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Assessing and Ranking EU Cities Based on the Development Phase of the Smart City Concept

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Abstract: Policymakers face numerous challenges in benchmarking and assessing cities' current development states. This study extends the understandings of previous research to provide a new perspective about how to rank smart cities' developments by comparing the existing initiatives with city population density (as a proxy of socio-demographic characteristics) and the respective smart city phase. Quantitative analysis was performed to cluster the European Union cities according to the number of existing projects in the literature organized by smart city categories. Furthermore, to allow for the assessment of the city's state, a composite indicator was developed that takes into consideration the different category weights to ultimately provide a smart city ranking. By clustering the categories using a Principal Component Analysis (PCA), it was possible to relate them with a specific smart city phase. In addition, for a reasonable benchmark, the city's population density was considered. Moreover, this paper ranks the cities of the European Union and provides insightful information about the development phase of the smart city concept of each territory. The results show that on a normalized scale of 0 to 1000, the largest cities or the ones with most initiatives do not rank first. Furthermore, it shows that in similar socio-demographic contexts, there are variations in the smart city stage. Therefore, applying the contribution and findings of this research can help identify these differences and establish a set of best practices for improving the design and effectiveness of smart city strategies.

Keywords: smart city; ranking; urban planning; strategy and development stage

Citation: Correia, D.; Marques, J.L.; Teixeira, L. Assessing and Ranking EU Cities Based on the Development Phase of the Smart City Concept. *Sustainability* **2023**, *15*, 13675. https://doi.org/10.3390/su151813675

Academic Editor: Mohamed A. Mohamed

Received: 20 August 2023
Revised: 5 September 2023
Accepted: 7 September 2023
Published: 13 September 2023

1. Introduction

Smart cities emerged to address rapid urbanization and urban agglomeration, solving traffic issues, waste management, air quality, social pressure and inequality, economic speculation, and the inefficiency of emergency bodies [1,2].

In the 1990s, this concept started being associated with information and communication technologies (ICTs) and how they would improve and optimize city management [3–7].

Until 2010, the number of studies reported in the literature was low. It was only with the support of Horizon 2020 funding from the European Commission that the proliferation of smart city initiatives gained significant attention [8]. In the recent years, the subject of the smart city has been gaining attention because of the emergence of extreme events such as the COVID-19 pandemic and the global discussion of climate change effects; As a result, a city's readiness to provide a prompt response based on the correct assessment

of the affected population, transportation, economic disaster risks, and integrated risk before major haze disaster events, all of which are important for disaster risk management operations, has come to the fore [9–11].

The concept of the smart city has passed through three stages [12,13]. Moreover, it evolved from the focus on technology led by corporate interests (Smart City 1.0) to using it as an enabler of the city's sustainability and citizens' quality of life (Smart City 2.0). Nowadays, citizens play a crucial participatory role in designing and contributing to city planning strategies (Smart City 3.0).

Nevertheless, the creation of a successful smart city strategy depends on existing data and correct benchmarking [14,15]. Therefore, it is important to categorise data in specific areas or smart city categories. Another synonym that can be associated with "areas" is "verticals", which Janurova, Chaloupkova, and Kunc [16] describes as the lens through which smart city solutions engage with specific city problems. Furthermore, Kitchin [17] suggests the technologies deployed in smart cities fall under eight verticals or domains comprising: (1) government; (2) security and emergency services; (3) transport; (4) energy; (5) waste; (6) environment; (7) buildings, and (8) homes. On the other hand, Griffiths [18], highlights six smart city indicators, namely: (1) city services; (2) smart utilities; (3) smart healthcare, (4) connected and autonomous vehicles, (5) last-mile supply chain and logistics, and (6) connectivity and data.

Since the increase in attention to the topic in 2010 [19], there has been an exponential growth of publications with a strong multidisciplinary nature in their subjects, dominated mainly by China, Italy, the USA, Spain, and the UK [20].

However, little importance and attention have been given to smaller cities, which tend to have lower representation and a lack of comprehensive understanding of their smart city initiatives [21]. The geographic portrait of existing smart city initiatives would give policymakers and researchers knowledge about existing case studies and enhance the sharing of best practices and benchmarking [22].

Correia, Teixeira, and Marques [22] reviewed the state of the art of smart cities in Portugal and concluded that cities are very dependent on financing opportunities to support smart city investments. In addition, Smékalová and Kučera [23] studied the implementation of the smart city concept in the Czech Republic and confirm the relation between the size and absorption capacity of European funds since the larger the city, the more intense the investment activity. Cities have been focused on specific applications and themes to leverage their smart city approaches, rather than promoting holistic strategies. Examples can be found in Finland [24], Romania [25], Slovakia [26,27], Poland, and Ukraine [28]. This led cities to a partial implementation of smart city strategies [29]. Therefore, scaling is widely perceived as a major concern [30]. Nevertheless, although the success of a development of a smart city strategy may be related to the capacity of securing funding, smaller cities' achievements have been neglected as a result of the challenge of assessing the current development phase of the smart city concept in each territory and understanding its meaning.

Following the approach used by Correia et al. [31] to evaluate existing projects in the European Union member states and compare these results with macroeconomic aspects, this study aimed to perform an in-depth analysis, bringing the focus from countries to the scope of cities. Furthermore, an extended analysis of the literature to study the existing smart city initiatives in the cities of the European Union was conducted.

Past research has not considered the evolution noticed in the smart city concept in the assessment and ranking of smart cities [15] and so it is common for larger cities to appear in the first places, neglecting what is being done in smaller cities [32–35].

Thus, the goal of this research was to establish a smart-city-level composite indicator to evaluate each city and compare them according to the territories' population densities (as a proxy of socio-demographic characteristics). Furthermore, we cross-compared the information found in the literature about the areas and scope of existing projects (weighting it according to the respective smart city phase) with the population and territory dimension.

The results of this assessment will set the foundations for a more structured and integrated debate about how policymakers can improve or design a dedicated smart city strategy.

The research questions are "How can the smart city development stage be assessed?" and "How can smart cities be ranked considering their socio-demographic context and development stage". A review of the literature was performed where a search was undertaken in Scopus for evidence of smart city implementations in each territory to draw conclusions about the development phase of the concept in each city. Finally, the cities were ranked as a practical example of the application of an indicator of smart city development stage.

The characterisation of current initiatives provides policymakers and researchers with knowledge about existing case studies that can enhance the sharing of best practices and benchmarking.

The following section describes a four-step methodology. Moreover, it details the research process undertaken to find the smart city composite indicator. The results of the methodology procedure are detailed in Section 3 and a ranking of the first 50 European Union cities is presented. Section 4 has a discussion of the results, and lastly, conclusions, limitations, and avenues for future research are presented.

2. Materials and Methods

The methodology started with a Scopus inquiry to collect data about the current state of the European Union's cities regarding the number and scope of the existing smart city initiatives.

The search was performed for each of the 27 European Union member countries, using the keywords "Smart Cit*" + "Name of the Country". An example of a search query is "Smart Cit*" + "Portugal". This way, all terminations (such as city, cities, citizens) were included to avoid biased results. The titles, abstracts, and keywords of each article were analysed.

Based on qualitative analysis, two codes were generated. A first code connected to the identification of the city (since the search query only referred to the country), and a second code concerning the subject of the paper were generated. Thus, in the case of a paper on a new algorithm to optimise waste management collection in the city of Lisbon, obtained by the search query "Smart Cit*" + "Portugal", two codes were allocated, Lisbon and Waste.

In this way, on the one hand, it was possible to find existing smart city categories based on the keywords referred to in the subject of the paper to ultimately quantify the number of projects by city and by category.

As inclusion and exclusion criteria, repeated and non-relatable papers were excluded from the sample, as were non-English manuscripts or those that did not mention any specific city or case study. Only journal and conference papers were considered. Furthermore, if there was no city (neighbourhood or urban district) identified in the title, abstract, or keywords, or the subject of the paper was about generic study of numerous cities within a country, the manuscript was excluded from the final detailed analysis. The results that spoke of projects in specific companies or rivers, for example, without necessarily identifying a specific city, or having the city as the main beneficiary of the initiative were also excluded. Double counting was only allowed when the paper referred to specific case studies in different cities, regardless of the country. In addition, each paper was only allocated to a single category.

Correia et al. [31] obtained 22 smart city categories. After conducting a principal component analysis, these 22 categories were reduced to four dimensions. Nevertheless, every category had a representation and contribution in each factor. Furthermore, if a city had only one project in a category that was significant in Factor 1, it would still have scores in the remaining factors, because although this category was not significant, it still contributed in the other factors. As an example, in Table A24 (Appendix A), the city of Poprad in Slovakia has only one project in the category of Community, Participation and Inclusion (Factor 4); however, Appendix B shows that the city has scores in every factor.

Thus, this analysis served to obtain the scores of each city according to the number of existing projects by the respective smart city category. Thus, after obtaining the values of

each factor by city, a composite indicator was built. This composite indicator was calculated by first multiplying the number of projects in each category by the significancy value of that category in the factor. As explained in the example above, the single project in that category was multiplied by the category's representation in each factor.

Furthermore, the four factors were directly associated with a specific stage of the smart city concept. Factor 1 joined the categories of Smart City 1.0; Factor 2 mirrored an extension of Smart City 1.0; Factor 3 considered the areas of Smart City 2.0; and Factor 4 was constituted by the categories of Smart City 3.0. When matching with the smart city literature, Factor 1 corresponded to the lowest stage (Smart City 1.0), while Factor 4 corresponded to the highest stage (Smart City 3.0). Thus, generically, Factor 1 should have a greater overall contribution because cities usually have more projects in the first stage of the concept. Therefore, the inverse values were considered to give greater preponderance to the cities that have projects in the third stage of the concept. This way, if two cities have the same number of projects, the one that has more in the third phase of the concept should rank higher.

Thus, after obtaining the city results for each factor based on the multiplication of the number of projects in each category and the representation of the category in each factor, the score values of each factor to calculate the smart city composite indicator were divided by the population density of the city to reduce biased results and give greater preponderance to the efforts of smaller cities. This way, if cities had the same number of projects, the city with lower population density would rank higher. Therefore, several classes of population density were constituted to ultimately allow the comparison according to specific population ranges. The ultimate goal was to weight the number of projects according not just to the explanation of each factor but also the relationship between their population and the area of the territory. Moreover, the sole consideration of the density value as a direct proportion to the final ranking would means smaller cities (which tend to have just one or two projects) had greater positions in the ranking. Moreover, it was important to define a fair proportion between the different density classes to overcome biased results.

The results of the factors by city were summed and normalized on a scale of 0 to 1000 to give a ranking score to each factor. Following, the resulting factor scores were multiplied by the inverse value of the contribution of each factor to rank higher cities that had more projects on the factors that matched later phases of the Smart City concept. Finally, the smart city compositive indicator was applied to each city, the results were sorted, and a ranking of the cities was established.

Figure 1 summarizes the methodology: Step 0 refers to the 22 smart city categories and four factors obtained explained in the past research; Step 1 describes the score results by city for each factor when multiplying the number of projects by the significancy of each category; Step 2 proposes several classes of population density to divide the score results by that value; Step 3 normalizes the final sum of the factor scores on a scale from 0 to 1000; and Step 4 introduces the smart city literature to explain why the scores should be considered and multiplied by the inverse values of the total variation explanation of each factor.

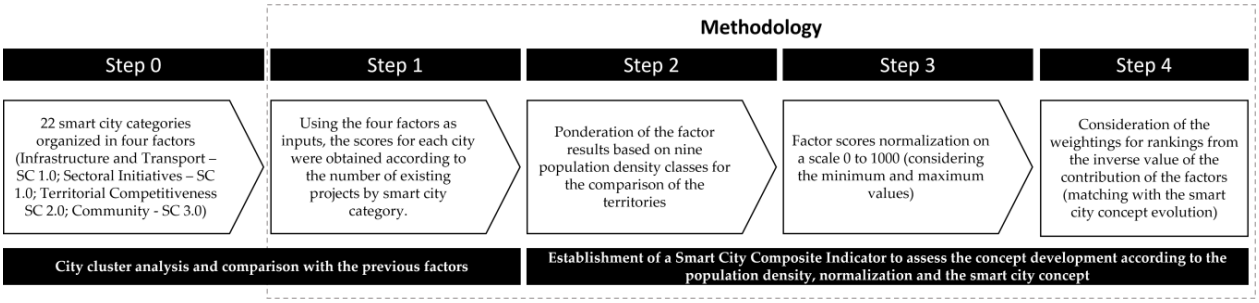


Figure 1. Methodological approach.

3. Results

This section provides a concise and precise description of the experimental results and their interpretation, as well as the experimental conclusions that can be drawn. The oldest research pieces obtained from the search queries are from 2010. Thus, the projects that constitute this sample range from 2010 to 2021. The calculation of each methodology step is represented in Figure 2.

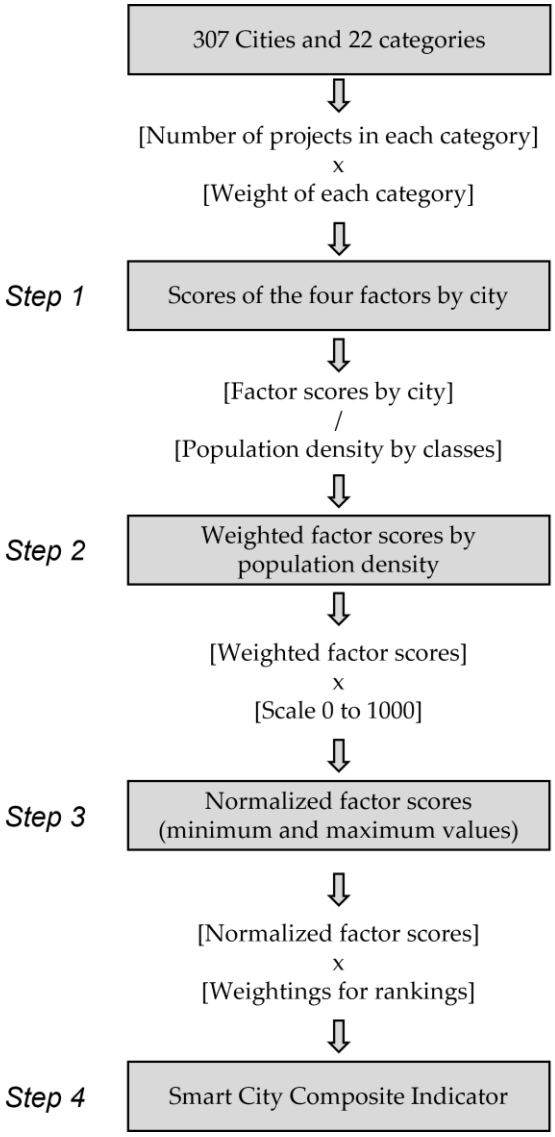


Figure 2. Smart city composite indicator per city (step-by-step).

3.1. City Cluster Analysis and Factor Scores

3.1.1. Smart City Categories

Smart city areas have been expanding throughout the years in terms of scope and number. Several authors have reflected on and identified several categories and dimensions in the literature [2,16–18,34–50]. However, until recently, it remained unclear what the existing verticals are and their respective smart city phases.

Following a multiple-step inductive qualitative analysis, Correia et al. [31] found 22 smart city categories. Thus, after the search on Scopus using the query "Smart Cit*" + "Name of the Country" (applied to every European Union member state), the titles, abstracts and keywords were analysed to allocate a first code connected to the identification

of the city and a second code concerning the contribution of the paper. Based on this codification, it was possible to inductively find the smart city categories.

Nevertheless, to reduce the number of dimensions and to group the categories in large dimensions and find their meaning, a principal component analysis (PCA) was carried out where the categories were grouped into four large areas (with a loss of only approximately 15% of the initial information). The factors were also connected to the respective smart city phase [21–23].

- The first factor: infrastructure and transport (waste, water, air, parking, communication networks, traffic, and mobility)—Smart City 1.0.
- The second factor: sectoral initiatives (sports, health, education, and culture)—Smart City 1.0 (extended).
- The third factor: territorial competitiveness (rural and agriculture, logistics, digitalization, economy, and industry)—Smart City 2.0.
- The fourth factor: community (community participation and security and privacy)—Smart City 3.0.
- The number of existing projects in each city by category and factor can be found in Appendix A. Furthermore, Appendix A provides a table with the results of the cities for each of the European Union countries. The data presented from Tables A1–A27 were organized and structured to give the possibility of comparing cities from the same country and between countries.

3.1.2. Cities Factor Analysis

The previous four factors (dimensions) were re-calculated based on the existing projects within the cities (weights of each category). Therefore, we applied a Principal Component Analysis (PCA) to the total existing projects in the cities of the sample to find the relationships between categories. Factor loadings or weights represent the correlation between each category (variable) and each factor. Thus, it is the amount of variance in each variable that is explained by each factor, as shown below in Table 1. In each specific category, the highest explanation value of the category contemplating the values of the category for the four factors was highlighted. In summary, the explanation of the Factor is represented by the categories highlighted in grey and bold (Table 1).

Table 1. Factor analysis.

Category	F1	F2	F3	F4	Dimension
Environment and air quality	**0.757**	0.409	0.287	0.344	Infrastructure and transport
Infrastructure and communication networks	**0.869**	0.356	0.156	0.149	
Mobility and transportation	**0.626**	0.579	0.425	0.171	
Parking	**0.892**	0.045	0.064	0.174	
Smart city foundations	**0.778**	0.151	0.255	0.394	
Strategy and governance	**0.592**	0.309	0.331	0.452	
Traffic	**0.654**	0.189	0.260	0.513	
Waste	**0.669**	0.554	0.136	0.056	
Water and irrigation	**0.651**	0.097	0.523	−0.020	
Culture, tourism, and heritage	0.588	**0.670**	0.227	0.189	Sectoral initiatives
Education	0.395	**0.737**	0.431	0.093	
Energy and lighting	0.537	**0.557**	0.486	0.171	
Health and well-Being	0.246	**0.738**	0.528	−0.088	
Sport	0.003	**0.899**	0.131	0.213	
Urban planning	0.415	**0.632**	0.520	0.243	

Table 1. *Cont.*

Category	F1	F2	F3	F4	Dimension
Buildings and housing	0.227	0.562	**0.708**	0.037	Territorial competitiveness
Digitization and interoperability	0.400	0.456	**0.614**	0.326	
Economy and industry	0.425	0.431	**0.541**	0.257	
Logistics	0.228	0.278	**0.732**	0.270	
Rural and agriculture	0.058	0.139	**0.837**	0.126	
Community, participation, and inclusion	0.516	0.459	0.305	**0.565**	Community
Privacy, security, and safety	0.238	0.062	0.129	**0.901**	
Eigenvalues	14.293	2.119	1.170	0.947	

The score of each of the four factors per city was obtained by multiplying the number of projects with the respective weights/loadings (a_{ij}) detailed in Table 1. As an example, if a city had just one project in the category "Community, Participation & Inclusion" (X_j, j = 1, . . ., 22), the final result (Y_i, i = 1, . . ., 4) would be the multiplication of that one project by 0.516 for Factor 1; 0.459 for Factor 2; 0.305 for Factor 3; and 0.565 for Factor 4. Generically, and since each principal component (Y_i) is given by a linear combination of the variables X_1, X_2, . . ., X_j, the scores for each of the four factors (Y_i, i = 1, . . ., 4) for each city were obtained according to the following formula:

$$Y_i = a_{ij}X_j,\ (j = 1, \ldots, 22;\ i = 1, \ldots, 4)$$

3.2. Population Density as a Proxy of the Socio-Demographic Context

Following the previous step, it was important to consider a socio-demographic variable that could also weight the results according to the characteristics of the territory. Furthermore, the population density was considered to standardise the results, instead of considering just the population or the area of the territory, which would cause great disparity. Therefore, the number of projects in each city was divided by their population density. This allowed cities with fewer projects to have greater preponderance in the understanding of smart cities.

Nevertheless, although the population density may be used as a proxy of the socio-demographic context of a city, the understanding is that it should not have a linear impact on the number of existing smart city projects. This means considering a non-linear relationship between these two variables. The proportion between the two variables that weigh on the final results tends to give preponderance to cities with fewer projects, while not forgetting cities with a greater number of smart city initiatives. Therefore, the cities were organized in population density classes and a specific ratio was established between them.

Furthermore, nine classes with specific proportions between them were constituted (represented in Figure 3).

3.3. Normalization of the Factor Scores

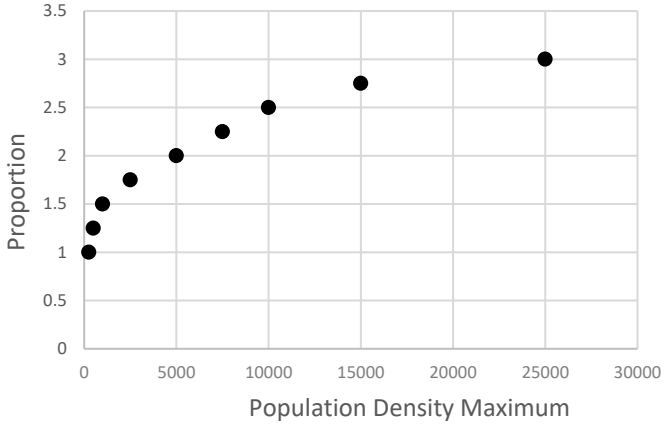
Afterwards, the maximum and minimum values among cities were considered for each factor to recalculate the average values considering the minimum and maximum values.

Thus, the factor scores were normalized on a scale from 0 to 1000. Therefore, the result of each factor by city (Y_i, i = 1, . . ., 4), took into consideration the minimum and maximum factor scores of every city (Y_j, j = 1, . . ., 307). Thus, each one of the four city factors' final result was obtained according to the following formula:

$$Y_i = \frac{Yi - Min\ (Yj)}{Max\ (Yj) - Min\ (Yj)} * 1000$$

Class	Min	Max	Proportion
1	0	250	1x
2	251	500	1.25x
3	501	1,000	1.5x
4	1,001	2,500	1.75x
5	2,501	5,000	2x
6	5,001	7,500	2.25x
7	7,501	10,000	2.5x
8	10,001	15,000	2.75x
9	15,001	25,000	3x

(**a**)



(**b**)

Figure 3. (**a**) Population density classes. (**b**) Representation between the proportion of the classes.

3.4. Composite Indicator to Assess the Development Phase of the Smart City Concept

A final smart city composite indicator considering the previous four factors was established. This composite indicator explains the development phase of the smart city concept of a territory.

Thus, in the final step, the values for the factor of each city value were multiplied by the total variation explanation of each factor. Nevertheless, since the understanding is that the most advanced cities have more projects in Factor 4 (Smart City 3.0) and did not necessarily have to go through all stages, more importance was given to the last factor. Therefore, to have a better weighting for the final result, the inverse value of the total variation explanation of each factor was considered to obtain the final smart city composite indicator for ranking. Moreover, as shown in Figure 4 and in Table 2 ("Weightings for rankings"), Factor 1 explains 2.85% of the development phase of the smart city concept, Factor 2 explains 19.24%, Factor 3 contributes 34.85%, and, finally, Factor 4 has an impact of 43.06% on the final result.

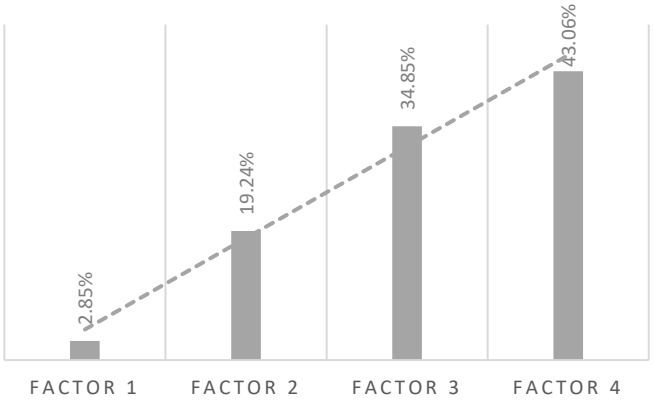


Figure 4. Development phase of the smart city concept: explanation of each factor.

Table 2. Final weights according to the inverse value.

	F1	F2	F3	F4
Eigenvalues (E_i, i = 1, . . ., 4)	14.293	2.119	1.170	0.947
Inverse value (smart city concept context) $(E_i)^{-1}$	0.067	0.472	0.855	1.056
Weightings for rankings (W_i)	**2.85%**	**19.24%**	**34.85%**	**43.06%**

In short, once the scores were calculated for each city, in the four factors (Y_i), it was possible to build a composite indicator (to calculate the final Smart City ranking), considering different weights. By assigning higher weights to eigenvectors associated with smaller eigenvalues, we ensured that factors contributing more significantly to the overall variation in the data received greater importance in the composite indicator. Thus, the final weights used to build the composite indicator are shown in Table 2, which was calculated as follows:

$$W_i = \frac{(\mathrm{Ei})^{-1}}{\sum(\mathrm{Ei})^{-1}}$$

This allows the level of maturity of development of the concept to be evaluated so that cities can design any roadmaps or establish any action plans that it may be necessary to implement.

At this stage, the smart city level would be directly impacted by the existing number of projects, weighted by their respective category (factor). This would mean that the smart city level would be directly impacted by the number of projects. This conclusion would be meaningless for decision makers.

3.5. Smart City Ranking

Table 3 shows the ranking of the first 50 territories. It is important to highlight the fact that the best city is Dublin, with a ranking of 907 out of a total of 1000. Table A28 (Appendix B) details the results of each of the 307 cities and provides insightful information about their factor sub-results. The results suggest that cities with fewer projects are also considered smart city territories, since the number of projects they have is significant for their population density, as is the cases of Trikala, Oulu, Antwerp, Thessaloniki, Graz, and Évora. All of them are in the top 20 and have less than 10 projects. The population density shown in Table 3 is rounded to the units.

Table 3. Ranking of 50 cities.

Position	City	Country	Projects	Density (People/km^2)	Class	Ranking
1	Dublin	Ireland	22	4756	5	907
2	Vienna	Austria	22	4633	5	889
3	Turin	Italy	21	6602	6	742
4	Madrid	Spain	22	5454	6	726
5	Barcelona	Spain	29	16,516	9	723
6	Aarhus	Denmark	14	752	3	714
7	Milan	Italy	21	7680	7	668
8	Amsterdam	Netherlands	18	5277	6	662
9	Trikala	Greece	8	134	1	656
10	Cagliari	Italy	14	1115	4	646
11	Oulu	Finland	8	70	1	631
12	Helsinki	Finland	14	3065	5	604
13	Antwerp	Belgium	9	247	1	597
14	Malaga	Spain	16	1462	4	572
15	Santander	Spain	15	4771	5	480
16	Thessaloniki	Greece	6	1	1	473
17	Hamburg	Germany	11	2453	4	464
18	Lisbon	Portugal	12	6418	6	421
19	Graz	Austria	9	2283	4	407
20	Évora	Portugal	5	41	1	399

Table 3. *Cont.*

Position	City	Country	Projects	Density (People/km^2)	Class	Ranking
21	Porto	Portugal	13	5617	6	388
22	L'Aquila	Italy	6	148	1	378
23	Brno	Czech Republic	9	1661	4	369
24	Tampere	Finland	5	459	2	361
25	Flanders Reg.	Belgium	6	484	2	360
26	Galicia	Spain	4	91	1	335
27	Eindhoven	Netherlands	7	2689	5	316
28	Berlin	Germany	8	4112	5	314
29	Florence	Italy	8	3527	5	308
30	Águeda	Portugal	4	138	1	302
31	Stockholm	Sweden	9	5217	6	298
32	Bologna	Italy	8	2798	5	297
33	Catania	Italy	6	1626	4	295
34	Vitoria-Gasteiz	Spain	5	914	3	294
35	Trento	Italy	6	752	3	291
36	Lyon	France	10	10,918	8	286
37	Valladolid	Spain	7	1512	4	284
38	Luxembourg	Luxembourg	6	2420	4	275
39	Prague	Czech Republic	7	2692	5	265
40	Warsaw	Poland	8	3469	5	265
41	Bari	Italy	8	2716	5	262
42	Copenhagen	Denmark	8	7231	6	257
43	Savona	Italy	5	900	3	255
44	Munich	Germany	6	4777	5	246
45	Nicosia	Cyprus	6	2740	5	245
46	Brussels	Belgium	4	756	3	244
47	Bratislava	Slovakia	6	1292	4	237
48	Pavia	Italy	5	1131	4	236
49	Heraklion	Greece	5	711	3	234
50	Rome	Italy	5	1837	4	234

Several outliers were excluded from the final analysis since they would bias the results, mostly because their population density was too low and therefore would weigh favourably on these territories. Moreover, they would be the best cities, even with a small number of projects. These territories were: Munzingen (Germany), Papagou (Greece), Nordhavn (Denmark), Osmannoro (Italy), Papagou (Greece), Region of Elefsina (Greece) and Les Orres (France), and the Sardinian Region (Italy).

3.6. The Example of Dublin—Application of the Methodology

Initially, from the content analysis of the literature, 22 papers were allocated to the city of Dublin. As shown in Table 4, the projects were distributed in 10 different categories.

Table 4. Number of smart city initiatives organized by category in Dublin.

Ireland	Population	Area (Km^2)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Dublin	554,554	116.6	1	1	1			1	4							1	3		4	2			4		22	10

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

The number of papers in each category was then multiplied by the significance of each category (see Table 1). The sum of values would give Dublin the following scores for each factor: Factor 1—11.222; Factor 2—9.726; Factor 3—8.688; and Factor 4—8.188 (Step 1—Table 5). After this, the results of the factors were divided by the population density class (see Figure 3).

Table 5. Dublin step-by-step factor results.

Factor	Step 1—Loading Scores	Step 2—Division Density Population	Step 3—Normalization (Scale 0–1000)	Step 4—Weightings for Rankings
1	11.222	5.611	869	24.79
2	9.726	4.863	1000	192.36
3	8.688	4.344	979	341.38
4	8.188	4.094	1000	348.54

Therefore, in the case of Dublin, since the population density is 4756 people/km^2, the respective class was number 5. Therefore, the factor scores were divided by 2. Thus, the scores of each factor turned into: Factor 1—5.611; Factor 2—4.863; Factor 3—4.344; and Factor 4—4.094 (Step 2—Table 5).

In the following step, the resulting values were normalized on a scale from 0 to 1000, considering the minimum and maximum factor scores (minimum and maximum values) as: Factor 1—min 0.04, max 6.45; Factor 2—min 0.02, max 4.86; Factor 3—min 0.03, max 4.43; and Factor 4—min 0.00, max 4.09. This resulted in the following final scores: Factor 1—869; Factor 2—1000; Factor 3—979; and Factor 4—1000 (Step 3—Table 5).

In the final step, the score values were multiplied by the weightings for rankings (from the inverse value of the total explanation of the factor—see Figure 4). Thus, the score of each factor was obtained before it was multiplied by Factor 1—2.85%, Factor 2—19.24%, Factor 3—34.85%, and Factor 4—43.06% to ultimately result in the final factor scores: Factor 1—24.79; Factor 2—192.36; Factor 3—341.38; and Factor 4—348.54 (Step 4—Table 5). The sum of the previous values makes Dublin rank first, with a final smart city composite indicator result of 907 (Appendix B—Table A28).

4. Discussion

Existing frameworks have ranked cities without considering the evolution noticed in the smart city concept [16]. Therefore, existing smart city rankings have only been looking at the number of projects (biased by communication) and have historically put larger cities in the first places, neglecting what is being done in smaller cities [32–35,51,52]. Ruohomaa et al. [24] point out that research on smart cities usually focuses on big cities, with the topic being widely neglected for medium and small cities. Moreover, the same cities are usually used as case studies. Several examples can be found in the literature [53–60].

Since the understanding of smart cities has evolved from a purely technical perspective to focus on the role that citizens may have in the development of city strategic plans, in this study, we developed a methodology that gives greater preponderance to projects in categories that are more related to the latest stages of the concept and weights that according to their population density. It is reasonable that a small city with only one project should rank higher than a larger city with the same number of projects.

Thus, the results of this study suggest that the territories that rank higher are not those with the highest number of projects nor the largest ones.

Two different assumptions were considered that can be subjective and have an impact on the final result. First, weighting the number of projects according to the population density contributes to filling the existing gap in terms of dimension versus development of the concept. Second, the definition of the classes was based on several hypotheses to guarantee that, on the one hand, the city that ranked first did not score 1000 points in each

factor; the goal was not to have a role-model city, but only a city that is doing better than the others yet still has a roadmap that can be obtained, and, on the other hand, to not allow cities with very low population density and only one project to rank significantly higher than cities with more projects.

Thus, although this study may present a methodology that may have some replicability issues, it provides a fair ranking because it made the necessary assumptions to improve the recognition of the work done by cities with a smaller population and to reduce the bias of final results.

Therefore, in the top 10 cities in this ranking can be found the city of Trikala, Greece, with only eight projects, but as the city is in class 1 of population density, these projects have greater significancy than, for example, Cagliari, Italy, that ranks immediately after it and has 14 projects.

Past rankings in the literature would put Barcelona first. In this ranking, Barcelona only appears in fifth place, because although it is the city with the greatest number of projects, its population density is high, and it has only one more project than Dublin in the categories of the third phase of the concept (see Appendix A, Tables A14 and A26). Thus, as explained before, the defined methodology aimed to consider several premises that would allow a final indicator (and a ranking) that would favour cities with the same (or almost the same) projects and lower population density, and cities that would have more representative projects in the categories of community, participation, and inclusion and privacy, security, and safety.

By giving greater preponderance to the projects and categories that are connected to the later stages of the concept, this study contributes by advocating that cities can significantly impact the quality of life of their citizens and rank higher on smart cities ranking by improving the involvement and participation of the community, rather than focusing on securing funding for investment in technological solutions.

Additional questions are raised about whether the decisions produced actually express citizens' preferences [50]. The understanding of the weighting of each variable in the development phase of the smart city concept may also be personalized to each city. Moreover, since the comprehension of what a smart city is may differ according to the understanding and preferences of citizens, a bottom-up approach could also be taken into account to weigh this top-level methodology [61]. In addition, the literature describes several smart city barriers that can be considered by cities according to the results obtained in this paper [62–67]. Correia, Teixeira, and Marques [68] even extend this interpretation by studying which endogenous barriers have higher impact and order them by priority.

5. Conclusions

This research aimed to provide a composite indicator for smart city mature development to allow the ranking of European Union cities.

The main goals of this study were not just to provide a ranking of every city present in the literature, but to weight the smart city level composite indicator and its results, firstly according to the respective smart city category of the projects (ultimately connected to the smart city concept phase) and secondly considering the population density of each territory (organized by classes). This avoids the fact that smaller cities are often neglected and unconsidered when considering smart cities. Therefore, the final values of the four factors that constitute the composite indicator for the development phase of the smart city concept were normalized on a scale from 0 to 1000. In addition, the population density of each territory was considered and the density value of each city was matched to a class to define a non-linear relationship. This allowed a greater comparison between smaller and larger cities, since using the direct value of the population density would rank smaller cities higher (since the impact of one project would be significant based on the small scale of the territory) and larger cities lower. Furthermore, the ranking mixes smaller cities and larger cities and raises new perspectives on the discussion about what truly makes a city smart.

The management of each territory, namely the definition of an action plan, can be based on the results of the assessment methodology defined in this paper. Moreover, depending on the territory results in each factor, a strategic plan can be designed to prioritize the initiatives in the categories that will have a significant impact on its smart city development.

The first limitation of this paper may be the fact that the only source considered was Scopus. However, since the goal was to study every city present in the literature, this recognized scientific database may the most suitable, given its reliability, coverage, and integrity to use as a proxy. In the future, this study can be enhanced to include other sources. Furthermore, this study took the existing articles in the literature as a proxy for existing initiatives in each territory and considered only the analysis of titles and abstracts. In future work, the exhaustive analysis of each paper can be performed to understand the success of the case study and what impact it had on the city's strategy. Thus, additional data such as the project size, scope, funding, and people involved can be considered.

A second limitation is the fact that cities may have skipped phases, and therefore may have not gone through Smart City 1.0 and 2.0 and have only projects in categories that constitute the third phase of the smart city concept.

Finally, the main objective of this paper was to define the process for the development phase of the smart city concept of a certain territory and not necessarily to provide a definitive ranking for cities, which can differ depending on the different assumptions and interpretations that can be made, namely the proxies that were used to weigh the results. In this case, since there are few reliable socio-demographic data for cities, population density was used as proxy for context and different classes with specific weights were considered (to overcome the linear relationship issue). Other socio-demographic (and socioeconomic) variables can be added to improve the weighting of the development phase of the smart city concept.

Author Contributions: Conceptualization, D.C., J.L.M. and L.T.; methodology, D.C. and J.L.M.; validation, J.L.M. and L.T.; formal analysis, D.C. and J.L.M.; writing—original draft preparation, D.C.; writing—review and editing, D.C., J.L.M. and L.T.; supervision, J.L.M. and L.T.; funding acquisition, J.L.M. and L.T. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by Portuguese national funds through the Foundation for Science and Technology, FCT, I.P., in the context of the JUST_PLAN project (PTDC/GES-OUT/2662/20).

Acknowledgments: This research was supported by Institute of Electronics and Informatics Engineering of Aveiro (UIDB/00127/2020) and by the research unit on Governance, Competitiveness and Public Policy (UIDB/04058/2020), both funded by national funds through FCT—Foundation for Science and Technology.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

As shown in Table A1, the sample of Austria concerns data about six territories. Graz and Vienna are the cities with most results in absolute terms. Only Vienna has results in the last phase of the smart city concept. It is also possible to notice the lack of projects in several categories.

Table A1. Number of smart city initiatives organized by city and category in Austria.

Austria	Population	Area (Km^2)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Graz	291,134	127.5	1									1		4			2		1						9	5
Innsbruck	131,059	104.9									1														1	1
Linz	206,537	95.99												1											1	1
Salzburg	155,416	65.65												1											1	1
Vienna	1,920,949	414.6	1		2		2	4	1				1	2			3	1	2				2	1	22	12
Villach	63,236	134.9												1											1	1

Table A1. *Cont.*

Austria	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Total			2	0	2	0	2	4	1	0	1	1	1	9	0	0	5	1	3	0	0	0	2	1		
Cities			2	0	1	0	1	1	1	0	1	1	1	5	0	0	2	1	2	0	0	0	1	1		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A2, the sample of Belgium concerns data about 13 territories. Antwerp is the city with most results. However, it does not have any project in the last two categories. It is also possible to note several small cities with fewer projects and greater representation in the last phase of the smart city concept, such as Knokke-Heist.

Table A2. Number of smart city initiatives organized by city and category in Belgium.

Belgium	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Antwerp	53,000	215	4	3													1		1						9	4
Brussels	122,000	161.4															1		1		1		1		4	4
Flanders Region	6,589,000	13,625			1		1			1									2	1					6	5
Ghent	263,703	156					2																1		3	2
Knokke-Heist	33,086	56.4																					1		1	1
La Louvière	80,944	64.2																					1		1	1
Leuven	101,032	56.6		1																					1	1
Leuze	13,886	73.53												1											1	1
Liege	196,296	69.4	1																						1	1
Mons	95,705	147			3																				3	1
Namur	111,800	176																					1		1	1
Seraing	63,787	35.3																1							1	1
Wallonia Region	3,648,206	16,844															2								2	1
Total			5	4	4	0	3	0	0	1	0	0	0	1	0	0	4	1	4	1	1	0	5	0		
Cities			2	2	2	0	2	0	0	1	0	0	0	1	0	0	3	1	3	1	1	0	5	0		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A3, the sample of Bulgaria concerns data about three territories. There are few initiatives in this country. There are only results in the categories of environment and air quality, culture, tourism and heritage, and digitization and interoperability.

Table A3. Number of smart city initiatives organized by city and category in Bulgaria.

Bulgaria	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Ruse	147,500	543.8																	1						1	1
Sofia	1,275,000	1349	1																1						2	2
Varna	375,000	238.5										1													1	1
Total			1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0		
Cities			1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A4, the sample of Croatia concerns data about eight territories. There are few initiatives in each city. However, there are a couple of cities that have results in the last stage of the smart city concept.

Table A4. Number of smart city initiatives organized by city and category in Croatia.

Croatia	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Bol	1694	23		1																					1	1
Dubrovnik	41,671	144	1																1						2	2
Koprivnica	28,666	91.5																					1		1	1
Osijek	10,000	175		1																					1	1
Rijeka	100,000	43.2																					1		1	1
Sisak	40,185	419												1											1	1
Split	161,312	79.6			1																				1	1
Sveti Križ Začretje	5660	40.4												1											1	1
Total			1	2	1	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	2	0		
Cities			1	2	1	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	2	0		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A5, the sample of Cyprus concerns data about two territories. Nicosia has the most results, and there is a noticeable representation of multiple categories.

Table A5. Number of smart city initiatives organized by city and category in Cyprus.

Cyprus	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Limassol	101,000	35.09			**2**																		**1**		3	2
Nicosia	55,014	20.08							**2**					**1**					**1**			**1**		**1**	6	5
Total			0	0	2	0	0	0	2	0	0	0	0	1	0	0	0	0	1	0	0	1	1	1		
Cities			0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	1	1	1		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A6, the sample of the Czech Republic concerns data about 13 territories. Brno has the most results. Several smaller cities, although they have few projects, are starting the smart city approach with categories of the third stage of the concept.

Table A6. Number of smart city initiatives organized by city and category in Czech Republic.

Czech Republic	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Brno	382,405	230.2	1	2	1		1	1									1		1				1		9	8
Havířov	70,165	32.1																1							1	1
Jeseník	37,709	719												1											1	1
Karlovy Vary	293,311	3315															1								1	1
Karvina	50,902	57.5						1																	1	1
Lovosice	8873	11.89			1																				1	1
Moravia Silesian	1,192,834	5427																	1						1	1

Table A6. *Cont.*

Czech Republic	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Ostrava	284,982	214																						1	1	1
Prague	1,335,084	496			2			1					1		1		1			1					7	6
Uherske Hradiste	25,001	21.3						1																	1	1
Usti nad Labem	91,982	94					1					1											1		3	3
Zdarna	800	10.36									1														1	1
Zlín	74,478	1040						1															1		2	2
Total			1	2	4	0	2	5	0	0	1	1	1	1	1	0	3	1	2	1	0	0	3	1		
Cities			1	1	3	0	2	5	0	0	1	1	1	1	1	0	3	1	2	1	0	0	3	1		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A7, the sample of Denmark concerns data about six territories. Aarhus is the most-represented city, having projects in 11 smart city categories.

Table A7. Number of smart city initiatives organized by city and category in Denmark.

Denmark	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Aalborg	219,487	1144		1							1	1													3	3
Aarhus	352,751	468.9	2		1	1			1				1	1	1		2		1	1			2		14	11
Copenhagen	638,117	88.25	1								2			3					1				1		8	5
Odense	205,509	304.3							1																1	1
Region of North Jutland	590,439	7933																			1				1	1
Sønderborg	73,831	496.6												1			1								2	2
Total			3	1	1	1	0	0	2	0	3	1	1	5	1	0	3	0	2	1	1	0	3	0		
Cities			2	1	1	1	0	0	2	0	2	1	1	3	1	0	2	0	2	1	1	0	2	0		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A8, the sample of Estonia concerns only data about two territories. Nevertheless, these cities already count several projects.

Table A8. Number of smart city initiatives organized by city and category in Estonia.

Estonia	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Tallinn	438,341	159.4															1		4						5	2
Tartu	95,430	154			1												1	1	1						4	4
Total			0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	1	5	0	0	0	0	0		
Cities			0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	1	2	0	0	0	0	0		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A9, the sample of Finland concerns data about eight territories. Helsinki and Oulu are the cities with the greatest number of projects. There is a noticeably greater focus of the country on the third stage of the concept, since five cities have projects in these categories.

Table A9. Number of smart city initiatives organized by city and category in Finland.

Finland	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Espoo	290,000	312.3											1	1					1				1		4	4
Hämeenlinna	67,848	1785																	1						1	1
Helsinki	656,920	214.3	2				1	1									3		4		1		2		14	7
Lohja	45,886	939.1															1								1	1
Oulu	207,327	2971		1				3	1														3		8	4
Region of Häme	170,577	5199																					1		1	1
Tampere	241,009	524.9						1											2				1	1	5	4
Tuusula	38,783	219.5															1								1	1
Vaasa	67,551	364.7			1			1																	2	2
Total			2	1	1	0	1	6	1	0	0	0	1	1	0	0	5	0	8	0	1	0	8	1		
Cities			1	1	1	0	1	4	1	0	0	0	1	1	0	0	3	0	4	0	1	0	5	1		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A10, the sample of France concerns data about 11 territories. Lyon is the city with the greatest number of projects and categories represented. The dispersion reveals that this city passed through all the smart city phases.

Table A10. Number of smart city initiatives organized by city and category in France.

France	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Grenoble	160,000	18.1		1														1							2	2
Lille	234,475	34.8		1	1						1														3	3
Lorraine Region	23,547	2,346,000												1											1	1
Lyon	522,969	47.9	1	1				1	2					1					1				3		10	7
Marseille	870,731	241							1																1	1
Nancy	105,058	15	1						1									1							3	3
Nantes	318,808	65.2																	1						1	1
Nice	342,669	71.9																	2					1	3	2
Paris	2,165,423	106			1				1								1		1	1					5	5
Rennes	220,488	50.4																	1						1	1
Saint-Nazaire	69,993	46.79												1											1	1
Total			2	3	2	0	0	1	5	0	1	0	0	3	0	0	1	2	6	1	0	0	3	1		
Cities			2	3	2	0	0	1	4	0	1	0	0	3	0	0	1	2	5	1	0	0	1	1		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A11, the sample of Germany concerns data about 30 territories. Hamburg is the city with the greatest number of projects and categories represented. The dispersion reveals that this city passed through all the smart city phases.

Table A11. Number of smart city initiatives organized by city and category in Germany.

Germany	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Augsburg	295,830	146.8							1																1	1
Baden-Württemberg	11,103,043	35,748																			1				1	1
Berlin	3,664,088	891.1	2		1		1							1					2	1					8	6

Table A11. *Cont.*

Germany	Population	Area (Km^2)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Bonn	330,579	141.1															2								2	1
Brandenburg	2,531,071	29654																				1			1	1
Cologne	1,086,000	405.2							1					1							1		1		4	4
Darmstadt	159,174	122.1																					1		1	1
Dortmund	587,696	280.7		1										1											2	2
Düsseldorf	620,523	217.4											1												1	1
Erfurt	213,692	269.9			1																2				3	2
Essen	582,415	210.3																					1		1	1
Frankfurt	764,104	248.3									1				1										2	2
Freiburg	230,940	153																	1						1	1
Hamburg	1,852,478	755.1					2	1	2	1		1		1					1				2		11	8
Hannover	536,925	204.3																1							1	1
Heilbronn	126,458	99.9																			1				1	1
Herrenberg	31,465	65.71															1								1	1
Karlsruhe	310,000	173.4		1								1													2	2
Leipzig	595,000	297.8						1									1								2	2
Lübeck	216,000	214.2																	1						1	1
Ludwigsburg	93,584	43.4												1			1								2	2
Mainau-Lake Constance	185	0.448		1																					1	1
Mainz	218,578	97.73				1																			1	1
Munich	1,484,226	310.7			2			1										1	1				1		6	5
Nuremberg	518,370	186.4															1								1	1
Regensburg	153,094	80.86								1															1	1
Ruhr Valley	10,680,783	4435	1		1														1						3	3
Stuttgart	635,911	207.3	1																				1		2	2
Vaihingen	28,901	73.41																1	1						2	2
Wüstenrot	6613	30.02															1								1	1
Total			4	3	5	1	3	3	4	2	1	2	1	5	1	0	7	3	8	1	5	1	7	0		
Cities			3	3	4	1	2	3	3	2	1	2	1	5	1	0	6	3	7	1	4	1	6	0		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A12, the sample of Greece concerns data about 15 territories. Trikala is the city with the greatest number of projects and categories represented. There is a noticeably greater focus of the country on the third stage of the concept, since eight cities have projects in these categories.

Table A12. Number of smart city initiatives organized by city and category in Greece.

Greece	Population	Area (Km^2)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Athens	664,046	38.96	1									1					1								3	3
Elefsina	29,902	36.59	1				**1**																		2	2
Heraklion	173,993	244.6		1	1		1													1			1		5	5
Igoumenitsa	25,814	428.4	1																						1	1
Island of Kos	33,388	287.2																					1		1	1
Kavala	70,501	35.13																	1				1		2	2
Korydallos	63,445	4320																					1		1	1
Lesvos	86,436	1633																						1	1	1
Mykonos	10,134	105.2															1								1	1
Patras	213,984	334.9	1						1																2	2
Samos Island	32,977	477.4																					1		1	1

Table A12. *Cont.*

Greece	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Skiathos	6088	49.9									1														1	1
Thessaloniki	325,182	315,196	1		1				2								1						1		6	5
Trikala	81,355	607.6			1		1	1						1					1	1			2		8	7
Volos	144,449	385.6			1																				1	1
Total			5	1	4	0	3	1	3	0	1	1	0	1	0	0	3	0	2	2	0	0	8	1		
Cities			5	1	4	0	2	1	2	0	1	1	0	1	0	0	3	0	2	2	0	0	7	1		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A13, the sample of Hungary concerns data about three territories. Budapest is the city with the greatest number of projects and categories represented. The dispersion reveals that this city passsed through all the smart city phases.

Table A13. Number of smart city initiatives organized by city and category in Hungary.

Hungary	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Budapest	1,752,286	525.1							2			1		1									1	1	6	5
Miskolc	154,521	972.8																1							1	1
Szeged	160,766	281	1																						1	1
Total			1	0	0	0	0	0	2	0	0	1	0	1	0	0	0	1	0	0	0	0	1	1		
Cities			1	0	0	0	0	0	1	0	0	1	0	1	0	0	0	1	0	0	0	0	1	1		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A14, the sample of Ireland concerns data about four territories. Dublin is the city with the greatest number of projects and categories represented. The dispersion reveals that this city passsed through all the smart city phases. Nevertheless, there are data about few Irish cities, and there is a great discrepancy between Dublin and the remaining cities, which can mean that the country's efforts are concentrated in the capital city.

Table A14. Number of smart city initiatives organized by city and category in Ireland.

Ireland	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Cork City	209,655	186.7																					1		1	1
Dublin	554,554	116.6	1	1	1			1	4							1	3		4	2			4		22	10
Ennis	25,276	19.65																					1		1	1
Limerick	94,192	59.2											1				1								2	2
Total			1	1	1	0	0	1	4	0	0	0	1	0	0	1	4	0	4	2	0	0	6	0		
Cities			1	1	1	0	0	1	1	0	0	0	1	0	0	1	2	0	1	1	0	0	3	0		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A15, the sample of Italy concerns data about 64 territories. Milan and Turin are the cities with the greatest number of projects and categories represented.

Nevertheless, there are cities with smaller dimensions also with great smart city representation, as the example of Cagliari.

Table A15. Number of smart city initiatives organized by city and category in Italy.

Italy	Population	Area (Km^2)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Altavilla Silentina	6724	52												1											1	1
Apulia Region	3,926,931	19,363			1																				1	1
Bagheria	53,149	29.7												1											1	1
Bari	315,000	116					1			2				5											8	3
Basilicata	547,579	9992						1													1				2	2
Bay of Pozzuoli	78,870	43.2									1														1	1
Bergamo	119,684	38.8															1								1	1
Bologna	394,463	141	1	1	1							1			1				2				1		8	7
Bolzano	107,760	52.3												3											3	1
Brescia	195,102	90.7											1				2	1							4	3
Bresso	26,285	3.38									1														1	1
Cagliari	149,474	134			2							3				1	3		1				4		14	6
Calabria Region	1,877,728	15,080									1										1				2	2
Campania Region	5,679,759	13,595	1									1		1											3	3
Catania	294,298	181			1				1								1		2				1		6	5
Cesena	97,254	249												1											1	1
Cosenza	65,197	37.2	1									1		1											3	3
Cuneo	55,980	120												1											1	1
Emilia-Romagna Region	4,445,549	22,451																		1					1	1
Florence	359,755	102	1	1					2					1			1		2						8	6
Genoa	558,930	239					1			1			1	1											4	4
Gioia Tauro	19,970	38																1							1	1
Glurns/ Glorenza	888	13											1												1	1
Iglesias	29,075	207.6															1								1	1
L'Aquila	69,941	473.91	1		1						1	3													6	4
Lazio	5,720,796	17203												1											1	1
Lecce	94,000	238													1				1						2	2
Liguria	1,509,805	5418																		1					1	1
Lombardy Region	9,966,992	23,844																					1		1	1
Madonna di Campiglio	700	0.73										1													1	1
Matera	60,000	388															1								1	1
Merano	40,047	26.34																	1						1	1
Messina	225,546	212													1				1						2	2
Milan	1,397,715	182			2	1	1	3	1			1		3			1	1	3		1		3		21	12
Modena	187,977	184							1																1	1
Montieri	1186	108.2			1							1		1			1								4	4
Naples	922,094	117	1																						1	1
Padova	209,730	92.8		2										1											3	2
Palermo	637,885	159		2										1				1							4	3
Parma	195,988	261			1																				1	1
Pavia	71,122	62.9	1		1												1						2		5	4
Pescara	118,766	33.6																1							1	1
Piedmont	4,273,210	25,399	1		2																				3	2
Pisa	89,969	187			1											1									2	2
Prato	201,410	97.6		1						1															2	2
Rende	34,511	54																		1					1	1
Rome	2,770,226	1508	1		1												2						1		5	4
Rovereto	33,175	50																					1		1	1
Salerno	129,206	59.2		1								1													2	2
Savona	58,949	65.5												5											5	1

Table A15. *Cont.*

Italy	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Settimo Torinese	45,495	32																1							1	1
Siena	54,195	119			1																				1	1
South Tyrol	1,078,460	13,607																	1						1	1
Sulcis Iglesiente—Guspinese	136,345	2117.44										1													1	1
Sutri	5055	60.85										1													1	1
Syracuse	117,053	204	1																				1		2	2
Taranto	190,717	310																				1			1	1
Terni	107,982	212	1											1											2	2
Trento	118,879	158			2							1		1	1		1								6	5
Trieste	200,609	84.5															1								1	1
Turin	858,205	130			4		2	4	1			1	1				1	1	2	1			3		21	11
Tuscany Region	3,668,333	22,993	1		1																				2	2
Vallelunga Prata-meno	3844	39												1											1	1
Venice	256,083	457																	1						1	1
Total			12	8	23	1	5	8	6	4	4	17	4	31	4	2	18	7	17	4	3	1	18	0		
Cities			12	6	16	1	4	3	5	3	4	13	4	19	4	2	14	7	11	4	3	1	10	0		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A16, the sample of Latvia concerns only data about two territories, which can mean that the country's efforts are concentrated in these cities. Riga has only projects in the first and last phase of the smart city concept.

Table A16. Number of smart city initiatives organized by city and category in Latvia.

Latvia	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Jelgava	55,517	60.6				1			2																3	2
Riga	621,120	304		1	1																		1		3	3
Total			0	1	1	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0		
Cities			0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A17, the sample of Lithuania concerns only data about one territory with a single project in a category of the first stage of the smart city concept. This can mean that this topic is still in its early days in Lithuania.

As shown in Table A18, the sample of Luxembourg concerns only data about the capital city, which can mean that the country's efforts are concentrated in this city. Although it does not have any project in the last stage of the concept, this city seems to be following the evolution of the smart ciy concept.

As shown in Table A19, the sample of Malta does not contemplate data about any city, which can mean that the country has still not looked into this subject.

Table A17. Number of smart city initiatives organized by city and category in Lithuania.

Lithuania	Population	Area (Km^2)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Kaunas	298,753	157			1																				1	1
Total			0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Cities			0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

Table A18. Number of smart city initiatives organized by city and category in Luxembourg.

Luxembourg	Population	Area (Km^2)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Luxembourg	124,509	51.46								1				1			2		2						6	4
Total			0	0	0	0	0	0	0	1	0	0	0	1	0	0	2	0	2	0	0	0	0	0		
Cities			0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	1	0	0	0	0	0		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

Table A19. Number of smart city initiatives organized by city and category in Malta.

Malta	Population	Area (Km^2)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
-	-	-																							-	-
Total			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Cities			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A20, the sample of Netherlands concerns data about 12 territories. Amsterdam is the city with the greatest number of projects and categories represented. Nevertheless, there are cities with smaller dimensions also with great smart city representation, such as the example of Eindhoven. A greater focus of this country on the third stage of the concept can also be noticed, since six cities have 15 projects in these categories.

Table A20. Number of smart city initiatives organized by city and category in Netherlands.

Netherlands	Population	Area (Km^2)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Amersfoort	157,462	62.62																					1		1	1
Amsterdam	873,338	165.5	1		1		2	3						1			2	1	1				4	2	18	10
Apeldoorn	164,781	339.9												1											1	1
Delft	103,581	22.65							1																1	1
Den Bosch	155,490	110										1													1	1
Eindhoven	235,691	87.66												1					2				3	1	7	4
Enschede	159,732	140.8							2																2	1
Helmond	92,627	53.18																			1				1	1
Rotterdam	651,631	217.6						1						2										2	5	3
Schiedam	79,297	17.82																					1		1	1

Table A20. *Cont.*

Netherlands	Population	Area (Km^2)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Utrecht	359,370	93.83						1												1			1		3	3
Zaanstad	156,901	73.87												1											1	1
Total			1	0	1	0	2	5	3	0	0	1	0	6	0	0	2	1	3	1	1	0	10	5		
Cities			1	0	1	0	1	3	2	0	0	1	0	5	0	0	1	1	2	1	1	0	5	3		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A21, the sample of Poland concerns data about 19 territories. Warsaw is the city with the greatest number of projects and categories represented. Nevertheless, the number of cities represented in this sample may mean a greater focus of the country on this subject.

Table A21. Number of smart city initiatives organized by city and category in Poland.

Poland	Population	Area (Km^2)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Bialystok	296,958	102.1							1											1					2	2
Bydgoszcz	344,091	176												1						1					2	2
Czestochowa	217,530	159.7																		1					1	1
Gdańsk	470,805	262						1						1											2	2
Katowice	290,553	164.6						1																	1	1
Krakow	779,966	326.9	1		1									2					1						5	4
Małopolska province	3,404,863	15,108									1														1	1
Plock	118,268	88.04															1								1	1
Poznań	532,048	261.9																					1		1	1
Rzeszów	196,638	120.4																	1						1	1
Sandomierz	23,193	28.69						1																	1	1
Silesian Province	4,492,330	12333																					1		1	1
Sosnowiec	197,586	91.06									1														1	1
TriCity	742,432	418.18		1													1								2	2
Warsaw	1,794,166	517.2		1	4	1		1															1		8	5
Wroclaw	641,928	292.8			1																		2		3	2
Zabrze	170,924	80.4	1																						1	1
Zielona Góra	140,892	278.3			1																				1	1
Żuromin	8941	11.02															1								1	1
Total			2	2	7	1	0	4	1	0	2	0	0	4	0	0	3	0	2	3	0	0	5	0		
Cities			2	2	4	1	0	4	1	0	2	0	0	3	0	0	3	0	2	3	0	0	4	0		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A22, the sample of Portugal concerns data about 17 territories. Porto and Lisbon are the cities with the greatest number of projects and categories represented. The number of cities represented in this sample of the small country of Portugal may represent a greater focus of the country on this subject.

Table A22. Number of smart city initiatives organized by city and category in Portugal.

Portugal	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Águeda	46,134	335.3			3															1					4	2
Algarve	467,495	4996															1								1	1
Aveiro	80,880	197.5		1	1				1		1														4	4
Braga	193,333	183.4							1								1								2	2
Bragança	34,580	1174										1		1											2	2
Cascais	214,134	97.4					1																		1	1
Castelo Branco	52,272	1438		2																					2	1
Cávado	438,466	1246									1														1	1
Coimbra	140,796	319.4												1											1	1
Covilhã	46,453	555.6			1																1				2	2
Evora	53,568	1307												4									1		5	2
Lagoa	23,718	88.3		1																					1	1
Lisbon	544,851	84.9			1			1				2		1	1		1	2					3		12	8
Madeira	251,060	313.4										1													1	1
Paredes	84,414	156.8	1																				1		2	2
Porto	231,962	41.3		1	1				4	2		2		1			1							1	13	8
Viana do Castelo	85,864	318.6			1																				1	1
Total			1	5	8	0	1	1	6	2	2	6	0	8	1	0	4	2	0	1	1	0	5	1		
Cities			1	4	6	0	1	1	3	1	2	4	0	5	1	0	4	1	0	1	1	0	3	1		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A23, the sample of Romania concerns data about seven territories. Nevertheless, the dispersion of projects and the number of cities represented in this sample may mean a great focus of the country on this subject.

Table A23. Number of smart city initiatives organized by city and category in Romania.

Romania	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Alba Iulia	60,400	104											1					1							2	2
Brasov	246,200	267										1			1										2	2
Bucharest	1,819,419	238	1	1										1											3	3
Cluj	324,700	180																		1			1		2	2
Galati	227,800	246																1							1	1
Iasi	303,000	101												2											2	1
Oradea	187,000	116								1													1		2	2
Total			1	1	0	0	0	0	0	1	0	1	1	3	1	0	0	2	0	1	0	0	2	0		
Cities			1	1	0	0	0	0	0	1	0	1	1	2	1	0	0	2	0	1	0	0	2	0		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A24, the sample of Slovakia concerns data about eight territories. Bratislava is the city with the greatest number of projects and categories represented. Nevertheless, there are cities with smaller dimensions also with great smart city representation, such as the example of Zilina. A greater focus of the country on the third stage of the concept is also noticeable, since three cities have projects in these categories.

Table A24. Number of smart city initiatives organized by city and category in Slovakia.

Slovakia	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Banská Bystrica	76,018	103						1																	1	1
Bratislava	475,503	368		1	3							1											1		6	4
Komárno	32,967	103										1													1	1
Košice	229,040	244																	1						1	1
Lučenec	25,902	47.8	1									1													2	2
Poprad	49,855	63.1																					1		1	1
Trenčín	54,740	82															1								1	1
Žilina	82,656	80			2	1														1			1		5	4
Total			1	1	5	1	0	1	0	0	0	3	0	0	0	0	1	0	1	1	0	0	3	0		
Cities			1	1	2	1	0	1	0	0	0	3	0	0	0	0	1	0	1	1	0	0	3	0		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A25, the sample of Slovenia concerns only data about two territories, and one of them only counts with a single project, which can mean that the country's efforts are only in the capital city. Ljubljana seems to be following the evolution of the smart city concept.

Table A25. Number of smart city initiatives organized by city and category in Slovenia.

Slovenia	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Ljubljana	294,464	275			1															1				1	3	3
Logatec	14,681	173		1																					1	1
Total			0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1		
Cities			0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A26, the sample of Spain concerns data about 38 territories. Barcelona and Madrid are the expected cities with the greatest number of projects and categories represented. However, there are smaller cities with great representation, as in the case of Malaga. The number of smart city projects and cities represented in this sample unveil the focus and efforts of the country on the development of this subject.

Table A26. Number of smart city initiatives organized by city and category in Spain.

Spain	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Alicante	337,304	201									1						1						1		3	3
Ávila	57,949	231										1		1											2	2
Barcelona	1,636,732	99.1			3	1	4	7	1		1	1	1	4					1				3	2	29	12
Béjar	13,403	45.74																	1						1	1
Betanzos	13,328	24.3																1							1	1
Bilbao	346,405	41.4			1			1		1				1									1		5	5
Cartagena	216,365	558	1							1															2	2
Castelló de la Plana	172,589	111			1																				1	1

Table A26. *Cont.*

Spain	Population	Area (Km^2)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Coruña	245,468	37.8	1	1																					2	2
Donostia-San Sebastián	187,415	60.89										1													1	1
Elda	52,551	45.8															1								1	1
Galicia	2,695,645	29,574	1		1														2						4	3
Girona	101,932	39												1			1								2	2
Gran Canaria Island	865,756	1560		1																					1	1
Granada	231,775	81.1																	1			1			2	2
Guadalajara	87,064	235																					1		1	1
Huelva	142,538	152	1								1														2	2
Huesca	53,429	161																					1		1	1
Jaén	111,932	424	1										1		1										3	3
Llíria	22,796	228	1																						1	1
Madrid	3,305,408	606	4	1	6			1	2		1	1		1			1			1			3		22	11
Malaga	577,405	395	2	1	2	2			1	2		1		4									1		16	9
Murcia	460,349	886	1						1														1		3	3
Navarre	661,537	10,390							1																1	1
Oviedo	217,552	187												2											2	1
Pamplona	203,081	25.1		1	1																1				3	3
Rois	106,084	52.9															1								1	1
San Sebastián	188,102	60.9	1																				1		2	2
Sant Cugat del Vallès	94,012	48.2					1																		1	1
Santander	172,221	36.1	1	3	2	2	1	1	2								1						2		15	9
Santiago de Compostela	97,858	220		1										1											2	2
Seville	684,234	141				1																			1	1
Soria	39,398	271.8												1											1	1
Tarragona	135,436	58.8										1													1	1
Valencia	789,744	139		2							2	3											1		8	4
Valladolid	297,775	197		1			2	2						1					1						7	5
Vitoria-Gasteiz	253,093	277	1														1		2				1		5	4
Zaragoza	675,301	974				1			1								1		1						4	4
Total			16	12	17	7	8	12	9	4	6	9	2	17	1	0	8	1	9	1	1	1	17	2		
Cities			12	9	8	5	4	5	7	3	5	7	2	10	1	0	8	1	7	1	1	1	12	1		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

As shown in Table A27, the sample of Sweden concerns data about 11 territories. Stockholm is the city with the greatest number of projects and categories. However, it does not count any project in the last stage of the concept. On the other hand, there are smaller cities with representation in that phase.

Table A27. Number of smart city initiatives organized by city and category in Sweden.

Sweden	Population	Area (Km^2)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Eskilstuna	106,975	1100												1											1	1
Gothenburg	583,056	448			1		1							2											4	3
Karlshamn	32,402	489																	1						1	1
Linköping	164,616	1428																					1		1	1
Luleå	78,549	2094																					1		1	1

Table A27. *Cont.*

Sweden	Population	Area (Km²)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	Total	Categories
Malmö	347,949	157	2											3											5	2
Örebro	156,381	1373	1																						1	1
Skellefteå	72,840	6801		2										1											3	2
Stockholm	975,551	187						1		1				2	2		2		1						9	6
Uppsala	233,389	2182	1																1						2	2
Växjö	94,859	1665						1										1							2	2
Total			4	2	1	0	1	2	0	1	0	0	0	9	2	0	2	1	3	0	0	0	2	0		
Cities			3	1	1	0	1	2	0	1	0	0	0	5	1	0	1	1	3	0	0	0	2	0		

Legend: (A)—environment and air quality; (B)—infrastructure and communication networks; (C)—mobility and transportation; (D)—parking; (E)—smart city foundations; (F)—strategy and governance; (G)—traffic; (H)—waste; (I)—water and irrigation; (J)—culture, tourism, and heritage; (K)—education; (L)—energy and lighting; (M)—health and wellbeing; (N)—sport; (O)—urban planning; (P)—buildings and housing; (Q)—digitization and interoperability; (R)—economy and industry; (S)—logistics; (T)—rural and agriculture; (U)—community, participation and inclusion; (V)—privacy, security, and safety.

Appendix B

Table A28. Full ranking.

N	City	Country	Projects	Density (People/km²)	Class	Factor 1	Factor 2	Factor 3	Factor 4	Ranking
1	Dublin	Ireland	22	4756.038	5	869	1000	979	1000	**907**
2	Vienna	Austria	22	4633.259	5	898	976	1000	938	**889**
3	Turin	Italy	21	6601.577	6	790	855	837	755	**742**
4	Madrid	Spain	22	5454.469	6	945	906	792	713	**726**
5	Barcelona	Spain	29	16515.96	9	872	713	738	872	**723**
6	Aarhus	Denmark	14	752.2947	3	779	923	837	638	**714**
7	Milan	Italy	21	7679.753	7	691	741	794	655	**668**
8	Amsterdam	Netherlands	18	5276.967	6	635	640	653	840	**662**
9	Trikala	Greece	8	133.8957	1	679	698	734	709	**656**
10	Cagliari	Italy	14	1115.478	4	594	970	649	619	**646**
11	Oulu	Finland	8	69.78357	1	750	584	521	907	**631**
12	Helsinki	Finland	14	3065.422	5	539	635	733	607	**604**
13	Antwerp	Belgium	9	246.5116	1	1000	779	617	584	**597**
14	Malaga	Spain	16	1461.785	4	944	831	605	501	**572**
15	Santander	Spain	15	4770.665	5	815	523	443	577	**480**
16	Thessaloniki	Greece	6	1.031682	1	559	503	460	574	**473**
17	Hamburg	Germany	11	2453.288	4	590	485	438	578	**464**
18	Lisbon	Portugal	12	6417.562	6	382	606	505	336	**421**
19	Graz	Austria	9	2283.404	4	415	589	526	283	**407**
20	Evora	Portugal	5	40.98546	1	409	550	504	305	**399**
21	Porto	Portugal	13	5616.513	6	536	490	344	453	**388**
22	L'Aquila	Italy	6	147.5829	1	586	635	428	259	**378**
23	Brno	Czech Republic	9	1661.186	4	513	433	388	390	**369**
24	Tampere	Finland	5	459.1522	2	262	283	355	502	**361**
25	Flanders Region	Belgium	6	483.5963	2	405	430	462	299	**360**
26	Galicia	Spain	4	91.14915	1	334	388	433	285	**335**
27	Eindhoven	Netherlands	7	2688.695	5	238	296	306	418	**316**
28	Berlin	Germany	8	4111.871	5	359	352	391	285	**314**
29	Florence	Italy	8	3527.01	5	359	330	356	316	**308**
30	Águeda	Portugal	4	137.5902	1	353	443	405	188	**302**
31	Stockholm	Sweden	9	5216.85	6	275	470	412	161	**298**
32	Bologna	Italy	8	2797.61	5	337	421	351	242	**297**
33	Catania	Italy	6	1625.956	4	262	322	348	299	**295**
34	Vitoria-Gasteiz	Spain	5	913.6931	3	253	328	347	294	**294**
35	Trento	Italy	6	752.3987	3	310	513	388	140	**291**
36	Lyon	France	10	10,917.93	8	335	284	266	370	**286**
37	Valladolid	Spain	7	1511.548	4	399	266	308	326	**284**
38	Luxembourg	Luxembourg	6	2419.53	4	247	383	368	191	**275**
39	Prague	Czech Republic	7	2691.702	5	253	409	356	159	**265**
40	Warsaw	Poland	8	3468.998	5	413	355	283	247	**265**

Table A28. *Cont.*

N	City	Country	Projects	Density (People/km^2)	Class	Factor 1	Factor 2	Factor 3	Factor 4	Ranking
41	Bari	Italy	8	2715.517	5	368	413	329	166	**262**
42	Copenhagen	Denmark	8	7230.788	6	312	288	367	185	**257**
43	Savona	Italy	5	899.9847	3	273	379	361	139	**255**
44	Munich	Germany	6	4777.039	5	227	299	312	210	**246**
45	Nicosia	Cyprus	6	2739.741	5	192	160	286	311	**245**
46	Brussels	Belgium	4	755.886	3	156	247	321	229	**244**
47	Bratislava	Slovakia	6	1292.128	4	337	376	248	198	**237**
48	Pavia	Italy	5	1130.715	4	246	295	232	264	**236**
49	Heraklion	Greece	5	711.3369	3	328	267	247	250	**234**
50	Rome	Italy	5	1837.02	4	237	315	260	219	**234**
51	Tallinn	Estonia	5	2749.944	5	151	249	331	189	**233**
52	Budapest	Hungary	6	3337.052	5	243	215	182	348	**233**
53	Tartu	Estonia	4	619.6753	3	167	302	336	127	**224**
54	Krakow	Poland	5	2385.947	4	249	297	291	165	**223**
55	Espoo	Finland	4	928.5943	3	186	300	271	188	**223**
56	Piedmont	Italy	3	168.2432	1	307	319	251	168	**216**
57	Malmö	Sweden	5	2216.236	4	272	289	256	168	**211**
58	Rotterdam	Netherlands	5	2994.628	5	161	155	170	317	**204**
59	Valencia	Spain	8	5681.612	6	363	305	229	151	**202**
60	Žilina	Slovakia	5	1033.2	4	269	242	221	187	**196**
61	Aveiro	Portugal	4	409.519	2	343	197	241	159	**187**
62	Brescia	Italy	4	2151.069	4	123	298	276	86	**187**
63	Zaragoza	Spain	4	693.3275	3	239	177	214	205	**187**
64	Wallonia Region	Belgium	2	216.5879	1	123	256	229	119	**174**
65	Erfurt	Germany	3	791.7451	3	106	152	279	116	**170**
66	Basilicata	Italy	2	54.80174	1	122	117	234	176	**169**
67	Zlín	Czech Republic	2	71.61346	1	167	154	137	248	**169**
68	Campania Region	Italy	3	417.7829	2	229	266	174	138	**166**
69	Cologne	Germany	4	2680.158	5	145	149	195	186	**165**
70	Uppsala	Sweden	2	106.961	1	174	174	197	164	**164**
71	Jaén	Spain	3	263.9906	2	168	307	219	68	**164**
72	Gothenburg	Sweden	4	1301.464	4	215	213	207	127	**163**
73	Covilhã	Portugal	2	83.60871	1	127	172	256	108	**163**
74	Sønderborg	Denmark	2	148.673	1	142	241	221	101	**163**
75	Skellefteå	Sweden	3	10.71019	1	349	258	174	115	**160**
76	Växjö	Sweden	2	56.97237	1	122	175	229	119	**159**
77	Murcia	Spain	3	519.5813	3	194	141	122	232	**156**
78	Vaasa	Finland	2	185.2235	1	184	179	164	152	**150**
79	Aalborg	Denmark	3	191.8593	1	323	227	199	78	**149**
80	Wroclaw	Poland	3	2192.377	4	142	172	127	182	**145**
81	Mons	Belgium	3	651.0544	3	189	235	186	84	**144**
82	Usti nad Labem	Czech Republic	3	978.5319	3	190	172	112	187	**143**
83	Bilbao	Spain	5	8367.271	7	177	198	146	138	**142**
84	Tuscany Region	Italy	2	159.5413	1	210	199	154	126	**142**
85	Genoa	Italy	4	2338.619	4	206	231	163	100	**142**
86	Vaihingen	Germany	2	393.693	2	72	164	233	71	**139**
87	Ljubljana	Slovenia	3	1070.778	4	109	122	135	185	**138**
88	Nice	France	3	4765.911	5	75	96	147	190	**138**
89	Bragança	Portugal	2	29.45486	1	169	249	155	88	**137**
90	Ávila	Spain	2	250.8615	1	169	249	155	88	**137**
91	Calabria Region	Italy	2	124.5178	1	131	73	278	61	**136**
92	Paris	France	5	20428.52	9	125	153	171	123	**136**
93	Ruhr Valley	Germany	3	2408.294	4	153	166	165	117	**135**
94	Dubrovnik	Croatia	2	289.3819	2	138	138	156	131	**131**
95	Bolzano	Italy	3	2060.421	4	138	193	182	72	**129**
96	Alicante	Spain	3	1678.129	4	135	136	168	110	**127**
97	Lecce	Italy	2	394.958	2	75	193	200	47	**125**
98	Utrecht	Netherlands	3	3830.012	5	114	119	126	156	**124**
99	Ghent	Belgium	3	1690.404	4	179	85	99	189	**122**
100	Palermo	Italy	4	4011.855	5	189	184	164	62	**120**
101	Naples	Italy	4	7881.145	7	129	197	143	76	**118**
102	Cosenza	Italy	3	1752.608	4	162	188	123	98	**118**
103	Limassol	Cyprus	3	2878.313	5	132	162	124	111	**117**

Table A28. *Cont.*

N	City	Country	Projects	Density (People/km^2)	Class	Factor 1	Factor 2	Factor 3	Factor 4	Ranking
104	Riga	Latvia	3	2043.158	4	173	160	108	124	**116**
105	Jelgava	Latvia	3	916.1221	3	223	54	81	195	**113**
106	Sofia	Bulgaria	2	945.1446	3	114	114	129	109	**108**
107	Pisa	Italy	2	481.1176	2	72	240	94	75	**107**
108	Syracuse	Italy	2	573.7892	3	126	115	82	148	**106**
109	Paredes	Portugal	2	538.3546	3	126	115	82	148	**106**
110	Kavala	Greece	2	2006.86	4	76	103	112	124	**104**
111	Alba Iulia	Romania	2	580.7692	3	59	174	165	21	**100**
112	Nancy	France	3	7003.867	6	108	102	119	97	**98**
113	Bonn	Germany	2	2342.87	4	68	145	128	68	**98**
114	Cluj	Romania	2	1803.889	4	78	100	103	115	**97**
115	Terni	Italy	2	509.3491	3	129	128	110	84	**96**
116	Patras	Greece	2	638.9489	3	141	78	76	140	**94**
117	Santiago de Compostela	Spain	2	444.8091	2	169	146	109	63	**93**
118	Hämeenlinna	Finland	1	38.01008	1	56	90	132	80	**93**
119	South Tyrol	Italy	1	79.25773	1	56	90	132	80	**93**
120	Karlshamn	Sweden	1	66.26176	1	56	90	132	80	**93**
121	Moravia Silesian	Czech Republic	1	219.7962	1	56	90	132	80	**93**
122	Leipzig	Germany	2	1997.985	4	84	106	103	97	**93**
123	Ludwigsburg	Germany	2	2156.313	4	79	136	123	58	**91**
124	Padova	Italy	3	2260.022	4	197	145	96	65	**90**
125	Braga	Portugal	2	1054.16	4	89	92	94	106	**90**
126	Region of North Jutland	Denmark	1	74.42821	1	30	53	159	66	**89**
127	Montieri	Italy	1	10.96118	1	74	90	62	138	**89**
128	Korydallos	Greece	1	14.68634	1	74	90	62	138	**89**
129	Region of Häme	Finland	1	32.80958	1	74	90	62	138	**89**
130	Linköping	Sweden	1	115.2773	1	74	90	62	138	**89**
131	Samos Island	Greece	1	69.07625	1	74	90	62	138	**89**
132	Island of Kos	Greece	1	116.2535	1	74	90	62	138	**89**
133	Luleå	Sweden	1	37.51146	1	74	90	62	138	**89**
134	Limerick	Ireland	2	1591.081	4	66	157	116	47	**89**
135	Bydgoszcz	Poland	2	1955.063	4	80	112	126	60	**89**
136	Messina	Italy	2	1063.896	4	52	136	141	33	**88**
137	Lesvos	Greece	1	52.9308	1	31	8	22	220	**87**
138	Lučenec	Slovakia	2	541.8828	3	134	144	71	87	**86**
139	Elefsina	Greece	2	817.2178	3	154	72	75	120	**86**
140	Gdańsk	Poland	2	1796.966	4	95	98	99	87	**86**
141	Cartagena	Spain	2	387.7509	2	172	155	70	78	**86**
142	Granada	Spain	2	2857.891	5	30	57	158	55	**86**
143	Lohja	Finland	1	48.86168	1	59	126	111	59	**85**
144	Karlovy Vary	Czech Republic	1	88.47994	1	59	126	111	59	**85**
145	Mykonos	Greece	1	96.3308	1	59	126	111	59	**85**
146	Iglesias	Italy	1	140.053	1	59	126	111	59	**85**
147	Matera	Italy	1	154.6392	1	59	126	111	59	**85**
148	Tuusula	Finland	1	176.6879	1	59	126	111	59	**85**
149	Wüstenrot	Germany	1	220.2865	1	59	126	111	59	**85**
150	Algarve	Portugal	1	93.57386	1	59	126	111	59	**85**
151	Oviedo	Spain	2	1163.38	4	90	127	119	48	**85**
152	Castelo Branco	Portugal	2	36.35049	1	265	142	64	73	**82**
153	Brasov	Romania	2	922.0974	3	81	189	107	16	**82**
154	Enschede	Netherlands	2	1134.46	4	111	40	60	143	**82**
155	Pamplona	Spain	3	8090.876	7	101	96	112	58	**80**
156	Emilia-Romagna Region	Italy	1	198.0112	1	60	84	116	63	**80**
157	Girona	Spain	2	2613.641	5	68	118	107	51	**80**
158	Brandenburg	Germany	1	85.35344	1	3	24	183	31	**79**
159	Miskolc	Hungary	1	158.8415	1	29	111	154	9	**79**
160	San Sebastián	Spain	2	3088.703	5	93	85	60	111	**79**
161	Stuttgart	Germany	2	3067.588	5	93	85	60	111	**79**
162	Bialystok	Poland	2	2908.501	5	78	59	84	94	**76**
163	Huelva	Spain	2	937.75	3	140	65	115	53	**75**
164	Jeseník	Czech Republic	1	52.44645	1	78	110	103	42	**74**
165	Sisak	Croatia	1	95.90692	1	78	110	103	42	**74**

Table A28. *Cont.*

N	City	Country	Projects	Density (People/km^2)	Class	Factor 1	Factor 2	Factor 3	Factor 4	Ranking
166	Lorraine Region	France	1	0.010037	1	78	110	103	42	**74**
167	Altavilla Silentina	Italy	1	129.3077	1	78	110	103	42	**74**
168	Sveti Križ Začretje	Croatia	1	140.099	1	78	110	103	42	**74**
169	Leuze	Belgium	1	188.8481	1	78	110	103	42	**74**
170	Vallelunga Pratameno	Italy	1	98.5641	1	78	110	103	42	**74**
171	Eskilstuna	Sweden	1	97.25	1	78	110	103	42	**74**
172	Soria	Spain	1	144.9522	1	78	110	103	42	**74**
173	Iasi	Romania	2	3000	5	78	110	103	42	**74**
174	Ruse	Bulgaria	1	271.2394	2	44	71	104	64	**73**
175	Béjar	Spain	1	293.0258	2	44	71	104	64	**73**
176	Bucharest	Romania	3	7644.618	7	129	105	77	65	**73**
177	Oradea	Romania	2	1612.069	4	100	115	50	87	**73**
178	TriCity	Poland	2	1775.389	4	108	112	80	55	**72**
179	Navarre	Spain	1	63.67055	1	96	34	52	125	**71**
180	Athens	Greece	3	17044.3	9	85	113	71	63	**71**
181	Baden-Württemberg	Germany	1	310.592	2	22	41	126	53	**71**
182	Huesca	Spain	1	331.8571	2	58	71	48	110	**71**
183	Koprivnica	Croatia	1	313.2896	2	58	71	48	110	**71**
184	Lombardy Region	Italy	1	418.0084	2	58	71	48	110	**71**
185	Guadalajara	Spain	1	370.4851	2	58	71	48	110	**71**
186	Silesian Province	Poland	1	364.2528	2	58	71	48	110	**71**
187	Apulia Region	Italy	1	202.8059	1	92	115	89	42	**70**
188	Glurns/Glorenza	Italy	1	68.30769	1	56	148	91	23	**69**
189	Lille	France	3	6737.787	6	143	90	104	33	**69**
190	Igoumenitsa	Greece	1	60.25677	1	112	80	58	84	**68**
191	Örebro	Sweden	1	113.8973	1	112	80	58	84	**68**
192	Llíria	Spain	1	99.98246	1	112	80	58	84	**68**
193	Herrenberg	Germany	1	478.8464	2	46	100	87	47	**67**
194	Dortmund	Germany	2	2093.68	4	119	103	76	45	**65**
195	Liguria	Italy	1	278.6646	2	47	67	91	50	**63**
196	Košice	Slovakia	1	938.6885	3	36	58	86	53	**61**
197	Venice	Italy	1	560.3567	3	36	58	86	53	**61**
198	Sulcis Iglesiente-Guspinese	Italy	1	64.39143	1	86	134	44	46	**60**
199	Sutri	Italy	1	83.07313	1	86	134	44	46	**60**
200	Coimbra	Portugal	1	440.814	2	61	87	81	33	**58**
201	Lazio	Italy	1	332.5464	2	61	87	81	33	**58**
202	Cesena	Italy	1	390.5783	2	61	87	81	33	**58**
203	Cuneo	Italy	1	466.5	2	61	87	81	33	**58**
204	Villach	Austria	1	468.762	2	61	87	81	33	**58**
205	Apeldoorn	Netherlands	1	484.7926	2	61	87	81	33	**58**
206	Knokke-Heist	Belgium	1	586.6312	3	48	59	39	92	**58**
207	Namur	Belgium	2	635.2273	3	48	59	39	92	**58**
208	Poprad	Slovakia	1	790.0951	3	48	59	39	92	**58**
209	Rovereto	Italy	1	663.5	3	48	59	39	92	**58**
210	Salerno	Italy	2	2182.534	4	124	116	42	47	**57**
211	Karlsruhe	Germany	2	1787.774	4	124	116	42	47	**57**
212	Frankfurt	Germany	2	3077.342	5	64	82	112	0	**57**
213	Żuromin	Poland	1	811.343	3	37	82	71	40	**56**
214	Trenčín	Slovakia	1	667.561	3	37	82	71	40	**56**
215	Siena	Italy	1	455.4202	2	72	91	70	33	**56**
216	Volos	Greece	1	374.6084	2	72	91	70	33	**56**
217	Viana do Castelo	Portugal	1	269.5041	2	72	91	70	33	**56**
218	Rende	Italy	1	639.0926	3	38	55	75	42	**52**
219	Taranto	Italy	1	615.2161	3	0	14	119	21	**52**
220	Gioia Tauro	Italy	1	525.5263	3	18	73	100	6	**51**
221	Galati	Romania	1	926.0163	3	18	73	100	6	**51**
222	Betanzos	Spain	1	548.4774	3	18	73	100	6	**51**
223	Rzeszów	Poland	1	1633.206	4	30	49	72	46	**51**
224	Lübeck	Germany	1	1008.403	4	30	49	72	46	**51**
225	Freiburg	Germany	1	1509.412	4	30	49	72	46	**51**
226	Merano	Italy	1	1520.387	4	30	49	72	46	**51**
227	Heilbronn	Germany	1	1265.846	4	14	28	88	38	**50**
228	Helmond	Netherlands	1	1741.764	4	14	28	88	38	**50**

Table A28. *Cont.*

N	City	Country	Projects	Density (People/km^2)	Class	Factor 1	Factor 2	Factor 3	Factor 4	Ranking
229	Sandomierz	Poland	1	808.4001	3	56	38	43	74	**49**
230	Karvina	Czech Republic	1	885.2522	3	56	38	43	74	**49**
231	Banská Bystrica	Slovakia	1	738.0388	3	56	38	43	74	**49**
232	Cork City	Ireland	1	1122.951	4	40	50	32	79	**49**
233	La Louvière	Belgium	1	1260.81	4	40	50	32	79	**49**
234	Ennis	Ireland	1	1286.31	4	40	50	32	79	**49**
235	Darmstadt	Germany	1	1303.636	4	40	50	32	79	**49**
236	Poznań	Poland	1	2031.493	4	40	50	32	79	**49**
237	Rijeka	Croatia	1	2314.815	4	40	50	32	79	**49**
238	Ostrava	Czech Republic	1	1331.692	4	15	3	9	126	**48**
239	Coruña	Spain	2	6493.862	6	107	66	37	54	**47**
240	Elda	Spain	1	1147.402	4	31	70	60	34	**47**
241	Trieste	Italy	1	2374.071	4	31	70	60	34	**47**
242	Plock	Poland	1	1343.344	4	31	70	60	34	**47**
243	Rois	Spain	1	2005.369	4	31	70	60	34	**47**
244	Komárno	Slovakia	1	320.068	2	67	106	34	37	**47**
245	Grenoble	France	2	8839.779	7	62	71	71	18	**47**
246	Odense	Denmark	1	675.35	3	62	21	32	84	**46**
247	Lovosice	Czech Republic	1	746.2574	3	59	75	57	28	**46**
248	Zielona Góra	Poland	1	506.2594	3	59	75	57	28	**46**
249	Parma	Italy	1	750.9119	3	59	75	57	28	**46**
250	Zdarna	Czech Republic	1	77.22008	1	96	15	112	0	**45**
251	Skiathos	Greece	1	122.004	1	96	15	112	0	**45**
252	Małopolska province	Poland	1	225.3682	1	96	15	112	0	**45**
253	Rennes	France	1	4374.762	5	25	42	62	40	**45**
254	Nantes	France	1	4889.693	5	25	42	62	40	**45**
255	Czestochowa	Poland	1	1362.116	4	32	46	63	36	**44**
256	Prato	Italy	2	2063.627	4	131	103	31	29	**44**
257	Szeged	Hungary	1	572.121	3	73	52	36	56	**44**
258	Settimo Torinese	Italy	1	1421.719	4	14	62	85	5	**44**
259	Seraing	Belgium	1	1806.997	4	14	62	85	5	**44**
260	Havířov	Czech Republic	1	2185.826	4	14	62	85	5	**44**
261	Essen	Germany	1	2769.448	5	34	43	27	69	**43**
262	Schiedam	Netherlands	1	4449.888	5	34	43	27	69	**43**
263	Amersfoort	Netherlands	1	2514.564	5	34	43	27	69	**43**
264	Uherske Hradiste	Czech Republic	1	1173.756	4	47	32	36	63	**42**
265	Katowice	Poland	1	1765.207	4	47	32	36	63	**42**
266	Nuremberg	Germany	1	2780.955	5	26	61	52	30	**41**
267	Bergamo	Italy	1	3084.639	5	26	61	52	30	**41**
268	Saint-Nazaire	France	1	1495.897	4	42	61	56	24	**41**
269	Bagheria	Italy	1	1789.529	4	42	61	56	24	**41**
270	Linz	Austria	1	2151.651	4	42	61	56	24	**41**
271	Salzburg	Austria	1	2367.342	4	42	61	56	24	**41**
272	Zaanstad	Netherlands	1	2124.015	4	42	61	56	24	**41**
273	Osijek	Croatia	1	57.14286	1	130	69	28	36	**39**
274	Bol	Croatia	1	73.65217	1	130	69	28	36	**39**
275	Logatec	Slovenia	1	84.86127	1	130	69	28	36	**39**
276	Modena	Italy	1	1021.614	4	52	18	26	72	**39**
277	Augsburg	Germany	1	2015.191	4	52	18	26	72	**39**
278	Kaunas	Lithuania	1	1902.885	4	50	64	48	24	**39**
279	Split	Croatia	1	2026.533	4	50	64	48	24	**39**
280	Castelló de la Plana	Spain	1	1554.856	4	50	64	48	24	**39**
281	Madeira	Portugal	1	801.0849	3	55	88	27	31	**39**
282	Madonna di Campiglio	Italy	1	958.9041	3	55	88	27	31	**39**
283	Pescara	Italy	1	3534.702	5	12	53	73	5	**38**
284	Hannover	Germany	1	2628.12	5	12	53	73	5	**38**
285	Zabrze	Poland	1	2125.92	4	61	44	30	48	**37**
286	Cávado	Portugal	1	351.8989	2	75	11	88	0	**35**
287	Delft	Netherlands	1	4573.113	5	45	15	22	63	**34**
288	Marseille	France	1	3612.992	5	45	15	22	63	**34**
289	Düsseldorf	Germany	1	2854.292	5	25	71	42	11	**33**
290	Varna	Bulgaria	1	1572.327	4	46	74	22	26	**33**

Table A28. *Cont.*

N	City	Country	Projects	Density (People/km^2)	Class	Factor 1	Factor 2	Factor 3	Factor 4	Ranking
291	Den Bosch	Netherlands	1	1413.545	4	46	74	22	26	**33**
292	Tarragona	Spain	1	2303.333	4	46	74	22	26	**33**
293	Cascais	Portugal	1	2198.501	4	63	13	26	55	**33**
294	Sant Cugat del Vallès	Spain	1	1950.456	4	63	13	26	55	**33**
295	Liege	Belgium	1	2828.473	5	53	38	25	42	**32**
296	Mainau-Lake Constance	Germany	1	412.9464	2	102	54	21	29	**31**
297	Lagoa	Portugal	1	268.607	2	102	54	21	29	**31**
298	Donostia-San Sebastián	Spain	1	3077.927	5	40	65	19	23	**28**
299	Gran Canaria Island	Spain	1	554.9718	3	84	44	16	24	**25**
300	Innsbruck	Austria	1	1249.371	4	52	7	61	0	**24**
301	Sosnowiec	Poland	1	2169.844	4	52	7	61	0	**24**
302	Bay of Pozzuoli	Italy	1	1825.694	4	52	7	61	0	**24**
303	Leuven	Belgium	1	1785.018	4	71	37	13	21	**21**
304	Regensburg	Germany	1	1893.322	4	54	61	10	8	**20**
305	Bresso	Italy	1	7776.627	7	35	3	40	0	**16**
306	Mainz	Germany	1	2236.55	4	73	1	1	24	**11**
307	Seville	Spain	1	4852.723	5	64	0	0	21	**9**

Note: Data of Population Density was collected from Eurostat—The Statistical Office of the European Union.

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