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Revitalization of the industrial heritage: guidelines for Kryvyi Rih

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Abstract. The post-industrial stage of development determined a significant reduction of the importance of industrial production, which led to restructuring the economy. An active process of revaluation has begun – reassessing the value of industrial heritage and finding options for its further use. Kryvyi Rih is the most powerful industrial center of Ukraine and despite the fact that the industry is in an active stage of operation, the issue of diversification of the city's economy and further transformation of industrial facilities is raised in a timely manner. The tasks of this research are theoretical analysis of the concept of revitalization", the essence of this process, the study of practical experience of revitalization in Ukraine and abroad, the result of which should be an analysis of prospects for the implementation of this process in the industrial heritage of Kryvyi Rih. The analysis of the possibilities of Kryvyi Rih industrial heritage revaluation was carried out through the prism of an interdisciplinary approach based on research in architecture, ecology, economics, geography and culturology. Disclosure of this issue took place at two levels of research: theoretical and empirical. Theoretical research was based on the use of general scientific systems approach, analysis and synthesis, structural-functional analysis, comparative analysis, modeling methods, design, SWOT and PEST-analyzes of the probable effectiveness of revitalization in Kryvyi Rih. Empirical research was expeditionary methods, observations, the method of field visual inspections. The study has structured the concept of "revitalization", revealed promising areas of industrial facilities revitalization. The world tendencies and the best national examples of transformation of industrial territories into various innovation spaces have been analyzed. An assessment of the potential of the city's various objects in terms of revitalization opportunities has been given. Conceptual models of creation of the Industrial Culture Park "SHAKHTA" on the place of the preserved mine "Artem-2", and also industrial and landscape park on the place of Burshchitsky dump have been prepared, futuristic possibilities of their use in the tourist activity have been allocated. Intensification of efforts of specialists in various related fields to ensure the sustainable development of the urban environment of old industrial areas is the key to a qualitative revival of industrial spaces, harmonization and ecological optimisation of the former industrial environment, solving a number of socio-economic problems.

1. Introduction

Postindustrial processes influence the entire modern world – economies of industrial, industrial-agrarian and agrarian countries, since all countries are interconnected by a complex system of ties. All advanced and economically developed countries of the world have passed the stage



of industrial development. Significant industrial areas resulted from it require now not just utilization, but revision of their functions and revival.

In the era of industrialization, cities were planned and built presuming the fact that industrial zones and enterprises would be located on the outskirts, and residential areas would be beyond the negative influence of enterprises but at a convenient transport distance for commuting with necessary objects of social infrastructure and cultural life for the workers in the center rather far from industrial zones. However, over time, with the growth of urbanization and the rise in births, it turned out that industrial enterprises became surrounded with residential areas. In the course of time, natural resources – the basis of industry – fell short, production volumes declined and depressed post-industrial zones replaced powerful industrial giants.

Thus, there has arisen a question of changing the functional planning of areas of industrial cities. The problem of industrial areas in urban zones is typical of many developed countries. Gradually, the idea of revitalization of industrial zones and objects or their relocation outside cities has come into being. Such post-industrial zones continue to develop based on the cluster principle, which implies a combination of business, science and production in the form of industrial parks.

Revitalization is a term used in scientific practice to refer to the processes of reproduction, revitalization and restoration of the urban space. Revitalization of existing industrial complexes located within the city is very popular now, which is associated with contradictions between the needs of society and the established structure of the urban environment.

However, revitalization of industrial zones and objects should be treated with caution. First, it is necessary to determine the purpose and function, then carry out partial reconstruction to preserve historical technical features of industrial architecture. Revitalization of city industrial objects aims to optimize the use of industrial facilities and territories, improve architectural and spatial characteristics and aesthetic qualities of the urban environment, and most importantly, identify, preserve and use monuments of industrial architecture and technical culture, protect and restore the natural landscape [1].

Revitalization of industrial facilities and zones is a sign of society's transition to the post-industrial stage of its development. Revitalization of industrial heritage in developed countries is manifested on a total scale. Ukraine is trying to follow the world's mainstream trends, so there are successful examples of revitalization in the country. Sooner or later, all industrial areas face the need to raise questions about the future of industrial objects. The city of Kryvyi Rih is no exception to this historical evolution in Ukraine. The city is still characterized by availability of powerful operating enterprises of the mining and metallurgical complex. However, some of the objects of the iron ore industry are already abandoned or mothballed, which logically sets the task of their revitalization.

2. Publication overview

The issue of studying ways of transforming abandoned industrial facilities is treated in many works by foreign scientists. In the USA and Europe, revitalization projects were implemented in the early 50s of the XX century. Accordingly, attention of scientists has been focused on this issue for a long period and it is still topical nowadays [2].

In Ukraine, this issue is also gaining significant popularity, but it is only covered by journalists, public figures, analysts, bloggers, etc., but not by scientists. Studies and publications on this subject very often apply somewhat different terminology. Therefore, it is worth differentiating between a number of concepts that are sometimes used as synonyms when disclosing the issue of revitalization. The most used terms in scientific publications are the following:

Conversion is the process of restoring, reconstructing or rebuilding production facilities that have a historical load, with their modern use for other purposes [3].

Reorganization is transformation of the organizational structure and the structure of

enterprise management while preserving fixed assets and production potential of the enterprise. In this context, it is a kind of radical complex innovations, consisting in the organizational restructuring (of the system, goals, relations, norms) of any object [1]. This concept mainly appears in Russian scientific publications.

Reconstruction is rebuilding a duly commissioned construction object: change of its geometric dimensions and/or functional purpose that results in changed main technical and economic indicators, improved operating conditions and quality of services. It provides for complete or partial preservation of elements of bearing and enclosing structures [4].

Renovation (from Latin *renovatio* – renewal, restoration) is a technical and economic process of replacement of machines, equipment, tools that are out of production due to physical and moral wear by new fixed assets at the expense of the depreciation fund [1].

Redevelopment of industrial zones is a process that consists in improving the industrial zones planning structure that involves more rational use of an industrial territory with an increase in operative efficiency; identification of territorial reserves, an increase in their exploitability degree due to increased density of their development; improvement of transport links and liquidation of low-performance industrial enterprises; improvement of the architectural qualities of the development, reduction of harmful effects of enterprises on the environment [5].

Brownfield is a type of reorganization of urban industrial zones that means creation of industrial parks on preexisting production sites (former factories, plants, shops, port docks). As a rule, in such places there are already structures that undergo further reconstruction and finishing building; there usually exists appropriate infrastructure, utilities and ready-made warehouses [6]. This term is mainly used in analytical commercial research rather than in scientific sources.

Revalorization provides for priority changes (scale of transformation, preservation) of volumetric-spatial and planned characteristics in order to increase the aesthetic and artistic value of urban environment, implementation of fragmentary restoration works and possible compensatory construction in order to restore the lost dominants with preservation of functional type of the object to be transformed [7].

However, after analyzing these definitions, we have opted for the concept of **revitalization**, although its interpretation in many sources highlights various aspects. Revitalization means “return to life”. In the Cambridge Dictionary, revitalization is defined as *the process of making something grow, develop, or become successful again* [8].

Based on the research of Polish scientists, it can be argued that revitalization is “a certain sequence of planned measures aimed at restoring the economy and changing the spatial and functional structure of degraded areas of a city. This is a process that can be applied to urban areas of various intended functions, such as industry, military, ports, residential buildings, transport infrastructure” (courtesy translation) [9].

Revitalization in a broader sense implies a moral and spiritual revival which is the result of a purposeful social and urban planning policy. Revitalization is the highest content, a super-task of conversion and concerns not only specific objects, but also the urban area in general, the environment in which man exists. According to M. Stratton, “philosophy” of revitalization implies that cities are historically endowed with different resources and many other benefits that can be grown or revived; and the benefits of improving urban environment and the increased number of new jobs are followed by stable strategic benefits for the whole society [10].

O. A. Sych defines revitalization as a process of spatial, technical, social and economic changes, as well as activities that are carried out for the greater public good and aimed at overcoming the crisis in the region, restoring its former functions and creating conditions for further development using its endogenous features [11]. According to A. P. Bronevtskyi, revitalization is a complex of organizational, technological, architectural and economic measures aimed at partial or complete reconstruction of an industrial facility with a further change in its intended functions [12].

3. Methods

The study of possible revitalization of the industrial heritage of Kryvyi Rih is conducted on the basis of the interdisciplinary approach underlain by a thorough analysis of numerous studies on architecture, construction, urban science, ecology, economics, geography, tourism and cultural studies. When disclosing these problems, a combination of the following general scientific methods and approaches is used: analysis and synthesis of all available information on the problems of research; the system approach to prospects for implementation of revitalization of industrial facilities in accordance with the concept of sustainable development; comparative analysis – comparison of the best revitalization practices of European countries and Ukraine; system-functional analysis in the study of a complex of relationships in the system of “non-operating industrial facilities” – “the city as a territorial entity within which these objects are located” – “the city population interested in creating new jobs, and obtaining new facilities for leisure and self-development”.

Theoretical research is impossible without applying a complex of empirical methods, in particular, on-site visual examinations of the objects described during field expeditions. In addition, the authors of the article have been organizers of multiple excursions to these objects and had the opportunity to both observe tourists’ reaction to the objects to be revitalized and attract tourists to the visual and aesthetic assessment of these formations.

Besides general scientific theoretical and empirical methods, a number of applied techniques are used in the study, in particular, the design method in describing and assessing potential efficient revitalization of the Burshchytsky dump and the underground mine “Artem-2”, modelling their territory and marking future locations, and assessing potential efficiency of revitalization in Kryvyi Rih using SWOT and PEST-analysis techniques.

4. Results

Revitalization is one of the elements of development policy aimed at preventing degradation of urban areas, crises, as well as contributing to protection of national heritage, development, and qualitative changes occurring through increasing social and economic activity, improving the living environment with simultaneous adhering to the principles of balanced development [13].

The need for revitalization arises when degradation and decline of landscapes, complexes or individual objects, previously actively used in industry or everyday life, take place. However, an important requirement for revitalization is the need to preserve the authenticity of the object. That is, if it is a mine headframe room, it must retain the industrial atmosphere given to it.

After analyzing the existing approaches to the definition of revitalization, the attempt has been made to formulate the author’s definition. Thus, in our opinion, revitalization is a process aimed at the complex transformation of depressed industrial facilities and territories for their functional reformation in order to improve the social living conditions of the population.

As a basis for revitalization, the premises of former factories or other industrial facilities which already contain special structures, design and technical equipment that can be used in the future as an element of interior, exterior, or, in general, be involved in an active use are usually chosen.

The results of the revitalization of old industrial facilities are impressive, because, if they are commercialized, they bring significant profits due to their authenticity, uniqueness, certain exoticism and, of course, the brand, which is usually formed around the main attraction of the institution.

After analyzing a number of different publications we can identify the classification of the main types of revitalization projects: 1) creation of food establishments; 2) creation of accommodation facilities (both temporary and permanent); 3) creation of educational and scientific space; 4) creation of leisure and recreation facilities (including active ones); 5) creation of sports facilities; 6) creation of business centers; 7) multifunctional projects (combining all or several of the above

types) [14].

The tasks of revitalization are: socialization of space and creation of conditions for urban development; improving the environment and forming creative elements of infrastructure; creation of new space for leisure and recreation of the population; increase of tourist and cultural potential; stimulating economic development; protection of industrial and architectural heritage; investment attraction, etc.

The practice of revitalization in European countries has already gained considerable momentum, but the worldrenowned classic of giving “a second life” to industrial facilities is the Zolferine mine in Essen, Germany, one of UNESCO’s most visited industrial sites. Today it is a cultural and creative center where you can visit the Coal Path Museum, the Ruhr Museum, the North Rhine-Westphalia Design Center, the Margaretenhöh Ceramics Museum, and the exhibition of contemporary art at the former coke plant [15].

Successful examples of revitalization in Europe include: the ABS Museum in Madrid (Spain) on the site of an old brewery, where a modern art center with the latest architectural forms has been created; the park on the site of the metallurgical plant in Luxembourg; Wunderland Kalkar amusement park, founded on the territory of an unfinished nuclear power plant, which was built in Kalkar (Germany) in 1972 – this park was opened in 2001 and includes a hotel, gastronomic and leisure complexes; Duisburg-Nord Landscape Park, one of the largest in the world (formerly Meiderich Metallurgical Plant, which now houses a diving center in the former gas storage facility, a concert hall in the former power plant, and an open-air cinema in the former steel melting shop); Kunststad Shipyard in Amsterdam (Netherlands), which has been transformed into a festival district and is the workplace of artists and cultural managers (now in the harbor there are artists’ and designers’ studios, theater stages, record companies, cafes, restaurants and even a skate park) [16]; Culture Factory Polymer in Tallinn (Estonia) – a multidisciplinary art center set up in the premises of a former Soviet toy factory; Trzcyna Factory is an art and educational complex located in the building of the former factory in Warsaw (Poland), where marmalade and canned food were made; “Sapnu Fabrika” in Riga (Latvia), which is a cultural and communicative space created in the building of the former glass factory built in 1911 and many others.

Lithuania belongs to countries with a noticeable industrial component of the economy. Some industrial facilities are operating and some are closed. Closed industrial enterprises are now partially revitalized. The main direction of revitalization is creation of various museums. Non-operating defence-industrial objects include Plokštinė missile base with 40-meter-deep silos located in northwestern Lithuania (Žemaitija National Park), where the Cold War Museum was created to preserve its authenticity. This site is one of the most unique and visited in Western Lithuania.

In the central part of Vilnius, the first industrial power plant built in 1903 is located. Currently, its premises are transformed into the museum of power engineering. A complex of the 19th and 20th century fortifications can be found in Kaunas. The complex is a complicated engineering system of nine forts; each of them is very individually adapted, from a theriological reserve (protection of bats) to a museum of military equipment or the Holocaust.

The Ignalina nuclear power plant, which is no longer on operation, has a great potential for revitalization, but in the context of development of the Baltic states, it is a unique object of this type, where educational excursions are organized. Thus, the experience of Lithuania shows its own national practice of revitalization of industrial facilities of different ages and purposes.

Such practice is beginning to be introduced in our country only in recent years. The first large enterprise revitalized in Ukraine was the insulation materials plant in Donetsk, which was transformed into the Art Foundation “Izolyatsia” in 2010. The first project implemented by this fund was the exhibition about miners’ life “1040 Meters under Ground”, which was realized by world-famous Chinese artist Cai Gotsiang, who was the artistic director of visual and special

effects of the Olympic Games in Beijing. However, due to the beginning of war in eastern Ukraine in 2014, the fund was evacuated to Kyiv [17].

The next project, implemented in 2014, was the Art Factory “Platforma”, located on the territory of a former Darnytsya Silk Factory. It is a complex that combines business, festivals, coworking, art, IT sphere, fashion, education and other industries of creative economy.

“UNIT.City” was also created in the capital on the territory of a former Kyiv Motorcycle Plant. It positions itself as the first innovation park in Ukraine, a place where ecosystem and infrastructure for business development in the field of high technology and creative industries are built. There are plans to equip 25-hectare area with co-working spaces, a dozen research centers and even a housing estate with a developed infrastructure. There is a free programming school “UNIT.Factory” in the park.

A well-known example of revitalization is the National Art and Culture Museum Complex “Mystetsky Arsenal”, located in the building of the Old Arsenal - a former workshop for the manufacture, repair and storage of ammunition and parts for guns.

Another project is “Pivzavod” in Kyiv. The aim of this project was to transform the territory of a former brewery into multifunctional environment with domination of a new educational cluster in the historic building of a former brewery. There are also small offices, a hotel and residential buildings there [18].

In Kharkiv on the site of a former locomotive plant, founded in 1985, Art Plant Mechanica was established, which is multifunctional cultural and creative space. Its revival began in 2016. Concerts and festivals are regularly held on the site of the “plant”.

Western Ukraine has made significant progress in revitalizing industrial facilities. In Lviv the most successful examples of revitalization are: “Lem Station” on the basis of a former tram depot, “! FESTrepublic” - on the site of a former plant “Halychsko”, “ReZavod” - formerly a plant of electronic medical equipment. The most successful project in Ivano-Frankivsk is the innovation center “Promprylad. Renovation” (formerly a Soviet instrument plant). This is one of the first examples of transforming an abandoned enterprise into a modern business cluster with the involvement of public investment in Ukraine. It focuses on four areas of region development - new economy, urban design, contemporary art, and education. This is a project in the field of impact investment, where investors simultaneously invest in the social impact on the region and receive a return on investment in the form of dividends [19].

In the south of Ukraine, the most successful example of revitalization is “Urban CAD” in Kherson, which was created on the site of the former ventilation shop of the machine-building combine plant.

The city of Kryvyi Rih, the most powerful industrial center of Ukraine, has a huge potential for revitalization of industrial facilities. But instead of the fact that the city has more than 200 different types of industrial heritage sites, in our city there are a number of deterrents for implementation of revitalization: 1) the Soviet heritage, as a rule, is not perceived as a value, and most industrial facilities belong to the Soviet period; 2) misunderstanding the value of objects and approaches to their preservation by the residents; 3) the low interest of investors in such projects due to the difficulty of restoring old industrial premises; 4) the neglected condition of buildings and significant need for investment [14].

At the same time, at the initiative of the public, namely the public organizations Kryvyi Rih Foundation of the Future, Urban Development Agency, with the assistance of the Metinvest group of companies, on November 15-16, 2019, the city held “Urban Hackathon”. During this event the leaders of the “Urban CAD” project from Kherson presented their experience of giving a second life to the industrial heritage. In addition, five objects of the city promising for revitalization were put forward for discussion. They were the mine “Artem-2”, the premises and dill of the mine “Ventylyatsiyua-3”, the premises of the former management office of the Lenin mine, the abandoned greenhouse and Burshchytsky dump.

Expert groups have prepared options for revitalization of these facilities. In particular, 2 projects were proposed for the revitalization of the greenhouse. Within the first one the creation of a thematic complex where it will be possible to place a museum, a photo area, a restaurant and gift-shops for selling thematic souvenirs is planned. Another project proposes to grow vine and make wine from it, as well as to breed snails in these vineyards and use them in cooking, as the main concept of this project is to create a restaurant of French cuisine.

On the site of the former management office of the Lenin mine it is proposed to create a youth center, on the roof of which it is planned to create an observatory with a relaxation area. Four floors of the building may be made thematic ones, where there will be rooms for work and rest, an art hub, a hostel, a multifunctional center, a thematic museum with the involvement of moving and interactive elements, exhibition halls, etc. Another option was to create a social center “InTerny” on the basis of this building. The task of the center is to help the most affected categories of the population - the elderly and people (especially children) with special needs, where they will be offered professional help and temporary, or even round-the-clock care.

On the territory of the mine “Ventyliatsiyna-3” there is a complex of buildings connected by outlet shafts with a diameter of 2 m and a small metal headframe. On the basis of this object it is proposed to create an active leisure center “StreetTown”, the main purpose of which is to provide active leisure for children and youth of the city. The buildings offer the following locations: an administrative zone, a food zone, a sanitary zone, an indoor skate park, a trampoline, dance floors. It is also planned to place speleological training locations in the mine shafts and a climbing wall on the wall of one of the buildings. Near the buildings a small parking, a skate park, a bicycle area and a fountain with iron fish as a symbol of the iron ore basin are planned to create.

During “Urban Hackathon”, the authors of the study participated in the development of projects for revitalization of the Burshchytsky dump and the mine “Artem-2”. The hackathon outlined the guidelines by which these objects can be developed, the opportunities and directions of revitalization of these objects were also determined. So let us have a more detailed look at them.

The Burshchytsky dump is one of the three panoramic observation points of Kryvyi Rih. This is an object of industrial heritage resulted from disposing waste rocks by the former Novokrivoriizkyi mining and processing plant in the early 1970s. The area of the dump itself makes 35 hectares (0.35 sq.km), its length is 0.9 km, the largest width is 0.5 km. The relative height of the dump (from the foot on the Inhulets River side to the top) is 68 m. The highest absolute mark above sea level is 138.2 m.

The dump is located in close vicinity to the left bank of the Inhulets River. It has a steep terraced part facing the river valley side and the hilly part that consists of one tier and borders on the mine allotment of open pit No. 2-bis of the PJSC “ArcelorMittal Kryvyi Rih”. The type of the dump is rocky, partially reclaimed. The main types of rocks are non-metallic quartzites, schists, oxidized quartzites. The reclaimed areas are covered with a thin layer of loesslike loam. The dump structure is complex, fragmentary tiered with a top plateau. The surfaces of the plateau and tiers are flattened due to technical reclamation. There are remnants of an entrance motorway leading to the top of the dump. The largest number of tiers (five) face the Inhulets River (figure 1).

The degree of overgrowth with tree and shrub vegetation is insignificant and makes 20 percent. Many surfaces are just covered only with thin herbaceous vegetation.

The top plateau of the dump is an excellent observation point which offers a panoramic view of the western, central and southern parts of the city. From its highest point, turning around, one can see:

- a chain of underground mines that go far northwards;
- the historical part of the city;



Figure 1. The Burshchytsky dump (photographed by V. Kazakov).

- pipes and workshops of the metallurgical plant of the PJSC “ArcelorMittal Kryvyi Rih”;
- open pit No. 2-bis of the PJSC “ArcelorMittal Kryvyi Rih” and a new very high dump of pit No. 3 of the same enterprise;
- the open pit and dumps of the Pivdennyi GZK in the distance;
- numerous old and new dumps and working heavy mining equipment – excavators, 130-t BeLAZ trucks, powerful drilling rigs;
- the canal of the Inhulets River sandwiched between dumps and open pits (figure 2);
- a high pre-revolutionary (1884) Beleliubskyi bridge and Katerynivska railways (figure 3);
- numerous objects of industrial heritage of the old mine Hdantsivskyi and iron foundry Hdantsivsky (1892);
- concentrating plants of the Pivdennyi GZK and “ArcelorMittal Kryvyi Rih”.



Figure 2. The canal of the Inhulets River and panorama of man-made landscapes from the Burshchytsky dump (photographed by A. Orlova).

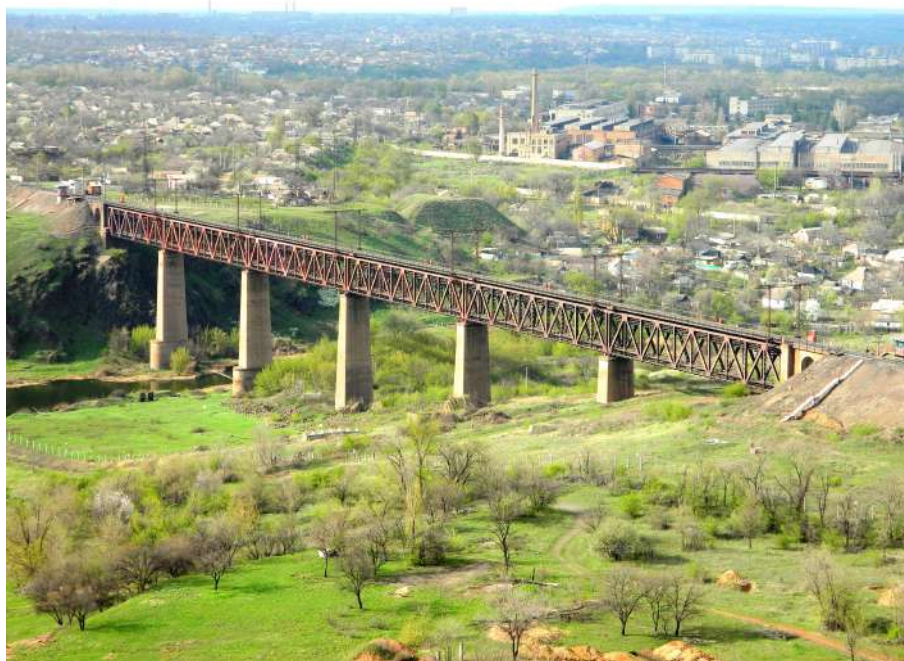


Figure 3. Panorama of Belebyskyi bridge and the city from the Burshchytskyi dump (photographed by V. Kazakov).

In the immediate vicinity of the dump there are several objects of industrial heritage: the ruins of surface facilities of underground mines No. 5 Nova and Valiavka-Pivdenna of the former Ilyich mine administration (built in the 1950s); open shafts of these mines that go as deep as 60 and 380 meters respectively.

Breathtaking is the panorama of the city from the height of the Burshchytskyi dump at night, when Kryvyi Rih turns into a constellation of lights.

Since 2014, the dump has been the all-season tourist attraction of numerous excursions at the daytime and at night.

Based on the above, it can be stated the territory of the Burshchytskyi dump is diverse in nature and promising in terms of revitalization of this object and as a tourist attraction. In the study, an attempt is made to create the concept of the author project of the industrial and landscape park “VIDVAL”. The project is aimed to build a creative area at the industrial heritage object in order to expand the range of leisure activities and improve the tourist image of the city.

This project is suggested for implementation in three stages: the first stage involves area beautification, creation of the most necessary infrastructure and basic non-capital-intensive leisure facilities; the second stage provides for a more fundamental modernization of the object with attraction of investments to create capital-intensive locations; the third stage involves filling this territory with creative trendy objects and holding various events regularly at this location.

Thus, at the first stage, it is planned to create a parking area at the foot of the dump in the place closest to the main road. It is appropriate to place the main monetized infrastructure nearby: catering facility, a stall for of selling souvenirs and renting equipment (they will be of a modular format initially), an information stand with the layout of the object.

Also, at this stage it is planned to:

- gravel and strengthen paths;

- build stairs in steep areas;
- mount several benches at the top and in the most panoramic places;
- create multiple selfie zones;
- create a rope adventure park on one of the dump slopes;
- build an alley of gabions with stones specific for Kryvyi Rih (one of the gabions will be in the form of a horn – the tourist logo of the city of Kryvyi Rih);
- create a food zone and a water equipment rental zone near the Inhulets River to provide the opportunity to run a boat, a kayak or catamaran;
- create a dirt – a specialized track for BMX or mountain bikes in the dirt jumping style on one of the slopes;
- install a sundial at the top of the dump in addition to observation points in order to create a certain brand and reveal the ideological concept of the project developers.

At the second stage, after the suggested industrial landscape park has become a specific attraction core for the city residents and tourists, it should be made as safe as possible to visit by arranging an underground walkway under the railway, and fence the railway track itself. Also, it is suggested to create a stationary administrative and information zone with free Wi-Fi and a medical center that will be located at the entrance; a stationary all-year catering facility, and a tent camp. On one of the slopes facing the railway, it is planned to install the letters VIDVAL and build a staircase and an observation point nearby. It is also possible to place an aerolift – a hot air balloon tied to the surface. This balloon can rise up 50-100 meters and it offers a magnificent panorama of the industrial city.

At the third stage, there are all relief and technological possibilities to build a funicular to connect the Burschchytsky dump with one of the two opposite dumps across the Inhulets River and arrange an industrial-style soft play area.

In the future, this object can be used to organize a variety of events. In particular, in 2017, the city launched the festival “Night of Industrial Culture” (a similar festival is also held in Germany and Poland), which has transformed into IndustrialFEST in Kryvyi Rih. The venue for the festival has been one of the most pressing issues for the organizers. Creation of a thematic site for such events would solve this problem. The site location far from the main transport system and absence of a convenient access are the only obstacles. However, this problem can also be solved through additional investment in creating the access road and powerful promotion.

Besides, this object can be used for holding a variety of events: sports competitions, artistic plein airs, thematic festivals, wedding ceremonies, etc. In the process of promoting this object, it is reasonable to create thematic legends that will add to the brand of the location.

In general, entrance to the park is planned to be free, the leisure area and renting the territory for events are monetized.

One of the city’s closed underground mines may become another promising object for revitalization. However, implementation of such a project is much more capital intensive. In Kryvyi Rih, there are several promising objects for possible revitalization of underground mines: “Hihant Hlyboka”, “Ventliatsiina V-4”, “Peremoha” (all three are the former mine named after Dzerzhynskyi), “Pivnichna” and “Ventliatsiina No. 1”, “Ventliatsiina No. 2”, “Ventliatsiina No. 3” of the former mine named after Kirov, “Pershotravneva 1-2” and others. However, at the moment, in our opinion, the underground mine “Artem-2” could become the most successful project.

“Artem-2” is an underground mine for producing rich iron ores in Kryvyi Rih iron ore basin. It was part of the mine named after Kirov (figure 4). In the mid-1970s, the mine included 4 underground mines: “Artem-1”, “Artem-2”, “Klitiyova named after Kirov”, “Pivnichna”; the open pit “Pivdennyi”, a crushing and sorting plant, a mechanical repair and other shops.



Figure 4. External view of the underground mine “Artem-2” (photographed by V. Kazakov).

“Artem-2” is unique, even within Kryvyi Rih because ore was transported on the daylight surface not by the traditional vertical skip mechanism, but by two belt conveyors installed in inclined (not vertical) shafts (figure 5). In addition to them, the deposit named after Kirov was also opened by a number of vertical shafts.



(a)



(b)

Figure 5. Internal view of the underground mine “Artem-2”, (a) and (b) (photographed by V. Kazakov).

Since 2010, due to liquidation of the enterprise, “Artem-2” has been operating in the mode of retaining equipment and pumping out mine waters.

The authors have conducted a study and identified a number of prerequisites favorable for revitalization of “Artem-2” and development of the project “Industrial Culture Park “SHAKHTA” (the ICP “SHAKHTA”).

- (i) **Sufficient degree of preservation of the on-surface and underground structures of the industrial object**, including wide opportunities for their involvement in revitalization:
 - (a) Preserved mining equipment, subject to its restoration and filling with new mining artifacts, can become the basis for creating the Museum of Mining Equipment. This

museum can be equipped with various installations and modern exhibits: a 3-D model of the mine, stands with pictures of technological processes, sculptures from mining equipment spare parts, etc.

- (b) The existing outdoor area (free courtyard) can become the basis for creating a skansen (exhibition) displaying rocks and minerals. It is expedient to form a promotion advertising and training career guidance center for young people by organizing various events on the basis of the created museum and the skansen (“SkillCity”, “Geology Lecture Hall”, “Mining Master Class”, etc.).
- (c) The mechanisms to go down and underground levels of “Artem-2”, preserved in the good working condition, subject to careful preparation, can be used for implementing the main edutaining attraction of the ICP “SHAKHTA” – “Descending into the mine”. Before descending, visitors are instructed on safety, and dressed in working suits of miners. During the descending, visitors get acquainted with the mine history and peculiarities of iron ore mining in Kryvyi Rih basin in different historical periods. The descending is supplemented by multimedia presentations located on both sides of the descending and brief stops on different levels.

At least one underground level can be prepared for visiting by tourists in order to illustrate the real process of underground iron ore mining with involvement of working equipment, etc. Interactive activities for tourists may include borehole-drilling, imitation of blasting, ore loading and transportation on the level to the conveyor. On other underground levels, there can be located exhibition halls, underground cafes, souvenir shops. Such an attraction tour will be a good alternative to visiting operating underground mines that are reluctant to receive tourists.

The maximum depth of descending for potential visitors is 550 meters.

- (d) The on-surface facilities (buildings of the engine room and auxiliary shops) that are available on the territory can be distributed according to the functional content and used for exhibitions, forums, fairs, quests, seminars; partially equipped offices for craft manufacturers and small production complexes, photo studios, etc.
 - (e) The industrial site of “Artem-2” is functionally planned: a park area with a modern playground, a rope adventure park, a climbing center, an art installations site, etc.
- (ii) **Favorable geographical position** “Artem-2” is located in the part of the city without well-developed edutaining complexes but with convenient access roads (Volodymyr Velykyi Street, Bykov Street, Ivan Avramenko Street, the city roundabout road). Within a 10-minute travel by car, there are large residential areas with potential visitors to the ICP “SHAKHTA” (Artem, microdistricts Skhidnyi I, II and III, Vechirnyi Boulevard, microdistricts Yuvileinyi, Hirnytskyi, Soniachnyi, the 95th quarter area (Gorkyi Square)), as well as the malls “Metro” and “Epicentr”.

Subject to sufficient landscaping and designing an open area, the following structures can be created in the future: artificial ponds and recreation areas near them, ecological paths for excursions to other places of interest.

- (iii) **The object belonging to the PJSC “Tsentralnyi Mining and Processing Plant”** which is part of the structure of the international mining and metallurgical company “Metinvest”. This is the most powerful holding structure in Ukraine that could invest in revitalization of this object by itself. In addition, such proposals in the format of a political program were articulated by one of the candidates during the mayoral elections. The project of revitalizing the mine “Artem-2” and creating the ICP “SHAKHTA” is aimed to preserve identity and authenticity of the industrial object (the mine) by creating conditions for modern rethink of industrialization processes. The implementation of the project is possible subject to a flexible planning structure. To achieve the purpose, the following is proposed:

- (a) Creation of locations on mining (historical) themes:
1. The Museum of Mining Engineering and a skansen of rocks and minerals located outdoors;
 2. An exhibition hall for changing expositions (photos on industrial themes, art objects made of metal, etc.), a training geological laboratory placed in the premises of the on-surface facility on the first level;
 3. The attraction-excursion “Descending into the mine”.
The second level can host a free recreation area, divided into: a souvenir shop of the ICP “SHAKHTA”, a hall “Free microphone”, a café “Tormozok”.
- (b) Creation of post-industrial tourist locations:
1. A tourist information center (TIC) and the branch of a children tourism center - on the first level;
 2. A rope adventure park; a climbing wall, a sports ground; a free art-zone and information stands on industrial tourism in Kryvyi Rih – in the yard.
- (c) Creation of locations for small-scale and private functions (administration offices, tenants’ offices in a separate room.
- (d) Creation of an open space. The project provides for “soft” planning of the courtyard – we suggest preserving its function of the central space from where all buildings can be entered. It will be adapted for lectures, movie screening, performances, exhibitions, community meetings, hackathons, etc.
Since the main territory of the ICP “SHAKHTA” is already planned and does not provide for parking (due to seasonality of mass events), parking is provided in the parking area of the mall “Metro” which is located opposite the mine area.
- (e) Use of the ICP “SHAKHTA” as a location for development of event tourism: *Industrial FEST* (a festival of industrial culture that introduces diversity of industrial Kryvbas through demonstration of mining equipment, master classes, photo-exhibitions, etc.); *IndustrialWeek* (the Week of industrial culture that provides for preferential visits to attractions of the ICP “SHAKHTA”, lectures by tourism activists, etc.); IRON BIKE (the international biker festival), etc.

The universality of the project consists in the fact that it can be both social and commercial; in general and partly, the project may comprise financing at the expense of the city budget funds, investments of individuals and funds; providing an opportunity to lease land to small and medium businesses with the purpose of commercial activities and tax collection to the city budget.

Currently, “Artem-2” revitalization project has no competitors within Dnipropetrovsk region and in Ukraine. Operation of the ICP “SHAKHTA” will ensure preservation of the industrial heritage of Kryvyi Rih and sustainable development of industrial tourism in the city. Visualisation of “Artem-2” revitalization model was performed by “Metinvest” in 2020 (figure 6). However, at the moment, there are no practical changes in implementation of this project.

In order to confirm or refute the need to revitalize industrial facilities as one of the factors of the city’s cultural development and attract tourists, it is worthwhile to conduct additional analysis. We have chosen two methods: a SWOT analysis and a PEST analysis. The former characterises the object through characteristics of four main sides – “strengths”, “weaknesses”, “opportunities” and “threats”. The latter allows conducting a marketing analysis to identify political, economic, social and technological aspects of the environmental impact.

The SWOT-analysis of possible revitalization potential of industrial facilities in Kryvyi Rih:
“S” – strengths

- (i) The city has a rich industrial heritage and, accordingly, a large number of promising objects for revitalization.



Figure 6. Project of creating an interactive industrial museum and scientific and educational Experimentarium [20].

- (ii) Possible objects to be revitalized are presented as engineering and architectural complexes of closed mines, factories and plants, as well as various man made landscapes.
- (iii) There are no revitalized industrial objects in the city, so this niche is completely free.
- (iv) In the city, there are very powerful and wealthy enterprises that can sponsor revitalization of certain industrial facilities, especially if these belong to their structures.
- (v) The city authorities are interested in revitalizing both industrial and other purpose objects.

“W” – weaknesses

- (i) Implementation of revitalization projects requires very significant financial allocations.
- (ii) The management of powerful industrial enterprises do not consider it is expedient to invest in such projects.
- (iii) Some promising objects are characterized by either an inconvenient remote location or, in particular like the Burschchytsky dump, they are located next to the solid domestic waste landfill.
- (iv) The negative tourist image of the region.
- (v) The negative environmental situation which affects adversely the desire to visit the city.
- (vi) Lack of an established strategy for revitalization of abandoned industrial facilities.
- (vii) Incompleteness, ambiguity and inconsistency of the current regulatory framework, which complicates the process of changing the ownership of certain land territories.
- (viii) Lack of recreation culture among the local population.

“O” – opportunities

- (i) Revitalized objects can become completely new attractions for the residents and visitors to the city.
- (ii) Their creation can significantly intensify development of industrial tourism in Kryvyi Rih and, accordingly, increase tourist flows.

- (iii) Revitalized objects can serve as a training ground for activation of small and medium businesses, as attracting visitors will contribute to additional opportunities for businesses to sell their own products.
- (iv) Certain remoteness of revitalized objects from the populated part of the city will allow holding noisy events there (festivals, concerts, etc.).
- (v) A high degree of attractiveness of these objects can raise investors' interest.
- (vi) These projects envisage creation of completely new and creative locations, infrastructure facilities and attractions.
- (vii) Eradication of the negative stereotype of Kryvyi Rih, which is figuratively called "Ukrainian Detroit".
- (viii) Attraction of additional funds to the budget of the region; Creation of additional jobs.
- (ix) Expansion of the network of tourist infrastructures; Increase in the volume of attraction of foreign investments.
- (x) Preservation, development and popularization of industrial heritage monuments.

"T" – threats

- (i) Since implementation of these projects is planned in several stages, there is a risk of not finalizing it, not advancing past initial stages.
- (ii) The situation in the city and the country is not stable, so financial investments in creation of such large-scale projects bear significant risks associated with possible bankruptcy of executors and unprofitability of the leisure infrastructure today.
- (iii) The situation with the owners of abandoned industrial facilities is not always transparent, which makes it impossible for third-party organizations to promote investments.
- (iv) Restored mining equipment and available specific industrial orientation of attractions can cause injury if they are used improperly.
- (v) According to the proposed projects, revitalization involves preservation of authentic industrial themes, life of local residents is oversaturated with this matter, so it may not find sufficient positive feedback and, accordingly, the demand for visiting the created facilities from local residents.

In order to identify how external factors will affect the process of revitalization and further operation of these objects, we have conducted a PEST analysis. According to its results, the following conclusions are highlighted.

In **the political aspect**, a special role is played by changes in power, in legislation, influence of power structures on industrial performance, etc. If we consider the direct influence on development of revitalization processes in the city, it should be noted that such organizations as Kryvyi Rih Foundation for the Future, Urban City, which develop various socially oriented projects, involve city activists in their development and help in implementation, are a positive factor. The opportunity for city residents to participate in open contests and competitions on the platform "Public Budget" to win funding for implementation of their projects creates favorable conditions for implementation of revitalization projects as well. In addition, some political candidates include revitalization projects in their election programs, which is also a favorable factor. Among the negative factors, one should note certain difficulties associated with obtaining ownership of or transferring the above-mentioned objects to the city fund in order to further conduct the processes of revitalization, renovation, reclamation, or complete reconstruction. In general, based on both the shortcomings and the advantages of political influence on this process, it should be noted that the political aspect can be considered favorable rather than unfavorable one.

In **the economic aspect**, it should first be noted that in the context of the global pandemic, any projects, especially related to the field of leisure and tourism, are in less demand. Funding is mostly aimed at development and maintenance of the medical sphere. That is why at present, the opening of new leisure facilities is not profitable, and their funding by the state and third-party investors is almost impossible due to current irrelevance of this area development. At the moment, external economic factors are unfavorable.

The analysis of **the social aspect** enables asserting that in general, residents of the city need new both cultural and leisure objects, which will lead to not only improvement of the city, but also new jobs, and small and medium businesses will have new opportunities to sell their own products. Unfortunately, this need is currently complicated by the pandemic situation in the world, permanent quarantine restrictions on leisure facilities functioning, and a decrease in the number of those wishing to visit crowded places. In addition, a significant proportion of the city's population are workers with not sufficiently established culture of leisure activities. Therefore, within the framework of the current epidemiological situation, the social aspect is rather unfavorable, but the end of the coronavirus epidemic could revive cultural life.

The analysis of **the technological aspect** enables stating that in general, the construction technologies available in the country and the possibility of installing certain infrastructure facilities are sufficient for implementing planned revitalization projects, since all projects have been planned within the framework of existing and real opportunities for attracting certain technologies. However, involvement of certain technologies will be regulated exclusively by the current budget allocations for revitalization of old industrial facilities. Therefore, this aspect should be determined as rather neutral.

Thus, analyzing the data of the two methods, it can be argued about the huge potential and opportunities of revitalization of the industrial heritage in Kryvyi Rih, but realization of this potential is restricted by a number of not quite favorable economic and social factors.

5. Conclusions

Revitalization of industrial facilities is now a trend in many leading countries. Ukraine has clearly focused on the European model of development and actively begun to implement the practice of giving "a second life" to both industrial facilities and urban complexes in general. Unfortunately, the most powerful industrial center of the country – Kryvyi Rih region – is not yet implementing such a positive practice, although it has a significant resource and potential for this.

Thus, the main tasks facing the city authorities in this context are:

- convincing the city community of the need and prospects for revitalization of industrial facilities, since the majority of residents have a low level of industrial culture and, accordingly, lack of awareness of this issue;
- involving leading industrial enterprises in cooperation and investment in industrial heritage objects, especially if these objects were operated by these enterprises or are in their zone of influence;
- encouraging investors from both Ukraine and abroad, in particular, by creating favorable tax conditions for investment and by submitting various proposals for various grant financing competitions;
- developing a step-by-step strategy for revitalization of Kryvyi Rih region industrial heritage, considering economic, social, cultural, tourist effects;
- combining efforts of small businesses engaged in tourism, organization of leisure and cultural events to develop a common algorithm of actions in the field of activating the cultural component and holding various events at those industrial heritage sites where it does not

require significant investments (the Burshchytskyi and the Petrovskyi dumps, damaged zones, remnants of the Chervonyi Bridge, flooded open pits, etc.);

- improving the city infrastructure.

Implementation of everything outlined will stimulate preservation and popularization of the industrial heritage, maintain authenticity of the urban cultural complex, form a culture of leisure activities among the population and a tolerant attitude to achievements of the industrial era of society development.

Emerged modern revitalized objects will become an additional tourist magnet and another important step to popularize industrial tourism, which the city is trying to intensively develop and which is identified as one of the priorities of its strategic development. All this, in turn, will contribute to stabilization of the socio-economic situation in the city and improvement of both its tourist and overall image.

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