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Evaluation of spatial differentiation in the Pilsen region from a socioeconomic perspective

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Abstract. The main objective of this article is to evaluate spatial differentiation in the Pilsen region in the Czech Republic, to create a typology of territorial units, and to evaluate the potential for development and possible threats to development in relation to individual territorial types. To this end, municipal statistical indicators pertaining to population, employment, and economy, were gathered from each of the given territories. The Voronoi map technique was applied to interpolate the values of selected indicators. The typology was created using one of the multivariate statistical methods, namely, the cluster analysis. Furthermore, typological regions and strategies for their development were created.

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1. Introduction

There are many variables in the social and economic development of regions with different hierarchical levels. When monitoring the development of macro-regions, a number of indicators are usually available, which may reveal the social and economic condition and development of those regions. Statistical approaches used in processing data for hierarchically higher territorial units ultimately lead to the blurring of social and economic distinctions in relation to hierarchically lower territorial units. In addition, some lower territorial unit indicators are not included in published statistics and the spatial level data base varies with regard to both accessibility and detail. Therefore, implementing social and economic analysis, synthesis, and typology at the regional level is highly dependent on the size of the monitored area and the availability of data.

Some analysis of socioeconomic data at the municipal level (LAU 2) has been conducted in statistical surveys made in the Czech Republic, but most of the analysis has only been done at the regional level (NUTS 3), or at the level of municipal administrative units with extended powers and municipalities with authorized municipal office. For regional development, policy, and strategic planning purposes, detailed information regarding spatial differentiation from a socioeconomic perspective is required. From this data, a detailed synthesis and typology must then be derived. Using this information, it is possible in the smaller units (usually LAU 2 municipalities) to monitor both the inequalities and similarities of development levels, in socioeconomic terms. Many authors stress the need to work on a large-scale level, while others prefer using case studies for smaller areas (Macešková et al., 2009).

Problems associated with the selection of regions and their aggregation had been previously pointed out by Openshaw (1984), who called it a "modifiable areal unit problem" (MAUP). This problem arises from the imposition of artificial units for spatial research of continuous geographical phenomena, which leads to the creation of artificial spatial phenomena. There are two types of MAUPs: scale problems and aggregation problems. A scale problem result from a "variation in results that can often be obtained when data for one set of areal units are progressively aggregated into fewer and larger units for analysis" (Openshaw, 1984: 8). An aggregation problem arises when different results are obtained from the same data set, "due to the use of alternative units of analysis when the number of units is held constant" (Openshaw, 1984: 8).

The quality of the results strongly depends on the input indicators. Analysis at the municipal level is often hindered by insufficient data and, when several parameters are used, processing the data may be challenging. While creating the synthesis, multivariate statistical methods are frequently applied and when visualizing the results of cartographic processing methods, GIS (Geographical Information System) is used. Statistical analysis enables us to process large data files quickly, find various patterns, and discover statistical relationships between different variables. GIS integrates important territorial unit spatial properties into statistical analysis. These methods, i.e. multivariate statistical methods and GIS, may be applied when using reliable data for appropriate territorial units, e.g., extensive files with statistical municipal data. One drawback to the use of these methods is the high level of complex geographical phenomena and their limited repeatability.

The main objective of this paper is to propose an accurate approach to analysing the socioeconomic differentiation of municipalities in the Pilsen region, create a typology of municipalities, define typological regions, and outline both the possibilities for development and potential threats to specific types of socioeconomic space which can significantly contribute to regional policy and strategic planning. The resulting typology may help to harmonize various regional projects in the area.

2. Overview of approaches

The evaluation of differentiation, the creation of regionalization, and the creation of typologies are three important concepts which were addressed in geographical works during the second half of the 20th century. The basic classical approach to regional geographic analysis and syntheses was summarized by Lauko and Bašovský (1990). In theory, as well as in practice, issues of spatial organization and

the development of socioeconomic activities were presented in the many works of Hampl (e.g. 1978, 1998, 2007 and 2010). «The current transformation phase of social development is characterized by the extraordinary dynamics of differentiation tendencies. Their orientation from the perspective of different social groups or local communities is different and sometimes conflicting, so it is legitimate to talk about the growing internal social and spatial polarization of national systems» (Hampl, 2007: 890). This development corresponded with the fundamental reshaping of economic performance evaluation, particularly relating to the increased use of qualitative factors, such as human or social capital, in creating an evaluation. According to Hampl (2007), one important aspect of the evaluation is the degree of integrity in the transformation process, i.e. the distinction of the changes within individual subsystems of a society.

Interregional differences in the Czech Republic were evaluated by Blažek (2007). Regional disparities were addressed from different points of view by many other geographers, as well as economists and experts from other fields. With society constantly changing and developing, data used for evaluation had to be modified. Gradually, data related to unemployment, foreign investment, progressive services, and migration were examined from new perspectives (Blažek, Csank, 2007). Research regarding regional disparities was done by Kutscherauer (2008), while the causes and creation of territorial disparities was examined by Hučka (2008). Viturka (2010) also addressed this issue, including an assessment of regional disparities at the regional (NUTS 2) level. The relationships between various aspects of territorial development and the connection between social capital, economic development, and regional government were analysed by Illner, Kostelecký and Patočková (2007). Halás and Klapka (2010) examined the disparity in terms of spatial interactions. Blažek, Netrdová (2009) and Macešková, Ouředníček, Temelová (2009) are examples of authors who addressed the micro level. Unfortunately, geographers often lacked sufficient data to create a detailed analysis, e.g., Halás (2008) in Slovakia, and Marada (2001).

Some geographical works did not deal with disparities in relation to whole territories, but were either devoted to researching specifically-defined types of areas in response to the current social topics of that time, e.g., peripheral areas (Marada, 2001; Havlíček, Chromý, 2001), internal peripherals (Musil, Müller, 2008), and rural area typology (Perlín et al., 2010), or they were dedicated to presenting specific points of view with regard to sub-peripheral territories. Kubeš and Kraft (2011) studied the territory of South Bohemia, in relation to social and population stability. It may be concluded, therefore, that literature presenting a socioeconomic assessment of differentiation is varied in both content and the area examined.

Studies of regional differences abroad were also quite common. Celebioglu and Dall'erba (2010) researched spatial differences among Turkish regions using socioeconomic indicators. In Mexico, this subject was addressed by Seingier et al. (2011), who focused mainly on coastal area typology. In China, Yang and Hu (2008) examined regional disparities by using cluster analysis on calculated Human Development Index. Tykkyläinen and Lehtonen (2010) grappled with municipal typology in Finland as it related to migration and socioeconomic conditions. Pecher et al. (2013) created a regional typology of the European Alps. In the United Kingdom, Coombes and Raybould (1989) evaluated regional differences by developing the Local Enterprise Activity Potential (LEAP) Index, while, in the U.S., Michael E. Porter (2003), compared regions in terms of economic performance. In Poland Konecka-Szydłowska and Maćkowiak (2014) explored the spatial differences in terms of population and settlement within the region Wielkopolskie voivodship (NUTS 2 level) and Nazarczuk (2015) used the concept of regional distance to measure economic diversity between regions within whole Poland. Eupen et al. (2012) created a rural typology for the entire European Union, demonstrating that typology is not limited to the country level alone, but may also be created at a higher territorial unit level as well.

Searching for disparities, differentiating territory according to various criteria, and creating typologies are all prerequisites for applying different characteristics and creating various scenarios for potential regional development. In general, regional development theories in the Czech Republic have been addressed in the works of Blažek and Uhlíř (Blažek, 1996, 1999; Blažek, Uhlíř, 2011). Problem-

atic regions were primarily defined by using unemployment rate and income per capita indicators.

The positive development of these regions may be ensured through the aid of regional policy. Regional policy includes all public interventions which lead to improving the geographical distribution of economic activities, respectively those which attempt to correct certain spatial consequences of a free market economy to achieve two dependent goals: economic growth and improving social distribution of economic effects (Vanhove, Klaassen, 1987). Some underlying principles which should have a positive effect on regional policy in territories of interest (for example, economically-weak or structurally-afflicted regions) are: concentration, partnership, programming, and complementarity (additionality). Regional policy instruments on a micro-regional level are usually focused on business support, infrastructure equipment, civil and technical facilities, human resource development, and the protection of the environment (Wokoun, 2008). Jančák, Chromý, Marada, Havlíček and Vondráčková (2010) address issues related to the development of different territorial types and the effect of various factors on this development, from a social capital perspective, while Chromý and Skála (2010) address these same matters from a cultural and historical perspective.

When creating a geographical typology, the difference between statistics pertaining to only a few specific municipalities and those pertaining to neighbouring municipalities sometimes proves to be a problem. But in reality neighbouring municipalities influence one another. For example, if one village, with a tendency toward depopulation, exists amongst several communities with population growth, it is not a major problem for the region. On the other hand, if there are several municipalities with depopulation tendencies, this fact will be noticeable and will significantly affect the statistics for the whole region. It is possible to eliminate the spatial imbalance created by large fluctuations in these phenomena by using the interpolation method called "Voronoi maps". A Voronoi diagram is a universal geometric structure which, as Ohya et. al. (1984) previously pointed out, may be applied in various fields. This method is often used in human geography when the need to interpolate point values into a space arises (Kusendová, 2002; Lovacká, 2008). "From the Voronoi diagram we can derive all kinds of information about the trading areas of the sites and their relations. For example, if the regions of two sites have a common boundary, then these two sites are likely to be in direct competition for customers that live in the boundary region" (De Berg et al., 2008: 148).

3. Applied methods and procedures

On the basis of analysis of other authors' approaches to this issue, the evaluation of regional differentiation and the creation of socioeconomic types and typological regions in the Pilsen region were all based on processing comprehensive data sets pertaining to population, employment, and the economy in various communities. This was accomplished through the use of multivariate statistical methods, cartographic visualization of created types and typological regions, and expert evaluation of types, as they specifically pertain to potential future development and threats to growth in these territories.

For the purpose of spatial disparity analysis, the smallest possible units were chosen (municipalities). The basic premise of this research is that identified data, i.e. established facts, do not only affect isolated communities, but also their surrounding areas. Therefore, the Voronoi method, whose principle is to aggregate the values of neighbouring points (municipalities), was used. Finally, the selected data was processed using cluster analysis, hence common tool were used for the evaluation of socioeconomic differentiations in regions similarly as in the case of the works of Perlín et al., 2010, or Yang, Hu, 2008.

3.1. Data selection

At first, it was necessary to select indicators which would be appropriate for expressing socio-economic spatial differentiations of regions. There are different theoretical approaches to the selection of proper indicators for spatial socio-economic evaluation. Wong (2002) proposed an approach of analysing 29 indicators to measure the capacity of 11 factors which were designated as determinants of local economic development (LED). To accomplish this, she

went beyond common statistical methods, also using component analysis to analyse the structure and relationship between those 29 indicators. Yet, in the end, she stated that: "the empirical analyses reported here are limited in terms of developing a fully established theoretical model of LED" (Wong, 2002: 1857).

Both a correlation analysis and a component analysis of a wide range of indicators were originally calculated for this paper. While the correlation analysis aided in excluding correlated indicators, the results of the component analysis were limited in quality and, therefore, not used. Data selection for socioeconomic analysis was eventually based on the goals set forth in this article and their accurate representation of socioeconomic realities. Selection was also affected by the availability of data for each municipality. Originally 21 indicators were chosen to represent: 1) population growth, 2) selected aspects of population structure, 3) the labour market, 4) new housing construction, and 5) economic factors which significantly affect municipal development. Population growth was evaluated using the population growth indicator from 2001–2011, with data taken from the 2001 and 2011 Population and Housing Censuses as it takes place once every 10 years).

The following indicators were originally used to evaluate population structure: 1) portion of the population in post-productive age range, 2) portion of the population in pre-productive age range, 3) number of inhabitants per capita who have completed secondary education, including those who have not completed a graduation exam, and 4) number of inhabitants per capita who have completed tertiary education. Instead of the first two indicators, an age index was used. With the third indicator, no regularity related to the size of the municipality or significant spatial differentiation was found; therefore, this indicator was not used for the analysis. The fourth indicator, however, did produce regularities related to the size of the municipality and significant spatial differentiation was found; thus, it was selected for the analysis.

The labour market originally included the following indicators: 1) unemployment rate, 2) number of primary sector employees out of total number employed, 3) number of secondary sector employees out of total number employed, 4) number of tertiary sector employees out of total number employed, and a related indicator 5) number of commuters out of total number employed. Differentiation according to economic sectors was sufficiently represented by the primary and tertiary employment indicators that the secondary sector employee values were excluded from the analysis.

Values for new housing construction represent the number of dwellings completed between 2005 and 2011, in relation to the total population. The year 2005 was selected as the baseline for data because data preceding 2005 were not available.

The following economic indicators were originally proposed: 1) number of economically-active people out of the total population, 2) number of microenterprises, small enterprises, medium enterprises, and large enterprises per capita, 3) number of entrepreneurs per capita, and 4) legal entities per capita. In the end, these type indicators, which are often used by economists for micro, small, medium, and large enterprises, were not used. This categorization was defined by the European Commission, and basically separated firms according to the number of employees, annual turnover, and annual balance sheet. The main parameter for division was the number of employees, which separated firms into the following four categories: fewer than 10 employees (microenterprise), 10–49 employees (small enterprise), 50–250 employees (medium-sized enterprise), and more than 250 employees (large enterprise). These artificially-set boundaries between individual categories of businesses caused significant changes in the assignment of municipalities into clusters and, therefore, were not used for the analysis. Conversely, the individual entrepreneurs per capita and legal entities per capita numbers successfully revealed the municipal business activity and were, consequently, included in the analysis. The economically-active portion of the population indicator was excluded from the analysis because most municipalities had similar numbers and significantly lower numbers only showed up in those municipalities which had a high age index.

Data regarding municipal finances, i.e. per capita municipal revenue, assets, and percentage rate of tax revenue, were excluded after discussion, because they were not suitable for the methods we were using due to averaging numbers in the Voronoi map method. Generally speaking, the resulting indica-

tors (Table 1) were selected for their suitability in presenting municipal differentiation. All indicator values represent 2011 statistics for the 500 municipalities in the Pilsen region, except for those indicators which describe long-term development (U6, U9). In the analysis of regional differentiation, we omitted the interregional centre – the city of Pilsen. The main reason for this was the use of the Voronoi method, which creates types by averaging the values of a municipality's characteristics with those of neighbouring municipalities. If we used Pilsen's values, then the area of Pilsen and its neighbours would create its own individual type and the aim of the article was just the opposite, i.e. to determine which municipalities are similar to the municipalities in the vicinity of Pilsen.

3.2. Data analysis

The indicator values were standardized on a uniform scale and added (using GIS) to the municipality's point feature (municipal area centroids). The Voronoi map (VM) method was used in order to transform the municipal socioeconomic indicator values into diagrams. Voronoi polygons, or Thiessen polygons, represent a spatial method which interpolates values based on the values in the cell and the values of its nearest neighbours (Sibson, 1981). The method's fundamental characteristic is that it excludes significant local differences which are manifested in individual polygons. In geometric terms, this method smooths out the socioeconomic area in the region where isolated extremes occur and, conversely, emphasizes significant regional differences. Furthermore, it is well-adapted to the local structure of the input data, and does not require user input regarding the size, e.g., radius, of the research area, number of sites from which the polygon's value is calculated, nor the shape of the research area. It also works equally well on regularly and irregularly distributed data (Watson, 1992). We used this method because we believe that the selected socio-economic phenomena not only influence individual municipalities in the polygons, but also surrounding municipalities (polygons).

Using this method, each municipality is represented by a dot and the area surrounding that dot is assigned, creating a polygon around the municipality. For each point inside the polygon, the following rule is applied: the distance to the point inside the polygon representing the given municipality is always less than the distance to the point representing a neighbouring municipality. The regional diagram is completely covered with polygons, and the indicator values of the polygons and their neighbours (polygons having a common edge), as well as the values obtained through the statistical processing of those indicator values, were assigned. In our study, we averaged the polygon values and the values of its neighbours together for each individual indicator. The results of the VM method application are shown in Fig. 1.

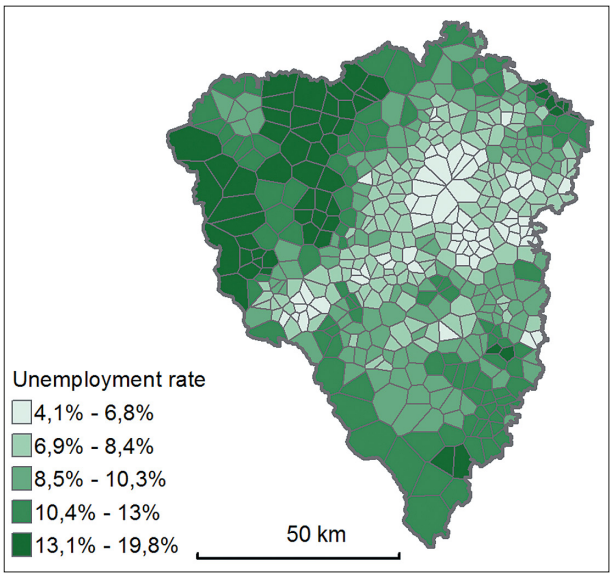
In order to create a spatial typology of the Pilsen region from the results of the VM input data, it was necessary to find a method which could divide the municipalities into several groups. Each group would have similar values for the selected indicators, and each individual group would differ as much as possible from other groups. The method we selected, therefore, was the cluster analysis, one of the statistical methods of multivariate analysis. Cluster analysis may be done in several ways, which can basically be divided into two categories: hierarchical and non-hierarchical. In this case, we selected a non-hierarchical method, called "k-means," found in the STATISTICA program. We chose this particular non-hierarchical method because it provides a simple way to grasp complex geographic data by creating initial classification and typology, which is subsequently easy to work with.

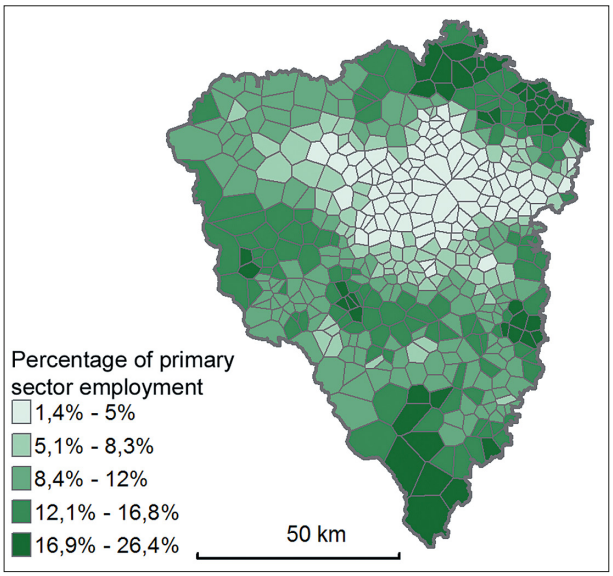
The k-means method was introduced in 1967 by James MacQueen and further developed by Stuart Lloyd (1982), who proposed the standard algorithm. This method enables the dividion of n observations into k clusters, so that each observation is assigned to a cluster whose average value is most similar to the value of the observation itself. The calculation is performed using a number of iterative steps. With the k-means method, it is first necessary to determine the number of clusters. Some consider this a disadvantage of the method when compared with hierarchical methods, where the number of clusters is formed during the calculation. Therefore it is advisable to make the calculation several times, with different numbers of clusters, in order to find the optimal number of those. The foundation of the method is that, after initially dividing the data

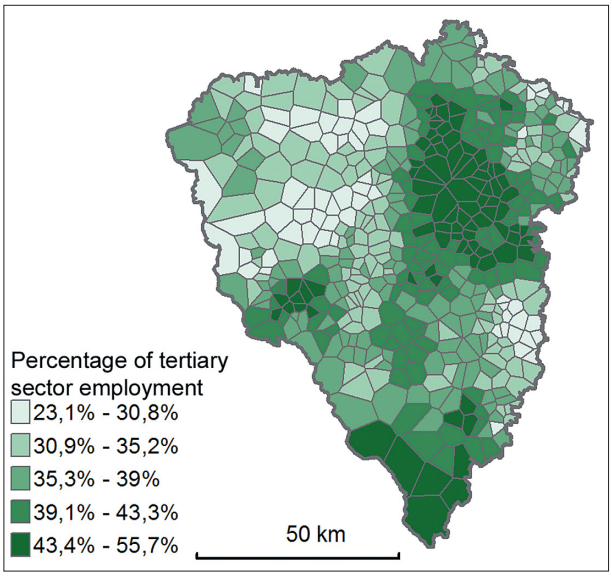
into clusters, it is necessary to calculate the value of each centroid (centre of gravity), which is the average of the data values in any given cluster. Then, the distance between each individual piece of data and the centroids is measured (Euclidean distance), compared to the other data, and reallocated, if necessary. Various data are moved to other clusters if their distance to the centroid of another cluster is shorter than the distance to their current cluster's centroid. This process is repeated until all data are assigned to their proper clusters.

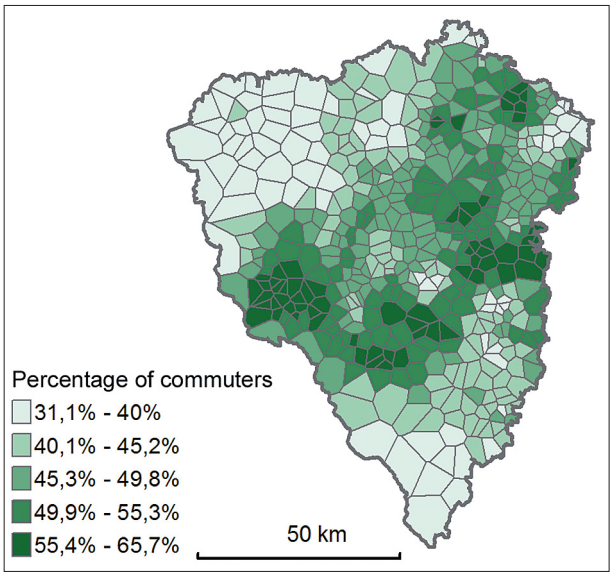
3.3. Cartographic processing using GIS

Thematic maps are an excellent tool for conveying spatial differentiation in relation to socioeconomic phenomena. The visualization of regional differentiation according to indicators in the Voronoi maps (Fig. 1) and the arrangement of socioeconomic types resulting from these maps (Fig. 2) were created in the ArcGIS program, on a thematic layer called, "Voronoi Polygons of the Pilsen Region".









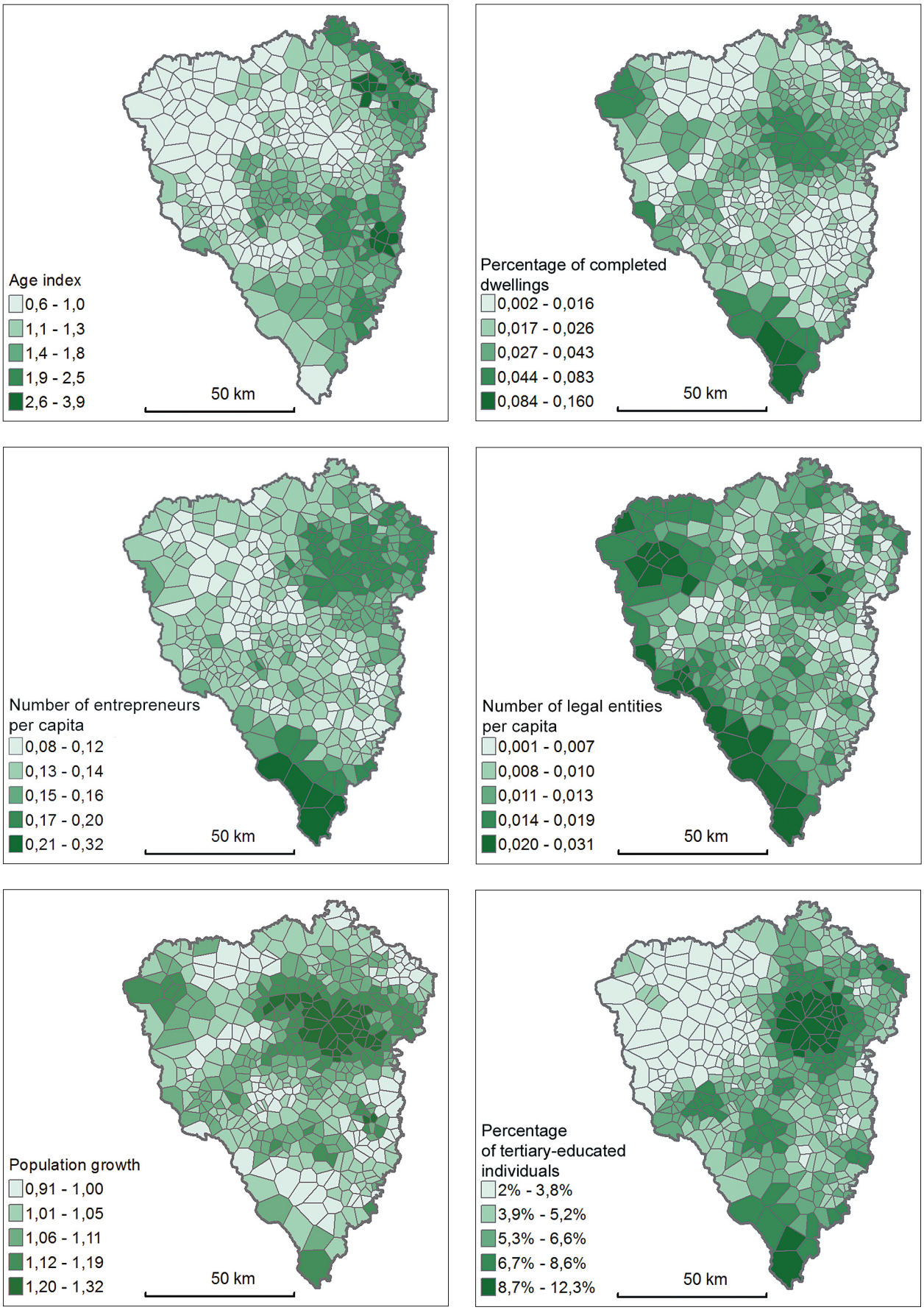


Fig. 1. Average of spatial differentiation indicators using Voronoi map technique

Source: Authors' own elaboration

4. Type evaluation

4.1. Results of processing indicators using Voronoi Maps

Fig. 1 represents spatial differentiation in the Pilsen region, with each cartogram depicting individual selected indicator. The central part of the region stands out significantly as well as the west-northwest region. With certain indicators, e.g., number of tertiary sector employees, number of completed dwellings, number of entrepreneurs per capita, common features are apparent in the Šumava region and the internal peripherals (near the regional borders of South Bohemia and Central Bohemia).

4.2. Results of cluster analysis and spatial definition of types

Using the k-means method from the STATISTICA program, the municipalities were divided into clusters. An expert estimate concluded that there should be five clusters, three of which contain most of the municipalities. Two clusters with extreme indicator values contain far fewer municipalities. Individual clusters represent municipal types, the characteristics of which are shown in Table 1.

Table 1. Characteristics of particular municipality types

	Indicator	Type 1 average	Type 2 average	Type 3 average	Type 4 average	Type 5 average	Total Average
U1	Unemployment rate	6,963	8,501	7,854	10,103	13,553	9,403
U2	Percentage of primary sector employees out of total number employed	3,771	6,542	10,071	16,067	10,398	10,016
U3	Percentage of tertiary sector employees out of total number employed	46,123	36,654	40,388	35,435	31,631	37,446
U4	Percentage of commuters out of total number employed	50,266	45,322	55,484	44,278	41,276	47,373
U5	Age index	1,003	1,297	1,271	1,879	0,966	1,344
U6	Percentage of completed dwellings (2005–2011) out of total population	0,045	0,023	0,020	0,021	0,019	0,024
U7	Number of entrepreneurs per capita	0,160	0,131	0,135	0,146	0,121	0,137
U8	Number of legal entities per capita	0,014	0,009	0,010	0,011	0,013	0,011
U9	Population growth (2001–2011)	1,217	1,096	1,054	1,009	1,026	1,067
U10	Percentage of inhabitants having completed tertiary education out of total population	9,344	4,985	5,970	5,453	3,200	5,508
Total number of municipalities in the type		54	123	120	120	83	501

Source: Author's calculations

This table shows the (non-standardized) average indicator value for each cluster (or type), with each row representing one indicator and each column representing an individual cluster. The highest values are marked in **bold** and the lowest values in *italics*. The basic characteristics of the municipal types are shown in Table 2.

Table 2. Basic characteristics of particular municipality types

Municipality type	Number of municipalities in the type	Change in population 1991–2001	Change in population 2001–2011	Percentage of inhabitants in the region	Percentage of region's total area	Average population of all municipalities per type
				%		
1	54	1,02	1,14	19,6	9,5	1454,1
2	123	1,01	1,04	28,8	16,6	936,4
3	120	0,99	1,02	25,8	18,9	860,4
4	120	0,95	0,97	11,2	25,9	372,1
5	83	1,03	1,00	14,6	29,1	704,5

Source: Author's calculations

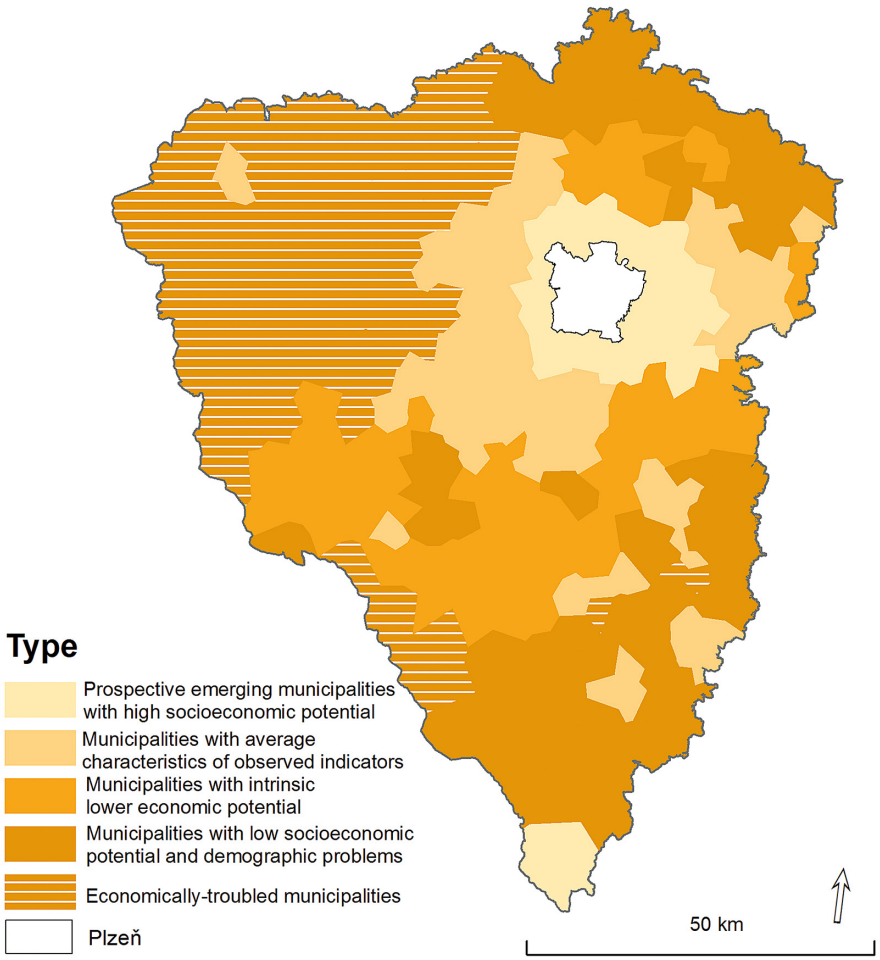


Fig. 2. Socioeconomic types of municipalities in Pilsen region

Source: Authors' own elaboration

As stated previously, the statutory city of Pilsen was excluded from this analysis. Its socioeconomic characteristics are, of course, significantly different from the other regional municipalities. The suburban zone of Pilsen **(Type 1 – prospective emerging municipalities with high socioeconomic potential)** contains fifty-three municipalities, which are characterized by high employment among the population's tertiary sector, by strong housing construction in the area, by a long-term population growth, by a high level of education, and by a high level of economic activity (represented in the number of self-employed individuals and legal entities). In addition to numerous smaller municipalities, this cluster also includes the town of Rokycany, as well as the village of Modrava, in Šumava, where very similar socioeconomic conditions are found. Modrava has developed very quickly, due to its convenient location in a major recreational area. Its potential for successful businesses and concentration of large numbers of people participating in summer and winter recreation enhance the tertiary sector, qualifying this municipality to be included in the Type 1 cluster. This type is spatially less extensive than the other types (9.5% of the regional territory), but relatively strong in population (19.6% of the regional population).

Primarily to the east and west of the Pilsen suburban zone are bordering municipalities whose socioeconomic indicators represent **average characteristics (Type 2)**. In addition to these bordering municipalities, Type 2 also includes the towns of Tachov, Sušice, Horažďovice, Kdyně, Přeštice, Nýřany, Stod, Hrádek u Rokycan, and Nepomuk. Type 2 consists of 123 municipalities, occupying 16.6% of the regional territory, and containing 28.8% of the regional population.

Type 3 municipalities with intrinsic lower economic potential and a stagnating demographic trend primarily run south of the Pilsen region, from the western border to the eastern border, plus a small area to the north. Type 3 is characterized by a small number of local job opportunities and, as a result, a high number of commuters, a high rate of tertiary sector employment, and basically little or no population growth or new housing construction. Type 3 represents an area of 18.9% of the whole region, containing over one quarter of the region's inhabitants.

A large part of the Pilsen region is occupied by municipalities with **low socioeconomic potential and demographic problems (Type 4)**. This type is primarily found in the northeastern part of the region, and the so-called "internal periphery" on the border with Central Bohemia, as well as non-neighboring areas, but is most highly represented in the southeast (also internal periphery), near South Bohemia and partially in the Šumava area. The population of these municipalities predominantly works in the primary sector, with a high proportion of retirement-age people. In addition, there is low business activity, high unemployment, a lower level of education, and stagnation in population growth. Kralovice, the region's agricultural centre, belongs to this type. Type 4 covers an area one quarter of the size of the Pilsen region and contains only 11.2% of the regional population, revealing that, on average, Type 4 municipalities represent the smallest population in the region.

Lastly, **Type 5, economically-troubled municipalities with unbalanced population structures**, includes municipalities located in the northwestern part of the region. In particular, these are found to the west of Tachov, northwest of the Pilsen region, and in the westernmost part of Šumava. Economically, this type is characterized by high unemployment and lower individual entrepreneurial activity. In terms of social characteristics, the most significant positive point is the age structure of the population (the age index average is less than 1) and the worst point is the low education level. The municipalities closest to the western border of the Czech Republic are positioned well for potential cooperation with foreign companies, but this potential is rarely taken advantage of. Type 5 represents the Pilsen region's largest area (29.1%) and contains 14.6% of the regional population.

4.3. Strategies for positive socioeconomic development

Based on the created types, it is possible to discuss the types' strengths and weaknesses and propose strategies for further development of the territories. While the approach and methods are generally valid, the processed types, as well as the proposed strategies, will vary in different territories. However,

due to the large number of municipalities in various types, the strategies cannot take into account specific local circumstances. In our paper the first defined type (Type 1) is the suburban zone within the Pilsen agglomeration. It is a developing area with an excellent location for transport neighbouring the city of Pilsen, close to highway D5, and near a railway corridor. This area is undergoing extensive residential and commercial suburbanization.

From a social perspective, it will be necessary in the future to stabilize the municipal community. This would mean, for example, increasing and strengthening services for families with children (preschools, kindergartens, nurseries, etc.) as well as addressing the issue of the integration of newly-arrived residents into the area. Active municipal and civic associations may also contribute to the area's social development. From an economic point of view, it is necessary to develop mutual cooperation among local enterprises, as well as with Pilsen firms; apply know-how in order to increase value-added production; actively support services catering to entrepreneurship; and develop cooperation with West Bohemia University in areas of research, development, and innovation. A growing population requires the expansion of civic and technical facilities, as well as increased new construction corresponding with the rising number of inhabitants. At the same time, there needs to be a balance between the pressure to develop more businesses and new housing and the importance of maintaining environmental sustainability and landscaping. Increased economic development in this area creates an on-going demand for the appropriation of more agricultural land, which must be regulated in order to maintain ecological stability. Public transport issues must be resolved by improving the integrated transport system, reducing the number of individual commuters which most greatly burden transportation networks and the environment. In Modrava, it is particularly important to harmonize the interests of the growing number of evolving businesses and visitors (i.e. tourists & sports enthusiasts) in the Šumava area with residence regulations in Šumava National Park. It is also crucial to ensure basic conditions (e.g. job opportunities and basic services) for the local population.

For **Type 1** (**prospective emerging municipalities with high socioeconomic potential**) long-term prospects are good, but only under the condition that pressure for housing development and increased economic activity will be appropriately supervised.

In **Type 2** communities (**municipalities with average socioeconomic characteristics of observed indicators**) a harmonious development in all areas of social and economic life is needed. Through careful strategic and spatial planning, the region needs to move toward preventing uncontrolled and/ /or chaotic building and housing development, taking into account its strategic transport position near Pilsen and important communication routes. One specific problem of the region is its declining areas (industrial and agricultural brownfields), which are no longer able to renew themselves, requiring outside help. **Type 3** municipalities (**with intrinsic lower economic potential and a stagnating demographic trend**) are usually stable in the long term, with inhabitants who strongly identify with their surroundings. Due to high employment in the primary sector, it is particularly important to support the establishment of small and medium-sized industrial enterprises and, in general, support and encourage small towns to become development poles in an otherwise rural area. In both Type 2 and Type 3 regions, it is essential to ensure satisfactory public transportation. In addition, Type 2 and Type 3 municipalities are located near Pilsen, in predominantly agricultural regions, with industrial activities tied to strongly-populated towns and major traffic routes. Type 2 is marked by its average characteristics in all observed indicators while, in contrast, Type 3 has significantly higher numbers of commuters and fewer entrepreneurial businesses. In **Type 4** municipalities (**low socioeconomic potential and demographic problems**) demographics necessitate the expansion and improvement of a support system for seniors and an increased development of customized products and services to meet their needs. At the same time, it is possible for communities to benefit from the experience and knowledge of elderly people by encouraging their greater involvement in public life.

Maximum attention should be given to stabilizing the population with regard to the addition of new residents. For example, this would pertain to amenity migrants who come to the region because of its high quality natural environment, the draw of

rural housing, and/or the appeal of a pleasant rural community atmosphere with its varied traditions and customs. New residents may also move into the region for its lower cost in purchasing property. At least two basic conditions must be secured for the population: 1) adequate living conditions, including affordable, good-quality amenities and public services, and 2) accessible transport to larger communities, including the availability of secure public transportation for scattered settlements, e.g., minibus, taxi, car sharing or rental, etc. It is also important to promote entrepreneurship, for example creating incentive programs which will increase entrepreneurial motivation through supporting new directions in business, local crafts, and food production, and promoting traditional manufacturing and services in tourism and leisure activities. One possible way to accomplish this would be to integrate small and medium-sized local businesses into regional development projects and consciously work toward raising awareness of the importance of local cooperation. In Type 4 municipalities, agriculture and other primary sector activities will always be important, so it is, therefore, desirable to promote cooperative economic activity, e.g., organic farming, agro-tourism, hippo-tourism, and other experiential activities of rural tourism. In order to stabilize the region, it is important to strengthen the sense of regional identity, foster the development of civil society, and develop cultural and sports activities in these municipalities.

Finally, in respect to **Type 5** (**economically-troubled municipalities with unbalanced population structures**), which consists of Tachovsko (the area west of Tachov), the area northwest of the Pilsen region, and the westernmost part of Šumava, it is characterized by common historical development. After 1945, people claiming German nationality in the region were evicted; then, several waves of colonization swept over the region; and finally, due to its geographical position and the «Iron Curtain», the majority of the region became a declining peripheral area. After 1989, due to its open borders and newly-built highways, the area gained new potential to connect with the booming German economy, but these potential benefits were not widely experienced. Though there are quite a few legal entities in the Tachovsko area, in particular funded by foreign capital, located along highways or in industrial zones, and primarily related to logistics, these companies employ relatively few inhabitants. The region has a persistently high unemployment rate and the population's low long-term education level is problematic. Therefore, it is necessary to focus on improving the educational structure, not only in relation to the youth, but also in the following ways: offering requalification programs for adults, familiarizing people with examples of good business practices, enabling the exchange of work experiences, and helping new entrepreneurs. It is also important to develop forms of lifelong learning and education in the region, both in the context of public institutions and also commercial businesses, as well as, more importantly, non-profit entities. Higher education and the development of more useful competencies in the workforce will be critical for the successful development of this region in the future.

A significant factor in stabilizing the population is the strengthening of regional identity, especially among young people, as strong regional identity will be a deterrent to their leaving the region when they become adults. It should also increase their desire to continue living there and contributing to the region's development. Strengthening civil society, developing micro-regional centres, and integrating those centres into the region, may significantly contribute to the region's development.

In the economic field, it is vital to ensure the development of trade. Equally important is the restoration of traditional crafts and the development of production sectors for these crafts; though conditions for these activities exist in the region, these types of firms are underrepresented in this area when compared with other regions. At the same time, it is also important that those involved in agricultural production and forestry activities comply with the rules of sustainable development by using alternative forms of farming, in accordance with policies related to the "Bohemian Forest Protected Landscape Area" (PLA Český les) and Šumava National Park. In addition to agricultural and industrial brownfields in the border areas, there are also abandoned former military facilities which have potential to be renovated and used for other purposes. There is also the problem of not taking advantage of potential funding which might be available for the Tachovsko area. On one hand, the narrowly-de-

fined purpose of the funding significantly restricts its usage; and, on the other hand, people in the region are simply not taking advantage of potential grant monies, like the "Objective 3" Czech-Bavaria Programme and similar projects. Once again, the remoteness of the region requires ensuring at least basic amenities and transport accessibility to regional centres, even in the smallest communities.

5. Discussion

One of the key issues in geography is the question of spatial dislocation of both phenomena and processes. Often, the result of evaluating spatial dislocation is the creation of a typology and typological regionalization (Perlín et al., 2010; Novák, Netrdová, 2011; Halás, Klapka, 2010), with each typology having its own particular purpose. The goal is to assess the differentiation of specific phenomena or processes which relate to the solved problem. When creating types for hierarchically-lower territorial units found within larger territorial units (districts, regions, or countries), the results are extremely diverse (greater segmentation). Though some experts select larger units in order to create typologies and regionalizations, e.g., districts (Perlín et al., 2010) or regions (Viturka, 2010), working with larger units does not adequately capture the heterogeneity of observed phenomena, processes, and problems.

One way to create regional types is through the use of the "daily urban system" (DUS), proposed by Coombes et al. (1979), who devised spatial units for the United Kingdom in 1981. The authors define the DUS as a two-stage process, where it is first necessary to identify urban employment centres (cores) and then identify each core's commuter frontiers. According to the authors, the main difference between these two types of units is the degree of self-containment. Another possibility for regionalization was proposed by Farmer and Fotheringham (2011), who approach "commuting patterns as a network of flows in order to delineate functional regions useful for representing local labour markets" (Farmer, Fotheringham, 2011: 2738), thus trying to create functional regions for the use of network access (i.e. a network-based approach).

In comparison with the past, today's technology and methodologies enable the processing of more hierarchically-lower unit typologies and regionalizations, which reflect the actual situation, while complying with the principles of typology and regionalization. One way to process these larger quantities of data is to create regional types and definitions using Voronoi maps (Gold, 1991) and multivariate statistical methods, which, in our case, meant using cluster analysis (k-means method). The fundamental advantage of using these processes is that when dealing with large numbers of smaller spatial units containing a greater number of indicator values, the end result is fewer types containing regions with a certain internal homogeneity related to the indicators studied. In order to obtain satisfactory results, it is essential to choose suitable quality indicators corresponding to the problem being addressed.

The Pilsen region's spatial differentiation is both similar to and different from the differentiation found in other regions of the Czech Republic. One particular similarity is the existence of large-city agglomerations. The extent of this similarity, however, varies according to the population size and economic strength of the core city, as well as whether the agglomeration is created by only one core city or more than one, where no one core is significantly dominant. The shape of the agglomerated area and suburbanized zone depends on various factors, particularly the nature of the natural environment and its various barriers for example, with regard to location, it specifically affects housing construction and the shape and density of transportation networks, but they also depend on the distribution of socio-economic activities. The most significant centres, i.e. development poles, the main population concentration areas, economic activities, and main development axes clearly affect the socio-economic situation of the whole monitored area.

Furthermore, this article's defined municipality types similarly occur in other regions, but in different spatial units and arrangements. For example, the lowest long-term economic potential and economic development we see in the Pilsen region are found in the westernmost area (particularly near Tachov), a compact area comprising almost a third of the region. This is due to historical factors related to the events of the Second World War

and post-war period, whose effects, even after decades, have still not been overcome. Even a change in the relative position of this area with regard to its economically-strong foreign neighbours and, thus, a significant change in the area's potential, e.g., due to the possibility of foreign investment, the proliferation of innovation, and cross-border cooperation, has not managed to help kick-start greater economic development in the area. In addition, protracted demographic challenges and population structure problems have started to appear.

In other areas of the country, economically-weak regions are not only located in the borderlands. For example, low economic potential and a low level of socio-economic development are recorded in Bohemia's internal peripheral regions, or in structurally disabled regions. Although the spatial distribution of municipality groups fitting within our defined socio-economic types is different in various hierarchical levels of administrative units, we can state that the existence of these defined types of municipalities has been proven and is repeated in all administrative unit levels. Similarly, the cores, peripherals and semi-periphery may also be observed at the global level, where it is possible to define territories with similar general characteristics in much lower hierarchical levels and in even more detailed categories.

In the previous chapter, we outlined strategies which could potentially lead to positive development in each individual region. The success of each of these long-term goals is mutually dependent upon the success of all of the other goals. The primary common element is ensuring basic conditions for quality of life. When implementing these strategies, it is important to remember to keep a certain balance between various spatial activities. To lean too greatly or not enough in one direction with regard to a particular activity may have a reverse impact on a related or corresponding activity. For example, developing transport networks, which leads to the improvement of transport accessibility, often has a negative impact on environmental quality. Creation of strategies is always based on selected information or data. However such information (data) can never describe the entire reality. The development and change in regional quality of life can be influenced by unpredictable and unrecorded events or processes that cannot be captured statistically.

It is also important to realize that the creation and implementation of specific strategies in the territory, based on the above described procedures, should be further coordinated and corrected with the wishes of the local population and trends they want to aim in order to fulfil the concept of participative management. The Community-Led Local Development Strategy which was frequently used in recent years in the Czech Republic is a good example. This strategy if often applied in the activities of the so-called Local Action Groups, i.e. organizations which are formed by voluntary association of municipalities. These organizations seek to develop their territory from below – at first identifying the wishes of region's inhabitants, then planning jointly the region's future, and at last implementing those plans.

6. Conclusions

In our work, we studied the theoretical aspects of regional differentiation in the Pilsen region, primarily in the socioeconomic sphere, and the potential practical application of the resulting typologies in strategic regional planning. We designed a framework for developmental strategies in five defined types according to municipal economic and social capital. It is assumed that these proposals will contribute to the debate on regional development in the Pilsen region, as well as its individual municipalities. These proposals may also assist in the harmonization of various regional projects in the area. The Voronoi map method allows the creation of a typology and subsequent regionalization of data suitable for solving specific problems which, in our case, is the definition of types for area strategic planning.

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References

Bašovský, O. and Lauko, V., 1990: Úvod do regionálnej geografie (Introduction to regional geography – in Slovak), Bratislava: SPN.

Blažek, J. and Csank, P., 2007: Nová fáze regionalniho rozvoje v ČR? (A New Phase of Regional Development in the Czech Republic? – in Czech). In: *Sociologický časopis/Czech Sociological Review*, Vol. 43, No. 5, pp. 945–965.

Blažek, J., 1996: Meziregionální rozdíly v České republice v transformačním období (Inter-regional disparities in the Czech Republic During the Transition – in Czech). In: *Geografie – Sborník ČGS*, Vol. 101, No. 4, pp. 265–277.

Blažek, J. and Netrdova, **P.,** 2009: Can Developement Axes Be Identifi ed By Socioeconomic Variables? The Case Study of Czechia. In: *Geografie – Sbornik ČGS*, Vol. 114, No. 4, pp. 245–262.

Blažek, J., 1999: Teorie regionálního vývoje: je na obzoru nové paradigma či jde o pohyb v kruhu (Regional development theories: a vicious circle? – in Czech). In: *Geografie – Sborník ČGS*, Vol. 104, No. 3, pp. 141–159.

Blažek, J. and Uhlíř, D., 2011: Teorie regionálního rozvoje. Nástin, kritika, klasifikace (Regional development theories: Outline, criticism, classification – in Czech), 2. edition, Prague: Karolinum.

Celebioglu, F. and Dall'erba, S., 2010: Spatial disparities across the regions of Turkey: an exploratory spatial data analysis. In: *The Annals of Regional Science*, Vol. 45, No. 2, pp. 379–400. DOI: http://dx.doi.org/10.1007/s00168-009-0313-8

Czech Statistical Office, 2011: Registr ekonomických subjektů (Register of economic entities – in Czech) [online]. Prague [cit. 2014–09–17]. Available at: http://apl.czso.cz/irsw/

Coombes, M.G., Dixon, J.S., Goddard, J.B., Openshaw, S. and Taylor, P. J., 1979: Daily Urban Systems in Britain: From Theory to Practice. In: *Environment and Planning A*, Vol. 11, pp. 565–574. DOI: http://dx.doi.org/10.1068/a110565

Coombes, M. and Raybould, S., 1989: Developing a Local Enterprise Activity Potential Index. In: *Built Environment*, Vol. 14, No. 2, pp. 107–117.

De Berg, M., Cheong, O., Van Kreveld, M. and Overmars, M., 2008: Computational Geometry: Algorithms and Applications, Berlin: Springer-Verlag Berlin Heidelberg, pp. 386. DOI: http://dx.doi.org/10.1007/978-3-540-77974-2

Eupen, M.V., Metzger, M.J., Pérez-Soba, M., Verburg, P.H., van Doorn, A. and Bunce, R.G.H., 2012: A rural typology for strategic European policies. In: *Land Use Policy*, Vol. 29, No. 3, pp. 473–482 DOI: http://dx.doi.org/10.1016/j.landusepol.2011.07.007

Farmer, C.J.Q. and Fotheringham, A.S., 2011: Network-based Functional Regions. In: *Environment and Planning A*, Vol. 43, No. 11, pp. 2723–2741. DOI: http://dx.doi.org/10.1068/a44136

Gold, C.M., 1991: Problems with Handling Spatial Data — the Voronoi Approach. In: *CISM Journal*, Vol. 45, pp. 65–80.

Halás, M., 2008: Priestorova polarizacia spoločnosti s detailnym pohľadom na periferne regiony Slovenska (The Spatial Polarisation of Society with a Detailed Review of Peripheral Regions in Slovakia – in Slovak). In: *Sociologicky časopis /Czech Sociological Review*, Vol. 44, No. 2, p. 349–369.

Halás, M. and Klapka, P., 2010: Regionalizace Česka z hlediska modelováni prostorových interakci (Regional division of Czechia on the basis of spatial interaction modelling – in Czech). In: *Geografie*, Vol. 15, No. 2, pp. 144–160.

Hampl, M., 2007: Regionální diferenciace současného socioekonomického vývoje v České republice (Regional Differentiation of Current Socio-Economic Development in the Czech Republic – in Czech). In: *Sociologicky časopis / Czech Sociological Review*, Vol. 43, No. 5, pp. 889–910.

Hampl, M., 1998: Realita, společnost a geografická organizace: hledání integrálního řádu. Reality, society and geographical organization: Search for Integral order – in Czech), Prague: DemoArt, pp. 110.

Hampl, M., 2010: Regionální diferenciace společnosti: obecné typy vývojových procesů (The regional differentiation of society: general types of development processes – in Czech). In: *Geografie,* Vol. 115, No. 1, pp. 1–20.

Hampl, M., Ježek, J. and Kühnl, K., 1978: Sociálně geografická regionalizace ČSR (Social geographical regionalization of Czechoslovakia – in Czech), Prague: VUSEI.

Havlíček, T. and Chromý, P., 2001: Příspěvek k teorii polarizovaného vývoje území se zaměřenim na periferni oblasti (Contribution to the theory of polarized development of a territory, with a special attention paid to peripheral regions – in Czech). In: *Geografie – Sbornik ČGS*, Vol. 106, No. 1, pp. 1–11.

Hučka, M., 2008: Vznik a příčiny územních nerovností (The origin and cause of regional disparities – in Czech). Regionální disparity (Regional disparities), In: *Working papers*, No. 1, Ostrava: EF VŠB-TU, OPF SU, pp. 13–19.

Chromý, P. and Skála, J., 2010: Kulturně geografické aspekty rozvoje příhraničních periferií: analýza vybraných složek územní identity obyvatelstva Sušicka (Cultural-geographical aspects in the development of borderland peripheries: an analysis of selected elements of territorial identity among residents of the Sušicko region – in Czech). In: *Geografie*, Vol. 110, No. 2, pp. 223–246.

Illner, M., Kostelecký, T. and Patočková, V., 2007: Jak fungují kraje – příspěvek k hodnocení výkonu krajských vlád (How Regions Function – An Attempt at Evaluating the Performance of Regional Governments – in Czech). In: *Sociologický časopis /Czech Sociological Review*, Vol. 43, No. 5, pp. 967–992.

Jančák, V., Chromý, P., Marada, M., Havlíček, T. and Vondráčková, P., 2010: Sociální kapitál jako faktor rozvoje periferních oblastí: analýza vybraných složek sociálního kapitálu v typově odlišných periferiích Česka (Social capital as a factor in the development of peripheral areas: an analysis of selected components of social capital in Czechia's typologically different peripheries – in Czech). In: *Geografie*, Vol. 115, No. 2, pp. 207–222.

Konecka-Szydłowska, B. and Maćkowiak, H., 2014: Spatial differences in the level of population and settlement development in Wielkopolskie voivodship. In: Szymańska, D. and Biegańska, J. editors, *Bulletin of Geography. Socio-economic Series*, No. 24, Toruń: Nicolaus Copernicus University Press, pp. 93–104. DOI: http://dx.doi.org/10.2478/bog-2014-0016

Kubeš, J. and Kraft, S., 2011: Periferní oblasti jižních Čech a jejich sociálně populační stabilita (South Bohemian Peripheral Areas and Their Social-Population Stability – in Czech). In*: Sociologický časopis /Czech Sociological Review*, Vol. 47, No. 4, pp. 805–829.

Kusendová, D., 2002: Aplikácia vzdialenostných operátorov GIS v demogeografických analýzach (Application of distance GIS operators in geodemographic analysis – in Czech). In: *GIS...Ostrava 2002.* Ostrava, VŠB-TUO. Available at: http://gis.vsb.cz/GIS_Ostrava/GIS_Ova_2002/Sbornik/Referaty/kusendova.htm, DoA: 17 September 2014

Kutscherauer, A., 2008: Východiska výzkumu regionálních disparit v územním rozvoji České republiky (Background research on regional disparities in regional development Czech Republic – in Czech). Regionální disparity (Regional disparities), In: *Working papers*, No. 1, Ostrava: EF VŠB-TU, OPF SU, pp. 6–12.

Lehtonen, O. and Tykkyläinen, M., 2010: Self-reinforcing spatial clusters of migration and socio-economic conditions in Finland in 1998–2006. In: *Journal of Rural Studies*, Vol. 26, No. 4, pp. 361–373. DOI: http://dx.doi.org/10.1016/j.jrurstud.2010.02.003

Lloyd, S.P., 1982: Least squares quantization in PCM. In: *IEEE Transactions on Information Theory*, Vol. 28, No. 2, pp. 129–137.

Lovacká, S., 2008: The Use of the Voronoi Tessellation for Purposes of Service Distribution District Delimitation (the Example of the Prešov Nodal Region). In: *Acta Facultatis Studorium Humanitatis et Naturae Universitatis Prešoviensis: Prírodné vedy: Folia Geographica 12: special issue for the 31th Congress*, Tunis, Vol. XLVII, No. 12, pp. 163–171.

Macešková, M., Ouředníček, M. and Temelová, J., 2009: Sociálně prostorová diferenciace v České republice: implikace pro veřejnou (regionální) politiku (Socio-spatial Differentiation in the Czech Republic: Implications for Public (Regional) Policy – in Czech). In: *Ekonomický časopis*, Vol. 57, No. 7, pp. 700–715.

MacQueen, J.B., 1967: Some Methods for classification and Analysis of Multivariate Observations. In: Lucien, M. and Jerzy, N., editors, *Proceedings of 5th Berkeley Symposium on Mathematical Statistics and Probability*, Berkeley, Calif.: University of California Press, pp. 281–297.

Marada, M., 2001: Vymezeni periferních oblasti Česka a studium jejich znaků pomoci statistické analýzy (Delimitation of peripheral regions of Czechia and their features studied with the help of statistical analysis. – in Czech). In: *Geografie – Sborník ČGS*, Vol. 106, No. 1, pp. 12–23.

Marada, M., 2010: Doprava a geografická organizace společnosti v Česku (Transport and geographic organization of society in the Czech Republic – in Czech), 1st edition, Prague: Česká geografická společnost.

Musil, J. and Müller, J., 2008: Vnitřní periferie v České republice jako mechanismus sociální exkluze (Inner Peripheries of the Czech Republic as a Mechanism of Social Exclusion– in Czech). In: *Sociologicky časopis / Czech Sociological Review*, Vol. 44, No. 2, pp. 321–348.

Nazarczuk, J. M., 2015: Regional distance: the concept and empirical evidence from Poland. In: Szymańska, D. and Chodkowska-Miszczuk, J. editors, *Bulletin*

of Geography. Socio-economic Series, No. 28, Toruń: Nicolaus Copernicus University, pp. 129–141. DOI: http://dx.doi.org/10.1515/bog-2015-0020

Novák, J. and Netrdová, P., 2011: Prostorové vzorce sociálně-ekonomické diferenciace obcí v České republice (Spatial Patterns of Socioeconomic Differentiation in the Czech Republic at the Level of Municipalities – in Czech). In: *Sociologicky časopis/Czech Sociological Review*, Vol. 47, No. 4, pp. 717–744.

Ohya, T., Iri, M. and Murota, K., 1984: Improvements of the incremental method for the Voronoi diagram with computational comparison of various algorithms. In: *Journal of the Operations Research Society of Japan,* Vol. 27, No. 4, pp. 306–336.

Openshaw, S., 1984: The Modifiable Areal Unit Problem. In: *CATMOG 38*, Norwich: *Geo Books*, p. 41.

Pecher, C., Tasser, E., Walde, J. and Tappeiner, U., 2013: Typology of Alpine region using spatial-pattern indicators. In: *Ecological Indicators*, Vol. 24, pp. 37–47. DOI: http://dx.doi.org/10.1016/j.ecolind.2012.05.025

Perlin, R., Kučerová, S. and Kučera, Z., 2010: Typologie venkovského prostoru Česka (A Typology of Rural Space in Czechia according to its Potential for Development – in Czech). In: *Geografie – Sborník ČGS*, Vol. 115, No. 2, pp. 161–187.

Porter, M., 2003: The Economic Performance of Regions. In: *Regional Studies,* Vol. 37, No: 6–7, pp. 549–578. DOI: http://dx.doi.org/10.1080/0034340032000108688

Seingier, G., Espejel, I., Fermán-Almada, J.L., González, O.D., Montaño-Moctezuma, G., Azuz-Adeath, I. and Aramburo-Vizcarra, G., 2011: Designing an integrated coastal orientation index: A cross-comparison of Mexican municipalities. In: *Ecological Indicators*, Vol. 11, No. 2, pp. 633–642. DOI: http://dx.doi.org/10.1016/j.ecolind.2010.08.009

Sibson, R.A., 1981: Brief Description of Natural Neighbor Interpolation. Chapter 2. In: *Interpolating multivariate data*, New York: John Wiley & Sons, pp. 21–36.

Vanhove, N. and Klaassen, L.H., 1987: Regional policy: a European approach. Avebury: Aldershot.

Viturka, M., 2010: Regionální disparity a jejich hodnocení v kontextu regionální politiky (Regional disparities and their evaluation in the context of regional policy – in Czech). In: *Geografie*, Vol. 115, No. 2, pp. 131–143.

Watson, D., 1992: Contouring: A Guide to the Analysis and Display of Spatial Data, London: Pergamon Press.

Wokoun, R., 2008: Regionální rozvoj: východiska regionálního rozvoje, regionální politika, teorie, strategie a programování (Regional development: the basis of regional development, regional policy, theory, strategy and programming – in Czech), Prague: Linde.

Wong, C., 2002: Developing Indicators to Inform Local Economic Development in England. In: *Urban Studies*, Vol. 39, No. 10, pp. 1833–1863.

Yang, Y. and Hu, A., 2008: Investigating Regional Disparities of China's Human Development with Cluster Analysis: A Historical Perspective. In: *Social Indicators Research*. Vol. 86, No. 3, pp. 417–432. DOI: http://dx.doi.org/10.1007/s11205-007-9177-4