Impulse Development of Cities Caused by the Range of Certain Infrastructural Factors. Forms and Experience

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Abstract. The issue of impulse development of cities caused by different infrastructural factors is considered. Taking Tenochtitlan, Stockholm and Alexandria as the example, the content and functional structure of infrastructural impulse changes have been outlined. By these we mean rethinking of life support systems, which leads to sharp population growth and employment diversification. To become a ‘growth spurt’ factor, such changes must contain a number of special qualities: convenience, accessibility and uniqueness. Convenience is the difference in the use of infrastructural benefits between the locality in which the impulse change takes place and other similar cities. Accessibility means the ability to use (access) the infrastructural benefits by as many residents as possible. While uniqueness stands for a feature or set of infrastructure features that are notably absent in the cities of the competing area.

1. Introduction
Formulation of the problem. History and long experience of urban development, which is considered one of the signs of the existence of a civilized society [1–4], provides significant material for analyzing the dynamics and nature of the development of its structures and evolutionary patterns. In this work we will consider those that indicate the existence of impulse factors that can significantly improve and complicate the urban system at different stages of its initial state.

The main array of the analyzed material is structured according to the following: one impulse - one urban structure. Thus, in this article we will analyze the phenomenon of rapid development of urban structure in a short period of time under the influence of a clearly defined factor.

Analysis of recent research and publications. The study is based on the range of materials which made a significant contribution to the national urban discourse on the current issues of transformation (V. Abyzova, Y. Bilokon, V. Vadimov, M. Gabrel, S. Danilov, M. Demin, Y. Kryvoruchko, O. Panchenko, T. Panchenko, B. Posatsky, O. Remizova, O. Rybchynsky, V. Timokhin, I. Ustinova, O. Fomenko, I. Fomin, B. Cherkes, N. Shebek, etc.). The direction in which one can see the preconditions of the impulse-based strategy of urban environment development is presented in the concept of urban interpretation of the “heterotopia” category. Proponents of this trend are T. Blockland, F. Vera, M. Deane, L. de Cotter. H. Mayoral, R. Merotra, M. Savage, E. Soya and D. Harley;

A valuable source of information in terms of the objectives of this work is “Ephemeral Urbanism, cities in constant flux” [5], the book in which the authors provide various examples of spontaneous
urban formations, as well as acceleration of their growth under the influence of various natural and anthropogenic factors. In particular - festivals/events, cooperation, self-disclosure, influx of refugees, military activity, religion, catastrophe. All of these can be viewed as impulses which led to creation of a new settlement, of different historical duration, which is the relevance of this work.

The purpose of the article is to develop the main provisions and analysis of the architectural component of the formation factors of urban impulses which led to creation and development of a large city.

The aim of the study is to reveal the historical forms of evolution of urban settlements under the influence of impulse factors and to identify the main problems and patterns that characterize the formation of infrastructural factors.

The limits of the study. The chronological framework of this study covers the periods of antiquity. The lower limit of the chronological boundaries is determined by the beginning of urban construction. Territorial boundaries of the study are determined by the cities, which experienced a sharp acceleration of development, followed by either stabilization or relative slowdown (Tenochtitlan, Stockholm, Alexandria). The choice of these cities for the study is due to the fact that they are best manifested impulse factors in the design of urban fabric and allow us to distinguish and formulate the main patterns of infrastructural factors.

Research methods. Identification and analysis of examples of rapid development of urban structure in historical retrospect and in chronological order. The research is based on materials, of descriptive and documentary nature, cartographic, illustrative data, as well as analytical materials, which constitute comprehensive discursive material, including that of modern urban theory. The evolutionary-chronological aspect, in this case, also reveals the factors that not only influenced the rapid growth of a particular urban planning system, but also caused its decline, if any.

2. Presenting main material
Consideration of the historical experience of the formation of urban structures is based on the premise of isolating the group of settlements, the development of which is characterized by two conditions of growth - rapidity over time and large scale in terms of its territory. These examples of urban planning experience, however, may have different assessments of their effectiveness due to the fact that:

a) not all of them led to steady, maintained growth and long-term results;

b) the fact of significant population increase cannot be considered a positive indicator per se, especially in the modern era of so-called hyperurbanism, when many cities with experience of rapid development due to impulse factors have not been able to deal with basic social problems of large populations.

The presence of signs of rapid development of urban fabric indicates the existence of the root cause, which became their stimulus and which can be empirically determined.

Thus, depending on the nature of their development, settlements here are divided into two categories: spontaneous and impulse-based.

By spontaneous category, we mean the category of the cities that have developed gradually, without noticeable evolutionary leaps from the original core, through the long-term accumulation of complications. Mostly these are historical centers (Rome, Istanbul, New York, Cairo, London, Sao Paulo, Beijing, etc.) or those that have undergone a faster evolution, but without rapid changes (Sydney, Seattle, Ho Chi Minh City, Tianjin, Faisalabad, Los Angeles etc.).
By impulse-based type, we mean the category of the cities, which are characterized by a stage of sharp acceleration of development, after which there is either stabilization or a relative slowdown. Given the objectives set in this study, this group of cities will be the subject of further consideration. However, it is important to note that we excluded the settlements, rapid development of which was a consequence of the modernist legacy of total urban planning, which considered the possibility of creating a large urban structure from scratch, based on a one-time master plan (Brasilia, Chindigarh, Slavutych, Eilat, Astana, Nova Guta, etc.). This is due to the principled focus of such research on the search for alternative to modern urban formations and ways of city administration, which will be free from the directive-hierarchical systematics of the industrial epoch.

The analysis of the source base conducted in the previous sections and the research methods used allow us to talk about four fundamental factors of historical urban planning, which can be considered as impulse-based. They took the form of clearly determined infrastructural, demographic, economic and myth-making changes (Figure 1). Each of these factors is not unique to the experience of a city (although often only one of them becomes the leading driver of rapid settlement growth). In this case, it is a question of defining the characteristic features of the impulse, which, as will be shown below, can have different consequences depending on the historical and economic conditions in which it then develops. Characteristic features of the impact of such an impulse are the expansion of urban living space to facilitate a greater supply of employment and expansion of the range of knowledge and information exchanged by different groups of residents.

| IMPULSE-BASED URBAN SETTLEMENTS |
|---------------------------------|
| THE FACTORS OF HISTORICAL URBAN DEVELOPMENT WHICH CAN BE VIEWED AS IMPULSE-BASED ONES |

| INFRASTRUCTURAL | DEMOGRAPHIC | ECONOMIC | MYTH-MAKING |
|-----------------|-------------|----------|-------------|

**Figure 1.** Impulse-based ontology of urban systems

Infrastructural changes make the first category of the transformations. Here we mean a radical reconsidering of the ways life support systems function, which led to a rapid increase in the population rates and diversification of the occupation types. As a rule, to become a factor/trigger of rapid growth, it must contain, at least temporarily, a number of special qualities. There are three main qualities which are typical for the infrastructural type of change: convenience, accessibility and uniqueness.

Each of these three qualities is self-sufficient, having even one of them is enough for the infrastructural transformation to become an impulse factor, but often such qualities arise together, at the same time, complementing and reinforcing each other. In retrospect of historical experience, one of the most striking examples of the combination of infrastructural qualities can be considered the rapid development of a small settlement Tenochtitlan, which as of 1500, 175 years after its establishment, became the largest city in the world at that time, or at least equal to such huge settlements of the time as Paris (whose history at that time was about 1700 years) and Venice (whose history at that time was about 1100 years).
So we can talk about the combination of only the last two qualities of infrastructural transformation: accessibility and uniqueness. Despite the difficult initial conditions of the settlement, under the influence of political and probably religious factors on a small swampy island in the middle of the Texcoco lake, a small group of settlers learnt to use silt from the bottom of the lake to grow crops and increase fertility of the soil by living organisms which they took from the lake. The settlement on the small swampy island began to grow rapidly, and the population, which harvested several yields a year on its plantations, was becoming richer and larger. Notwithstanding the pressure of rapid development, the large area of the lake provided an opportunity for constantly growing population to develop new plantations, gradually expanding the city and, as a result, reducing the area of the lake. Each generation of settlers witnessed a new phase of settlement development, and the great-grandchildren of the founders were living in the center of a large state with great potential for further improvement of the urban structure through the use of a large number of workers. As a result, a dam system was laid, which allowed to remove saline water from the city and surround it with fresh water, as well as to build a number of viaducts to provide residents with mountain drinking water. These infrastructural changes allowed the city to exist as a center of highly developed living space with a significant amount of opportunities for residents (domestic, educational, cultural, religious, etc.).

On the other hand, it should be noted that one of the defined qualities of the infrastructural impulse - convenience, was not typical for this city. Complicated communication with the surrounding settlements, in the early stages played, in part, a positive security role, but later, after the transformation into a large metropolitan center and the conquest of large areas, this factor became a significant infrastructural problem, which was partly solved by dams and embankments. However, as we have seen, this drawback did not affect the infrastructure impulse factor determined by the qualities of accessibility and uniqueness.

The influence of the quality of convenience, as we understand it in this context, can be seen in the history of urban development of Stockholm, which became the capital of Sweden only in 1634 due to growing importance and influence of this city, despite the historical significance of the ancient religious and political center in Uppsala. The rapid growth of Stockholm, the city to which the royal and archbishop's residences moved after gaining independence from Denmark, is due to the settlement of merchants from Lübeck. At that time, they took advantage of the favorable location of the settlement at the mouth of a narrow strait connecting the Baltic Sea with a large basin of inland lakes and different regions of central Sweden. Given this, the city became a central point of accumulation and processing of the main goods exported from the country - salt and copper. Between the mid-16th and mid-17th centuries, the city's population grew from about 3,000 to 30,000 [9-10].

Thus, infrastructural changes, even if they lack some of the qualities, can turn into the impulse stimulus, which brings about a spike in settlement growth and development. It can last until such changes become the norm for other settlements, which is quite rare, or run out of resources. An example of such infrastructural degradation can be the process of gradual disappearance of infrastructural systems of Alexandria in the IV - VI centuries. The city was designed to provide all residents with access to fresh water supply through an underground water source, which was fed by the Nile water. The entire northern side of the city was converted into a port with its infrastructure, which enabled transcontinental trade between the Mediterranean and the Indian Ocean basin, as the canal connected the mouth of the river Nile with the Red Sea. In the first hundred years of its existence, Alexandria grew from the size of a small fishing village to a metropolis with a population of about 500,000 inhabitants. There were observed virtually all three factors of the infrastructural impulse: convenience (efficient transport network, communication with the Mediterranean basin and the inland Egypt, oversupply of food and security, etc.), availability of resources (large yields of wheat from the Nile Valley, significant reserves of freshwater fish in lake Marriott and sea fish from the Alexandrian lagoon, a wide network of freshwater underground canals, etc.), uniqueness (exceptional geographical location and the presence of
an administrative management center, made it possible to accumulate wealth and resources from a vast area stretching from Gibraltar to India). However, after several earthquakes and the gradual siltation of the canal between the delta and the Red Sea, the water level in the lagoon rose and all port infrastructure was submerged, the freshwater underground canal system was disrupted, and the administrative center was moved to Fort Babylon (now Cairo). All these factors led to the fact that at the time of the Ottoman conquest in the XVI century, the city, in fact, returned to the state of a small fishing town with port fortifications [11].

3. Results and discussions
It has been determined that the rapid development of urban structure over a short period of time can be considered an effective urban development impulse, with exception of the states when they: a) did not lead to maintained results, b) did not provide any solutions which would facilitate a sustainable livelihood, but only triggered mechanical population growth, c) resulted from the modernist legacy of total urban planning, which considered the possibility of creating a large urban structure from scratch, based on a one-time master plan (Brasilia, Chindigarh, Slavutich, Eilat, Astana, Nova Guta, etc.).

We have defined two types of evolution of urban structures: a spontaneous one, where we mean the category of the cities that have developed gradually, without noticeable evolutionary leaps from the original core, through the long-term accumulation of complications. Mostly these are historical centers (Rome, Istanbul, New York, Cairo, London, Sao Paulo, Beijing, etc.) or those that have undergone a faster evolution, but without rapid changes (Sydney, Seattle, Ho Chi Minh City, Tianjin, Faisalabad, Los Angeles etc.). By impulse-based type of evolution, we mean the category of the cities, which are characterized by a stage of sharp acceleration of development, after which there is either stabilization or a relative slowdown. Given the objectives set in this study, this group of cities has been the subject of our consideration.

4. Conclusions
Based on the analysis of the source base, we outlined four fundamental factors of historical urban development, which can be considered as impulse-based. They took the form of clearly determined infrastructural, demographic, economic and myth-making changes (Figure 1). Here we mean the characteristics of the impulse, which can bring about different results depending on the historical and economic conditions in which it then develops. Characteristic features of the impact of such an impulse are the expansion of urban living space to facilitate a greater supply of employment and expansion of the range of knowledge and information exchanged by different groups of residents.

The content and functional structure of infrastructural impulse-based changes have been outlined. By them we mean a re-considering of life support systems, which leads to sharp population growth and employment diversification. To become a factor of rapid growth, such changes must contain a number of special qualities: convenience, accessibility and uniqueness. By convenience we mean the difference in the use of infrastructural benefits between the settlement in which the impulse change takes place and other similar cities; accessibility means the opportunity to use the infrastructural advantages of the settlement by the largest possible number of residents; uniqueness is a feature or set of infrastructure features that are visibly absent in the cities of the competing area.

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