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Estimation of flow rate calculation errors on the example of five rapid response catchments in the Mecsek Hills

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Abstract

Today flash floods are one of the most significant extreme weather-related natural hazards. Due to the global climate change and altered land use, intense runoff and flash floods may exert catastrophic hydrologic impacts on developed areas. To measure and observe runoff-affecting environmental factors we have calculated characteristic flow values (CFV) with five empirical equations for five selected watersheds in the Mecsek Hills, SW Hungary. CFV's were then compared with measured characteristic Q_{max} values of 5, 10, 20, 33 and 100-year return period. From the empirical equations the Rational method was the most accurate while the largest differences between the calculated and measured values was observed for the Csermák-method. Nonetheless, determination of the input parameters for the Rational and Virág methods is rather challenging, thus, for practical applications, the Koris-method was found to be the most applicable equation to determine CFVs. Additionally, the median Koris errors showed a strong exponential correlation with the 5% specific runoff. If specific runoff could be estimated for any given outflow point, then error-specific runoff functions could be used to increase the accuracy of the Koris calculation method. To further increase the accuracy of CFVs for selected outflow points and cross sections, area and watershed-specific variables need to be included in the equation to account for topography, land use and soil properties.

Keywords: flash flood, runoff calculation, CFV, calculation error

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Introduction

Today flash floods are one of the most significant extreme weather-related natural hazards. Due to the global climate change and altered land use, intense runoff and flash floods may exert catastrophic hydrologic impacts on developed areas (Montenegro, S and Ragab, R. 2012). In Hungary, weather phenomena often cause disasters (hail storms, floods and mudflows) that subsequently generate considerable economic loss and may jeopardize human life.

The most severe natural hazards in the country are associated with atmospheric convections and storms (Horváth, A. 2005). Intense upward convection triggers various atmospheric phenomena ranging from small cumulus clouds to devastating super cells. Their devastation is further exacerbated by prediction challenges, as their magnitude and exact location varies considerably in space (Bartholy, J. and Pongrácz, R. 2010, 2013).

Convective processes develop rapidly and, with their associated features and consequences, may generate catastrophic damage. Typical observed hydrologic consequences and phenomena related to convective storms in hilly and mountainous regions are flash floods that are primarily characterized with short (less than 6 hours) response time and high flux (Horváth, E. 1999).

According to the report of the Environmental Protection Agency of the European Union, floods generate the largest economic loss in Europe (Lóczy, D. and Juhász, Á. 1996; Gaume, E. *et al*. 2009). Over the period of 1998 to 2002, about 100 devastating floods caused 700 fatalities, evacuation of 25,000 people and an economic loss of 25 billion Euros (Gaume, E. *et al.* 2009). Although the majority of the losses are caused by „conventional" large-river floods, over the past decades, floods more frequently occur on small streams located in small (10 to 100 km^2) mountainous watersheds (Marchi, L. *et al*. 2010; Mueller, E.N. and Pfister, A. 2011).

Flash floods are usually last for a few hours (in extreme cases up to a day) and due to their short time of concentration, prevention and evacuation effort are often challenging. In certain cases, however, snowmelt may also contribute to the generation of flash floods, hence low-intensity rainfall, amid ideal environmental settings may also trigger flash floods (Pirkhoffer, E. *et al*. 2008). A third, recently more frequent type of flash flood occurs in heavily urbanized areas, where paved surfaces are impervious and, in general, runoff is affected by various human factors (Gyenizse, P. 2009). This latter type of floods is called urban floods; however, some authors clearly differentiate them from typical flash floods (e. g. Georgakakos, K.P. 1986, 2006; Cobby, D. *et al.* 2008).

The majority of flash floods, at least in Hungary, occur between March and mid-October. Torrential, high-intensity precipitation caused significant economic loss in the hilly and low-mountain parts of Hungary. For example, a stream in North-West Hungary, the Által-ér inundated its valley following a

253 mm torrential rainfall on June 4, 1953 (Szilágyi, J. 1954). On June 27, 1987, several houses and part of the railroad were washed away in the Bükkösd Valley (Mecsek Hills, South-West Hungary) when 71 to 88 mm rain fell during a 6-hour period (Eszéky, O. 1987, 1992; Vass, P. 1997; Gyenizse, P. and Vass, P. 1998). Perhaps the largest economic loss was associated with flash floods in Mátrakeresztes, when a flash flood inundated the valley of the Csörgő and Kövicses Streams on April 18, 2005 (Horváth, A. 2005). Economic loss was estimated to reach 1 billion HUF (approx. 5 million USD) there (Koris, K. and Winter, J. 2000).

The city of Kaposvár was flooded by the Kapos Stream on August 21, 2008 (Hizsák, I. 2005) when 105 mm rain fell in 3 hours. According to insurance claim records, many of these torrential rainfall-associated floods in South-West Hungary occurred at and around the foothills of the Mecsek Hills on the catchments of the Kapos, Völgységi and Bükkösd Stream *(Figure 1).*

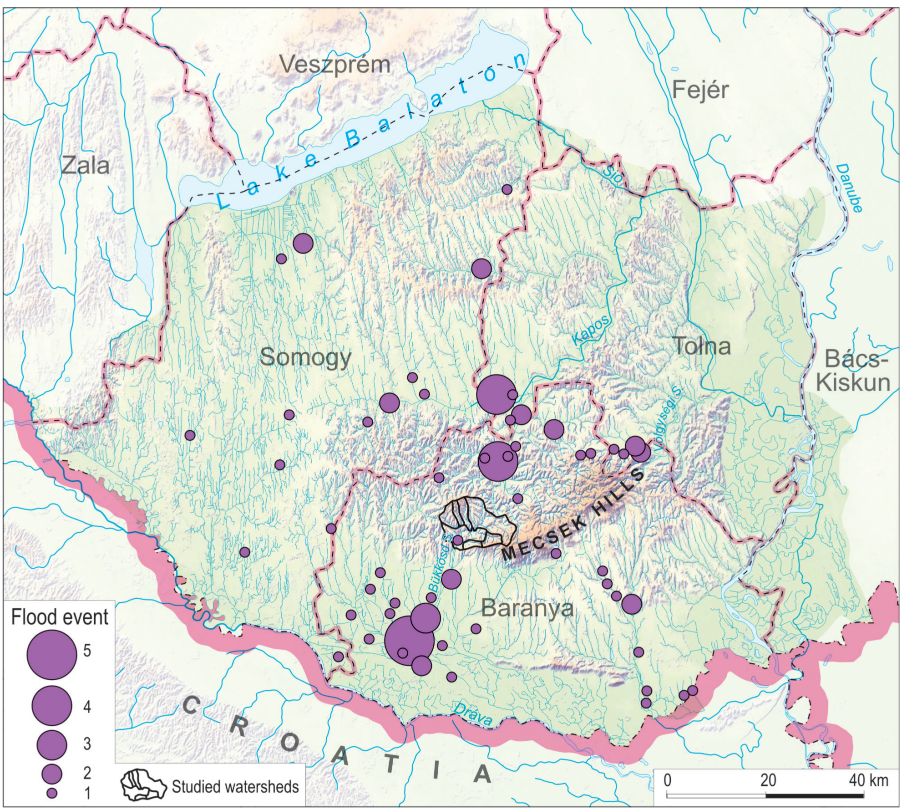

Fig. 1. Location of reported flood events in South-West Hungary between 1985 and 2005

Literature overview on the prediction methods usually applied in Hungary

Flash flood prediction is rather challenging, due to the large spatial and temporal variability of the convective rainfall events and the heterogeneous pattern of topography, land use and soil types (Yates, D.N. *et al*. 1999; Szlávik, L. and Kling, Z. 2007). In addition, prediction uncertainty is very high due to the available rainfall forecasting methods, and the localized characteristics of the precipitation (Szlávik, L. *et al*. 2002; Szlávik, L., Sziebert, J. and Zellei, L. 2002; Szlávik, L. 2003).

One way to estimate runoff and flow at the outflow point of the studied watershed is to use empirically derived equations. Equations of these types have been developed for small rapid-response watersheds located in Hungary. The most widely used equations employed by Hungarian researchers in the field of fluvial hydrology as well as the Hungarian Water Directorates include the *Koris*, *Csermák*, *Kollár*, *Rational* and *Virág equations* (estimation methods). Neither in the Introduction, nor in the Materials and Methods chapters of this paper it was not intended to describe these methods in full detail, instead a selection of literature was presented from which the reader could obtain further information about the calculation methodologies (e.g. Csermák, B. 1985; Zsuffa, I. 1996; Koris, K. 2001, 2002; Kontur, I. *et al*. 2003; Kaszab, F. 2009).

The basis of the calculations, with the exception of the Csermák rely on area-specific runoff (runoff calculated for a unit area, usually with a unit of m^3 km^{-2} s^{-1}) correlations (functions). Primarily based on topographic attributes, for the Koris equation Hungary is subdivided into broad runoff regions of about 15,000 to 25,000 km^2, each region having its own area-specific runoff correlation function (e.g. South-West Hungary, South Transdanubia Region). The other equations, however, do not differentiate unique runoff regions in Hungary.

The specific runoff value is then multiplied with the area of the watershed to obtain total runoff for a given recurrence time. Recurrence probability flow values calculated by the multiplication of the area and the specific runoff are discharge values of 5% and 10% probabilities for the Koris and the Kollár equations, respectively. The rational and Virág equations calculate a given probability runoff of $Q_{p\%}$ as a function of the flood-generating rainfall intensity with the same recurrence period ($i_{p\%}$). The Virág equation was primarily elaborated for large watersheds covering at least several 100s km^2 making it hard to accurately estimate runoff from minute watersheds.

The Csermák method considers an empirically generated map of runoff regions with a higher resolution than the aforementioned Kollár map. The individual runoff regions (classified from 1 to 5, 5 having the highest specific runoff) here are bordered by isohyets are the basis for determining the relative runoff attributes of the given watershed.

The rational method includes parameters that account for land use, soil and hydraulic properties (time of concentration).

Nevertheless, when compared with measured flow data, the output results of these equations are often burdened with significant errors when used for watersheds that were not included in the elaboration and calibration processes used during the generation of the given equations. To increase the accuracy of the equation, and to minimize the differences between the measured and calculated flow values, the equations need to be further improved by introducing modifying variables to account for the differences in topography, land use and soil properties among the individual watersheds.

Although these equations were developed in the 1970s and 1980s, there have not yet been fully adapted to digital, specifically to GIS-environment (see more details is VMS 1977a; 1977b, 1977c, 1977d, 1977e). Thus, a two-fold long term goal of the recently initiated research study of the flash flood research group of University of Pécs, Pécs, Hungary would be the improvement and adaptation of the runoff-calculating equations for a visual, watershed-based digital interface.

The short-term goal of the current paper is (a) to identify the most suitable runoff-calculation method to reproduce runoff from minute (1.7 to 12.13 km^2) watersheds of rugged topography that is characteristic for low-mountain conditions in Hungary and (b) to quantify the runoff calculation errors associated with individual runoff calculating equations when compared with the corresponding characteristic flow values of 5 selected watersheds from the Mecsek Hills.

Material and methods

Location and properties of the studied pilot catchments

To compare calculated and measured VFCs, five pilot watersheds were selected in Baranya County, SW Hungary. All watersheds are characterized by, at least under conditions typical in Hungary, with relatively high relief. Four selected watersheds, namely the Sás, Gorica, Sormás and Kán are tributary watersheds of the Bükkösd Stream Watershed that ultimately belongs to the drainage area of the Drava River.

For discharge value calculation and analysis, four pilot watersheds were selected – which are the tributary catchments of the Bükkösd Watershed – namely the Sás, Gorica, Sormás and Kán Watersheds. Each of the monitoring watersheds covers a relatively small land area (1.70 to 12.13 km^2) and topography of high relief. The four larger watersheds are dominantly undeveloped and are covered by deciduous forests, mainly beech and hornbeam.

For modeling purposes 5 rapid response-type catchments were selected in the Mecsek Hills, South-West Hungary, namely the catchment area of Kán, Gorica, Sormás, Sás and Bálics streams. The latter catchment is located on the Southern slopes of the Mecsek Hill within the administrative Borders of Pécs, with significant fraction of built-up areas (27%). The other four catchments are located in the North-Western part of the Mecsek Hills in predominantly forested areas (*Figure 2*). Catchment areas range between 4.0 and 12.1 km^2 while average slope values vary between 9.16 and 14.43 degrees (*Table 1*).

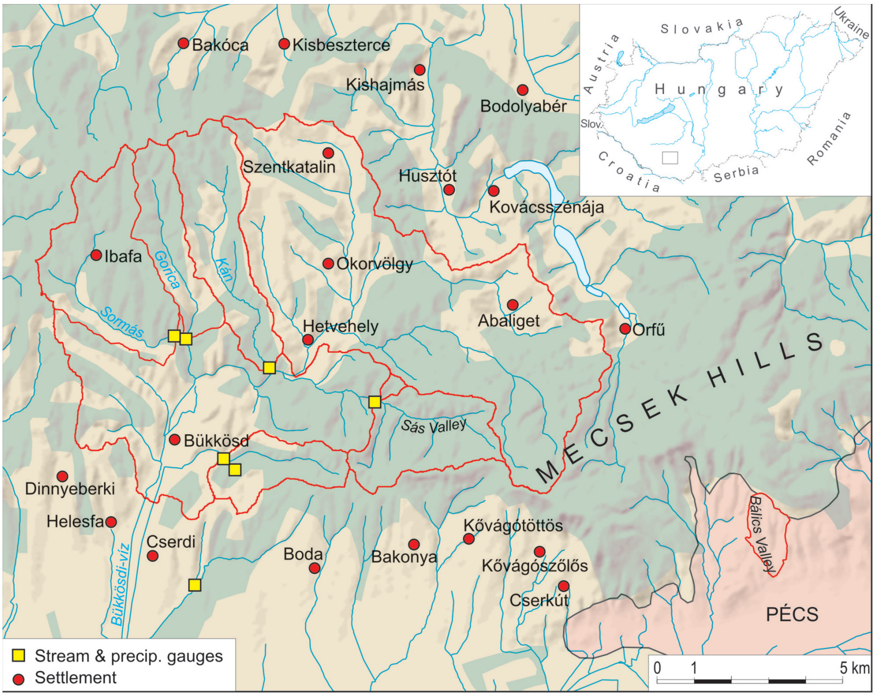

Fig. 2. Location of the studied watersheds (encircled by red lines) with the location of stream and precipitation gauges

Analysis of the selected runoff calculation methods and their comparison with measured characteristic flow values

Discharge measurements at the outflow point of the four undeveloped watersheds (Kán, Sormás, Gorica and Sás) were taken between January 1, 2005 and December 31, 2010 by the South Transdanubian Water Directorate (DDVIZIG) and the Mecsek Ore Company (Mecsekérc Zrt.). From the obtained data se-

Table 1. Land use and physical soil type characteristics of the studied watersheds

Indicator	Min	Max	Range	Mean	Std
Sormás Stream, 12.13 km^2					
Elevation, m	153.00	343.00	190.00	241.85	36.53
Slope, °	0.00	36.71	36.71	9.26	4.57
Aspect, azim °	flat	359.96	360.96	170.88	91.11
Gorica Stream, 5.84 km^2					
Elevation, m	151.00	355.00	204.00	255.56	43.03
Slope, °	0.00	35.41	35.41	11.02	5.32
Aspect, azim °	flat	358.60	359.60	174.74	90.91
Kán Stream, 9.58 km^2					
Elevation, m	154.00	356.00	202.00	248.88	43.63
Slope, °	0.00	35.16	35.16	10.00	4.86
Aspect, azim °	flat	359.78	360.78	160.82	88.04
Hetvehelyi/Sás Stream, 7.73 km^2					
Elevation, m	181.00	437.00	256.00	303.45	53.97
Slope, °	0.00	38.67	38.67	14.43	6.60
Aspect, azim °	flat	359.99	360.99	184.67	111.98
Bálics Stream, 1.70 km^2					
Elevation, m	166.00	390.00	493.00	262.11	28.47
Slope, °	0.00	36.15	36.15	10.72	7.15
Aspect, azim °	flat	354.80	355.80	183.20	99.24

ries, characteristic flow values (CFV) for 5 probabilities (1, 3, 5, 10 and 20%) were calculated for each watershed. Probability distributions were calculated with the Gumbel-probability function, widely used in hydrology. Hereafter these characteristic flow values are called the measured CFVs. For the Bálics Stream stage values were available for 2012 and until March 31, 2013, using an automated logger and the attached hydraulic head meter Dataqua (Dataqua Company, Balatonalmádi, Hungary). Stage values were then converted to discharge based on the Q-H function, which was generated with regular flow measurements. Due to the short measurement interval of this latter watershed, the reliability of the peak flows of long recurrence time is relatively low.

The CFVs (i.e. recurrence times of 5, 10, 20, 33 and 100 years) were calculated with 5 estimation methods being widely used by the Hungarian hydrological professionals. The employed runoff estimation methods are the following ones: Koris-, Csermák-, Kollár-, Rational, and the Virág-type discharge estimation. The calculated runoff (flow) values were then compared with the corresponding measured CFVs. The selected CFVs of 1, 3, 5, 10, 20% peak flow values (Q_{max}) values, are equivalent with recurrence periods of 100, 33, 20, 10, 5 years, respectively. For comparison, specific discharge values were also calculated by dividing the measured discharge values with the land area of the given watershed.

These Q_{max} estimation methods are standardized hydrologic methods in Hungary and have been developed for watersheds representative for Hungarian topographical conditions (lowlands and low-mountains). For these equations Q_{max} values are calculated as a function of watershed area and runoff characteristics (specific runoff, m^3 s^{-1} km^{-2}), while exclusively the rational-method considers precipitation as input parameter. Calculation methods of the five selected runoff-estimating techniques are briefly described below.

a) Koris estimation method:

$$Q_{p\%} = a_i q_{5\%} A, \tag{1}$$

where a_i is the probability multiplier which are 1.7, 1.2, 0.8 and 0.6 for the 1, 3, 10, 20% probabilities of discharge, $q_{5\%}$ is the specific flow rate estimated form the appendix (VITUKI, 1977) and A is the area of the pilot watershed (km^2).

b) Csermák estimation method (based on the Myer equation):

$$Q_{p\%} = rB_{3\%} F^n, \tag{2}$$

where r is a probability coefficient, $B_{3\%}$ is the 3% probability of peak flow occurrence estimated for the area, F is the area of the watershed, and n is a constant equals to 0.75, if the area is under 10 km^2; or 0.5, if the area is over than 10 km^2.

c) Kollár estimation method:

$$Q_{10\%} = q_{10\%} A, \tag{3}$$

where $q_{10\%}$ is a 10% probability of a specific peak flow occurrence (m^3/s km^2), and A is the extent of the watershed. Other than 10% probability estimation can be calculated with a multiplier factor based on the ratio of $Q_{p\%}/Q_{10\%}$.

For the Kollár and Koris methods, we used the median of the function range that accounts for the rainfall intensities (as well as topography and watershed shape) in the area-specific runoff correlation function. Here, when specific runoff is calculated using the lowest part of the range, low rainfall intensities and relatively flat topography (long time of concentration and storage coefficient) is assumed. When the upper boundary of the range is used for calculating specific runoff for the Koris and Kollár methods, 'torrential' conditions are assumed, referring to high-intensity rainfall events and topography, land use and soil types favorable for intense runoff.

d) Rational method (first applied by MULVANEY, T.J. in 1847):

$$Q_{p\%} = i_{p\%} \alpha A, \tag{4}$$

where $i_{p\%}$ is a $p_{\%}$ probability ($T = t$) rainfall intensity, α is the runoff coefficient, A is the area of the watershed.

e) Virág estimation method:

$$Q_{p\%} = A q_{p\%} C_{p\%} \tag{5}$$

where A is the area of the watershed, $q_{p\%}$ is an estimated specific runoff, and $C_{p\%}$ is a specific correlation factor.

Results

Regarding their land use types and physical soil properties, the studied watersheds were divided into two main groups, an urban one and an undeveloped category. The Bálics Stream watershed is exclusively located within the administrative borders of Pécs, predominantly in the North-West part of the city (150.286 residents according to the 2010 census). This catchment is a highly developed urban area with a high proportion of impermeable surfaces favorable for intense runoff. The other four catchments are primarily covered by deciduous forest (beech and hornbeam) in 81.53 to 95.05%. In the undeveloped watersheds natural conditions dominate the land use, paved surfaces cover only insignificant proportion of these watersheds (*Table 2*). The proportion of the paved surfaces is highest in the Bálics Watershed covering 26.78% of the entire land area of the watershed. Similarly, the area of agricultural and horticultural areas was highest in the Bálics Watershed, with the dominance

Table 2. Land use and physical soil type characteristics of the pilot watersheds, in %

Land use, physical soil type	Sormás	Gorica	Kán	Sás	Bálics
	Watershed				
Agri/Horticultural areas	8.98	10.08	21.18	–	65.47
Artificial surfaces	–	–	–	–	26.78
Forests	81.53	89.91	76.93	95.05	7.73
Shrubs	9.48	–	1.87	4.95	–
Loam	100.00	–	0.83	1.27	–
Clayey loam	–	92.30	68.47	98.73	–
Clay	–	5.81	30.68	–	–
Coarse fragments	–	–	–	–	100.00

of grape, fruit trees, lawn and vegetable gardens. Forested areas within the Bálics Stream are only found in the northernmost tip of the watershed.

The predominant physical soil types of the undeveloped watersheds are loam and clayey loam according to measurements of Zalavári, P. (2008). Loamy soils are the sole soil physical soil types in the Sormás Watershed, while clayey loam cover the surface almost exclusively in the Gorica and Sás Watersheds (*Table 2*). The prevailing physical soil types of the Bálics Watershed are characterized by rocky and stony topsoils, primarily at higher elevations at the Northern tip of the watershed by field experiments, while, according to the AGROTOPO database, this soil type is the prevailing one within this watershed. Based on our field experiences and the former studies of Zalavári (2008), genetic soil types in the Bálics Watershed include rendzinas, carbonate-rich forest soils formed on carbonaceous parent material and forest soils with significant clay illuviation (FAO: Luvisols, USDA: Alfisols, dominantly Xeralfs).

CFV calculations and comparison of measured and calculated CFVs

For the five aforementioned watersheds we have calculated discharge values (a) at different recurrence periods (5, 10, 20, 33 and 100 years), and (b) with different estimation methods (Csermák, Koris, Kollár, Virág and Rational-type calculation). A total of 25 cases (five watersheds, five calculation methods) were analysed, i.e. for this many cases were the calculated and measured CFVs compared.

In the majority of the analyzed cases, calculated CFVs were larger than the measured values. Out of the 25 analyzed cases, calculated values exceeded the measured values in 21 cases. In general, the highest error was found for the Csermák-type calculations with a mean error of 695% between the calculated and measured values.

Best correspondence was observed for the Virág estimation method with a mean value of 102% (standard deviation, σ = 80.3). Error percentages ranged between 1.42 and 1641% for all cases (*Table 3, Figure 3*). Among all the 25 cases, the lowest error was found for the Sás Stream at a recurrence period of 5 years using the Virág equation. The highest error was found for the Sormás Stream at a recurrence period of 100 years.

When the five employed calculation methods were compared, the lowest error was found at the Virág-type estimation for the Sás and Kán Watershed (10.00 and 4.96%, respectively). The Sás Watershed has the highest mean slope (14.42%) among the five studied watersheds and also has the highest proportion of clayey loam soils. These two factors likely contribute to increased runoff. However, the Sás Stream has the highest proportion of forest cover within its watershed; this property, through the process of interception will

*Table 3. Calculated errors between the measured and calculated characteristic flow values of five recurrence time intervals **

Stream	Return period, years	Relative error of measured and specific Q	Error of calculated – measured Q, %				
			Koris	Csermák	Kollár	Rational	Virág
Sás	5	1.243	84.41	612.13	157.42	21.40	***10.00***
	10	1.410	115.27	693.54	192.70	14.14	35.63
	20	1.550	145.33	809.49	246.90	4.87	94.11
	33	1.640	179.10	879.84	317.44	3.56	118.10
	100	1.798	261.14	1,152.82	373.70	26.00	169.00
Gorica	5	0.843	123.21	*720.53*	184.30	15.00	18.58
	10	0.907	176.60	*870.67*	262.00	1.42	55.22
	20	0.955	228.34	*1,058.73*	346.86	13.77	131.38
	33	0.984	282.37	*1,177.80*	450.41	26.76	166.17
	100	1.035	415.18	***1,601.41***	550.37	60.63	241.78
Sormás	5	1.025	208.27	*927.43*	330.93	59.34	123.00
	10	1.228	242.84	*990.68*	392.37	65.81	161.96
	20	1.416	271.85	*1,089.75*	455.40	74.86	256.82
	33	1.546	308.60	*1,137.98*	533.76	83.81	287.30
	100	1.812	393.80	*1,378.55*	584.16	108.90	346.10
Kán	5	2.830	8.83	327.30	39.54	50.17	38.00
	10	3.726	7.67	313.07	29.26	52.77	33.68
	20	4.586	6.23	321.90	26.02	53.37	15.42
	33	5.200	0.91	322.20	29.47	52.86	11.71
	100	6.532	11.91	371.25	34.93	49.92	4.96
Bálics	5	2.770	39.22	121.60	11.74	91.62	74.17
	10	2.920	38.44	114.22	18.24	90.10	72.36
	20	3.030	37.48	118.80	20.29	88.40	64.76
	33	3.490	33.94	118.95	18.11	88.43	63.21
	100	3.720	25.38	144.40	14.66	85.54	60.40

* 5, 10, 20, 33 and 100 years. The maximum errors are marked with bold italics, the minimum values with italics.

delay and diminish throughfall and runoff as a direct consequence. The Kán watershed is slightly more developed than the Sás Stream Watershed, still, we found better correspondence between the calculated and the measured CFVs for this watershed using the Virág-type estimation method.

Relatively low errors were found for the Rational method, however, in this case time of concentration, as an input value was set in a rather arbitrarily fashion (and unrealistic values were found) to obtain the best correspondence between the calculated and measured values. Nonetheless, the time of concentration values did not always represent the actual (field-observed) values adequately. Calculated times of concentration are shown in *Table 4*, using the so-called Wisnovszky equation (Koris, K. 2003).These values, in many cases, are rather different from the observed data that was based on field monitoring between 2005 and 2010. This

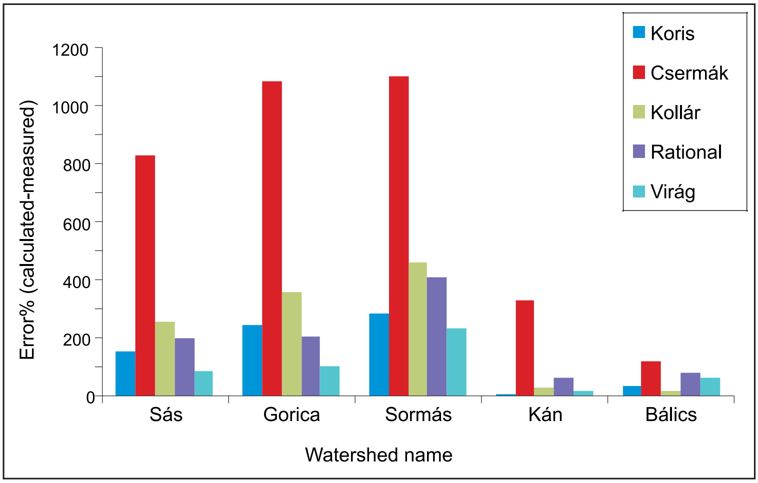

Fig. 3. Error percentages for the five selected CFV calculation methods for the five studied watershed

Table 4. Time of concentration values for the studied watersheds

Stream	Stream gauge loc.	Area, km²	Calc. Tc, h	Number of events studied	Tc. used for best fit, h	Measured Tc., h		
						Min.	Max.	Mean
Bálics	Pécs	1.7	0.28	17	40.0	0.25	5.33	2.15
Gorica	Bükkösd	5.9	0.67	17	1.5	0.83	29.92	10.99
Kán	–	9.6	0.98	20	5.7	1.08	23.75	7.83
Sormás	Bükkösd	12.2	3.40	18	0.8	1.75	14.50	7.75
Sás	Hetvehely	7.7	1.83	22	2.0	1.25	32.25	12.12

way, through its arduous parameterization protocol (in respect of the calculation of concentration times), the Rational method is considered rather inadequate for direct runoff estimation for the five studied watersheds.

In general, the third lowest errors were obtained for the Koris method when the centerline (median) of the 5% probability range was use to estimate specific runoff (*Figure* 3). This way, in respect of parameterization accuracy, the Koris equation seems to be the most adequate method for estimating runoff among the presented five calculation methods.

If the mean values analyzed with respect to the individual watersheds, lowest errors were detected for the Bálics Stream (65%). Due to its environmental settings (topographical, land use and soil properties), the Bálics Stream has the highest runoff coefficient value. The Sás, Gorica and Sormás Streams are characterized by relatively high mean errors ranging between 306.4% and 498.9%, with standard deviations of 299.2 to 394.4 (*Table* 5).

Table 5. Mean error (differences between the calculated and measured CFVs) percentages relative to the corresponding measured CFVs

Stream	Koris	Csermák	Kollár	Rational	Virág	*Mean*	*St. dev.*
Sás	157.0502	829.5640	257.6320	14.00	85.3680	*268.72*	*291.77*
Gorica	245.1400	1,085.8280	358.7880	23.52	102.3035	*363.11*	*379.36*
Sormás	285.0720	1,104.8780	459.3240	78.55	235.0360	*432.58*	*357.44*
Kán	7.1100	331.1440	31.8440	51.82	20.7540	*108.90*	*128.80*
Bálics	34.8920	123.5940	16.6080	88.82	66.9800	*66.18*	*38.07*
Mean	*145.8528*	*695.0016*	*224.8392*	*51.34*	*102.0883*	–	–
St. dev.	*123.4172*	*446.5843*	*196.6012*	*29.37*	*80.3159*	–	–

The Kán Stream has the second lowest mean error when the corresponding calculated and measured CFVs are compared (91%). This behavior is unexpected, as the Kán Watershed, regarding its general environmental settings and its catchment area (see *Table 2* and *3*) is rather similar to the Sás, Gorica and Sormás Watersheds. Slight differences, nevertheless, are observed at the higher proportion of clay-rich soils and the deforested areas, both parameters being significant contributors to increased runoff.

Impact of runoff coefficient and specific runoff on the Koris median-derived CFV errors

As it was concluded above, the Koris median calculation method was proven to be the most adequate to directly estimate runoff for the five studied watersheds. Thus, in the current chapter we compared the impact of runoff coefficient (ratio of precipitation and outflow) and the specific area (runoff from a unit watershed area) on mean CFV errors that were obtained from the Koris median values.

By looking at *Table 4* two distinct groups of watershed types is identified. The first group consists of the Sás, Sormás and Gorica Watersheds, while the other group includes the Kán and Bálics Streams, two watersheds with rather different environmental settings and medium runoff coefficients, at least among the five studied watersheds. Highest runoff coefficient for the four undeveloped watersheds, based on the 2005 to 2010 flow and precipitation data, was found for the Sás Stream (0.4005). The Bálics Stream, which has the lowest mean error value among the five studied watershed, has a runoff coefficient value of 0.275 (second highest value) for the 5% probability discharge (*Table 6*) based over the period of October 1, 2012 to May 1, 2013 when 562 mm rain fell over the measurement period. Consequently, runoff coefficient, as a combined parameter that describes the general hydrologic behavior of a given watershed, does not readily influences the errors that appear between the calculated and measured CFVs (*Figure 4*).

Table 6. Specific runoff and runoff coefficient values comparing to mean error values

Stream	Mean	Max	$Q_{5\%}$ measured	Area, km²	Specific runoff 5%, m³/s/km²	Runoff coefficient mean	Mean Koris error
	m³/s						
Sás	0.0657	1.580	1.789	7.73	0.231	0.401	157.0502
Gorica	0.0250	1.000	1.150	5.84	0.195	0.202	245.1400
Sormás	0.0316	1.530	1.542	12.13	0.126	0.123	285.0720
Kán	0.0352	1.960	5.119	9.58	0.533	0.174	7.1100
Bálics	0.0025	0.548	0.964	1.70	0.567	0.275	45.8700

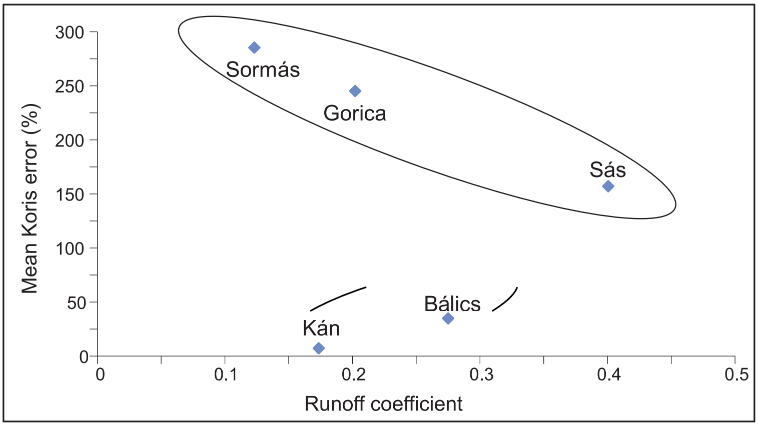

Fig. 4. Correlation between runoff coefficients and mean Koris estimation errors: two distinct groups are differentiated

Better results were obtained when correlation between specific runoff (another combined parameter that illustrates the overall hydrologic behavior of a given watershed) and measured CFV errors was analyzed (r^2 = 0.7643) (*Figure 5*). We need to emphasize that calculation errors are rather high for the Bálics Stream, firstly by the Q-H function calculation and secondly by the error arising from the short monitoring period used for the probability calculations of the CFVs, thirdly by the significant communal waste water input and (d) karstic environment and the flow and baseflow-buffering due to the underground water storage of the limestone aquifer. The Kán Watershed seems to be a good example to demonstrate the correlation between measured and calculated discharges for different estimation methods (*Figure 6*).

Generally, with increasing return period, the errors have also increased. When error percentages were analyzed as a function of the five studied recurrence periods (recurrence probabilities) we found increasing error percentages

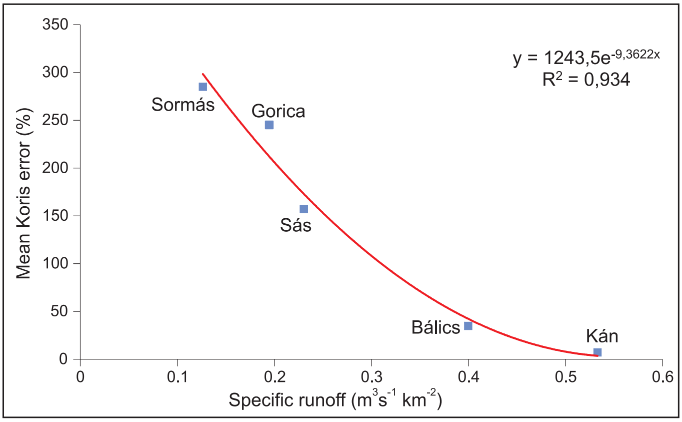

Fig. 5. Second degree polynomial correlations between the specific runoff and mean Koris estimation error

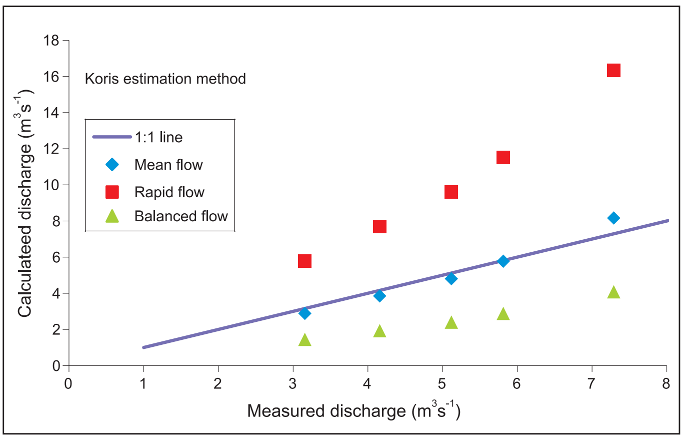

Fig. 6. Correlation between measured and calculated discharges for different estimation methods, at various return periods (5, 10, 20, 33, 100 years) for the Kán Watershed

with increasing recurrence times for the Sás, Gorica and Sormás Streams. Error percentages as a function of recurrence time remained relatively constant for the Kán and Bálics Streams. This way one could again differentiate two types of watersheds regarding their hydrological and hydraulic behaviors. When the Koris-, and the Virág-type estimation were used to calculate peak runoffs for the Kán Watershed, decreasing error percentages were found with increasing return period (*Figure 7*).

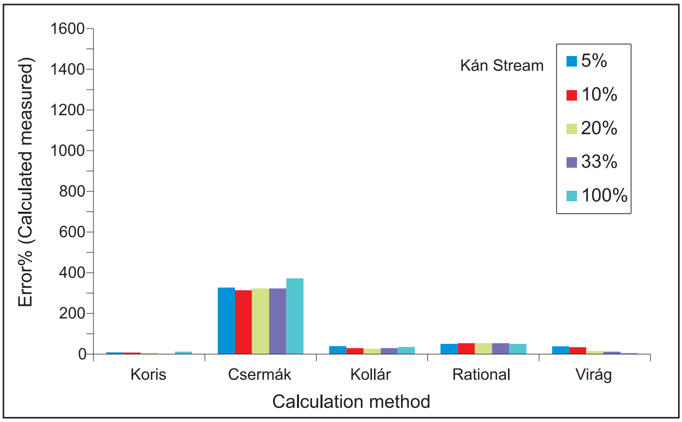

Fig. 7. Error values for the different estimation methods at different recurrence periods (for the five studied watersheds, in percentages)

Conclusion

During the course of the currently proposed research we investigated the appropriateness of 5 runoff estimation methods that are widely used in Hungarian hydrology were investigated for 5 selected watersheds in the Mecsek Hills, Baranya County. In general we claim that significant deviations were found between the measured and calculated CFVs for the five selected watersheds and all methods. Best results were obtained for the Virág and Rational methods, however, both methods are difficult to use due to the difficulties involved with input parameter estimation. Third lowest errors were associated when the Koris equation was used for the median of the area-specific runoff correlation range. Due to its easy parameterization and calculation methodology, this method was proven to be the most applicable with a reasonably accuracy to estimate runoff for the five selected watersheds.

Usually, for the Kollár and Koris-estimation methods, the lower boundary runoff character range within the area-specific runoff function gave the best results. This is likely explained in the light of climate change and the altered climatic conditions of today compared with the time when these estimation methods were developed, dominantly over the period of 1970s and 1980s. Secondly, the dominance of the lower boundary runoff character is explained by the fact, that, with a very few exceptions, both methods were predominantly developed by calibrating the model for large watersheds (several 100s km^2), rather than those used in the current study (around 10 km^2). Furthermore, each watershed behaves according to an individual rainfall-runoff pattern reflecting its unique topographic, land use and soil properties, in addition to the topography-induced meso-scale climatic differences and spatial rainfall patterns primarily due to the local orographic effects.

To overcome this watershed-specific problem, i.e. the uniqueness of each watersheds from the viewpoint of hydrography, hydrology and hydraulics, watersheds need to be categorized into selected classes according to their size, soil type, land use and topography. This way, based on the calculated flow correlations between the measured and calculated flow values, constants (being equal to the mean errors between calculated and measured CFVs) need to be developed to calibrate the various flow estimation methods in order to modify the currently available equations to obtain better correspondence with the measured values.

Specific correlation functions need also be generated to account for the aforementioned attributes of the watersheds. Such attempt is included in the rational method, however, this method needs to be automated and used in GIS-environment with subsequent calculations based on the available digital spatial databases (e. g. topography, land use and soil types).

By the automatization of the runoff calculations for selected cross-sections (outflow points) of the watershed of interest the CFVs could be calculated over a relatively short period of time (if sufficient calculation capacity is available). If pre-calculated inundation scenarios are available for the selected CFVs, the area of flooded terrain within the floodplains could be promptly determined, and warnings could be issued in advance with sufficiently long time lead. This way, residents of the affected areas could be evacuated in a short period of time, primarily in flash flood affected watersheds and in areas of rapid-response catchments. With increasing flood resilience, socio-economic consequences of torrential weather phenomena and disastrous hydrologic events could be diminished.

To develop an automated GIS-based method, correlations need to be found between the calculation errors and complex environmental parameters that expresses the topographic, land use and soil properties of a given watershed and readily expresses the hydrologic behavior of the individual watershed. In the present study the impact of two types of complex properties were analyzed: (i) runoff coefficient and (b) specific runoff. For the five studied watersheds no correlation was found between runoff coefficients and the Koris median- derived errors.

However, specific runoff exerts a strong impact on the Koris median-derived specific errors. In this case a relatively strong exponential correlation was found between the two parameters. This way, for any given cross-section along the watercourse relative error could be estimated for the Koris calculation method, and a correction constant could be introduced that accounts for the topographic, land use and pedologic properties of the watersheds located upstream from the selected cross section (or outflow point). In an ideal case, the correction factor would decrease moving upstream from the outflow points along the watercourse, as the headwater portion of any watershed would express increased runoff characters, i.e. increased specific runoff, where CFV errors are expected to be lower than in the vicinity of the outflow point of the watershed.

However, prior to generation of the correlation function between the upstream distance of the outflow point and the CFV errors, watersheds need to be classified into individual groups according to their runoff characteristics. In the present study, the five selected watersheds had very similar properties; nevertheless, two distinct watersheds were identified. This classification scheme is rater arbitrary, thus it provides significant challenges for reliable runoff prediction in watersheds of high relief. Hence, further studies are indispensable in order to increase the output accuracy of runoff calculations.

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Prague, the city of traditions and shopping centres A case study

Tamás SIKOS T.[1]

Abstract

Prague is one of the most beautiful cities in Europe. In this metropolis of history and traditions shopping centres have also appeared and they have made remarkable impact on the city's commercial structure. The impact of shopping centres on trade and shoppers in Prague was examined in details. In our research we aimed to describe the evaluation and the changes in buying habits in the city. We gave a brief historical review of the opening of the centres and their locations in the Czech capital were also examined. Our examination was based on primary and secondary researches. In our primary research we relied on a questionnaire in which 501 customers were inquired about the aim of their shopping. Data collection took place in Palladium shopping center in the Old Town of Prague and in Arkády Pankrác shopping center in the suburban area. The number of respondents in Palladium was 252, while in Arkády Pankrác it was 249.

Keywords: shopping centres, gravity zone, customer behaviour

Introduction

Shopping centres are essential elements of the daily life of costumers and they play an increasing role in the European urban societies. These centres have been a result and a motor of the economic boom since the 1950s. According to the definition, they are designed for shopping and they serve as market places for sellers and costumers. They are meant to place a specific offer in a single location and building with a specifically designed ambiance. They can be characterised by a common marketing strategy, activity and management being typical for all retailers operating in the shopping centre.

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Nevertheless, beyond the mail commercial purpose of shopping centres, they are also used as a place for leisure and wellness as well as meeting places and places for entertainment. This is quite new for Europe where the historical city centres used to fulfil those functions and where shopping centres designed for the general public appeared only relatively late.

The recent work focuses on those features through the spatial organization and geographical structure of retail trade network concerning shopping centres of Prague, the capital of the Czech Republic. The study attempts to indicate the specifics of the shopping centres of Prague, the main characteristics of their costumers as well as the shopping patterns of theirs.

Preliminaries and methodology

Our research was part of an international project referred to four Central European capitals (Budapest, Bratislava, Vienna and Prague) (Sikos T., T. and Mrs. Hoffmann, M. 2012). Earlier more experiences were collected on the basis of preliminary comparative studies aimed at shopping centres of smaller cities such as Klagenfurt in Austria, Bern in Switzerland (Wastl-Walter, D. 2010), Komárno in Slovakia (Sikos T., T. 2007; Sikos T., T. and Tiner, T. 2007) and Tatabánya in Hungary (Kovács, A. 2010) .

The research was carefully established both theoretically and methodologically. The typology of Prague shopping centres was worked out on the basis of Dawson's models (Dawson, J.A. 1983). The location strategy and the trends of spatial dynamics were evaluated according to the works of Brown, S. (1991) and Borchert, G.J. (1998), respectively. Additional Hungarian, Austrian and Slovakian experiences end procedures were also absorbed into research during the analytical phase of the study (Sikos T., T. 2000, 2009; Kovács, A. 2010; Tiner, T. 2010).

Moreover, it could be possible to draw more sophisticated conclusions on the development of retail trade and the shopping centre evolution in Prague by studying comparative studies referring to certain shopping centres in Budapest (Sikos T., T. and Mrs. Hoffmann, M. 2004) and in Vienna (Sikos T., T. 2013). The main streams in evolution trends in shopping centre development (Dawson, J.A. 2007, 2010) were also taken into consideration.

The method of the research was based on the processing of huge quantity of data collected from a large number of questionnaires. Here we have to emphasize, that all the volunteers taking part in the survey were selected randomly, but despite that fact, the sample cannot be considered representative. Data processing was made by mathematical and statistical software SPSS 19. The analysis of gravity zones of shopping centres in Prague was supported by GIS methods.

Evolvement of shopping centres in the capital of the Czech Republic

Prague's administrative area is 496 km^2; the number of inhabitants is 1,233,211, making it the biggest city in the Czech Republic. 25% of the country's GDP is concentrated there, which makes the city the most productive capital in East -Central Europe. The headquarters of several large international corporations are located in Prague. It is an important tourist center; half of the touristic activities of the country also take place in the capital. 40% of the college and university students of the Czech Republic study here; and so do 55% of the international students in the country. Prague is an important transport hub. Three underground lines, 25 tram lines, 200 bus lines and the train network make up the city's public transport system. Ruzyně, the airport of the city, receives more than 11 million travellers a year, thus being the fastest developing airport in East Central Europe. Road transport routes are radial. Two highways lead through the capital, highway D5 in the direction of Plzeň, connecting the country with Germany, while highway D8 goes to Bratislava, in the direction of the Slovak Republic. At the moment 33 shopping centres operate in the Czech capital.

Before 1996 only three commercial centres existed in Prague. The increase in the number of shopping centres happened at approximately the same pace as in Hungary. The actual increase started in 1996, and until 2000 another six commercial centres were opened for the public. The real boom happened after the millennium, from 2001 until today 24 shopping centres were established. These trends are rather similar to the processes in Hungary, but different from those in Slovakia. The delay can be captured in the development processes, which can be partly explained by the differences in the income-levels of the countries.

The location of the shopping centres in Prague

The 34 shopping centres of the capital are concentrated in eight districts of Prague. Their locations do not reflect completely the concentration of purchasing power. The individual gravity zones considerably overlap, especially in the case of Old Town shopping centres. In the capital, the Old Town has a distinguished place as well as the districts with housing estates and houses, which provide home for 64.7% of the shopping centres. Most of them (11) can be found in the Old Town. The shopping centres are embedded among historical buildings or they are situated in one of them. Some of them are declared historical and cultural heritage (*Figure 1* and *2).*

A smaller part of shopping centres in Prague are situated on the outskirts of the city near the highways. Their buyers coming by cars and they provide

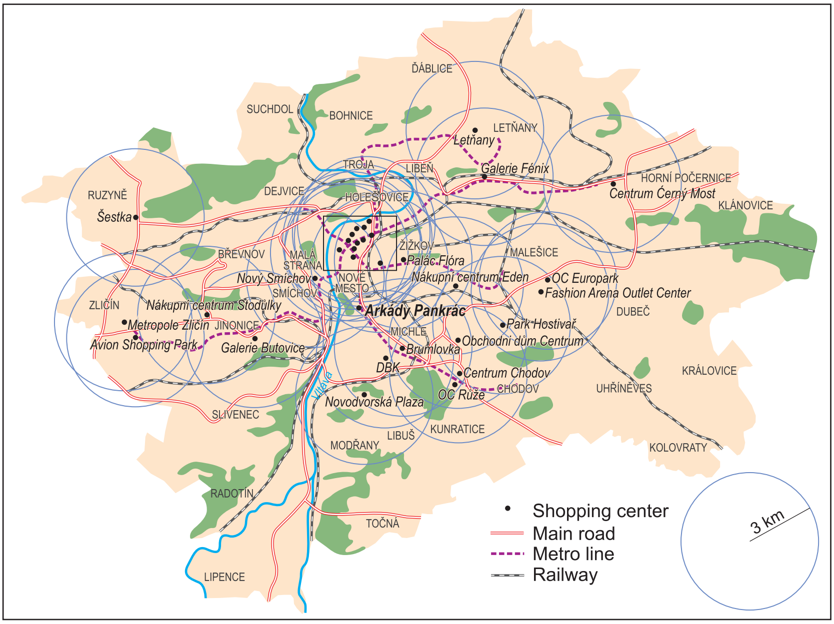

Fig. 1. Locations of shopping centres with their 3 km gravity zones in Prague. *Source*: own edition

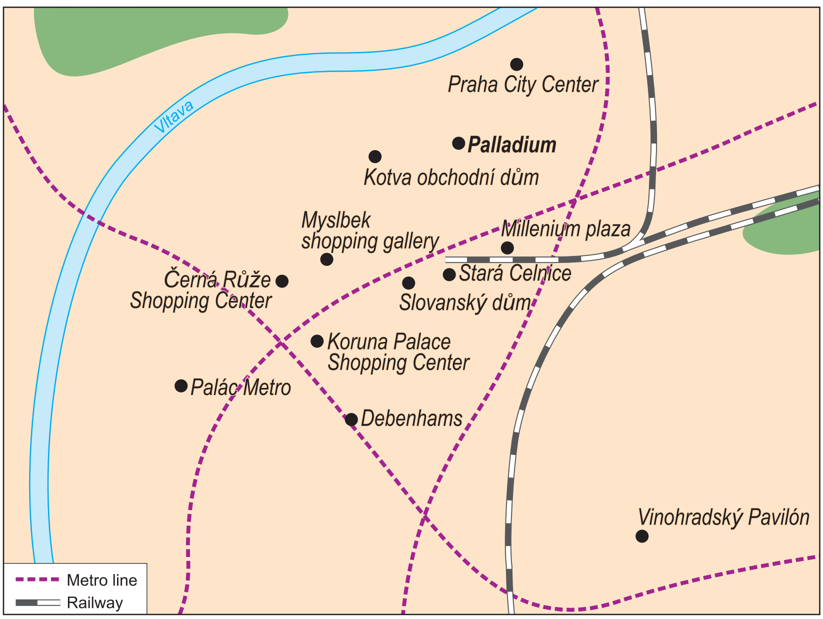

Fig. 2. Shopping centres in the historical city centre. *Source*: own edition

convenient parking places as part of their services. In the majority of the shopping centres in Prague the above mentioned criteria are not fulfilled, because the narrow downtown streets and historical heritage buildings do not allow parking lots to be built. The largest one of Prague and at the same time of the Czech Republic is Letňany with a shopping area of 125,000 m^2 and more than 300 parking places near highway E55. There are 200 shops providing comfortable shopping facilities. Among its commercial units we can find Tesco hypermarket open all around the clock and Kika with its largest shop in the Czech Republic. The shopping complex offers numerous services to its visitors; they can spend their free time in the sports center: there is a skating rink, a tennis court, an aqua center and a gym. For families with children, a child care unit helps comfortable shopping. There are restaurants and cafés to improve the experience. Palace Cinemas multiplex movie theatre also offers a possibility to relax.

The development process of shopping centres similarly to the development process of the Hungarian shopping centres can be divided into different phases which will be analyzed in the following chapters.

According to their age, Prague's shopping centres belong to three generations. The first period lasted until 1996, as we see it, the second phase of development lasted from 1996 to 2000 and the third one from 2000 up to now. Next we will introduce the most characteristic commercial centres of the individual periods.

First generation of shopping centres before 1996

Prague's oldest shopping center *Kotva* was opened in 1977 and it still operates. Its opening took place after a three-year-long building and construction process. The idea of the project originated from the Machonin family. The capital for the implementation was provided by Siab, a Swedish company. In its underground parking place 360 cars can be parked. The center provides home for 100 shops and restaurants and several service units; its unique feature is its free Wi-Fi. A dance and a wellness studio and a child care unit also operate there. The center issues its own magazine called Kotva Magazine listing the sales and discounts from which shoppers can choose (*Figure 3, Photo 1.*)

In the period of 1991–1996, two other shopping centres were opened. In 1991 Palác Metro, then in 1994 Vinohradský Pavilon opened their gates to the public. *Palác Metro* is located in a Victorian building on the border of the Old and the New Town. The building was purchased by Mr. and Mrs. Kleinhampl in 1919. Back then several catering and entertainment units – cafés, restaurants and a cinema were established in the building. After the nationalization, the palace lost its character as a commercial and service center. The successors of the Kleinhampl family bought back the building and in 1991 they opened it again as a shopping center.

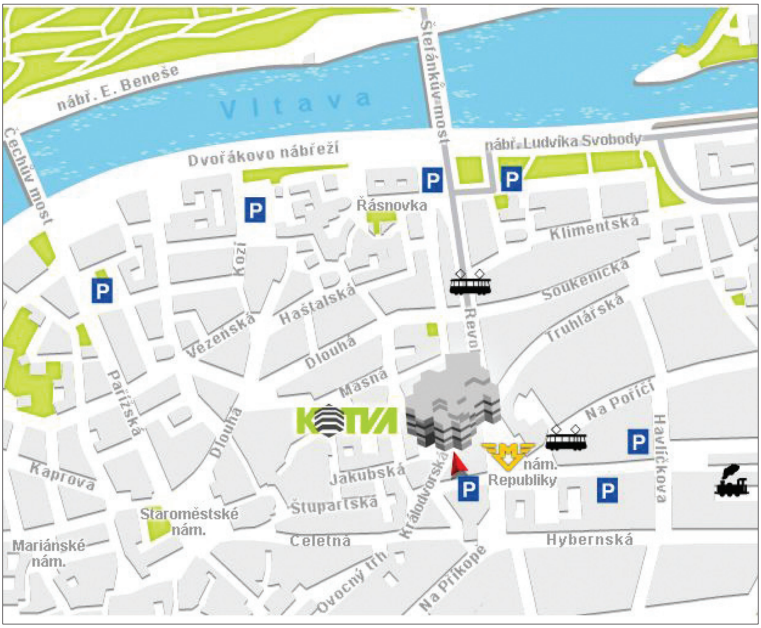

Fig. 3. The location of Kotva shopping center in the downtown of Prague. *Source:* www.od-otva.cz

Photo 1. Massive concrete building of the Kotva shopping center. (Photo: Sıkos T, T.)

Vinohradský Pavilon is one of the three market halls surviving in Prague. It was built in 1903 by the suggestion of Antonin Turk, an outstanding engineer of the city since 1899. When designing the building, an important point to consider was its short distance from the main square. The chief city architect suggested that a classical market place should be built with a central hall lit by the sunlight as well as two other floors for shops and storage places underneath.

Second generation of shopping centres between 1996 and 2000

The first years of the 1990s were only the beginning. From 1996 a new shopping center was born opening new dimensions for shopping and entertainment. New commercial complexes built in Prague utilized contemporary buildings, so relatively few manifestation of modern architecture can be captured there.

Koruna Palace Shopping Center serves customers with its 5,115 m^2 shop floor. The building of the shopping center was ready in 1912. Its main characteristic is the tower with its great number of statues and with a crown ("koruna") on the top after which the building was named. The L-shaped building was re-modelled at the beginning of the 20th century to home offices and business premises; back those times a café and an art gallery operated on the ground floor. During the years it experienced several reconstructions, finally, in 1931 after another conversion, the café was closed and between 1957 and 1978 when the underground line was built, the building witnessed further structural changes. Among those, the biggest one took place during the period of 1991–1996, when the building reached its present character as a shopping center (*Photo 2a, b).* Its location in one of the main pedestrian streets of the city greatly contributed to the fact that Koruna Palace Shopping Center was accepted and liked by the inhabitants.

Slovanský dům, a historical monument, is located in the centre of Prague (*Photo 3*). It was opened in 1997, previously it served several purposes. According to the earliest records, in 1414 the building already existed. During its existence it had a number of owners. In the 17th century a geometric, French style garden was added to it, in 1873 the Deutsches Casino company bought the palace and its name was also changed. Its new name was Německý dům (German house). After World War II it got back its original name. Nowadays a shopping center operates in it on 32,000 m^2. In the center there are cafés, restaurants and the only multiplex cinema of the city can also be found here.

Avion Shopping Park was opened in 1998 in the Czech capital (*Photo 4*). The "Power center"-type Avion with its 52,400 m^2 is one of the biggest and most popular shopping and entertainment centres focusing on customers with families. The magnet tenants of Avion Shopping Park are IKEA, Tesco, Datart, Giga Sport and H&M Studio. The "open-air" center has an L-shaped layout

Photo 2a, b. Koruna Palace Shopping Center. *Source:* www.koruna-palace.cz

Photo 3. Slovanský dům. *Source:* www.slovanskydum.com

Photo 4. Avion Shopping Park. *Source:* ww.prague.avionshoppingpark.cz

Photo 5a, b. Černá Růže Shopping Center. *Source:* www.cernaruze.cz

with some 2,400 parking places in its central area. The number of visitors in the complex reaches 5.7 million annually; its attraction zone – in a time zone of 60 minutes – is estimated to encompass 800,000 people.

Černá Růže Shopping Center is located in the Nové Město ('New Town') part of Prague near Univerzita Karlova (Charles University) (*Photo 5a, b*). The center consists of two parts, vertically connected to each other.

One wing located in Na Příkopě was built based on the plans of Jan David Frenzl in the 1840s. The interior design was created by Josef Fanty in 1880. The court and the entrance were built in 1932 after the plans of Oldřich Tyl. The building was declared a historical monument a few years ago. Reconstruction works started in 1996 and the rule of preserving the original style of the building was strictly observed. The shopping center opened its gates in 1998. It goes with the atmosphere of the city architecture; still, it offers proper conditions for modern shops and services. The number of retail units in Černá Růže Shopping Center is 200.

Third generation of shopping centres between 2001 and 2010

In the first decade of the 21st century, 24 shopping centres were opened in Prague. The dynamic increase enlarged the total size of shop floors by 600,000 m^2 in the capital of the Czech Republic. 14 out of the 24 centres were built in the second half of the decade. In the following parts we are going to introduce the two complexes which served as a location of our research. Both of them were opened in the second part of the decade.

A unique feature of *Palladium* – inaugurated in 2007 – is that its building (located in the center of the town, in Old Town) carries modern and old architectural features in the right proportion (*Photo 6a, b).*

In this part of the capital architectural monuments from as early as the 12th century can be found. The building of the center served as an army barrack from the 1780s. By the second part of the 20th century the property had been deteriorated, it needed reconstruction. Its renovation process started in 2005. As much emphasis was placed on refurbishing the facade of the building as on designing interior places. Historical monuments were also included: for

Photo 6a, b. Palladium shopping center. (Photo: Hodján, T.)

example, there is a fountain in the office lounge. Apart from relics from old times, the art pieces of several contemporary artists also contributed to forming the present look of the center. Natural light, fountains, benches, plants, pillars, pavilions for shopping all create a special ambience for customers and offer pleasant pastime. The center awaits shoppers on its 13,500 m^2 area with its 200 retail units, 20 cafés, restaurants and bars making Palladium one of the most remarkable centres in Prague. The center is served by a 900-place parking lot and there are office buildings on 19,500 m^2 connected to it. Palladium's 24-hour opening makes shopping comfortable in the historical part of the town.

Arkády Pankrác Praha opened its gates for the public in 2008 and with its 45,000 m^2 area it became one of the most significant centres in the Czech capital (*Photo 7*). The center can be found in the residential area of the city, the number of inhabitants is approximately 141,000. The attraction zone of the center reaches 1,000,000, which is actually the total number of the inhabitants in the capital. The building can boast of modern architectural features, so Arkády Pankrác fits into the line of ECE-owned shopping centres represent in style.

In its square layout, a unified indoor space was created giving the complex a homogenous spatial structure. Arkády Pankrác gives room to 125 retail units; its magnet tenant is Interspar. The complex was formed to attract families. Inside the center an Aztec playhouse was also formed. It evokes the atmosphere of South American jungles. To please the children, the management of the house planned a separate mini movie theatre in the building. The shopping center can be easily reached by car and by public transport as well.

Photo 7. Interior of Arkády Pankrác Praha. *Source:* www.arkady-pankrac.cz

Arkády Pankrác Praha provides about 1,100 parking places for its customers. And for the convenience of people arriving by car, a text message based on booking system was introduced in parking.

A comparative analysis of Arkády Pankrác Praha and Palladium

Prague belongs to the most beautiful metropolises in Europe. Its rich history, dynamic present and promising future captures visitors immediately. Luckily, urban planners considered its characteristics and the individual centres were placed into the ancient buildings in the Old Town. The way the commercial centres were formed and located was different from the processes in Bratislava or Budapest. The establishments are not situated in the outer area of the city, along highways, but are concentrated in t he downtown. They operate almost next to each other, in historical buildings, in the pedestrian street. There are 33 centres at the moment. This large number proves that the solvency of the inhabitants of the Czech capital is considerable.

Next, we examine two shopping centres in Prague in details: the Arkády Pankrác Praha and the Palladium. The architecture elements and locations of the two buildings show remarkable differences. While Palladium can be found in the historical Old Town, Arkády Pankrác Praha is located in the residential area of the capital. Their ages are similar: Palladium opened its gates in 2007 and Arkády Pankrác a year later. The number of retail units in Arkády Pankrác is 125 and they are situated on 45,000 m^2, while Palladium's 200 shops take up 13,500 m^2. The number of parking places in Arkády Pankác is considerably larger (1,100), which can be explained by its outer location. Providing a large number of parking places is essential.

In our survey 501 shoppers were interviewed. In Palladium 249, in Arkády Pankrác 252 people were asked. Our questionnaire of 12 questions helped us get a picture about the customer behaviour of the two centres. Customers were selected randomly, but in spite of that fact, the sample cannot be considered representative.

Distribution of customers according to their age and gender

First the gender distribution of the visitors was examined. In the case of both malls, the proportion of female visitors was larger, but only slighter. At the same time, there was no significant difference between the two centres. 55% of visitors in Palladium were women, while that number in Arkády Pankrác was 58%. So there was no significant difference in the distribution of sexes among visitors in the centres. The age group of 21–30 was determinative in both places.

The aforementioned age group mainly uses the establishments for points of meeting, dating. They will make the determinative group of customers in the future. Almost twice as many young people under the age of 20 visit Palladium (downtown) than Arkády Pankrác (suburban). That considerable shift derives from the geographical location of the centres. Age groups of 30–40, 40–50 and 50–60 are represented almost equally in the sample. These are the age groups shopping centres focus on. The older generation – customers over 60 – represent only 8% in both places. Our researches so far underline that shopping centres do not concentrate on the elderly because of their lower income level (*Figure 4* – A = Palladium; B = Arkády Pankrác).

In our research we examined the distribution of customers by the places of their residence (*Figure 5*). The majority of shoppers were Prague residents:

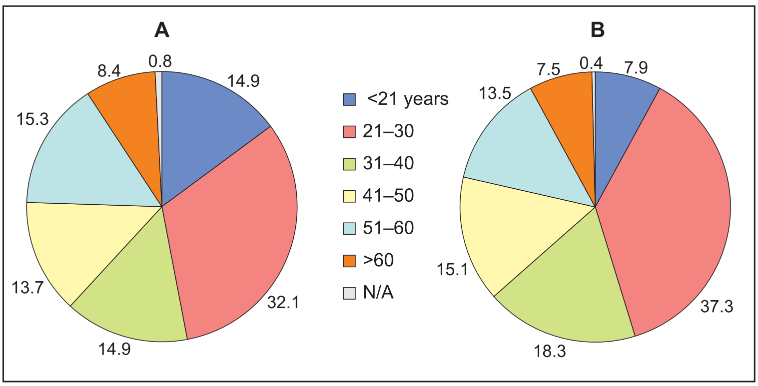

Fig. 4. Distribution of the visitors according to age. *Source:* own data collection

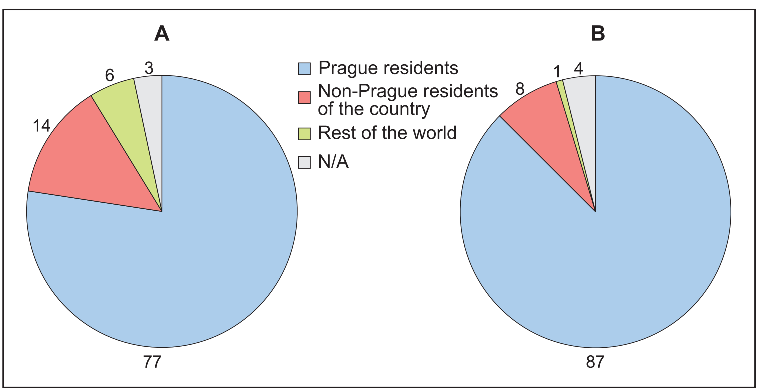

Fig. 5. Distribution of customers by the places of their residence. *Source:* own data collection

in Palladium 77% of the buyers came from the capital, while in case of Arkády Pankrác, that number was 10% higher. The centres have considerable gravity zones in the country, because in Palladium 14% of the people came from another settlements, while in Arkády Pankrác 8% of the visitors were not from Prague.

The percentage of foreign visitors was 5% in Palladium which was a higher ratio than in Arkády Pankrác. It can be explained by Palladium's central location in the Old Town. It offers a great entertainment opportunity for tourists. However, some – rather few, about 3–4% – respondents failed to declare the places of their residence. The proportion of local residents was 10% higher in Arkády Pankrác, which reflects the fact that it is mainly visited by the locals.

Employment structure of customers

The fifth question of the survey referred to employment. It was an open question; the answers we received were grouped into eight categories (*Figure 6*). In case of Palladium, the three main categories were "students", "skilled workers" and "other intellectual workers". In case of Arkády Pankrác, the same categories were the strongest, but their order was different: "skilled workers", "other intellectual workers" and "students". Skilled workers were the most represented group in Arkády with its 32%. The ratio of "other" employment (police officers, army officers, housewives and unemployed) was low, only 2%.

Most visitors go to Palladium for private purposes (81%) and the same applies to Arkády Pankrác (92%). It is not surprising since people go to shopping centres for buying goods and looking for entertainment. We must note here that 14% of Palladium's customers are private entrepreneurs, while that number in Arkády Pankrác is only 4%. The ratio of people doing errands for

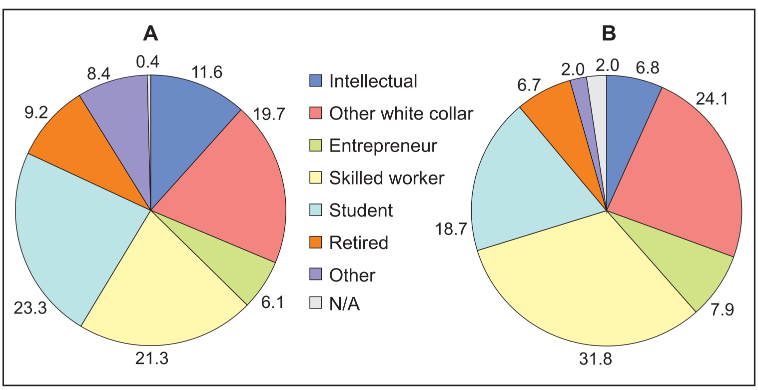

Fig. 6. Distribution of visitors by the structure of employment. *Source:* own data collection

their company in Palladium is only 3%; this group could not be detected in Arkády Pankrác. Public employees make up 1–1% of shoppers in both centres. In Palladium only 1% of the respondents did not answer the question concerning their employment, in Arkády Pankrác 3% of them failed to answer.

The purpose of shopping

Concerning the purpose of shopping, the answers showed notable differences in the two centres. While in Palladium only 19% of the respondents marked "shopping for food" as the purpose of their visit, in Arkády Pankrác that number was 58%. In Palladium Albert hypermarket can be found, in Arkády we can find an Interspar. As for its price range, Interspar is more favourable than Albert, but we must bear in mind that Arkády is located in a residential area, while Palladium is in a tourist zone. Shoppers buy clothes in a larger proportion in Arkády – 44% do so – while in Palladium only 33% of shoppers buy clothes.

17% of shoppers go to Arkády intending to buy electric goods, while only 7% of shoppers choose Arkády Pankrác for the same purpose. To dine, more people go to Palladium. 24% of the people asked choose restaurants and cafés there, while in Arkády only 12% of them do the same. The same percent of people (15%) use the services available in the center, while people arriving without any definite purpose prefer Palladium (20% compared to 6% in Arkady) (*Figure 7*).

People visiting the centres with other purposes belong to the last category. They are the ones who did not want to answer the questions. Palladium attracts visitors with its services and a great selection of clothing items, whereas people go to Arkády for food and buying clothes.

Frequency of visits

Asking about the frequency of shopping, we gave five options to choose from (*Figure 8*). The largest part of the visitors comes to their preferred center weekly. It is reflected in the 40–41% frequency of weekly trips. At the same time, 13% of Palladium's customers go there on a daily basis; that share is 23%. in Arkády. It/they can be explained by the role of the centres in the area they are located in. The gravity zone of Arkády is based on the surrounding residential area, mainly on the citizens of Prague. Palladium's regulars arrive from the historical city center and they are mainly tourists and employees. The other categories do not show remarkable differences. People coming to the centres every two weeks make up 17 and 16%. Visitors who come more rarely have 20 and 17% share in Palladium and Arkády Pankrác. As a conclusion, we can say that the majority of shoppers visit the centres once a week.

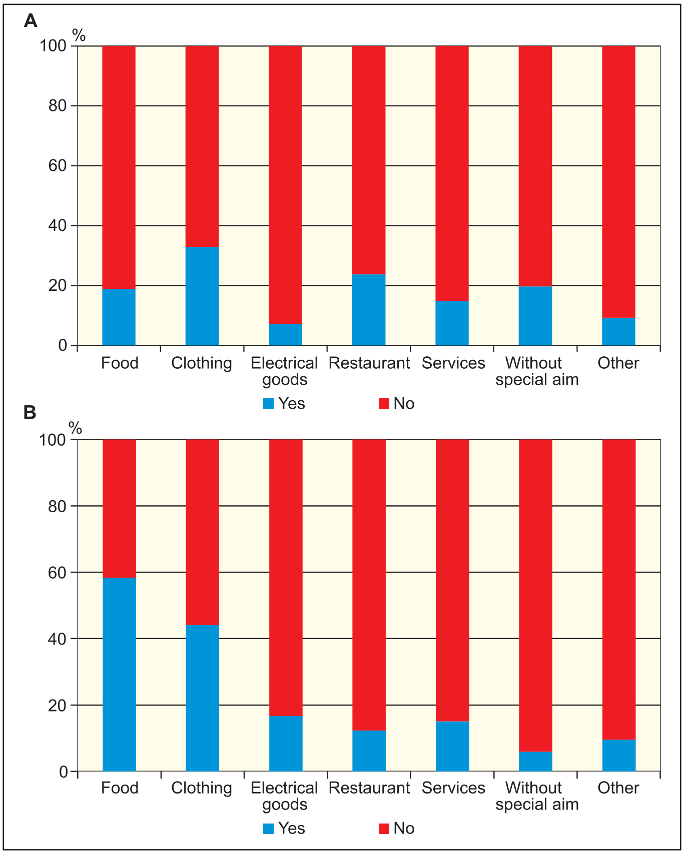

Fig. 7. Distribution by the purpose of visit. *Source*: own data collection

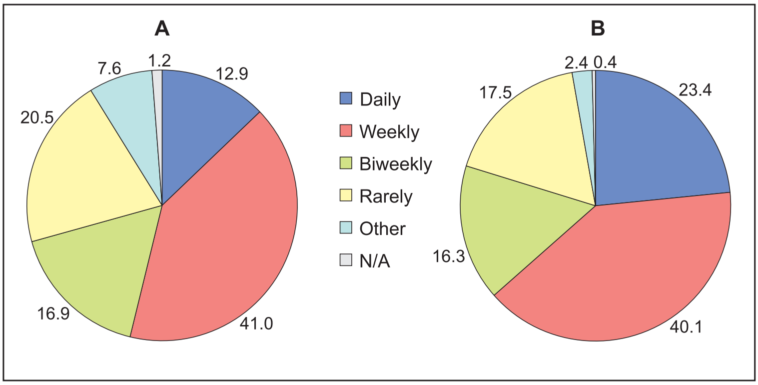

Fig. 8. Distribution of visitors by the frequency of visits. *Source:* own data collection

Among Palladium's visitors, Kotva is the most popular, the very first shopping center in Prague which awaits its customers with about 100 shops, restaurants and several other services. Its favourable location opposite Palladium also increases the number of visitors. Palladium's customers do not prefer visiting Arkády, only 8% of them goes there. Prague's largest shopping center, Letňany, with its 6% share takes only the fourth place among people surveyed in Palladium. Visitors to Palladium mentioned the names of 222 shopping centres altogether; each respondent could name more than one center. The number of centres mentioned in Arkády Pankrác was even higher: it reached 369. Among people who visit Arkády, 42% visit Centrum Chodov too; it is the most popular one among them. Palladium comes second with 21%. The following places are evenly distributed among centres and centres with non-center characteristics. Arkády's customers named some 40 shopping centres, while the customers of Palladium listed 32.

Another difference is that while the visitors of Palladium mostly named larger centres, Arkády's customers prefer smaller ones, and hyper- and supermarkets were also mentioned (*Figure 9*).

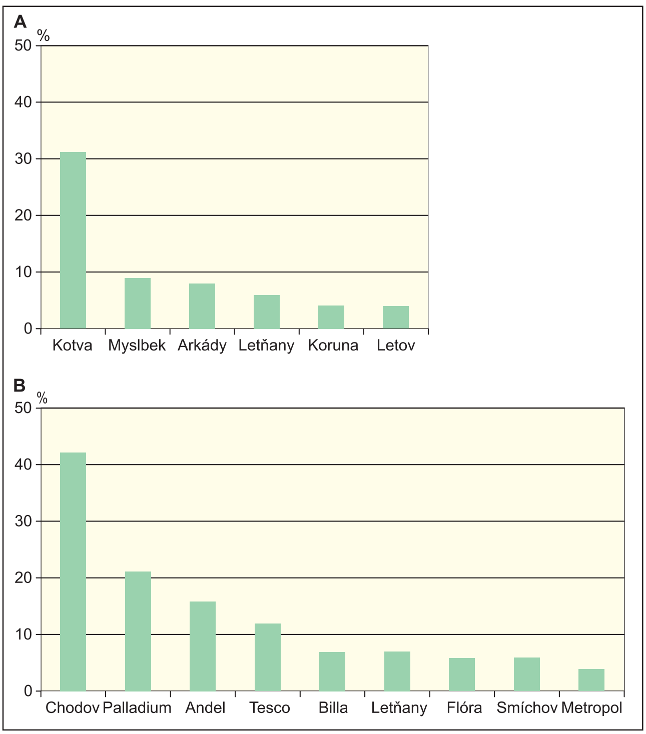

Fig. 9. Differences among purchasers according to visit of other centres. *Source:* own data collection

The fact that Palladium's customers named fewer units as alternative shopping facilities suggests that they are happier with the center or they find its facilities more satisfactory for spending their free time there. Centrum Chodov can be regarded as the biggest competitor of Arkády. It is not surprising because they are located in the same part of the city. The main advantage of Centrum Chodov is that although its area is not much larger than Arkády's, with its 210-unit shop-mix, it can offer a wider range of supply than its competitor with 120 shops.

The value of shopping

The next question aimed at examining the amount of money spent in the different centres. As *Figure 9.* shows, inclination to spend is rather similar among the visitors of the two centres.

The types of shopping are classified into six categories. In the first category there are purchases less than 100 CZK (Kč). The ratio of the first category was rather low in case of both centres, which is obvious, since that amount of money is enough only for very few articles. 6% of Palladium's and 4% of Arkády's shoppers spend less than 100 CZK. It includes the representatives of all age groups, but mainly people under the age of 20 and between 20 and 30 spend such a small amount of money. The previously mentioned age groups visit the centres regularly to buy food products and to go to cafés and restaurants. The representatives of that group visit the centres on a daily or weekly basis. Among Arkády's customers, a considerable group of people belonging to the age group of 50+ also spend less than 100 CZK. They go to the shopping center to buy foodstuff once a week.

The customers spending 101–500 CZK form the second category. That value of shopping is remarkable in both centres: 31% (Palladium) and 29% (Arkády). The second group is mainly made of people aged 21–30 and under 21, but we can also find customers belonging to the age group 51–60 or older than 60 who visit the centres to purchase food, visit restaurants or for recreation purposes once a week. Buying pieces of clothes and the possibility of using services are also important factors. In case of Arkády, the majority of people who spend between 101 and 500 CZK belongs to the age group of 21–30. Among the other age groups, there are no significant differences. Considering the purpose of shopping, we can say that 75% of customers buy foodstuff in the centres. The value of shopping for other items (clothes, services) is insignificant *(Figure 10).*

Spending money between 501 and 1,000 CZK belong to the third category which is the most common in both centres. In Palladium 34% and in Arkády 36% of the customers belong to that group. As for their age, most visitors fall into the age group 21–30, while visitors older than 60 were few. The

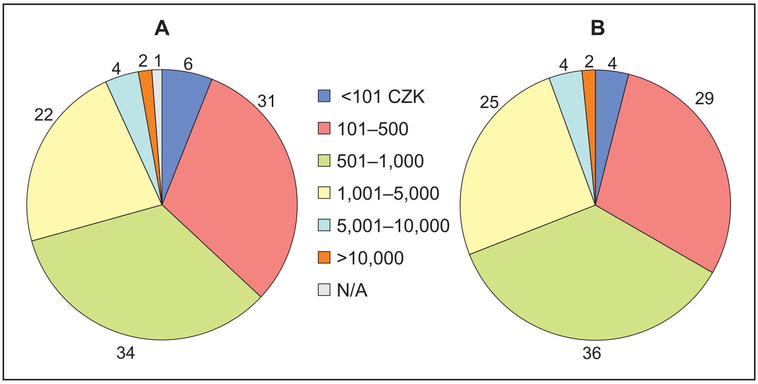

Figure 10. Distribution of consumers by the value of shopping. *Source:* own data collection

main purpose of their visit was shopping for clothes. Among the other options respondents could choose from, the results do not show many differences. The only exception may be electric goods with very few indications. Most people visit Palladium on a weekly basis. Shoppers go to Arkády mainly to buy food and clothing items.

Next, the purchases for 1,001–5,000 CZK are examined. 22% of customers in Palladium and 25% of customers in Arkády belong to that category of spending. Most of themare between 21 and 30 and mainly interested in clothes. They are the ones who come to the shopping centres weekly, every two weeks or rarely. Two age groups of Arkády's customers spend 1,000–5,000 CZK. They are between 21–30 and 31–40. People aged 41–50 must also be mentioned. The number of customers younger than 20, aged 51–60 or older than that is insignificant in the category. The aim of the visit is mostly to acquire new clothes or to buy food. Most respondents come to the center weekly, but some of them show up there every day.

People shopping for 5,001–10,000 CZK account for only 4% of respondents in both places and in Palladium they are mainly 21–60 years old. HHalf of the surveyed customers bought clothing items. Most of them visit the centres only every second week. Among Arkády's shoppers, there are no customers younger than 20 or older than 60. The majority is between 31 and 40 and usually go to the center to buy electric appliances, many shopped for clothes or food. There are no daily shoppers among them, a great number of them rarely visit the centres.

Only 2% of the respondents fall into the category of spending more than 10,000 CZK in both shopping centres. In Palladium they belong to the age group of 21–50. They mainly bought electric goods or used services and they claimed to visit the shopping centres occasionally. In Arkády the same amount of money was spent by people aged 21–60, again, on buying electric goods. They also said they rarely visit the centres.

Distribution of services

In our analysis, we also examined the distribution of using services (*Figure 11*). We established five categories for the different kinds of services: restaurants, movies, banks, post offices and other services. The majority of people surveyed indicated that restaurants and movie theatres were the most important.

Restaurants, cafés and bars have a determinative role in both centres. In case of Palladium, 57% of the visitors found those services important, while in Arkády 60% of them said the same. Mainly the younger generation, people

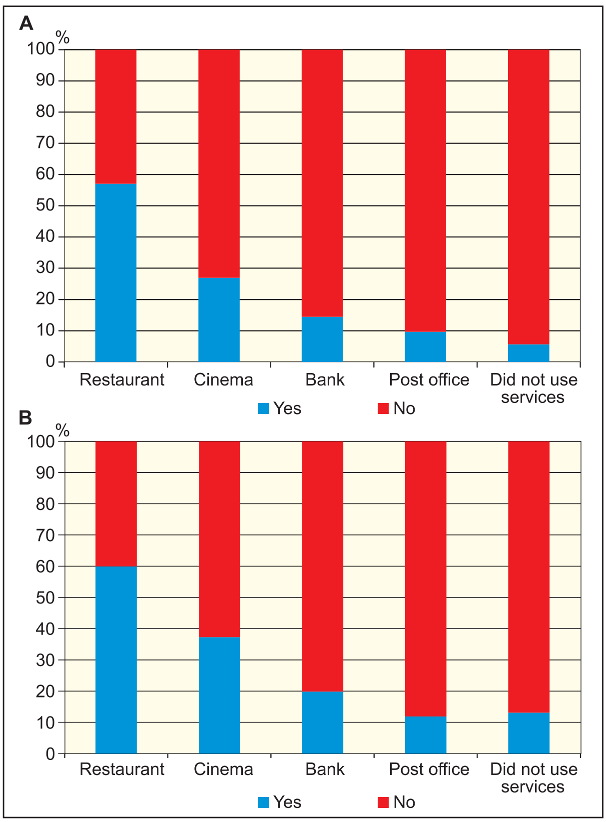

Fig. 11. Distribution of consumers by the use of different services. *Source*: own data collection

aged 21–30, use them; at the same time, the proportion of people older than 60 is almost infinitesimal. The second most popular service is the movie theater. 27% of Palladium's visitors go to see a film; in Arkády that rate is 37%. The younger generation is the largest age group in this respect as well. Considering the other services, the recipients of them are evenly distributed, except for banking where the ratio of pensioners (older than 60) is low.

Transport

At last we also asked the respondents about the means of transport they used to get to the shopping center. We set up three categories (by public transport, by car, by other modes of transport, e.g. by bicycle, on foot etc.). The evaluation of the answers showed that in case of both shopping centres the majority of visitors arrived by public transport (59% in Palladium and 63% in Arkády). It is reflected in the numbers too: arrived by that means of transport. The ratio of people arriving by car is approximately the same for both centres (Palladium: :37%, Arkády 30%. The higher rate in case of Palladium can be attributed to the larger parking lot. Only the very minority (4–7%) of people arrived in these centres on foot or by bike.

Peculiarities of Prague centres

Shopping centres cannot be missing from the Czech capital either. However, taking the city's characteristics into consideration, urban planners tried to fit them into the structure of the city. It practically means that using the special features of the city, old buildings were converted into centres, often as so-called rust zone investments. Another characteristic of Prague shopping centres is that they are concentrated in the historical part of the city with a considerable overlap between their attraction zones. Their downtown location is a logical choice, because they rely on the large number of foreign tourists.

Most shopping centres are located in renovated old buildings, the new, modern shopping centres are situated on the outskirts of the city; the urban planners' main intend was to introduce a new approach of establishing shopping centres. In Prague, the spatial concentration of centres is remarkable: half of the Czech shopping centres can be found there. Certainly, the functions of Prague centres do not digress from the functions of centres, we examined previously. The city's shopping centres also aim to satisfy customers' demand and to provide services of high quality which are their ultimate goals.

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The dimensions of peripheral areas and their restructuring in Central Europe

János PÉNZES[1]

Abstract

The current paper tries to provide a general overview about the restructuring spatial pattern of peripheral areas in Central Europe. The Visegrad Countries are regarded as Central European countries, in this case, Poland, Slovakia, the Czech Republic and Hungary are involved. Major methodological problems hampered the process of data collection and the comparison of different delimitations of peripheral areas in different countries. However, a general overview could have been made in order to detect the most important alterations of the spatial structures of the investigated countries. The territorial structures of peripheral areas during the socialist era and nowadays were compared to each other. The changes in the location of peripheral areas reflect back the increasing role and the influence of the capital cities and the largest towns and the ongoing development of the Western territories. At the same time, the crisis of the Eastern border areas – traditional backward areas – became deeper and it can be regarded as permanent along with the process of concentrating and cumulating social-economic problems. The structural changes triggered the backsliding of some of the former industrial and mining areas causing a new phenomenon in the pattern of peripheral territories in Central Europe.

Keywords: Central Europe, centre-periphery dichotomy, regional disparities, spatial pattern

Introduction

Central European countries have gone under a fundamental transformation during the regime change of 1989-1990. The political changes had an impact on almost all kind of socio-economic processes. The spatial pattern of the changes was significantly different from the features of the socialist era, from the centre-periphery conditions which evolved in the past decades. The changes were accompanied by the significant increase of regional disparities, differences between developed and undeveloped areas. The 1990s was the period of rapid

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changes. In addition to the crisis phenomena, the concentrated start of regional development also played a role.

The accession of Central European countries to the European Union in 2004 essentially has not changed the economic processes since they took place during the last 10 years. Out and away, the availability of financial resources opened up new perspectives for the regional policy. The assessment of the cohesion funds is controversial, because neither the convergence of the most backward areas nor the reduction of regional differences is unambiguous. It is partly because of the multi-dimensional nature of regional development and partly because of the spillover impact of the 2008 crisis.

The ineffective regional policy also played a role. The spatial pattern got "frozen" and the significant regional inequalities seemed to be stabilized in Hungary after 2000. The present study is an attempt to analyze and compare the spatial patterns of the four (until 1992 only three) countries of the socialist era and those of the period after the 2000s. In addition, the study aims to reveal the changes occurring in spatial locations as well as the regional characteristics of the peripheral areas.

The study tool is typically the review of the associated literature. In addition, I/we overviewed the most important factors which are the limitations of the testing facilities.

Definition of centre and periphery, core-periphery models

The centre means midpoint, central position in space or it represents a space portion which also involves a positive quality in addition to the geometric situation. In a particular spatial system, it refers to the relative central position designated by the quantitative and qualitative characteristics, comparing to other space element. Accordingly, it can vary depending on the position and scale of space and time together with the size of the spatial system (Regionális Tudományi Kislexikon, 2005).

The core concept is combined with social and functional content, flow and node characteristics together with a leading role in addition to the geometric nature. The centre is not only limited to points, but it may also have a more significant spatial extent major region, a country a group of countries can be identified as core areas. (Tóth, J. and Csatári, B. 1983; Sárfalvi, B. 1991; Nemes Nagy, J. 2009).

The periphery is also relative, meaning a space element or space portion located on the edge. The geometric position can cover a negative quality, too. As the counterpart of the centre, it features the dependence from the centre, but it can also mean the lack of relationships and isolation. The peripheral issue can be analyzed by multiple disciplines, therefore a shift may occur in the content of peripheral meaning, which can have a social filling beyond geographic point of view (Nemes Nagy, J. 2009).

The core-periphery concept is a basic social science paradigm of which dual aspect is not entirely clear. The most well-known propagator is Immanuel Wallerstein who made the concept triad in a way that he created the semi-periphery category (Wallerstein, I. 1983). The centre-periphery pair of concepts can be interpreted in three ways (Nemes Nagy, J. 1996):

– positional (geographical) centre and periphery where the centre means a designated, enhanced place, while the periphery means the marginalized settlements, it is more often coupled with the issue of accessibility (Tóth, G. 2006; Tóth, G. and Dávid, L. 2010);

– development (economic) centre and periphery which can be identified as the economic development and underdevelopment;

– authority (social) centre and periphery in which the dependence of power and the imbalance of interests appear.

The centre-periphery situation of a particular region or settlement may change in time. The three meanings can overlap each other. It often occurs that spatial elements are both central and peripherical depending on the meaning of content (Nemes Nagy, J. 1996; Lőcsei, H. and Szalkai, G. 2008). However, in most cases, the principal of "the trouble does not come alone" and a peripheral phenomenon also appear in several factors as a cause or as an effect (Kanalas, I. and Kiss, A. eds. 2006).

Raúl Prebisch, an Argentinean economist, casted the first stone of the centre-periphery theory in 1950. He remarked the apropos of the international trade's unequal exchange rates that the world market prices serve the industrial centres more and more frequently at the expense of raw material producers (Barta, Gy. 1990).

John Friedmann's well-known centre-periphery theory (Friedmann, J. 1966) tries to explain the stages of regional economic growth by exploring the regional context of "Rostow's stages of growth" model (Lengyel, I. and Rechnitzer, J. 2004).

Based on Friedmann's Latin American studies, linked the level of development and the pace of progress of regional disparities (Kozma, G. 2003). According to his opinion, innovation is the source of economic development which viable conditions are provided by the core cities and areas (Barta, Gy. 1990).

Thereupon, the most suitable platform for economic developments are the urban regions. Peripheries depend from the centres' authorities, therefore the centre-periphery forms a closed spatial system. The relation system is an essential element of spatial differences which exists at different scales. The centre-periphery relations in the Central European countries have re-evaluated during the last two and a half decades, too.

The effect of change of regime on the socio-economic processes in Central Europe

The political shift of Central Europe's countries[2] at the end of the communist regime caused market economic transformations there the economy were determined by spatial situation (Nemes Nagy, J. 1998). Thus, the majority of the countries faced a dramatic economic setback, the drastic increase of unemployment, a structural crisis and the formation of acute crisis areas (Gorzelak, G. 1996). The significant decrease of industries which were supported during the socialist era caused very fast transformation of occupation in addition to a considerable amount of reduction of employment (Keane, M.P. and Prasad, E.S. 2006).

The regions which developed infrastructure, a skilled labor force, hence best survived the transition, attracted innovation supporting, competitive foreign direct investments. Consequently, the tertiarization of the economy began. The decisive factors for the success of the transformation:

- the initial stages of development, the sectoral distribution of economic activities;
- the properties of the factors of production;
- and the political and economic situation(Gorzelak, G. 1996).

In the countries, the former, more leveling spatial pattern became (much) more polarized (e.g. Szabó, P. 2003; Abrhám, J. 2011). In the 1990s, the rapidly growing regional inequalities were prevalent in those countries, compared to the more moderate socio-spatial pattern of the period of socialism.

The essentially similar regional inequality trends can be included in a single model (the modified Kuznets-Williamson's inverted U hypothesis) which focuses on the socialist redistribution. That kind of redistribution maintained the more-balanced spatial pattern artificially. As a result of the switchover to market economy, that influence eliminated and the regional differences returned to the country's appropriate level of development (Nemes Nagy, J. 2005).

Primarily, the metropolitan regions which could provide the benefits of agglomerations (Heidenreich, M. 2003), the major urban agglomerations (Burda, A. 2013) and the western border areas which were closer to the developed Western Central European economic centres and generally had a higher level of development could benefit from the transformation (Süli-Zakar, I. 2007; Nemes Nagy, J. and Tagai, G. 2011).

At the same time, the Eastern, often agro-industrial profiled border areas of the Central European countries being a continuous peripheral band evolved and the former mining and heavy industrial areas became predomi-

[2] In this study, under the concept of Central Europe we understand the Visegrad Countries (Hungary, Slovakia, Czech Republic and Poland).

nantly structural crisis areas. That kind of spatial structure materialized in many socio-economic indicators and progresses, e.g. migration within countries, the presence of FDI, differences in employment and income patterns.

The aim of our study is to introduce the peripheral areas of Central Europe in two segments of time, after the period of socialism and after the millennium. We try to point out the main processes of change based on two periods' spatial image and summarize the dimensions of transformation, of course, in parallel with the review of relevant literature.

The methodological problems of the delimitation of peripheral areas

As a result of the characterized processes, in some cases the spatial pattern was significantly transformed in a way that it changed the centre-periphery spatial specificities, as well. It was also pointed out that the spatial position of the peripheral areas despite the presence of the traditionally underdeveloped areas could be considered as dynamic. So it can be interpreted as an indicator of spatial processes which took place during the last nearly quarter century.

Several studies were created focusing on spatial processes and development's spatial pattern of the Central European countries (Nemes Nagy, J. 1987; Gorzelak, G. 1996; Horváth, Gy. 1998, 2009; Sokol, M. 2001; Kuttor, D. 2009; Nemes Nagy, J. and Tagai, G. 2011; European Commission, 2010). However, they have mainly static aspect and they focused on NUTS 2 and NUTS 3 levels using some very important indicators available in the Eurostat database.

Principally, GDP and HDI are often used as complex indicators. The recent EU Cohesion Report contains a detailed map of the disadvantaged areas of the EU, but it takes mainly natural and agricultural aspects into account (European Commission, 2010, p. 193). Lately, poverty and the analysis of marginalization in the European-scale regional analyzes get more and more emphasis.

In this paper, we try to create a more complex view in which the areas qualified as underdeveloped ones of the examined countries can go beyond national borders (as detailed regional analyzes were created in each country). One the one part the aim is that the similarities or differences should become detectable, on the other hand, the "overview" of the common border areas could be used as a guide in regional development planning (including the multi-country aspect of contiguous peripheral regions' comparative study, even exploring the possibilities of cross-border co-operations).

Unfortunately, the examination of the problem of the peripheral regions is quite difficult, because the phenomenon may appear in multiple dimensions (Kanalas, I. and Kiss, A. eds. 2006) (the term itself can be approached from several directions – see above) (Nemes Nagy, J. 1996). The impoundment of peripheral areas is, therefore, generally taken into consideration together with multiple indicators and different methods to bring the indicators to the same unit (see e.g. Dávid, L. and Baros, Z. 2007). The comparability problem of the calculations made in each country is due to several factors:

– the available and accessible databases are extremely heterogeneous (either the range, the content, the methodology of compilation or in terms of spatial splitting and time interval of indicators)

– partly for that reason, it is almost impossible to find a same (or similar) spatial splitting in the various countries of which delimitations apply the same methodology in the same period

– the previous statement is explained by the fact that spatial issues occur in different phasis (some factors can carry here and there serious inequalities; elsewhere they do not express the level of development or backwardness) in different countries

– the same indicator which usually outlines the peripheral areas because of the spatial characteristics well may not provide a realistic image, e.g. in the agricultural areas of Eastern and Southeastern Poland, the agriculture disguises the significant latent unemployment (Tokarski, T. and Gajewski, P. 2003))

– moreover, calculations can have different results, none the less, they take similar methods referring to the same time and the same area into consideration (Pénzes, J. 2010)

– all of these things can be further complicated by the issue of temporal comparison, since the content of the indicators can change in different manner. And on top of it all, a few years difference between each survey can be sufficient to distort the results

– the comparative analyses examining the same area for a longer period of time are rare (e.g. Musil, J. and Müller, J. 2006)

– the periphery term is relative (the same is true for the term of centre), therefore either country's least developed area, optionally can count as developed one in the neighboring country.

As a consequence, it is clear that different analyses made for the delineation of peripheral areas in each country simply cannot be inserted next to each other (although to analyze differences of the impoundment can be made such as this figure – see e.g. Szabó, P. 2010, figure 3, p. 30).

However, the schematic spatial pattern maps which are generalized at the appropriate level can be suitable for the illustration of relative peripheral conditions in the countries studied. A study, which would be made uniformly to all countries and based on indicators, which clearly reflects the level of development, and possibly using more detailed spatial splitting; could overcome the listed problems.

The locations of peripheral areas and the characteristics of the spatial pattern during the socialism and after the turn of the millennium

The consolidated and significantly generalized maps which were made according to the available sources, cited in the footnote, provide a characteristic point of view *(Figure 1)*.

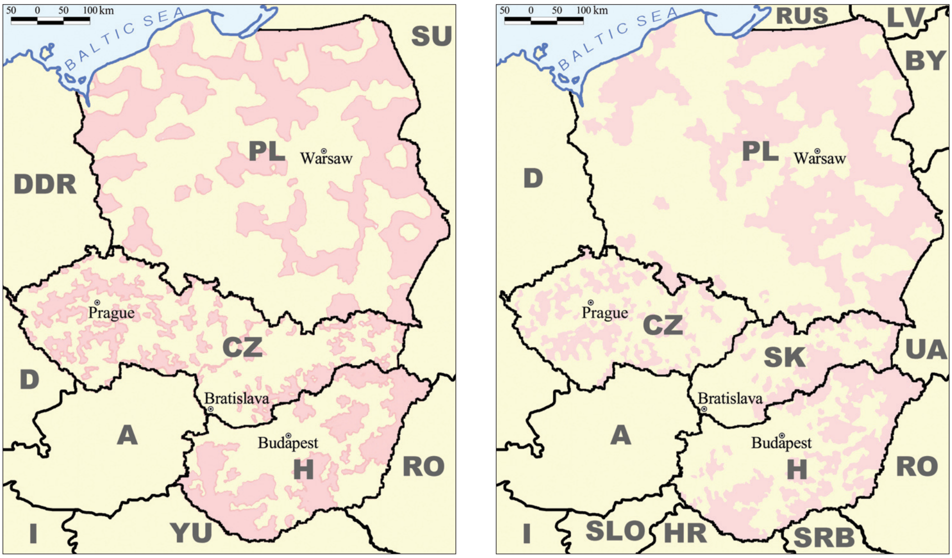

Fig 1. Peripheral areas of the Visegrad Countries during the socialist period (left) and after 2000 (right). *Source*: own edition, based on the sources in the footnote 3 (referring to map on the left)[3] and footnote 4 (referring to map on the right).[4]

Unfortunately, due to the listed several methodological issues and problems, the further quantitative GIS-based comparative analysis would be a concern, therefore we only want to draw attention to the visible changes that have affected the location of peripheral regions.

The investigation of the peripheral areas was quite subordinate during the socialist era, though the conceptions and objectives also served the regional equalization (Cotella, R. 2006) through the public development

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[3] By Potrykowska, A. 1985, p. 124.; Ciechocińska, M. 1986, p. 253; Gawryszewski, A. and Potrykowska, A. 1988, p. 91.; Musil, J. and Müller, J. 2006, p. 38.; the data of ŠSR and Beluszky, P. 1976, p. 305.

[4] By Potrykowska, A. 1985, p. 124.; Ciechocińska, M. 1986, p. 253; Gawryszewski, A. and Potrykowska, A. 1988, p. 91.; Musil, J. and Müller, J. 2006, p. 38.; the data of ŠSR and Beluszky, P. 1976, p. 305.

policy and redistribution which resulted in a levelized spatial pattern on a superior regional level. The concentrated developments generated considerable inequalities, as well (Fuchs, R. J. and Demko, G. J. 1979; Beluszky, P. 2002). The researches related to regional differences in living conditions gained momentum in Hungary primarily during the 1970s. Since 1986, the delimitation of underdeveloped areas has occurred (although any substantive regional development policies have not evolved).

Thereafter the 1980s in Poland, researchers placed more emphasis on the territorial aspect to examine the living conditions, the quality of life and the access to services. In the former Czechoslovakia such researches were subordinated as the most important spatial disparities (especially the significant differences in the development of the Czech-Moravian and Eastern Slovak areas) were known.

Each of the countries the *capital city and rural area* spatial dichotomy was stressful. In the case of Hungary, especially conspicuous the veg ("water head") type of Budapest, which was significant during the period of socialism, too (Fuchs, R.J. and Demko, G.J. 1979) but became more dominant after the end of the communism (see. inter alia Enyedi, Gy. 1996; Nemes Nagy, J. 1998). In Slovakia, the appreciation of Bratislava and the neighbouring region characterized by suburbanization especially in the new millennium can be observed Halás, M. and Hurbanek, P. 2008). It is coupled with the constipation of the peripheral areas lying east from the capital. However, Bratislava's spatial weight is far less oppressive than in case of Hungary and the same can be said of Czech Republic, too. The role of Warsaw in Poland is less characteristic because of the feature of the city network and the existence of major metropolitan sub-centres (Fuchs, R. J. and Demko, G. J. 1979).

Relation to the latter country, which is more due to the large *urban-rural dichotomy*, can be highlighted – Poznań, Kraków, Wrocław and the so called 'Tricity' (Gdańsk, Gdynia and Sopot) (Gorzelak, G. 2006) – however, the largest cities are not necessarily the regional development centres, which the Polish regional policy strives to concentrate (Churski, P. 2010). The urban-rural dichotomy has a significant presence in all Central European countries and its importance has grown since the democratic transition. In rural areas, the economic obsolescence was much more significant, particularly in the eastern part of the studied area which is agrarian-dominant.

The employment in the cities was revalued by a smaller decrease in the number of jobs. The phenomenon of suburbanization around the city moves forward the development, while the regions which are farther from the agglomeration lag behind (Novák, J. and Netrdová, P. 2011; Czyż, T. 2012; Pénzes, J. 2013; Bujdosó, Z. *et al*. 2013). This process is also enhanced by the selective migration which leads to the conservation of divergences and leads to further concentration (Miszczuk, A. and Wesołowska, M. 2012).

The *East-West dichotomy* can be detected in some forms in all four countries. The valorizing of the western areas and the crisis phenomena in the eastern areas are mentioned in the introduction and we also referred to the structural background (Nemes Nagy, J. 1998; Gorzelak, G. 2006; Halás, M. and Hurbanek, P. 2008). Due to the foreign direct investments and the proximity to the core European areas, the economy revived in the Poznań–Wrocław emerging development axis. This effect bring along the convergence of the peripheral areas of South-Western Poland (Czyż, T. 2012).

After the end of the communism, the progress which took place in Western Slovakia and Northwest Hungary also resulted in the transformation of the backward regions, especially along the main transport axes (Lőcsei, H. and Szalkai, G. 2008; Tóth, G. 2013). The automotive industry and the related supplier sectors had a prominent role in the industrial restruction of the Western areas (Pavlinek, P. *et al.* 2009). The process was the least spectacular in the Czech Republic as Prague and its surroundings have always been the most dynamic region.

As the other projection of the West–East lean, there is a trend which shows *the increasing spatial concentration of peripheral areas in the Eastern regions*. This concentration appears in the "Eastern Wall" zone of Poland; in the accumulated spatial problems of South-Eastern and Eastern Slovakia and the concentration of peripheral territories in North-East and East Hungary. A high level of backward areas is concentrated in the *geographical peripheries along/at the borders*. In this area, the proportion of the agricultural sector is typically high because of the agricultural trade relations with the Eastern Soviet markets. After the end of the communist era and the collapse of the Soviet Union, a prolonged crisis of the agricultural sector evolved.

In addition to the outer periphery of the Central European countries, *internal peripheries* are present, too. In the case of Poland, in the region of Warsaw–Łódź–Kielce–Lublin, the increase of peripheral areas is particularly conspicuous. The region of the Świętokrzyskie Mountains is traditionally a backward area of Poland, however, the elements of the restructuring crisis overlap the previous one. In the Czech Republic, the greater part of the internal peripheries are concentrated along the administrative borders, so called "kraj" borders and their extent have not seem to decline over the past decades (Musil, J. and Müller, J. 2006). In Hungary, the Central Tisza Region ("Közép-Tiszavidék") is regarded as an internal periphery, in which the post-communist processes have resulted in the strengthening of the peripheral status (Pénzes, J. 2011).

The structural crisis of the mining, textile- and heavy industry caused the emergence of unfamiliar socio-economic difficulties including high unemployment, high social inputs, declining tax revenues and environmental problems in the areas which were prosperous during the socialism, for instance, in the region of Upper Silesia and Łódź in Poland, and in the surroundings of Salgótarján, Ózd and Komló in; Hungary.

A significant part of the region is traditionally backward, therefore its peripheral status is not recent. In Eastern Poland, the fragmented farm structure of agriculture and the neighborhood of Belarus and Ukraine conserve the disadvantages which go hand in hand with similar socio-economic problems in all countries (e.g. low employment rate, selective and significant emigration) (Miszczuk, A. and Wesołowska, M. 2012). In case of Slovakia and Hungary (in the North-Eastern part and in the South-Western part), social and employment problems of the Roma population aggravate the close up of the region (Matlovičová, K. *et al*. 2012).

Conclusions

As a conclusion, it can be stated that in the peripheral territories, the most significant features are the change, the dynamic transformation and consistency. Because of the non-homogenous nature of the change, after the years of communism, there were regions in each of these countries which once were about to be prosperous, but did not succeed. It can be observed especially in the structural crisis-stricken areas and also in the converging peripherals (primarily along the Western border, in the capital and in the main cities of the agglomerating, suburbanizing areas).

However, some of the peripheral areas are traditionally backward ones (mainly the eastern border regions and the so called internal peripherals), which has a convergence that is still not detected. The regional problems and the socio-economic symptoms overlap each other in many cases and they show a number of common elements in the Central European countries.

Although with different emphasis, the evolution of regional inequalities, the question of increasing polarization in the future, the exploration of peripheral territories' processes and in particular to outline the response capabilities of the regional policy in all of these countries are present in this research. It is mainly due to the distribution of the EU's regional development funds and the consumption which serve the regional cohesion. The analysis of the summarized processes and the detailed methodological problems submitted in the present study will be the definite object of further studies.

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Location–allocation models applied to urban public services. Spatial analysis of Primary Health Care Centers in the city of Luján, Argentina

Gustavo BUZAI[1]

Abstract

The actual digital technologies and particularly the association between the Geographical Information Systems (GIS) and the assistance to the Spatial Decision Support System (SDSS) have generated important possibilities for the treatment of spatial information. As regards the use of location-allocation models, this presentation assesses the possibilities of using such models in the field of the geography of services. In this paper theoretical aspects of the analyzed problems are presented, as well as methodological standardized questions for their solution through the use of GIS+SDSS. An applied case study related to the spatial analysis of Primary Health Care Centers (PHCC) in the city of Lujan, Argentina is also presented.

Keywords: Spatial analysis, location-allocation models, primary health care centres, GIS, SDSS.

Introduction

The application of geographical analysis procedures, oriented towards service planning, is actually presented as a very dynamic field of investigation starting from the use of Geographical Information Systems (GIS) as well as the Spatial Decision Support Systems (SDSS).

The models of higher application were defined from a conceptual and practical view some four decades ago (Revelle, Ch. and Swain, R. 1970; Austin, C. 1974; McAllister, D. 1976) and during the decade of 1990 this information slowly spread throughout the digitalization field, through software intended to support decision-making.

Digital standardization of procedures has evolved along with socio-economic aspects in population´s basic services diversification as in the ap-

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pearance of a post-fordist model in which small and medium enterprises (SMEs) supplying services to the industry and other enterprises have an important role.

In view of the above, the spatial location of services appeared to be of a great importance in many aspects, particularly in the field of public services, and in attempts to improve the levels of spatial equity for the population to be served.

Along these lines, the present work may be considered as a later stage for spatial data exploration and has as a principal objective to set forth a standardization of the theoretical methodological aspects of spatial localization in order to prioritize, from a geographical perspective, the process of decision making at the moment of installing, relocating or increasing a given number of installations of public urban services.

The application implemented here will be centered on the spatial localization of the PHCCs in the city of Luján, Argentina (34°34´13´´S and 59°06´18´´ W), with a population of 78,500 in 2012 (Municipalidad de Luján, 2012). Efficient and equitable access to public services must be guaranteed.

Theoretical background

Location-allocation models

Geographical studies have a broad tradition in the generation of theories and general models for the analysis of human activities. Particularly, as regards the tertiary activities, it is possible to consider the *theory of central places* proposed by Walter Christaller in 1933 as a model of optimum spatial localization of urban centres at a regional level. In its formulation, the concepts of *threshold and reach* are presented as a deductive basis from which we can explain certain empiric regularities that were presented in the systematization carried out by Beavon, K. (1980).

From a model-based view, the localizations (potential supply and demand points), the distances (ideal or real) and the costs of displacements (spatial friction) are presented as the principal factors that produce different territorial configurations in the system. A series of studies focuses on the tertiary activity and as regards evolution, goes forward in a change of scale from the analysis of urban centres (regional) towards the inside centres of the city (local). This materializes in the *geography of marketing*, a concept presented by Berry, B. (1971) having been widely analyzed in its current capacities by a series of authors (Moreno-Jiménez, A. 1995, 2004; Bosque-Sendra, J. 2004; Bosque-Sendra, J. and Moreno-Jiménez, A. 2004; Salado-García, M. 2004; Moreno-Jiménez, A. and Buzai, G. eds. 2008).

From this point of view, the theory of localization takes into consideration problems in the installation of services and generates a double objective: on the one hand to find the optimum localizations, and on the other to determine the allocation of demand for such centres. To resolve this double objective models of *allocation-localization* have been developed.

According to Ramírez, L. and Bosque-Sendra, J. (2001), the location-allocation models meet the following characteristics: a) they are mathematical models since this language is considered appropriate to capture reality; b) they are spatial models at intermediate scale because the aspects to be solved are already delimited in a territory; and c) they are normative models because it is necessary to look for the best solution to a given problem.

In synthesis those models attempt to assess the actual locations of service centres on a demand distribution basis, and to generate alternatives to achieve a more efficient and/or equitable spatial distribution. Those models are designed to find the optimum localizations and determine the best links of the demand (allocation).

In recent years the application of location-allocation models, even those operationalized based on a Geographical Information Systems basis, have been framed in a specific system called Spatial Decision Support System (SDSS).[2] According to Bosque-Sendra, J. *et al*. (2000), the SDSS's principal objective is to supply a necessary environment in hardware and software to facilitate users in spatial decision-making matters. In this sense, the study of *exploration* problems, the *generation* of various solutions and the *evaluation* of different alternatives need to be assessed. .

Densham, P. (1991) presents two well differentiated levels as regards the application of SDSS, one in which the user takes decisions through generating, evaluating and choosing solution alternatives, and the system interface achieving a multidirectional interaction between the data base and its possibilities for making numerical and graphical reports.

Finally, it must be noted that location-allocation models are very useful methodologies to support decision-making for health care in developing countries (Rahman, S. and Smith, D. 2000).

[2] Decision Support Systems (DSS) were initially developed in the economic and management sciences during the 1950s and 1960s and were widely diffused during the next two decades. Likewise, the concept of Spatial Decision Support Systems (SDSS) was developed at the same time, being the Geodata Analysis and Display Systems (GADS) developed by IBM (*International Business Machines*) during the 1970s. Since the second half of the 1980s, DSS have begun to be adopted as tools for the enlargement of the technology capacity GIS. Some aspects of this process were developed by Malczewski, J. (1998).

Orientation of the location-allocation

From a general point of view, the orientation supplied for the model of location-allocation, will be influenced by the nature of the service. If the service is private, it will basically focus on improving *spatial efficiency,* on the other hand, if it is public, it will try to improve *spatial equity*. Both refer to the enhancement of global parameters for the access to the service: the sum of the total displacements, accessibility values or differences among extreme values.

Similarly, a notorious difference is shown if the equipment to be installed is *desired* (beneficial) or *not desired* (prejudicial). While the first ones basically generate positive externalities (hospitals, schools, cultural centres etc.) the second ones generate negative externalities (cemeteries, jails, rubbish dumps, etc.).

Therefore, taking in to account the previous considerations, the SDSS will contemplate different possibilities of methodological application according to the objective in charge of finding the localization of the service centres.

Methodology

Searching for candidate sites and their combinations

The application of location-allocation models implies having an offer, distributed in a point manner, and a demand which, for reasons of simplification, may be assigned to a centroid of each area and a transport network linking them. However, the application of methods attempt to find new supply locations must first consider the determination of possible *candidate sites*, that is to say a quantity of selected points with the purpose of selecting the best one(s) according to the applied model objective.

There are two basic possibilities for the consideration of candidate sites: a) obtain them through procedures of thematic superposition and multi-criteria evaluation (MCE) techniques, and b) consider each centroid of demand as a possible site for the installation. The MCE techniques were extensively developed in Buzai, G. and Baxendale, C. (2011) and the use of the centroids of areas as candidate sites was studied methodologically by Fotheringham, A. *et al*. (1995). The second technique appears to be linked with the modifiable area unit problem (MAUP) at the moment in which a variation in the number of spatial units will allow possible modification of the results obtained.

Therefore, avoiding the necessity of assessing the infinite localizations, the models work with the combinations of p centres in n candidates points, being $p<n$; where p will be the best sites obtained (Church, R. and Sorensen, P. 1994; Lea, A. and Simmons, J. 1995).

Even when the above-mentioned simplifications are carried out, the calculations are extensive, and thus heuristic mechanisms (for iterative procedures of proof and error in a continuous approximation to the best solution) are being sought to obtain results (Densham, P. and Rushton, G. 1992). One such method is presented in this work.

The identification of possible solutions based upon the application of combinatorial supplies extremely high values when changing the elements *n* and *x* applying:

$$\frac{n!}{x!(n-x)!} \tag{1}$$

For example, in a simple case of locating 2 entities among 10 candidate sites, the result is 45 possibilities. If we raise the number of entities to 4, the result will be. To obtain the best 12 sites within the 70 candidate sites (centroids) in Luján, we need to use heuristic methods as there are 10,638,894,058,520 election possibilities.

Facing the overwhelming amount of calculations, the heuristic strategy of approximation to the best solution is theoretically quite acceptable; another proposal also points to the consideration of a multiple interchange of two or three candidates simultaneously, however, for the substantial improvement in the time calculations, the advance in the computational capacities of *hardware* continues being fundamental.

Models for desirable equipments

p-median model

The *p-median model* is an initial and simpler form of the location-allocation modelling procedures. Its objective is to *minimize* the sum of the total of the products of the population displacements from the points of demand (centroids that group the dispersed demand) to the supply points. The function objective is:

where a_i is the weight associated to each demand point d_{ij} is the distance be-

$$\text{Minimize } \{F = \sum_{i=1}^{n}\sum_{j=1}^{m} a_i d_{ij} x_{ik}\} \tag{2}$$

tween potential demand *i* and supply *j* points, x_{ij} is the allocation factor which is equal to 1, if the center of offer *j* is the closest to the point of demand *i* and 0 to the contrary; *n* is the total amount of demand points and *m* the potential supply points (considering the existing ones).

The model is called *p-median* because it is considered that p is the number of installations to be located. The objective of this model is to find the minimum value of the function objective F and with this the greater spatial efficiency in respect to the total number of displacements from demand centres towards the p supply points.

The *p-median* model can be enlarged by incorporating a restriction of distance. It has a similar objective as the previous one, but in this case considering none of the (d_{ij}) surpass a determinate reach value (S).

$$\text{If } d_{ij} \leq S \Rightarrow x_{ij} = 1 \tag{3}$$

$$\text{If } d_{ij} > S \Rightarrow x_{ij} = 0 \tag{4}$$

even though d_{ij} is the lowest value for both points.

This way, on one side it is intended to act on the global cost of displacements (efficiency) and on the other, it is intended to minimize the maximum distances of transfer (equity).

Applying this restriction, it is possible that the solution does not appear from the quantity of the requested points, in this sense it is possible that the necessity of extending them emerges.

Maximum coverage model

The *maximum coverage model* has the objective to *maximize* the total of demand values within a coverage ratio (R) prefixed for the supply points. Within these surfaces the largest amount of demand must remain assigned.

$$\text{Maximize } \{F = \sum_{i \in I} a_i x_i\} \tag{5}$$

where I is the group of demand points (indexed by i) a_i is the population in the demand node i and x_i are 1 if the center of demand i is located inside the area of coverage $(x_i \leq R)$ and 0 in a contrary case.

Maximum coverage model with distance constraint

The maximum coverage model can be enlarged by incorporating a restriction of distance, whose object is to maximize the total demand values within a ratio of coverage prefixed for the supply points, considering that all the demand exists within a radio S, greater than the reach of the goods or services.

The formulas which are present in BUZAI, G. and BAXENDALE, C. (2011) are used to find optimum locations, for non-desirable equipment will not be developed here. Conceptually, those seek for the inverse effect to those presented here.

Modelling for distances calculations

When applying location-allocation models, the development of distance calculation from the demand and supply points (d_{ij}), that is, from the centroids of areas with grouped demand towards the existing installations, or towards the candidate points, is an important procedure.

From the coordinates of each location in an absolute space different measures of distance, named metrics, can be calculated.[3]

The straight line distance or Euclidean distance which appears due to the consideration of an ideal space where there are no limitations to transit in any sense is obtained through the application of the following formula:

The *Manhattan* distance or *city block* which assumes a displacement through a regular grid is given by:

In both cases, the results are obtained considering absolute coordinates over the geographical space and while in the first case is used the Pythagorean solution for calculating the hypotenuse of the triangle, in the second case is used the sum of the measure units for both hicks.

$$d_{ij} = \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2} \quad (6)$$

$$d_{ij} = \left| x_i - x_j \right| + \left| y_i - y_j \right| \quad (7)$$

With the aim of generating possibilities of more flexible calculations which tend to surpass the *Manhattan* metric considering the sub-estimation problems caused by localizations among blocks or the appearance of barriers, or overestimation from the appearance of streets in different direction of the basic circulation grid (HODGSON, M. *et al.* 1995), the *Lp* metric has been proposed.

$$d_{ij}^{\beta} = \left(\left| x_i - x_j \right|^p + \left| y_i - y_j \right|^p \right)^{\frac{\beta}{p}} \quad (8)$$

[3] A metric that permit the calculation of distance between points, as has been expressed in BOSQUE-SENDRA, J. (1992), must meet certain conditions: Positivity ($d_{ij} \geq 0$), Identity, if $d_{ij} = 0$, Simmetry ($d_{ij} = d_{ji}$) and Triangular Inequality ($d_{ij} \leq d_k + d_{kj}$).

Here appears a β parameter which indicates a modification of the costs of displacements with the distance, and note that when β=1 we have the *Manhattan* distance with p =1 and *Euclidean* with p = 2. The *Lp* metric was proposed by Love, R. and Morris, J. (1972) and turns out to be an excellent application alternative when it is not possible to calculate over the street network, yet knowing the urban road structure.

However, when the distance calculus is carried out on a geometrical basis from a structure of a *raster* layers, it is also possible to initially establish a correspondence with the analyzed metrics.

A step forward from *absolute space* to *relative space* happens when the distances between two locations are calculated in other units of measurement (time or any other types of cost), which are based on a *map of friction* which incorporates for each pixel a relative value to the effort which must be expended in order to traverse it. In this way, from each point entity we can generate a *cost surface* which corresponds to the cost (effort) which accumulates in each pixel of the study area in order to reach the said entity.

The present application incorporates the thematic layer of the road network of the study area. The distance calculations were made up on such a basis.

Application: location-allocation model applied to Primary Health Care Centers (PHCC) in the City of Luján, Argentina [4]

The application carried out is based in the theoretical and methodological aspects carried out and it presents an analysis based on vector spatial structure made up by points, arcs (lines) and polygons (areas). The application focusing on the analysis of the spatial justice of the health services, considered as a fundamental issue of the development procedure with GIS in the framework of geography of health studies (Buzai, G. 2009; Fuenzalida, M. 2010).

In this configuration, the points correspond to the existing PHCC and centroids of census radii which work as demand points (upon assigning the population values of potential demands) and at the same time as candidate sites for new center localization; the lines correspond to the streets through which the demand and supply points will be spatially linked and the polygons are areas with diverse population values of potential utility.

Figure 1 demonstrates the study area. *Figure 2* presents some of the mentioned components on the studied area: street net, localization and census

[4] The thematic layers used in the application, correspond to (1) 70 census radii of Luján city, 2010 (2) centroids of census radii as points of demand and candidate sites for localization of the service offer (3) 12 PHCC as offer points, and (4) vial net as friction map. The numerical data taken in to account are: (5) Population of 6 to 14 years per census radii with potential offer value. Software: Flower Map © Ultrecht University, Holland.

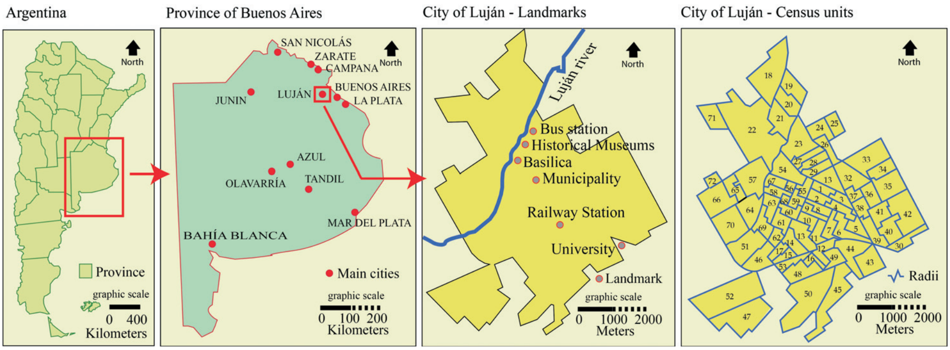

Fig. 1. Location of sutdy area of Luján. *Source:* Edited by the author

radii limits and localization of the 12 existing PHCC which, for the purpose of modelling, were assigned to the centroid of the corresponding census radii.

The first calculus carried out successfully determines the best placement for a total of 12 PHCC considering that each one of the 70 census radii, through its centroid, is presented as a candidate site for the localization. The result presents the spatial configuration of 12 selected points from a total of 70 that is a unique solution of the immense number of possible combinations.

To obtain this, we have used a model of maximum coverage of demand, one of the practical orientations of great possibilities in the environment of Geographical Information Systems (Spaulding, B. and Cromley, R. 2007). In this model, candidate sites which may capture all the population demand were selected considering that no inhabitant of the study area is located more than 1,500 meters from the nearest PHCC, since through a previous exploratory analysis, it was possible to determine that with this distance restriction one can obtain, the same quantity of existing PHCC, which would permit its perfect comparison.

Figure 3 presents the map with the 12 optimum centres obtained; and *Figure 4* is the spider map (also called *desire map*), made up from the centres and the demand allocation from the census radii which are included within each influence area, is presented in the following figures.

The alphanumerical data correspond to this spatial configuration can be seen clearly in *Table 1* from which the following information is presented:

Column 1 – Label: Number of census radii/centroid.

Column 2 – CAPS 1: Existing PHCC.

Column 3 – CAPS 2: Optimal PHCC.

Column 4 – Demand (around a distance of 1,500 meters): Population UBN of potential demand to each optimum center.

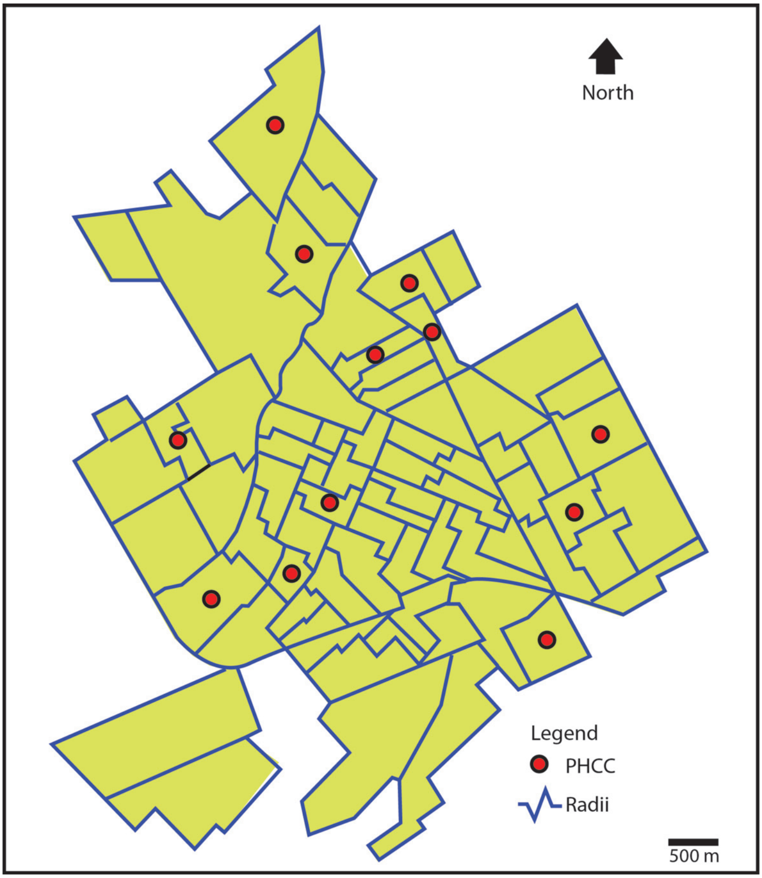

Fig. 2. City of Luján. Census radii, streets and twelve Primary Health Care Centers (PHCC).
Source: Edited by the author (performed with Flow Map)

Column 5 – Center (around a distance of 1,500 meters): Centroid to which the data of the census radii are assigned.

Column 6 – Distance (around a distance of 1,500 meters): Distance between centroids.

Column 7 – UBN: Population of Unsatisfied Basics Needs in each census radii (Original variable from the Argentine national census: NBI *Necesidades Básicas Insatisfechas*, *Synthesis of poverty*).

The 12 existing PHCC are in the centroids of the census radii 18, 21, 24, 26, 27, 35, 41, 43, 51, 60, 62 and 65, while the optimum localization PHCC with a maximum coverage of 1,500 meters, would be located in 20, 21, 26, 36, 42, 48, 49, 51, 52, 59, 65 and 71. Upon being coincident the census radii centroids

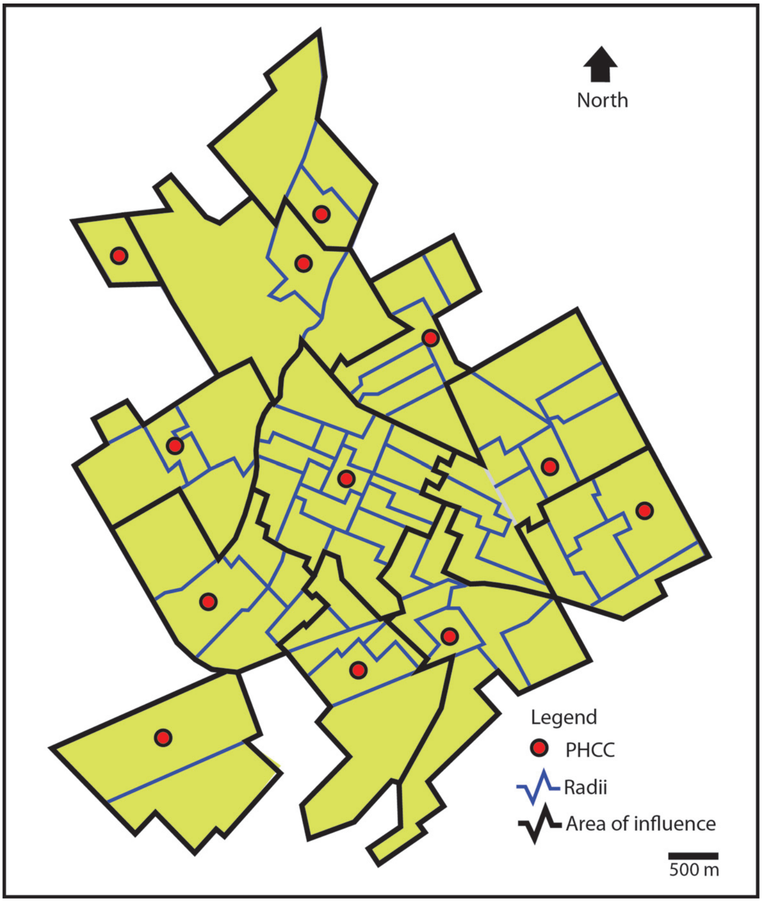

Fig. 3. 12 PHCC optimum location identified and influence areas obtained as model of coverage with a solution of 1,500 meters. *Source:* see *Fig. 2.*

of 21, 26, 51, and 65, there is a 33% of spatial correspondence between the real and the optimum spatial configuration.

The data about the population of *potential demand* was adjusted to the inhabitants with UBN. The localization 36 has the highest value of potential demand with UBN, with 1,552 inhabitants and localization 52 has the smallest value with 72 inhabitants, in their respective influence areas. The entire values are useful in order to figure out the calculations of distance and the population assignation to the localization of the 12 optimum PHCC. The calculations made on the total values give out the following results *(Table 2).*

Figure 5 shows the accumulative values of population with UBN as regards of distance to the optimum centres as a group, and *Figure 6* presents the

Table 1. Results of the allocation solution

Label	PHCC-1	PHCC-2	Demand	Center	Distance	UBN
1	–	–	0	59	1,156.43	1
2	–	–	0	59	858.08	16
3	–	–	0	36	1,000.76	28
4	–	–	0	36	1,178.04	54
5	–	–	0	36	1,342.81	15
6	–	–	0	36	1,409.72	32
7	–	–	0	49	1,449.77	36
8	–	–	0	59	776.50	10
9	–	–	0	59	808.25	4
10	–	–	0	59	1,030.10	12
11	–	–	0	49	1,275.07	7
12	–	–	0	49	442.75	44
13	–	–	0	59	1,355.58	25
14	–	–	0	48	1,241.13	98
15	–	–	0	48	1,161.43	133
16	–	–	0	48	719.14	26
17	–	–	0	51	1,288.40	54
18	x	–	0	20	1,123.14	366
19	–	–	0	20	725.80	427
20	–	x	1,320	20	0.00	527
21	x	x	467	21	0.00	253
22	–	–	0	21	1,340.49	139
23	–	–	0	21	1,095.67	75
24	x	–	0	26	662.02	174
25	–	–	0	26	1,031.66	91
26	x	x	568	26	0.00	106
27	x	–	0	26	702.79	10
28	–	–	0	26	656.45	60
29	–	–	0	26	869.44	43
30	–	–	0	42	1,094.01	57
31	–	–	0	26	1,184.07	84
32	–	–	0	36	1,037.71	36
33	–	–	0	36	1,411.08	209
34	–	–	0	36	1,071.01	419
35	x	–	0	36	724.51	332
36	–	x	1,552	36	0.00	164
37	–	–	0	36	724.31	42
38	–	–	0	36	603.73	47
39	–	–	0	42	1,280.13	59
40	–	–	0	42	853.03	138
41	x	–	0	36	991.11	174
42	–	x	535	42	0.00	281
43	x	–	0	49	1387.81	68
44	–	–	0	49	706.16	109
45	–	–	0	49	1,490.86	164

Table 1. (Continued)

Label	PHCC-1	PHCC-2	Demand	Center	Distance	UBN
46	–	–	0	51	914.01	224
47	–	–	0	52	936.32	23
48	–	x	664	48	0.00	63
49	–	x	506	49	0.00	78
50	–	–	0	48	1,286.38	213
51	x	x	951	51	0.00	264
52	–	x	72	52	0.00	49
53	–	–	0	48	458.37	131
54	–	–	0	59	1,286.35	32
55	–	–	0	59	653.28	14
56	–	–	0	59	613.87	2
57	–	–	0	65	902.74	124
58	–	–	0	59	685.21	7
59	–	x	319	59	0.00	5
60	x	–	0	59	466.56	33
61	–	–	0	59	958.29	66
62	x	–	0	51	1,296.78	64
63	–	–	0	59	1,136.41	62
64	–	–	0	65	898.86	121
65	x	x	773	65	0.00	124
66	–	–	0	65	925.70	167
67	–	–	0	59	1,043.33	28
68	–	–	0	59	485.96	2
69	–	–	0	51	962.81	136
70	–	–	0	51	1,398.99	209
71	–	x	84	71	0.00	84
72	–	–	0	65	1,282.49	237

Source: Calculation by the author

expansion of the calculus considering the 12 existing PHCC and it calculates the localization of 5 PHCC in potential optimal locations.[5]

In effect, the five selected sites correspond to peripherals census radii: three sites in the South, one site in the North, and one site in the Eastern sector. The allocation of potential demand (*Figure 7*) generates minor displacements.

The alphanumerical data corresponding to this spatial configuration can be seen in *Table 3* composed by the following information:

Column 1 – Label: Number of census radii (centroid).

[5] The *social map* of the city of Luján shows a typical configuration of the Latin American city (Buzai, G. 2003; Buzai, G. and Marcos, M. 2012), where the favored areas have central location and the non favored areas are located in the periphery. In 2010 Luján presents 20 peripherals census radii, therefore it was considered the possibility of including 1/4 of the spatial unities with vacancy of PHCC.

Table 2. Calculations on the basis of total values of Table 1

Calculations	Meters
Distances to centroids	59,853
Distances to population	5,961,586
Averages of distances to centroids	831
Averages of distances to population	83,949
Minimum distance	0
Maximum distance	1,490
Standard deviation to distances to centroids	453
Standard deviation to distances to population	104,409

Source: Calculation by the author

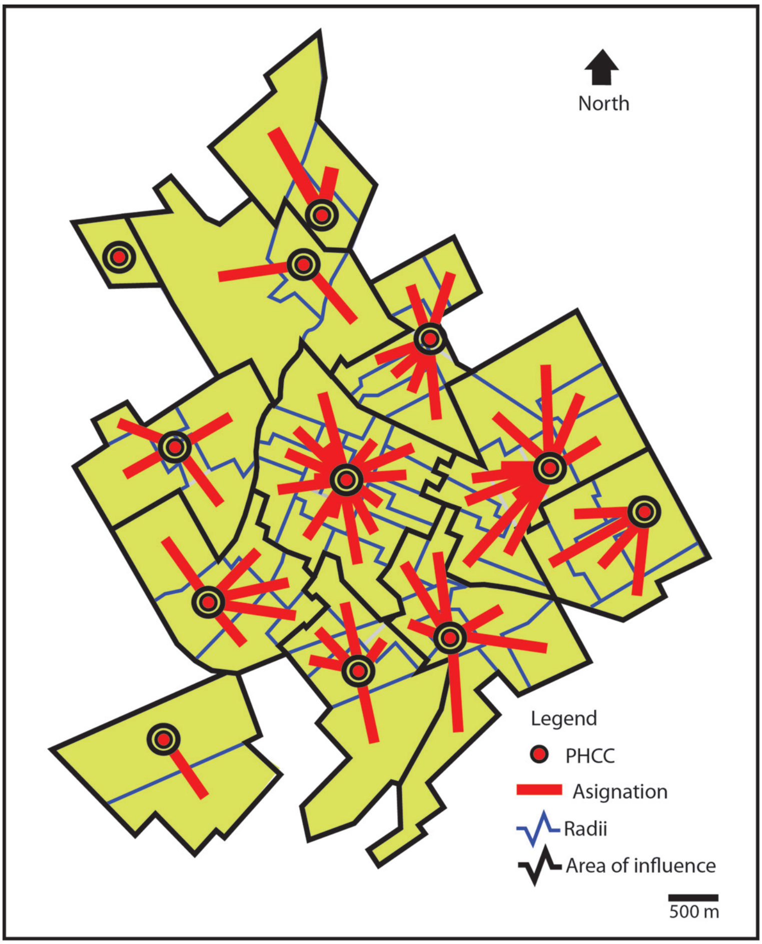

Fig. 4. 12 optimum locations and allocations of potential demand. *Source:* see *Fig. 2.*

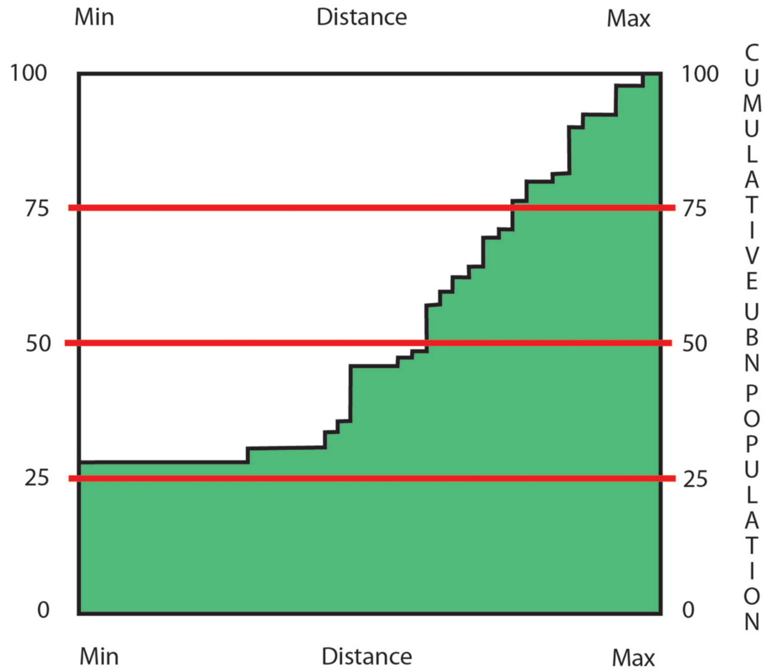

Fig. 5. Graphic of accumulated frequencies covering the potential demand.
Source: see *Fig. 2.*

Column 2 – CAPS 1: Existing PHCC.

Column 3 –CAPS 3: Optimal PHCC (result obtained considering PHCC-1).

Column 4 – Demand (within 1,500 meters of distance): Population UBN of potential demand to each optimum center.

Column 5 – Center (within 1,500 meters of distance): Centroids to which the data of the census radii are assigned.

Column 6 – Distance (within 1,500 meters): Distance between centroids.

Column 7 – UBN: Population with Unsatisfied Basics Needs in each census radii.

The 12 PHCC of Luján are selected in *Table 3* (PHCC-1). To those were added the localizations 39, 48, 49, 52, and 71 (PHCC-2). The configuration expands to 20 PHCC. The values of assigned potential demand decrease remarkably. In general, although localization 35 maintains a high value of 1,166 inhabitants, being that localization 43 has the lowest value with 68 inhabitants with UBN in its influential area. All the values are useful for calculating the distance and the assignation of population for the location of the 20 optimum

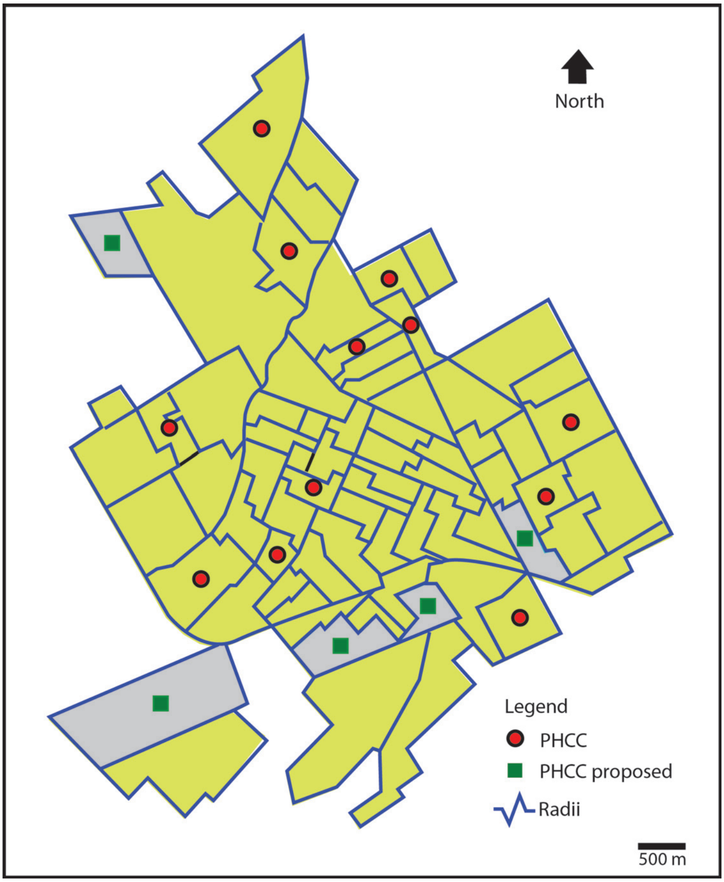

Fig. 6. 12 PHCC+5 proposal. Calculations made with Flow Map software.
Source: see *Fig. 2.*

PHCC. The calculations figured out upon the total values give the following results *(Table 4)*.

Figure 8 graphics the accumulative values of population with UBN as regards the distance to the optimum centres.

Comparing the data given by the statistics presented in *Table 2* and *Table 4*, we can see that there exists a decrease in the following values: *Distances to the population of* 59,611,586 to 5,091,082; *Distances covered departure and return* of 11,923,172 to 10,182,164 and *Standard deviation* from distances to population from 104,409 to 101,211. This indicates that with the second solution the parameters of spatial efficiency (distances) and spatial equity (standard deviation) have improved.

Table 3. Allocation solution results

Label	PHCC-1	PHCC-3	Demand	Center	Distance	UBN
1	–	–	0	27	1,368.54	1
2	–	–	0	60	1,247.07	16
3	–	–	0	39	1,449.72	28
4	–	–	0	39	1,395.17	54
5	–	–	0	39	733.11	15
6	–	–	0	39	1,099.96	32
7	–	–	0	60	1,363.27	36
8	–	–	0	60	1,165.49	10
9	–	–	0	60	899.70	4
10	–	–	0	60	636.11	12
11	–	–	0	60	1,256.18	7
12	–	–	0	49	442.75	44
13	–	–	0	60	959.74	25
14	–	–	0	62	734.39	98
15	–	–	0	62	813.39	133
16	–	–	0	48	719.14	26
17	–	–	0	62	603.54	54
18	x	x	793	18	0.00	366
19	–	–	0	18	994.75	427
20	–	–	0	21	757.82	527
21	x	x	919	21	0.00	253
22	–	–	0	21	1,340.49	139
23	–	–	0	27	626.24	75
24	x	x	265	24	0.00	174
25	–	–	0	24	527.85	91
26	x	x	226	26	0.00	106
27	x	x	221	27	0.00	10
28	–	–	0	27	322.62	60
29	–	–	0	27	579.61	43
30	–	–	0	39	1,434.59	57
31	–	–	0	26	1,184.07	84
32	–	–	0	26	1,374.13	36
33	–	–	0	35	1,178.16	209
34	–	–	0	35	521.75	419
35	x	x	1,166	35	0.00	332
36	–	–	0	35	724.51	164
37	–	–	0	35	1,291.02	42
38	–	–	0	41	852.10	47
39	–	x	383	39	0.00	59
40	–	–	0	39	618.73	138
41	x	x	502	41	0.00	174
42	–	–	0	41	1,013.56	281
43	x	x	68	43	0.00	68
44	–	–	0	49	706.16	109
45	–	–	0	49	1,490.86	164

Table 3. (Continued)

Label	PHCC-1	PHCC-3	Demand	Center	Distance	UBN
46	–	–	0	51	914.01	224
47	–	–	0	52	936.32	23
48	–	x	433	48	0.00	63
49	–	x	395	49	0.00	78
50	–	–	0	48	1,286.38	213
51	x	x	697	51	0.00	264
52	–	x	72	52	0.00	49
53	–	–	0	48	458.37	131
54	–	–	0	27	889.29	32
55	–	–	0	60	991.48	14
56	–	–	0	60	927.30	2
57	–	–	0	65	902.74	124
58	–	–	0	60	990.64	7
59	–	–	0	60	466.56	5
60	x	x	329	60	0.00	33
61	–	–	0	60	502.41	66
62	x	x	485	62	0.00	64
63	–	–	0	60	684.59	62
64	–	–	0	65	898.86	121
65	x	x	773	65	0.00	124
66	–	–	0	65	925.70	167
67	–	–	0	60	1,348.76	28
68	–	–	0	60	523.24	2
69	–	–	0	62	750.62	136
70	–	–	0	51	1,398.99	209
71	–	x	84	71	0.00	84
72	–	–	0	65	1,282.49	237

Source: Calculation by the author

Table 4. Calculations on the basis of total values of Table 3

Calculations	Meters
Distances to centroids	51,505
Distances to population	5,091,082
Averages of distances to centroids	715
Averages of distances to population	71,686
Minimum distance	0
Maximum distance	1,490
Standard deviation to distances to centroids	485
Standard deviation to distances to population	101,211

Source: Calculation by the author

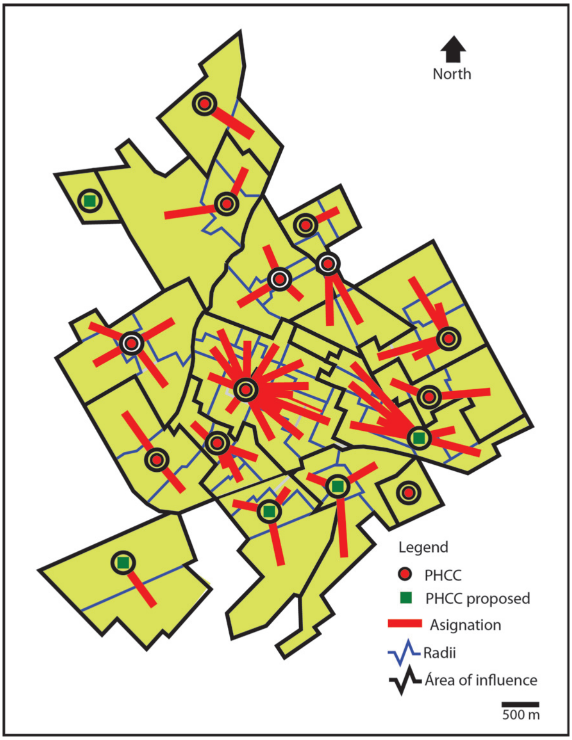

Fig. 7. Allocation of potential demand to solution of 17 PHCC. *Source:* see *Fig. 2.*

Fig. 8. Graphic of the accumulated frequencies coverage of potential demand. *Source:* see *Fig. 2.*

Conclusions

In this work the aptitude of the location-allocation models was exemplified based on the calculus of coverage, mainly applied in the search of efficiency and spatial equity of the Primary Health Care Centers (PHCC) in the city of Luján. Also, the obtaining of solutions that start going into the process of verticalisation (Eastman, J. 2007) through the Geographical Information Systems (GIS) and of the Spatial Decision Support System (SDSS) supply important possibilities for the right support on decision making in spatial issues.

The questions answered in this work are the following: which is the rate of correspondence between the real localization of the supply points and the ideal localization based on the spatial distribution of the demand population? In which way the spatial efficiency and the spatial equity is modified in accordance to the reallocation of these points and finally where should new installations be settled in order to satisfy the distributed demand? The application carried out for the city of Luján has clearly answered these aspects by presenting key elements for the urban planning of the studied area.

By generating concrete results which allow us to answer these questions, one may note that the theoretical–methodological guidelines currently developed in the interior of the technologies GIS+SDSS allow a valid approximation to the solution of complex localization.

We consider that automated spatial analysis contributes to support the theoretical–methodological geographical basis, in decision-making processes in urban planning issues, thus allowing one to confront actions oriented to reducing aspects of socio-spatial inequalities of the population.

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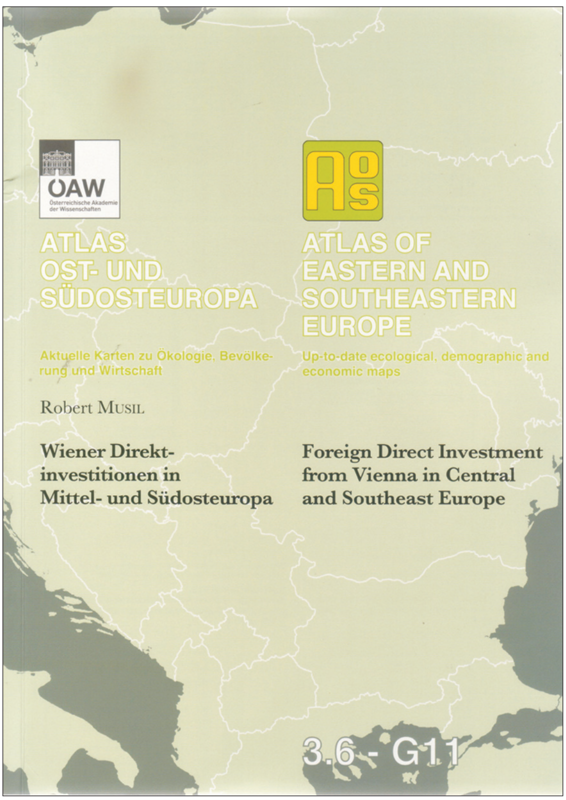
Robert Musil: Foreign Direct Investment from Vienna in Central and Southeast Europe. Atlas of Eastern and Southeastern Europe. Institute for Urban and Regional Research of the Austrian Academy of Sciences, Vienna, 2011. 60 p.

Globalization has displayed acceleration since the 1980s. Foreign investments have played a giant role in that process. During the last decades, not only the amount of invested capital has increased, but also the destinations of investments have changed a lot. It can be seen particularly, after 1989 when the former European socialist countries successfully put themselves "on the map of investors". (After World War II this part of Europe received only a small share of the foreign investments.) Since then, the amount of the capital invested in Central and Southeastern Europe has continuously increased and in 2012 the rate of the global investments has reached 11%.

Studying of the origin of the invested capital in a given region can also be important. That is why this publication is interesting. It was submitted by Robert Musil and published by the Institute for Urban and Regional Research of the Austrian Academy of Sciences in 2011. In the literature publications like the "Atlas of Eastern and Southeastern Europe" demonstrating the foreign investment coming from a capital city in details are rare. In fact, the publication itself is a text accompanying the maps and its title is "Foreign direct investment from Vienna in Central and Southeastern Europe."



The Atlas consists of four colourful maps, the titles of which are the followings:

– Map 1: Active FDI stock 1993–2005, gross regional product 2005.

– Map 2: Employees in branches of Viennese headquarters 2005, share of the tertiary sector in the total of employees.

– Map 3: Development of passive FDI stock 1993–2005, infant mortality 2005.

– Map 4: Origin of active direct investments 2005, population density 2005.

Each map demonstrates the foreign direct investments in Central and Southeastern Europe in an interesting and special approach. In addition, the explanation of the maps provides a theoretical and methodological background.

The text has six major parts and nine chapters. Taken as a whole, it is a short publication with 30 pages, but as it is bilingual, its total length is 60 pages. The first half of the text is in German and the second half is in English. It would have been useful and advantageous to have the English version checked by a native speaker. The great advantage of the bilingual version is that much more people can read and use it.

The *first part*, the "Introduction" has got an interesting subtitle: "Foreign direct investment (FDI) from Vienna, the Wild East and selling of the family silver…"However, the term "Wild East" is not defined exactly. Instead, we get information on the reason for publishing of the atlas. Several reasons were mentioned, but the most important one was the "delayed internationalization of the Austrian economy". The phrase "selling off the family silver" was used by the Austrian media when the acquisition of e.g. Bank of Austria took place, although the author remarked that "very little understanding is expressed when the situation is reversed". For example, when OMV intended to acquire the Hungarian Mineral Oil Corporation (MOL).

The *second part* (Foreign direct investment: definition, data and methodology) focuses on the definition of the concept of FDI; the data and methods. Foreign direct investment is one of the main forms of the international investments. It is generally a long term investment in contrast to portfolio investments. Its purpose is not only an investment in another country, but also the control of business activities of a given company. As a consequence, the concept for FDI given by the Austrian National Bank and adjusted to the guidelines of the OECD can be entirely accepted. According to it, "foreign direct investments can be considered as capital investments which are made by investors with the intention of establishing and maintaining a permanent economic relationship with business in another country. Simultaneously, they intend to exert their influence upon the management of the company in question".

There are four types of FDI (the establishment of new companies, mergers, acquisitions, profit reinvestments). Lately, a shift has taken place in favour of mergers and acquisitions. They account for about 80% of all new investments. Indeed, FDIs can be considered as the "vehicle of the globalization", because transnational companies (TNCs) use them to expand the global network of their locations and to create global chains.

FDIs can also be classified by the direction of investment and it can be active or passive. "Active investments emanate from a domestic business and are destined for a foreign country, while passive investments flow in the opposite direction, arriving inland from abroad." The author also emphasized that the indication of direction must always be considered as relative, "from the perspective of the observer".

According to Musil, studying FDIs is a fascinating subject for geographical researchers because they can be spatially determined. In other words, FDIs can be studied well in space from a geographical viewpoint.

Foreign direct investments are usually motivated by different reasons, the most important ones are the followings:

- market or sales orientation,
- cost orientation,
- supply security,
- acquisition of technical knowledge.

Those factors can be combined to a different degree. At the beginning, mostly the first two reasons were important in FDIs, but nowadays the acquisition of technical knowledge is getting more and more important for the companies located in Central and Southeastern

Europe in order to get technological knowledge from the East European and North American corporations. Viennese investments into the countries of Central and Southeastern Europe have two main reasons: market orientation and cost orientation.

The data of maps refer to the years 1989–2005. That period reflects the internationalization of the Austrian economy. It is a pity that data after 2008 are not available, because the impacts of the economic crisis which broke out in 2008 particularly affected the Viennese investors and thus Central and Southeastern Europe. The researched area which is presented on the maps has 137 regions at NUTS-2 and NUTS-3 level.

The *third part* ("The internationalization of Vienna through foreign direct investment – the initial geopolitical and macroeconomic situation") which have five chapters, draws a historical overview about the eventful relationship between Vienna and Central and Southeastern Europe and about the role played by Vienna in the development of the region during the different historical periods.

Getting acquainted with the past is extremely important to be able to interpret the current processes "described on the maps" as the historical past considerably affects them. The author also pays a special attention to the development and structure of FDI from Vienna after 1989, because that year was a relevant turning point for the Austrian capital city. Since then, the role of the city in foreign capital investments and employment has become even more important. This part of the text also gives a response to the question whether Vienna is a bridgehead between West and East. The geographical location of the capital city, its geopolitical situation, historical connections and cultural factors "also prompt the investors from Vienna to focus on the regions formed part of the Danube".

The central role of Vienna is well-reflected – among the others – by the direct flights from Vienna to the Eastern parts of Europe. It is demonstrated in Figure 4 in, while Figure 7 illustrates "the most important locations according to the balance of profits, weighted by the volume of active and passive FDIs". On the map, it can be clearly seen that the regions situated east from Vienna receive more investments from the city than others.

In the *fourth part* (titled "Spatial patterns of foreign direct investment from Vienna in Central and Southeast Europe") the spatial distribution of FDIs (coming from) from Vienna in Central and Southeast Europe is analysed by three different factors (distance, agglomeration, the level of development). In fact, it looks for the explanation of three key questions:

– How do the FDIs (coming from) from Vienna are distributed in space, namely, in Central and Southeastern Europe?
– What are the reasons for that?
– What kind of structural differences exist between those locations?

In the first three chapters the author examines the regional distribution of active direct investments with regard to their correlation with the three factors mentioned before, then he provides information on the sectoral structure and the origin of active direct investments in 2005. The fourth chapter puts the emphasis on the analysis of the origin of passive FDIs invested in 1993–2005 from different aspects.

In 1990s Budapest was the number one destination of the ten most important investment locations among cities of Central and Southeastern Europe, but after the turn of millennium, Prague took over its place. Foreign direct investments from Vienna are characterized by a considerable spatial concentration. In the 1990s approximately two thirds of the investments were concentrated within 250 km of Vienna. Between 2003 and 2005 the investments in location more than 500 km from Vienna increased and they accounted for 34% of the whole investments. The main reason for that shift is the increasing importance of those distant markets. According to the sectoral structure, the locations were classified into four main groups with about 206 thousand employees:

– industrial locations: where 75% or more of employees work in the industry

– consumer-oriented service locations: where 75% or more of employees work in the service industry, mainly for commerce.

– producer-oriented service locations: where 75% or more of employees work in services, mainly for financial sectors, telecommunications.

– mixed locations: neither industry nor service dominant.

The first group is the largest one, because 36 of 86 investment locations were industrial locations. Almost 64% of the investments flowed from Vienna in Central and Southeast European countries come from its urban fringe. Only a few locations which are usually peripheral regions (like Somogy County in Hungary) have exclusive investments originating from the urban fringe of Vienna.

The last part of the text contains the sources and the literature. They give an opportunity for the readers to deepen their knowledge in this special field.

In the text, there are 16 tables and 13 black and white figures providing important information and completing the text on the FDIs from Vienna in Central and Southeast Europe. They also promote the better understanding of the flow and nature of FDIs.

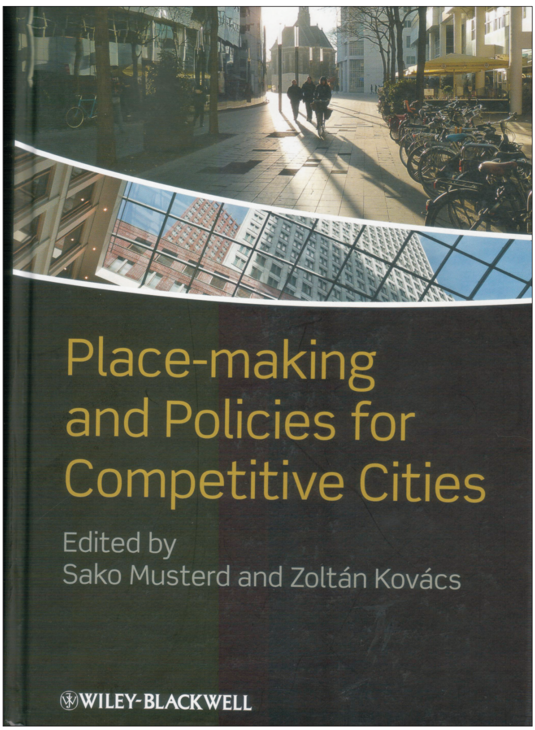
Taken as a whole, this publication can be very useful for people interested in the fate of Central and Southeastern Europe and in their economic processes, particularly in the spatial characteristics of FDIs.

Éva KISS

Sako Musterd and Zoltán Kovács: Place-making and Policies for Competitive Cities. Oxford, Wiley-Blackwell, 2013. 340 p.

Creativity, competition of cities, path-dependent development, networks, policy: they are my arbitrarily chosen keywords for the book which shall attract the attention of many. Its main value is making people think about policy-related issues and it encourages us to consider what could possibly go wrong in the city we live in or, on the contrary, what events favour the emergence of a creative milieu.

The book departs from a critical attitude towards Richard Florida's celebrated 3T model in which *Talent*, *Technology* and *Tolerance* are defined as critical factors for urban development. Based on US metropolitan regions, Florida argues that companies settle their high-value-added activities in vibrant, stimulating locations where creative employees feel inspired. Put it differently, jobs go to places creative people like in this way of conceptualization. However, as Musterd and Kovács point out in their introduction correctly, the 3T model suffers from major theoretical shortcomings and European policy-makers should not follow that guidance without special precaution because European urban development differs from the US path. For example, European employees are less mobile than US employees; the previous pathways of urban development in Europe are more important. The creative class reasoning seems to be very elitist in nature and it assumes an automatic spill-over effect from that highly-educated group of people to the whole society, which might differ across countries. Last but most importantly, according to many critics towards the 3t model, economic and industrial structure (and not only human workforce) might remain the primary determinant of urban development. Therefore, there is no universal receipt working in all places; it is not enough to copy policy initiatives from elsewhere. We can learn that tailoring policies is needed in order to address local challenges; the authors also provide us with some crutches for that.



The work upon the book is built was carried out in the frame of ACRE project (Accommodating Creative Knowledge) collecting cases from 13 European metropolitan regions: Amsterdam, Barcelona, Budapest, Birmingham, Dublin, Helsinki, Leipzig, Milan, Munich, Poznań, Riga, Sofia, Toulouse. The research focused on the question of what factors attract or retain creative and talented employees in the city. It is a central question for policy makers but I have to note that it fails to provide a holistic view on human capital development. For instance, it remains unclear whether a city should invest in freshly designed buildings or it should develop the education instead. Main findings of the research were published in a previous volume (Musterd, S. and Murie, A.: Making competitive cities. Oxford, Blackwell, 2010), whereas the present book gives an overview of policy implications organized along three keywords: *Path*, *Place* and *People*.

Contributions within the *Path* chapter concentrate on special circumstances determining city policies. A strong argument is made tclaiming that the past development of cities strongly influences what officials can do in present initiatives. A very interesting section elaborates on the post-socialist challenges for urban development. The authors premise these locations differ from the Western European ones in many regards. For example, capital cities usually have a stronger dominance in the city structure than in Western Europe; therefore capitals might be targeted relatively stronger in these countries, which might have a direct effect on local living conditions and creative class attraction. Also, the section suggests that strong local debates rise frequently whether to support new private projects or the state-controlled cultural sector currently suffering from budget cuts. I would give a further argument to the section: we observe growing social and regional inequalities in these countries and Florida's ideas are really elitist here because there might be very limited spill-over effects from internationally mobile and competitive creative to other locals. For instance, while the centre of Budapest attracts more and more foreigners and creative projects are mushrooming, the outskirts of the city lag behind with an increasing gap. Iin my opinion, researches should pay an extra attention to the aforementioned issues.

The *Place* chapter addresses place-making, marketing and branding as key tasks of local policymakers and municipalities simply because the reputation of a city is crucial in order to attract talented people. I believe that in spite of the fierce intercity competition, the role of the above mentioned factors is still unclear. Therefore, a well-framed and policy mix should synthesise local housing, social environment, and economic development in a way in which a city brand is created as well. Related sections offer a helpful summary.

The last chapter called *People* contains excellent contributions from the broad area of network studies. Transnational networks are mainly discussed from the viewpoint of immigrants: "Are they embedded into local environment or not?" The integration might depend on the cultural and institutional constraints of the city population and it should be supported by knowledge-based policy. I found that the section on university-industry networks provided the most substantial overview. It contains an outstanding typology of personal connections between university employees and other local actors (Figure on page 274). The last section provides a nice reflection on previous propositions from the viewpoint of professional and social networks complementing each other and providing different spaces of learning and innovation in a city. From the network chapter, one can get the impression that policymakers should pay an extra attention to the support of (new) platforms and the creation of infrastructure. The networks of creatives will probably establish a vibrant atmosphere on that basis.

Three types of people will certainly benefit from reading the book. Researchers conducting qualitative work in planning studies will surely find areas in the volume they can relate themselves to. People working in quantitative fields will most probably find the book thought provoking and they can easily get the feeling that it is worth focusing on knowledge-based urban development. Nevertheless, the book is a must for urban planners too. Although creatives always find the way to survive, create and express themselves, major policy failures can ruin and a right policy mix can speed up the shaping process of a creative milieu. The major takeaway is that policies should not be automatically/simply adopted from somewhere else, but they should be always tailored to special circumstances.

Balázs LENGYEL

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Report on the Association of American Geographers Annual Meeting

Los Angeles, April 9–13. 2013

The Annual Meeting of AAG is one of the greatest and most colourful events among the geographical conferences with a great number of attendees outside of the United States. In recent years the AAG meeting has become a global meeting place for geographers. The 2013 meeting was held in Los Angeles, California. More than 5,000 participants attended the event which was held in The Westin Bonaventure Hotel, The LA Hotel Downtown and The Biltmore Hotel in the downtown of Los Angeles.

It is hard to summarize a conference with an official program book which is over 400 pages (without the abstracts of the presentations). Partly because of the great number of the participants, the meeting was very diverse thematically and a wide range of approaches were present, which evoked interesting discussions and debates. The majority

The Westin Bonaventure Hotel, one of the three locations of the meeting

The exhibition hall

Conference break on the ground floor of Westin Bonaventure (photos by Lajos Boros) of presentation were related to the field of human geography, but several sessions dealt with topics regarding geographical information systems, anthropologic geomorphology , and climate change, too. Because of the location of the conference, activism and research on Asian regions were particularly important. Los Angeles (and generally California) is known as a place of diverse social and activist groups with innovative ways of thinking and struggles around the issues of immigration, freedom, borders, etc. Moreover, being one of the most "Asian" metropolises in the United Stated, Los Angeles as a meeting place highlighted the changing geopolitical and economic role of Asia and the cultural diversity of the continent.

The Activist Geographies: Struggles for Social and Environmental Justice and Geographies of Hope Symposium with wide range of topics demonstrated the longstanding shared work of geographers and activists. Spatial and environmental justice, scale and class struggle, rationalisation of space, segregation and dispossession, the relations between universities and the public were among the most discussed topics.

As a part of the Activist Geographies series, several sessions were dedicated to Neil Smith who passed away in the fall of 2013. During the sessions and discussions the theoretical legacy of Neil Smith was arranged around the following topics: nature and development, geography and scale, cities, critical engagements, radical geography. The last session (Remembering Neil) of the so-called "Neilathon" focused on the personal loss: friends and colleagues shared their memories about Neil Smith and a compost poem was written by some of his friends, too. (The genre of compost poem means that various authors contribute to the poem and their work is placed side by side forming a collaborative project.)

As it was mentioned earlier, sessions on Asia were among the key issues of the meeting. Maybe the most important contribution to the discussion was Eric Sheppard's presidential plenary session entitled "Emerging Asias". It addressed the most important aspects on contemporary Asia as a rapidly re-emerging centre of the world economy, emphasizing the diversity of the continent as a region and a geopolitical construct at the same time and the expanding differences in livelihood possibilities.

The "Author meets critics" sessions were exciting parts of the conference: during the events the author of a recent book and a few reviewers discussed the volume. For example, Michael Dear presented his new book, entitled "Why Walls Won't Work: Repairing the US-Mexico Divide" tracing the cultural interaction in the border zone. He calls the spaces in the border zone as "third nation" claiming that it is characterized by shared identity, common history and traditions. Michael Dear studied the effects of after 9/11 fortifications on the third nation; finding that although difficulties emerged as consequences of stricter border control, cross-border lives are undiminished. Third nation proved to be essential to the prosperity of both US and Mexico. The book presentation fitted well into the series of borders sessions which analysed the changing meaning and role of borders in the contemporary world.

In the special sessions entitled "Climate Change, Variability, Adaptation and Justice" more than 40 sessions focused on the social and spatial effects of global climate change. A lot of presentations analysed the connection between climate change and extreme events, the climate change-induced challenges of urban policy, the modelling of climate change and the future of Artic regions.

Among the various GIS sessions, it is important to highlight the health-related ones in which the analysis of spatial inequalities of health conditions, spatial patterns of drug abuse, obesity and neighbourhood effects of health behaviours were discussed. On April 12 a closing plenary (Synthesis, Trends, and Directions for Geography, GIScience, and Health) summarised the topics analysing the future directions of GIS based geography of health.

The events of Jobs and Career Center were aimed to help geographers to facilitate their career development through offering seminars on job searching, possibilities of working in business, non-profit or academic sector and skills needed for a successful career building. The most important issues of geographic education were also discussed during the panels.

Following the tradition of recent meetings, several Hungarian attendees also presented their research at the conference. Zoltán Kovács (HAS, Institute of Geography and University of Szeged) spoke about the processes of peripheralisation in Budapest and the related social conflicts claiming that these processes on the city-region level are the outcome of the decentralised public administration system and the locational mechanisms of global investors. Tamara Rátz (Kodolanyi Janos University of Applied Sciences, Székesfehérvár) presented the so-called "invisible tourism" of Hungary; how is it possible to study the tourism behaviour of the visitors who are not visible to statistics? What are the main characteristics of their consumption, motivations, etc.? Balázs Forman's (Corvinus University of Budapest) presentation focused on the value of money; how and why do cultural differences influence it? Lajos Boros (University of Szeged) presented the connections among peripheralisation, ethnicity and environmental injustice through the case of flood-hit gypsy communities.

The scientific programme of the conference was extended by a book exhibition and numerous guided tours in Los Angeles and California and social events like the International Reception or the meetings of various specialty groups. Most of the field trips focused on the diverse social environment of Los Angeles presenting various ethnic neighbourhoods, the locations of cultural industries and the constantly changing downtown. Physical geographers also had the opportunity to participate interesting field trips since guided tours were organised to visit Santa Monica Mountains, San Fernando Valley, Mojave Desert and San Andreas Fault as well.

The next meeting will take place in Tampa, Florida in 2014 while the 2015 meeting will be held in Chicago. Hopefully, Hungarian geographers will be able to present their work at the conferences as well, demonstrating the versatile nature of Hungarian geography and representing it in the global arena of geographical research.

Lajos BOROS

The 8th International Conference on Geomorphology of the IAG

Paris, 27–31 August 2013

Since the first meeting in Manchester in 1985, the International Association of Geomorphologists (IAG) has been established and evolved into a world-wide association of 43 national members (31 countries with voting right and 12 developing countries not paying a membership fee but annually reporting on their activities to the Executive Committee). It is almost of symbolical significance that we find one of the most enthusiastic initiators (and first president) of the association, Professor Denys Brunsden, among the keynote speakers in Paris again. Other supporters of the idea of international cooperation among geomorphologists, like Andrew Goudie, became Honorary Members of the IAG.

The 8th conference was organized by the Group of French Geomorphologists (GFG) in the La Vilette Park, in the Cité des Sciences et de l'Industrie and included 27 sessions which covered most of the geomorphological topics from theory (e.g. the history of the discipline) to applications (e.g. geomorphological mapping). The largest number of papers were presented in the sessions "Fluvial geomorphology and river management" and at the meeting of the Working Group "Human Impact of the Landscape".

After the long paper and poster sessions, started at 8 a.m., in the evenings the fatigued audience could listen to one-hour keynote lectures, which equally reflected the great the-

The venue of the Conference: Cité des Sciences and de l'Industrie

Decorative hall in the Hôtel de Ville, where we had the welcome party

Some of the young geomorphologists who got an IAG grant to participate matic variety of geomorphological research: Denys Brunsden (United Kingdom) told ”Tales from the Deep” (i.e. ocean-floor topography); Victor Baker (United States) lectured on planetary geomorphology; Ana Luiza Coelho Netto (Brazil) on the significance of extreme events in the tropics; Asfawossen Asrat (Ethiopia) on human origins in Ethiopia and Xiaoping Yang (China) on the paleoenvironments of arid Central Asia. Fortunately, after two days of sessions we could take a rest and go on one-day field trips. Some preferred just a short walk along the Seine River, while others decided on a whole-day bus excursion to the famous cliffs of Etretat on the coast of La Manche (called English Channel on the opposite coast). The cultural programs included a welcome cocktail in an elegant hall of the Hôtel de Ville, built in the pompous style of the Second Empire; wine and cheese tasting in the Cité des Sciences and the traditional gala evening on board of the old freight vessel Boreas, now converted into a pleasure boat. The illuminated Paris remains an unforgettable experience for all participants present.

At the Second General Assembly it was announced that President Michael Crozier (New Zealand) was succeeded by the geoarcheologist Eric Fouache, professor at the Université Paris Sorbonne Abou Dhabi, a new filial of that renowned institution. As vice-presidents Irasema Alcantara Ayala (Mexico), Mauro Soldati (Italy) and Xiaoping Yang (China) were elected in close competition. The new Secretary General, Sunil Kumar De (India), undertook the laborious task of organization of the next world conference in Kolkata in 2017. It was decided that the next regional conference will take place in the Siberian city of Barnaul, a convenient starting point for excursions to visit sites of glacial paleofloods in the foreland of the Altay Mountains – as Andrei Panin, one of the new members of the Executive Committee, explained to us.

Traditionally, scientific pre- and post-conference excursions are organic parts of such meetings of geomorphologists. Although the cancellation of pre-conference trips rightfully caused much disappointment among the participants involved, the post-conference excursions ran successfully. In the Massif Central, for instance, a small but highly international group could study the fluvial morphology of the Allier River, building stone weathering, the eruption history of the Chaîne des Puys, Monts-Dore, the maar lakes and enjoy the sight of numerous architectural monuments in Issoire, St-Saturnin, St-Nectaire and Besse. This excursion was organized by Marie-Françoise André, Jean-Claude Thouret and Pierre Boivin from the University of Clermont-Ferrand.

The unfavourable financial situation at the centres of Hungarian geomorphological research prevented many colleagues from participating at this – not exactly inexpensive – conference, but the universities of Pécs and Debrecen and the Budapest Technical and Economic University were represented with papers and posters. Other countries had similar financial problems, so the IAG Executive Committee supported as many as 21 young geomorphologists from various parts of the world with grants.

Two valuable books were published on the occasion of the Conference: ”Géomorphologie de la France” edited by Denis Mercier for Dunod Publishers and the English-language description of a selection of geomorphological sites entitled ”Landscapes and Landforms of France” edited for Springer by Marie-Françoise André and Monique Fort, who were also the main organizers of the whole event. Along with Stéphane Costa, President of the Organizing Committee, they deserve the gratitude of all participants, who had a wonderful week in a major scientific and cultural centre of Europe, also appropriately called the ”City of Light” and tourism capital of the world.

Dénes LÓCZY

Report on the EUGEO 2013 Congress

The fourth EUGEO Congress took place in Rome, Italy, 5–7 September 2013, at the University of Rome La Sapienza and at the Italian Geographical Society (Società Geografica Italiana). EUGEO is the Association of Geographical Societies in Europe which aims to represent its members at the European level and to coordinate and initiate joint activities of the members to advance research and education on the Geography of Europe and to promote the discipline of geography in Europe. EUGEO has members from 21 countries, including Hungary.

Researchers and experts from all over the world were invited to submit proposals to the congress where more than 450 presentations were given within 4 plenary and 38 paper sessions and 3 thematic panels. The EUGEO Executive Committee also wanted to stimulate the participation of young researchers at the congress by offering grants for PhD students and young researchers. The motto of the congress was "Europe, what's next? Changing geographies and geographies of change" which shows that the main aim of the congress was to discuss the destiny of continents in an era of globalization and the future of Europe during and after a period of serious economic crisis. The congress aimed to find answers to questions which have arisen in the past few years due to modernization, globalization, and economic crisis. The congress inspired geographers to reassess the role and future of geography in Europe, as well as to rethink the concepts which are used to describe and analyze the world around us, such as the notion of states, boundaries, urban systems, landscapes, and regions.

The main Congress venue was the Faculty of Arts and Humanities (Facoltà di Lettere e Filosofia) at the University of Rome La Sapienza, moreover, two additional venues were given in the program, Campidoglio and Villa Celimontana. Fortunately, all the Congress venues were centrally located and well-connected by public transport, in addition, a bus service was freely available to congress registered participants to different congress locations. The basement floor of the main congress venue hosts the magnificent Museum of Classical Art founded in 1892 by Emanuel Löwy, the first scholar in Italy to be appointed professor of Archeology and History of Art. The museum displays a collection of plaster

The main gate of University of Rome La Sapienza during the EUGEO 2013

Gábor Michalkó is in the chair of session "Recent developments in global changes and human mobilities". Lionel Kieffer (from France) sits on the left

The audience of the session

casts of Greek statutes and this unique exhibition could be visited by congress participants freely during the conference.

The congress started on 5 September, the opening ceremony was held at the Campidoglio, which was chaired by Henk Ottens, president of EUGEO and the Royal Dutch Geographical Society. Participants were welcomed by Franco Salvatori, former president of the Italian Geographical Society, Massimo Bray, minister for culture and tourism, Luigi Frati, rector of the University of Rome La Sapienza and Ignazio Marino, mayor of Rome. The opening ceremony was followed by the first plenary session with two keynote speeches by Vladimir Kolossov, president of the International Geographical Union (IGU) and Anne Buttimer, former president of the IGU. Kolossov's presentation focused on the concepts of sovereignty, states and borders in the contemporary geopolitical context, while Buttimer addressed the changing practices of geography and the challenges of the 21st century.

The second day of the conference (6 September) started with parallel paper sessions and thematic panels and it continued with two plenaries in the afternoon. In the evening a concert and a social dinner were offered to congress registered participants in Villa Celimontana where the Italian Geographical Society is located in 1582. The congress participants had the opportunity to visit this unique palace and the library, one of the largest in Europe with approximately 400,000 books and over 2,000 Italian and foreign periodicals and numerous rare maps and atlases.

The last day of the congress (7 September) was comprised of parallel paper sessions, thematic panels and the fourth plenary session. One of the keynote speeches in the fourth plenary session was given by Gyula Horváth representing the Institute of Regional Studies, Hungarian Academy of Sciences (HAS). He introduced the regional structure and decentralization of science in Central and Eastern Europe and in Hungary. The conference ended with the closing ceremony chaired by Henk Ottens, president of the EUGEO and the Royal Dutch Geographical Society.

Many Hungarian geographers and researchers introduced their latest results in various paper sessions of the congress. Zoltán Kovács (HAS, Institute of Geography and University of Szeged) organized a session on comparative urban geography of post-socialist cities wherein he gave a presentation on neighbourhood dynamics and socio-spatial change in post socialist cities. Géza Salamin (Ministry for National Economy, State Secretariate of Planning Co-ordination, Department for Territorial Development Planning, ESPON Hungarian Monitoring Committee) also organized a session under the title: ESPON evidence in changing Europe.

Two presentations were given by Hungarian authors in the session called Ethno-Cultural Diversity and the Question of the National: the first one by academician Károly Kocsis (Geographical Institute HAS) who introduced the geographic aspects of the changing ethnic diversity and of the question of the national in the Carpatho-Pannonian area; the second one by Norbert Pap (University of Pécs) who spoke about the everyday life of Muslims in East-Central Europe.

The session "Recent developments in global changes and human mobilities" also contained two presentations by Hungarian researchers: the first one by Gábor Michalkó (Geographical Institute HAS), Tamara Rátz and Anna Irimiás (Kodolányi János University of Applied Sciences) under the title: Invisible tourism within the Carpathian Basin: mobility patterns and new features. The second onepaper was presented by Mihály Tömöri (College of Nyíregyháza) who analyzed changes and new trends of mobility in Hungary's retail sector due to the economic crisis[1].

[1] The research was supported by the European Union and Hungary and co-financed by the European Social Fund under the project ID "TÁMOP 4.2.4.A/2-11-1-2012-0001"

Péter Reményi and Áron Lépháft (University of Pécs) gave their presentation under the title Vojvodina as a frontier zone in the session called "Beyond fortress Europe? Bordering and cross-border processes along the EU external frontiers". Mátyás Jaschitz's (CESCI and ELTE) presentation under the title "The key factor for a successful territorial cohesion: cross-border cooperation – How can some EU instruments make a new geography?" was introduced in the session called "Breaking down boundaries: geographies for a new geography of Europe". The title of Judit Ütő-Visi's presentation (Eszterházy Károly College, Eger) was "Progress report and perspectives – on geographical education in the light of a survey" which was introduced in the session called "Geography education's challenges in response to changing geographies".

György Csomós (University of Debrecen) gave a presentation in the session called "Old and new economic geography: perspectives for city growth and development" under the title: "Major headquarter cities of the global economy in 2012: Rise of the East". Viktor Varjú (Institute of Regional Studies, CERS of HAS) introduced his research results in the session called "Sustainable Land Management: smart governance for changing geographies of land use" under the title: "The role of governance modes in environmental policy integration (EPI) in regional development: experience from Hungary and some comparison to CEC." The title of Ildikó Egyed's presentation (Institute of Regional Studies, CERS of HAS) was "The efficiency of new governance tools in the light of Western and Central and Eastern European experiences" which was introduced in the session called "The European city: is there still a distinctive European model of urban governance?"

Ádám Kertész and Anna Őrsi (Geographical Institute RCAES HAS) introduced their research results under the title "Is present land use in accordance with landscape capability and sustainability?" within the session on land use and sustainability.

Besides sessions, participants had many opportunities to exchange new ideas, discuss problems and solutions, ask questions, build new relationships in an informal environment during tea, coffee and lunch breaks. In the framework of social and cultural events, the congress attendees could participate in numerous pre- or post-congress programs and excursions. For instance, the participants could taste genuine Italian foods and wines, take a walking tour to two districts of Rome: EUR (Esposizione Universale di Roma: Rome Universal Exposition) and Garbatella, take a bike tour along the ancient aqueducts of Rome, or visit Ostia Antica which is one of the most important archaeological sites in Italy.

The fourth EUGEO congress in Rome provided an excellent opportunity for European geographers to introduce their research topics and results, discuss debated questions, exchange views and opinions and to think about the future of Europe and the European geography. The congress was well organised, the staff and congress assistants managed to tackle all tasks and problems.

The fifth EUGEO congress will be held in Budapest, Hungary, in 2015, which will be an excellent opportunity for Hungary and the Hungarian geographers to show their most important research results and values to Europe. We hope that the next EUGEO congress, which will be organised by the Hungarian Geographical Society, will be as successful and inspiring as the fourth was in Rome. See you all again in Budapest in 2015.

Mihály TÖMÖRI