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Regionalization in Global Space

Myroslava SOLDAK

INSTITUTIONAL ASPECT OF BROWNFIELDS REVITALIZATION: THE CASE OF UKRAINE

Abstract

The article investigates the institutional aspect of brownfields revitalization – areas or sites that are derelict, contaminated and in need of active measures before they can be effectively used again for social and economic development of the area. The method of expert survey was used as a tool to identify problematic issues of brownfields revitalization and test the hypothesis of the need for institutional support to ensure the modernization of the economy of old industrial regions. The general conclusion that can be drawn from the conducted research is that institutional measures for brownfields revitalization should be aimed at developing special institutions that would facilitate the revitalization of brownfields in order to modernize the economy of the regions. Namely, brownfields should be transformed into locations for innovation infrastructure and organizations to support small and medium enterprises; advantageous specialization of the region should be ensured by creating industrial sites that meet the current technological requirements, have modernized production facilities, specialize in the production of science-intensive products or waste recycling, and operate on principle of circular economy.

Soldak, Myroslava, Candidate of Economic Sciences, senior researcher, scientific secretary, Institute of Industrial Economics of the National Academy of Sciences of Ukraine, Kyiv, Ukraine. ORCID: 0000-0002-4762-3083 Email: soldak@nas.gov.ua.

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Literature Review and Problem Statement

In the countries of Eastern Europe, the industrial landscape, which had expanded significantly during the socialist period and dominated most urban centres, began to undergo major changes at the end of the 20th century (Haase et al., 2021; Mirea et al., 2012). Most state-owned industrial enterprises experienced restructuring that has necessitated their privatization or close down. Deindustrialization in post-socialist countries occurred later than in Western Europe and was more dramatic due to overvalued and uncompetitive local industry and the imperfection of the legal framework governing privatization processes. (Duží & Jakubínský, 2013; Jigoria-Oprea & Popa, 2016). Not all industrial companies have managed to survive the deindustrialization stage and retain their original field of operation to this day. Some of them have undergone structural and functional transformations (Krzysztofik et al., 2016; Amosha et al., 2017). All these changes have led to the emergence of brownfields – areas or sites that are abandoned, contaminated and in need of active measures before they can be effectively used again to ensure social and economic development of the territory. Their number is likely to increase as industrial activity continues to change and migrate to keep pace with technological development and globalization (offshoring and reshoring processes). A recent study (Pérez & Eugenio, 2018), covering 28 EU countries, found that there were about 2.8 million sites where contamination had occurred / was taking place. Since 2014, more than 76,000 new sites have been registered, according to data provided by 16 countries.

Brownfields are often a source of inconvenience to nearby residents, especially in cases of contaminated sites (risks to the environment and human health) or abandoned buildings (risk of accidents, high crime rate) (Amosha et al., 2018). It is possible to overcome these problems through revitalization, i.e. changing the function of the derelict industrial sites, taking into account emergence and development of new sociocultural needs of urban dwellers and current level of development of industrial technologies. The revitalization of brownfields creates real opportunities for urban development through increased cohesion of urban areas, revitalization of depressed areas, reductions in the costs associated with urban growth (e.g. environmental degradation, infrastructure expansion, increased transport costs) (Batunova, 2020).

The decline of industry in Ukraine is the result of economic and political transformations and, in a broader context, a shift in global politics, which affected Central and Eastern Europe and the entire post-Soviet space. At the same time, industrial transformations should not be considered universal models, as economic relations are influenced by institutional features, social interactions and cultural values shaped by history (Hann & Hart, 2011; Jóźwiak, 2019).

Deindustrialization in Ukraine was accompanied by redistribution of property, detachment of new legal entities from large enterprises with the full cycle of goods production. Mining companies severed ties with domestic processing enterprises, entering the world markets with their raw materials and semi-finished products. This put the domestic industries in difficult conditions, complicating the supply of their enterprises with raw materials and semi-finished products of domestic producers. (Amosha et al., 2017). The branches of national industry adapted to the new economic conditions mainly by closing individual enterprises and even eliminating almost entire industry branches (e.g. light industry), whose products were uncompetitive, rather than by creating new high-tech companies. Many of the companies that have managed to adapt to new economic relations (in mining, ferrous metallurgy, power engineering, gas industry, chemistry and petrochemistry, mechanical engineering) use outdated machinery and technology, which negatively affects the productivity and environment in the region. This decline is crucial for day-to-day operations and survival strategies in old industrial regions, especially in small mono-functional towns, where consequences of deindustrialization are felt acutely in rising unemployment, lack of new jobs, declining purchasing power, unsatisfactory housing and utilities services, poor environmental conditions, and increasing social tensions.

The problem of modernizing the economy of old industrial regions can be solved by creating a new industrial base through the support and development of medium- and high-tech production enterprises. Economic structure can be further differentiated by, first, realizing the full potential of regional innovation systems as the most productive, holistic approach to innovation, and second, introducing structural and technological changes that would meet current requirements of intensifying global competition and numerous domestic economic and social challenges affecting the prospects of the economy, state and society.

In the context of such a task, **the aim of the article** is the theoretical justification of the institutional support for the revitalization of brownfields. This will make it possible to consider the derelict sites of former industrial use as opportunities for economic modernization of old industrial regions, achieved through implementation of innovative solutions to revitalize brownfields, for example by transforming them into spaces for innovation infrastructure, support for small and medium enterprises, industrial installations that meet modern technology requirements and have modern production facilities, specializing in the production of science-intensive products, or industrial waste management plants operating on the principles of circular economy.

Research Methods

The method of expert survey was used as a tool to identify problematic issues of brownfield revitalization and test the hypothesis of the need for institutional support to ensure the modernization of the economy of old industrial regions. An expert questionnaire was developed to gather information, which included the key questions related to this study. The purpose of the survey is to reveal and generalize the informed opinion of the expert community on the development of policy measures at the local and state level that meet the current requirements in terms of brownfield revitalization, as well as to substantiate management decisions to modernize the economy of old industrial regions of Ukraine and develop scientific and practical recommendations on resolving problems of revitalization of abandoned and derelict industrial sites at national, regional and local levels.

The main actors of the survey were representatives of regional administrations, city councils, regional development agencies, public organizations for territorial development. In total, the study covered 32 cities in 19 regions of Ukraine, including 22 cities in the old industrial regions: Donetsk, Luhansk[1], Dnipropetrovsk, Zaporizhzhia, Poltava, Kharkiv oblasts and city of Kyiv. A representative sample of actors was formed in the period from April to June 2020 by obtaining complete answers to all questionnaires from 39 respondents, of which 24 experts represented the old industrial regions. Most data processing was conducted in July-November 2020.

In total, the experts were asked to answer 23 questions, which can be divided into the following blocks: the causes of brownfields and their characteristics; local strategies of brownfield revitalization; problems of stimulating and financing revitalization; local preferences for promising forms of revitalization; information about the respondent.

[1] The study examined the territories of Donetsk and Luhansk oblasts controlled by the Ukrainian authorities.

Research Results

Block 1. The causes of brownfields and their characteristics

The vast majority of respondents – almost 80% – considered deindustrialization to be the main reason for the appearance of brownfields in their cities. Almost 30% of experts chose the processes of property rights' transformation as the second most important factor in the emergence of brownfields.

Experts noted that brownfields appeared on the sites of industrial enterprises of the machine industry (13%), food production (28%), textile production (21%), mining industry (10%), metallurgical production (10%), chemical industry (5%), production of building materials (5%), electronic industry (2%).

In order to identify approaches to the functional transformation of brownfields, the international organization CABERNET (Concerted Action on Brownfield and Economic Regeneration Network, EU) has developed the A-B-C classification, which focuses on how brownfields can be used effectively (Ionescu-Heroiu, 2010).

According to the classification, there are three types of reuse potential of derelict industrial sites in world practice. Type A is the group of minimally contaminated sites that are in a commercially attractive location; they can be revitalized by private investors for high returns. The role of the government in these projects is reduced to the necessary approvals and issuance of permits within the framework of city development planning. Type B refers to sites with moderate or severe contamination; projects are implemented on the basis of public-private partnerships (which are becoming more widespread) and the various stages of the process are regulated by appropriate agreements and contracts. Sometimes direct financial assistance from the public sector is allocated for the redevelopment of existing enterprises, provided that the planned socio-economic objectives are reached. Type C – socially oriented – projects are carried out mainly in case of significant contamination of the industrial site, uncertainty of brownfield specialization and unclear prospects for commercial land use.

The majority of respondents believed that brownfields in their residence area mainly belonged to category B (54%). Category A was the second most common choice in experts' answers (49%), while category C was the last with 21%. *Thus, it can be concluded that all categories of brownfields are widespread in Ukraine to varying degrees: from slightly contaminated and located in commercially attractive areas to heavily contaminated and located in commercially unattractive areas with inactive real estate market (e.g. in depressed cities and districts). It is obvious that Ukraine should develop institutes necessary for realization of all forms of brownfields' redevelopment.*

Block 2. Local strategies of brownfield revitalization

The leading countries of the world take into account the environmental component of revitalization projects and clearly define goals in the field of environmental protection with accompanying appropriate regulatory framework. National strategies for the brownfield revitalization are formed on the basis of strong environmental legislation. The strategies reflect future goals for the restoration and redevelopment of derelict sites. In England, the strategy developed by the development agency is called English Partnerships, in Canada – The National Round Table on the Environment and the Economy. Strategies to revitalize derelict sites do not necessarily have to be in a separate document. For example, in Germany, the revitalization of derelict sites is outlined in the country's Sustainable Development Strategy.

Regional development strategies provide for the coordination of state regional policy with other state policies aimed at territorial development. In Ukraine, national strategic goals and priorities for brownfield revitalization are not defined clearly. As a result, the issue of revitalization of derelict sites is not included in the regional strategic development documents. Analysis of development strategies of such industrialized regions as Dnipropetrovsk, Donetsk, Zaporizhzhia, Kharkiv, Odessa oblasts reveals a lack of clauses on revitalization of derelict industrial sites. In the Kyiv Development Strategy 2025, the SWOT analysis classifies the derelict industrial sites as «Opportunities», but does not define strategic goals for their management. At the same time, local politicians are aware of the importance of transforming brownfields into drivers of territorial economic development. Two thirds of respondents indicated an intention to include the issue of revitalization of abandoned and derelict industrial sites in the development strategy; 13% admitted that the strategic planning of the territory would not include the redevelopment of derelict sites of former industrial use in the near future; 3% had no answer to this question.

An inventory is needed for a successful policy to revitalize derelict sites. Less than half of respondents (46%) indicated that a database of derelict industrial sites was being created in their city. Almost 29% answered negatively to this question, 2.6% had no answer. The experts also pointed out that information on brownfield sites (real estate) of various (private, state, community) forms of ownership was already available on the official websites of the Office for Strategic Development and Investment of the Regional State Administrations, Agency for Investment Attraction and Investor Services, while some derelict industrial sites are included in the business catalogue of the oblast or in the Integrated Concept of City Development.

The creation of a brownfield database is meant to provide access to the register of derelict industrial sites suitable for reconstruction and construction of new facilities. It should enable all stakeholders to work together on investing in brownfields and establish channels of communication between potential investors and decision-makers in the field of urban development policy. It should also

facilitate access to all the necessary information, for example, the former functional purpose of the site; ecological condition of the site; risks of distribution of property rights to the site; infrastructural support of the site and capacity of its engineering communications; trends in the local real estate market; the prerogatives of local authorities to encourage investors to use derelict sites. Half of the experts noted that their database would contain information on the functional purpose of the site. A further 44% indicated that infrastructural support of the site and capacity of its engineering communications would be included.

Critical overview of the world experience and systematic analysis of models for revitalization of derelict industrial sites from around the globe identify several important stages of brownfield revitalization. Stages of implementing revitalization projects differ from those of other urban development projects in that there is a component of environmental rehabilitation depending on the degree of contaminated and clean-up requirements. Due to the implementation of the European integration strategy, the transformation of urban policy should use the introduction of the basic principles of the common regional and environmental policy of the EU into the legislation of Ukraine as its basis. Ukrainian legislation has undergone significant changes in recent years due to the need to adapt to EU requirements. In particular, the Law «On Strategic Environmental Assessment» was adopted in 2018, providing for the definition, description and assessment of the consequences of implementing state plans for the environment, including public health, or justified alternatives, as well as for the development of measures to prevent, reduce and mitigate possible negative consequences. The environmental assessment procedure includes determining the scope of strategic environmental assessment, compiling a report on strategic environmental assessment, conducting public discussions and consultations (if necessary – cross-border consultations), taking the report on strategic environmental assessment and results of public discussions and consultations into account in the state planning document, informing the public about the approval of the state planning document. Despite the importance of assessing environmental risks, and, accordingly, informing potential investors about their severity, only 15% of respondents indicated this option when answering the question about the information contained in the brownfield database that was being created.

Registration of property rights is one of the problems faced by public and private stakeholders in the brownfields revitalization. In a significant number of cases, the asset is owned by several individuals who do not have sufficient authority for sole control, which makes it impossible to make decisions on its renovation and management. The industrial facility can be operated in only a partial capacity, without taking into account the investment potential. Usually, such is the case of administrative buildings of former industrial enterprises acting as the registration location of several legal entities, while production facilities and land are not used. In some cases, the frequent change of owners of industrial enterprises during the years of privatization led to the situation when the city authori-

ties lack information about the owner of the asset. However, only 18% of respondents noted this option as planned to be included in the brownfield database.

Despite the existing problems that hinder the revitalization of derelict sites, cases of brownfield revitalization were known to happen. More than half of the respondents answered yes to this question. At the same time, the majority of them (41%) noted that a private investor initiated the transformation. Local authorities or local self-governments were the initiators in 33% of cases, while a foreign investor initiated revitalization efforts 13% of the time. *Thus, the special tools for improving the investment climate that the city authorities can employ to encourage the investor to implement a project in a commercially unattractive (depressed) area of the city are of great importance to the revitalization efforts.* The results of the survey indicate that the authorities are more likely to offer consultations and other organizational support (77%), speed up the bureaucratic process in providing the necessary documents (56%), develop infrastructure or public transport (39% each) than any other measures (10%).

Block 3. Restriction, stimulation and financing of brownfield revitalization

Experts were asked open questions about what they think is delaying the active revitalization of derelict sites, as well as what will help intensify the transformation of brownfields into drivers of community economic development. All answers suggested by the respondents are listed in tables 1 and 2 and grouped by the following factors: institutional, financial, socio-economic and environmental, socio-political and socio-psychological (behavioural).

Table 1

Expert assessments of factors delaying the intensification of transformations of brownfields into drivers of community economic development

Suggested answers	No of answers
Institutional factors	***32***
Lack of normative legal status of brownfield and greenfield in the current legislation of Ukraine	3
Lack of a clear state policy for the revitalization of derelict sites	5
Lack of clear guarantees and possible priority measures for businesses that are going to start the revitalization of brownfields (tax exemptions, calls for the best sites, favourable lending conditions)	5
Unfavourable investment climate, extensive bureaucracy and corruption	4

Suggested answers	No of answers
Lack of incentive benefits and unresolved issue of tax preferences for participants of industrial parks	4
Lack of effective mechanisms to influence brownfields owners who do not use sites for economic activities, including the forced transfer of such sites to the local community (except for the voluntary consent of the owner to transfer ownership to local governments and / or for public use)	2
The problem of legal regulation of brownfields ownership	5
Lack of a clear urban development policy regarding the development of industrial sites	4
Socio-political factors	***11***
Location's proximity to the demarcation line, which leads to the impossibility of land reclamation works of the liquidated coal mining enterprises, limits the range of potential sources of funding, nullifies the investment attractiveness of the city for potential investors	10
Problems with the creating a United Territory Community	1
Socio-economic and environmental factors	***9***
Low level of economic development in Ukraine and regions	3
Outflow of labour	2
Lack of qualified specialists in blue-collar professions	1
Depreciation of the city's engineering infrastructure and limited engineering capacity	1
Impossibility of performing land reclamation works due to high cost and / or location of the site on the demarcation line	2
Financial factors	***7***
Lack of funds for the implementation of brownfields revitalization projects (including environmental assessment and cleanup of a derelict site)	7
Socio-psychological (behavioural) factors	***5***
«Industrial» thinking of people for whom the transformation of a plant (industrial site) into a public facility is unacceptable	1
Owners are not interested in using the brownfield to their advantage	2
Low level of communication between local development actors	1
Indifferent attitude of civil servants to the business, which is going to do what is necessary for the country and the city	1

Table 2

Expert assessments of factors facilitating the intensification of transformations of brownfields into drivers of community economic development

Suggested answers	No of answers
Institutional factors	***27***
State policy aimed at encouraging future investors, stimulating their interest, improving the legal framework in land management, urban planning, taxation and other areas	18
Improving the legal and institutional field of regulation over the creation and operation of industrial parks	1
Decentralization leading to expanded and increased powers of territorial communities in terms of control over the use of industrial sites, with the possibility of their return to community ownership (with reimbursement to such owners and / or granting tax and other benefits), including over attraction of foreign investments (under agreements on joint activity, concessions, etc.)	3
Inventory of brownfield sites according to the main criteria: location, type, size, ownership, level of contamination, possibility of use after revitalization, priorities and financing, creation of a general state register	2
Resolving the issue of ownership of brownfields and transfer of brownfields into the ownership of investors interested in development	3
Socio-economic and environmental factors	***10***
Stable economic and political situation in the country	2
Creating a national programme of employment and retraining, a state programme to create jobs in high-tech sectors of the economy	2
Adaptation of educational institutions to new opportunities in the field of business, innovation and the labour market	1
Improving local infrastructure, ensuring the transition to sustainable energy production (installation of renewable energy generators, energy efficiency, etc.)	2
Reclamation and restoration of soil fertility in s that have been negatively affected by mining, waste and wastewater disposal	2
Ensuring the transition to sustainable energy production (installation of renewable energy generators)	1
Socio-political factors	***3***
An integrated approach to resolving the situation in the eastern regions of Ukraine, coordinating the efforts of central and local executive bodies, local governments, civil society institutions aimed at restoring socio-economic infrastructure and peacebuilding	3

Suggested answers	No of answers
Socio-psychological (behavioural) factors	***4***
Entrepreneurial initiative, investor interest	1
Investor interest – without progressive business ideas and investments revitalization of brownfield sites is problematic	2
Interest of local authorities	1

According to experts, the effective use of brownfields as a resource for local development requires the use of several types of tools. First, *financial tools* (82%) – receiving funds under assistance programs and grants of the European Union, from international organizations, in particular for environmental assessment, research, and / or cleanup of abandoned and derelict industrial sites; use of SFRD funds. Second, *tax tools* (67%) – introduction of a single tax that can be imposed on an industrial site that is derelict; setting preferential rates for national and / or local taxes and fees for legal entities that are implementing a brownfields revitalization project in a depressed area of the city and / or sites requiring environmental clean-up measures (types B and C); introduction of tax breaks for potential investors in the framework of revitalization projects. Third, *administrative tools* (67%) – sanctions, fines for forcing the owner of the brownfields to clear and further use it; possibility of forced alienation of land and real estate located on it.

Thus, *experts believe that the active revitalization of brownfields is delayed mainly by institutional factors, but at the same time, they can contribute to the intensification of the transformation of brownfields into drivers of community economic development. One of the first steps in cultivating special institutions aimed at promoting the transformation of brownfields may be the development and adoption of a state programme that would be consistent with legislation in the field of public policy aimed primarily at boosting investment, stimulating domestic and foreign interest of investors in the implementation of projects in brownfields, as well as solving problems of regulation of such sites' ownership.*

In addition to institutional factors, the cities of Luhansk and Donetsk oblasts have faced the need for a comprehensive approach to resolving the situation related to the armed conflict in the east in recent years. Coordination of efforts of central and local executive bodies, local governments, and civil society institutions aimed at restoring socio-economic infrastructure and building peace has also become important.

Economic institutions, in particular institutions that shape the interactions during modernization of the region's economy, are closely linked to the culture, social values and beliefs of the economic actors. In this context, culture can be

considered as one of the most important factors determining the prospects for economic and technological development of social or economic order (Mokyr, 2016). Experts highlight the behavioural factors among those delaying the revitalization of brownfields. *Thus, the more intensive revitalization of derelict industrial sites can be greatly facilitated by shaping of habits, norms and beliefs of actors that promote the adoption and adaptation of new ideas, practices and processes, which increase the effectiveness of brownfield revitalization in terms of modernizing the economy of the regions.*

Block 4. Further use of brownfields

This block includes questions concerning the experts' perception and ideas for the further use of brownfields. The creation of economic activity zones is the undisputed leader among the preferred forms of recovery – 92% of experts consider this form the most acceptable in their cities. According to 36% of respondents, the future lies in the creation of green recreation areas, 31% of experts expect new housing, and 21% are looking forward to the creation of a cultural site.

Among the types of economic activity zones, experts prefer a new industrial enterprise (69%) and an industrial park (54%), or a mixed form of use for the site (62%).

In mining towns, attention is focused on several specific forms of brownfields revitalization, including the introduction of reverse osmosis to purify mineralized mine water to the quality of drinking water; use of mine water for heating social facilities with the use of heat pumps; exploration, degassing and extraction of methane gas from the "Karabanka" dome of the Toretska mine of SE "Toretskvugol" and further use of methane gas for public utilities.

The vast majority of experts (72%) consider it appropriate and possible to place organizations whose activities are aimed at meeting the needs of small and medium enterprises (business centres, business incubators, innovative business incubators, technology parks, business support funds, innovation and investment funds and companies, consulting centres, business associations and other organizations) on the territory of the former brownfield. Such forms have already been implemented in countries with a rich industrial heritage (Figure 1).

Figure 1

Examples of organizations on the territory of former brownfields

Gliwice Technology Park (Poland)

Gliwice Technopark was built on the site of a mine that closed in 1999. 20 million euros were spent on the project with the support of the European Union, half of which was provided by the local budget. The Silesian University of Technology participated in the creation of the park. High development of technological background provided the basis for the launch of new high-tech firms. For example, *Flytronic* is known for its software development for unmanned aerial vehicles used by the Polish army, *Wasko S.A.* is one of the largest telecommunications companies in Europe, *Infinite Dreams* is a developer of games and official mobile apps for Windows Phone, Symbian, iOS, Android, macOS. Developed infrastructure, training and consulting services, as well as the implementation of international, central and regional support programmes create a friendly atmosphere for business. Gliwice Technopark's active participation in the development of entrepreneurship in the region and beyond is confirmed by strong cooperation with technological institutes, universities, science parks, foreign organizations and numerous implemented projects. Today, the park houses almost 80 companies, more than 80% of which are associated with the units of the Silesian University of Technology (Park Naukowo-Technologiczny Technopark Gliwice, n.d.).

Creative hub in Genk (Belgium)

Genk – a small town with a population of 65 thousand people, which attracted miners from all over Europe to its three mines. However, after the gradual closure of the mines, 7,000 miners lost their jobs. The area was cleared by the owner of the enterprise, and the buildings of the Winterslag C-Mine mine were classified as historically important. The project was under construction from 2005 to 2010. The total cost amounted to € 8 million, of which € 3 million came from ERDF funding.

The C-Mine Hub is built on four interrelated areas: artistic creativity: space for contemporary culture and works of art; recreation: C-Tour of underground passages to mine buildings; higher education: creation of the Academy of Media and Design (product and graphic design, animation and video, as well as continuous professional training); creative economy: building links between knowledge, innovation and entrepreneurship.

The city is developing a group of related initiatives using Genk's knowledge of higher art education with entrepreneurship and creative innovation at the company level. Among the companies is *Design Innovation Lab*, which provides support services to companies looking to incorporate creative innovation into their products and services. This is facilitated by a multifunctional space for creative projects and services, including a meeting place and a workplace for the Design Innovation Lab; for project groups, platforms for joint work, start-ups; for students; for training courses, seminars; space for organizing innovative corporate events (Ramsden, 2010).

Thus, *despite the deindustrialization processes, experts associate the prospects for further development of the territories mainly with industrial activities. Therefore, the revitalization of brownfields should be conducted by transforming them into locations for industrial sites that meet the current technological requirements, have modernized production facilities, specialize in the production of science-intensive products or waste recycling, and operate on principle of circular economy. Respondents also consider creating innovation infrastructure facilities and small and medium business support organizations (business centres, business incubators, innovation business incubators, technology parks, business support funds, innovation and investment funds and companies, consulting centres, business associations and other organizations) to be an acceptable form of brownfields revitalization.*

Institutional measures to facilitate the revitalization of brownfields in order to modernize the economy of old industrial regions

1. Institutional measures should be aimed at developing special institutions that would facilitate the revitalization of brownfields in order to modernize the economy of the regions. Namely, as a result of the sites' revitalization, innovation infrastructure and organizations to support small and medium enterprises (business centres, business incubators, innovation business incubators, technology parks, business support funds, innovation and investment funds and companies, consulting centres, business associations and other organizations) should be created and ensured of their successful operation. Advantageous specialization of the region should be ensured through implementation of innovative solutions for stimulating economic activity, in particular creating industrial sites that meet the current technological requirements, have modernized production facilities, specialize in the production of science-intensive products or waste recycling, and operate on principle of circular economy.

2. It is necessary to introduce the term «brownfield» into the official vocabulary at the national level. Table 3 shows examples of definitions of this concept, which have already been adopted by a number of international and national organizations. When choosing the most acceptable definition for the specifics of Ukraine, one must not forget to recognize the brownfield's ability to revive the economic activity of the surrounding area, and not just refer to the inherited territorial problems. It should be noted that thanks to the project *Integrated Urban Development of Ukraine*, the term «brownfield» is already being used for the concepts of integrated urban development in the framework of international technical assistance[2].

[2] Concept of Integrated Development «Vinnytsia 2030», available at: https://www.vmr.gov.ua/Lists/IntegratedUrbanDevelopment/Default.aspx; Concept of Integrated Development «Poltava 2030», available at: http://www.2030.poltava.ua/ua/kontseptsiya-intehrovanoho-rozvytku-mista-2030

Table 3

Interpretation of the term «brownfield» in world practice

Organization	Definition
CABERNET – Concerted Action on Brownfield and Economic Regeneration Network, EU *CLARINET – Contaminated Land Rehabilitation Network for Environmental Technologies*, EU *World Bank*	sites that have the following characteristics: previously used; derelict or underused; mainly in fully or partly developed urban areas; require intervention to bring them back to beneficial use; have real or perceived contamination
European Court of Auditors	former industrial and military areas, which are often derelict and contaminated
EPA – U.S. Environmental Protection Agency	a property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant
DOE – Department of the Environment, Great Britain	land that is so damaged by industrial or other activities that it cannot be suitable for use without measures to revitalize it
FCSAP – Federal Contaminated Sites Action Plan, Canada	derelict, unused or underused commercial or industrial sites in which past activities have caused contamination, but which still have the potential for revitalization or other economic opportunities; usually located in urban areas.
HUD – U.S. Department of Housing and Urban Development	an abandoned, idled, or underused property where expansion or redevelopment is complicated by the presence or potential presence of contamination

Note: compiled by O. V. Liakh and M.O. Soldak on the basis of (CLARINET, 2003; Ramsden, 2010; Department of Environment, 1995; European Court of Auditors, 2013; Ionescu-Heroiu, 2010).

3. One of the first steps in developing special institutions aimed at facilitating the transformation of brownfields may be the development and adoption of a state programme that would set clear national goals and standards for brownfields revitalization, contain recommendations for revitalization depending on the types of contamination and further directions for use of a former industrial site. Such standards should be based on the A-B-C classification devel-

oped by CABERNET. The programme must comply with legislation in the field of public policy aimed at encouraging investment and stimulating the interest of domestic and foreign investors in the implementation of projects in brownfields. The programme may be funded through assistance programmes and grants from the European Union or international organizations, in particular those concerned with environmental assessment, research, and / or clean-up of abandoned and derelict industrial sites. State Regional Development Fund (SFRD) should be considered as a source of funding for the programme, given that in many countries the implementation of brownfields revitalization projects has become possible thanks to funding from the European Regional Development Fund (ERDF). The activities of the European Fund are aimed at reducing economic, environmental and social problems in cities, emphasizing sustainable development. It is established that at least 5% of ERDF resources are directed to the fulfilment of sustainable development objectives, and the revitalization of derelict industrial sites is, in fact, a complex of environmental, economic and social problems.

4. Ensuring the effective use of brownfields to modernize the economy of old industrial regions requires special tools and additional services within a special management regime (incentives and restrictions). These measures can be divided into financial, tax, customs, and administrative tools (Table 4).

Table 4

Types of special tools and additional services to ensure effective use of brownfields

Type of measures	Example of measures
Financial tools	• obtaining funds under assistance programmes and grants from the European Union or international organizations, in particular those concerned with environmental assessment, research, and / or clean-up of abandoned and derelict industrial sites; • using SFRD funds.
Tax tools	• establishing a single tax that may be imposed on an industrial site that is abandoned or not fully used; • setting preferential rates for national and / or local taxes and fees for legal entities implementing a brownfield revitalization project in a depressed area of the city and / or sites requiring environmental clean-up measures); • exemption from income tax for five years and payment of only 50% of income tax for the next five years subject to export activities (for industrial parks)*;

Type of measures	Example of measures
	• introduction of a 3% VAT rate on imports of equipment and components for construction for a period of ten years (for industrial parks)*; • introduction of a minimum VAT rate of 3% on imports of raw materials, semi-finished products and appliances, subject to further production of the final product and export of at least 50% of finished products (for industrial parks)*; • exemption from import duties on foreign equipment and components (for industrial parks)*; • partial reimbursement to exporters of the interest on loans for external supplies (for industrial parks participants)*.
Customs tools	• exemption from import duties (for industrial parks established in brownfields); • crediting the accrued amounts of import duty to special accounts (for technology parks created in brownfields, their participants and joint ventures).
Administrative tools	• use of the single window principle for application of registration documents; • sanctions and fines to induce the owner of a brownfield site to cleanup and reuse it; • possibility of forced alienation of property for further implementation of the brownfield revitalization project.

*Note: According to the draft law No. 3724 «On amendments to the Tax Code of Ukraine aimed at attracting investment in the industrial sector of the economy by introducing incentives for industrial parks» and draft law No. 3725 «On amendments to the Customs Code of Ukraine aimed at attracting investment in the industrial sector of the economy by introducing investment incentives for industrial parks».

5. Industrial parks are a tool that in many countries stimulates economic growth and the creation of innovative technologies in the former brownfields (Figure 2).

Incentives and preferences, state guarantees, unchanging rules of the game and full assistance of local authorities in the development of enterprises in the park are needed in order to effectively use the successfully tested investment attraction tools for the revitalization of brownfields in Ukraine. The availability of legally guaranteed operating conditions and clear procedures for obtaining state support from state and local budgets that they are obligated to provide it are very important for investors.

Figure 2

Experience of industrial parks in Poland

In Poland, industrial parks are located in the areas of former machine-building, chemical, and metallurgical plants, or mining sites. Parks are created to attract foreign investors, ensure economic and social revitalization of derelict industrial sites and job creation, develop and modernize the existent infrastructure in redeveloped sites. Implementation of projects was made possible thanks to the funding from the European Regional Development Fund (Bydgoszcz Industrial Park, Silesian Industrial Park). Silesian Industrial Park was created in collaboration with the Faculty of Architecture and Urban Planning of the Silesian University of Technology in Gliwice. It is supported by the Marshal of the Silesian Region, the Agency for Industrial Development, the Ministry of Economy and Labour. Podlaski Industrial Park was created as part of the Operational Programme for the Development of Eastern Poland in 2007. The project to establish the Upper Silesian Industrial Park was implemented as a result of the Cooperation Agreement between Katowice, the Agency for Regional Development in Bielsko-Biała, the Upper Silesian Agency for Corporate Transformation in Katowice and the Upper Silesian Industrial Park.

6. The challenges faced by Ukrainian regions in terms of economic modernization, in particular the revitalization of derelict industrial sites, show that no region is able to implement large investment projects on its own, as they require fundamentally new knowledge of the problem that can be obtained only through the use of the potential of the other regions. To this end, it is necessary to make most of opportunities for integration in the field of innovation, science and education, in particular within the framework of the Association Agreement signed with the EU. In order to form a modern brownfield revitalization policy, cooperation can be developed and deepened through:

- exchange of knowledge and best practices on industrial waste management policy;
- exchange of knowledge and best practices for the development of mining areas in order to promote the economic welfare of communities;
- scientific cooperation in the field of industrial waste management on an innovative basis, in particular, the principles of circular economy, creation of effective policies for the development of old industrial sites through the involvement of the National Academy of Sciences of

Ukraine in relevant areas of the EU «Horizon Europe» Research and Innovation Framework Programme;

- exchange of information on measures taken by the Parties to accelerate the process of revitalization of old mining sites;
- dissemination of knowledge, exchange of best practices through training and information activities at all stages of implementation of projects for revitalization of old mining sites;
- expanding the possibility of Ukraine's participation in technical and financial assistance programmes within the framework of sustainable development programmes of the European Union.

7. Involvement of regional development agencies in solving problematic issues of brownfields revitalization can be the key to the success of the institutional measures. The experience of the Moravian Regional Development Agency can be used as an example. The agency plays the role of an auxiliary institution in the field of revitalization of derelict sites; it compiles maps, registers and analyses areas and buildings that are not used, raises awareness of the possibilities of using brownfields through publications and promotional activities. The agency's work focuses not only on finding successful solutions through the acceptable use of brownfields and project funding, but also on sharing the experience already gained in supporting the brownfields revitalization with other regions of the Czech Republic, as well as through international projects involving relevant specialists who prepare documents of national and regional importance aimed at fixing problematic issues. In Ukraine, the use of such an institution as a regional development agency to revitalize brownfields requires an individual approach based on the study of specific features of the regions of Ukraine, the scale and quantity of brownfields and their characteristics. The experience of other countries should be adapted to institutional characteristics, industrial and innovative development of Ukraine. This will aim the potential of regional development agencies towards supporting the establishment of habits, norms and beliefs of actors promoting the adoption and adaptation of new ideas, practices and processes that increase the effectiveness of activities in the field of brownfields revitalization. It will also help align state, regional and local initiatives with private sector interests within regions and communities in terms of revitalizing derelict industrial sites in order to modernize the region's economy.

Conclusions

Deindustrialization and the transformation of property rights have led to the emergence of brownfields – derelict sites that have contamination problems and require a number of measures before they can be effectively used again for social and economic development of the area. Brownfields are often a source of inconvenience to nearby residents, especially in cases of contaminated sites (risks to the environment and human health) or abandoned buildings (risk of accidents, high crime rate). It is possible to overcome these problems through revitalization, i.e. changing the function of the derelict industrial sites, taking into account emergence and development of new sociocultural needs of urban dwellers and current level of development of industrial technologies. The revitalization of brownfields creates real opportunities for urban development through increased cohesion of urban areas, revitalization of depressed areas, reductions in the costs associated with urban growth (e.g. environmental degradation, infrastructure expansion, increased transport costs).

The institutional support for the revitalization of brownfields must make it possible to consider the derelict sites of former industrial use as opportunities for economic modernization of old industrial regions, achieved through implementation of innovative solutions to revitalize brownfields, for example by transforming them into spaces for innovation infrastructure, support for small and medium enterprises, industrial installations that meet modern technology requirements and have modern production facilities, specializing in the production of science-intensive products, or industrial waste management plants operating on the principles of circular economy.

The method of expert survey was used as a tool to identify problematic issues of brownfields revitalization and test the hypothesis of the need for institutional support to ensure the modernization of the economy of old industrial regions. An expert questionnaire was developed to gather information, which included the key questions related to this study. The purpose of the survey is to reveal and generalize the informed opinion of the expert community on the development of policy measures at the local and state level that meet the current requirements in terms of brownfields revitalization, as well as to substantiate management decisions to modernize the economy of old industrial regions of Ukraine and develop scientific and practical recommendations on resolving problems of revitalization of abandoned and derelict industrial sites at national, regional and local levels.

The results of the expert survey make it possible to determine the reasons for the existence of brownfields; generalize the opinion of experts on the characteristics of abandoned and derelict sites according to the classification of the World Bank; summarize expert assessments of local strategies for brownfields

revitalization, problems of stimulating and financing brownfields remediation processes, as well as promising forms of revitalization of abandoned and derelict sites. The following conclusions were drawn as the result of analysing the questionnaires.

First, the vast majority of respondents considered deindustrialization and property rights' transformation to be the main reasons for the appearance of brownfields in their cities. Brownfields appeared on the sites of industrial enterprises of the machine industry, food production, textile production, mining industry, metallurgical production, chemical industry, production of building materials (industries are listed in descending order according to the answers of experts).

Second, all categories of brownfields are widespread in Ukraine to varying degrees: from slightly contaminated and located in commercially attractive areas to heavily contaminated and located in commercially unattractive areas with inactive real estate market (e.g. in depressed cities and districts). It is obvious that Ukraine should develop institutes necessary for realization of all forms of brownfields' redevelopment.

Third, despite the lack of clear national strategies, goals and priorities for brownfields revitalization in Ukraine, politicians of Donbass cities still plan to include this issue in local strategic and planning documents. At the same time, politicians seem to underestimate the importance of environmental remediation of brownfields depending on the degree of contamination and, accordingly, the requirements for cleanup, as well as that of informing potential investors about the degree of contamination of abandoned and derelict industrial sites.

Fourth, experts believe that the active revitalization of brownfields is delayed mainly by institutional factors, but at the same time, they can contribute to the intensification of the transformation of brownfields into drivers of community economic development. One of the first steps in cultivating special institutions aimed at promoting the transformation of brownfields may be the development and adoption of a state programme that would be consistent with legislation in the field of public policy aimed primarily at boosting investment, stimulating domestic and foreign interest of investors in the implementation of projects in brownfields, as well establishing sources of projects' funding. In addition to institutional factors, the cities of Luhansk and Donetsk oblasts have faced the need for a comprehensive approach to resolving the situation related to the armed conflict in the east in recent years. Coordination of efforts of central and local executive bodies, local governments, and civil society institutions aimed at restoring socio-economic infrastructure and building peace has also become important.

Fifth, despite the deindustrialization processes, experts associate the prospects for further development of the territories mainly with industrial activities. Therefore, the revitalization of brownfields should be conducted by transforming them into locations for industrial sites that meet the current technological requirements, have modernized production facilities, specialize in the production

of science-intensive products or waste recycling, and operate on principle of circular economy. Respondents also consider creating innovation infrastructure facilities and small and medium business support organizations (business centres, business incubators, innovation business incubators, technology parks, business support funds, innovation and investment funds and companies, consulting centres, business associations and other organizations) to be an acceptable form of brownfields revitalization.

At this stage, to kick-start revitalization of brownfields, it is necessary to develop and adopt a state programme that would be consistent with legislation in the field of public policy aimed at boosting investment, stimulating interest domestic and foreign of investors in the implementation of projects in brownfields. Such a programme should define clear national goals and standards for brownfields revitalization and offer recommendations for revitalization and further use of derelict industrial sites depending on the types of site contamination.

Ensuring the effective use of brownfields to modernize the economy of old industrial regions requires special tools and additional services within a special management regime (incentives and restrictions), which can be divided into financial, tax, customs, and administrative tools.

Large investment projects on brownfields revitalization require fundamentally new knowledge of the problem that can be obtained only by making the most of the integration opportunities in the field of innovation, science and education, in particular within the framework of the Association Agreement signed with the EU.

The use of such an institution as a regional development agency to revitalize brownfields requires an individual approach based on the study of specific features of the regions of Ukraine, the scale and quantity of brownfields and their characteristics. The experience of other countries should be adapted to institutional characteristics, industrial and innovative development of Ukraine. This will aim the potential of regional development agencies towards aligning state, regional and local initiatives with private sector interests within regions and communities in terms of revitalizing derelict industrial sites in order to modernize the region's economy.

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