

Self-similarity within urban development

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Abstract. *Cities have existed as a version of urban form since the beginning of civilization, constantly being shaped according to cultural and technological trends.*

The city from a holistic perspective has a similar structure in terms of functions and social connections with micro-level formations in the urban tissue (small neighbourhoods).

An apparent chaos in the cities organization can be explained through an analysis of its works and pattern of expansion, by identifying its nuclei/urban poles that can be identified within the city limits (functions like living, commerce, "loisir", business, education etc.)

To avoid a segregation phenomenon in urban regions, we must understand that these areas follow the same dynamic pattern, functionally and socially, as all the neighbourhoods within the city limits, fact that eases the transition from area exterior to the city line - urban periphery - complete integration within the city.

Keywords: self-similarity; fractal; irregularities; urban development; peri-urbanisation; decentralization; urban recentralization; polycentric development; environmentally friendly; mobility; integration.

Introduction

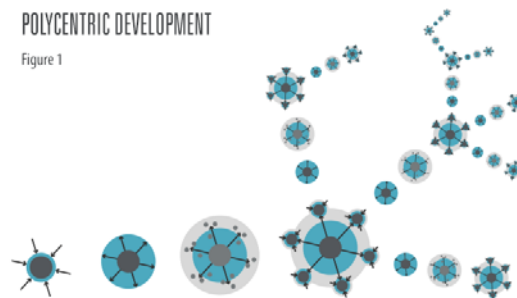
There is no doubt that more people are living in cities than ever before. Exactly how many, is rather difficult to determine, as the criteria used to define what is urban differs from country to country. However it is widely accepted that the year 2006 was an important turn in the world's urbanization.

"In its report 'The State of the World's Cities', the United Nations Habitat office made a formal pronouncement that, for the first time, the majority of the world's population - nearly 3,3 billion - now live in urban agglomerations rather than rural areas"

The growing urbanization of the world has brought into effect new terms to define the notions of city and metropolitan area. The term "global city" was introduced to describe the increasing global influences on urban life.

In the recent years the world's urban agglomerations have taken on additional descriptions. Thus the term "global-city region" was defined as a new metropolitan form characterized by sprawling of polycentric networks of urban clusters. The identifiable nuclei found within these networks are most often along the primary access routes to and from the city, usually at intersection points with the city limits.

Economic, social and ecological factors along with the change in climatic conditions and resources redistribution are the elements that result from the general on-going globalization. By the year 2050 it is estimated that two thirds of the world's population will be living in some form of urban settlement.



"The rural population of the world has grown slowly since 1950 and is expected to reach its peak around 2020. The global rural population is now close to 3.4 billion and is expected to decline to 3.1 billion by 2050"

Understanding the implications that this growth in urban population has on the way a city functions has become a necessity, as the link between urban planning, architecture and society become even more complex and fragile.

To understand the phenomenon of urban self-similar expansion, we must first define the concept of *self-similarity* from an architectural and urbanistic point of view.

Self-similarity is a typical property of fractals (Figure 1). Colloquial a fractal is a "fragmented or a divided geometrical shape that can be split into parts so as each of them is (at least approximately) a miniature copy of the whole".

We can define fundamental concepts of fractal geometry and means through which they can be used to generate new shapes in terms of analytical and practical developments of "organic" structures. These structures take the form of complex human settlements in different cultural areas with consideration towards the social connections and dependencies that derive from urban concentrations (in this particular scene, we can exemplify the web-like development tendencies of Bucharest's periphery).

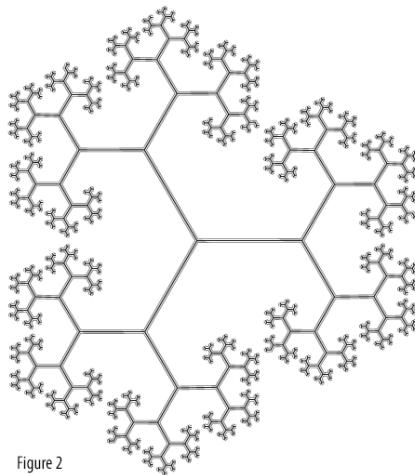


Figure 2



Figure 3

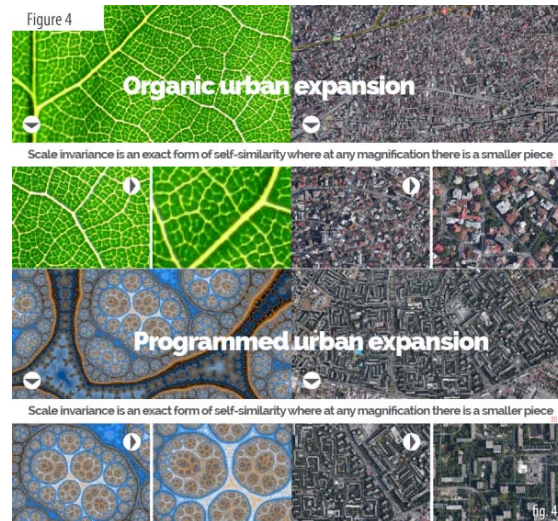
FRACTAL SELF-SIMILARITY IN NATURE

Self-similarity can be found in complex natural entities (Figures 2 and 3) as well as in man-made structures. In this latter case, it takes on a more conceptual role, that of connections between components.

"A fractal object has two basic characteristics: infinite detail in each point and a degree of self-similarity between parts of the object and its overall characteristics. Process rather than equations" (Gausa et al., 2003, p. 1).

From a schematic point of view we can observe the 2 types of development possibilities (Figure 4):

- Organic urban development (also known as vernacular; that does not have a predetermined plan).
- Programmed urban development (based on a designed programmed plan; it often follows an identifiable regulated pattern).



Peri-urbanisation relates to those processes of dispersive urban growth that creates hybrid landscapes of fragmented urban and rural characteristics. Peri-urban areas are transition areas from rural to urban land, located between the outer limits of urban and regional centres and the rural environment. The limits of peri-urban areas are porous and adaptive as urban development extends into rural and industrial land.

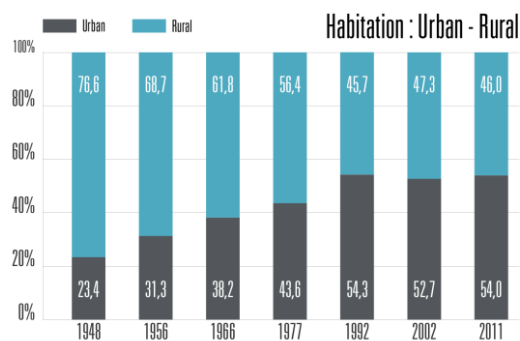


Figure 5

Looking at the above image (Figure 5) we can clearly see the city's growth as well as the organic nature of the outer limits.

The city limits are ever changing because of continuous expansion. The phenomenon here is that the entity of the city having porous limits, grows and assimilates the outer small urban formations such as small new residential areas, business platform and commerce area.

The balance shift from rural to urban habitation (Figure 6) in the last years has generated new and more complex forms of urban landscape. Modern cities are bigger and more complex than ever.

As the definition of urban area is a relevant concept defined by each country, in this case we can say that the present limits are a combination between the "administrative city, transport lines, newly constructed areas (with different functions as habitation, commerce, business, education, entertainment, health). As long as we have a strong connection between the young urban clusters and the city in matter of accessibility and social relations than we can presume that those clusters may in the future be part of the growing city.

If we take a closer look at these urban clusters we can see the similarities between its local functions and the main city's general functions. We have the same relationship between people and the existing functions.

In a small cluster we have the relationship between individual and: living accommodation, commercial area, education and culture, health system, business area, industrial area etc. The same relationship can be seen on a larger scale inside the city and its functional areas.

The phenomenon is that of Decentralisation and Urban Recentralisation which has 4 phases (Figure 6).

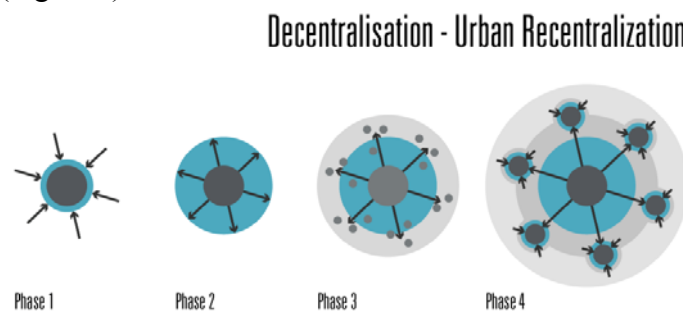


Figure 6

Phase 1 - Concentration: centripetal attraction of the city; phase of urbanization (suburbs at city limits).

Phase 2 - Deconcentration: the first wave of expansion - centrifugal explosion; suburbanization phase.

Phase 3 - Deconcentration: the second wave of expansion - extensive peripheral growth; rurbanisation phase.

Phase 4 - Clustering: the third wave of expansion - intensive peripheral polycentric growth; re-urbanization phase.

The grey area in the above schematics represents a unit of different functions and the relationship between them. As we can see, once the city starts to expand, it does so by creating new clusters with the same general organization (habitation, commerce, business, education, culture etc.). This happens as the city or better yet,

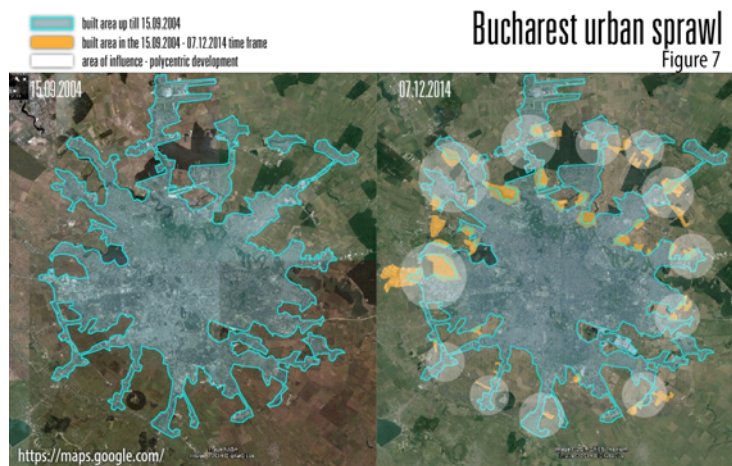
the people living within the city have the same needs independent of their location. An individual living within the center of the city is going to have the same necessities for accommodation, shopping and healthcare as someone living in the outer skirts of the periphery.

The reason why the city's growth is oriented outwards may be caused by the apparent chaotic rumble of everyday life and the sense of overwhelming suffocation due to undersizing of the transport system (here including streets, parking areas and public transport). Due to this impediment, the never-ending transits between different functional areas within the city are inevitable. As long as we have large dormitory type neighbourhoods like *Militari* and *Balta Alba*, only concentrated on one function - that of living, and huge commercial and business platforms such as *Pipera* and *Baneasa*, we are going to have a permanent shift of population from one place to the other.

Such is the case in clusters but at a much smaller scale and less intrusive.

We have living areas, commerce zones, healthcare. Even if at first not all of the functional zones needed by the population exist, in time they will appear, thus forming another complex, multi-functional urban cluster part of the polycentric network.

Bucharest's urban sprawl in the recent years followed the same pattern of polycentric development.



If we compare the urban footprint of Bucharest in 2004 to the one in 2014 (Figure 7) we can observe what are the general regions that have expanded. Most of them are at the intersection between the main access points into the city and the outer ring.

In the analysis in Figure 7 we can observe the new constructions colored in orange and their influence area.

The city is growing by developing new clusters in the periphery, assimilating them and changing the previous exterior limit.

In a way it's similar to nature's assimilation of complex organisms, becoming a living metabolism (Craciun, 2008, p. 99).

Such a transfer in concepts from fractal theory into urban development is useful in urban analysis, in particular where there is a very clear hierarchy of constituents, especially at street level, of the circulation (circulatory) system, as well as in the studies of settlements that can be fragmented according to certain characteristics and can have a fractal dimension.

Acknowledgements

Doctoral and postdoctoral scholarships for your researchers in the fields of Political Science, Administrative Science, Communication and Sociology, POSDRU/1.5/159/134650

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