DOI: 10.20472/EFC.2018.010.042

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ASSESSING THE DEVELOPMENT STATUS OF LOCAL ADMINISTRATIVE UNITS WITH THE USE OF A MODIFIED QUANTIFIABLE SWOT METHOD

Abstract:

The purpose of this paper is to assess the development status of local administrative units (LAUs) with the use of a modified quantifiable SWOT analysis based on Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS). The proposed method was used for assessing the socio-economic development status of municipalities located in the Poznań district (Poland) in 2016. Based on research, four main types of development status were identified: the aggressive, competitive, conservative and defensive type. Also, the level of exogenous and endogenous socio-economic development was assessed. The study was based on statistical data from the Central Statistical Office in Poland. The method presented in this paper is of a universal nature and may be used as well for SWOT analyses of other spatial and economic units.

Keywords:

modified quantifiable SWOT method, TOPSIS, socio-economic development, development status, municipalities, planning

JEL Classification: C38, H70, O12

1. Introduction

Local socio-economic development[1] has become a global issue and involves different issues (Pike, Rodriguez-Pose,Tomaney, 2017). There is not a clear approach to develop local socio-economic development (Pedrana, 2013). Local economic development should always be based on a thorough investigation of the condition of local administrative units (LAUs). This is done by diagnosing the socio-economic situation and the close and remote surroundings of a LAU. In a local socio-economic development perspective, the interaction between LAU and its surroundingis fundamental. The final outcome is a diagnosis, i.e. an assessment of the unit's current situation. One of the basic featuresof a diagnosis consists in focusing on specific aspects. The information on local administrative units and potential factors of impact, as collected and analyzed, should be comprehensive and focused at the same time. A focused diagnosis is centered around reality aspects which are of utmost importance for planning the development of the local administrative unit under consideration (Petru, 2008).Diagnosing should consist in identifying the properties of a territory and the active (potential) external factors which have an impact thereon. Depending on the size and specifics of the local administrative unit, environmental, social, demographic, cultural, infrastructural and economic aspects are taken into consideration (see Blakely, 1989;Kisman, Tasar, 2014). It is important to properly choose the variables (indicators) representing the topics covered by the diagnosis. They are selected depending on the decision maker's professionalism and knowledge of theoretical foundations for topics related to local development, territorial specificities and information requirements. Therefore, it is essential to investigate the existing condition and to assess the unit's socio-economic situation and development conditions.

A SWOTanalysis is helpful in arranging and analyzing the diagnosed aspects. It is one of the most common methods for condition assessment which comprehensively examines the LAU's interiorand surroundings, i.e. strengths, weaknesses, opportunities and threats. The relevant literature describes this method as one of the methods for diagnosing and forecasting the determinants of strategy (Marchesnay, 1993). A SWOT analysis covers factors, i.e. such phenomena and processes that affect the region's current and future development capabilities. These factors may be grouped by two criteria: their origin (exogenous or endogenous factors) and impacts (positive or negative factors). A classical SWOT identifies the basic factors, i.e. only those that are critical for the future of a local territorial unit. However, the classical SWOT allows only to identify the key factors while not enabling the quantification of the importance of exogenous and endogenous conditions. A quantifiable SWOT analysis helps solving that problem as it allows to

[1]Pike, Rodriguez-Pose and Tomaney (2017) widely presented and critically reviewed the main existing and emerging definitions and conceptions of local and regional development.

assess the level of exogenous and endogenous impacts. It also provides the ability to determine the development status (situation) of an administrative unit compared to other surrounding units. Development status is somehow related to development strategy which explains the similarity between the terms. However, the development status shows the development level of a territorial unit at a given time while the strategy presents the outlooks for future development.

2. Methodology

SWOT analysis is the most known technique for a strategic planning. It is used to analyze the internal and external conditionsof various spatial and economic units.The major limitation of classical SWOT analysis is that the significance of each SWOT factor cannot be quantified.The result of SWOT analysis is often an incomplete qualitative examination of internal and external factors (Kurttilaet al., 2000).Review of past publications on SWOT analysis reveals that most presented a description of the analysis and some of these have quantified analysis (Chang, Huang, 2006).Connecting SWOT with quantitative methods yields analytical priorities for the characteristics included in SWOT analysis and make them comparable (see e.g. Kurttilaet al., 2000; Chang, Huang, 2006; Shinno et al., 2006; Łuczak, Wysocki, 2009; Łuczak, 2016).Applying a hybrid approachwith quantitative methods, especially multi-criteria decision making(MCDM[2]) methods, andSWOTanalysis can be applied in improving and increasing theinformation basis of strategic planning processes (Kangas et al., 2003).The proposed quantifiable SWOT methodis anexample of hybrid methodsand based on values of characteristics identified in classical SWOT analysis. The modified quantifiable SWOT makes combined use of the TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) (Hwang, Yoon 1981)[3]and SWOT.In the approach proposed in this paper, the procedure consists of four stages (cf. Łuczak,Wysocki, 2009; Łuczak, 2016):

Stage 1. Constructing two hierarchical diagrams for the analysis of exogenous and endogenous development factors of LAUs.

Stage 2. Determining and normalizing the values of variables forLAUs.

Stage 3. Calculating the location coordinates of LAUs in relation to endogenous and exogenous development conditions.

Stage 4. Identifying the types of development status for LAUs.

[2] Many various MCDM methods exist, including the most popular: TOPSIS, AHP, VICOR, ELECTRE, PROMETHEE. Review of MCDM methods was conducted by e.g.: Velasquez, Hester (2013), Zavadskas, Turskis and Kildienė (2014) and Mardani, Jusoh and Zavadskas (2015).

[3] TOPSIS was developed by Yoon (1987), Hwang, Lai and Liu (1993), Lai, Liu and Hwang (1997) and in other publications.

In the approach proposed in this paper, the first stage is to construct two hierarchical diagrams for the analysis of exogenous and endogenous development factors (SWOT factors) of LAUs. Each diagram includes three levels: the main criterion, secondary criteria and variables of strengths and weaknesses (endogenousfactors) and of opportunities and threats (exogenous factors).

Stage 2 consists in determining and normalizing the values of variable forLAUs (e.g. municipalities). The selected variables may have a stimulating or destimulatingeffect on the phenomenon (see e.g. Walesiak, 2016). Once entered to data matrices $x_{ik}^{(\bullet)}\left(i=1,\ \ldots, N, k=1,\ldots,K^{(\bullet)}\right)$, ($K^{(\bullet)}$: number of variables covered by endogenous (internal) (*I*) and exogenous (external) (*E*) conditions; *N*: number of LAUs in the geographic area considered), the values of variables are normalized using the zero unitarization procedure. This transformation results in converting variables with an inhibiting or nominal effect into variables with a stimulating effect while also enabling the comparability of their values. This procedure is as follows(Kukuła, 2000):

forstimulants[4]
$$z_{ik}^{(\bullet)}=\frac{x_{ik}^{(\bullet)}-\min\left\{x_{ik}^{(\bullet)}\right\}}{\max\left\{x_{ik}^{(\bullet)}\right\}-\min\left\{x_{ik}^{(\bullet)}\right\}}, \tag{1}$$

for destimulants[5]
$$z_{ik}^{(\bullet)}=\frac{\max\{x_{ik}^{(\bullet)}\}-x_{ik}^{(\bullet)}}{\max\{x_{ik}^{(\bullet)}\}-\min\{x_{ik}^{(\bullet)}\}} \tag{2}$$

for nominants[6]
$$z_{ik}^{(\bullet)}=\frac{x_{ik}^{(\bullet)}-\min\left\{x_{ik}^{(\bullet)}\right\}}{\operatorname{nom}\left\{x_{ik}^{(\bullet)}\right\}-\min\left\{x_{ik}^{(\bullet)}\right\}}, \qquad x_{ik}^{(\bullet)}\le \operatorname{nom}\left\{x_{ik}^{(\bullet)}\right\}, \tag{3}$$

$$z_{ik}^{(\bullet)}=\frac{\max\left\{x_{ik}^{(\bullet)}\right\}-x_{ik}^{(\bullet)}}{\max\left\{x_{ik}^{(\bullet)}\right\}-\operatorname{nom}\left\{x_{ik}^{(\bullet)}\right\}}, \qquad x_{ik}^{(\bullet)}>\operatorname{nom}\{x_{ik}^{(\bullet)}\}. \tag{4}$$

with $\max\left\{x_{ik}^{(\bullet)}\right\}$: maximum value of the k^{th} variable; $\min\left\{x_{ik}^{(\bullet)}\right\}$: minimum value of the k^{th} variable; $\operatorname{nom}\left\{x_{ik}^{(\bullet)}\right\}$: nominal (optimal) value of the k^{th} variable; these may be replaced with model values, e.g. the maximum and minimum values for a specific type of territorial units (e.g. municipalities) within a voivodeship or the country.

The next (third) stage is the calculation of location coordinates of LAUs in relation to endogenous (IC_i) and exogenous (EC_i) development conditions to show their development status in accordance with the SWOT analysis (cf. Chang and Huang, 2006):

$$IC_i=IS_i-IB, \qquad EC_i=ES_i-EB \tag{5}$$

[4]Stimulant is the type of variable which the higher values are desirable and small values are undesirable from the viewpoint of the considered synthetic property.

[5]Destimulant is the type of variable which the smaller values are desirable and high values are undesirable from the viewpoint of the considered synthetic property.

[6]Nominant is the type of variable which is stimulant in some range of a variable and destimulant in other its range (for the nominant it is possible to define the optimal (desirable) value).

where IS_i (ES_i): synthetic measures – development level of endogenous (exogenous) conditions; *IB* (*EB*): benchmarking value for endogenous (exogenous) conditions; the above may be calculated as follows[7]:

$$IB = \frac{1}{N}\sum_{i=1}^{N} IS_i \,, \qquad EB = \frac{1}{N}\sum_{i=1}^{N} ES_i \,. \tag{6}$$

The classical TOPSIS method may be proposed for the calculation of synthetic measures values IS_i and ES_i. The procedure starts by setting the positive ideal solution(PIS) (pattern) $z^{(\bullet)+}$ and negative ideal solution(NIS)(anti-pattern) $z^{(\bullet)-}$ of development which may be the maximum and minimum values of the variables examined across the administrative units under consideration:

PIS $$z^{(\bullet)+} = \left(\max_i\left\{z_{i1}^{(\bullet)}\right\}, \max_i\left\{z_{i2}^{(\bullet)}\right\}, \ldots, \max_i\left\{z_{iK^{(\bullet)}}^{(\bullet)}\right\}\right) = \left(z_1^{(\bullet)+}, z_2^{(\bullet)+}, \ldots, z_{K^{(\bullet)}}^{(\bullet)+}\right) \tag{7}$$

NIS $$z^{(\bullet)-} = \left(\min_i\left(z_{i1}^{(\bullet)}\right), \min_i\left(z_{i2}^{(\bullet)}\right), \ldots, \min_i\left(z_{iK^{(\bullet)}}^{(\bullet)}\right)\right) = \left(z_1^{(\bullet)-}, z_2^{(\bullet)-}, \ldots, z_{K^{(\bullet)}}^{(\bullet)-}\right) \tag{8}$$

Once the PIS and NIS are set, Euclidean distances are calculated between each unit considered and PISand NIS:

$$d_i^{(\bullet)+} = \sqrt{\sum_{k=1}^{K^{(\bullet)}}\left(z_{ik}^{*(\bullet)} - z_k^{(\bullet)+}\right)^2} \qquad d_i^{(\bullet)-} = \sqrt{\sum_{k=1}^{K^{(\bullet)}}\left(z_{ik}^{*(\bullet)} - z_k^{(\bullet)-}\right)^2} \tag{9}$$

Afterwards, the following values are calculatedused the TOPSIS (Hwang, Yoon, 1981):

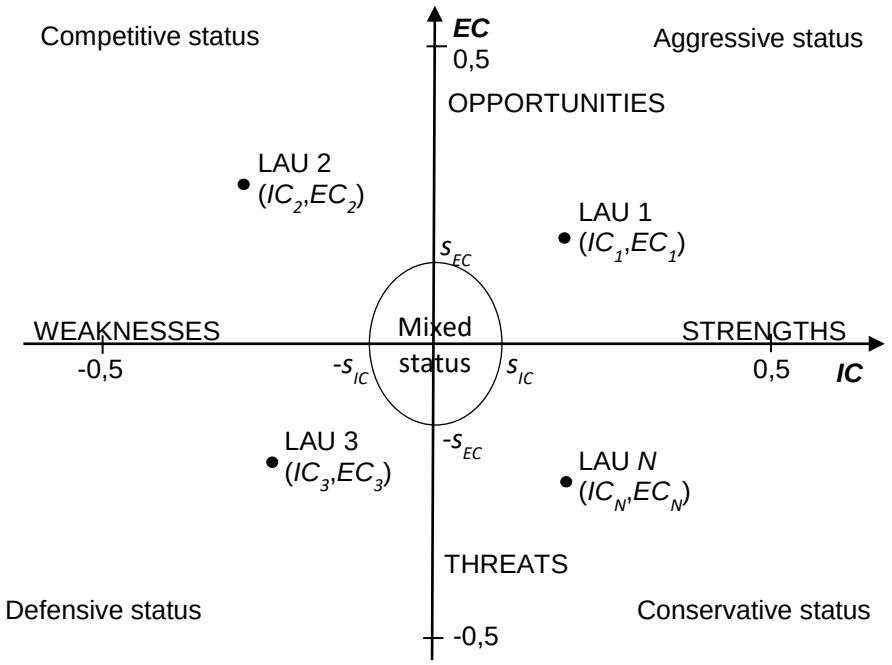
$$IS_i = \frac{d_i^{(I)-}}{d_i^{(I)+} + d_i^{(I)-}} \qquad ES_i = \frac{d_i^{(E)-}}{d_i^{(E)+} + d_i^{(E)-}} \quad (i = 1, 2, \ldots, N) \tag{10}$$

Synthetic measures IS_i and ES_i fall into the interval $\langle 0,1\rangle$.

That approach enables determining the development status of local territorial units in a local context.The last (fourth) stage consists in identifying the types of development status for LAUs. The coordinates (IC_i, EC_i) specify the location of units in relation to endogenous and exogenous development conditions on a diagram plane split into quadrants representing four types of development status: aggressive (maxi-maxi) status, conservative (maxi-mini) status, competitive (mini-maxi) status and defensive (mini-mini) status (Fig. 1). These are the four main model development statuses of an administrative unit which depend on whether positive or negative factors prevail inside the unit and in its surroundings (cf. Weihrich 1982; Łuczak, Wysocki 2009; Łuczak 2016).

[7]The benchmarking value for exogenous (*IB*) and endogenous (*EB*) conditions may also be the respective averages of values of synthetic measures(of exogenous and endogenous conditions) IS_i and ES_i for the voivodeship.Thise approach shows the development status in relation to units located within a voivodeship (in a regional context).

Figure 1: Types of developmental statuses



s_{IC}, s_{EC} – standard deviations of the coordinate values of status of the local administrative units respectively with respect to endogenous and exogenous conditions.
Note: The development status of municipalities may be considered immature (mixed) (area bouded by ellipse: $IC=s_{IC}\cos t$ and $EC=s_{EC}\sin t$for $0\leq t\leq 2\pi$).).
Source: Own adjustment based onŁuczak, Wysocki (2009), Zioło (2011).

3. Results of the study

The study was about determining the development status of LAUs (municipalities of the Poznań district, Wielkopolskievoivodeship, Poland) in relation to endogenous and exogenous development conditions in 2016. The quantifiable SWOT procedure starts by defining a set of variables. Based on a statistical analysis, 20 variables were selected that described the socio-economic development level of districts considered. As regards exogenous conditions of socio-economic developmentwere identified secondary criteria: demographic and socialsituation, technical infrastructure, social infrastructure, economy and public finance.The secondary criteriainvolve following variables:share of population of non-productive age per 100 persons of working age (x_1), natural increase per 1000 population (x_2), share of registered unemployed people in the total number of people of working age (%)(x_3),employed persons 1000 population (x_4),share of people using water system in the total population (%) (x_5), share of people using sewage system in the total population (%) (x_6),share of people using gas system in the total population (%) (x_7), number of doctors consultations per capita (x_8),students per section in general secondary schools (x_9), population per generally available pharmacy (x_{10}),entities of the national economy entered in the REGON register per 10000 of population (x_{11}),share of own revenue of LAU's budgets in the total revenue (%) (x_{12}).

In turn, as regards exogenous conditions, the following was used:general subventions per capita (PLN) (x_{13}), targeted grants from the state budget per capita (PLN) (x_{14}),the total value subsidy agreements signed – funding from the European Union per capita (PLN) (x_{15}), value of projects by funding from the European Union per capita (PLN) (x_{16}), net migration in internal movement per 1000 population (x_{17}), net migration abroad per 1000 population (x_{18}), share of companies with participation of foreign capital (%)(x_{19}), foreign tourists per 1000 population (x_{20}).

For the financial variables denoted as x_{13}-x_{16},5-year average values were calculated. The analysis assumed that three variables (x_1, x_3 and x_{10}) arethedestimulants, onevariable (x_9) is nominant while other arestimulants. The variables were normalized with the zero unitarization method. Once normalized, the values of variables were used to calculate the coordinates of endogenous and exogenous conditions for the districts in terms of their socio-economic development capacity (Table 1). The benchmarking value was defined as the average 2016 values of endogenous and exogenous conditions (*IB*=0.478, *EB*=0.354).

The position of municipalities of the Poznań district in quadrants of the coordinate plane is shown in Figure 2. The axes divide the plane into four quadrants which correspond to four types of the municipalities' development statuses: the aggressive, conservative, competitive and defensive type. Note that the values of endogenous and exogenous coordinates for the municipalities under consideration rarely go beyond 0.1 in absolute terms. This means in the Poznań districts, these types are still poorly developed and are of a mixed nature.

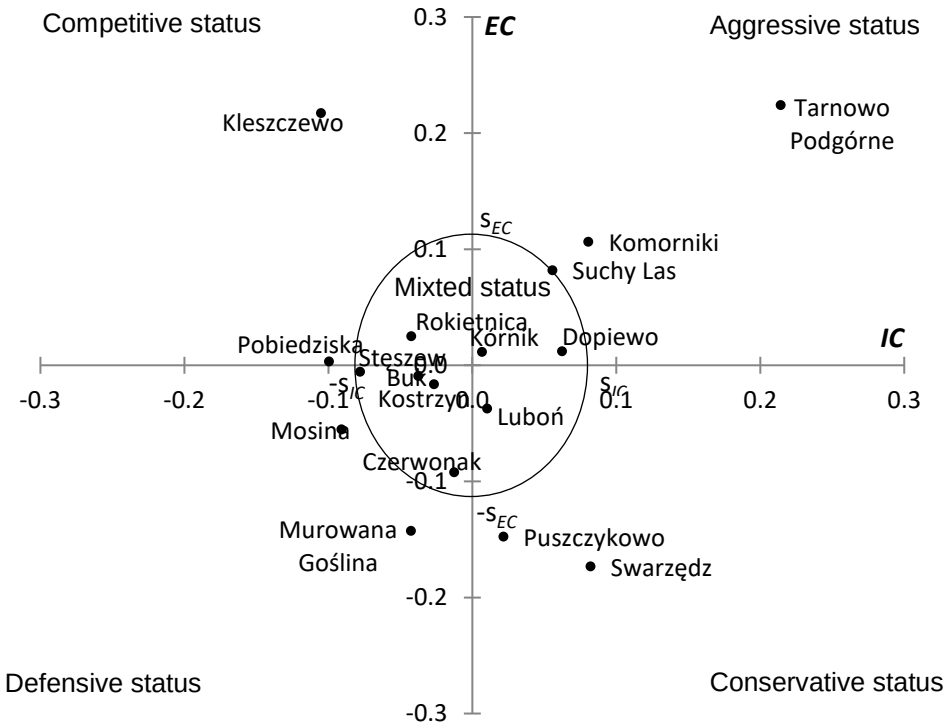
Table 1: Synthetic measures and coordinates of endogenous and exogenous conditions of social and economic development of municipalities in the Poznań district in 2016

i	Municipalities	Development level of		Coordinates of LAUs in relation to	
		endogenous conditions(IS_i)	exogenous conditions(ES_i)	endogenous conditions(IC_i)	exogenous conditions(EC_i)
1	Luboń	0.488	0.317	0.010	-0.037
2	Puszczykowo	0.499	0.207	0.022	-0.148
3	Buk	0.440	0.345	-0.037	-0.009
4	Czerwonak	0.465	0.262	-0.013	-0.092
5	Dopiewo	0.540	0.366	0.062	0.012
6	Kleszczewo	0.373	0.572	-0.105	0.217
7	Komorniki	0.558	0.461	0.081	0.106
8	Kostrzyn	0.451	0.338	-0.026	-0.017
9	Kórnik	0.484	0.366	0.007	0.012
10	Mosina	0.387	0.299	-0.091	-0.055
11	Murowana Goślina	0.435	0.212	-0.042	-0.143
12	Pobiedziska	0.378	0.358	-0.099	0.003
13	Rokietnica	0.435	0.379	-0.042	0.025
14	Stęszew	0.400	0.349	-0.078	-0.006
15	Suchy Las	0.533	0.436	0.056	0.082
16	Swarzędz	0.560	0.181	0.082	-0.173
17	Tarnowo Podgórne	0.692	0.578	0.214	0.224

Source: Own calculations based on data from the Central Statistical Office (Local Data Bank).

Figure 2 presents the types of the municipalities' development statuses in 2016. Note that in the Poznań district, the development status varied from one municipality to another. An aggressive development status is based on advantages brought by endogenous and exogenous conditions, i.e. strengths ofmunicipalitiesand opportunities provided by theirsurroundings. In 2016, it was characteristic forfive municipalities of the Poznań district. Note that among them, the municipality of TarnowoPodgórne had the strongest status. As regards municipalities with an aggressive development status, a highly developed technical infrastructure is a variable with a stimulating effect. The share of the population who have access to the water supply system, sewage system and gas supply network is ca. 97%, over 75% and 86%, respectively. A well-developed infrastructure is also conducive to economic development. These municipalities are home to a large number of economic operators (1,840 entities of the national economy entered to the REGON register per 10,000 population). This also translates into low unemployment levels. In these municipalities, the ratio of unemployed per 100 working-age population was not above 1.6% in 2016.

Figure 2: Types of development statuses for municipalities in the Poznań district in 2016



s_{IC} = 0.080, s_{EC}= 0.105.
Source: Own adjustment based on Table 1.

The above-average exogenous conditions were reflected in particular by the large amount of funds disbursed from the European Union budget. In 2011-2016, these municipalities accessed an average amount of PLN 8,636 per capita under projects co-financed by the European Union. Also, the municipalities with an aggressive status

experience a considerable influx of population. The net migration in internal movement between districts was above 11 persons per 1,000 population. Another characteristic feature of these municipalities was a large number of foreign tourists (ca. 70 persons per 1,000 population, compared to the average level of 54 persons per 1,000 population in the Poznań district). In these municipalities, strong development opportunities are also driven by a high degree of financial self-sufficiency: the share of own incomes in total incomes was ca. 68%.The share of foreign-invested companies was nearly 17% (the highest value in the district) which considerably affects the economic development level of the municipalities.

Three municipalities (Swarzędz, PuszczykowoandLuboń) tended to move towards the conservative development status. They enjoyed favorable endogenous conditions, especially as regards technical infrastructure, just like municipalities with an aggressive development status. The share of the population who have access to the water supply system, sewage system and gas supply network was above 92%, 86% and 77%, respectively, which is above the countrywide average figures (91.9%, 70.2% and 52.1%, respectively). Also, these municipalities are not affected by unemployment. The ratio of unemployed per 100 working-age population did not exceed 2.5%. One reason for this is the relatively large number of economic operators per 1,000 population (ca. 16,934 per 10,000 population; the average figures for the district and for Poland are 1,531 and 1,103, respectively). These municipalities also have a strongly developed social infrastructure in terms of healthcare and education. In turn, when it comes to exogenous conditions, some weaknesses were revealed. The development level of exogenous conditions was below average. Contributing to this situation was the poor ability to access Union and state budget funds. In 2012–2016, the average total value of projects co-financed by the European Union was PLN 1,715per capita, compared to PLN 7,006 (four times as much) in the Poznań district and PLN 6,604 (more than three times as much) on a countrywide basis. The value of general subsidies and targeted grants from the state budget reached the lowest levels of all types considered: PLN 531 and PLN 347 per capita (respectively). On a countrywide basis, the corresponding amounts are PLN 1,011 (nearly twice as much) and PLN 589 (70% more). Furthermore, the net migration in internal movement between districts reported by these municipalities was ca. 6 persons per 1,000 population, the lowest level across the district.

Also, three municipalities (Kleszczewo, Pobiedziska, Rokietnica)tended to implement a competitive status.The level of endogenous conditions was below the district’s average. The municipality demonstrated an unfavorable socio-demographic structure. In 2016, there was 60 % of population of non-productive age per 100 persons of working agewhich is symptomatic of an ageing society. Other weaknesses of the municipality were related to the technical infrastructure. The population had unequal access to the

water supply and sewage system. Despite a well-developed water supply system (accessed by over 96% of the population), only 57% of the population used the sewage system. With a rather unfavorable combination of endogenous conditions, the municipality enjoyed advantageous, above-average exogenous conditions. Funds from the European Union and state budget provided some opportunities for the municipality. The amounts of general subsidies andtargeted grants from the state budget were PLN 828 per capita and PLN 441 per capita, respectively, which is above the average levels for the Poznań district (PLN 672 and PLN 387, respectively) but not in excess of the countrywide average figures (PLN 1,011 and PLN 589, respectively). In 2012–2016, the average value of the subsidy agreements financed with European Union funds were signed for the amount of PLN 2,238 per capita; for the district and for the country as a whole, that ratio was nearly 3.5 times lower (PLN 643) and nearly five times lower (PLN 342), respectively. Also, the averagevalue of projects co-financed by the European Union was PLN 15,973 per capita in 2012–2016.

Other six municipalities of the Poznań district tended to move towards the defensive development status. They suffered from a slight preponderance of weaknesses over strengths while also experiencing an unfavorable combination of exogenous conditions. The weaknesses were primarily related to the relatively underdeveloped gas supply network accessed by only 54% of the population, approximately. Characteristically, these municipalities reported the lowest population growth across the district: ca. 3.6 persons per 1,000 population, compared to the district's average level of 6.6 (nearly twice as much). The number of economic operators (ca. 1,284 per 10,000 population) was also the lowest throughout the district. In the defensive type of development status, the development level of exogenous conditions was below average. Contributing to this situation was the poor ability to access EU and state budget funds in 2012–2016. The value of general subsidies (PLN 671 per capita) and targeted grants (PLN 425 per capita) from the state budget was below the average levels for both the Poznań district and the country as a whole. Moreover, the total value of projects co-financed by the European Union was PLN 4,960 per capita, which is also less than the average figures for the district and for Poland. It should be noted that the defensive development status of most of municipalities in the Poznań district is not mature. In terms of socio-economic development, this is a positive aspect which means there is a chance for the municipalities to shift towards a better development status.

4. Conclusion

The modified quantifiable SWOT method proved to be useful in assessing the LAUs' development status. The proposed method allowed to determine the LAUs' development statuses and to assess their endogenous and exogenous conditions for socio-economic development.Four main types of development statuses were identified in the

Wielkopolskievoivodeship. The aggressive development type was discovered in five municipalities, and was particularly noticeable in TarnowoPodórne municipality. Most of municipalities are located in the immediate vicinity of the city of Poznań, the largest city of the Wielkopolskievoivodeship. The conservative type of the development status was recorded in three municipalities also located in the direct impact zone of the city of Poznań, and was the most pronounced in the Swarzędz municipality. Also the competitive development status was found in three municipalities. The defensive development status was revealed in six municipalities (located mostly in remote areas). However, that type seems not to be clearly established which is a good sign in terms of assessing their development level. The conclusion is that the development statuses of municipalities in 2016 were far from maturity stage, as reflected by the IC_i and EC_ivalues being close to zero. Only a few municipalities had a mature development status, which was manifested by relatively high values of endogenous (IS_i) and exogenous (ES_i) development conditions. In 2016, the municipality of TarnowoPodgórne was the most developed one in terms of endogenous and exogenous conditions. Conversely, the worst socio-economic development situationwas noticed in the MurowanaGoślina municipality.

The method presented in this paper is of a universal nature and may be used as well for assessing the development status of other territorial units or economic units (enterprises, agricultural holdings).

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