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The Method to Compare Cities to Effective Management of Innovative Solutions

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Dariusz Masłowski[1], Ewa Kulińska[2]

Abstract:

Purpose: *The aim of the article is to propose an innovative method of selecting cities, functioning on the basis of appropriately selected criteria shaping them. The article presents the possibility of matching the model city that was Opole with other 15 Polish cities, selected on the basis of the number of inhabitants approximating to the model city, in the context of the implementation of passenger transport within the city bus transport. The proposed methodology is aimed at selecting appropriate conditions and selecting an appropriate city, similar to the model city, in which an appropriate infrastructural or technical solution can be used.*
Approach/Methodology/Design: *The following research methods were used to verify the objective: statistical analysis, which consisted of a detailed analysis of all surveyed cities, comparison of the analysed centres in order to create the most advantageous solution, and expert methods, which consisted of conducting a survey among 14 experts in management, transport, logistics and production engineering.*
Findings: *The analysis has shown which cities are most likely to be able to introduce innovative solutions to improve the functioning of these centres and has identified various comparative aspects of urban development.*
Practical Implications: *Carrying out such analyses will help city authorities in the development of their land, as well as show in which areas there are some shortcomings in relation to other centres.*
Originality/Value: *There is a lack of unambiguous methods in the literature, consisting in searching for the best matches to the tested patterns, which are to be used to implement innovative solutions. A method has been developed which may serve to solve such problems.*

Keywords: *Benchmarking, cities, city logistics, selection factors, method of city selection,*

JEL classification: *O14, P42, P51.*
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[1]*Faculty of Production Engineering and Logistics, Opole University of Technology, Opole, Poland, 0000-0002-3964-540X, d.maslowski@po.edu.pl*
[2]*Faculty of Production Engineering and Logistics, Opole University of Technology, Opole, Poland, 0000-0002-3227-057X, e.kulinska@po.edu.pl*

1. Introduction

The economy has been changing for many years, but despite the major changes that have taken place in the economic dimension, the basic objective of management has not changed, which is to make people able to cooperate in the implementation of specific objectives set for them, to define the ways of their implementation, continuous improvement and development of the organizational system of enterprises (Kaszubski, 2011; Kiba-Janiak, 2015). However, the problems faced by a modern manager and a modern corporation have a completely different dimension. Today, as never before, we can meet a global economist (Ingvardson and Nielsen, 2019). Therefore, management requires newer and more effective techniques (Grudzewski and Hejduk, 2004).

Companies usually operate in a highly competitive environment. They often have only limited financial resources and insufficient human resources, in terms of staff numbers as well as their qualifications (Śnihur, 2005). Due to these limitations, companies are not able to design, implement and test all the innovative strategies, the failure of which could mean limiting the development of the company (Rok, 2013). This is where benchmarking - one of the most effective contemporary management tools - is applied (Urbaniak 1999; Deiss, 1999).

The basis for benchmarking is to construct evaluation criteria that will allow for comparison of different solutions and selection of the most effective one, taking into account the limitations resulting from the individual characteristics of the organisation which is to be affected. W.M. Grudzewski and J.K. Hejduk define the essence of benchmarking as comparing organizations with other entities with the best results or setting the directions of development and adapting their good practices to improve (Kijewska, 2017).

Benchmarking activities implemented for the development of cities and regions are a premise for a broad thematic analysis in the search for role models (Votsis and Haavisto, 2019). Therefore, it is worth making constant comparisons of cities in order to generate investment benefits and thus develop them and come closer to similar solutions in the EU and worldwide (Jerabek, Kubat, and Fabera, 2020a). In the literature, apart from benchmarking, there are also many other solutions for comparing cities: DEA, VRS, CRS, FDH models (Jerabek, Kubat, and Fabera, 2020b).

Comparison is now considered important for the constitution of knowledge about cities and urban planning. However, the debate on comparative urban planning pays much more attention to the advantages of inter-urban comparisons than to the potential and challenges of intra-city comparisons (McFarlane, Silver, and Truelove, 2017).

Popular theories underscore too much the importance of large cities for innovation activities (Fritsch and Wyrwich, 2020). For urban units, competitiveness is a positive phenomenon, which is a motivation to develop and improve the quality of life of the inhabitants. Therefore, "smart" information and communication solutions are an important element in increasing the competitiveness of a city (Gotlibowska, 2018).

Describing and understanding how innovative solutions implemented in cities affect urban traffic, as the main driver of urban dynamics, will help us to better understand how such solutions in turn form the basis and structure of wider social, economic and environmental urban processes (Pont *et al.*, 2017).

2. Criteria for Factor Selection

Criteria for the selection of factors are an important issue for the proper management of the different research actors. Thanks to appropriate selected factors, selected through the analysis of their impact on cities, an appropriate method for comparing cities for product implementations in urban infrastructure can be proposed. The algorithm of the proposed method implementation is as follows:

1) to define the area of study,
2) identification of the cities participating in the survey (taking into account the population),
3) identification of individual criteria that shape the city,
4) execution by means of an expert method of evaluation of the factors shaping the city,
5) to make a scale for the division of the identified criteria,
6) to collect data on the criteria for each city,
7) to assess the fit of the cities to the pattern indicated,
8) monitoring the results.

The premise for selecting the cities in which the method can be applied is to assess the analysis carried out and in this case the condition that there is only one means of public transport in the city, which is a bus. The specifics of the performed studies were explained in the book entitled “Urban public transport safety management motorways” by Kulińska and Masłowski (2020).

The weights of the individual factors were selected by means of an expert method consisting of a questionnaire survey among 14 experts in management, transport, logistics and production engineering (Table 1). The survey was conducted with representatives of the following research and economic centres:

- AB - Managing Director, Solidarity Group,
- MD, AK, BM, LW - Opole University of Technology, Faculty of Production Engineering and Logistics,

- SI, MJ, KK - Maritime Academy in Szczecin, Faculty of Engineering and Economics of Transport,
- MK - Wrocław University of Economics, Department of Strategic Management and Logistics,
- JK - Koszalin University of Technology, Faculty of Economic Sciences,
- KM - West Pomeranian University of Technology, Faculty of Information Technology,
- JN - Częstochowa University of Technology, Faculty of Management,
- MP - Częstochowa University of Technology, Faculty of Production Engineering and Materials Technology,
- MS - Warsaw University of Technology, Faculty of Production Engineering.

Table 1. *Expert judgements for each criterion*

	LW	BM	MD	AK	MS	KK	JN	MK	MJ	KM	JK	SI	MP	AB	Suma
1	4	5	4	5	5	5	5	5	5	5	5	5	5	5	**0,46**
2	3	5	3	4	5	5	4	3	4	4	5	4	4	5	**0,39**
3	5	4	5	4	5	5	5	4	5	5	5	5	4	4	**0,44**
4	2	3	2	3	5	4	4	1	2	2	2	3	4	1	**0,25**
5	3	3	2	2	3	4	4	4	2	2	2	3	4	3	**0,28**
6	3	3	3	2	3	3	4	4	3	3	2	3	4	3	**0,29**
7	2	3	2	1	1	4	3	4	1	1	2	3	2	1	**0,20**
8	2	3	2	1	4	4	3	3	2	2	1	3	3	2	**0,23**
9	1	3	1	1	4	3	3	3	2	2	1	3	3	2	**0,21**
10	1	3	1	1	2	3	3	2	1	1	1	3	3	1	**0,17**
11	2	3	1	2	4	2	3	2	1	1	1	3	3	1	**0,19**
12	1	3	1	4	4	3	4	3	3	3	1	3	2	2	**0,25**
13	3	3	3	4	4	4	4	4	3	3	2	3	4	2	**0,31**
14	3	3	3	5	3	4	4	4	3	3	2	3	4	2	**0,31**
15	5	4	4	3	5	5	5	2	5	5	4	5	5	4	**0,41**
16	4	3	4	3	5	5	5	3	5	5	4	5	5	4	**0,40**
17	4	3	4	5	5	3	4	4	5	5	4	5	5	3	**0,40**
18	4	4	4	2	5	3	4	5	4	4	4	4	4	3	**0,36**
19	4	4	4	4	5	2	4	4	3	3	4	5	4	3	**0,36**
20	2	3	2	1	5	4	4	2	1	1	4	5	3	2	**0,26**
21	2	4	2	5	5	2	5	1	4	4	4	4	3	2	**0,31**
22	4	4	4	5	5	4	3	5	2	2	1	4	3	2	**0,32**
23	4	4	4	4	5	5	4	3	3	3	4	5	4	3	**0,37**
24	5	5	5	4	5	5	5	4	4	4	5	5	4	4	**0,43**
25	4	4	4	5	5	4	4	4	4	4	3	4	5	4	**0,39**
26	4	4	3	5	5	3	4	4	4	4	3	4	5	3	**0,37**
27	4	3	3	2	5	3	3	4	2	2	3	4	4	3	**0,30**
28	5	3	5	5	4	4	4	2	3	3	2	2	3	2	**0,32**
29	5	3	5	5	4	3	4	3	2	2	2	2	3	2	**0,30**
30	4	3	4	5	4	2	3	4	3	3	3	2	4	2	**0,31**
31	4	3	4	4	4	2	3	4	3	3	4	2	4	1	**0,30**
32	5	4	5	3	5	4	4	5	5	5	5	4	5	3	**0,42**
33	4	3	3	1	5	4	4	4	5	5	3	3	4	2	**0,34**
34	4	3	3	2	5	3	4	1	5	5	2	3	3	3	**0,31**
35	5	4	5	4	5	5	4	4	5	5	3	3	4	5	**0,41**
36	5	5	5	5	5	5	4	5	5	5	4	5	5	5	**0,46**
															11,83

Source: *Own.*

Table 2 presents a selection of criteria used in the conducted city benchmarking by means of the weighted average method.

Table 2. *Scale for the breakdown of the identified criteria*

l.p.	Factor	Group	Factor weight	Evaluation				
				Min	(Min + average)/2	Average	(Average + max)/2	Max
				1	2	3	4	5
1	Population	Demographic data	0,46	108668	123681	138694	159701	180708
2	Area [km^2]		0,39	33	71	110	194	278
3	Population density [persons/km^2]		0,44	503	1017	1530	2401	3273
4	Number of districts		0,25	4	12	21	30	39
5	Number of Shopping Centres (area >5,000 m^2)	Trade	0,28	1	2	3	5	6
6	Number of larger storefronts (>10)		0,29	3	6	10	14	18
7	Number of pools	Culture/City recreation	0,20	1	3	6	10	14
8	Number of cinemas		0,23	1	2	3	4	6
9	Number of theatres and philharmonics		0,21	0	2	4	6	9
10	Number of museums		0,17	1	3	5	10	15
11	Number of libraries		0,19	1	6	11	15	20
12	Number of gyms/fitness		0,25	5	8	11	18	24
13	Number of sports halls		0,31	1	3	5	9	12
14	Number of stadiums		0,31	1	2	3	5	6
15	Number of primary schools	City education	0,41	20	25	30	37	43
16	Number of junior high schools		0,40	1	4	7	11	15
17	Number of trade schools		0,40	4	5	7	8	10
18	Number of high schools, including adult schools		0,36	6	12	18	27	36
19	Number of technical schools, including art schools		0,36	5	8	11	21	32
20	Number of special schools		0,26	1	2	4	5	7
21	Number of post-secondary schools, including for adults		0,31	2	9	16	24	32
22	Number of kindergartens		0,32	30	41	51	70	89
23	Number of universities		0,37	0	2	3	6	8
24	City budget [million PLN]	City financing	0,43	645	795	945	1115	1284
25	Number of production companies	City economy	0,39	4	14	23	45	66
26	Number of service companies		0,37	42	98	153	245	336
27	Number of economic zones		0,30	0	0	1	1	2
28	Number of national roads passing through the city	City infrastructure	0,32	0	1	2	4	5
29	Number of provincial roads passing through the city		0,30	0	2	3	4	5
30	Number of county roads passing through the city		0,31	2	21	41	88	135
31	Number of municipal roads passing through the city		0,30	49	176	303	483	663
32	Number of vehicles registered in the city		0,42	31360	52750	74140	91826	109511
33	Number of railway stations		0,34	1	3	5	8	11
34	Number of railway lines passing through the city		0,31	1	2	3	5	8
35	Types of public transport	Communication	0,41	5	4	3	2	1
36	Number of bus rolling stock		0,46	10	64	118	184	251
Sum of weights			**11,83**					

Source: *Own.*

The assessments in the selected method were selected according to the collected data, where they were respectively:

1 - minimum value of the tested values,
2 - average of minimum and average value,
3 - average value of the examined factor,
4 - average of average and maximum value,
5 - maximum value of tested values.

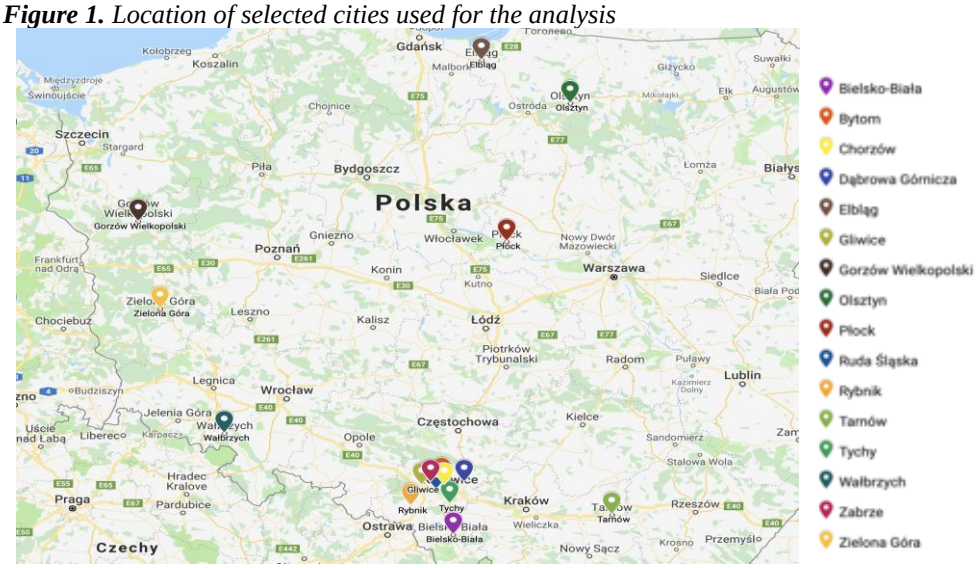
3. City Comparison

Cities which were selected by means of population size in relation to the surveyed city (Figure 1) were divided into the following groups according to the number of inhabitants of the given cities:

- group 1 - Chorzów, Tarnów, Wałbrzych, Płock, Elbląg - from 100 000 to 120 600 inhabitants (Table 3),
- group 2 - Dąbrowa Górnicza, Gorzów Wielkopolski, Tychy, Opole, Ruda Śląska, Rybnik - from 120 601 to 140 000 inhabitants (Table 4).
- group 3 - Zielona Góra, Bytom, Bielsko-Biała, Olsztyn, Zabrze, Gliwice - from 140,001 to 200,000 inhabitants (Table 5).

The selection of the groups was made only to organize the data and to qualify them according to a certain order. Moreover, it gives an opportunity to examine whether the number of jobs affects the result of the analysis.

Figure 1. *Location of selected cities used for the analysis*



Source: *Own.*

In Tables 3, 4, 5 abbreviations are used to explain the values:

- 1, 2, 3, ..., n - factor number assigned in table 2,
- D - value assigned to a given factor for the specified city,

- O- evaluation of a given factor for a specified city,
- I - the product of the factor weighting value and its evaluation for the specified city,
- O_o - overall assessment of a given city (sum of weights of a given city divided by the sum of weights values (11.83)),
- R - difference between the O_o value of a given city and the O_o value of the pattern (Opole).

Table 3. *Comparative analysis of the first group of Polish cities towards the possibility of applying the developed model*

	Elbląg			Plock			Wałbrzych			Tarnów			Chorzów		
	D	O	I	D	O	I	D	O	I	D	O	I	D	O	I
1	120568	2	0,91	120403	2	0,91	113100	2	0,91	109358	2	0,91	108668	1	0,46
2	79,8	3	1,17	88	3	1,17	84,7	3	1,17	72,4	3	1,17	33,2	1	0,39
3	1510,9	3	1,31	1368,2	3	1,31	1335,3	3	1,31	1510,5	3	1,31	3273,1	5	2,18
4	27	4	1,02	23	4	1,02	21	4	1,02	16	3	0,76	4	1	0,25
5	2	2	0,55	3	3	0,83	1	1	0,28	3	3	0,83	1	1	0,28
6	4	2	0,58	3	1	0,29	4	2	0,58	14	5	1,44	5	2	0,58
7	2	2	0,40	6	4	0,81	5	3	0,60	5	3	0,60	5	3	0,60
8	2	3	0,70	2	3	0,70	2	3	0,70	3	4	0,94	2	3	0,70
9	2	3	0,64	3	3	0,64	4	4	0,86	5	4	0,86	2	3	0,64
10	1	1	0,17	5	4	0,70	5	4	0,70	5	4	0,70	2	2	0,35
11	4	2	0,39	13	4	0,78	3	2	0,39	3	2	0,39	9	3	0,58
12	13	4	0,99	8	2	0,49	6	2	0,49	9	3	0,74	15	4	0,99
13	2	2	0,62	11	5	1,54	4	3	0,93	4	3	0,93	3	2	0,62
14	4	4	1,23	2	2	0,62	6	5	1,54	4	4	1,23	4	4	1,23
15	22	2	0,82	27	3	1,23	20	1	0,41	20	1	0,41	27	3	1,23
16	7	4	1,61	14	5	2,01	1	1	0,40	15	5	2,01	6	3	1,21
17	7	4	1,58	7	4	1,58	6	3	1,19	8	4	1,58	6	3	1,19
18	14	3	1,09	25	4	1,45	12	2	0,73	17	3	1,09	15	3	1,09
19	10	3	1,07	11	4	1,42	5	1	0,36	32	5	1,78	10	3	1,07
20	5	4	1,05	4	4	1,05	4	4	1,05	3	3	0,78	3	3	0,78
21	12	3	0,94	21	4	1,26	7	2	0,63	17	4	1,26	15	3	0,94
22	50	3	0,97	42	3	0,97	38	2	0,65	30	1	0,32	32	2	0,65
23	7	5	1,85	3	3	1,11	2	3	1,11	8	5	1,85	5	4	1,48
24	644,809	1	0,43	980,523	4	1,72	735,142	2	0,86	873,1	3	1,29	754	2	0,86
25	10	2	0,78	9	2	0,78	4	1	0,39	66	5	1,95	24	4	1,56
26	128	3	1,11	108	3	1,11	42	1	0,37	336	5	1,85	140	3	1,11
27	2	5	1,51	1	4	1,21	1	4	1,21	2	5	1,51	0	1	0,30
28	2	3	0,95	2	3	0,95	1	2	0,63	2	3	0,95	1	2	0,63
29	4	4	1,21	4	4	1,21	5	5	1,52	2	3	0,91	1	2	0,61
30	131	5	1,55	46	4	1,24	13	2	0,62	7	2	0,62	20	2	0,62
31	155	2	0,61	382	4	1,21	335	4	1,21	267	3	0,91	300	3	0,91
32	57183	3	1,25	74767	4	1,67	31360	1	0,42	51000	2	0,83	47642	2	0,83
33	3	2	0,67	2	2	0,67	7	4	1,34	2	2	0,67	3	2	0,67
34	1	1	0,31	1	1	0,31	1	1	0,31	1	1	0,31	3	4	1,24
35	2	4	1,64	2	4	1,64	1	5	2,05	1	5	2,05	2	4	1,64
36	13	2	0,91	116	3	1,37	20	2	0,91	94	3	1,37	225	5	2,28
O_o	**2,924**			**3,294**			**2,521**			**3,306**			**2,769**		
R	**0,885**			**0,515**			**1,288**			**0,503**			**1,041**		

Source: *Own.*

The analysis of the first group of cities with the smallest population showed that the city which is closest to the pattern is Tarnow with a difference of 0.503 and an

average score of 3.306. The city uses one type of public transport, which is a bus. Taking this assumption into account, the city of Tarnow is suitable for the proposed model. The second group of cities were those with an average number of inhabitants. This group also included the model, i.e. the city of Opole (Table 4).

Table 4. *Comparative analysis of the second group of Polish cities towards the possibility of applying the developed model*

	Opole			**Tychy**			**Ruda Śląska**			**Rybnik**			**Gorzów Wielkopolski**			**Dąbrowa Górnicza**		
	D	**O**	**I**	**D**	**O**	**I**	**D**	**O**	**I**	**D**	**O**	**I**	**D**	**O**	**I**	**D**	**O**	**I**
1	128 224	3	1,37	128049	3	1,37	138215	3	1,37	138919	4	1,82	124177	3	1,37	120777	2	0,91
2	148,9	4	1,55	81,8	3	1,17	77,7	3	1,17	148,4	4	1,55	85,7	3	1,17	188,7	4	1,55
3	861,1	2	0,87	1565,4	4	1,75	1778,8	4	1,75	936,1	2	0,87	1449,0	3	1,31	640,0	2	0,87
4	29	4	1,02	17	3	0,76	11	2	0,51	27	4	1,02	17	3	0,76	18	3	0,76
5	3	3	0,83	3	3	0,83	5	5	1,38	2	2	0,55	3	3	0,83	1	1	0,28
6	9	3	0,87	15	5	1,44	13	4	1,15	6	2	0,58	11	4	1,15	4	2	0,58
7	4	3	0,60	7	4	0,81	7	4	0,81	7	4	0,81	1	1	0,20	7	4	0,81
8	3	4	0,94	1	1	0,23	2	3	0,70	6	5	1,17	3	4	0,94	2	3	0,70
9	5	4	0,86	6	4	0,86	2	3	0,64	1	2	0,43	6	4	0,86	0	1	0,21
10	8	4	0,70	7	4	0,70	3	3	0,52	2	2	0,35	4	3	0,52	1	1	0,17
11	19	5	0,97	14	4	0,78	11	4	0,78	3	2	0,39	15	4	0,78	1	1	0,19
12	9	3	0,74	8	2	0,49	5	1	0,25	14	4	0,99	9	3	0,74	6	2	0,49
13	3	2	0,62	2	2	0,62	12	5	1,54	1	1	0,31	3	2	0,62	2	2	0,62
14	5	5	1,54	1	1	0,31	3	3	0,93	3	3	0,93	2	2	0,62	3	3	0,93
15	30	3	1,23	28	3	1,23	28	3	1,23	38	5	2,05	25	2	0,82	30	3	1,23
16	6	3	1,21	5	3	1,21	5	3	1,21	4	3	1,21	4	3	1,21	3	2	0,81
17	7	4	1,58	7	4	1,58	4	1	0,40	5	2	0,79	8	4	1,58	6	3	1,19
18	29	5	1,81	9	2	0,73	6	1	0,36	16	3	1,09	17	3	1,09	13	3	1,09
19	11	4	1,42	8	3	1,07	6	2	0,71	6	2	0,71	12	4	1,42	6	2	0,71
20	2	2	0,52	1	1	0,26	3	3	0,78	2	2	0,52	4	4	1,05	2	2	0,52
21	23	4	1,26	11	3	0,94	2	1	0,31	16	4	1,26	14	3	0,94	7	2	0,63
22	57	4	1,29	52	4	1,29	40	2	0,65	49	3	0,97	47	3	0,97	44	3	0,97
23	5	4	1,48	2	3	1,11	1	2	0,74	1	2	0,74	2	3	1,11	2	3	1,11
24	1169,438	5	2,15	1058,6	4	1,72	796,6	3	1,29	1071,9	4	1,72	823,5	3	1,29	749	2	0,86
25	17	3	1,17	47	5	1,95	14	3	1,17	30	4	1,56	9	2	0,78	28	4	1,56
26	129	3	1,11	250	5	1,85	117	3	1,11	67	2	0,74	70	2	0,74	172	4	1,48
27	1	4	1,21	1	4	1,21	1	4	1,21	0	1	0,30	0	1	0,30	0	1	0,30
28	3	4	1,27	4	5	1,58	1	2	0,63	2	3	0,95	1	2	0,63	3	4	1,27
29	5	5	1,52	0	1	0,30	2	3	0,91	4	4	1,21	4	4	1,21	3	3	0,91
30	13	2	0,62	48	4	1,24	2	1	0,31	28	3	0,93	27	3	0,93	12	2	0,62
31	663	5	1,51	310	4	1,21	249	3	0,91	535	5	1,51	53	2	0,61	49	1	0,30
32	103741	5	2,08	70901	3	1,25	67488	3	1,25	77217	4	1,67	69357	3	1,25	69766	3	1,25
33	9	5	1,68	1	1	0,34	2	2	0,67	8	4	1,34	7	4	1,34	3	2	0,67
34	8	5	1,55	4	4	1,24	3	4	1,24	3	4	1,24	2	3	0,93	3	4	1,24
35	1	5	2,05	2	4	1,64	2	4	1,64	1	5	2,05	2	4	1,64	2	4	1,64
36	92	3	1,37	127	4	1,83	45	2	0,91	108	3	1,37	90	3	1,37	251	5	2,28
O_o	**3,809**			**3,286**			**2,801**			**3,186**			**2,965**			**2,681**		
R	**0,000**			**0,523**			**1,009**			**0,623**			**0,844**			**1,128**		

Source: *Own.*

The only city in this group that can use the model is Rybnik, because the public transport means of transport in its area are buses. The result of the analysis for Rybnik is 3.186 points, which gives a difference between the 0.623 points pattern, although it is not the best match from this group (Tychy - 3.286). The last group analyzed are the cities with the largest number of inhabitants among the surveyed entities. Table 5 presents the results of the analysis.

Table 5. *Comparative analysis of the third group of Polish cities towards the possibility of applying the developed model*

	Zielona Góra			Bytom			Bielsko - Biała			Olsztyn			Zabrze			Gliwice		
	D	O	I	D	O	I	D	O	I	D	O	I	D	O	I	D	O	I
1	140113	4	1,82	167672	5	2,28	171277	5	2,28	173784	5	2,28	173784	5	2,28	180708	5	2,28
2	278,3	5	1,94	69,4	2	0,78	124,5	4	1,55	88,3	3	1,17	80,4	3	1,17	133,9	4	1,55
3	503,5	1	0,44	2416,0	5	2,18	1375,7	3	1,31	1968,1	4	1,75	2161,5	4	1,75	1349,6	3	1,31
4	39	5	1,27	14	3	0,76	30	5	1,27	23	4	1,02	18	3	0,76	21	4	1,02
5	3	3	0,83	3	3	0,83	4	4	1,10	6	5	1,38	4	4	1,10	4	4	1,10
6	12	4	1,15	18	5	1,44	15	5	1,44	12	4	1,15	13	4	1,15	10	4	1,15
7	4	3	0,60	6	4	0,81	14	5	1,01	9	4	0,81	2	2	0,40	6	4	0,81
8	3	4	0,94	3	4	0,94	3	4	0,94	4	4	0,94	3	4	0,94	3	4	0,94
9	2	3	0,64	9	5	1,07	2	3	0,64	3	3	0,64	2	3	0,64	6	4	0,86
10	9	4	0,70	1	1	0,17	15	5	0,87	6	4	0,70	3	3	0,52	7	4	0,70
11	9	3	0,58	7	3	0,58	16	5	0,97	19	5	0,97	20	5	0,97	17	5	0,97
12	11	3	0,74	11	3	0,74	24	5	1,24	13	4	0,99	9	3	0,74	17	4	0,99
13	8	4	1,23	5	3	0,93	12	5	1,54	9	5	1,54	5	3	0,93	3	2	0,62
14	6	5	1,54	5	5	1,54	1	1	0,31	6	5	1,54	1	1	0,31	1	1	0,31
15	30	3	1,23	31	4	1,64	43	5	2,05	34	4	1,64	43	5	2,05	36	4	1,64
16	10	4	1,61	10	4	1,61	9	4	1,61	5	3	1,21	2	2	0,81	6	3	1,21
17	7	4	1,58	7	4	1,58	8	4	1,58	8	4	1,58	10	5	1,98	6	3	1,19
18	18	3	1,09	21	4	1,45	25	4	1,45	36	5	1,81	10	2	0,73	25	4	1,45
19	9	3	1,07	8	3	1,07	15	4	1,42	12	4	1,42	10	3	1,07	11	4	1,42
20	2	2	0,52	4	4	1,05	5	4	1,05	7	5	1,31	6	5	1,31	3	3	0,78
21	19	4	1,26	16	4	1,26	15	3	0,94	32	5	1,57	16	4	1,26	25	5	1,57
22	60	4	1,29	47	3	0,97	85	5	1,61	89	5	1,61	52	4	1,29	58	4	1,29
23	2	3	1,11	1	2	0,74	7	5	1,85	4	4	1,48	0	1	0,37	2	3	1,11
24	885,675	3	1,29	846	3	1,29	1242,228	5	2,15	1182,345	5	2,15	976,280	4	1,72	1284,163	5	2,15
25	13	2	0,78	24	4	1,56	46	5	1,95	12	2	0,78	11	2	0,78	29	4	1,56
26	104	3	1,11	173	4	1,48	290	5	1,85	128	3	1,11	162	4	1,48	190	4	1,48
27	1	4	1,21	0	1	0,30	1	4	1,21	1	4	1,21	2	5	1,51	1	4	1,21
28	3	4	1,27	4	5	1,58	2	3	0,95	2	3	0,95	0	1	0,32	5	5	1,58
29	5	5	1,52	3	3	0,91	3	3	0,91	2	3	0,91	2	3	0,91	3	3	0,91
30	10	2	0,62	15	2	0,62	20	2	0,62	131	5	1,55	31	3	0,93	135	5	1,55
31	49	1	0,30	157	2	0,61	51	2	0,61	533	5	1,51	501	5	1,51	566	5	1,51
32	75223	4	1,67	77630	4	1,67	106162	5	2,08	87573	4	1,67	83862	4	1,67	109511	5	2,08
33	6	4	1,34	5	3	1,01	11	5	1,68	6	4	1,34	10	5	1,68	5	3	1,01
34	3	4	1,24	3	4	1,24	1	1	0,31	1	1	0,31	1	1	0,31	5	4	1,24
35	1	5	2,05	2	4	1,64	1	5	2,05	2	4	1,64	2	4	1,64	1	5	2,05
36	78	3	1,37	10	1	0,46	137	4	1,83	189	5	2,28	205	5	2,28	205	5	2,28
O_o	**3,463**			**3,447**			**4,078**			**4,051**			**3,488**			**3,963**		
R	**0,347**			**0,363**			**-0,268**			**-0,242**			**0,322**			**-0,154**		

Source: *Own.*

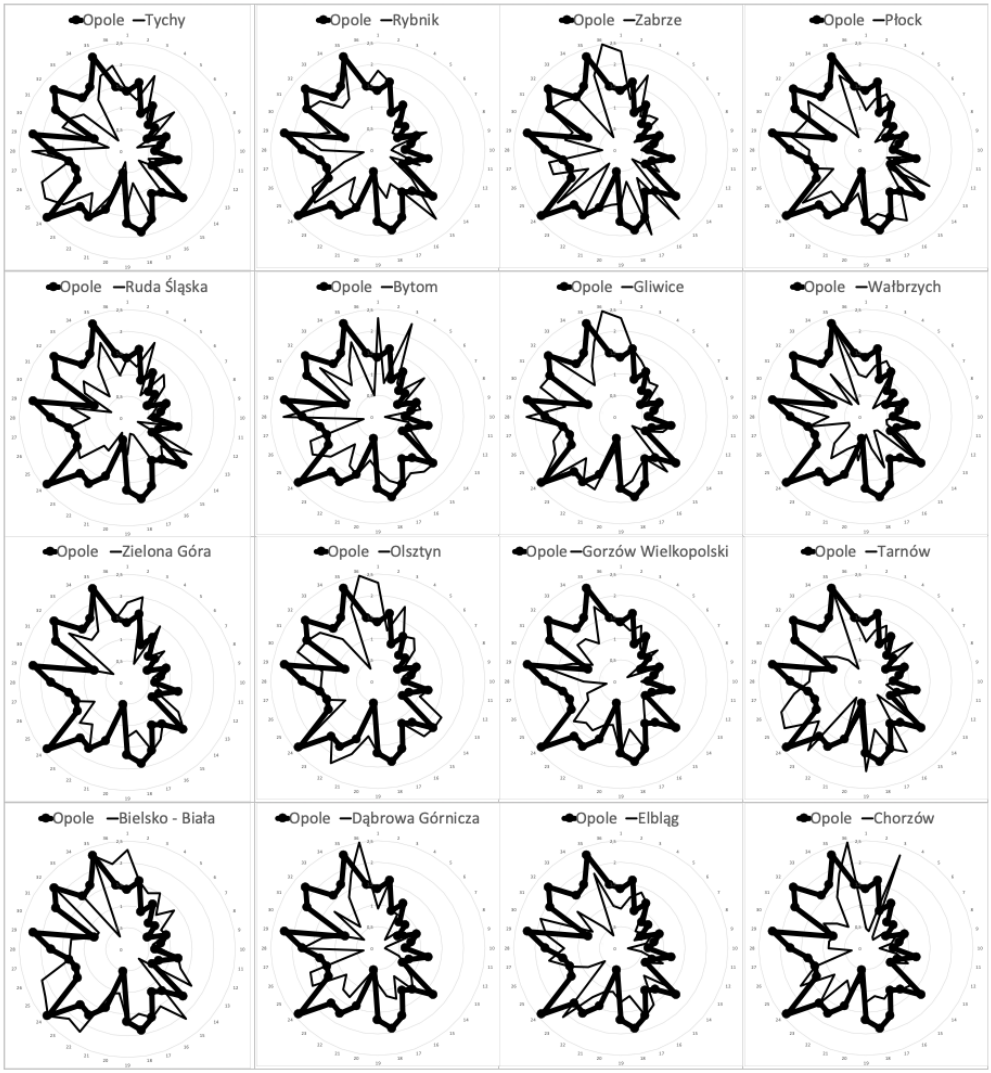
This group, interestingly enough, is the best match for the pattern. Because the values that differ the examined city from Opole are the smallest and range from -0.268 to 0.363. Each city in this group performed better in the analysis than all cities in the previous groups. The best fit for the application of the multi-criteria model is in Gliwice, where they were evaluated at 3.963 points, which at the same time gives the difference between Opole only -0.154. A negative number means that Gliwice has a higher score than the analysed pattern.

4. Presentation of the results of the analysis

The radar charts (Figure 2) show all the analysed cities compared to Opole. Each of the 36 points on the graph is marked with an appropriate number, which indicates

the assignment to the relevant factor. This graphic representation facilitates the comparison of the cities and helps in the selection of similarities between the analysed entities.

Figure 2. *Radar charts compiling Opole separately with all survey subjects*



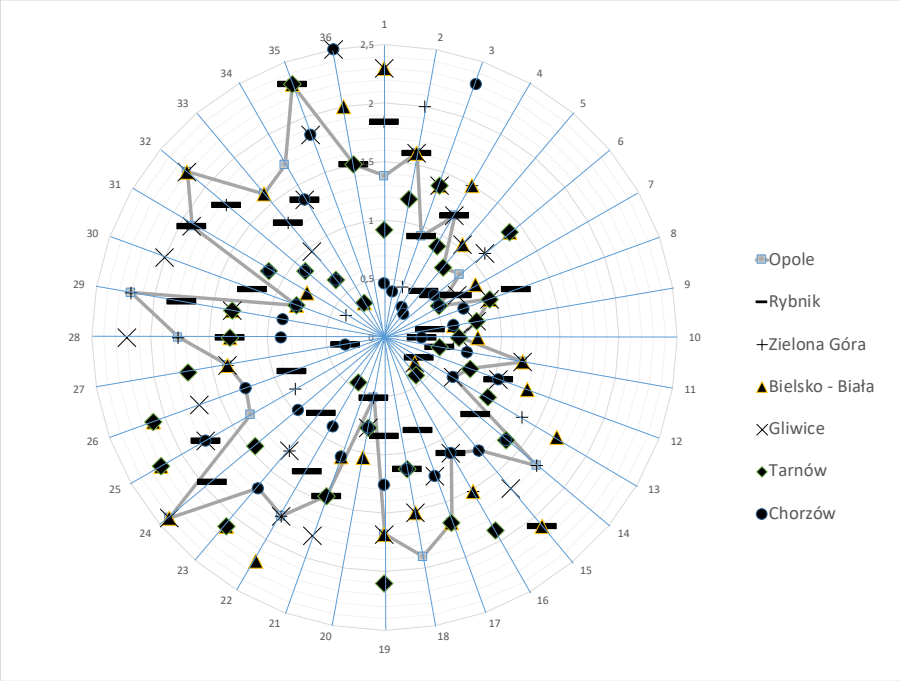
Source: *Own.*

The graphs show which factors had the greatest impact on building the differences between the analysed objects, moreover, they show which factors (from those listed in Table 2) the city of Opole has highly developed and which should be worked on by the city authorities in order to match the compared research entities. In addition, special attention should be paid to the chart concerning the comparison between Opole and the city of Gliwice, which confirms the conclusions drawn earlier

concerning the best fit. It can be read from it that the lines practically overlap, which means that their values are consistent with each other. Such a situation occurs when the analysed cities are similar in terms of their characteristics, which may also mean that implementation of innovative projects in one entity may achieve similar results by implementing it in another "similar" entity.

Figure 3 presents a summary of those cities which, according to the earlier analysis, are best suited to the model city of Opole presented in the form of radar charts.

Figure 3. *A radar chart that juxtaposes cities with the best fit for the pattern.*



Source: *Own.*

The summary chart (Figure 3) first of all indicates what are the differences between the analysed cities in different aspects studied in the study. The points located outside the line depicting the city of Opole describe first of all what factors are more attractive in other research subjects. Thanks to this, the city managers can take concrete steps to improve these factors. On the other hand, the points located within this area are the elements rated higher in the analysed city than in the others. This may prove the appropriate way of managing these segments by the city managers of the analysed city. The elements which the city of Opole should mainly work on are:

- the number of bus rolling stock,
- number of county roads,
- number of manufacturing companies,
- number of service companies,

- number of special schools,
- the number of primary/junior schools,
- number of sports halls,
- number of gyms/gym-clubs in the city,
- the number of larger shoppers.

Of course, it should be remembered that the proposed changes can only be an indication of effective city management. On the other hand, with certainty, thanks to the improvement of the above mentioned aspects, the comfort and satisfaction of the residents will increase, which may result in e.g. a larger number of residents, which, on the other hand, will affect the faster and more effective development of a given city.

From the analysis and the performed graphs one can deduce some dependencies of the model city with respect to other examined cities:

- strengths,
- weak points,
- areas with the same comparative values.

The points that are on the outskirts of the chart that show the strengths of cities in the analysis are:

- number of gyms
- number of kindergartens,
- number of county roads,
- number of vehicles registered.

As far as the data are concerned, however, there are weaknesses in relation to other cities:

- the number of libraries,
- the number of high schools,
- number of national roads.

Similar elements of cities will be the population or the number of stadiums. In view of the results presented in this way, it is possible to look for the best matches to factors which fully depend on innovative solutions which can be implemented in many cities.

5. Conclusion

The analysis has shown which cities are most likely to be able to introduce innovative solutions to improve the functioning of these centres and has identified various comparative aspects of urban development. The analysis will help city authorities to develop their land and will also show in which areas there are some shortcomings in relation to other centres.

One of the main problems in applying this method is the selection of appropriate factors to ensure the quality of the data used. There are two main factors that determine the quality of the data collected: availability and quality consisting of accuracy, comparability, completeness and timeliness. A separate very important problem related to the application of the method is the ability to adapt the solutions chosen by this method, which is undoubtedly related to appropriate knowledge management and, above all, the learning process.

The cities that are best suited to the city of Opole and where public transport solutions can be implemented are:

- Gliwice (best fit),
- Tarnów,
- Rybnik,
- Zielona-Gora,
- Bielsko-Biała.

In the future, this method can be used to select the best fit for the respective cities to match the benchmark, with a view to implementing newer and newer solutions that cannot always adapt flexibly to equal centres. In the future, the author plans to examine the application of the method on the example of other centres and verify the correctness of its execution, as well as to check the reliability of the obtained results.

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