A METHODOLOGY FOR THE EVALUATION OF FUNCTIONAL URBAN AREAS IN ROMANIA

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Key-words: accessibility, polycentricity, functional urban areas, metropolitan areas, GIS.

Abstract. One of the main concern that arises when we acknowledge metropolitan areas as territorial units of analysis and policy development in European countries, is the lack of generic standards specifically assigned for their identification. This adversely affects the findings/results of the comparative research between European countries which use metropolitan areas as territorial units of analysis. The main objective of this article is to present an urban diagnosis methodology that aims to identify cities with the highest potential to become regional engines of development. Achieving this goal requires/involves an assessment of the 'area's ability' to generate and disperse urban development. This methodology is redefining functional urban areas and is based on the study of polycentric ESPON 1.1.1 and on a statistical-mathematical model for assessing the Functional Urban Areas (FUA-s), using a spatial database in ARCGIS 10.2.2. Any assertion of European metropolitan integrated areas requires a new strategy for maximizing the integrated development of large cities in Romania. Taking this into consideration, this scientific methodology aims to map the performance/efficiency FUA index.

1. INTRODUCTION

In order to achieve territorial development and make efficient use of the territorial potential, the European Union recommends a joint effort of the member states. Therefore, it defines six EU territorial priorities which can contribute to the successful implementation of the Europe 2020 project.

The main territorial priority is to promote polycentric and balanced territorial development, a key objective for achieving territorial cohesion. The most developed cities and regions in Europe cooperate as parts of a polycentric pattern, they add value and act as centres of contribution to the development of their wider regions (European Commission, 2011).

Polycentricity is considered a useful spatial planning tool to enhance competitiveness of cities, social cohesion and environmental sustainability (Davoudi, 2003). The use of the term polycentric or polynuclear urban region has increased greatly in the European urban (planning) literature and also in policy documents. Polycentricity within urban context literally refers to a city, region, or other geographical unit, with multiple centres (Musterd *et al.*, 2001). Polycentric development plays a key role both in academic debate on regional topics and in EU planning policies (Bertolini *et al.*, 2011).

Even one decade after the concept of polycentric development became popular and increasingly widespread in Europe as a normative policy stance, allegedly leading to cohesion and competitiveness, its empirical basis is still rather weak. This is partly due to a lack of conceptual clearness, which makes its measurement difficult (Meijers *et al.*, 2008).

The most important outcome of the discussion on the polycentricity-concept is the expressed need for a change in the perspective of the governance problem associated with multifunctionality. Taking polycentrism seriously means to understand governance as a process within which people develop knowledge and skills in order to participate in their own decision-making (Hanisch, 2006). Meijers and Burger (2010), for instance, have shown how different spatial structures – and in particular the monocentricity/polycentricity dimension – affect the economic performance of

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metropolitan areas. Also, Green (2007) argues that defining polycentricity in terms of both morphology and function is possible by drawing on techniques originating in social network analysis.

Another opinion (Shaw *et al.*, 2004) concludes that further 'bottom-up' comparative research and analysis is the key to future research on polycentricity in European spatial planning. Today, polycentrism is a common feature of European urban systems. In 2009, the report 'An Agenda for a Reformed Cohesion Policy' (Barca, 2009) acknowledged the role of networked polycentric regions as a way to promote balanced territorial development, as well as to overcome the disadvantages arising from big urban agglomerations.

From a governance and functional perspective, the functional urban areas are internationally considered to be basic units necessary for polycentric development. In the context of affirmation of metropolitan areas and intelligent metropolitan areas, an accurate definition of functional urban areas represents a process to maximize the integrated territorial development policies.

Any conceptualization and delimitation of functional urban areas must reflect their formation on the micro-scale and detect the smallest complete, complex, organic territorial units where the daily life of the population is organized. This is often neglected when a top-down approach is applied, leading to incomplete representations of reality that can misinform territorial policies (Sýkora *et al.*, 2009). S. Krätke (2007) sees metropolisation and globalisation as the main trends of spatial development in Europe. One of the key factors for business development in a region is the access to labor market and the size of it. The larger and closer the labour market, the better conditions for business development in the region are. Large cities and regions are in need to expand their labor market in order to grow and to maintain an increase in businesses, as well as to develop a proper infrastructure for transportation in order to carry commuters when it is needed (Krey *et al.*, 2011).

In polycentric regions, cities are well-connected (Meijers, 2008) and interrelated through co-operation flows (Cowell, 2010). Today, more and more jobs are created in the fringe areas, e.g. along motorways and in the vicinity of airports, but people prefer to live in the city centers resulting in genuine two-way travel to work flows. Thus, the core (the center) of the urban region and the fringe areas (the adjacent municipalities) have formed an increasingly interwoven and interactive functional region (L. Van der Laan, 1998). Metropolisation is one of the most dynamic processes of contemporary world, changing the existing settlement patterns and creating new relations between large cities (Jałowiecki, 2006). Metropolisation is transforming the economic structure and the spatial organisation of the cities involved. These cities are becoming increasingly specialised in high-order economic activities, which are intensively involved in skilled labour and information.

These typical 'metropolitan functions' relate essentially to creation, decision, and control. They include research and development, high-order producer services, financial activities, large companies' headquarters, and educational and cultural activities (Bourdeau-Lepage, 2002). Mega-City Regions are nodes in the network of information flows and therefore important locations of the knowledge-based economy (KBE). This new spatial scale is recognized by planners and politicians as being crucial to develop competitive national economies (Goebel V. *et al.*, 2007).

Metropolitan areas have intensified their competition to attract and retain specific economic activities, investors and labour force. The Strategic Concept of Spatial Development – Romania 2025, had as main objective the conversion of the concepts of the European Union's territorial policy and defining strategic objectives for spatial development in Romania, in accordance with the particular national territory (Urbanproiect, 2008). There are major socio-economic differences between cities and municipalities, but the substantial/relevant differences are observed between large urban centres and urban areas – small and medium – and rural areas (CONREG, 2013), and between the majority of resources and investments at regional or local level.

At a national level, polycentric development is needed in order to identify priorities and development goals. It is also necessary to develop an effective polycentric network, directly correlated with functional and strategic levels at a regional, county and local scale.

In the current context, a polycentric development strategy for small and medium cities, can develop on the opportunity to integrate the objectives, priorities and strategies at a larger and more relevant level (CRPE, 2013). Competitive metropolitan development challenges have become the subject of extensive academic discussions about governance (Dieleman F. M, 1998).

Several methodologies to identify functional urban areas or metropolitan areas have been developed at national and international level. In fact, the demarcation of a functional urban area or metropolitan area will differ notably depending on the methodology used.

In this regard, we chose the functional approach which defines functional urban areas or metropolitan areas based on flows between the core area and the surrounding territories. In addition, the functional approach permits to define the extension of expanding metropolitan areas, whereas the administrative approach captures static urban forms (Boix, 2007).

2. METODOLOGY AND DATA

The methodology for the identification, evaluation and classification of functional urban areas in Romania has two distinct phases: a phase of identifying potential functional urban areas in Romania and an economic evaluation stage in evolution, using numerical methods to describe non-pooled quantitative data. The first step of the methodology is to identify the potential functional urban areas using methodology ESPON 1.1.1. (Nordregio *et al.*, 2004), spatial databases and GIS capabilities. The lack of data regarding commuter flow around large cities in Romania, requires approximation of functional urban areas with Potentially Urban Strategic Horizons (PUSH according ESPON 1.1.1.).

Therefore, car travel times from the centers of the Functional Urban Areas (FUA centroids) to each node of the road network are estimated, and based on these travel times, isochrones are determined. For the purpose of this study, 30 minutes isochrones are determined.

As long as the calculation of travel time is based on an unloaded network, i.e. no traffic flows should be taken into account, it is assumed that a 30-minute-drive-time threshold turns into 45–60 minutes in real time, which is equivalent to the average commuting time. The result of this first step of the methodology is materialized by isochrones for each FUA.

For the purpose of statistical analysis and in order to assign municipalities to the FUAs, these isochrones are then approximated to municipality boundaries. The isochrones are overlaid with the municipality boundaries, and if they overlay to a certain degree, then the municipality is considered part of the Potential Urban Strategic Horizon (PUSH) (Kloosterman *et al.*, 2001). For our analysis we considered the optimal coverage of at least 50% of the municipality territory (i.e. more than half the NUTS 5 area was overlapped).

Defining 30 minutes isochrones around urban centres is based on the formation of a continuous cost surface model, in raster format, using all the transportation nodes. The travel cost value that each cell on the surface will be assigned to, is the absolute time of travelling towards the transportation nodes or towards specific network elements. On this matter, we used the Cost Distance tool to perform the cost-weighted distance analysis. This tool is an application of GIS software ARCGIS 10.2.2. Data used: Digital Terrain Model, Road Network, Rail Network, Administrative divisions, Built-up areas, Water courses and Lakes, Raster data set that contains land use according to Corine 2006.

The Cost Surface Model (MSC) result is a map raster, where each cell value represents the total number of seconds required for displacement of a specified point (or points) from a particular cell.

The second stage of the methodology acknowledges that functional urban areas stimulate the growth of the number of inhabitants, number of employees, the total turnover and local government revenue.

Starting from this premise, we developed a spatial database, which contains dynamic statistical indicators for Population, Number of employees, Revenues and Expenses, and Turnover.

The evaluation indicators in case of potential functional urban areas are:

Population Chapter – Population Urban Areas proposed in 2004–2014, The evolution of the population during 2004–2014, The evolution of the urban core (urban centre with a polarizing role in the urban areas proposed) during 2004–2014, Assessment type of population evolution for the years studied – 2004, 2008, 2011, 2014.

Number of Employees Chapter – Total number of employees in urban areas proposed in 2013, Evolution of the number of employees during the period studied (2004–2008–2011–2013), The ratio of number of employees and size of the population of urban areas proposed for the year 2013.

Revenues and Expenses Chapter – The amount of revenue from the proposed Urban Areas – 2013, The evolution of revenues Urban Areas proposed for 2013 compared with 2012, Ratio between revenue and expenditure for the proposed Urban Areas in 2013, Ratio between revenues and population for the proposed Urban Areas in 2013.

Turnover Chapter – Turnover ratio between 2013 and 2009 Turnover, Turnover ratio 2013 to population 2013 in the proposed Functional Urban Areas, Share Turnover proposed functional urban area in total turnover in 2013.

The values for each indicator are divided in 10 classes according to the quintiles method and physical values of each indicator is replaced by the quintile class. Thus, the values of all the indicators used will be transformed into quintiles values of the classes they belong to. The assessment methodology is based on identifying a single indicator for each chapter.

For the Population Chapter, a single indicator was calculated by aggregating the 4 indicators, weighted according to the following algorithm: Population Urban Areas proposed in 2004–2014 (P1) – weighting 30%; The evolution of the population during 2004–2014 (P2) – weighting 50%; The evolution of the urban core (urban centre with a polarizing role in the urban areas proposed) during 2004–2014 (P3) – weighting 10%, Assessment type of population evolution for the years studied – 2004–2008–2011–2014(P4) – weighting 10%.

For the Number of Employees Chapter, a single indicator was calculated by aggregating the 3 indicators, weighted according to the following algorithm: Total number of employees in urban areas proposed in 2013 (S1) – weighting 40%; Evolution of the number of employees during the period studied (2004–2008–2011–2013) (S2) – weighting 30%; The ratio of number of employees and size of the population of urban areas proposed for the year 2013 (S3) – weighting 30%.

For the Revenues and Expenses Chapter, a single indicator was calculated by aggregating the 4 indicators, weighted according to the following algorithm: The amount of revenue from the proposed Urban Areas – 2013 (V1) – weighting 60%; The evolution of revenues Urban Areas proposed for 2013 compared with 2012 (V2) – weighting 5%; Ratio between revenue and expenditure for the proposed Urban Areas in 2013 (V3) – weighting 5%, Ratio between revenues and population for the proposed Urban Areas in 2013 (V4) – weighting 30%.

For the Turnover Chapter, a single indicator was calculated by aggregating the 3 indicators, weighted according to the following algorithm: Turnover ratio between 2013 and 2009 Turnover (CA1) – weighting 20%; Turnover ratio 2013 to population 2013 in the proposed Functional Urban Areas (CA2) – weighting 40%; Share Turnover proposed functional urban area in total turnover in 2013 (CA3) – weighting 40%.

3. RESULTS AND DISCUSSION

The first stage in evaluating the potentially functional urban areas in Romania is based on surveys concerning accessibility on the main communication routes (roads, railway stations, airports and ports) and on the degree of accessibility within the network of urban settlements, the network of county capitals and within the urban network with a population over 20,000 inhabitants.

These accessibility studies offer the possibility to define possible functional urban areas around the county capital and around the cities that are not part of the influence area of the county capital. The steps required to identify potentially functional urban areas demanding further analysis map are:

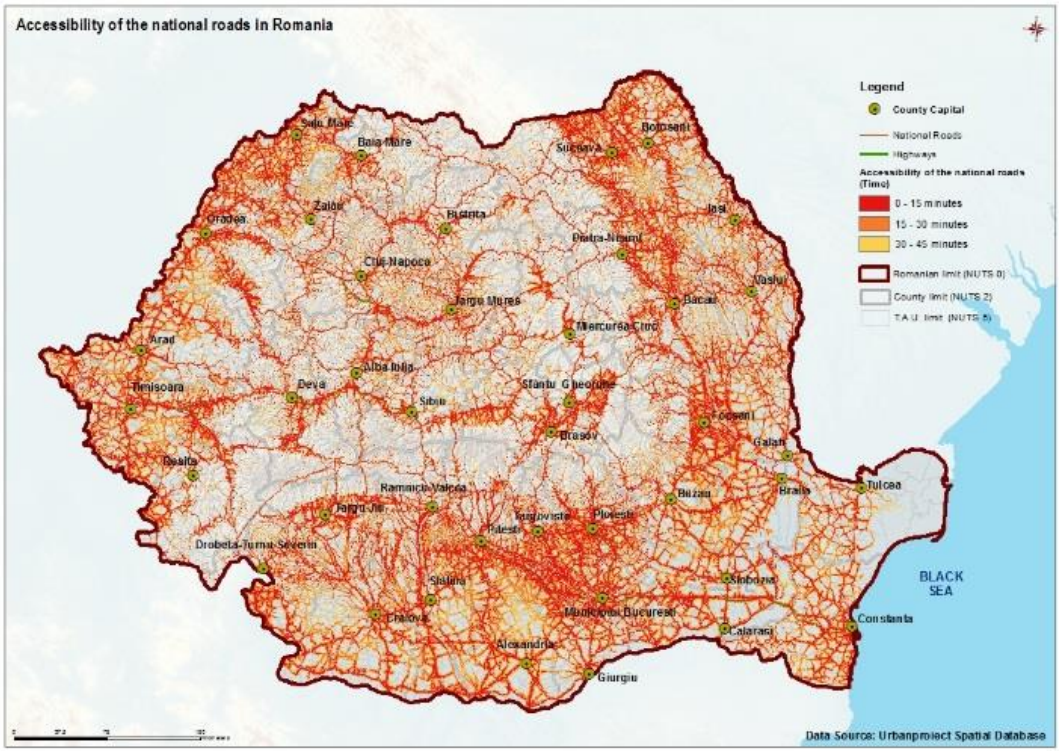

Fig. 1 – Accessibility of the national roads.

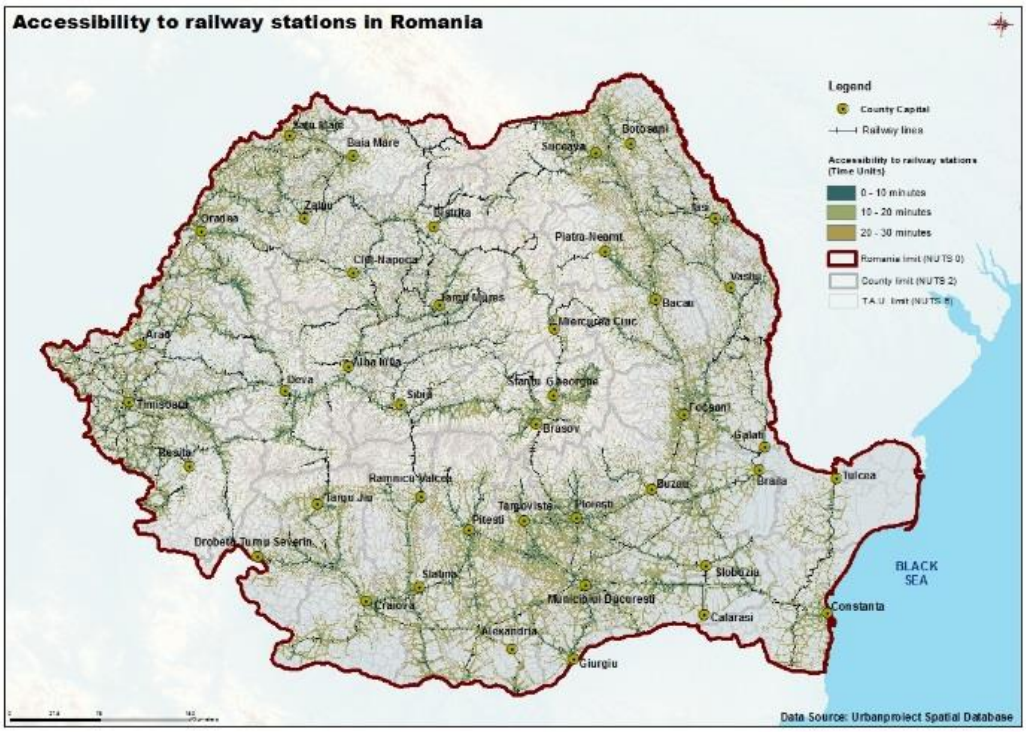

Fig. 2 – Accessibility to railway stations.

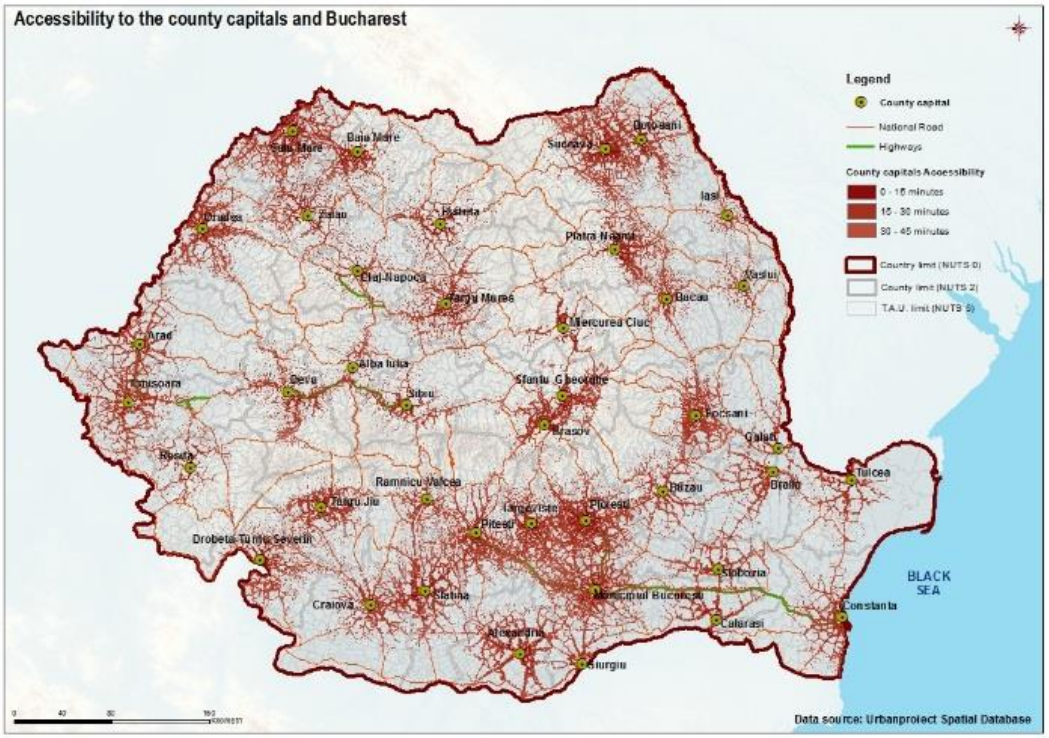

Fig. 3 – Accessibility to the county-seats and Bucharest.

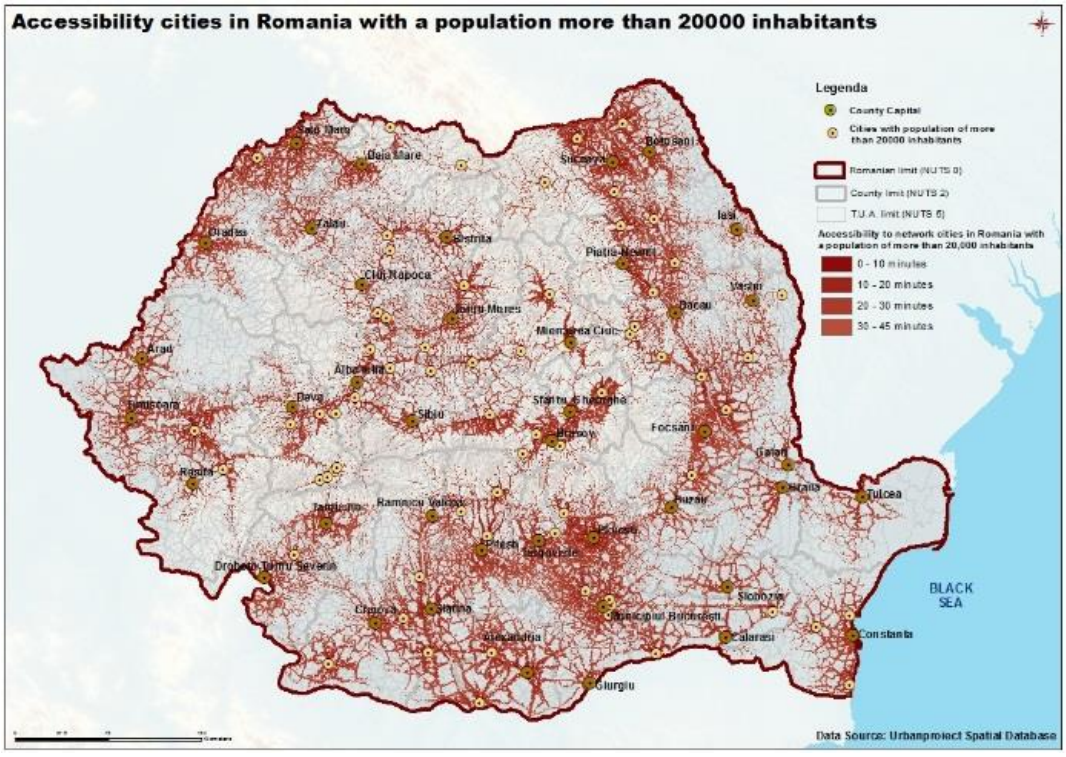

Fig. 4 – Cities accessibility with population more than 20,000.

A polycentric urban system presumes a uniform distribution of cities in the territory and not a highly polarized distribution where usually major cities are clustered only in a certain part of the studied territory. Therefore, a correct polycentric study (analysing the territorial distribution of towns, namely functional urban areas) is an important precondition. A possible approach is to divide the territory in service sectors, so that each city lies within an area which is served and can be measured in relation to the centroid of the cities studied.

For a correct evaluation we took into account the connectivity between centres, which is reflected in an increase in the annual average daily traffic.

In this study, we assume that the centers of functional urban areas are all county capitals of Romania, alongside urban centers that have a number of population exceeding 30,000 inhabitants, and do not belong to Strategic Urban Horizons of the potential county capitals.

According to the analyses conducted to evaluate potentially strategic urban horizons (PUSH) we determined the following 67 countrywide possible functional urban areas:

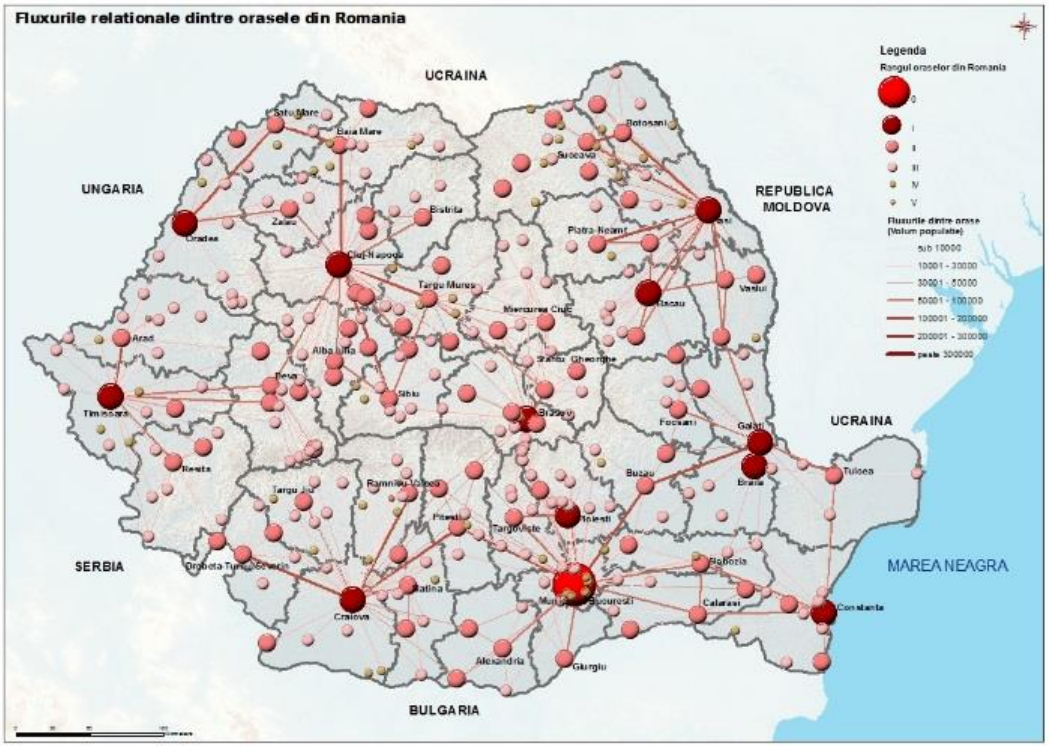

Fig. 5 – Relational flows in the regions of Romania.

The next step in Urban Areas assessment was to determine Thiessen polygons in order to characterize the spatial distribution. The territorial distribution program was made possible through ARCGIS 10.x capabilities and territorial analysis module - Spatial Analyst. We determined centroid cities that make up the network of functional urban areas and then, using the mathematical tool in Spatial Analyst module for determining a network Thiessen polygons points and a defined territory, we determined Thiessen polygons for each network of potential functional urban areas. An important element in this analysis of national polycentricity is the calculation of the polygons areas. It demonstrated that if Thiessen polygons surfaces are similar the territorial distribution of cities is closer to an ideal polycentric urban system.

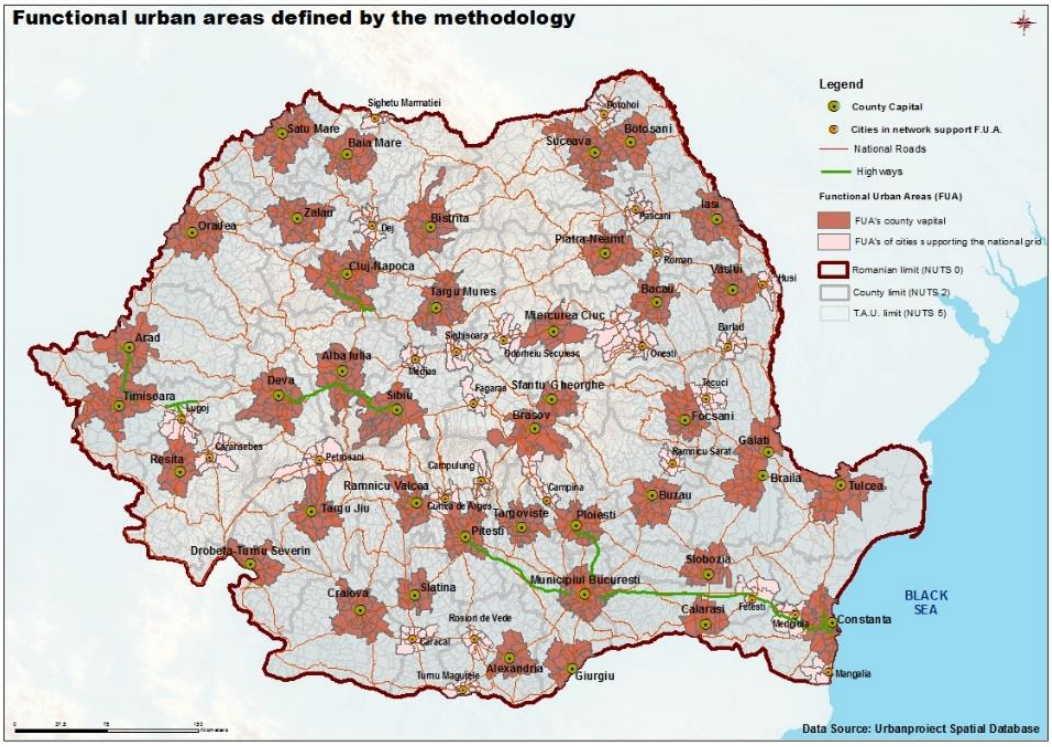

Fig. 6 – Possible functional urban areas defined by methodology.

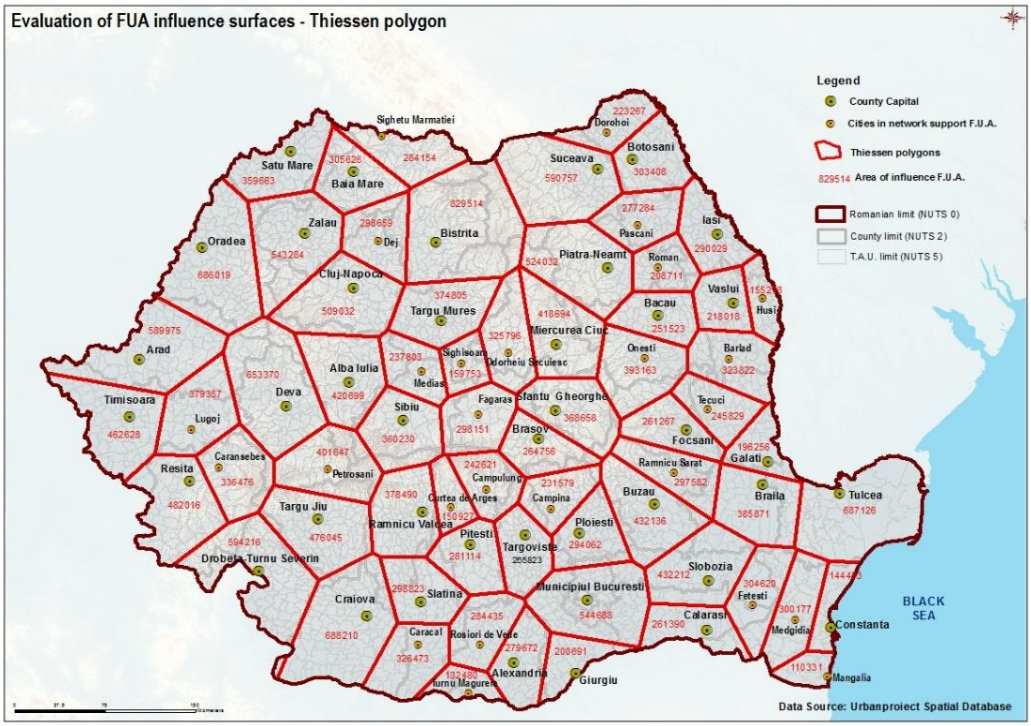

Fig. 7 – The distribution map of urban centres for functional urban areas results (Thiessen polygons).

The next step in establishing a possible polycentric urban system is to evaluate the potentially Functional Urban Areas based on the indicators already specified in the methodology part. For this purpose, a database was made, consisting of proposed territorial indicators and a study of their dynamics. The software used for these analyses was ARCGIS 10.2.2.

The final analysis was performed by determining the final index calculated by summing up the four weighted aggregate indicators as follows:

– Population Indicator– 20% weighting

– Number of employees Indicator– 30% weighting

– Revenues and expenses Indicator – 20% weighting

– Turnover Indicator – 30% weighting.

The index map of the final analysis of the potential functional urban areas in Romania is the following:

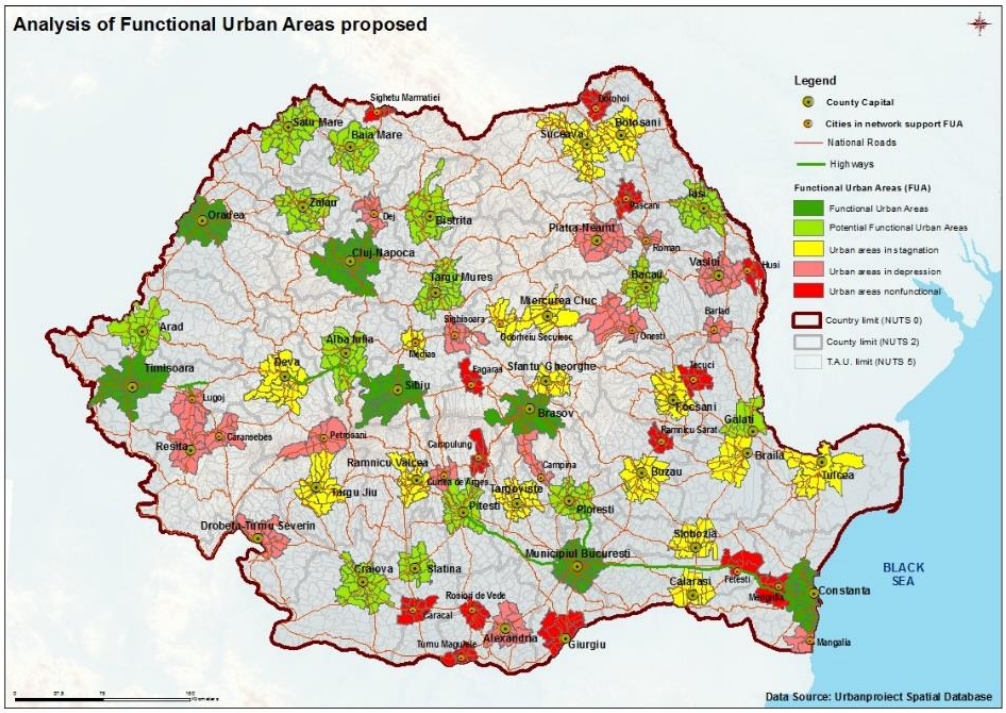

Fig. 8 – Typology of functional urban areas.

Based on the unique index obtained for all the 67 possible functional urban areas we considered five types of urban areas: Non-functional urban areas; Urban areas in depression; Urban areas in stagnation, Potentially functional urban areas; and Functional Urban Areas.

We notice that developments of communication technologies and transport infrastructure led to populating adjacent areas of the urban centres and of the adjoining communication lines. Thus, several urban areas based on urban migration in both directions emerged, actually comprising an urban centre and the surrounding settlements.

Cities like Bucharest, Cluj, Timişoara, Arad, Oradea and Ploieşti became ‘metropolitan areas’ by outsourcing production into new industrial platforms, within their suburban area. They also using the network infrastructure surrounding smaller cities for logistics and production.

Thus, in Figure 9 we synthesised the functional urban areas and the potentially functional urban areas.

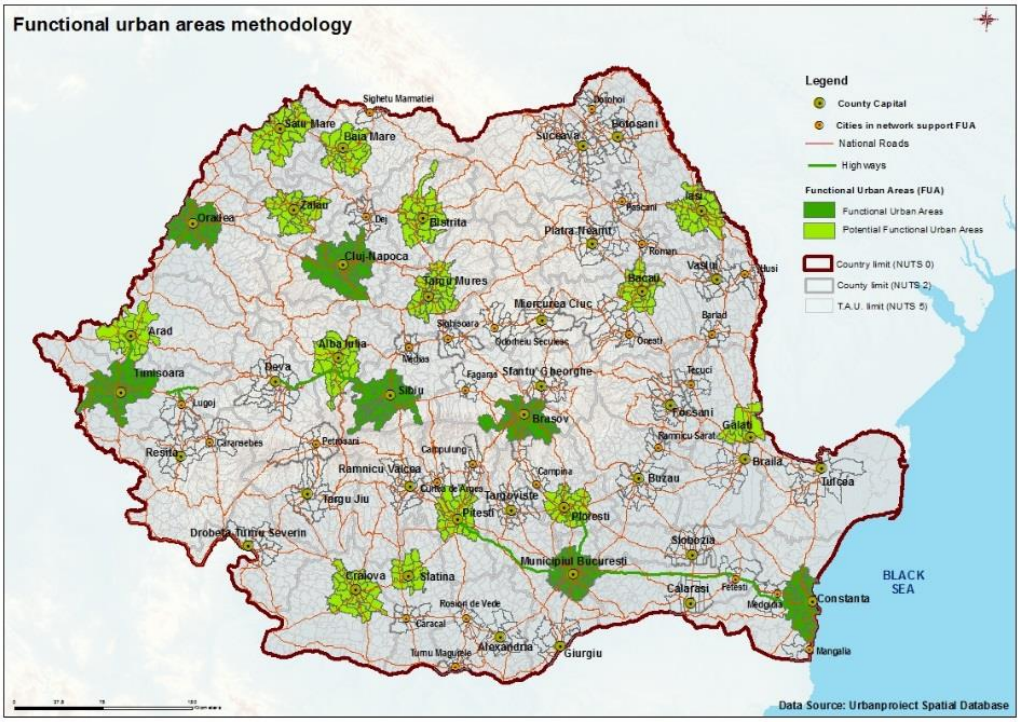

Fig. 9 – Functional Urban Areas in Romania.

4. CONCLUSIONS

Polycentricity is largely a function of connectivity, indicating the frequency and form of exchanges between urban centres, which requires connecting transport infrastructure development strategies with spatial planning strategies. Blockages occurring in Romania regarding the evaluation of polycentric development is due to the lack of data on the number of commuters and daily commute.

The proposed methodology at the Romanian level contains seven functional urban areas (2 areas in Muntenia – Bucharest, Constanţa, and five areas in Transylvania – Timişoara, Cluj-Napoca, Oradea, Sibiu and Braşov). Areas with potential to become functional urban areas are 14 in number: in Muntenia – 4 (Ploieşti, Piteşti, Craiova, Timişoara), in Moldova – 3 (Iaşi, Bacău, and Galaţi) and in Transylvania – 7 (Arad, Alba Iulia, Târgu Mureş, Bistriţa, Zalău, Satu Mare and Baia Mare). But, territorial development policies are primarily based on foreign capital inflows rather than on national, county or local capital. These foreign capital inflows support labour polarization around large cities by outsourcing production into new industrial sites, located in their suburban area.

In terms of operationality and governance, at European level, functional urban areas are considered elementary units which are compulsory for a polycentric development, therefore it is regarded as appropriate to implement the concept of functional urban areas in territorial policies, administrative procedures and legal prerequisites (Espon 1.4.3, 2007).

The assertion of European metropolitan integrated areas requires a new strategy for maximizing the integrated development of large cities in Romania. Therefore it is necessary to perform a diagnostic analysis that redefines urban functional areas of the county municipalities and to implement national strategies on achieving functional specializations and smart functional specializations. Romania needs a process of regionalization-decentralization to enable a collaboration based on integrated territorial principles. Current Intercommunity Development Associations and Local Action Groups do not qualify for the implementation of large projects.

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Received June 3, 2015