Basic methodical design stages of renovation of municipal industrial development

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Abstract. The paper concentrates on renovation of industrial territories, particularly topical in the Ukrainian cities. As a result of reduction in production there are large-scale decaying industrial areas with constructions, storage facilities and related infrastructure which stay off stream. Over the past few decades de-industrialization of big cities received wide publicity. In that context the necessity arises to carry out works related to renovation of industrial development, its adaptation to present-day conditions of city functioning and sustainable growth. The paper gives definitions to renovation and industrial and production area. Basic city-planning tasks in enhancement of industrial areas were determined. Outstanding problems, obstacles and motivational instruments when implementing projects related to renovation of industrial areas were studied. On the basis of analysis of global experience and study of central problems, which arise when recovering industrial areas, we have developed methods of renovation of industrial facilities located within the limits of the city.

1. Introduction
As of today, immediate complex city planning problem is determination of prospects for the development and reconstruction of big industrial cities. Industrial economy, which is determined by domination of industrial production, lost its characteristic features, and the role of service sector grew significantly. At this particular time the concept of a new society was formed, namely, post-industrial one, where information and knowledge is of crucial significance. That is why, development planning of cities has to take into consideration, in particular, practice of transformation of industrial areas of big cities into new multifunctional buildings [1,2].

Compactly built-up area is the biggest obstacle in the way of satisfaction of new social, ecological and technical needs of the public, implementation of which is usually connected with engagement of new territories. Although, gradual reconstruction of territories of existing cities allows for constantly renewing city body, however, great conservatism of its historically established plans and material values of the old development significantly complicate any efforts of arrangement of their area. Development of industrial areas of many cities in the world with due time acquires special cultural and historical significance, although, industrial facilities may not be officially considered as samples of architecture. The significance of such a development consists in that precisely due thereto it is possible to preserve historical appearance of city, to reproduce cultural and historical environment, which was peculiar at the initial stages of establishment and development of these cities.

The problem of industrial areas, locating within the city limits, is urgent in many developed countries. The European decision, which has been implementing during the recent decades, involves
cardinal transformation of industrial areas or their movement outside the cities [3]. Set free areas shall be developed on the basis of cluster principle, ensuring combination of business, science and production. As the result, industrial lands shall be transformed into high-technology, environmentally-clean manufacturing, science parks, or residential areas, public or green zones. Such transformations, or renovation includes complex renewal of urban architectural and landscape environment, in other words, simultaneous reconstruction of objects and area, where they exist, adaptive use of buildings, constructions, complexes when changing their functional use [4-8].

2. Analysis of some publications, most relevant to the subject of research
The scientists studied the problem of renovation of urban industrial areas in the context of architecture, construction and reconstruction [9-14]. The foreign scientists Pedko, I.[15], Agueda, B.F. [16], Kirkwood, N.G. [17], Gil, A. [18], Małuszyńska I., [19], Rosen, M & Sullivan, W. [20] studied broadly the concept renovation both in theoretical sense and on the basis of examples of certain cities.

First, industry in the historical cities was formed in the territories which had already been used for industrial purpose, they were restructred for a different function, and thereafter industry was developed in new territories [12-26]. For the recent years the problem of “re-development of industrial areas” was studied by such researchers as Bystrov P.N. [27], Golovanov E.B. [28], Zhurbei Е.В. [29].

Immediacy and acuteness of the problem of the Ukrainian industrial areas repurposing requires comprehensive display, objective and complex tools.

3. Research objective
To define renovation, industrial and production zone. To find out basic city-planning tasks related to enhancement of industrial territories. To analyse outstanding problems, obstacles and motivational instruments when implementing projects of renovation of industrial areas. To generate methods of renovation of industrial facilities located within the city limits.

4. Statement of basic materials
Reduction in numbers of production facilities leaves abandoned industrial territories in the central parts of cities, that results in improvement of infrastructure and ecological safety after re-use pf these territories.

Industrial cities are clearly divided into areas and transport systems, which unite residential area of city and industrial one. In post-industrial cities such a system will not work, since the conditions and economics have been changed. Now we can see mixture and hybridity of functions not only in one district, but sometimes in one building.

In big cities there are so-called transitional (contact) zones, that in city-planning context represents a great challenge. On the one hand, they are an obstacle to the development of center because of location of industrial facilities of low-density development and railway sanitary and medical corridors, but, on the other hand, they have potential of development of various functions, due to the opportunities of passenger and cargo transport, proximity of city centre, location in the ways of transit of inhabitants of peripheral residential areas.

A specific place in transit zone is hold by problem territories along railway lines and watercourses which cross the city and are barriers to urban planning. In these territories there are predominately objects of transportation facilities, storage facilities, maintenance services, some industrial enterprises. Development of transportation system (extension of main roads and streets, formation of ring roads, loop roads laying, highway-over crossing etc.) provided significant improvement of transport servicing of production. Existing standard buffer zone of railway does not protect the urban development against vibration and noise, but results in irrational use of essential urban areas.

As the result of historical development of planning structure of cities many production facilities were caught in the area of ecological corridors, near water sources and residential areas. Such location of production facilities surrounded by village territories can create danger of contamination of air in case of whatever wind directions. Except of negative influence on human health, such a situation
limits the growth of manufacturing capacity of the enterprises themselves according to ecological needs, and that is why, it requires permission through reconstruction, repurposing or change of function.

The term renovation (from Latin renovatio – renewal, reconstruction) stands for techno-economic process of replacement of machines, equipment, tools, being dropped out of production as the result of wear and tear and obsolescence, with new basic assets by means of accumulated depreciation.

In the state building regulations DBNB 2.2-12:2019 “Territory Planning” [30] there are two terms related to determination of renovation:

1. Renovation of objects of historic development – renewal of external appearance of obsolete and worn-out buildings and constructions (except for monuments and recently revealed cultural heritage sites) with modernization of internal planning in accordance with current requirements and using advanced materials.

2. Renovation of territories of historic development – complex reconstruction of historic development with retention of initial/existing function.

This terminology very briefly describes only historic urban development. As you can see, now in Ukraine in regulatory instruments related to the urban area development there is no common, systematized scientific and technological terminology with regard to renovation of urban development.

Comprehensive resolution of the problems of city-planning is the most closely connected to the formation of development of urban production facilities, which often occupy up to 3–40% of urban territories and plays not only national-economic, but also important architectural and composition role.

According to DBNB.2.2-12:2019 Territory Planning” [30] among production areas are enterprises, objects, utility facilities, transport infrastructure, warehouse development, innovative development (science parks, industrial parks) as a part of industrial areas, industrial parks, groups of enterprises or free-standing.

Industrial and production area is a function-specific part of urban territory, uniting objects of material production, public utilities, production infrastructure and another non-productive asset, which service material and non-material production. Industrial are an arrangement shall be determined by city-planning and sanitary rules in accordance with the sanitary classification of enterprises and urban specificity.

Industrial area of city is a complex of all production territories of populated area: industrial districts, individual enterprises and objects. The size of industrial area in city varies from 10–12% to 30–40% and depends on sector profile of its components, largeness of city and its administrative status. The higher this status is, the less is industrial area, city becomes multi-functional, here are structures of district, republican and other departments, more developed system of educational, scientific and research and medical establishments and others.

Industrial enterprises are mainly located in the production territories, which are specially allocated in city. Areas of production territories depend predominately on production purpose.

Enterprises are not located separately, they are united in groups with cooperation of energetic, auxiliary and servicing objects both of production and non-production purpose. These groups of enterprises together with their general territory create industrial areas (Figure 1).

Grade of concentration of production functions in industrial area varies from 50–60% to 85–95%. In the territory of industrial area one or more corporate groups (industrial hubs).

When reconstructing, re-equipping existing industrial areas and corporate groups, it is reasonably these territories within which they are located to divide into components taking into consideration science parks, technopolis, technical and industrial parks on the basis of general architectural and space-planning design with evident planning limits. Furthermore, combination of engineering and technical infrastructure, auxiliary production units and objects of public services.
Figure 1. Location of industrial districts within the cities.

Relatively cheap lands of production areas in the city centre are “honey pie” for real property market. Instead of them there is large-scale fashionable housing, office and retail buildings development, or there is transformation of production premises into offices, business and entertainment centres and residential buildings, if circumstances allow. City shall response to new conditions of development. Nowadays, the most promising is renovation of these territories with the development of new spatial and functional structures thereon.

Among main urban planning tasks related to enhancement of industrial areas are as follows:

- renovation of historic industrial objects of the city centre;
- enlargement and unification of small-size territorially isolated production units, when moving them or winding up;
- cooperation of warehouse, energetic, transport objects of industrial and village zones;
- creation of production complexes of multi-functional purpose in the railroad territories;
- relating to planning breakdown of big industrial territorial entities in the city nuclear with a focus on development of smaller enterprises of various forms of ownership;
- increase of production facility development density in the transit zone of city;
- evacuation of industrial facilities from the areas of ecological corridors;
- formation of integrated and functionally saturated contact-joining zones between industry and area intended for development;
- liquidation of sanitary protection zones (buffer zones) by means of re-purposing of industrial enterprises;
- creation of new industrial complexes on the periphery or far from city in order to replace facilities of winded up production units.

However, we shall treat transformation of industrial areas with caution, because, first, it is necessary to determine future purpose of buildings, and then to carry out partial reconstruction, retaining main peculiarities of industrial architecture.

5. Offers
Based on the research conducted the authors developed methods of renovation of production facilities located within the limits of the city.

Stage No. 1. Predevelopment analysis of industrial and production area. Drawing up certificate of industrial area subject to renovation.

Under the conditions of renovation of industrial building the determination of purpose and space planning decision of building is influenced by city-planning and historical and cultural characteristics
of production facility which is under the reconstruction. That is why, on-site investigations of buildings and their surrounding shall be carried out within the predevelopment analysis.

Estimate of city-planning situation shall include the following analysis: location of industrial area in the spatial planning, functional use of adjoining territories, pedestrian and vehicle junctions and opportunities of their transformation, architectural and spatial surrounding development, landscape components of the environment.

Certificate of industrial area, which is subject to renovation, consists of the following elements: place of location (in city plan and general location plan), description of industrial area (basic parameters, main enterprises and entities, historical background, current status), photographic evidence of renovation project and adjoining territory, disposition plan, functional zoning diagram and social services, scheme of transport services and pedestrian traffic, grounding territory functional purpose change, estimate of industrial area renovation potential (advantages and defects).

Stage No. 2. Technical expertise of building. Existing building planning: drafting plans, cross-sections, building faces.

Technical expertise of buildings (constructions) shall be carried out for the purpose of finding actual technical state of building constructions, determination of actual load-carrying capability of structural components taking into consideration real loads and field survey data (estimate of residual operation life). Practical result of work shall be development of technical solutions related to elimination of defects and damaged found during the inspection, as well as drafting recommendations related to the further operation of object. Scope, content and type of diagnostics depend on type and characteristics of object as well as set particular tasks.

When investigating architectural and structural component of building, its physical state is estimated and spatial, structural, compositional and design solution is analysed. Based of knowledge of architectural engineering and output data, drawings of existing buildings shall be made: floor plans, longitudinal and cross-sectional plans, faces of existing building.

Stage No. 3. Choice of functional program of industrial building renovation. Study of basic requirements to building design with specified function.

Based on data received as a result of predevelopment analyses, we shall choose a function for re-use of industrial building. Grounding variants of functional programs shall be built in compliance with city-planning situation, architectural and spatial parameters of building, its historic and architectural merit.

In terms of urban planning we should pay attention to nowadays and future use of territory, functional purpose, scope and architecture of the surrounding development, transport and pedestrian connectivity of the object under renovation, availability of landscape elements. Use of building after reconstruction can be oriented towards inhabitants of the nearest-neighbour environment or have municipal significance.

When considering potentiality of the industrial building adaptation for accommodation or civil functions, its spatial parameters, existing design structure and, to a lesser extent, space-planning design shall be taken into account. We should select such a function in order to meet typological requirements in the most comfortable way in the available area.

Stage No. 4. Analysis of foreign and domestic experience of the renovation project implementation according to new functional program.

There is a necessity to adapt global and domestic experience to introduction. That is why, it is required to study carefully examples of renovation according to the chosen functional program.

Successful foreign practice of renovation project implementation is based, first, on deep research and methodological analysis of each specific city-planning situation, preceding the development and creation of urban area development. For this purpose, the notion of a project means not only architectural and spatial solutions and inventions, but also it includes a complex of social and economic, organizational and legal, financial and together therewith city-planning and design events. Reconstruction and construction shall be carried out using big city-planning areas, that is urban land
improvement zones, moreover, not only of certain buildings, but also new engineering and transport infrastructure, system of cultural and social services, taking into consideration territorial zoning.

Domestic experience of industrial facilities renovation is not so wide and Ukraine just cuts teeth in this sphere. Renovation bears partial, but not the integrated nature. For the purpose of receiving maximum profit from industrial area after renovation it shall be supplemented with shopping and entertainment and business functions, very often historical value of industrial facilities is ignored and is not taken into consideration in the projects.

Stage No. 5. Searching a concept of spatial and graphic implementation of new functional program. Making layout diagrams of functional relations between premises and functional zoning plans of interior space of building.

The most important in creative sense is searching a concept of spatial and graphic implementation of new functional program when reconstructing a building for new purpose. Here it is required to propose an alternate solution, which combines the conditions as follows: maximum use of architectural potential of industrial building; determination of new function of a building; provision of spatial relations with the surrounding development. The basis of conception can be a character of building, being formed as the result of subjective individual object perception and its environment during the on-site investigation. The conception is built also on the traditional idea of place and time of existence of industrial building, development of its architecture, reflecting city and production development. Sometimes the conception ground is to reveal vivid architectural peculiarities of a certain building or even its part.

Reconstruction conception shall be worked out by means of sketching and layout drawings of functional relations between premises and plans of functional zoning of building interior space according to the functional program of renovation.

Stage No. 6. Development of space planning decisions related to industrial building reconstruction. Building drawings after reconstruction: floor plans, framing plans, roofing plan, longitudinal and cross-sectional drawings.

Space planning decision of building, which is reconstructed, shall be based on the approved general architectural and spatial conception. It includes development and detailed elaboration of planning structure and interior space, structural layout, building faces and architectural character. Planning pattern shall be interconnected with formed architectural space and structural layout. Offer regarding planning shall include provision of optimal room arrangement of main and auxiliary purpose, required for horizontal and vertical relations between them, formation of entry units.

Decisions taken shall be implemented in drawings of a building after reconstruction: floor plans, framing plan, roofing plan, longitudinal and cross-sectional drawings.

Stage No. 7. Transformation of structural layout during spatial reorganization of building.

Modern requirements to structural layouts of building define the necessity to create spatial-solid, stable and balanced structure. Depending on peculiarities of design decisions of production facilities, being under reconstruction, and nature of spatial transformation, various measures concerning the change of structural layout shall be taken. One of the most popular methods is enforcement of structure for renewal of the lost or improvement load-carrying capability. At this stage building construction enforcement schemes and individual architectural units shall be developed. Increase of load-carrying capability shall be achieved by casing for strengthening, installation of jackets and extension.

Stage No. 8. Transformation of facade systems of industrial building. Drawings of building faces after renovation.

In solving building faces it is important to find and develop compositional approach, which is best matched to the chosen building character. It is required to provide succession in development of architectural composition and to solve problems of combination of “the old” and “new” architecture when using modern energy-efficient constructions and materials.

Stage No. 9. Development of general lay-outs of land plot under renovation. Generalization and preparation of project solutions related to the industrial building renovation.
General lay-outs shall reflect planning relations of building with the environment and offers relayed to the improvement of adjoining territories. Furthermore, general lay-outs shall also reflect the results of reconstruction of adjoining territories (building destruction, new transport and pedestrian ways, newly built objects of engineering infrastructure (for example, transformation substation) etc.).

On the basis of the materials developed it is required to generalize project solutions and prepare project documentation related to industrial building renovation: floor plans, building faces; cross-sectional plans (before and after renovation); framing and roofing plans, roofing plan (after renovation); general plan of land plot under renovation according to key plan (before and after renovation).

6. Conclusion
Renovation of industrial development is one of the most popular in the world transformation tools of urban space. However, in Ukraine this process has no systematic nature and integrated strategy of implementation, nevertheless, re-development, having analysed the foreign experience, can give an essential impulse to rational and stable development of city. This means creation of new space for real estate properties, business, space for communications, development of creative trends. Main city-planning tasks related to enhancement of industrial areas were identified. The policy focused on creating something new, re-thinking of industrial buildings will result inflow of funds, investors. Methods of renovation of industrial objects located within the city limits were formed.

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