Algorithm of allocation of territories included to agglomerations

A N Pankeieva, K I Viatkin, A V Zavalnyi

Department of Urban Construction, O.M. Beketov National University of Urban Economy in Kharkiv, 17, Marshal Bazanov Str, Kharkiv 61000, Ukraine

E-mail: pankeevaanna@i.ua

Abstract. The article covers topical issues of formation, development and functioning of agglomeration formed around large cities. A number of issues requiring further research have been identified, in particular, the definition of the essence of the concept of "agglomeration", the criteria for the allocation of agglomerations, its recognition in legislative and regulatory documents and the methods of delimitation of agglomerations. The algorithm of allocation of territories included to agglomerations has been suggested. The proposed algorithm for the allocation of territory, included in the agglomerations, will allow allocating agglomeration territories in a system way. The authors identify the existing boundaries of agglomerations and provide proposals for its further development.

1. Introduction
Currently, the issues related to the process of formation development and functioning of agglomerations in the modern theory and practice of urban planning and territorial planning are of particular importance. This phenomenon, which is impossible to create, naturally occurs around large cities. Cities due to their development, degradation for further development, and the need for greater spatial organization "go beyond their limits" effacing previously clear boundaries. Consequently, suburban areas actively settle down around the cities, satellite cities are deployed and communications between individual settlements in the affected areas of a large city grow. The complexity of the issue under consideration is enhanced by the fact that agglomeration is impossible to create. The process of agglomeration is a natural way and generally occurs spontaneously, which may cause problems of regulation and use of its territories.

2. Formatting the title, authors and affiliates
The term "agglomeration" was first used in the French and English literature in the late 19th century. Since then the works regarding this issue have been actively carried out. They included the following issues: analysis of the urbanization process, population concentration and productive forces in cities and the neighbouring suburban areas [1]; formation, development of agglomerations and the definition of their boundaries [2-4]; circular migration in agglomerations, consistency, exploitation of territory resources, common infrastructure, relatively small gaps between built-up areas, the presence of one or more city centers (urban nucleus) of agglomeration, "the space of potential and real interactions, which fits the weekly life cycle of most city residents and its satellite zone," etc. [5-8]. The most significant works include the works of such outstanding scientists: M. M. Baranskyi, Yu. M. Bilokon, D. I.
3. Research objective

Despite the large number of works devoted to the formation, development and functioning of agglomerations, many issues remain insufficiently studied and require further research. First and foremost, it is necessary to focus on the fact that there is still no single universally recognized definition of the concept of "agglomeration". Researchers representing various fields of science: urban specialists, sociologists, geographers, economists, managers have not come to a common understanding of the concept of "agglomeration". The term "agglomeration" in many countries, particularly in Ukraine, is only partially reflected in legislative and regulatory documents. Currently, there are no generally accepted criteria making it possible to determine the territory as an agglomeration, and the existing methods do not provide a way to carry out complex delimitation of agglomerations. That creates further significant challenges to determine the spatial structure of agglomeration, its composition and the establishment of a urban planning documentation system – the basis for the development of spatial agglomeration structure. An objective is set to develop an algorithm following which it is possible to determine the territory of agglomeration, to delineate, to provide suggestions for further directions of development of the territories included in the composition of agglomeration is not only established, but also agglomerations being formed.

4. Theoretical part

Researchers consider agglomeration as the main arena of urban processes, which is as a key form and a system of modern settlement.

Despite the widespread use of agglomerations, there is no common terminology in the scientific literature. The most commonly used concepts are: "urban agglomeration", "urbanized area", "local settlement systems", "mother country", "urbanized areas", "areas of large cities", "group settlement systems", "metropolitan territories", "metropolitan areas", "standard metropolitan areas", "metropolitan districts", etc.

The most common definition of "agglomeration" is given by the geographer G. M Lappo. According to him, "urban agglomeration is a compact territorial grouping of urban and rural settlements, united in a dynamic local system by various intensive ties: economic, labour, cultural, recreational, etc., as well as joint usage of the agglomeration area" [5].

One of the main features of agglomeration is the binding of neighbouring settlements. But for the binding, it is no different from the "group of populated cities".

The "metropole" term in its classical sense (ancient Greek. Μήτηρ for "mother"and πόλις for "town") is a city, which formed the colony towns and thus spread its urban features in the new territory [9].

The metropole differs from the agglomeration in the fact that it includes a suburban area, closely connected with a central city by labour migrations regardless of whether the settlements of the suburban area merge with a central city or not [10].

Modern territory urbanization of the largest cities and the affected areas is characterized by the processes of spatial development, one of which is metropolization. As a result, the largest cities turn into urbanized regions, which are called metropolitan areas.

To determine the developed form of urban agglomeration is often used the concept of "metropolitan area". Its boundaries are determined by the allocation of the territory with the reduction of borders or within the administrative divisions.

European experts consider metropolitan territory as a territorial settlement system [11-14].

To determine the affected area of the agglomeration core on the circumfluence in the scientific literature on urban planning and planning practice, the term "metropolitan area" is used denoting a territory within the range of the agglomeration centre. Specialists define the area of the most intensive
Impact adjacent to the metropolitan centre along with this city as a single integrated territorial system – the metropolitan subregion [15].

Scientific literature has a term "administrative agglomeration", which is considered as a sub-region within the administrative divisions forming the agglomeration, where the principles of sub-regional partnership apply [16].

Up to the 1990s, design works carried out by the Ukrainian State Research Institute of Urban Design "Dipromisto" included a section entitled "City Layout in the Settlement System (with suburban and green area)" in composition of the general urban plans. In the context of the current social and economic situation in the state, "the affected area of the city" – an area of joint interests of the city and the region - is drawn as part of the general plan. This term refers to the territory of the suburban area, or urban agglomeration.

The study of the essence of the concept of "agglomeration" shows that there is no single approach to its definition. All existing concepts are more or less related to the definition of "agglomeration" and the same phenomenon.

The laws of Ukraine haven't clearly defined the concept of "agglomeration" yet, and clear criteria that would help to establish its limits, and the existing administrative-territorial structure of the country the term "agglomeration" has no direct relationship [17].

Official agglomeration criteria are established in many countries (UK, USA, Canada, Switzerland, France) by statistical bodies that monitor the dynamics of agglomeration processes for decades. In this regard, various complex criteria have been developed, which are usually based on the attractive force of the districts in the central large city centres (cores) in the form of a certain intensity of labor trips.

Agglomeration in Ukraine and in the post-Soviet countries, unlike foreign countries, is ambiguously perceived by the statistical authorities, which greatly complicates the process of delimitation. It must be noted that agglomeration significantly extends beyond the city centres (cores) and extends from it in the beam-shaped rays, covering the territory, which does not always coincide with the existing administrative structure. Thus, the agglomeration boundaries can take only part of the administrative units. This raises the complexity of the issue consideration [18].

The methods of agglomeration delimitation differ in different countries, which makes it impossible to make correct international comparisons.

Delimitation of agglomeration territories is of fundamental importance for substantiation of perspective directions of its development, solution of its social, economic and ecological problems, as well as for strict urban planning regulation. Performing the delimitation of agglomeration, it is possible to study the spatial structure of agglomerations, to allocate functional areas, to calculate their area and population, as well as special coefficients and indices reflecting the spatial complexity of agglomeration [18].

World scientists have different approaches to determining the boundaries of agglomerations. The external boundary of agglomeration in many European countries is determined by the completion place of continuous urban development. Agglomerations in the United States and Canada have a formal status – an agglomeration government (metro government) is formed, although a separate administrative division is not created. Sometimes the boundaries of these entities do not coincide with the administrative boundaries of the units forming it. In France and Italy, the special status of agglomerations is established by law [19].

The existing methods can be compared with each other, but they do not provide enough information about the internal state and spatial characteristics of agglomeration. None of the methods makes it possible to carry out a complex delimitation of the territory within the agglomeration [20].

Agglomerations are classified (identified) by the number of urban population in its territory, population of the outer area, and by the population in the city-centre (core) [21-23].

The most common domestic developments in determining the boundaries of the agglomeration include the methods of the Institute of geography of the Russian Academy of Sciences, the Central Research Institute of Urban Planning, the unified method by P. M. Poliana, M. I. Naymark, I. N. Zaslavskyi, including the time-area method [23].
Since 2013, the United States has updated standards for the allocation of statistical areas of different levels. They were developed by the Office of Management and Budget, OMB.

There are five types of statistical areas:
1. Metropolitan Statistical Area.
2. Micropolitan Statistical Area.
3. Combined Statistical Area.
4. New England City and Town Areas (NECTAs).
5. Combined New England City and Town Areas [24].

In Canada, census metropolitan area (CMA) agglomerations and a census agglomeration (CA) are distinguished by certain rules: the core principal; the direct migration flows rule; the reverse migration flows rule; the spatial proximity rule; the historical comparability rule; the manual regulation rule; the merging of neighboring CMA and CA rule [25,26].

The European Union countries have their own unified system of accounting for statistical purposes – Nomenclature of Territorial Units for Statistics (NUTS) [27].

In General, the NUTS levels in the EU correspond to the population in administrative divisions, the first three levels of classification relate to the regions:

- NUTS I – from 3,000,000 to 7,000,000;
- NUTS II – from 800,000 to 3,000,000;
- NUTS III – from 150,000 to 800,000.

Eurostat allocates the metropolitan regions. These regions are defined as agglomerations (NUTS 3 regions or groups of NUTS 3 level regions), where at least 50% of the population reside in a suburban area, which consists of at least 250 thousand people.

The European Spatial Planning Analysis Network (ESPON) defines the general principles and methodology to define the agglomeration boundaries. The term "functional urbanized territory" is introduced to compare the metro regions of the universal territorial category. The definition of the boundaries of functional urban areas is based on the calculations of the density of the population residing within them, daily commuter labour trips, position indication and the outlines of the city centers [28].

In Switzerland, the definition of agglomeration includes a number of complex criteria. The main ones include: the population size and the settlement evolution; the continuity of development; the ratio of employed population and the population who live permanently; economic structure and relations with the city centres; the percentage of passengers travelling to the city centres [25,29].

The existing domestic methods of agglomeration delimitation are based on the determination of the agglomeration urban population, the population of the city centres (core) of agglomeration, the time availability to the outskirts of the city centres (core), the number of satellite cities and testing for development by calculating the values of special coefficients and indices.

The basis of foreign methods of delimitation of agglomerations assigned complex criteria, which are officially established by the statistical bodies: the population of the city centres (cores), the continuity of development, the ratio of the working population and the residing population, migration flows, etc.

5. Proposals

To solve this problem, the authors propose to create an algorithm for the allocation of territories that are part of agglomerations, which consists of the following stages:
1. Taking into account that there are interpretations of the concept of "agglomeration". First of all, it is necessary to determine what is embedded in the essence of the concept that is used in the study.
2. To form the principles on the basis of which the allocation of agglomerations is carried out.
3. To justify a method or technique of delimitation of agglomerations, which is used to define its borders. When determining the method, it is necessary to take into account the specifics of the country where agglomerations are allocated, quantitative and qualitative criteria are clearly
formulated. It is defined how delimitation is carried out, taking into account or without including the administrative region division since agglomeration in many countries, as noted above, is ambiguously perceived by statistical bodies.

4. Conducting the delimitations, the territory included in the boundaries of agglomeration are defined and their full features are provided.

5. Proposals on spatial development of agglomeration territories and determination of further directions of its development.

6. Drafting of general layout, schemes of territorial planning using which it is possible to regulate the processes that pierce through this territory.

6. Conclusion

The process of urban design and management of territories is quite complex. To solve urban problems, it is necessary to take into account a huge number of factors from different sciences, and not just take into account, but consider them in a cause-effect relationship. The proposed algorithm for the allocation of territory, included in the agglomerations will allow to allocate agglomeration territories systemically. To identify the existing boundaries of agglomerations and provide proposals for its further development. To fully define the interaction of all the individual units that make up the agglomerations. The creation of agglomeration territory planning schemes will allow to regulate the processes taking place in these territories and manage them.

References

[1] Kubiyovych V From the Anthropogeography of New Sancha 1996 (Paris – Lviv) pp 286–506
[2] Bogorad D I Urban agglomerations of the Ukrainian SSR 1966 (Kiev: Photoprint. Lab. NIISP Gosstroy of the Ukrainian SSR) p 73
[3] Vyshnevytskyi R City Planning. Resettlement issues 1996 (Kiev: Builder) pp 26–37
[4] Fomin I A Quantitative signs of urban agglomerations 1967 (Kiev: Budivelnik) pp 20–28
[5] Lappo G M 1997 Geography of cities (Moscow: Humanitarian ed. Center VLADOS) p 480
[6] Pertsik E N 1999 Cities of the World. Geography of World Urbanization (Moscow: International Relations) p 382
[7] Polyan P M 1988 Methods of selection and analysis of the reference frame of the settlement (Moscow: IGRAN USSR) p 56
[8] Merlin P and Choay F 1988 Ensemble constitué par une ville et ses banlieues (Paris: PUF)
[9] Markowski T and Marszal T 2007 Metropolie i procesz metropolizacji w Polsce (Lwów. Warszawa: Bieuletyn KPZK PAN) p 10
[10] Mazur T Evolution of the Term of Terminology in the Metropolitan Region, Metropolis, Metropolitan Area, and Metropolitan Region in the Context of the Urban Process of the XX - Cob XXI Stolit (Electronic Materials)
[11] Vliegen Mathieu 2005 Metropolitan agglomerations and urban regions delimited (Netherlands: Graduate School of Housing and Urban Research)
[12] Definition of Functional Urban Areas (FUA) for the OECD metropolitan database 2013 (Electronic Materials)
[13] Eurostat Definition of urban agglomeration in the European Community 1992 (Eurostat: Luxembourg)
[14] Le Gleau Jean-Pierre, Pumain D and Saint-Julien T 1997 Towns of Europe: to each country its definition (Electronic Materials) vol 6
[15] Metropolitan functions of the big cities of Ukraine: development potential and prospects for realization 2016 (Lviv: State Institution "Institute of Regional Studies named after M I Dolishni NAS of Ukraine") p 552
[16] The practice of innovative developments in spatial development of cities and regions 2016 (Kharkiv: O M Beketov National University of Urban Economy) pp134–185
[17] Zavalnyi A V and Pankeieva A N 2017 Urban Agglomerations in Ukrainian Legislation Proc. Int. Conf. Sustainable Urban Development (Kharkiv: O M Beketov, National University of Urban Economics) pp 43–45

[18] Zavalnyi A V and Pankeieva A N 2018 Urban Planning (Moscow) 5(57) 11–18

[19] Territorial development in Ukraine: development of agglomerations and subregions 2012 (Kyiv: USAID LINC) p 183

[20] Zavalnyi A V and Pankeieva A N 2017 Defining the Limits of Urban Agglomerations Proc. Int. Conf. New materials, equipment and technologies in industry (Mogilev: Belarusian-Russian Unitary Enterprise) p 149

[21] Pertsik E N 2009 Geo-Urbanistics (Moscow: Academy) p 432

[22] Regional Policy of the European Union 2016 (Kiev: KNUE) p 495

[23] Zavalnyi A V and Pankeieva A N 2017 Mistobuduvnaya and Territorial Plane (Kyiv: KNUBA) 64 84–93

[24] Revised Delineations of Metropolitan Statistical Areas, Micropolitan Statistical Areas, and Combined Statistical Areas, and Guidance on Uses of the Delineations of These Areas 2013 Office of Management and Budget bulletin 13-01

[25] Development of urban agglomerations: an analytical review (Electronic Materials) Vol 2

[26] CMA and CA: Detailed definition (Electronic Materials)

[27] Eurostat Statistics Explained (Electronic Materials)

[28] ESPON Atlas: Mapping the structure of the European territory 2006 (Bonn: Germany)

[29] Definition der städtischen Gebiete, Agglomerationen und Metropolräume 2000 (Electronic Materials)