DO POST-SOCIALIST URBAN AREAS MAINTAIN THEIR SUSTAINABLE COMPACT FORM? ROMANIAN URBAN AREAS AS CASE STUDY

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Abstract: The compact city is regarded as an important concept in promoting sustainable development, especially within the European Union. The socialist urban planning system maintained a high compactness of the urban areas through almost exclusive predominance of the public sector in housing provision, and ideological nature of the planning strategies. After the 1990's, the administrative decentralization allowed local authorities to adopt particular urban development strategies. However, development was directly influenced by the importance of the urban administrative centre. The aim of the paper is to determine if post-socialist urban areas maintained their compact urban form or they encountered different evolution trajectories. We determined the type of changes by calculating urban form indicators at two time moments: 1990 and 2006. Furthermore, the two-way repeated-measurement ANOVA was used to identify significant changes, and to assess the effect of the development level of the urban area on the variance of form indicators. The results show that Romanian post-socialist urban areas either shifted from the compact form, "inherited" after the collapse of socialism, to more dispersed patterns, either expanded in a compact manner. Moreover, as development level got higher, urban areas were more likely to be affected by suburbanization and periurbanization. In order to respond to these challenges, new instruments such as setting of metropolitan areas or spatial framework plans could be used. Furthermore, planning should be adapted to local circumstances and to the different development trajectories of big and mid-sized urban areas.

Key Words: *compactness, development level of urban areas, functional areas, horizontal planning.*

Sustainability of urban areas as reflected by the urban form

The concept of urban development has become increasingly significant as a target for creating a better future for the world – both economically, socially and environmentally (Munier 2011, Zhou et al. 2015). Within this situation, sustainable urban development plays an important role in achieving global sustainability targets. Thus, to “make cities and human settlements inclusive, safe, resilient and sustainable” is the specific urban goal proposed in 2014 by the Open Working Group on Sustainable Development Goals for United Nations’ Millennium Development Goals.

At the European Union level, the idea of moving from urban sprawl to a ‘compact city’ has been proposed as one way to achieve improved urban sustainability (European Commission 1990, 2014). The concept became central in the sustainable development debate and it consequently translated into policy and practice (Burton 2002). Strategies on revitalisation and regeneration of inner-urban areas, built-up densification or reuse of brownfields were used in land use planning policy in many countries to stimulate compactness.

Scientific research brought evidence in support of compact development (Jabareen 2006, Jenks and Burgess 2000). The claimed advantages of a compact city are well documented and they consist of increased efficiency of transport infrastructure (Gusdorf and Hallegatte 2007), lower costs for maintenance and higher performance of public utilities (Farmani and Butler 2014), much smaller areas of land used to extend the built-up environment and less landscape fragmentation (Chen et al. 2008), the ability to encourage social interaction due to high-density of built-up areas (Elkin et al. 1991), and less need to travel by car, thus reduced noise and fuel emissions.

However, the downsides of compactness should be acknowledged, especially by planners and practitioners (Burton 2002). A higher density of built-up areas is sometimes achieved through the conversion of open and green areas. Moreover, as cities become denser, they lose the ability to mitigate the urban heat island process (Cheval and Dumitrescu 2009). Such issues should be recognized and documented, as they are important in how planning decisions are taken.

Most former socialist cities are regarded as having a high degree of compactness (Hirt 2013, Sýkora and Ourednek 2007). The socialist urban planning system maintained the urban compactness through the almost exclusive predominance of the public sector in housing provision, the inhabitants' reliance on public transport that prevailed during that time and the ideological nature of planning strategies that promoted dense urbanization to foster collective identity (Halleux et al. 2012). Moreover, the patterns of urban expansion were governed by master plans devised and approved in a top-down approach.

In Romania, after the 1990's, decision-making and administrative decentralization allowed the county and local authorities to adopt particular urban development strategies (Stanilov 2007). Through projects of urban renewal, infill development or urban expansion, the authorities tried to meet the new expectations of the local communities. These projects were, however, directly influenced by the importance of the urban administrative centre and the authorities' ability to attract private investments and to support the public ones.

Scoffham and Marat-Mendes (2013) highlighted that the sustainability of an urban area lies mostly in its ability to adapt to society's needs. Local authorities should identify the means to maintain a balance between the pressures imposed by the demographic, social and technological changes (Chen et al. 2008), and to achieve the rational use of the resources necessary to support the development of built-up areas (Echenique et al. 2012).

Sustainable urban development can also be achieved through a balanced spatial structure promoted by well-coordinated spatial development policies (European Commission 1999). Thus, the role of spatial strategies is to encourage and to guide the spatial distribution of development (e.g., constructed areas and the related infrastructure), taking into account the need to preserve the environmental assets. To achieve this, a close cooperation between the authorities responsible with spatial planning at vertical and horizontal levels is needed (Ianoş et al. 2012).

The term **urban form** is used to express the spatial configuration of the fixed elements within the urban area (Anderson et al. 1996). The scale at which urban form analysis is performed can vary from building, street, block, neighbourhood and city (Dempsey et al. 2010), to the area located in the influence zone of the city (Arribas-Bel et al. 2011).

Different approaches have been proposed to systematically analyse and classify the urban form. While some authors refer to the physical structure of the city (i.e. morphological structure as expressed by shape and disposition of the urban patches) or land use/land cover structure (Galster et al. 2001), others include also aspects related to socio-demographic and economic

activities (Huang et al. 2007). Even so, a difference should be made between the urban form itself, as a static measure for a given moment in time, and urban growth which represents a dynamic process which alters the urban form (Schwarz 2010).

Urban form and its evolution over time are the result of a variety of factors. Natural features, such as topography or the presence of water bodies and natural risk areas, economic and demographic development, cultural background, are all elements that induce form differences (Anderson et al. 1996). Moreover, land-use policies (i.e. zoning, master plans, built-up containment limits) and planning approaches have been proven to have a strong impact over the dynamic of the urban form (Camagni et al. 2002, Zhao 2010).

Urban form dynamics highlights the relationship between the city (i.e. urban core) and its functional area (Grimm et al. 2008). The analysis which looks beyond the administrative borders of the urban core allows the identification of more efficient methods for the planning of urban areas (Aguilera et al. 2011, Schwarz 2010).

In the urban form analysis, the choice of indicators is essential. Indicators should be able to reflect the processes specific to urban expansion (Jaeger et al. 2010), such as sprawl or suburbanization, to allow researchers and practitioners to relate them to urban development strategies, and the necessity of adapting planning policies (Galster et al. 2001). Huang et al. (2007) identify four dimensions which should be covered by urban form indicators: (a) *centrality*, (b) *complexity*, (c) *compactness*, referring to the structure, shape and fragmentation of built-up patches, and (d) *porosity*, referring to the share and distribution of green areas.

The Territorial Agenda 2020 established by the EU (European Commission 2011), recommends a horizontal approach, focused on cities and their functional areas, in order to increase the sustainability of the planning process. In this case, the role played by planning becomes that of guiding urban development toward a desired form, without limiting the society's needs (Waldheim 2006). Throughout the rest of the paper, we will use the term **urban area** to refer to the **city core** and its **functional area**.

Post-socialist urban areas are characterized by significant administrative transformations, namely a higher importance of local and supra-local governance and the integration of public participation into the planning process (Petrișor 2010), and experience processes which were not present during the socialist times, such as urban sprawl (Suditu et al. 2010) or urban shrinkage. In the context of these transformations and urban sustainability being promoted both at European and global level through the concept of urban compactness, it becomes important to identify how post-socialist urban areas could contribute to achieving this target. Thus, the aim of the paper is to determine if post-socialist urban areas maintain their compact urban form or they encounter different evolution trajectories. Considering urban form as the result of the physical structure and the size of the urban fabric, and focusing on urban areas in Romania, the study addresses the following questions:

- a) What are the spatial and temporal form changes experienced by post-socialist urban areas?
- b) Is urban form dynamics connected to the development level of urban areas?

Methodology for assessing the spatial and temporal dynamics of urban form

Setting the study areas

A number of 29 urban areas in Romania (Fig. 1) were chosen for the urban form assessment. The urban areas were selected based on their location within the counties with the most severe

expansion of the built-up space, as identified by the studies of Suditu et al. (2010) and Petrișor et al. (2010).

The first step of the analysis was to delineate the administrative boundaries of each urban core and its functional area (Fig. 2). Following the Urban Audit methodology (Bretagnolle et al. 2011) we considered **urban areas** as having two spatial dimensions:

- a) the core city, which encompasses the administrative boundary of the city, and
- b) the Larger Urban Zone (LUZ), which is an approximation of the functional urban area centred around the core.

According to the National Institute of Statistics (NIS 2013), in Romania, the designation of functional areas consisted of the aggregation of "suburban communes", namely the neighbouring rural administrative units which are urbanized, industrialized or have a high economic development level. The rural administrative units are independently governed, they have lower budgets as compared to the adjacent cities, and less opportunities to access funding for the public infrastructure development. However, they are highly vulnerable to urban sprawl, and in some cases the intensity of built-up development is higher than in the city core (Suditu et al. 2010). For urban areas on which NIS did not provide specific information, the functional areas were determined based on the law promulgated in 1968 (National Assembly 1968), which provides a detailed list of the suburban communes in Romania. The borders of the urban areas were revised in order to meet the present administrative limits (e.g. some of the suburban communes have become districts of the city core).

Fig. 1 – Distribution of urban areas in Romania and selected case studies

Calculation of urban form indicators

The indicators employed to characterize the urban form cover the criteria set by Huang et al. (2007): centrality - *centrality index*, compactness - *compactness index* and *compactness index of the largest patch*, and porosity - *porosity index* (Galster et al. 2001, Schwarz 2010). "The largest patch" refers to continuous built-up areas within the city core administrative borders, without taking into account the neighbourhoods spatially detached from it.

Fig. 2 – Workflow of data processing and analysis

Corine Land Cover datasets for 1990 (EEA 2013a) and 2006 (EEA 2013b) were used to derive the land cover data necessary for urban form indicators computation. The calculation of the first three indicators was based on eight land cover classes corresponding to built-up areas (Table 1). These classes were grouped into one category named *sealed urban patches* (Schwarz 2010). *Porosity index* takes into consideration the CLC classes corresponding to *green and open spaces* (Milego 2007). A detailed description of the formulas and interpretation of the four indicators is provided in Table 2.

Table 1

Corine Land Cover classes used to set of open space and sealed urban patches

CLC code	Sealed urban classes	CLC code	Green and open space classes
111	Continuous urban fabric	141	Green urban areas
112	Discontinuous urban fabric	311	Broad-leaved forest
121	Industrial or commercial units	312	Coniferous forest
122	Road and rail networks and associated land	313	Mixed forest
123	Port areas	322	Moors and heath land
124	Airports	324	Transitional woodland-shrub
132	Dump sites		
133	Construction sites		

Table 2

Urban form indicators - formulas and interpretation

Indicator	Measurement	Interpretation
Centrality index (centrality)	$Centrality = \frac{\sum_{i=1}^{N-1} D_i / N - 1}{R} = \frac{\sum_{i=1}^{N-1} D_i / N - 1}{\sqrt{s/\pi}}$ <p>D_i is the distance of centroid of patch i to centroid of the largest patch, N is the total number of patches, R is the radius of a circle with area of s, and s is the summarization area of all patches</p>	<p>Centrality measures the average distance of the dispersed parts to the city centre, defined as the centroid of the largest patch.</p>
Compactness index (CI)	$CI = \frac{\sum P_i / p_i}{N^2} = \frac{\sum 2\pi \sqrt{s_i / \pi} / p_i}{N^2}$ <p>s_i and p_i are the area and perimeter of patch i, P_i is the perimeter of a circle with an area of s_i, N is the total number of patches</p>	<p>CI measures the individual patch shape and the fragmentation of the overall urban landscape; the more regular the patch shape and the smaller the patch number, the bigger the CI value.</p>

See the next page

Table 2

Urban form indicators - formulas and interpretation

Indicator	Measurement	Interpretation
Compactness index of the largest patch (CILP)	$CILP = \frac{2\pi\sqrt{s/\pi}}{p}$ <p>, s and p are the area and perimeter of the largest patch</p>	<p>CILP measures the overall shape of the urban centre and is higher for a more regular patch.</p>
Porosity (ROS)	$ROS = s' / s \times 100$ <p>, s' is the summarization area of all open space patches, s is summarization of the urban area</p>	<p>ROS measures the ratio of open space compared to the total urban area.</p>

The graphical representation for urban form indicators is an interpretation after Huang et al. (2007)

Analysis of urban form dynamics

We categorized the urban areas according to the **development level** (DL), based on the settlement ranking in the National Spatial Plan of Romania - Section Settlements Network (Romanian Government 2001). The DL reflects the level of modernization and it is an expression of the present and near future importance of a settlement within the urban network, from an economic, administrative, political, social, economic and cultural perspective (Petrișor 2010). The DL was set as follows:

City of Rank 0 } → DL 1
City of Rank 1 }
City of Rank 2 } → DL 2

In order to determine the significance of urban form changes over time, as well as the effect of the DL of the urban area on the variance of form indicators we performed a two-way repeated-

measurement ANOVA. The analysis allows observations on the effect of factors on a dependent variable (i.e. each urban form indicator). The repeated measurement design tests the following null hypotheses: a) factor 1 (e.g. time) has no effect on the urban form indicator mean; b) factor 2 (e.g. DL) has no effect on the urban form indicator mean; c) there is no interaction between factor 1 and factor 2 (Gotelli and Ellison 2013). Levene's test and Box's test were consulted for checking homogeneity of variance respectively the equality of covariance matrices assumptions (Field 2009).

Results

The results showed that the *Centrality* index (CE) recorded a dominant decreasing trend between 1990 and 2006 (Fig. 3, Table 3). The ANOVA analysis identified this change as being statistically significant (Table 4), but with no significant differences induced by the development level of the urban area. The decrease in Centrality expresses an increase of distance between the city centre and the new built-up areas as a result of both linear development along the transport routes, and occurrence of new built-up areas far from the urban centre. Higher decreases were recorded by Cluj Napoca, Oradea, Bacău (DL 1 urban areas), and by Suceava and Brăila (DL 2).

Compactness (CI) values have best highlighted the urban form variance induced by different development levels (Fig. 3). Overall, urban areas with a DL 1 recorded significantly lower values of compactness, regardless of considered time step (Table 4). The values suggest a higher fragmentation of built-up patches.

The trend of CI values for urban areas of DL 1 shows a dominant increase (i.e. decrease of patch fragmentation), most significant changes being recorded in Timișoara (Fig. 4). The trend is mainly due to the expansion of the city core, as built areas located in the near proximity (i.e. in the functional area) have been incorporated to it. For half of the DL 2 urban areas, the CI values have remained constant between the two time steps (Table 3), while for the other half the values predominantly decreased. Significant changes were recorded in Sibiu (decrease of CI values) and Bârlad (increase of CI values).

Table 3

Number of urban areas in respect to the trend of the indicators

Development level	CE			CI			CILP			ROS		
	↓	↑	-	↓	↑	-	↓	↑	-	↓	↑	-
DL 1	10	1	0	2	5	4	11	0	0	2	5	4
DL 2	17	1	0	6	3	9	17	0	1	4	6	8
Total	27	2	0	8	8	13	28	0	1	6	11	12

The symbols show: ↓ decrease of the index; ↑ increase of the index; - constant values.

The box plots (Fig. 3) and the ANOVA results (Table 4) on *CILP* values revealed significant differences between city cores, both due to development level and dynamics over time. Overall, the city cores of DL 1 type shown a higher fragmentation of the periphery, but over time the fragmentation tended to widen for both categories. Significant decreases were recorded in Galați (DL 1 urban area), Sebeș and Botoșani (DL 2 urban areas).

Porosity values (ROS) registered a slight increase for urban areas of DL 1 type and a decrease for those of DL 2 type (Table 3), but changes were not statistically significant (Table 4).

However, urban areas of DL 2 have higher porosity values, suggesting an increased proportion of green and open spaces as compared to those of DL 1 type.

Fig. 3 – Dynamics of urban form indicators between 1990 and 2006, for urban areas with different development levels

Table 4

Results of two-way repeated-measurement ANOVA analysis

Urban form indicator		Factor	F	df	p
Centrality	within subject effects	time	46.833	1	.000*
		time* DL	1.793	1	.191
	between subjects effects	DL	.917	1	.346
CI	within subject effects	time	.456	1	.505
		time* DL	2.443	1	.129
	between subjects effects	DL	7.665	1	.010*
CILP	within subject effects	time	49.807	1	.000*
		time* DL	.316	1	.579
	between subjects effects	DL	6.462	1	.017*
ROS	within subject effects	time	.095	1	.760
		time* DL	1.905	1	.178
	between subjects effects	DL	1.130	1	.297

*statistically significant values

Discussion on urban form changes in post-socialist Romania

Post-socialist cities are a special case in the analysis of urban form dynamics. The transition from a centralized, top-down planning system to the one based on market economy led to important changes to the planning system (Benedek 2013), having a direct effect on the spatial structure of urban areas. By using Romanian urban areas as case study, our study aimed to highlight the urban form changes that cities and their functional areas faced, sixteen years after the fall of the socialist regime. The results showed a shift from the "inherited" compact city to a type of expansion dependent on the administrative and economic power of the city core.

The selected indicators allowed us to highlight specific processes related to the transformations of city cores and their functional areas (Jaeger et al. 2010). In the following paragraphs, we will discuss the processes connected to the urban form changes and we will further emphasize the need to restructure spatial planning at local and supra local level in order to respond to development challenges.

Periurbanization accentuated in Romanian urban areas, as shown by the decrease of CE and CI values. This process highlights the pressure faced by functional areas (Schwarz 2010) as they become attractive due to lower taxes and land prices. One should bear in mind that functional areas with strong dynamics are mixed environments with a high degree of urbanization, but they are also rural in character. Many of the administrative units which are components of the functional areas do not have the financial capabilities to support the expansion of public utilities for the newly and rapidly developed built-up areas (Iojă et al. 2011, Iojă et al. 2014).

In line with the findings of Suditu et al. (2010), **urban sprawl** affects the vast majority of urban areas in Romania. The CE values show an increase of the distance between the city centre and the new built-up patches for all the analysed urban areas. However, the results showed that sprawl is more pronounced in urban areas of DL 1 type (Rank 0 and 1). The identified trend is similar to that observed by Stanilov (2007), who notes that in post-socialist countries the polarization of economic activities in large cities leads to them being more dynamic. The fact that these cities are the major centres of services, education, capital, know-how, and serve as "gates" to international markets, gives them an increasing role in the reorganization of

economic activities and real estate market at national level (Stead and Nadin 2008).

The evolution of CI values for DL 1 type urban areas revealed an **increase of compactness**. However, the result should be interpreted in the context of new built-up development in continuation of the existing one. Most frequently, development involves the expansion of built-up land in the functional areas. Nevertheless, spatial continuity is separated by the administrative arrangements (see Fig. 4, north of Timișoara).

Fig. 4 – Dynamics of sealed urban patches and green and open spaces in four urban areas in Romania

In 45% of cases, **compactness values remained constant** between the two time steps, the share of urban areas with this trend being higher for GD2 type cities. Although it does not provide an overview of urban growth, such values might indicate two possibilities: a) the positive impact of sustainable local policies on urban planning, or b) no significant increase of the built-up areas. Salvati (2013) indicates that under the influence of self-contained urban growth policies, urban areas which were historically compact are more likely to maintain their form over time. We recommend further research in this regard, in order to correlate the findings with local strategies of densification, urban conversion or urban regeneration.

The dynamics of CILP values highlight that **suburbanization** affects both large and medium-sized urban areas. Under the pressure of private investors and encouraged by the local authorities, as they saw it as a way to increase their budget, this process became characteristic to post-socialist cities (Sýkora and Ourednek 2007). In Romania, suburbanization is a severe threat to the sustainable development of the urban landscape due to its connections with exception driven urbanism, abandonment of agricultural land (Grădinaru et al. 2015) and excessive development in areas with low connection to public transportation. The effective control of suburban built-up expansion cannot be achieved as long as the national legislation permits the incremental increase of built-up areas (every 2-3 years), allowing for constant exemptions from the urban plans that are in force.

Even though lower porosity values for DL 1 urban areas indicate less sustainability, they must be analysed in a spatial context. The location of DL 1 urban areas in the plains, mainly involves an increased share of agricultural land in the functional areas. This is in contrast to the DL 2 urban areas, where the proximity to the Carpathians and Subcarpathians ensures high access to nearby green infrastructure.

The need to promote the sustainable development of urban areas is one of the focal points of urban planning at the European level. The European Commission (2014) points out that the unplanned expansion of compact cities compromises the advantages created through the efficient resources use. Furthermore, the Commission highlights the gap created by the differentiated planning of the urban centre and functional areas, and it recommends to focus planning on the functionality of urban areas as an optimal approach particularly where large cities are concerned (European Commission 2011).

As in Romania the horizontal collaboration between the authorities in the city core and the functional areas is rather weak, setting **metropolitan areas** as administrative bodies with decision power in spatial planning, or increasing the power of the existing ones, could become a step in the sustainable management of urban areas (Ianoş et al. 2012). However, this involves the need to reconsider the relation between the city core and its functional area, and the legal and administrative status of suburban communes. As planning tool, the use of **spatial framework plans** at local level for guiding built-up development could be a solution to promote and coordinate sustainable development (Stead and Nadin 2008). Such plans could strengthen cooperation between the local authorities who adopted the plans, thus minimizing the adverse effects of unorganized development due to the competition for attracting funds and investments.

The analysis has some limitations that must be considered. The spatial availability of Corine Land Cover data allowed the inclusion of a sufficient number of urban areas to have an overview of the situation at national level. However, the spatial resolution of the data (i.e. minimum mapping unit = 25 ha) does not allow a detailed analysis. The use of aerial imagery and other cartographic materials with high resolution might reveal a higher fragmentation of built-up areas. The temporal resolution of the data set offered the possibility to analyse the urban form in two periods characterized by different spatial planning approaches: the end of the socialist period and 16 years later. However, as the economic crisis in 2008 affected the real estate

market, and therefore the development of built-up areas (Grădinaru et al. 2015), more recent data might reveal new patterns. Since the Copernicus Program for monitoring land use at European level expects the validation and the launch of CLC 2012, the new dataset can be used for further research.

Conclusions

We showed that post-socialist urban areas either shifted from the compact form to more dispersed patterns, either expanded in a compact manner. Although specific processes of urban expansion, such as suburbanization or periurbanization, affect the vast majority of analysed cities, they are influenced by the development level of the urban area.

The DL 1 urban areas are more dynamic in terms of built-up development as compared to the smaller DL 2 urban areas. The much higher dispersion (e.g. sprawl) of DL 1 urban areas and the tendency to expand and incorporate the built-up land in the functional areas highlight the need to adopt alternative planning approaches. Efficient horizontal planning in the city core (officially, urban area) and its functional area (officially, rural communes) could be achieved by creating planning tools that strengthen their collaboration (e.g. functional metropolitan areas) (Ianoş et al. 2012).

The dynamics of DL 2 urban areas highlighted two issues: a) although urban areas are less affected by sprawl, suburbanization is a process as active as in the DL 1 urban areas; and b) in DL 2 urban areas, urban form indicators showed a greater variability compared to DL 1, but for a large number of urban areas the values remained constant. Such differences highlight the fact that planning should be adapted to local circumstances and to the different development trajectories of mid-sized urban areas.

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