

RE-URBANIZATION IN A MODEL OF SUSTAINABLE DEVELOPMENT OF AN ECO-CITY

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ABSTRACT

The contemporary models of city shaping introduce the principles of sustainable design. The possibilities for a resilient urban ecosystem, improving the parameters defining the urban environment as well as improving social integration are related to the modern way of designing a functional and spatial structure that forms an inseparable whole with the natural system as part of concepts, such as green and blue infrastructure. In urban planning, regenerativity provides a development of the eco cities and smart cities concept. For both of these types of cities, their functions need to be defined, as well modern, pro-environmental parameters must be specified relating to building developments and infrastructure of urban areas in connection with the natural system of the city. Problem areas concerning the transformation of urbanized areas are being indicated. These concerns refer to the problem of the revitalization of degraded areas in the city, “field reserves” in extensive development and in areas related to technical infrastructure and public transport. The characteristics of the resilient and regenerative design model lead to the definition of planning guidelines for the needs of new standards for shaping the functional and spatial structure associated with the city’s natural system. The issues of transformations of urbanized areas, with reference to defining the connection of buildings with biologically active areas and infrastructure in the city, are indicated.

Key words: re-urbanization, sustainable urban development, urban resilience, eco-city

INTRODUCTION

Due to the development in technology and awareness concerning the effects of interference of modern economy on the environment, the manner of shaping urbanized areas is currently undergoing changes. Transformations of the functional and spatial structure, as well as the transformation of equipment and infrastructure, concerns both urban areas and the phenomenon of so-called city sprawl observable in suburban areas. The intensification of works related to the acquisition and transformation of urbanized areas is related to the trends governing the migration of the population to cities. Numerous reports of research institutes and the World Commission on the Environment and Development of

the United Nations indicate, as it had been forecasted, the increase in the numbers of the population living in urbanized areas (United Nations, 2017).

Scientific studies concerning shaping the city environment and the natural system within the city, as well as concerning climate changes in the context of shaping the urbanized areas, affect the raising of awareness of decision-makers responsible for development strategies and such legislative amendments that introduce the principles of sustainable development and pro-environmental solutions in the city. The arrangements that exert a significant impact on the shaping of urbanized areas in Europe have been contained in *The New Charter of Athens 2003: The European Council of Town Planners’ Vision for Cities in the 21st century* (European Council of Town

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Planners, 2003) and in the so-called Leipzig Charter, i.e. *Leipzig Charter on Sustainable European Cities* (European Ministers for Urban Development and Regional Planning, 2007). The directions for the development of European cities have also been indicated in the document *Europe 2020: A strategy for smart, sustainable and inclusive growth* (Communication COM(2010)2020) and in the document *An EU Strategy on adaptation to climate change* (Communication COM(2013)216).

In relation to the indicated development strategies and the action of environments responsible for shaping urbanized areas and natural systems, further guidelines are being introduced on behalf of shaping cities in Poland. In October 2013, the Strategic Adaptation Plan for sectors and areas liable to climate change until 2020 with the prospect towards 2030 (so-called SPA2020) was adopted (Ministerstwo Środowiska, 2013). Works are being conducted on the Municipal Adaptation Plan to Climate Change, the conclusion report was published as *Climate change adaptation plans in 44 Polish cities* (Ministry of the Environment, 2018), for which the Ministry of the Environment has published the guidelines for the preparation of aforementioned plan (Ministerstwo Środowiska, 2014). Ministry of Infrastructure and Development has published the National Municipal Policy 2023, which obtain the status of the Council of the Ministers resolution on 20 October 2015 (Ministerstwo Infrastruktury i Rozwoju, 2015). The document defines problem areas and provides guidelines in order to facilitate the inter-disciplinary and multi-criteria transformation of the city and urban infrastructure. The issues related to the creation of guidelines for investment areas in the city are directly connected to the transformations of degraded areas, as well as to revitalization issues. The Revitalization Act was adopted in 2015 (Ustawa o rewitalizacji, Dz.U. 2015 poz. 1777), together with guidelines for revitalization on the basis of operational programmes for 2014–2020. These documents are related to the National Regional Development Strategy 2010–2020 adopted in 2010 (Ministerstwo Rozwoju Regionalnego, 2010) and the National Spatial Planning Concept until 2030 (so-called NSDC 2030) adopted in 2012 (Uchwała Rady Ministrów w sprawie przyjęcia Koncepcji Przestrzennego Zagospodarowania Kraju 2030, M.P. 2012 poz. 252).

Therefore, it is reasonable to conduct research and undertake studies on the possibilities and manner of

transforming urban areas in relation to global design tendencies related to the implementation of pro-environmental solutions.

MATERIAL AND METHODS

The research follows a theoretical research method, particularly, a literature-based research methodology to identify the analysed issues regarding the adaptation of contemporary cities points to the issue of re-urbanization, treated as activities from the scope of planning and implementation within the city structure. The majority of the initiatives refer to the notion of the revitalization of degraded areas, such as post-industrial areas, post-railway areas and building areas that require undertaking intervention and revitalization activities in the urban space.

The following study describes the notion of re-urbanization in the context of the forecasted development directions for contemporary trends towards pro-environmental solutions in the shaping of the city, with regard to currently published, ideological assumptions referred to as an eco-city and a smart city. The forecasted directions for further development of the indicated ideological assumptions lead to formulating a new approach in shaping urbanized areas, an approach called regenerative design. An attempt was made to define a regenerative re-urbanization model, which integrates the tasks related to shaping the functional and spatial structure, in addition to shaping the natural system in degraded urban areas subject to transformations in connection to spatial policy, as well as to regional and local strategies.

The conducted analysis into the methods of interference and “interventions” into the city space point to investments that serve as multifunctional urban units integrating buildings with vegetation (such as an eco-boulevard in Madrid called El Bulevar de la Naturaleza), as well as to projects of importance to the natural environment and the city’s natural system (for instance FlussBad in Berlin). The issues related to hybrid urban units and the way of building developments and greenery systems are constructed so as to improve the quality of the environment and to benefit the functional and spatial structure, providing the research area for the interdisciplinary scientific team associated with the Faculty of Architecture of the Warsaw University of Technol-

ogy. In publications on the topic of the forecasted directions for the development and transformations of urban areas, models of “hybrid urban units” are indicated that can be defined as such types of multifunctional building development units in which innovative pro-environmental technologies and new eco-production functions are implemented (Grochulska-Salak et al., 2018).

RESULTS AND DISCUSSION

Transformations of urbanized areas are related to the modification and complementation of building developments and functional programs in urban spaces, as well as infrastructure, including green and blue infrastructure, both of which are connected in the natural system of the city. The issue of shaping green infrastructure provides the subject matter for many studies and publications by Kinga Zinowiec-Cieplik, who points to the potential that lies in integrating plant forms with architecture (Zinowiec-Cieplik, 2017; 2018). The implementation of pro-environmental solutions seems to be the essence of re-urbanization, as well as of the directions for development in the city structure and equipment. Issues concerning the implementation of pro-environmental technologies and studies formulating new urban standards are published by Katarzyna Zielonko-Jung, who indicates the typology and methodologies of actions taken to achieve those goals (Zielonko-Jung, 2017). The analysis of numerous scientific publications, both domestic and foreign, together with their implementations, indicates the necessity to formulate new urbanistic guidelines for the transformed spaces. The forecasted advance in multifunctional complexes of building developments, equipped with public spaces with greenery related to building developments, is related to the research carried out in connection to design theories, as well as to the analysis of investments. It is important to review the solutions that have been approved and gained financing from the investor. It is also fascinating to conduct an analysis of potential opportunities applied in order to increase the efficiency of the investments under study in the context of changing standards and urban indicators.

Eco-city ideological assumptions

The ideological foundations for modern sustainable urban planning date back to the 1970s. In 1975, Richard Register established an organization called Urban

Ecology, whose mission was, and still is today, the reconstruction of modern cities in the direction of maintaining a natural balance. In 1987, eco-city was defined as an urban natural system in which input/resources and production/waste are minimized (Register, 2002). The Society for Urban Ecology organized its first international conference on the sustainable city concept in Berkeley in 1990 (Ecocity World Summit). Towards the end of the twentieth century, a set of criteria was created that an eco-city model should correspond to (Roseland, 1997; Joss, 2010; Rapoport & Vernay, 2011). Firstly, it should operate on the basis of a self-sufficient economy and make use of local resources. It should, moreover, be characterized by a method of production of energy from renewable sources that would be completely neutral in terms of carbon dioxide emission. In such a city, a particular type of efficient public transport becomes the basis for mobility, namely a system of public transport with the following priority layout: first and foremost on foot, then by bike, then by public transport. An eco-city saves water and maximizes the efficiency of water and energy resources. It also builds a circular economy, thus creating a waste-free system, as well as restores and recovers the damaged urban environment. It provides affordable housing for all socio-economic groups, including disabled people and the like. Furthermore, it supports local agriculture and production while also promoting a pro-environmental lifestyle and consumption. As a result, eco-city is a modern, sustainable city that faces the challenges of the regenerative creation of urban space, while respecting environmental, social, spatial and economic conditions. Cities such as Curitiba in Brazil, Freiburg in Germany, Stockholm in Sweden, Auroville in India and Adelaide in Australia are examples of leading cities in the eco-cities ranking.

In this case, the primary objective is not only concerned with such design that would allow for resources to be reproduced but, above all, with system solutions, involving such design that takes into account ecosystem regeneration, as well as numerous processes that affect the functioning of cities. The text was a forerunner of the transition from designing established forms to designing processes by means of integrating multiple areas: architects and landscape architects, biologists, environmentalists, hydrologists and geologists, even including specialists in the field of agriculture and economics as well as representatives of infrastructural specialties.

Sustainable development design – case studies

The eco-boulevard investment by the Ecosistema Urbano studio in Madrid of 2004–2007 can be put forward as an example of a regenerative project and its implementation. In the public space of the newly created Villa de Vallecas District, designers offered temporary pavilions/chimneys – attractors of public space. Three light constructions, named the air trees by their authors, easy to disassemble, reaching the height of three storeys and based on a circle plan, created shady, airy areas of integration, social recreation and contact with nature in the areaway of a new housing estate. They were covered with vines, planted in pots that prove resistant to the dry and hot climate of Madrid. Moreover, the structures were equipped with photovoltaic panels, thanks to which they also function after dark. Self-sufficient pavilions are also designed as objects intended to improve microclimatic conditions, provide invigorating shadow on hot days. A light breeze forces passive air movement that improves air quality owing to natural processes of plant photosynthesis (oxygen) and evapotranspiration (humidity), thereby reducing the

temperature by up to 10°C. The pavilions are designed as a complement to tree-lined avenues which, over the next 20 years, should take over the existing functions of the air trees. Once this period is over, the pavilions will be dismantled and moved to another place that will require their microclimatic, social and environmental intervention (Ecosistema Urbano, n.d.).

The FlussBad project in Berlin by the realities: united studio (1998–2011) displays another interesting solution for the regeneration of the urban environment. The project consists of the conversion of 1.8 km of the Spree Canal that flows to the South of the Museum Island into a bathing beach. The concept was based on the idea of natural water purification by means of using the processes occurring in the root of rush plants (commonly known as rush water treatment). These treatment processes are further supported by sedimentation and aeration processes. In the upper course of the canal, the installation of natural filters has been projected. As Berlin has the ambition to become the leader of eco-city and smart city movement, the functions of the filters for this part of the city, as well as for



Fig. 1. Eco-boulevard of air tree pavilions in the new district of Madrid (Google maps – Street View, access 01.12.2018)



Fig. 2. FlussBad in Berlin – natural water purification zone (https://points-of-contact.com/fileadmin/_processed_/5/b/csm_2_Perspektive_Friedrichsgracht_ret-1_6a13ae2624.jpg, access 01.12.2018)

Berlin itself, will, apart from the cleansing/phytoremediation function, be: ecological, as a habitat for the local flora and fauna (including the creation of habitats for waterfowl), aesthetic, microclimatic, social, as well as identification-related and image-related. In the upper canal course, on its last section (over 800 m), the designers foresaw the river city bathing beach. The banks were framed by graduated terraces that facilitate access to water. The project was complemented by tree compositions, modern equipment and lighting.

The revitalization of almost 2 km of the river section, based on a regenerative design approach, proves to be expensive and requires deep analyses of hydrological issues, resources, pollution of storm-water drainage, projects for the reconstruction and purification of drainage installations, as well as a feasibility study. Therefore, the implementation of such an ambitious pro-environmental undertaking requires a long process of research, testing and official procedures. Consequently, in 2012, FlussBad Berlin, a non-profit organization, was established, the aim of which is promotion, fundraising and research work on the project. In 2014, a preliminary feasibility study was prepared, while in 2016–2017, a test filter was launched. This year (2018), the filter began to work on a regular basis. In 2017, the FlussBad Berlin project was included in the principles of the city spatial policy (Flussbad Berlin, n.d.).

Transformations of urbanized areas – examples in Warsaw

Re-urbanization is an integrated process of permanent transformations in the functional and spatial structure of the city, as well as in its natural and social system. This issue, understood as the re-development of previously urbanized areas, is related to the issues of areas that have been either degraded or made open to investment purposes. In other words, re-urbanization may be explained as re-development conducted while taking advantage of new functional, spatial, construction and infrastructural solutions in relation to an urban unit being redefined. A question arises, however, concerning the scale and nature of such investments that may be considered as examples to illustrate the notion of re-urbanization. Spot investment activities that provide a complement to the functional and spatial structure, as well as infrastructure, are an element of city growth. However, such investments will not

define the phenomenon of urbanization if they fail to be systemic implementations characterized by an appropriate functional program and a proper method of environmental impact.

A number of interesting examples of re-urbanization in Polish metropolises may be mentioned. These include the transformation of areas by the Vistula, in particular, implementations of investments in the Powiśle District, in the area between the University of Warsaw Library building, located at Dobra Street, and the Świętokrzyski Bridge and Tamka Street. Over the last few years, the indicated area has seen public and commercial investments being created. Those investments determine the total change of the Powiśle district in functional, environmental and social terms. Powiśle has truly been revitalized, it favours social integration, both on the Vistula boulevards and inside buildings, as well as atop the roofs of buildings. A multifunctional urban unit was created that consists of several quarters of building developments constructed by various private and public investors, including the Capital City Warsaw. The structure of the newly created, spatially and functionally separated urban unit includes:

- Vistula embankments (bulwary wiślane) – public spaces with greenery, landscaping structure as well as equipment for sport and recreation related to the Vistula and river biotope. Investments are mostly implemented on the tunnel's plate, over road traffic along the river;
- A station of the underground and a public transport hub connecting functionally and spatially with the Vistula boulevards;
- Powiśle Power Station (Elektrownia Powiśle) – a multi-purpose building quarter – a revitalization project planned to have been completed by 2020. An office complex of Powiśle Power Station is being built in Warsaw within the Śródmieście District. It is located at Leszczyńska Street, as well as streets Wybrzeże Kościuszkowskie, Zajęcza and Dobra. The complex combines building developments that serve an educational, office, residential and commercial-service function linked by public spaces with greenery, implemented on buildings.
- University of Warsaw Library, Copernicus Science Centre – building developments serving an educational function with green roofs and spaces for social integration.



Fig. 3. Vistula embankments (https://warsawtour.pl/wp-content/uploads/2018/08/Bulwary-wi%C5%9Blane-5_fot.-m.st_.-Warszawa.jpg, access 10.12.2018)



Fig. 4. Vistula embankments (https://warsawtour.pl/wp-content/uploads/2018/08/Bulwary-wi%C5%9Blane-2_fot.-m.st_.-Warszawa.jpg, access 10.12.2018)



Fig. 5. University of Warsaw Library, Vistula embankments and Copernicus Science Centre (photo by P. Krajewski, <https://www.urbanity.pl/photos/51/08/65108.jpg>, access 10.12.2018)



Fig. 6. Vistula embankments and Copernicus Science Centre (https://warsawtour.pl/wp-content/uploads/2018/08/Bulwary-wi%C5%9Blane_fot.-Filip-Kwiatkowski-1.jpg, access 10.12.2018)



Fig. 7. Powiśle Power Station revitalization project (<https://www.urbanity.pl/mazowieckie/warszawa/z20845767>, access 10.12.2018)



Fig. 8. Powiśle Power Station revitalization project (<https://www.urbanity.pl/mazowieckie/warszawa/z20831473>, access 10.12.2018)

The analysed area and the methods of transformations applied in Powiśle, Warsaw, provides an example of re-urbanization and implementation of multifunctional building complexes in the revitalized areas belonging to the Powiśle Power Station and at the Vistula waterfront. Green roofs and climbing plants on facades have also been applied in the case of the examples mentioned. However, the above case is not fully an example of re-urbanization in regenerative terms, although both the transformations and nature of the investment contain many elements of the regenerative design model. Thus, the examples mentioned above were selected as a case study on behalf of the research related to setting new standards and urban coefficients, as well as investment standards in the city.

CONCLUSIONS

The analysis of adaptation possibilities should be based on the identification of factors affecting the transformation of urban infrastructure, urban building developments and urban systems, such as the natural system (biologically active areas), public spaces system and mobility system in relation to the functional and spatial structure in the urban landscape. The ability to adapt to changing factors as well as environmental, economic, spatial and social conditions is a subject of sustainable urban development. The analysis of the city's readiness for change and possibilities of implementing sustainability described the smart sustainable city (SSC) model (Ibrahim, El-Zaarta & Adams, 2018). While describing the model of shaping urbanized areas, it is necessary to determine the structure of connections and interactions of systems created in the city and to refer them to dependencies in connection to the functional and spatial structure, building development parameters and analysis of social needs.

The integrated design process is the subject of research by Elżbieta D. Ryńska, who points out multi-branch solutions co-operative with the climate parameters characteristic for specific location conditions (Ryńska, 2012).

The suggested solutions should take into account care for biodiversity as well as the integration of building developments and urban spaces with green and blue infrastructure while implementing new functions in the city's natural system like integrated water management and risk management in urban strategies, as well as co-creation of so-called green and blue infrastructure. Among the examples of new solutions for the integration of building developments and biologically active areas, the following installations may be listed: urban farms, vertical gardens, rain gardens (biologically active retention reservoirs that collect, absorb and filter rainwater).

Fostering the sustainable development of the transformed and converted urbanized areas provides the basis for determining new standards and urban indicators that define the methods applied for ground development, construction parameters and elements of the city's natural system, including green and blue infrastructure. It is suggested that modern urban indicators and planning guidelines should be developed in such a way as to define the parameters and efficiency of biologically active areas that affect the quality of the urban environment and natural system, as well as of the functional and spatial structure, and social structure in the city. Sustainable re-urbanization provides an advancement in the idea of sustainable urban development with an analysis of the possibilities for adaptation and co-creation, including adaptation and co-creation of production, leading to the definition of development strategies for the areas under transformation. The development elements may serve generative functions and be used to create symbiosis and integration of building developments, urban spaces and biologically active areas through decentralization of food and energy production, water filtration and water treatment, absorption of air pollutants, and production of oxygen. The correct determination of spatial, social and environmental needs will enable the optimization and implementation of spatial solutions in the process of re-urbanization implemented on the basis of integrated design and management by interdisciplinary teams in the city.

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REURBANIZACJA W MODELU ZRÓWNOWAŻONEGO ROZWOJU *ECO-CITY*

STRESZCZENIE

Współczesne modele kształtowania miast wprowadzają zasady tzw. projektowania zrównoważonego. Zagadnienia odporności miejskiego ekosystemu, poprawy parametrów definiujących środowisko miejskie oraz polepszenia integracji społecznej wiążą się z nowoczesnym sposobem projektowania struktury funkcjonalno-przestrzennej stanowiącej nierozdzielalną całość z systemem przyrodniczym, infrastrukturą tzw. zieloną i niebieską. W planowaniu urbanistycznym odporność w procesie reurbanizacji wprowadzają rozwijane koncepcje *eco-cities* i *smart cities*. Dla obu tych modeli miast należy zdefiniować ich funkcje, a także określić nowoczesne, prośrodowiskowe parametry dotyczące zabudowy i infrastruktury obszarów miejskich w powiązaniu z systemem przyrodniczym miasta. W publikacji wskazane są obszary problemowe dotyczące przekształceń obszarów zurbanizowanych. Zagadnienia te dotyczą problemu rewitalizacji obszarów zdegradowanych w mieście, „rezerw terenowych” w zagospodarowaniu ekstensywnym oraz w obszarach związanych z infrastrukturą techniczną i transportem publicznym. Charakterystyka modelu projektowania regeneratywnego i odporności prowadzi do określenia wytycznych planistycznych dla potrzeb nowych standardów kształtowania struktury funkcjonalnej i przestrzennej związanej z systemem przyrodniczym miasta. Wskazana jest problematyka przekształceń obszarów zurbanizowanych w odniesieniu do określenia połączenia budynków z obszarami biologicznie aktywnymi i infrastrukturą w mieście.

Słowa kluczowe: reurbanizacja, zrównoważony rozwój miasta, odporność miasta, *eco-city*