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Giffinger, Rudolf; Fertner, Christian; Kramar, Hans; Kalasek, Robert; Pichler-Milanovic, Nataša; Meijers, Evert

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Smart cities
Ranking of European medium-sized cities

Centre of Regional Science (SRF)
Vienna University of Technology

Department of Geography
University of Ljubljana

Research Institute for Housing, Urban and Mobility Studies (OTB)
Delft University of Technology

Final report, October 2007

General notes

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Contact:
Rudolf Giffinger
giffinger@srf.tuwien.ac.at
www.srf.tuwien.ac.at

Project team

The research was carried out in collaborative work of persons from the Centre of Regional Science at the Vienna University of Technology (lead partner), the Department of Geography at University of Ljubljana and the OTB Research Institute for Housing, Urban and Mobility Studies at the Delft University of Technology.

Rudolf Giffinger, Vienna UT
Christian Fertner, Vienna UT
Hans Kramar, Vienna UT
Robert Kalasek, Vienna UT
Nataša Pichler-Milanović, University of Ljubljana
Evert Meijers, Delft UT

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Project homepage

www.smart-cities.eu

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1 Background

1.1 Aim of the project

Globalization, with trade liberalization measures and fast technological changes altering the relations of production, distribution and consumption, has very substantial effects on city development. As one important consequence, (network-) economies evolved ”[…] with easier physical movement, globalized players making decisions with no regard to national boundaries”(Thornley, 2000). Along with this progress private firms of the service sector but even of the production sector are increasingly footless and flexible in their location behaviour. Besides the technological changes it is the European integration process, which reduces the differences in economic, social and environmental standards and norms and, thus, provides a common market. The ongoing reduction of differences and barriers between nations also makes cities more similar in their preconditions. Thus, only a few out of many location-based characteristics gain importance for global actors (Begg, 1999; Parkinson et al., 2003) enforcing competition across cites by altering each city as potential competitor to improve its location profile. Cities in Europe face the challenge of combining competitiveness and sustainable urban development simultaneously. This challenge is likely to have an impact on issues of Urban Quality such as housing, economy, culture, social and environmental conditions changing a city's profile and urban quality in its composition of factors and characteristics.

This project deals with medium-sized cities and their perspectives for development. Even though the vast majority of the urban population lives in such cities, the main focus of urban research tends to be on the ‘global’ metropolises. As a result, the challenges of medium-sized cities, which can be rather different, remain unexplored to a certain degree. Medium-sized cities, which have to cope with competition of the larger metropolises on corresponding issues, appear to be less well equipped in terms of critical mass, resources and organizing capacity. To enforce an endogenous development and achieve a good position, even these cities have to aim on identifying their strengths and chances for positioning and ensure and extend comparative advantages in certain key resources against other cities of the same level. City rankings are a tool to identify these assets. Although they are quite common in recent time, rankings are very different in their approaches or methods. Due to different interests behind rankings and the indicators and methodological approaches used it is also normal that one city is ranked very different in different rankings. Additionally, medium-sized cities are often not or only partially considered.

Hence, existing rankings and benchmarks are not satisfying for medium-sized cities. The smart cities ranking, based on a comprehensive catalogue of indicators, offers a new view on medium-sized cities in Europe and their respective differences and comparative (dis-)advantages towards each other and allows to

- illustrate differences in the respective characteristics and factors,
- elaborate specific perspectives for development and positioning and
- identify strenghts and weaknesses for the considered cities in a comparative way.

Finally, we will show that the aproach allows an in-depth analysis for every city based on the comprehensive description of characteristics and the large number of indicators.

1.2 The role of city-rankings in regional competition

City-rankings have become a central instrument for assessing the attractiveness of urban regions over the last 20 years. In these kinds of comparative studies cities are evaluated and ranked with regard to different economic, social and geographical characteristics in order to reveal the best (and the worst) places for certain activities. Consequently city-rankings are often used by the cities themselves to sharpen their profile and to improve their position in the competition of cities: a top-rank in a highly reputed city ranking helps to improve the international image of a city and can therefore play a central role in its marketing strategy.

Examining and comparing different city-rankings in Germany, Schönert (2003) found out that they are targeted on different goals and that they significantly differ in methods and results. According to the chosen indicators and their weights many cities showed rather different ratings in the city-rankings considered. Furthermore there is no evidence that the evaluations are reflected in actual economic performance. Based on a detailed analysis and comparison of 10 German rankings[1] Schönert points out the following assets of city-rankings:

- City-rankings draw public attention to major issues of regional science
- City-rankings stimulate a broad discussion on regional development strategies
- Regional actors are forced to make their decisions transparent and comprehensible
- Positive changes are also registered outside the region
- The results in detail may initiate learning effects of local actors

On the other hand he considers some handicaps:

- City-rankings tend to neglect complex interrelations in regional development
- The discussion is mainly focused on the bare rank
- Long-term development strategies may be threatened
- Existing stereotypes may be strengthened
- Badly ranked cities tend to ignore the results

In order to get a more detailed insight into the diverse methods, objectives and results of different city-rankings, some international examples (as listed in table 1) are described and compared. 3 main aspects of rankings should be noticed: The objective of the ranking, the methodology and the final dissemination of the results. The different characteristics from the chosen rankings will be used to illustrate these aspects.

Tab. 1: Elaborated city rankings

#	Title	Author	Published in	Spatial scope
1	Quality of Living Survey	Mercer Human Resource Consulting	2007	200 cities worldwide
2	Canada's most sustainable cities	Corporate Knights – The Canadian magazine for responsible business	2007	Large Canadian urban centres
3	How the world views its cities	Anholt City Brands	2006	60 cities worldwide
4	Worldwide cost of living	Economist Intelligence Unit	2006	130 cities worldwide
5	Dritter Großstadtvergleich	IW Consult GmbH / Institute of the German industry	2006	50 German cities

[1] The city rankings considered have been published by the magazines Focus, Capital, Impulse and Bizz between 1994 and 2003.

6	Europas attraktivstes Metropolen für Manger	University of Mannheim / Manager magazin	2005	58 European cities
7	Les villes Européennes. Analyse comparative	UMR Espace (Rozenblat, Cicille)	2003	180 Western European cities

Objectives

The objective of a ranking is not only specified by its aim and its target audience but also by its spatial scope and the desired factors and indicators behind the ranking. The rankings chosen for elaboration include between 50 and 200 cities – at least nation-wide but often also worldwide. This spatial scope depends of course on the aim and the target audience.

The target audience of most rankings are either companies which have to relocate executives (expatriates) or the (future) expatriates themselves (1,3,4,6), or political leaders of cities and communes which stand in direct competition with others (2,5,7). Hence, on the one hand a ranking can be used to rate certain costs of living or individual development chances, and on the other hand to illustrate lacks or advantages in a certain current state of development of a city opposite its direct competitors.

Additional to the spatial scope, the chosen factors (and later the indicators) are certainly bound to the actual aim and target audience of a ranking. Rankings focusing on managers and expatriates mainly focus on individual living conditions for that certain group (1,3,4,6). Rankings mainly focusing on the development state of cities include a broader choice of factors ranging from demographic factors, goods turnover to tourist attractivity etc. (5,7). However, rankings can also be used to analyse a certain characteristic of the cities state, as e.g. environmental sustainability (2).

Methodology

Methodology does not only include the way of data collection and processing but in a first step also the actual limitation of the selection of cities examined in the ranking. Certainly, a broad spatial scope is already defined by the objectives (e.g. only European cities). Still, as there are usually not enough resources to include all cities within this broad scope a further selection is necessary. Many rankings select cities on the basis of their population size (2,5,7), others by their importance in matters of global significance or perceptional importance for their target audience (1,3,4). Quite a comprehensive selection method was chosen for ranking 6: First a list of 643 European cities was elaborated which fulfilled one of various criteria (e.g. capital function, at least 100,000 inhabitants, listed in certain other rankings or at least one company headquarter according to Forbes 2000). All cities got a score for each criterion which was the basis for the selection of 58 cities for the actual ranking.

Finally, data availability (for the subsequent ranking) also plays an important role in the selection of the cities if resources are limited. The collection of data is mainly a question of available project resources. Some data for rankings were elaborated by field research, mainly by interviews (1,3), the majority of data, however, was acquired by desk research, analysing primary and secondary data (2,4,5,6,7).

A crucial point which has to be considered in the methodology is the use of weighting. Usually it is necessary to weight factors or indicators due to their influence or importance for the aim of the ranking. This is typically done by the executing agencies themselves, which have certain aims or targets in mind. Nevertheless it is also possible to assess the weight of the factors for the ranking by interviews again (1) if the target group is clearly defined.

Dissemination

The way, how the results are evaluated, interpreted and presented is crucial for the impact of the ranking. An overall list of cities ranked is the typical result of city rankings. All elaborated rankings include such a list; some studies also include more differentiated results. One differentiation refers to the difference of the current status of a city and its recent development. In ranking 5 two rankings over all cities, a "Niveau"-Ranking and a "Dynamik"-Ranking were elaborated. Therefore cities with a lower state but with a recently very positive development were rated also high in the final ranking. Another approach was chosen in ranking 6: As the target group of the ranking were managers, 3 types of different managers with different demands were elaborated which influenced the weighting of the factors used. In ranking 7 a typology of core function(s) for each city was additionally elaborated through the performance within the different factors. This approach focuses especially on the strengths of each city. Another part of the dissemination aspect is the final availability of the results. Mostly the overall list (or the top) is available free of charge. On the contrary, partial results and interpretations or deeper insights are often not freely available. This might also be a reason for the sole public attention on the final results as addressed below.

In brief it can be stated that there is a broad variety of how to do a ranking and it seems that rankings focusing on a more detailed and clearly defined issue provide more applicable results than rankings providing 'just' an overall list. Not only when analysing and interpreting existing city-rankings but also when developing a new one, it is important to consider these three aspects, giving evidence on their objectives, methodologies and dissemination. One serious problem of all city-rankings seems to be the fact that public attention is mainly focussed on the final ranking without considering the methodological aspects behind the ratings. This selective public perception of results enforces a confirmation of existing stereotypes and clichés neglecting the specific strengths and weaknesses of the cities in detail. The rankings are excessively acclaimed by the "winners" in order to improve their public image, while the "losers" tend to ignore the results which might threaten their position in city competition. Consequently both groups of cities pass up the chance to make use of the results in a constructive and positive way by discussing the main findings in detail. Only a serious examination of the results reveals actual strengths and weaknesses of cities and can therefore be used as an empirical base for detecting future fields of activity.

Another major handicap of most city-rankings, which is especially relevant for medium-sized cities, lies in their generalistic approach: Since many financiers ask for clear results which can easily be communicated in public, most rankings aim at finding the "best" or "most attractive" city in general terms. Consequently these studies try to cover all fields of local attractiveness totally ignoring the fact that different activities need different conditions. It is quite obvious, however, that a city that offers a high quality of life does not necessarily have to be the ideal location for all industrial branches. This is especially true for medium-sized cities, which are not able to compete in all fields of economic activity, but have to focus on selected

branches. This strategy of specialisation is based on an accurate examination of existing economic, social and environmental potentials in order to find specific niches in which the city is able to establish some competitive advantage. For that reason it does not really make sense to compare medium-sized cities generally and to evaluate their attractiveness in total. Even more than in the case of metropolises, city-rankings of medium-sized cities have to be highly specific in their approach and always be related to a particular aspect of attractiveness: The results of rankings focussing on quality of life or on cultural potentials will strongly diverge from the findings of studies which try to evaluate regional conditions for tourism or innovative industries. Consequently, rankings comparing medium-sized cities have to be interpreted thoroughly and with caution and the results should not be published without mentioning the factors and indicators considered.

Anticipating our own ranking approach as illustrated in the next chapter, some conclusions should be drawn for the design and application of rankings dealing with medium-sized cities:

- The largest part of European urban citizens live in medium-sized cities
- Need for definition of medium-sized cities
- Poor data availability makes inclusion of data from different spatial levels and limited sample necessary
- Transparent and well structured approach necessary for serious examination
- Focused rankings provide more applicable results
- Differentiation through relevant factors allows information and policy advice on strategic specialisation

These conclusions are especially relevant for the current study. However, for a possible successor project certain adaptations are conceivable. The large number of medium-sized cities and its weight in regards to citizens and number of cities is a strong argument for the need of expanding the sample and continue research as emphasized in the outlook in the last chapter.

2 Objective

2.1 Defining smart city

Rankings are only of value if the target is defined well and a transparent structure is used. The objective of this ranking is to compare characteristics and to identify strengths and weaknesses of medium-sized cities in a comparative way. Therefore it is not useful to solely focus on the performance of only one aspect of city development but on the performance in a broad range of characteristics. The specific feature of our approach is the evaluation of these characteristics regarding a forward-looking development on the basis of a combination of local circumstances and activities carried out by politics, business, and the inhabitants.

As elaborated in a first phase of the project, a forward-looking development approach should consider issues as awareness, flexibility, transformability, synergy, individuality, self-decisive, strategic behaviour. Especially awareness seems important for a smart city as certain potentials can only be mobilised if inhabitants, companies or the administration are aware of the cities' position – knowing the city from the inside but also being aware of the surroundings and the system of cities the city is located in.

Although the term smart city is understood as a certain ability of a city and not focusing on single aspects, a further definition requires identifying certain characteristics for the evaluation. Although the term "Smart City" is not very widely used yet in spatial planning literature or urban research, it is still possible to identify various aspects as a basis for further elaboration. Concluding from literature research the term is not used in a holistic way describing a city with certain attributes, but is used for various aspects which range from Smart City as an IT-district to a Smart City regarding the education (or smartness) of its inhabitants. In the following the various aspects will be summarized.

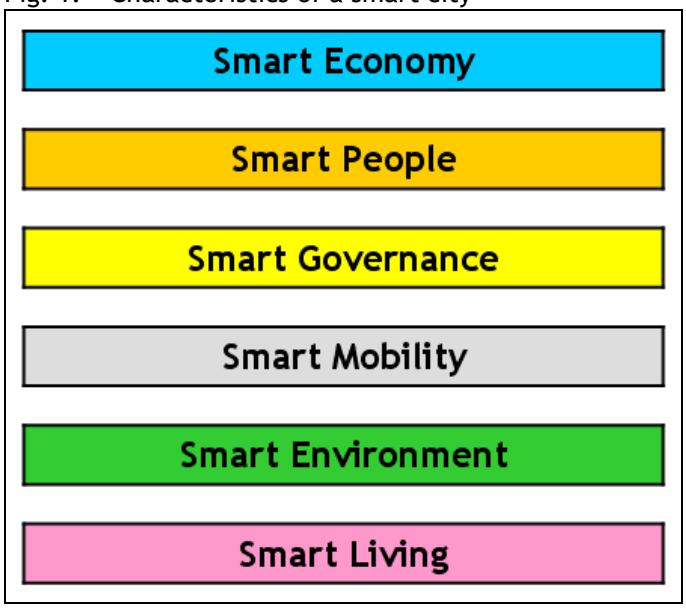
In association with economy or jobs Smart City is used to describe a city with a "smart" industry. That implies especially industries in the fields of information and communication technologies (ICT) as well as other industries implying ICT in their production processes. Also for business parks or own districts comprising of companies within this field the name Smart City is used. The term Smart City is also used regarding the education of its inhabitants. A Smart City has therefore smart inhabitants in terms of their educational grade. In other literature the term Smart City is referred to the relation between the city government resp. administration and its citizen. Good governance as an aspect of a smart administration often also referred to the usage of new channels of communication for the citizens, e.g. "e-governance" or "e-democracy". Smart City is furthermore used to discuss the use of modern technology in everyday urban life. This includes not only ICT but also, and especially, modern transport technologies. Logistics as well as new transport systems as "smart" systems which improve the urban traffic and the inhabitants' mobility. Moreover various other aspects referring to life in a city are mentioned in connection to the term Smart City like security/safe, green, efficient & sustainable, energy etc.

To sum up, there are several fields of activity which are described in literature in relation to the term Smart City: industry, education, participation, technical infrastructure, various 'soft factors'; finally we can identify six characteristics (see Fig. 1) as a roof for the further elaboration of smart cities which should incorporate the findings but also allow an inclusion of additional factors.

Referring to the first paragraph we can structure the findings as the following: A Smart City is a city well performing in a forward-looking way in these six characteristics, built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens.

Furthermore it should be emphasized that we are currently only able to draw a picture of the present state of a city. Still, the path of development is decisive for a smart city and should be considered in further research that builds on time-series data.

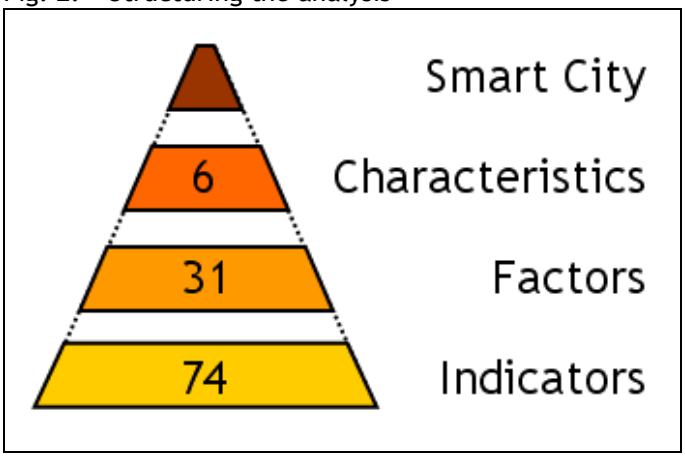
Fig. 1: Characteristics of a smart city



2.2 Operationalizing smart city

To describe a smart city and its six characteristics it is necessary to develop a transparent and easy hierarchic structure, where each level is described by the results of the level below. Each characteristic is therefore defined by a number of factors. Furthermore each factor is described by a number of indicators. The factors were defined in several workshops always having the overall target, smart city development in mind. Finally 33 factors were chosen to describe the 6 characteristics. To analyse the performance in each factor 1-4 indicators were selected (see chapter 3.2) and assigned to each factor. For two factors, "Ability to transform" and "Political strategies & perspectives" it was not possible to receive sufficient data at the moment. Therefore 31 factors finally remained for the ranking. However, for further rankings we recommend to include and elaborate also these two factors as they seem important for the completion of the model.

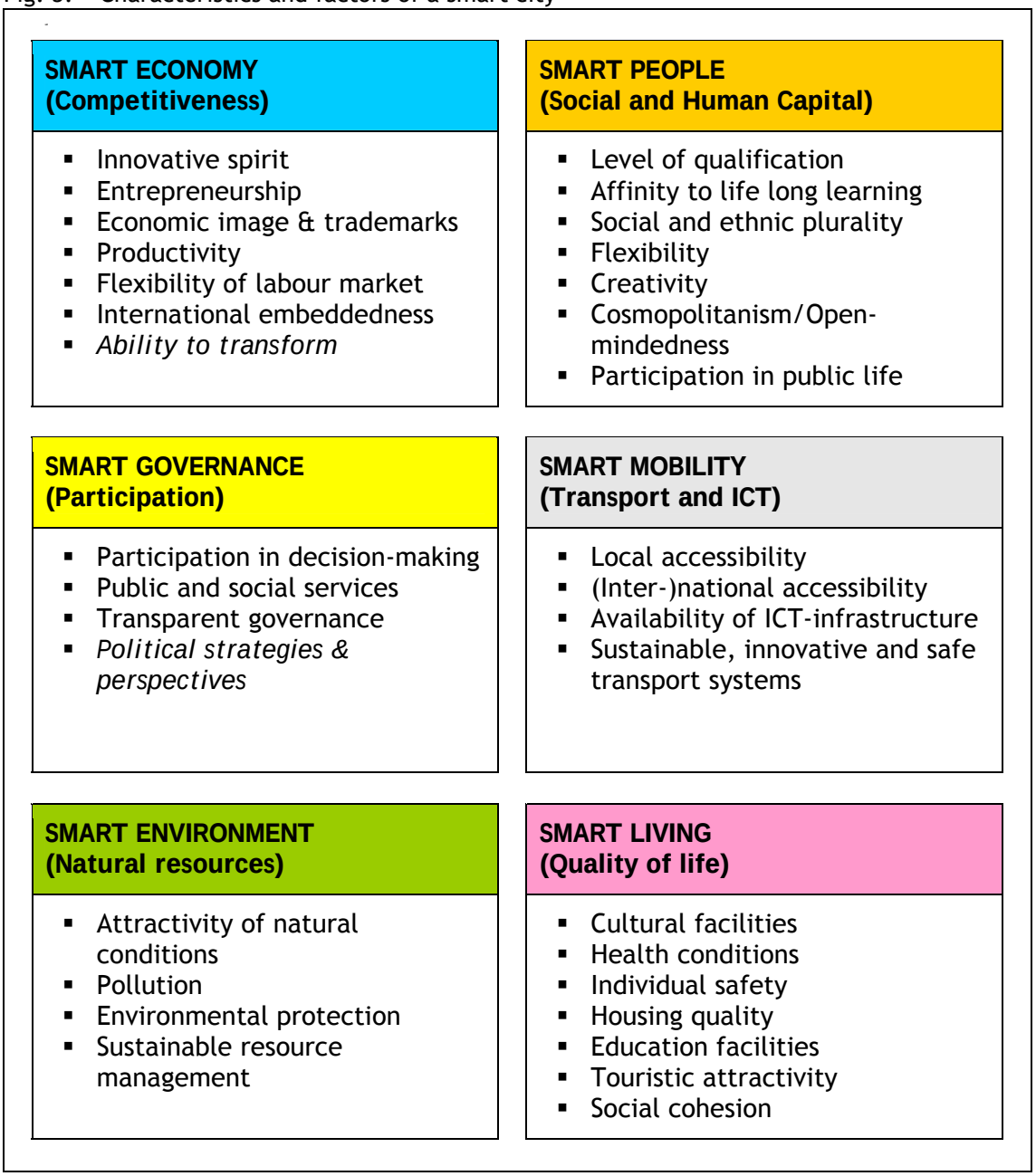
Fig. 2: Structuring the analysis



The following table illustrates the 6 characteristics and their assigned factors. Smart Economy includes factors all around economic competitiveness as innovation, entrepreneurship, trademarks, productivity and flexibility of the labour market as well as the integration in the (inter-)national market. Smart People is not only described by the level of qualification or education of the citizens but also by the quality of social interactions regarding integration and public life and the openness towards the "outer" world. Smart Governance comprises aspects of political participation, services for citizens as well as the functioning of the administration.

Local and international accessibility are important aspects of Smart Mobility as well as the availability of information and communication technologies and modern and sustainable transport systems. Smart Environment is described by attractive natural conditions (climate, green space etc.), pollution, resource management and also by efforts towards environmental protection. Finally, Smart Living comprises various aspects of quality of life as culture, health, safety, housing, tourism etc.

Fig. 3: Characteristics and factors of a smart city



These characteristics and factors form the framework for the indicators and the following assessment a city's performance as smart city.

3 Methodology

3.1 Selecting cities

As written in the previous chapters the focus of this ranking lies on medium-sized cities. However, there is no common definition of a medium-sized city. For this study we chose to understand medium-sized cities as cities often also understood as "second cities" on a European scale, cities which are mainly not recognised very well on a European scale but often of crucial importance on a national and regional scale. As a starting point we chose to focus on cities with a populuation between 100,000 and 500,000 inhabitants. The most comprehensive overview of cities or functional urban areas (FUA) in Europe provides the Espon 1.1.1[2] study incorporating almost 1,600 entities in Europe[3].

For the further selection of a feasible sample two main arguments were considered according to the project's aim and its timeframe: Cities should be of medium size and they should be covered by accessible and relevant databases. For these reasons three knock-out criteria were elaborated in a first selection phase on the basis of the Espon 1.1.1 study. Additionally, the fact if a city is covered by Urban Audit – a European wide database on cities – is decisive for the benchmark as for reasons of data availability. Hence 94 cities remained.

Tab. 2: Selection criteria

Crit.	Description	Cities (FUA)	thereof covered by Urban Audit
-	Starting point – functional urban areas in Europe	1,595	244
1	Population 100,000 – 500,000 (to obtain medium-sized cities)	584	128
2	At least 1 university (to exclude cities with a weak knowledge basis)	364	101
3	Catchment area less than 1.500,000 (to exclude cities which are dominated by a bigger city)	256	**94**

In a second step the project team did some further adaptation and elaboration of the city sample regarding data accessibility and quality. Also some cities which actually are of medium-size but situated in a denser populated area and therefore having a catchment area slightly larger than 1.5 mio. were included. Finally 70 cities were chosen for the sample.

[2] Nordregio (2004) ESPON 1.1.1: Potentials for polycentric development in Europe;
Project report, Luxembourg: European Spatial Planning Observation Network Coordination Unit.
[3] The Espon 1.1.1 study included the EU27-member states plus Norway and Switzerland

3.2 Identifying indicators and data sources

All indicators that jointly describe the factors of a smart city are derived from public and freely available data, obtained from the following databases:

Tab. 3: Databases used, number of indicators

Database	Spatial level	Basis for indicators
Urban Audit (CORE)	local	35
Espon 1.4.3 project (FUA level)	local-regional	3
Espon 1.2.1 project (NUTS3 level)	regional	1
Eurostat database (NUTS3)	regional	1
Eurostat database (NUTS2)	regional	8
Eurostat database (NUTS0)	national	1
Various Eurobarometer special surveys (NUTS0)	national	24
Study[4] on creative industries in Europe (NUTS0)	national	1

In total 74 indicators were selected for the evaluation, whereas 48 (65 %) are based on local or regional data and 26 (35 %) are based on national data. The inclusion of national data was necessary to broaden the database but also because very interesting data is available on that level. We tried to use the most current data as possible. However, as for reasons of data availability we also had to include older data, finally ranging from 2001 to 2007. Furthermore several datasets were complemented from other sources by individual research by the project team so that we finally could achieve a coverage rate of 87 % for the 70 cities by 74 indicators. The complete list of indicators is available in the annex.

3.3 Standardizing and aggregating data

To compare the different indicators it is necessary to standardize the values. One method to standardize is by z-transformation (see formula). This method transforms all indicator values into standardized values with an average 0 and a standard deviation 1. It has the advantage to consider the heterogeneity within groups and maintain its metric information. Furthermore a high sensitivity towards changes is achieved.

Fig. 4: z-transformation

$$Z_i = \frac{X_i - \overline{X}}{S}$$

To receive results on the level of factors, characteristics and the final result for each city, it is necessary to aggregate the values on the indicator level. For the aggregation of indicators of factors we consider also the coverage rate of each indicator. A certain result from an indicator of an indicator covering all 70 cities weights therefore a little more than an indicator covering only 60 cities. Besides this small correction the results were aggregated on all levels without any weighting. The aggregation was done additive but divided through the number of values added. That allows us to include also cities which do not cover all indicators. Their results are calculated with the values available. Still, it is necessary to provide a good coverage over all cities to receive reasonable results.

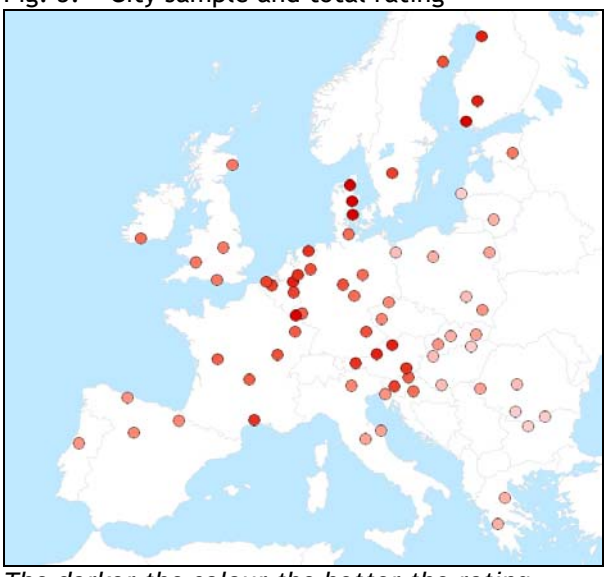
[4] Ministère de la culture et de la communication, Délégation au développement et aux affaires internationales (DDAI). Département des études, de la prospective et des statistiques (Deps): L'emploi culturel dans l'Union européenne en 2002. Données de cadrage et indicateurs. Paris, 2005

4 Results and dissemination

4.1 Performance of 70 cities

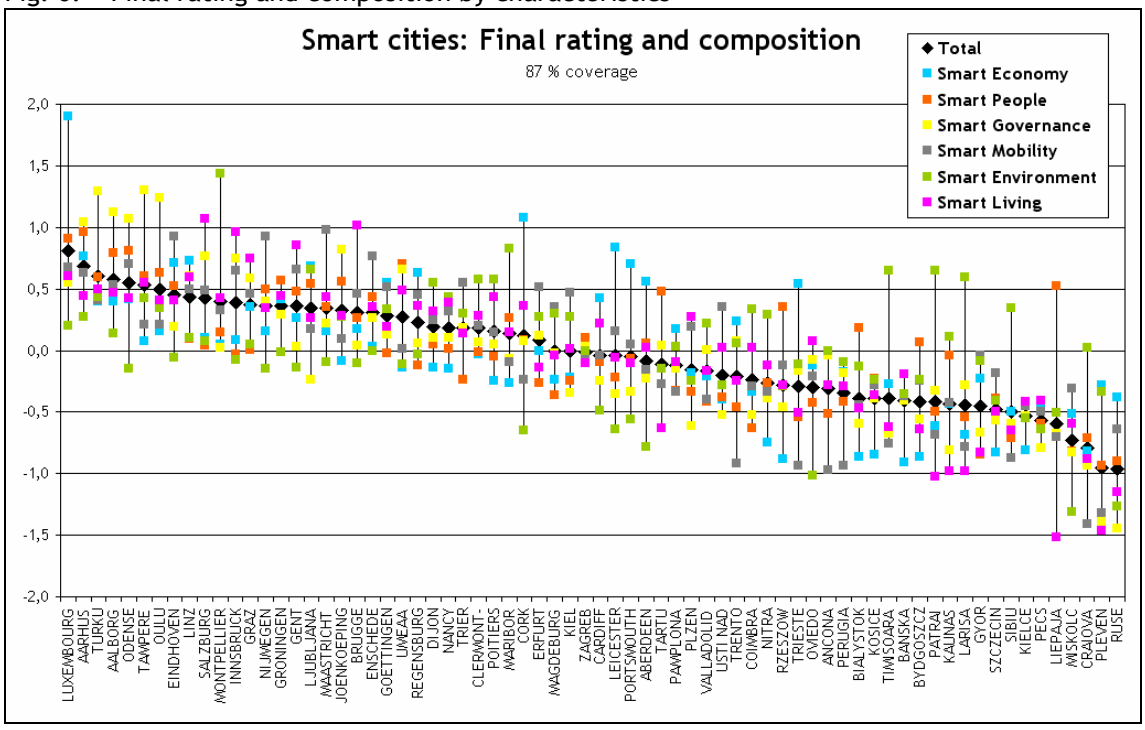
In the final ranking Scandinavian cities and cities from the Benelux countries and Austria are ranked in the top group. Also Montpellier and Ljubljana achieve top ratings. The cities ranked lowest are mainly in the new EU-member states. Within the respective characteristics a similar picture can be recognised. Still, also some differences appear. The best rating in Smart Economy achieve Luxembourg, British, Irish and Danish cities as well as Eindhoven, Regensburg, Ljubljana and Linz. Smart People is led by Scandinavian cities as well as Dutch cities and Luxembourg. Again Scandinavian and also Austrian cities achieve a very good rating in Smart Governance. The rating for Smart Mobility is very good in cities from Benelux countries and Denmark. Smart Environment is fairly different from the total rating. French, Slovenian and Greek cities as well as Timisoara achieve top ratings in this characteristic. The sixth characteristic, Smart Living, is lead by Austrian, Belgian and two Finnish cities as well as Luxembourg and Umeå. The following graph illustrates the composition of the total rating by characteristics for each city. It also allows a first evaluation of strengths and weaknesses of certain cities or groups of cities.

Fig. 5: City sample and total rating



The darker the colour the better the rating

Fig. 6: Final rating and composition by characteristics



Tab. 4: Final results and performance in characteristics

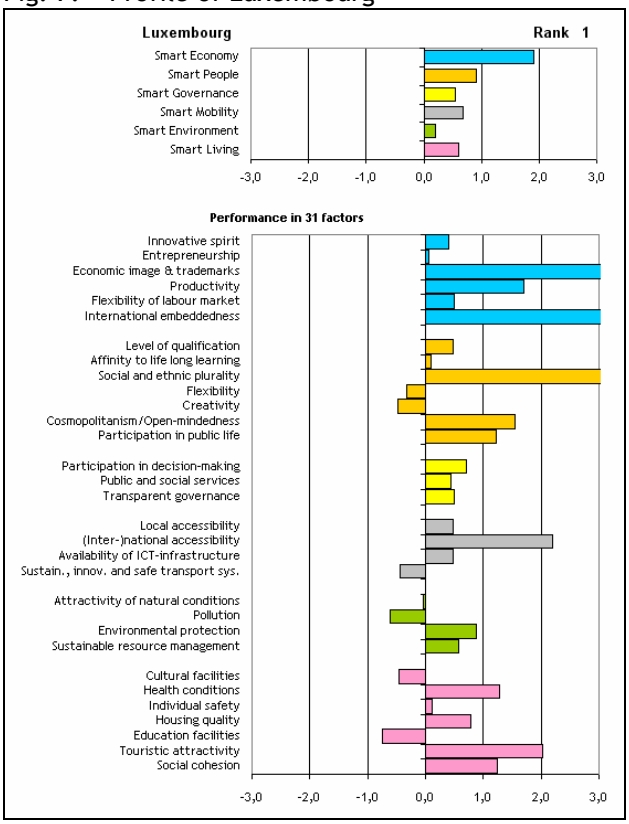
cc	city	Smart Economy	Smart People	Smart Governance	Smart Mobility	Smart Environment	Smart Living	total
LU	LUXEMBOURG	1	2	13	6	25	6	1
DK	AARHUS	4	1	6	9	20	12	2
FI	TURKU	16	8	2	21	11	9	3
DK	AALBORG	17	4	4	11	26	11	4
DK	ODENSE	15	3	5	5	50	17	5
FI	TAMPERE	29	7	1	27	12	8	6
FI	OULU	25	6	3	28	14	19	7
NL	EINDHOVEN	6	13	18	2	39	18	8
AT	LINZ	5	25	11	14	28	7	9
AT	SALZBURG	27	30	8	15	29	1	10
FR	MONTPELLIER	30	23	33	24	1	16	11
AT	INNSBRUCK	28	35	9	8	40	3	12
AT	GRAZ	18	32	12	17	31	5	13
NL	NIJMEGEN	24	14	14	3	51	24	14
NL	GRONINGEN	14	9	15	20	37	13	15
BE	GENT	19	16	31	7	48	4	16
SI	LJUBLJANA	8	11	43	31	3	29	17
NL	MAASTRICHT	26	18	17	1	43	14	18
SE	JOENKOEPING	36	10	7	34	22	26	19
BE	BRUGGE	23	20	29	18	44	2	20
NL	ENSCHEDE	31	17	16	4	35	23	21
DE	GOETTINGEN	11	34	20	12	15	31	22
SE	UMEAA	39	5	10	36	46	10	23
DE	REGENSBURG	9	40	27	19	38	22	24
FR	DIJON	38	29	22	26	9	25	25
FR	NANCY	41	31	23	25	10	20	26
DE	TRIER	21	44	19	10	18	33	27
FR	CLERMONT-FERRAND	33	33	26	29	7	27	28
FR	POITIERS	48	37	28	33	8	15	29
SI	MARIBOR	49	21	37	40	2	32	30
IE	CORK	2	26	25	45	66	21	31
DE	ERFURT	32	47	21	13	21	45	32
DE	MAGDEBURG	47	50	35	22	17	39	33
DE	KIEL	45	45	48	16	23	38	34
HR	ZAGREB	34	24	32	39	36	42	35
UK	CARDIFF	13	39	44	38	60	30	36
UK	LEICESTER	3	42	49	32	64	40	37
UK	PORTSMOUTH	7	38	47	35	63	43	38
UK	ABERDEEN	10	28	42	42	67	35	39
EE	TARTU	40	15	30	47	49	60	40
ES	PAMPLONA	22	48	39	51	32	41	41
CZ	PLZEN	43	49	61	30	54	28	42
ES	VALLADOLID	44	53	34	54	24	46	43
CZ	USTI NAD LABEM	54	51	55	23	55	36	44
IT	TRENTO	20	57	24	65	30	48	45
PT	COIMBRA	52	63	54	49	16	37	46
SK	NITRA	62	46	51	52	19	44	47
PL	RZESZOW	69	19	53	41	56	50	48
IT	TRIESTE	12	61	40	67	45	57	49
ES	OVIEDO	37	55	38	44	68	34	50
IT	ANCONA	35	59	36	68	34	49	51
IT	PERUGIA	42	54	41	66	42	51	52
PL	BIALYSTOK	67	22	59	56	47	55	53
SK	KOSICE	66	43	50	48	53	52	54
RO	TIMISOARA	50	64	64	62	4	59	55
SK	BANSKA BYSTRICA	70	41	52	53	58	47	56
PL	BYDGOSZCZ	68	27	57	46	52	61	57
GR	PATRAI	59	58	46	60	5	67	58
LT	KAUNAS	55	36	66	55	27	65	59
GR	LARISA	61	60	45	63	6	66	60
HU	GYOR	46	68	62	37	41	63	61
PL	SZCZECIN	65	52	58	43	59	56	62
RO	SIBIU	57	65	60	64	13	62	63
PL	KIELCE	63	56	56	57	62	54	64
HU	PECS	56	62	65	58	65	53	65
LV	LIEPAJA	60	12	63	61	61	70	66
HU	MISKOLC	58	67	67	50	70	58	67
RO	CRAIOVA	64	66	68	70	33	64	68
BG	PLEVEN	51	70	69	69	57	69	69
BG	RUSE	53	69	70	59	69	68	70

4.2 City profiles

The analysis in characteristics allows already a broad outline of strengths and weaknesses of the included cities. However, a more detailed analysis is necessary because the performance within the respective characteristics or even within factors can vary. The transparent structure of the ranking-approach enables a quick insight into characteristics and factors, providing detailed city profiles. The following graph shows a detailed profile of Luxembourg, ranked on first place in the final ranking.

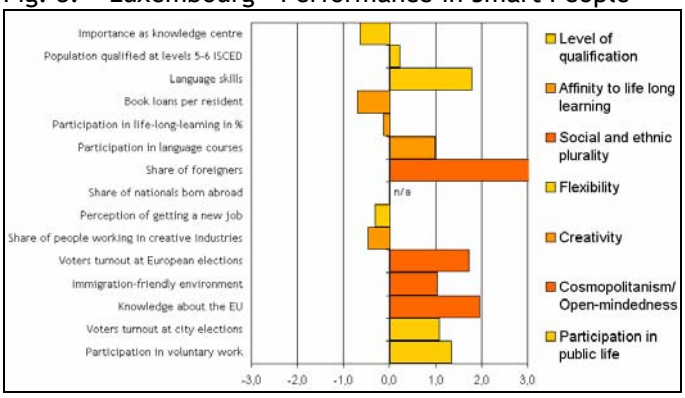
Luxembourg has in every characteristic a rating above average. Especially in Smart Economy is Luxembourg far above the average of all 70 cities. Still, even in this characteristic we can see a different picture when zooming on the level of factors. Three factors, economic image, productivity and international embeddedness are extraordinary well rated while the other three are closer to the average but still above. An even more diverse rating is within Smart People. One can see that the very good rating on the level of characteristics is mainly caused by the very good performance in the factor social and ethnic plurality. On the other hand, the factors creativity and flexibility are even under average. We can even have a deeper look on the results by changing one level lower to the level of indicators.

Fig. 7: Profile of Luxembourg



The figure to the right illustrates the performance of Luxembourg in Smart People on the level of indicators. While some factors comprise quite homogeneous indicators as Cosmopolitanism or Participation in public life, others offer a diverse picture. Within the factor Level of qualification Luxembourg achieves a relatively weak rating as knowledge centre – an indicator describing the quality of research centres and universities on a European scale. On the other hand the citizens of Luxembourg have language skills (at least one foreign language) far above-average. The analysis on the level of indicators provides most detailed information on a city's comparative performance.

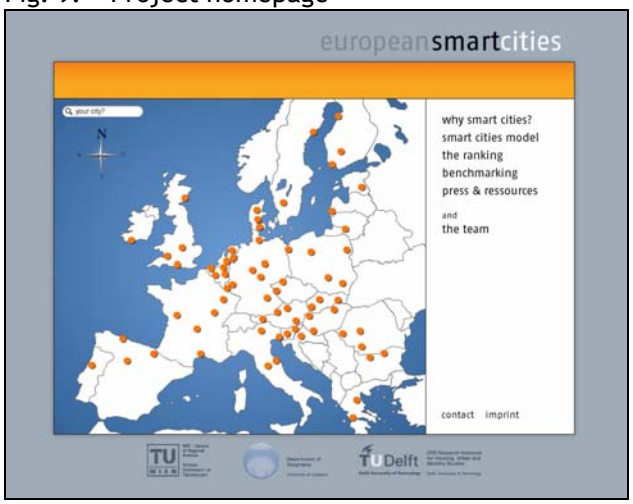
Fig. 8: Luxembourg – Performance in Smart People



4.3 Dissemination

Besides this report, the most important results are available on the project homepage, *www.smart-cities.eu*. With the implemented online database it is possible to get an insight view on the 70 cities and their comparative strengths and weaknesses on the level of characteristics and factors.

Fig. 9: Project homepage



www.smart-cities.eu

Besides, all project partners gave interviews to several newspapers in the Netherlands, Luxemburg (German and French newspapers), Germany and, most of all, in Austria. In particular, some cities (resp. their marketing sections) got into contact with us in order to get comprehensive information about their cities resp. on the factor and indicator scores.

4.4 Outlook

This study was the first of its kind to focus on medium-sized cities, thereby considering a broad range of factors and indicators, inherent to the concept of 'smart cities'. As was stated before, rankings can only be meaningful when the data-collection and analysis has been carried out in a transparent way (and hence, its results should be reproducible by others). Moreover, this transparency allows considering the ranking of medium-sized cities from various viewpoints. Which one prevails, depends on the objective of the user of the information and his/her needs. With other words, the consideration of different characteristics, factors and indictors in an non-weighted way expresses that the authors are convinced that urban development is a complex process in different dimensions and its perception and evaluation, finally, depends on the actors themselves resp. their preferences and individual objectives.

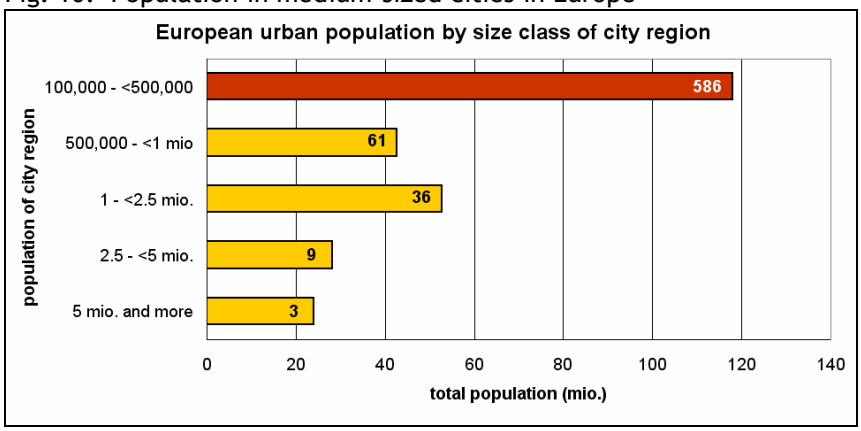
However, we do not have a complete overview about the perception of our study through corresponding actors across Europe, but we have got the impression that this ranking approach detected a niche within existing rankings and some of the medium-sized cities are very much aware of its usefulness for their own positioning. In front of these first reactions from newspapers and concerned cities two conclusions can be done:

First, some of the medium-sized cities resp. their marketing and planning sections are already aware of this increasing pressure of competition and their need for positioning within the European urban system. Thus, strategic advice through such a ranking and through the benchmarking with other cities along characteristics and factors seems to be useful for them. In particular some recent remarks and questions even let expect that a more detailed policy advice is in their interest. Of course, this policy advice could be realized on the base of the indicator scores identifying fields

of action according to strengths and weaknesses and advising the most effective governance approaches between competition and cooperation.

Second, this approach concerns a large number of cities and citizens in Europe. 120 mio. or 40 % of all urban citizens live in cities with a population between 100,000 and 500,000 inhabitants. These 600 cities figure as the engines of economic development in space. Because of their large number they are the most decisive actors in order to make Europe more competitive and at the same time to make spatial development more sustainable. Thus, this group should be object of further investigation in order to identify their recent strengths and weaknesses and their perspectives in positioning.

Fig. 10: Population in medium-sized cities in Europe



Source: Data derived from Nordregio et al (2004) Espon 1.1.1

Concluding, this research project presents a current overview of European medium-sized cities, but an analysis of time-series data was beyond its scope. Such an exercise, however, would be extremely useful, as smart city development is perhaps more concerned with making progress as concerns the smart indicators rather than a cities' positioning in a ranking – which inevitably is a snapshot in time. Nevertheless, the ranking features innovative aspects and results:

- Focus on medium-sized cities, a class of cities normally neglected in international comparative analyses
- Analysis of characteristics and factors decisive for a successful forward-looking city development
- Use of a transparent and comprehensive catalogue of indicators, using data from official, public and freely available sources
- Elaboration of detailed city profiles on the basis of 74 indicators providing applicable statements on comparative strengths and weaknesses

Perhaps it would not be an exaggeration to say that truly smart cities use this city-ranking as a tool to benchmark with other cities, and draw lessons from better performing cities, perhaps resulting in policy transfer. This should become evident in a follow-up to this project that will allow an assessment of the cities performance in each smart characteristic.

5 Annex

Literature

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Tab. 5: List of indicators

	factor	indicator	year	level
Smart Economy	Innovative spirit	R&D expenditure in % of GDP	2003	regional
		Employment rate in knowledge-intensive sectors	2004	regional
		Patent applications per inhabitant	2003	regional
	Entrepreneurship	Self-employment rate	2001	local
		New businesses registered	2001	local
	Economic image & trademarks	Importance as decision-making centre (HQ etc.)	2007	regional
	Productivity	GDP per employed person	2001	local
	Flexibility of labour market	Unemployment rate	2005	regional
		Proportion in part-time employment	2001	local
	International embeddedness	Companies with HQ in the city quoted on national stock market	2001	local
		Air transport of passengers	2003	regional
		Air transport of freight	2003	regional
Smart People	Level of qualification	Importance as knowledge centre (top research centres, top universities etc.)	2007	regional
		Population qualified at levels 5-6 ISCED	2001	local
		Foreign language skills	2005	national
	Affinity to life long learning	Book loans per resident	2001	local
		Participation in life-long-learning in %	2005	regional
		Participation in language courses	2005	national
	Social and ethnic plurality	Share of foreigners	2001	local
		Share of nationals born abroad	2001	local
	Flexibility	Perception of getting a new job	2006	national
	Creativity	Share of people working in creative industries	2002	national
	Cosmopolitanism/ Open-mindedness	Voters turnout at European elections	2001	local
		Immigration-friendly environment (attitude towards immigration)	2006	national
		Knowledge about the EU	2006	national
	Participation in public life	Voters turnout at city elections	2001	local
		Participation in voluntary work	2004	national
Smart Governance	Participation in decision-making	City representatives per resident	2001	local
		Political activity of inhabitants	2004	national
		Importance of politics for inhabitants	2006	national
		Share of female city representatives	2001	local
	Public and social services	Expenditure of the municipal per resident in PPS	2001	local
		Share of children in day care	2001	local
		Satisfaction with quality of schools	2005	national
	Transparent governance	Satisfaction with transparency of bureaucracy	2005	national
		Satisfaction with fight against corruption	2005	national

	factor	indicator	year	level
Smart Mobility	Local accessibility	Public transport network per inhabitant	2001	local
		Satisfaction with access to public transport	2004	national
		Satisfaction with quality of public transport	2004	national
	(Inter-)national accessibility	International accessibility	2001	regional
	Availability of ICT-infrastructure	Computers in households	2006	national
		Broadband internet access in households	2006	national
	Sustainable, innovative and safe transport systems	Green mobility share (non-motorized individual traffic)	2001	local
		Traffic safety	2001	local
		Use of economical cars	2006	national
Smart Environment	Attractivity of natural conditions	Sunshine hours	2001	local
		Green space share	2001	local
	Pollution	Summer smog (Ozon)	2001	local
		Particulate matter	2001	local
		Fatal chronic lower respiratory diseases per inhabitant	2004	regional
	Environmental protection	Individual efforts on protecting nature	2004	national
		Opinion on nature protection	2006	national
	Sustainable resource management	Efficient use of water (use per GDP)	2001	local
		Efficient use of electricity (use per GDP)	2001	local
Smart Living	Cultural facilities	Cinema attendance per inhabitant	2001	local
		Museums visits per inhabitant	2001	local
		Theatre attendance per inhabitant	2001	local
	Health conditions	Life expectancy	2001	local
		Hospital beds per inhabitant	2001	local
		Doctors per inhabitant	2001	local
		Satisfaction with quality of health system	2004	national
	Individual safety	Crime rate	2001	local
		Death rate by assault	2001-03	regional
		Satisfaction with personal safety	2004	national
	Housing quality	Share of housing fulfilling minimal standards	2001	local
		Average living area per inhabitant	2001	local
		Satisfaction with personal housing situation	2004	national
	Education facilities	Students per inhabitant	2001	local
		Satisfaction with access to educational system	2004	national
		Satisfaction with quality of educational system	2004	national
	Touristic attractivity	Importance as tourist location (overnights, sights)	2007	regional
		Overnights per year per resident	2001	local
	Social cohesion	Perception on personal risk of poverty	2006	national
		Poverty rate	2005	national

Tab. 6: City sample

Austria

GRAZ
INNSBRUCK
LINZ
SALZBURG

Belgium

BRUGGE
GENT

Bulgaria

PLEVEN
RUSE

Croatia

ZAGREB

Czech Republic

PLZEN
USTI NAD LABEM

Denmark

AALBORG
AARHUS
ODENSE

Estonia

TARTU

Finland

OULU
TAMPERE
TURKU

France

CLERMONT-FERRAND
DIJON
MONTPELLIER
NANCY
POITIERS

Germany

ERFURT
GOETTINGEN
KIEL
MAGDEBURG
REGENSBURG
TRIER

Greece

LARISA
PATRAI

Hungary

GYOR
MISKOLC
PECS

Ireland

CORK

Italy

ANCONA
PERUGIA
TRENTO
TRIESTE

Latvia

KAUNAS

Lithuania

LIEPAJA

Luxembourg

LUXEMBOURG

Netherlands

EINDHOVEN
ENSCHEDE
GRONINGEN
MAASTRICHT
NIJMEGEN

Poland

BIALYSTOK
BYDGOSZCZ
KIELCE
RZESZOW
SZCZECIN

Portugal

COIMBRA

Romania

CRAIOVA
SIBIU
TIMISOARA

Slovakia

BANSKA BYSTRICA
KOSICE
NITRA

Slovenia

LJUBLJANA
MARIBOR

Spain

OVIEDO
PAMPLONA
VALLADOLID

Sweden

JOENKOEPING
UMEAA

United Kingdom

ABERDEEN
CARDIFF
LEICESTER
PORTSMOUTH

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Vienna University of Technology

Department of Geography

University of Ljubljana

Research Institute for Housing, Urban and Mobility Studies (OTB)

Delft University of Technology