We consider a hypothetical mining company that is engaged in the development of conventional mineral deposits, i.e. the company for which waste management is the observance of process regulations for mining operations.

In our studies, we rely on the European experience of waste management [2, 3].

The purpose of this study is to validate the feasibility of a project-based approach in mining waste management.

## 2. Review of literature

Consideration of the waste as control objects requires their identification. Attributing things to waste entails the absence of the purpose of use of things and the owner's want to get rid of it (Pongrácz E., 2002)[4].

This positions are reflected in GOST R ISO 14050-2009, Article 3.12 – "Waste are the substances or objects the owner wants to get rid of which" that, in particular, corresponds to the definition of "waste" in the EU Directive on Waste (EC – Waste Framework Directive, 1991).

[1] Chernousov P.I.: Recycling. Technologies of processing and recycling of technogenic formations and wastes of ferrous metallurgy. "House MISA", 2011.
[2] BRGM: Management of mining, quarrying and ore-processing waste in the European Union, No. 79, 2001; from http://ec.europa.eu/environment/waste/studies/mining/0204finalreportbrgm.pdf.
[3] Reference Document on Best Available Techniques for Management of Tailings and Waste-Rock in Mining Activities, 2009; http://eippcb.jrc.ec.europa.eu/reference/.
[4] Pongrácz E:. Re-defining the concepts of waste and waste management. University of Oulu, retrieved July 9, 2015; http://herkules.oulu.fi/isbn9514268210/isbn9514268210.pdf.

The waste owner is the one who produced them, or the one who transferred the rights of waste ownership.

The National standard of the Russian Federation defines the "waste" as "remnants of the products or an additional product, which is formed in the production process or after completion of certain production and is not used in direct connection with these activities" (the National Standard of the Russian Federation. Resource-saving, 2009).

In the definitions of the Federal law "about the wastes of production and consumption" - waste management involves the operation, collection, transportation, treatment, recycling, waste disposal.

Waste management can be considered as a process that involves specific functions of organization, planning, accounting, monitoring and control in the implementation of activities, which are associated with their treatment.

Functional approach to waste management is effective in the case when the separate transactions are associated with the waste, and can be combined into a separate sphere of activity.[5]This would require an appropriate institutional environment.

In the foreign research, the principle of "The hierarchy of waste management" is widespread enough. This principle defines the logic of the waste management in accordance with the sequence of priorities (starting with preventing of the waste formation at the source and ending with the placing (burial process))[6].

In the legislation of the Russian Federation there are some problems associated with the identification of mining wastes.

Firstly, the law "On subsoil", which regulates activities related to mining, contains only the definition of "waste mining and related processing industries" but does not reveal the content of this concept.

Secondly, the law defines the use of mining waste as a type of subsoil use, limiting the ability of companies to dispose of waste[7].

Mining companies, at the same time, perform some administrative functions (such as accounting and monitoring of the waste, the organization of work on the disposal of waste in special landfills or in mined-out space, storage and reclamation of waste), according to the mining project. Now, in practice, waste management of mining production comes down to the observance of production schedules of mining projects and the provision of basic production processes.

The fact that most of the production of waste and primary processing of mineral resources may be used for production purposes, is an established fact. In the Russian Federation for the

[5] Kamenik L.L.: Modernization of the Russian economy. Recycling of resources - a new vector of business development. Economy and Entrepreneurship. No. 3, 2015, p. 16.

[6] Sustainable Materials Management: Non-Hazardous Materials and Waste Management Hierarchy, 2016; https://www.epa.gov/smm/sustainable-materials-management-non-hazardous-materials-and-waste-management-hierarchy.

[7] Nevskaya M., Kabak O.: State of regulation of mining and mineral processing waste. Organization and management. Scientific Paper No. 81, Gliwice 2015, p. 37-49.

designation of such waste accumulations there is a term «technological fields»[8], which is used in relation to the amounts of wastes (techno genic mineral projects) and has a certain resource potential, to which there is commercial interest among potential investors.

Technogenic deposits differ from primary deposits by durability, a high level of homogeneity, variability of qualitative composition and structure of the mineral substances, the presence of hazardous substances[9], which is not always possible to use them as part of the current process.

This requires independent projects, the development and the implementation of which demands certain efforts and commitment of companies. However, in the extensive subsoil use, feasibility of such projects is not always obvious.

Low interest in projects related to the use of waste can be neutralized under the condition that the aims of the projects are consistent with the strategic goals of the company and provide higher productivity and business processes[10].

The project approach to the management of mining waste represents the principles, the tools, a set of methods which help to justify feasibility of recycling projects, as well as reducing waste generation and accumulation.

## 3. Methods of the study

The methodology of the study is in a consistent justification of basic positions of mining production waste management methodology in the concept of project management.

Analysis of regulatory and scientific literature has shown that there are multidimensional (technological, economic, environmental) interpretation of the concept of «waste of mining production». In the context of this study, a waste of mining production we mean unrealizable, not used, and (or) derived from economic subsoil user turnover products production and processing of extracted rock mass presented by accumulations of mineral formations, rock masses, liquids and mixtures in the dumps, heaps, ponds drives, and other special forms.

In this case, we do not refer to the waste such products as mining and processing rock mass, if their use is foreseen by the draft development of the indigenous field (for example, stowing or the construction of dams or roads of overburden), as well as recyclable waste.

For mining enterprise management of production waste and processing of mineral resources, in the framework of the field development project, aimed at compliance with the technological regulations of mining and basic manufacturing process (mineral extraction and

[8] Chernousov P.I.: Recycling. Technologies of processing and recycling of technogenic formations and wastes of ferrous metallurgy. "House MISA", 2011.
[9] Ibidem.
[10] Yuryeva T.V.: Project approach as a tool for the realization of strategic goals. Economic sciences, No. 11 (120), 2014.

processing) throughout the entire enterprise life cycle, which can amount to tens of years. The possibility of using the waste cannot always be set at the design stage of field development: often, only in the course of activity of a mining enterprise can arise such a need, due to changes in internal and external conditions of the enterprise[11].

The response to these changes must be projects, which directed, under the principle of "hierarchy", to reduce the formation, the use of the resource potential of waste and specification of placement (dumping)[12].

The possibility of using a project approach to waste management is determined by the following circumstances:

- wastes are finite and have a pronounced "life cycle" (from extraction to recycling or disposal);
- the resource potential of waste depends on many external conditions (technology, demand, availability of alternative resources, environmental policy, etc.) and can vary depending on changes in external factors;
- the use or waste disposal can be interested in different structures: commercial organizations, municipalities, as well as public and individual citizens, so there is a need for methods of negotiation and formalization of different interests;
- The use and accommodation (disposal) of waste may be associated with certain commercial and environmental risks.

The project format allows for an economic assessment of the resource potential of waste and consider various options for their use, to take into account and harmonize the interests of stakeholders; identify and assess the possible risks including associated with the newly generated waste, to optimize the life cycle of waste in a changing environment [13].

Every project starts with setting a specific goal[14]. For mining companies the feasibility of projects aimed to reduce the use or waste, evident only in cases where the purpose of the project allows achieving strategic or production problems and results of the company[15].

[11] Nevskaya M.A., Marinina O.A.: Regulatory Aspects of Mining Waste Management in the Russian Federation/ Biosciences Biotechnology Res Asia, No. 12(3); http://www.biotech-asia.org/vol12no3/regulatory-aspects-of-mining-waste-management-in-the-russian-federation.

[12] Ulanova O.V., Tulohonova A.V.: Life cycle assessment of integrated management systems; http://www.rae.ru/monographs/267.

[13] Ponomarenko T.V., Koveshnikova K.I.: Chantsalmaa Bawuah. Increasing the effectiveness of the program of diversification based on the methodology of the project approach. Economy and Entrepreneurship, No. 12, 2015, p.1, p. 1125-1128.

[14] Guide to the Body of Knowledge of project management. PMBOK; http://startupseminar.ru/_ld/0/17_301907_2D9D3_pm.pdf.

[15] Zarenkov V.A.: Project Management. Textbook Publishing house, ASV 2006, p.216.

## 4. Results of the study

Based on the principle of waste management hierarchy and the logic of the process approach, we have highlighted two types of projects (Figure 1):

1. Projects that are integrated into the production process of the company, aimed at improving the efficiency and environmental safety.
2. Projects that are integrated into the company's development strategy.

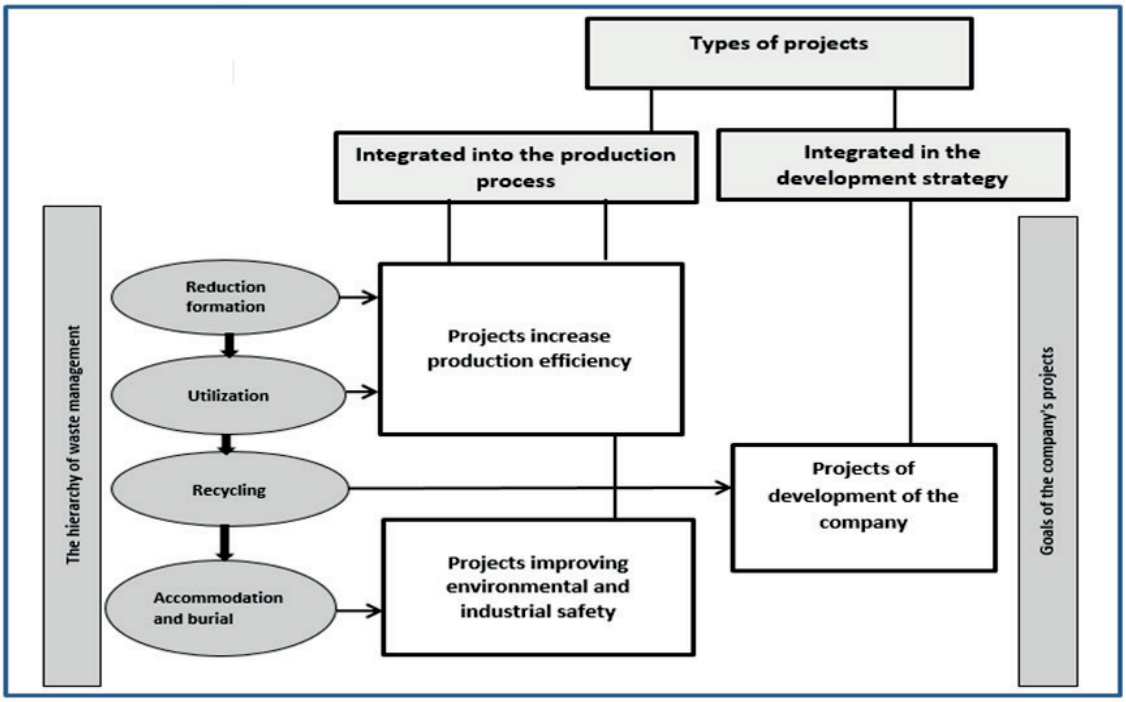


Fig. 1. Types of projects and goals are associated with directions of "waste management hierarchy"
Rys. 1. Rodzaje projektów i celów a „hierarchia zarządzania odpadami" w przedsiębiorstwie
Source: Developed and offered by the authors.

The projects that are integrated into the production process, may include:

The introduction of low-waste technological schemes of mining[16], projects production organization in a closed cycle (internal recycling), projects involving the use of waste in the secondary production technology reclamation and protection of environmentally dangerous substances contained in waste.

As specific objectives of the project that are integrated into the manufacturing process, may be considered as: reduction of costs associated with the placement, storage of waste; saving material and human resources; creation of conditions for safe operations.

Projects, aimed at the development of the company, must be coordinated with the strategic objectives, such as expansion of the existing or entering new markets. Such projects usually

[16] Holodnyakov G.A., Ligotskiy D.N.: Low-waste technology of open development of mineral deposits. National mineral resources university (Mining University), St. Petersburg 2015, p. 278.

involve the release of new products and expansion of the range, the production of products with a higher added value (Figure 2).

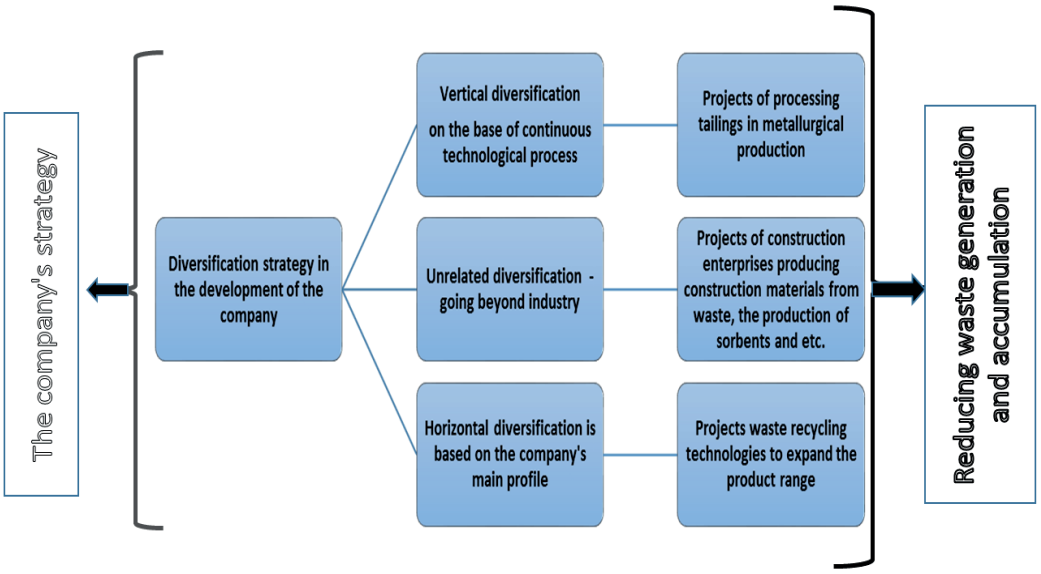


Fig. 2. The company's diversification strategy
Rys. 2. Strategia dywersyfikacji w przedsiębiorstwie
Source: Developed and offered by the authors.

Alternative possibilities of development of the company in the form of vertical, horizontal, and unrelated diversification are implemented via projects that involve the waste in the process of global recycling.

Vertical diversification involves the creation of a continuous mining process, processing and marketing of the finished product, the implementation of projects aimed at the formation of a minimum of waste production and enrichment, as well as - for processing of waste. Implementation of vertical diversification is possible by the inclusion of new stages in the production chain: production, refining, metallurgical conversion in order to reduce the waste of the life cycle[17].

Horizontal diversification is based on the creation of a new product on the basis of existing or new technologies within the company profile, the expansion of distribution channels and the growth of production scale-up.

Unrelated diversification assumes going beyond the industry, the formation of new types of activity - production of additional products with high added value and access to new markets. An example of an unrelated diversification is projects of production additional materials for the building industry from waste.

[17] Ponomarenko T.V., Koveshnikova K.I.: Chantsalmaa Bawuah. Increasing the effectiveness of the program of diversification based on the methodology of the project approach. Economy and Entrepreneurship, No. 12, 2015, p.1., p. 1125-1128.

By means of the diversification projects implementation, within the company achieves the effects of comprehensive utilization of mineral resources, the growth of company value, obtaining products with high added value, reducing the economic and environmental risks.

When selecting and justification projects it should be taken into account possible limitations due to the peculiarities of technogenic deposits and waste, as well as the external environment projects. External limitations for the project may occur at the company level, the business environment and macro level.

Constraining factors in the implementation of projects for the use of man-made objects on the company level can be: human, technological and economic factors. For example, the requirements for the quality of technogenic raw materials finished products, the technological conditions of use and recycling of waste.

The business environment for the project - it is the environment of the interbranch relations, sales and competition in the mineral resource sector. The main limitation in this area is represented by monopolized market.

Macro-level restrictions are institutional in nature and are manifested in the contradictions in the field of property law on the technogenic mineral objects, waste accounting systems, the lack of objective assessment methods, the complexity of the procedures and limitations of technological objects in use.

## 5. Conclusions

1. The results of the study allow to define the project approach to the management of mining production waste as a method that allows to reduce the formation and accumulation of waste in the environment in compliance with the principle of waste management hierarchy.
2. The feasibility of projects implementation, which are aimed to reduction and accumulation of waste, for mining companies is defined by an opportunity of integration projects, which are aimed to reducing the formation, accumulation and secure storage (disposal) into existing production processes or in the company's development strategy.
3. The resource potential of waste and technogenic deposits of existing mining companies can be regarded as one of the factors triggering the application of the diversification strategy, along with other factors, such as the introduction of new technologies, risk-sharing, the use of an excess of idle production capacity, reinvestment of profits, and others.
4. The implementation of diversification projects associated with reducing of the life cycle of waste and produce a new kinds of products, allows simultaneous form the process of global waste recycling of mining production.

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13. Yuryeva T.V.: Project approach as a tool for the realization of strategic goals. "Economic sciences", No. 11 (120), 2014.
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## Omówienie

W artykule zajęto się rozwiązaniem problemu gospodarki odpadami górniczymi i przetwórczymi przy wykorzystaniu podejścia projektowego. Autorzy uznali, że podejście projektowe w gospodarce odpadami jest sposobem pozwalającym na zrealizowanie celów strategicznych przedsiębiorstw górniczych.

Niemniej jednak możliwość wykorzystania podejścia projektowego w gospodarce odpadami jest zdeterminowana przez następujące okoliczności: 1) odpady są produktem końcowym i mają specyficzny „cykl życia"; 2) potencjał zasobowy odpadów zależy od wielu warunków zewnętrznych i może różnić się w zależności od zmian w czynnikach zewnętrznych; 3) decyzje o wykorzystaniu lub składowaniu odpadów mogą być uzależnione od różnych grup interesariuszy, w tym organizacji komercyjnych, samorządów oraz obywateli, stąd potrzeba rozwoju i wdrażania metod negocjacji i formalizacji różniących ich interesów; 4) wykorzystanie i umieszczenie (składowanie) odpadów może być kojarzone z określonym ryzykiem komercyjnym i środowiskowym. Rezultaty studiów przeprowadzonych w artykule pozwalają zdefiniować podejście projektowe do zarządzania odpadami górniczymi jako metodę, która pomaga zredukować akumulację odpadów w środowisku, zgodnie z zasadą hierarchii gospodarki odpadami.