



Revitalization of Mining Dumps. Assessment of Possibilities

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Article history

Received 21.01.2022
Accepted 25.04.2022
Available online 23.05.2022

Keywords

revitalization
algorithm
scenarios
SWOT/TOWS
FMEA
QFD analysis
sustainable development

Abstract

The revitalization of mining dumps in the Silesian agglomeration is a very difficult and complex problem. It has a substantial impact on the concepts of sustainable urban development. Other than the key areas including people, the environment and the economy, revitalization also refers to spatial management, and thus to a significant improvement in the functioning conditions of the local cities' communities. The article describes an algorithm assessing the possibilities of revitalizing a mining dump by one of the Polska Grupa Górnicza's mines. With legal status and location taken into account, several potential scenarios had been proposed, out of which one was chosen based on the adopted criteria. The chosen scenario had been subjected to further assessment using analyses such as SWOT/TOWS, FMEA, and QFD. The analyses had been carried out in order to acquire more effective and meaningful assessments, having taken social and economic aspects into consideration. In effect of the carried out analysis a recreational scenario was proposed. The adopted solution shows that the mine can continue its work in accordance with the principle of sustainable development as well as apply the concept of corporate social responsibility.

DOI: 10.30657/pea.2022.28.24

JEL: L23, M11

1. Introduction

The necessity to reduce CO₂ emissions emitted into the atmosphere is related to the end of hard coal mining in Poland (and not only). Therefore, mining is coming to an end in the area of Upper Silesia – the last mine is going to be closed in 2049 (Poland's ... 2021).

This industry has environmental, social and economic impacts, both during the process of extracting minerals from deposits and their storage. Coal mining wastes are mainly disposed on the surface, forming dumps. Most of these dumps are located in Silesian Voivodeship. In these regions, degradation of vegetation, impossibility of settlement and development of communication networks occur (Santarius et al., 2007). However, it is possible to restore coal waste dumps through revitalization (Białecka and Biały, 2014). In the post-mining areas, there are shopping centres, cultural centres, museums, technical monuments (Łączny et al., 2012). Achieving optimal

effects of the dump revitalization is determined by many factors. Therefore, the problem needs to be identified very carefully and all its related aspects taken into account. The task of all-level public authorities is to shape their policies in a sustainable manner – in the social, economic and environmental dimensions. Revitalization of urbanized areas in the context of sustainable development is a process of restoring social, spatial, economic and ecological functionality of degraded areas (Kasztelewicz and Ptak, 2011; Dz. U. 2020; Encyklopedia PWN, 2020).

The idea of sustainable development is summarized in the first sentence of the 1987 WCED report – Our common future¹: "At the present level of civilization, sustainable development is possible, which means development in which the needs of the present generation can be met without reducing the chances of future generations to meet them".

In sustainable development, the natural environment is its foundation, the economy is its tool, and the well-being of society is the goal.

¹ The term "sustainable development" was introduced and defined in 1987 by G. Brundtland in the report "Our Common Future" of the World Commission on Environment and Development.

According to the norms and documents of the United Nations: "Sustainable development of the Earth means the development that meets the basic needs of all people and preserves, protects and restores the health and integrity of the Earth's ecosystem, without compromising the ability of future generations to meet their needs and without exceeding the long-term limits of the Earth's carrying capacity".

The strategic goal of revitalization is to improve the living conditions of the community inhabiting a given region. Therefore, it is not about conducting only social or only spatial activities. The essence of revitalization is to carry out the above-mentioned activities simultaneously. It is undoubtedly a difficult, time-consuming and costly process. Apart from financial outlays, it often requires putting a lot of work into shaping people's attitudes and awareness.

The decentralization of power, by the act of 8 March 1990 on local self-government (Dz. U. 2004), forced the city authorities to reflect on local development, and thus to devise programs for the development, activation and revitalization of the city.

In the second half of the 90s of the last century, the issues of local economy development and social problems began to be combined with revitalization more and more often, because revitalization also involves working with people, the local community. That time the first concepts developing the so-perceived revitalization strategy in detail, building its programs, projects and operational plans, as well as the principles of their implementation.

An example to follow for our region should be Germany, where a significant part of the coal mining dumps has been developed. In our neighbouring western countries, there are year-round ski slopes in the post-mining dump areas (Fig. 1).

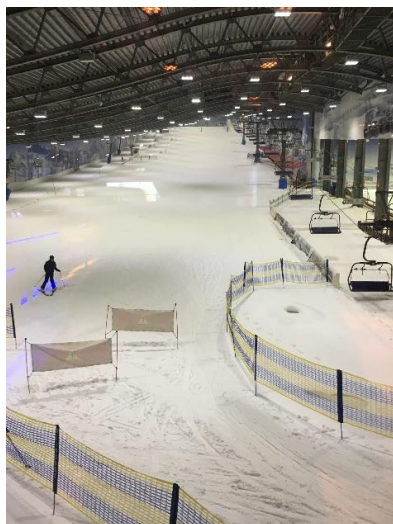


Fig. 1. A year-round ski slope on a post-mining dump

2. The need and the essence of implementing the revitalization programs. Review of the literature

Determination of the way in which brownfields would be reused is challenging not only from an urban, but also eco-

nomic and political point of view. The areas of former industrial plants are usually firmly "embedded" in the structure of the city, therefore granting them a new function may meet with greater or lesser resistance from the stakeholders of the revitalization process, who have different ideas about the target new use of such an area. The directions of new use also determine the manner and scope of necessary planning, organizational, financial and technical (material) activities that would enable realization of the aforementioned new function of the area.

Specific regulations concerning brownfield sites have been introduced at the European Community level, therefore they are ultimately binding on all member states. Just as directives, they require transposition into the national laws of the member states. These legal acts include the following directives:

- on the management of waste from extractive industries (Dyrekytywa, 2006),
- on environmental liability with regard to the prevention and remedying of environmental damage (Dyrekytywa 2004),
- establishing a framework for the protection of soil (Komunikat, 2006).

The Waste Management Directive (Dyrekytywa, 2006) requires Member States to draw up an inventory of closed, including abandoned, waste facilities located on their territory, in order to identify those that have a serious negative environmental impact or may pose a serious threat to human health or the environment over the medium or short term. These inventories should form the basis for a good action program. This inventory is to be periodically updated and made available to the public.

The second directive – on environmental liability (Dyrekytywa, 2004), was transferred to the domestic legal framework in the form of the act on prevention and remediation of environmental damage.

According to the draft act establishing a framework for soil protection (Komunikat, 2006; Baron, 2020; Friebe, 2020; Baron and Mosora, 2021), Member States identify sites across their territory where such a concentration of hazardous substances of anthropogenic origin have been found that poses a serious risk to the environment or human health, and this risk is assessed by considering the current or future approved land use. As is the case with the Extractive Waste Directive, this list is to be updated and made public.

With regard to the mining industry, detailed regulations can be found in the Geological and Mining Law (Prawo geologiczne, 2005) which directly refer to the liability for land degradation resulting from mineral extraction activities.

This liability also has an impact on the condition of the environment in which we live (Lapcik, et al., 2018; Lintukangas et al., 2012; Łacny et al., 2019, Parrotta and Knowles, 2001; Skousen and Zipper, 2014), which entails the costs of environmental protection. These expenses, related to investments in the environment, must be an integral part of investment programs, regardless of their nature (Santarius et al., 2007; Lima et al., 2016). Increasing investments in environmental protection is necessary given the environmental hazards (Dz. U., 2004).

For over 350 years, the Silesian Voivodeship has been dominated by the mining industry, mainly hard coal mines. All over the world, we are observing a retreat from hard coal. In Poland the last hard coal mine is going to be closed in 2049. The areas that will remain after the mines will need to be restored to a working condition. The process that will cause the areas to come into use again is revitalization (Wytuczne, 2020; Frankowski et al., 2012, Kasztelewicz, 2012, Kobyłańska and Gawor, 2017; Ostręga and Uberman, 2010; Paulo, 2008), "the process of restoring the areas damaged (degraded) by human activity to their original form or utility and natural values as close to their natural state as possible" (www.ekologia, 2020).

For an area where there is pollution or unfavourable anthropogenic transformation, the Environmental Protection Act imposes an obligation of reclamation on the land-owner, and when unable to enforce this obligation, this task is assigned to the starost (the level of powiat or city self-government with powiat rights). However, the act does not address the issue of devastated post-industrial buildings and the remaining technical infrastructure.

The number of developed revitalization programs in Poland has increased enormously in recent years (Urząd Mieszkalnictwa, 2003). The main subject of the study are downtown areas, with emphasis on public spaces. These studies cover brownfields and, to a lesser extent, post-military areas (Gorgoń et al., 2009; Jarczewski et al., 2010; Jarczewski, 2009).

Such an increase in projects is undoubtedly associated with the possibility of co-financing investments that can be implemented in areas revitalized under Regional Operational Programs (ROPs).

Local Regeneration Programs (LRP) should be consistent with the priorities and development goals set out in a number of strategic documents and operational programs, among which the following can be distinguished:

- European Regional Development Fund,
- National Development Plan,
- Voivodeship Development Strategy,
- Powiat Development Strategy,
- Commune Development Strategy,
- Study of the conditions and directions of the spatial development of the commune,
- Local Development Plan,
- Other development programs of the commune, in line with the Commune Development Strategy.

Revitalization programs should comply with the guidelines of the above programs.

At the stage of the study and directions of spatial development and in the Local Development Plan, degraded areas that require restructuring or revitalization should be designated. In practice, it rarely happens that such areas are already selected and indicated at this stage. However, at this level, it is possible to change the provisions of the local plan and study the conditions. Therefore, the commune development strategy should take into account the issues of revitalization, as it is a long-term program and an element of the social and economic development strategy.

A well-designed revitalization program participates in solving such problems as: housing, trade, services, employment,

communication, environmental protection, monument protection, social and economic development.

The main purpose of the revitalization program is to lead a given area out of a crisis state by removing the phenomena that caused its degradation, in accordance with the principle of sustainable development.

3. Theoretical aspects of revitalization

Revitalization (Latin: re- + vita – literally: "restoration to life, revival"), revitalization, urban renewal, urban redevelopment, gentrification – a set of urban and planning activities, coordinated by the local self-government administration, aimed at social, architectural, planning and economic transformation of a designated area of the commune in a state of crisis resulting from economic and social factors. Some revitalization programs are aimed at revitalizing degraded areas of cities that have lost their original function, e.g. post-industrial; then the objective is to find a new application for them and bring them to a state in which the areas change their function (Ekologia, 2020; Wikipedia, 2020; Harlow, 2015).

On the basis of this definition, it can be concluded that revitalization in terms of urban planning means bringing areas back to life. Restoration to life cannot be limited only to renovations, modernization of housing, social utility, etc., but must cause economic recovery and solve social problems in a given area (e.g. unemployment, crime).

Revitalization is the term most often used in relation to parts of a city or a group of buildings which, as a result of economic and other transformations, have partially lost their original function and purpose. In this sense, revitalization is a set of activities in the field of construction, spatial planning, economics and social policy, whose aim is to bring about the revival, improvement of functionality, aesthetics, comfort of use and quality of life in the revitalized complex.

Currently, in Poland, revitalization is usually mentioned in the context of spatial planning issues, which significantly limits the meaning of this concept (Ustawa, 2015).

On the other hand, revitalization consists in comprehensive activities, resulting in sustainable development. Revitalization should contribute to the creation of new jobs, activation of residents and causing them to shape entrepreneurial attitudes, preservation of cultural heritage – historic areas, especially.

4. Sustainable revitalization of lands

Sustainable revitalization of lands is a process conducted in the following way:

- ensuring the achievement and maintenance of meeting the environmental needs of contemporary and future generations,
- economically justified,
- institutionally prepared,
- socially acceptable,
- taking into account local and supra-local conditions.

Revitalization programs should be prepared individually for each city or district, considering its local (specific) problems

and conditions – there are no universal procedures and solutions. Nevertheless, experience (mainly English and German) shows four basic phases that should be considered in order for this process to be successful. These phases are:

- creating a strategy,
- economic justification,
- obtaining financing,
- implementation and monitoring.

Creating a strategy – a proper diagnosis is a prerequisite for the successful implementation of revitalization programs. It should take into account problems related to the economy, infrastructure and society. Based on these analyses, a vision for the revitalization implementation is created. This vision cannot be a plan detached from the city's long-term development strategy – it should be integrated into that strategy.

Economic rationale – should consist of an analysis of regeneration options and socio-economic benefits. Only a properly prepared economic justification will allow for rational spending of public funds, and last but not least, it will encourage the private sector to engage in revitalization.

Obtaining financing – at this stage we can distinguish: public funds (budget funds, funds obtained from the sale of real estate, etc.) public-private partnership (the city selects partner/s by tender), EU funds. Revitalization projects often combine very different forms of financing, they are divided into parts that are financed from different sources. Support for revitalization projects should be covered by individual Operational Programs (ROPs) created for individual voivodships.

Implementation and monitoring – implementation is the management of a complex project with a long term, involving many partners and institutions, while monitoring is the verification of achievement of the assumed goals during the project implantation. It is important at this point to take immediate corrective measures if any deviations from the assumptions or problems with the project implementation or the institution involved in the project implementation are identified.

On the basis of the above-mentioned phases of the revitalization process, it is possible to build a revitalization process scenario. Such a scenario of the revitalization process is presented in Fig. 2.

The concept of revitalization in Poland has ceased to include only issues related to renovation of buildings or conservation works – in the communes' policies, renovation programs have started to be distinguished from revitalization programs.

A well-designed and then systematically implemented revitalization program may lead to spatial, social and economic changes. It can improve the quality of life of the inhabitants,

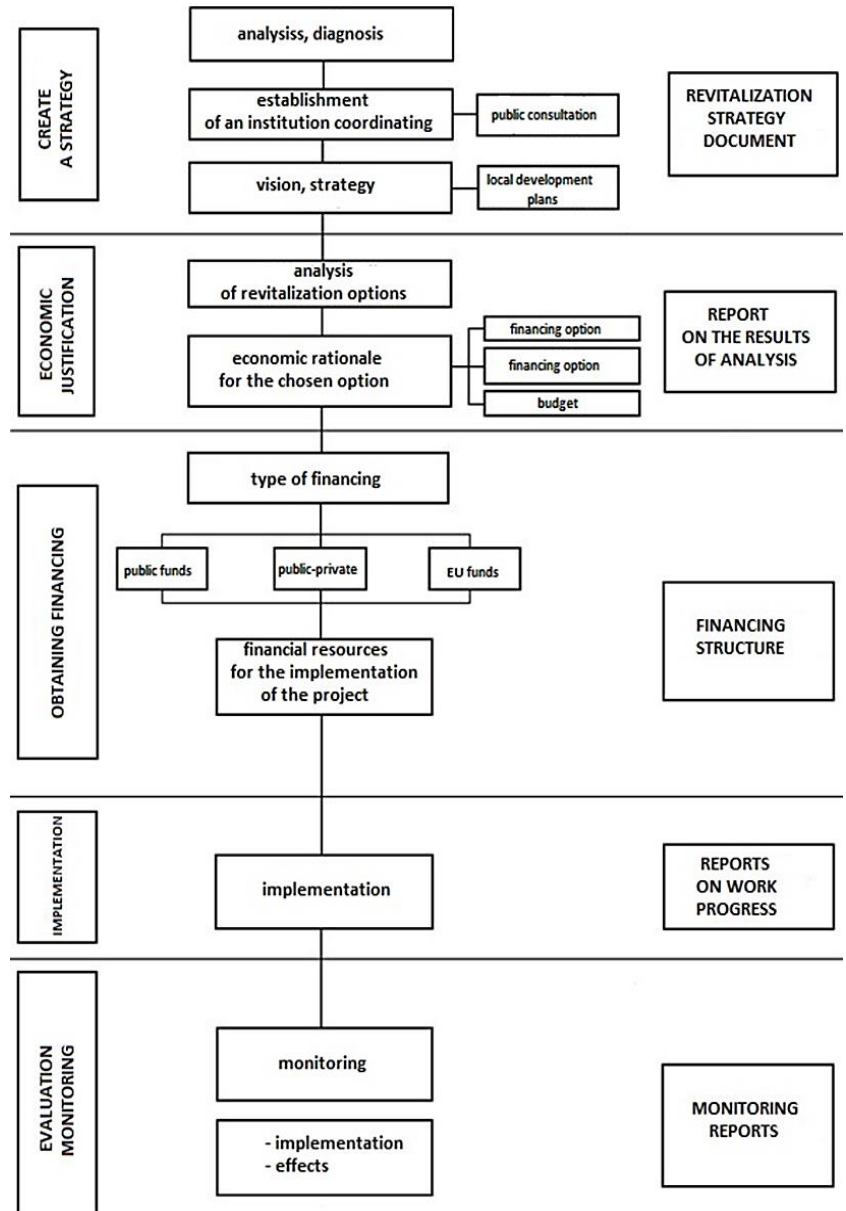


Fig. 2. Scenario of the revitalization process

the condition of the natural and cultural environment, restore spatial order, economic recovery and rebuild social ties.

5. Algorithm of evaluation of possibilities of revitalization of a mining dump

The condition for the development of an appropriate land development concept in the revitalization process is its proper recognition. This assessment can only be made by specialized staff who skilfully combine all aspects of reclamation.

This article presents an algorithm for assessing the possibility of revitalizing a mining dump at one of the mines of Polska Grupa Górnicza S.A. The proposed algorithm for the process of assessing the possibility of revitalizing a mining dump is presented in Fig. 3.

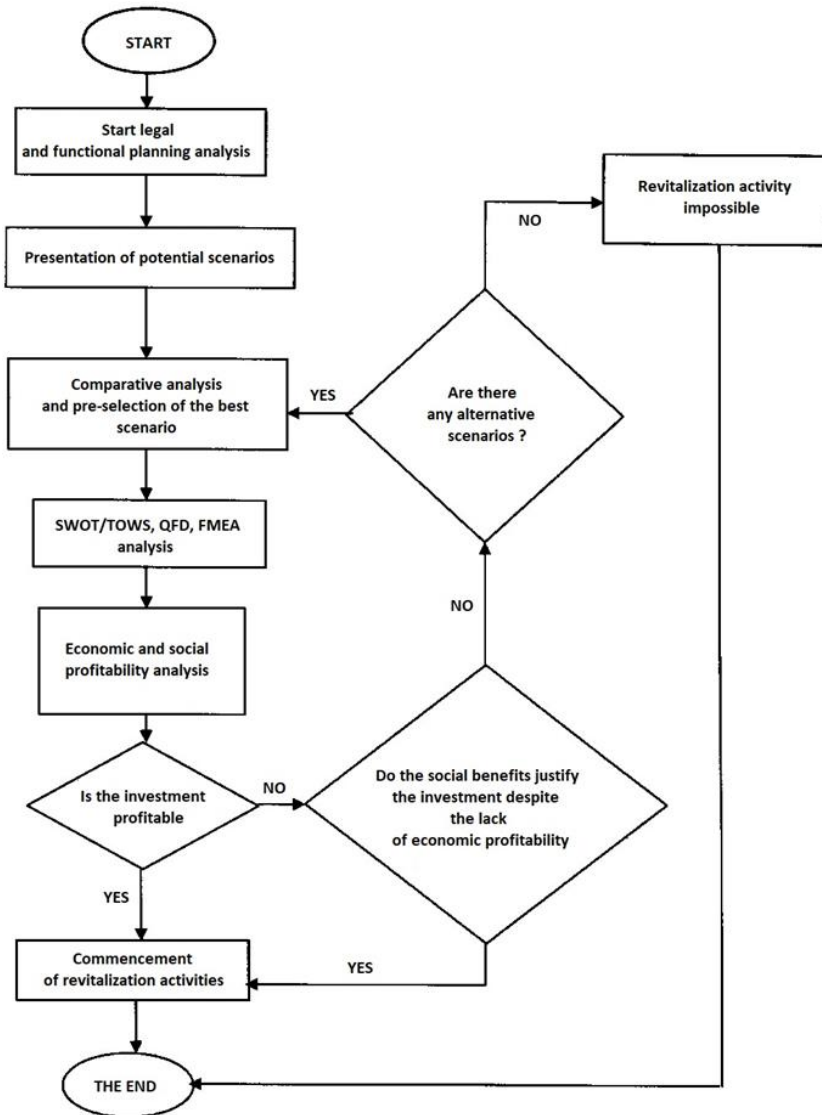


Fig. 3. Algorithm of the dump site revitalization assessment process

This algorithm covers such areas as:

- Planning, functional and legal analysis – collecting information about a given area in terms of: legal status, ownership, purpose in the local development plan, location.
- Presentation of potential revitalization scenarios – taking into account the results of planning, functional and legal analysis.
- Comparative analysis and preliminary selection of the best one. The selected scenario is subject to further analyses, which will give us the final answer whether the scenario is worth implementing.
- SWOT/TOWS, QFD, FMEA analysis – these analyses are carried out in favour of economic and social analyses.
- Economic and social profitability analysis.
- Conditional decisions – if a given investment is economically unprofitable, and social benefits justify the commencement of the revitalization process, such an undertaking can/should be implemented. If not, subsequent

revitalization scenarios are analysed until they succeed. If the alternative scenarios run out, it means that regeneration activities in this area are impossible.

6. Planning, legal and functional analysis

The analysed object (dump) is located in the area belonging to one of the mines of Polska Grupa Górnicza S.A., where the owner of this area is the mine.

In accordance with the Local Development Plan for the City, the area has been designated for:

- 1) high green areas, implemented in post-industrial areas,
- 2) industrial areas.

An important advantage of this area is also the fact that the land on which the dump is located is well connected, because it is located in the central street of the city, with the National Road nearby.

7. Potential site development scenarios

7.1. Production scenario

This scenario is compatible with the local development plan only in a small part, as only a small area of the analysed object (dumps) is located in the areas designated for "industrial areas". In this area, parking lots, warehouses and storage houses can be built. In the event of land development for a different purpose, changes to the local development plan are required. The implementation of this scenario requires securing construction objects against land subsidence.

7.2. Service scenario

The implementation of this scenario requires changes to the local development plan, because there is no area designated for service areas in the dump site. Given the favourable access, the choice of this scenario would be justified, but given the numerous service facilities (supermarkets) located in the immediate vicinity, the necessity of building another facility with similar functions should be carefully analysed.

7.3. Housing scenario

Given the housing needs of the city, new flats would fill the existing gap, but the dump is not a place to locate such facilities. Good access and proximity to service facilities foster such a scenario. On the other hand, a plant located in the vicinity causing noise, emitting pollution, will result in the lack of in-

terest in the purchase of apartments in such a location, moreover, changes to the local development plan would be necessary.

7.4. Recreational scenario

The recreational base of the city with a mine operating is very meagre – hence the justification for such a scenario. The implementation of the recreational scenario does not involve changes to the local development plan, because the areas (in accordance with the local development plan) designated as high green can be used to locate sports and small service facilities. The good access and the larger cities located in the immediate vicinity constitute the advantage. The construction of bicycle paths, jogging routes (cross-country skiing in winter), the development of places for rope parks, and a (natural) ski slope have social justification. Moreover (which is very important), such a scenario will generate new jobs.

8. Comparative analysis

A comparative analysis was conducted using questions and answers that will enable the initial selection of the best scenario. Each answer was assigned a value from 0 to 3 (Łączny et al., 2012). Questions (1 to 6) are presented below.

1. Is it necessary to make a change to the local development plan?
2. Will new, permanent jobs be created?
3. Will environmental/health conditions improve?
4. Are there similar facilities nearby?
5. Does the substrate affect the choice of a given scenario?
6. What is the expected public reaction?

Table 1. Preliminary selection of the heap revitalization scenario

Criteria/ Scenario	Question						Sum of points	Order
	1	2	3	4	5	6		
Production scenario	1	3	0	1	2	2	9	II
Service scenario	0	2	0	0	1	1	4	IV
Housing scenario	0	1	0	2	1	3	7	III
Recreational scenario	3	2	1	3	3	3	15	I

The comparative analysis presented (Table 1) shows that in relation to the adopted criteria, the recreational scenario is the best.

However, this is not the final decision, as the scenario with the highest number of points will be subject to further analysis. Economic and social aspects will be assessed and, on this basis, a decision will be made on the possibility of revitalizing the mining dump based on a recreational scenario.

9. SWOT/TOWS, QFD, FMEA analysis

Due to the limited nature of the article, only the results of the analyses and methods performed for the examined object will be presented.

9.1. SWOT/TOWS analysis

The purpose of this analysis is to define the strategy that needs to be implemented to ensure the designed complex the best possible position on the market (Obłój, 1998; Urbaniak, 2004).

Strengths:

1. Low prices.
2. A mining dump owned by the mine.
3. Attractive location.
4. Easy access.
5. The dump is partially reclaimed and further revitalization activities are underway.
6. Cooperation of the complex with the mine.

Weaknesses:

1. Lack of experience of the mine in this type of undertaking.
2. Financial resources.

Chances:

1. No similar complexes nearby.
2. Great interest in the forms of recreation available in the designed complex.
3. Improving public opinion about the mine.
4. Possibility of obtaining funding.

Threats:

1. Possibility of the emergence of new competitors.
2. Change in the interests of the community.

These factors were analysed for mutual links, and the links between them were examined. Then, the number of interactions was summed up in the columns and rows, and the obtained result was multiplied by the weight of a given factor. On the basis of the obtained results, ranks describing which factors have the greatest impact and which are the most susceptible to them were assigned. Finally, the products of the number of interactions and weights were summed up. The greatest sum of products indicated the appropriate strategy. The analysis showed that the most desirable strategy is an aggressive one, so it is important to strive for strong development and be prepared so that the strengths take advantage of the opportunities as they come.

9.2. Quality Function Deployment (QFD)

The QFD method was used to assess the implementation of the recreational scenario, which would be of the highest possible quality and meet the users' requirements (Urbaniak 2004). In order for the complex to develop and to have as many customers as possible, it is especially needed to focus on meeting the critical technical parameters. They include:

- the length of the bicycle path for technical reasons will be 2 km,
- the length of the jogging route for technical reasons will be 2 km,
- plastic on the ski slope, which would also allow skiing in summer.

9.3. FMEA analysis

The analysed object is a mining dump, which will be revitalized, and facilities that will be created on the dump as a result of revitalization. These are:

- rope park,
- ski slope,
- mountain climbing walls,
- running routes,
- cycle paths,
- parking lots for customers.

The study was carried out in order to detect potential defects, effects and causes of these defects, and to propose preventive measures to ensure that the constructed complex was of the highest possible quality (Łączny et al., 2012, Midor 2014). Potential disadvantages include:

- a) landslides of the dump,
- b) cracking of the ski slope/climbing walls/rope park structure,
- c) corrosion of the structure of the ski slope/climbing walls/rope park,
- d) cracking asphalt in the parking lot,
- e) contaminated bicycle path and jogging path,
- f) bad marking of running routes and bicycle paths,
- g) failure of monitoring cameras.

The causes of these defects were identified using the Ishikawa diagram.

9.4. Economic analysis

The economic analysis was conducted using the Net Present Value (NPV).

$$NPV = \sum_{t=1}^n \frac{CF_t}{(1+r)^t} - I_0 \quad (1)$$

where :

NPV – net present value,

CF_t – cash flow (net) in period t ,

r – discount rate,

I_0 – initial outlays,

t – consecutive periods (most often years), of investment exploitation.

It was assumed for the analysis that:

- development of the complex and construction of structures for selected forms of recreation will take about a year,
- assumptions for individual facilities of the complex were established on the basis of the results of the SWOT, QFD and FMEA analyses and on the basis of already completed projects of individual forms of recreation.

It was assumed that the funds for the project will come entirely from credit, so the credit amounts to € 1,720,000 (Table 2), – the interest rate is 7%.

The operating costs of the recreational complex are presented in Table 3, while Table 4 shows the annual revenues of the proposed scenario.

Assuming that the operating costs and revenues of the complex are stable, the investment expenses will pay off after 6 years, which means that the project will start to bring profits after this period of time.

Table 2. The level of expenditure on the implementation of the recreational scenario

Lp.	Type of inputs	The amount of expenditure (€)
1.	The cost of building a ski slope	1250000
2.	The cost of assembling and building a climbing wall	22500
3.	The cost of building bicycle paths	47500
4.	The cost of building running routes (cross-country skiing in winter)	50000
5.	The cost of building a rope park	125000
6.	The cost of building a car park	125000
7.	The cost of building a small gastronomy premises	100000
Sum		1720000

Table 3. Annual operating costs of the complex

Lp.	Type of running costs	Value (€)
I. Operation costs:		
1.	Wages for employees	200000
2.	Depreciation	86000
3.	Foreign Service	50000
4.	Insurance	3000
Sum		439000
II. Financial costs:		
1.	Interest on loan	~160000
Sum		499000

Table 4. Annual value of revenues from the proposed recreational scenario

Lp.	Type of revenues	Revenue amount (€)
1.	Income from the ski slope	450000
2.	Income from mountain climbing	90000
3.	Rope Park Income	180000
4.	Income from small eateries	60000
5.	Income from parking	12000
Sum		792000

10. Social aspect of revitalization

Considering the social aspect, the location of new forms of production and service activities in post-industrial areas is associated with the possibility of creating new jobs and the prospective increase in the attractiveness of the land, which may lead to a greater revival of various forms of activity (Dz. U. 2004). For most modern practitioners in the field of environmental protection, it is obvious that design processes can only be pursued when they are socially understandable, accepted, and especially when the processes of their reconciliation are carried out with the involvement of the public.

In all these activities aimed at gaining social acceptance for the proposed plans, the key issue is the ability to communicate with the society. The social communication, as well as the that related to the environmental matters, involves different goals where the most important ones include:

- disseminating specific knowledge;
- changing the behavioural model;
- involvement of the public in the course of a process;
- process improvement through cooperation with various interest groups;

- ensuring transparency of the process and confidence in its need and effectiveness;
- avoiding conflicts and, as a result, protests resulting from the lack of knowledge about the process;
- change of attitude towards the project executor (e.g. public authorities, environmental organizations);
- building a positive image of the organizer of the project.

The effectiveness of the communication process, i.e. raising the level of awareness in a specific field, changing the approach to the problem and changing the behaviour requires consideration of the basic principles. These include:

- engaging the widest possible representation of social groups;
- taking into account local conditions;
- involving the public at all stages of the process.

The need for understanding/consensus occurs wherever there are potential conflicts of interest between different interested social groups. This applies to spatial development plans and investment location. Communication with the community is also part of the legal procedures applied to assessing the impact of industrial investments on the environment or determining the forms of area protection.

In conclusion, it can be said that at this stage it is important to build the atmosphere of social trust based on transparency of decisions and intentions. It is also necessary to inform local communities about the nature of the planned investments and methods of securing people's health against possible inconveniences resulting from previous and planned activities.

Revitalization of the dump by the mine carries potential costs (Table 5) and social benefits (Table 6) for people living in the immediate vicinity of the dump.

Table 5. Social costs

Source of costs	Social costs
Short-term costs related to the construction of the complex (about a year)	- noise increase in construction equipment - increase in traffic, detours due to the construction of access roads and cars that will provide materials for the construction of the complex
Exploitation of the dump for recreational functions	- increase in traffic due to the arrival of customers

Table 6. Social costs

Source of benefits	Social benefits
Short-term benefits related to the construction of the complex (about a year)	- jobs related to the construction of the complex
Exploitation of the dump for recreational functions	- jobs related to the operation of the complex - society's identification with the place of residence - integration of residents - improving the health of residents - increase in physical fitness of the inhabitants

The short analysis shows that the implementation of the recreational scenario provide measurable social benefits. On the other hand, the vast majority of social costs are short-term and there are definitely fewer of them.

The transformation of brownfields by assigning them new economic, natural or recreational functions is a challenge for the entire region, in particular for all levels of administration, and creates a real alternative to occupying more green areas by production.

The problem of transforming brownfields/post-industrial areas and degraded areas is currently important throughout the European Union due to the necessity to protect soils, land and water. These considerations are reflected in the provisions of the formal and legal requirements at the EU level, therefore, they are binding on the EU member states.

11. Summary

The land transformation must be preceded by reclamation efforts aimed at increasing the land's ability to assume new functions. Remediation may include land clearance and disposal of on-site infrastructure remnants, and may also consists in restoration of the infrastructure.

In view of the scale of the problem regarding degraded areas in Silesia and in the context of the region's development, the awareness of the potential that lies in these areas is widespread. The regional authorities understand that these areas, due to their location in the city centres, constitute a barrier to the city's development and can become a new, "added" space, especially valuable in the absence of land for development within the city boundaries.

The main factors used in the evaluation process were economic and social analysis, significantly influenced by SWOT/TOWS, FMEA and QFD. The economic analysis showed that with the assumption of rational costs and revenues from the recreational complex and a bank credit taken to cover the entire project, the project will generate profits. However, the entire project does not have to require a loan, because it is possible to use European Funds for the revitalization process. Funds for revitalization are also allocated in the Regional Operational Program for the Silesian Voivodeship. Social considerations confirmed that the investment is possible and even advisable.

It cannot be overlooked, however, that the assessment of the possibilities is mostly subjective, presented from the authors' point of view, and yet the implementation of this project is worth considering. Revitalization activities of coal waste dumps are very rare in Poland, so the development of the dump site around the mine would have a positive response and receive vivid interest. Such action would show that the mine can also run its operations in accordance with the principle of sustainable development and apply the concept of corporate social responsibility. Germany should be a role model to follow for our country, where the waste dump re-management after hard coal mining is very frequent. In the territories of our western neighbours, there are: viewpoints, toboggan runs, ski slopes, and walking paths in the dump areas. Examples of Germany show a high potential for the use of post-industrial areas, including dumps left over from hard coal mining. In addition, dumps can also be a place for the production of energy from renewable sources (e.g. wind, solar), so such projects are also worth considering.

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矿场振兴。可能性评估

關鍵詞

振兴
算法
情
SWOT/TOWS
FMEA
QFD 分析
可持续发展

摘要

西里西亚集聚区矿场的振兴是一个非常困难和复杂的问题。它对可持续城市发展的概念产生了重大影响。除了人、环境和经济等重点领域，振兴还指空间管理，从而显著改善当地城市社区的运行状况。这篇文章描述了一种算法，用于评估 Polska Grupa Górnicza 的一个矿山恢复采矿垃圾场的可能性。考虑到法律地位和位置，已经提出了几种潜在的情景，其中一个是根据采用的标准选择的。使用 SWOT/TOWS、FMEA 和 QFD 等分析对所选方案进行了进一步评估。进行分析是为了获得更有效和更有意义的评估，同时考虑到社会和经济方面。根据所进行的分析，提出了一个娱乐场景。采用的解决方案表明，矿山可以按照可持续发展的原则继续开展工作，并体现企业社会责任的理念。