Università degli Studi di Napoli "Federico II"
Scuola Politecnica e delle Scienze di Base
Dipartimento di Ingegneria Civile, Edile ed Ambientale

Corso di Laurea in Ingegneria per l'Ambiente ed il Territorio
Tesi di Laurea in Strumenti di Governo del Territorio

THE SMART CITY TO SUPPORT THE AGEING SOCIETY: A GIS –BASED METHODOLOGY AN APPLICATION TO THE NAPLES AND LISBON NEIGHBOURS

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FINALITY

The **Smart approach** to improve the **quality of life** for the **over 65s** in the urban area

TARGET

A GIS-based methodology to evaluate the level of neighborhood Smartness for the elderly people

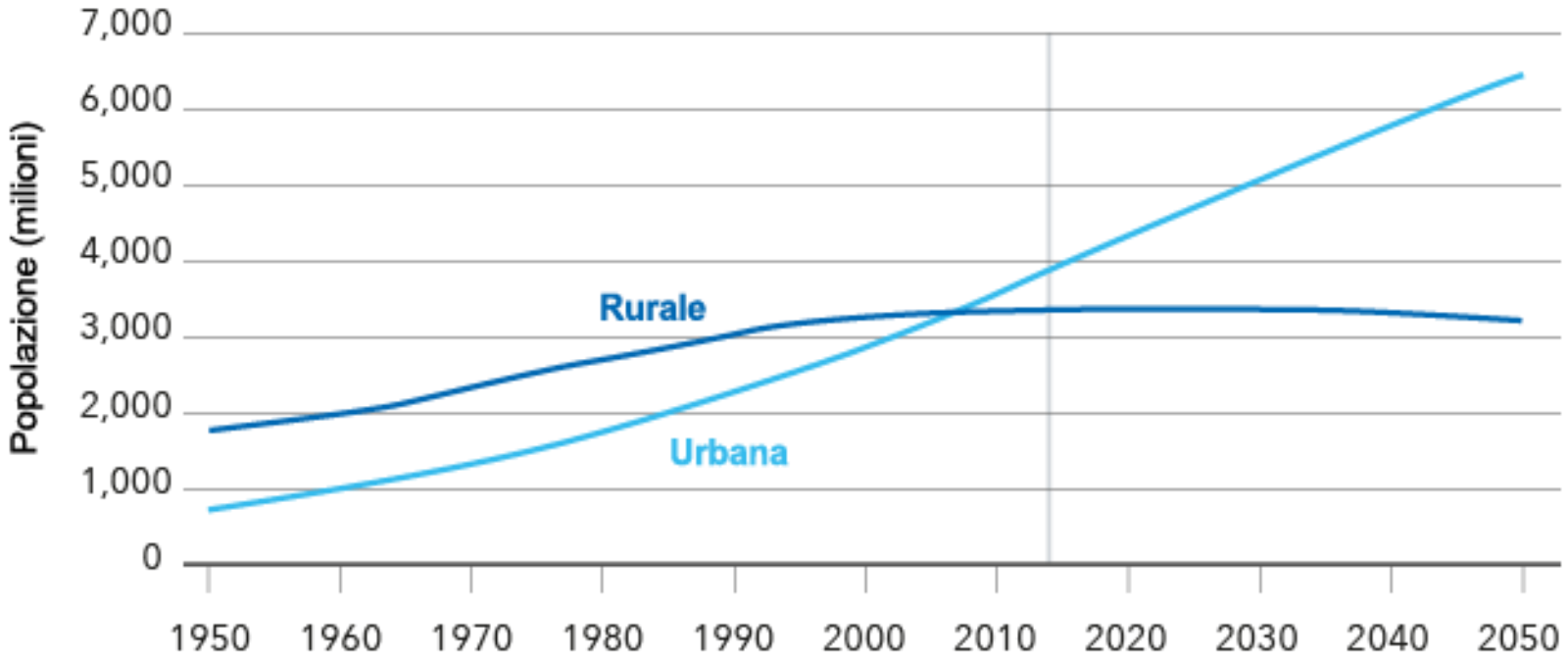
Structure

1. State of the Art
2. Methodology
3. Application
4. Conclusions

1 State of the Art

STATE OF THE ART

Movements over the years



ANNO	POPOLAZIONE %
1950	30%
2017	54%
2050	**67%**

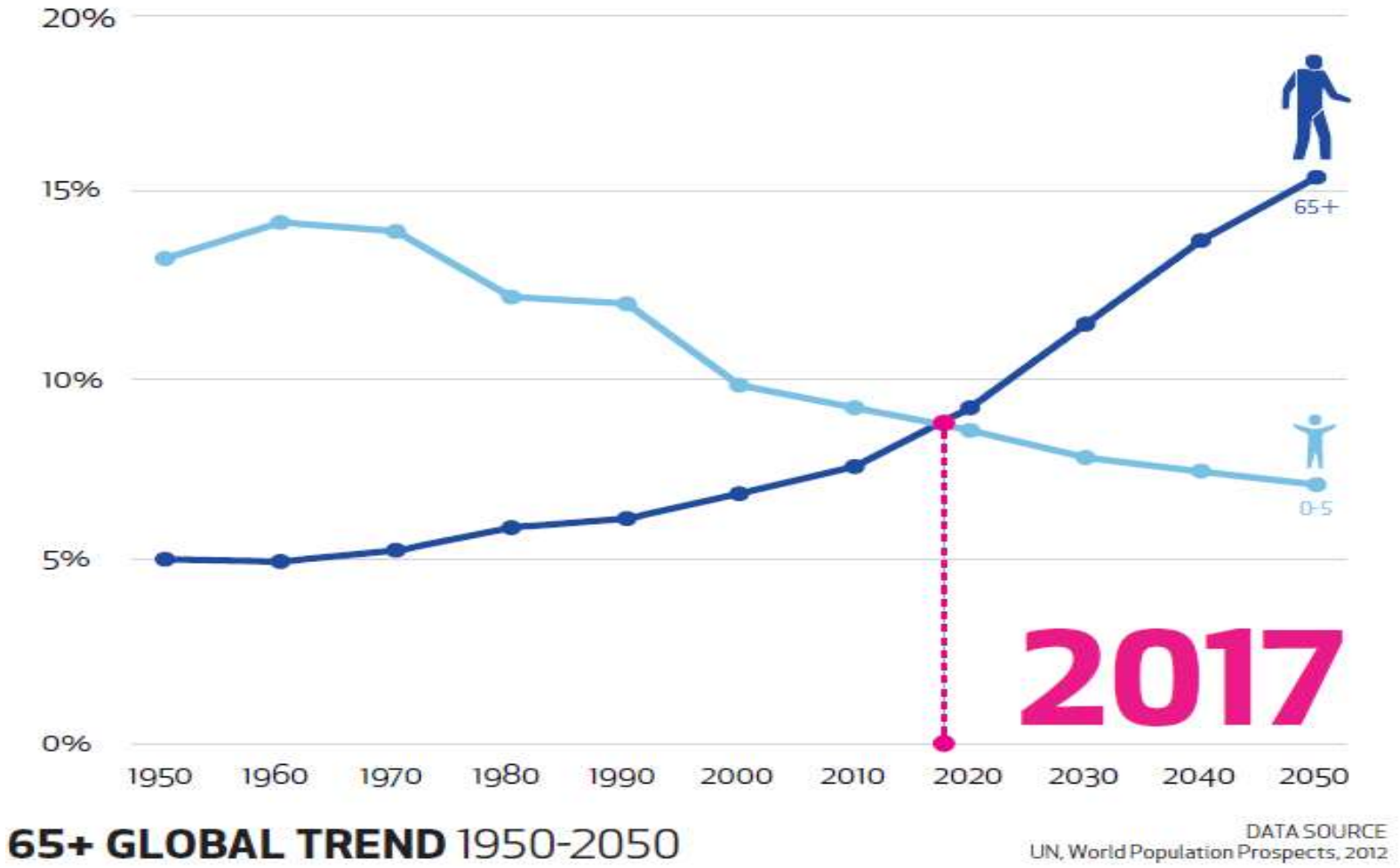
STATE OF THE ART

Increase in over 65s

- **Increased** population over 65

- **Reduction of young population In 2007**, for the first time in history, 50% of the population lived in urban areas

- **In 2050** the world's population living in cities is expected **to be 70%**



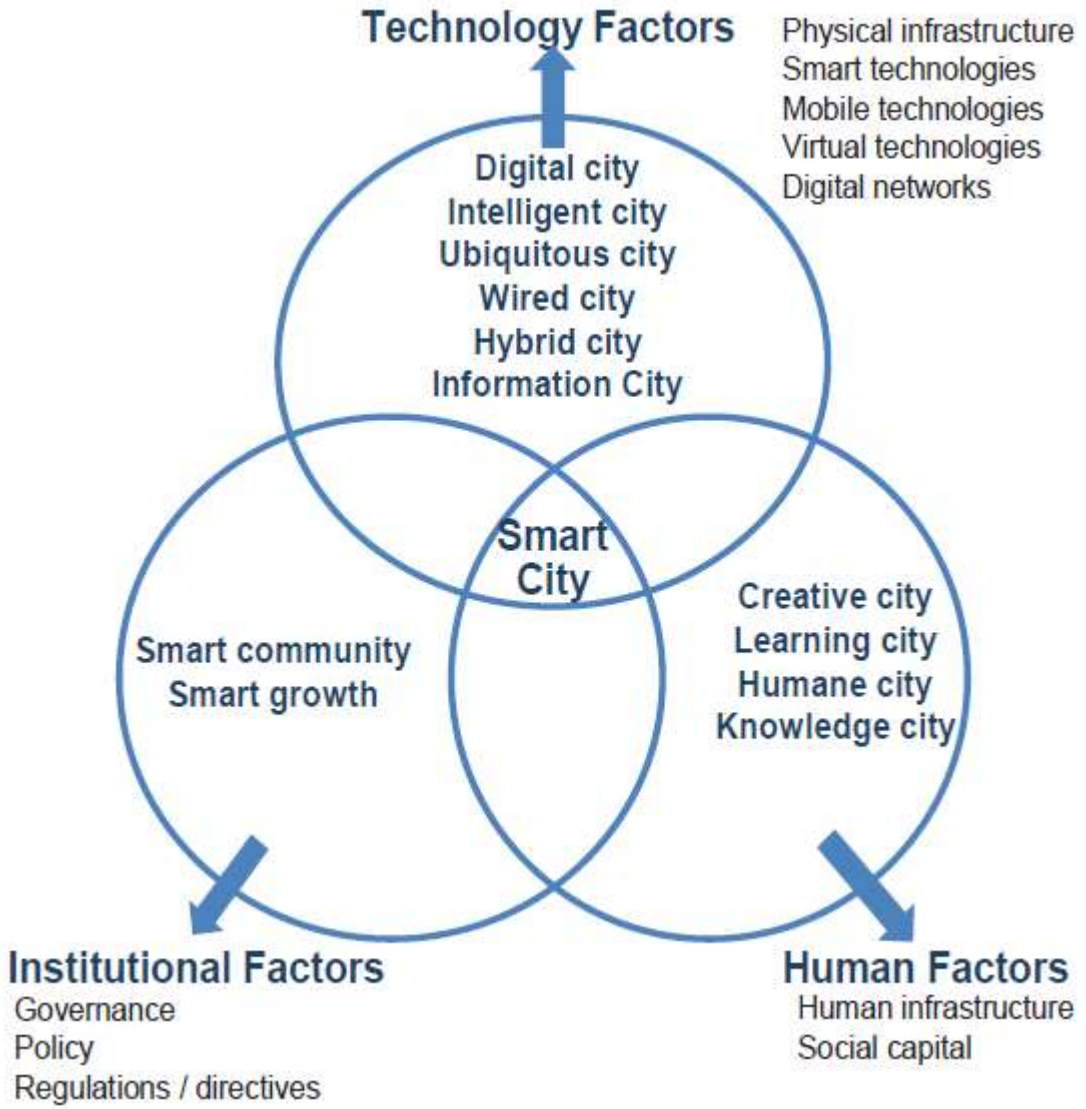
65+ GLOBAL TREND 1950-2050

DATA SOURCE
UN, World Population Prospects, 2012

STATE OF THE ART

Definition of the smart city

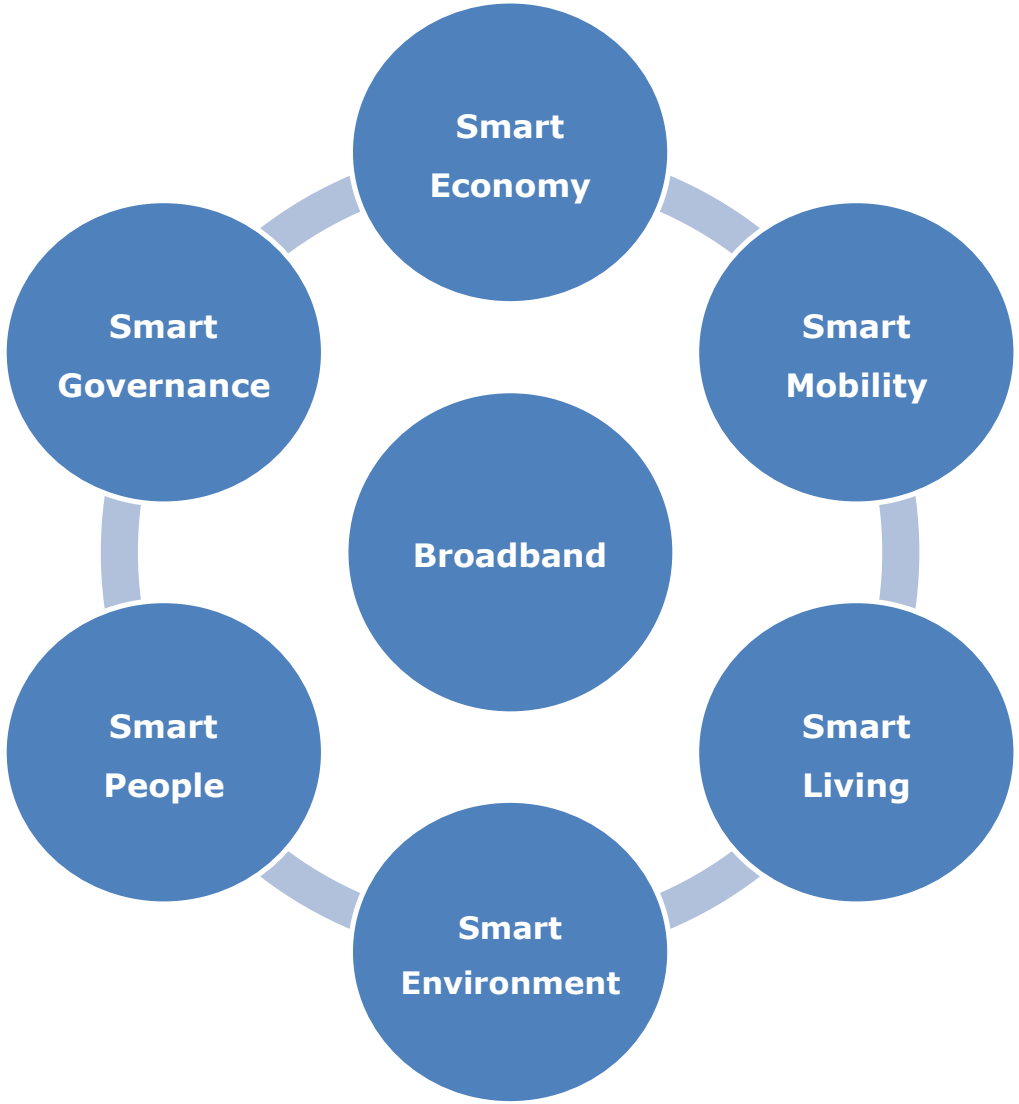
"**The Smart City is an abstract projection** of communities of the future, an application and conceptual perimeter **defined by a set of needs that find answers in technologies**, services and applications attributable to domains different "[1]



1- Report Monografico 01 - 2013 | Smart City

STATE OF THE ART

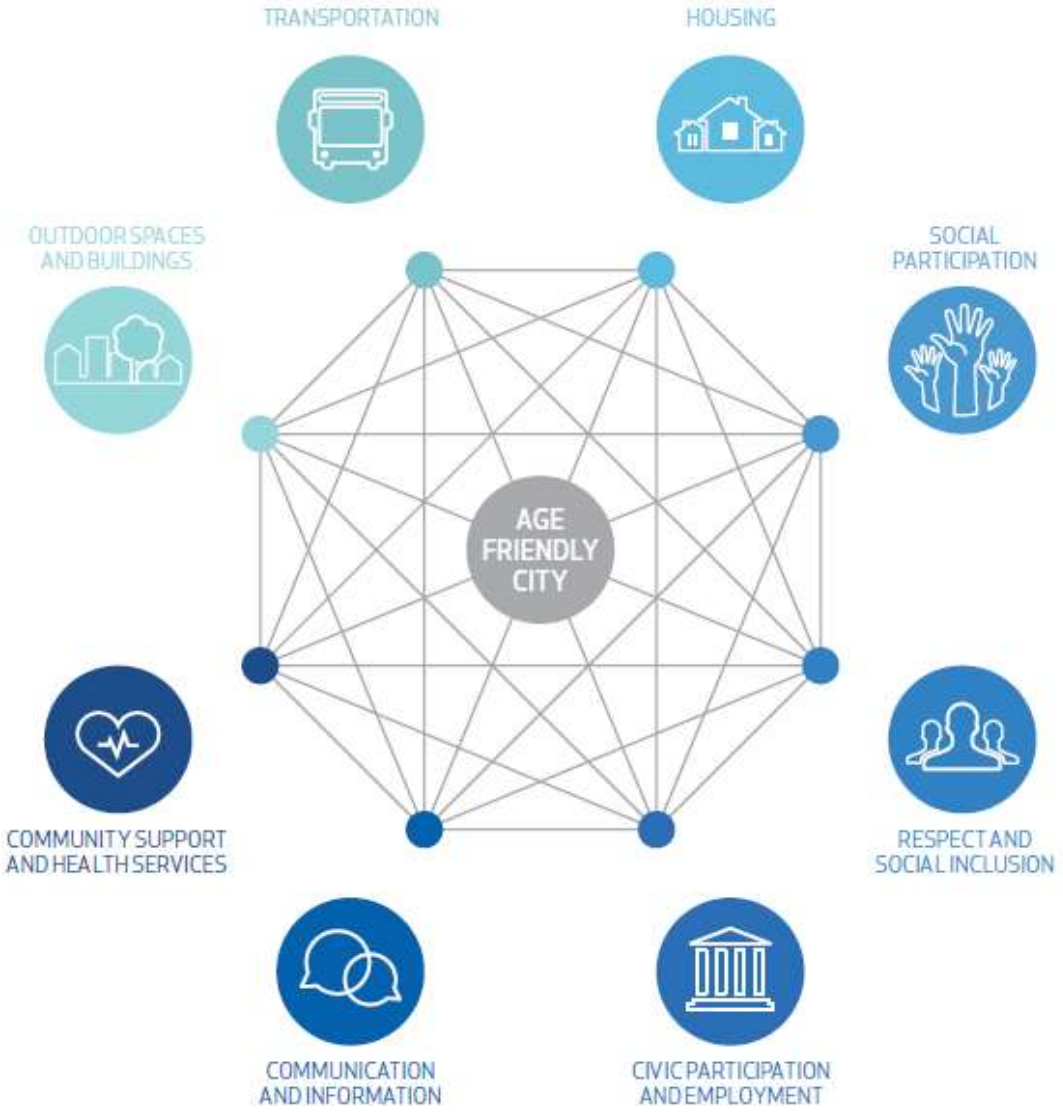
Category of Smart City



STATE OF THE ART

Smart City for the elderly

- Greater **accessibility to green**, recreational and collective areas;
- Saving on **health and transport** costs;
- Processes of participatory **requalification of neighborhoods** or areas of the city
- An improvement in **air quality** and **noise**



STATE OF THE ART

Characteristic Smart City for the elderly

WHO Classification[2]

Age-friendly transportation	Age-friendly housing	Social Participation	Social Inclusion	Age Friendly communication
Affordability	Affordability	Accessibility of events and activities	Respectful and inclusive services	Information offer
Travel Destinations	Essential services	Affordability	Public education	Oral communication
Transport Drivers	Maintenance	Range of events and activities	Public images of ageing	Plain Language
Safety and Confort	Ageing in place	Promotion and awareness	Intergenerational and family interactions	Computers and the internet
Transport stops and stations	Living environment	Addressing isolation	Community inclusion	
Age-friendly vehicles			Economic inclusion	

2- Report WHO-2015

2 METHODOLOGY

Methodology Recap

- **Search Indicators from reading**
- **Open data search**
- **GIS software**
- **Cluster processing (SPSS)**
- **Analysis (GIS)**

METHODOLOGY

Identification of indicators - selection criteria

- Smart Environment
- Smart Mobility
- Smart Living and People
- Smart Governance

Selection Criteria:

- Indicators for **ageing City**
- Data obtainable in every **European urban context**

RESULTS:

- Consulted literature: 32
- Indicators derived from the literature: 90
- Indicators by municipality
- Indicators used: **16**

METHODOLOGY

Environment Indicators

ENVIRONMENT

Litterature	Indicator	Category
I City Rate - 2017	PM10	Environment
I City Rate - 2017	PM2.5	Environment
I City Rate - 2017	NO2	Environment
I City Rate - 2017	Waste	Environment
Smart cities- Ranking of European medium-sized cities - 2011	Green Pianification	Environment
Smart cities- Ranking of European medium-sized cities - 2012	Altimetric Zone	Environment
Kim & Ulfarsson, 2004; Schmöcker et al. - 2012	Road slope	Environment
I City Rate - 2017	Recycling	Environment
I City Rate - 2017	Green incidence	Environment

METHODOLOGY

Mobility Indicators

MOBILITY

Litterature	Indicator	Category
I City Rate - 2017	Interchange	Mobility
I City Rate - 2017	Cycling	Mobility
I City Rate - 2017	Ecological Adaptation of Cars	Mobility
I City Rate - 2017	Eletric mobility	Mobility
I City Rate - 2017	TPL	Mobility
I City Rate - 2017	Car and Bike sharing	Mobility
I City Rate - 2017	Accidents	Mobility
I City Rate - 2017	Pedestrian Area	Mobility
una città a misura di anziano - 2017	Urban Transport Connection	Mobility
una città a misura di anziano - 2017	Railway Stations	Mobility
Kim & Ulfarsson, 2004; Schmöcker et al. - 2012	Public Transport Demand	Mobility
Kim & Ulfarsson, 2004; Schmöcker et al. - 2012	Public Transport Supply	Mobility
Kim & Ulfarsson, 2004; Schmöcker et al. - 20	Bus Stop Density	Mobility
Kim & Ulfarsson, 2004; Schmöcker et al. - 2012	Car Sharing Demand	Mobility
Kim & Ulfarsson, 2004; Schmöcker et al. - 2012	Car Sharing Supply	Mobility
Kim & Ulfarsson, 2004; Schmöcker et al. - 2012	Bike Sharing Suppy	Mobility
Kim & Ulfarsson, 2004; Schmöcker et al. - 20	Traffic Light Systems	Mobility

METHODOLOGY

Living and People Indicators

LIVING AND PEOPLE

Litterature	Indicators	Category
I City Rate - 2017	Crime in the City	Living and People
I City Rate - 2017	Voluntary Homicides	Living and People
I City Rate - 2017	Commercial Illegality	Living and People
I City Rate - 2017	Recycling	Living and People
I City Rate - 2017	Vaste Management	Living and People
Shaping Ageing Cities - 2015	Architectural Barriers	Living and People
Shaping Ageing Cities - 2015	Social Participation	Living and People
Shaping Ageing Cities - 2015	Respect and Social Inclusion	Living and People
Shaping Ageing Cities - 2015	Cultural Centre	Living and People
Shaping Ageing Cities - 2015	Communication and Information	Living and People
Shaping Ageing Cities - 2015	Life expectancy over 65	Living and People
Shaping Ageing Cities - 2015	Retirement age	Living and People
una città a misura di anziano - 2017	Street Lighting	Living and People
una città a misura di anziano - 2017	Railing and support systems along	Living and People
una città a misura di anziano - 2017	Stairs, Ramps and Slopes	Living and People
una città a misura di anziano - 2017	Accessible and adequaterly sized toilets	Living and People
una città a misura di anziano - 2017	Hospitals and Clinics	Living and People
una città a misura di anziano - 2017	City Market	Living and People
una città a misura di anziano - 2017	Pharmacies	Living and People
una città a misura di anziano - 2017	Shopping Centers	Living and People
una città a misura di anziano - 2017	Elderly care cost	Living and People
una città a misura di anziano - 2017	Benches	Living and People
città attiva - 2012	Courtyards	Living and People
città attiva - 2012	Efficient experimentation	Living and People
città attiva - 2012	Numer of robberies	Living and People
città attiva - 2012	Escalations with platform	Living and People
città attiva - 2012	Doctors for inhabitant	Living and People

METHODOLOGY

Governance Indicators

GOVERNANCE

Litterature	Indicators	Category
Shaping Ageing Cities - 2015	Voluntary Associations	Governance
Shaping Ageing Cities - 2015	Health service	Governance
I City Rate - 2017	Economic Suffering	Governance
I City Rate - 2017	Population at risk of poverty	Governance
I City Rate - 2017	Housing problems	Governance
I City Rate - 2017	Evictions	Governance
Shaping Ageing Cities - 2015	The Parish Organises Training Courses	Governance
Shaping Ageing Cities - 2015	Facility Technology for the Elderly	Governance

METHODOLOGY

Set of Indicators

SMART MOBILITY	5
SMART ENVIRONMENT	3
SMART LIVING AND PEOPLE	5
SMART GOVERNANCE	3
	16

METHODOLOGY

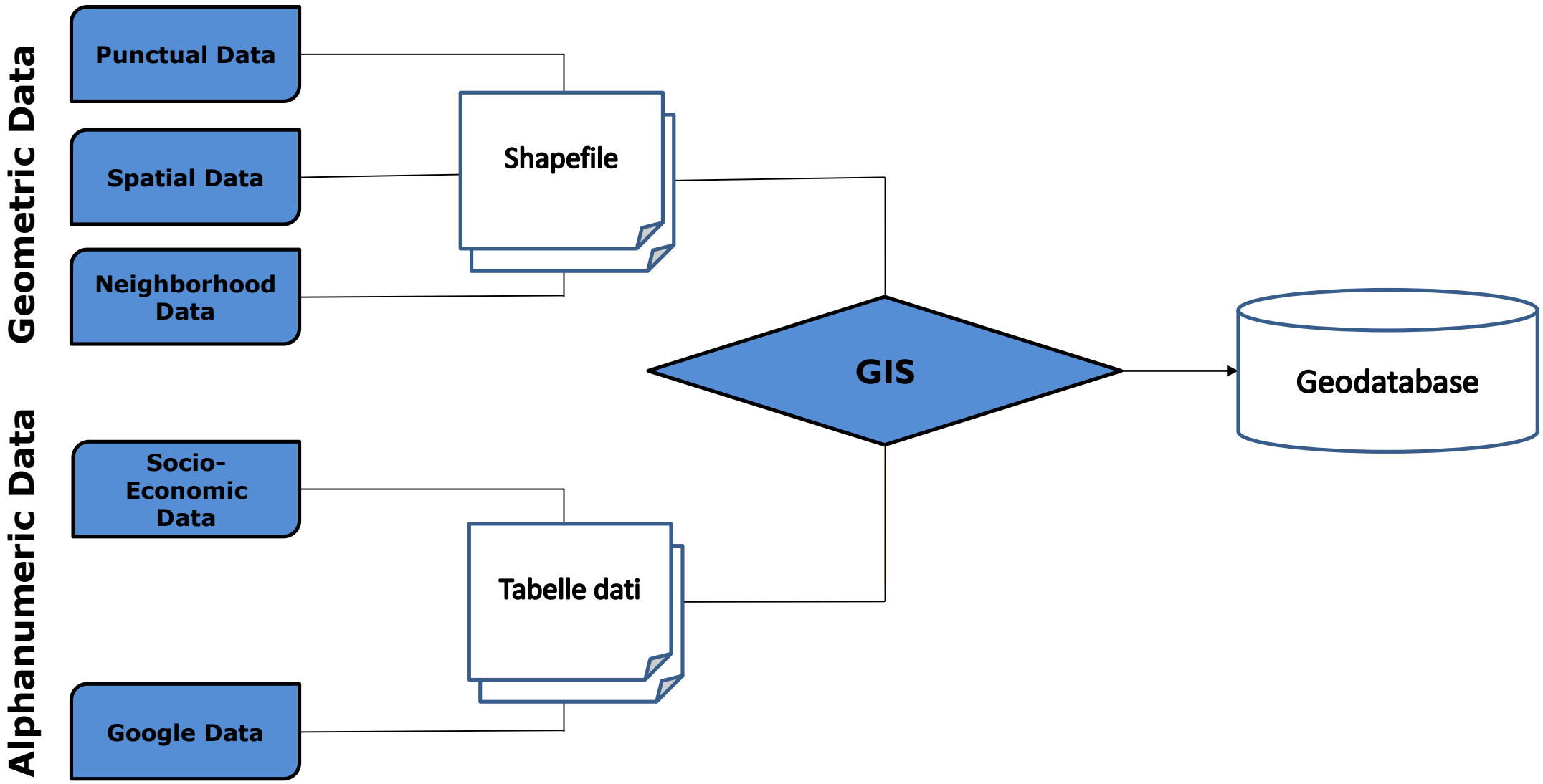
Identification of indicators - selection criteria

Category	Indicator	Literature
Environment	Green planning	Smart cities- Ranking of European medium-sized cities - 2011
	Road slope	Kim & Ulfarsson, 2004; Schmöcker et al. - 2012
	Recycling	I City Rate - 2017
Mobility	Pedestrian Area	I City Rate - 2017
	Railway Stations	Una città a misura di anziano - 2017
	Bus Stop Density	Kim & Ulfarsson, 2004; Schmöcker et al. - 2014
	Traffic Light Systems	Kim & Ulfarsson, 2004; Schmöcker et al. - 2018
Living and People	Cultural Centre	Shaping Ageing Cities - 2015
	Life expectancy over 65	Shaping Ageing Cities - 2015
	Hospitals and Clinics	Una città a misura di anziano - 2017
	City Market	Una città a misura di anziano - 2017
	Pharmacies	Una città a misura di anziano - 2017
Governance	Voluntary Associations	Shaping Ageing Cities - 2015
	Health service	Shaping Ageing Cities - 2015
	Facility Technology	Shaping Ageing Cities - 2015

Parametrs	Data Format	Source
Popolation	Alfanumeric Data	ISTAT - INE
District Area	Alfanumeric Data	ISTAT- INE

METHODOLOGY

Data use



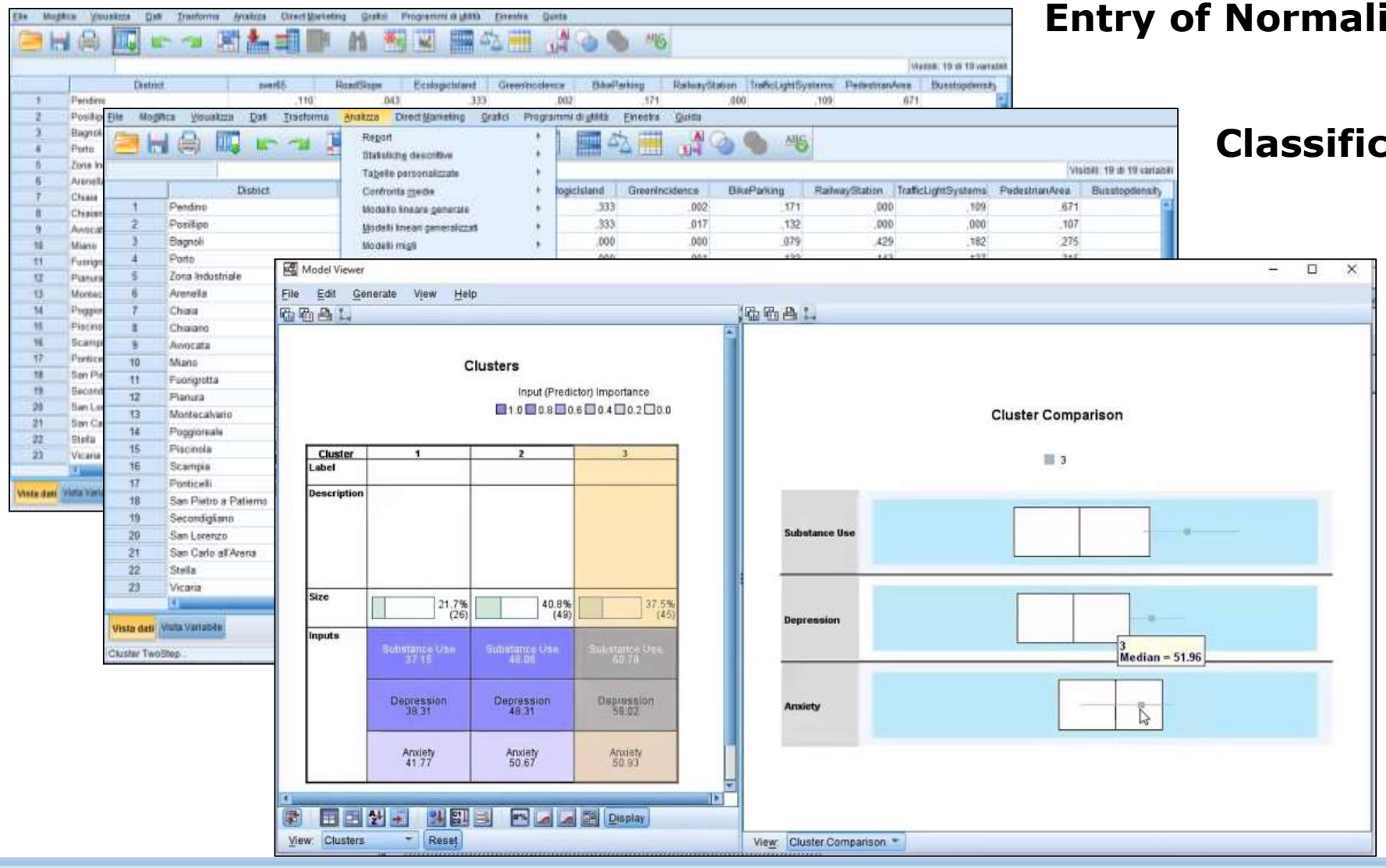
METHODOLOGY

Application of Cluster Analysis in SPSS

Entry of Normalized Indicator data

Classification with Cluster two step

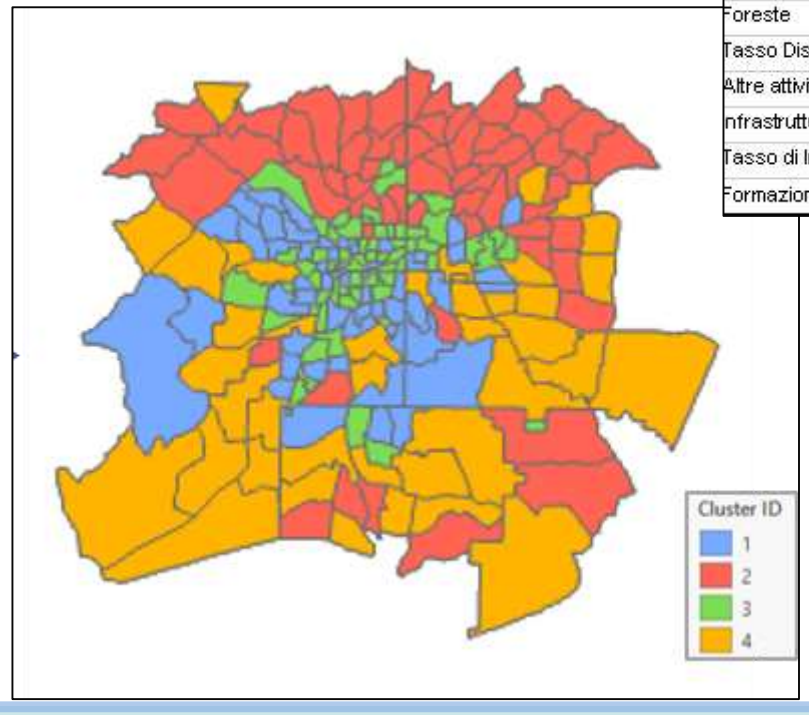
Cluster Results

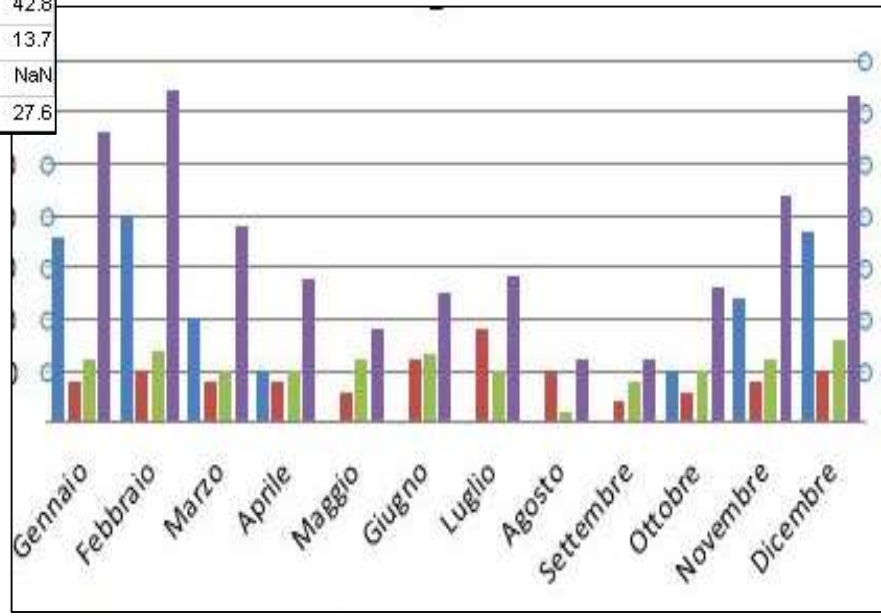


METHODOLOGY

Results of SPSS

Cluster	Aree urbane	Aree ricche emigrazioni	Aree turistiche	Periferia boschiva	Centro rurale manifatturiero	Aree urbane UK
Numero Nuts 3	58	115	83	52	245	2
Densità	1113	163	92	42	170	3.445
Pil pro capite	35.084	25.084	22.635	22.577	22.341	19.800
Val. Aggiunto agricoltura	0.2	1.5	2.4	3.8	2.5	0.1
Val. Aggiunto industria	19.4	29.4	13.8	26.2	18.9	23.7
Occ. agricoltura	0.5	4.1	5.8	6.7	5.1	0.5
Occ. industria	16.2	27.9	13.1	21.3	18.6	16.4
Accessibilità	112.9	114.3	79.1	68.7	105.4	95.2
Area artificiale	0.36	0.06	0.04	0.02	0.07	0.78
Area agricola	0.41	0.56	0.37	0.18	0.66	0.09
Foreste	0.17	0.34	0.31	0.60	0.22	0.02
Tasso Disoccupazione	9.8	5.2	8.2	7.8	6.3	11.6
Altre attività agricoltori	47.5	53.9	33.9	58.6	32.0	42.8
Infrastrutture Turistiche	33.5	58.4	385.4	81.8	69.4	13.7
Tasso di Immigrazione	1.6	-2.1	6.2	3.3	4.0	NaN
Formazione agricoltori	67.8	64.1	36.7	36.3	52.6	27.6



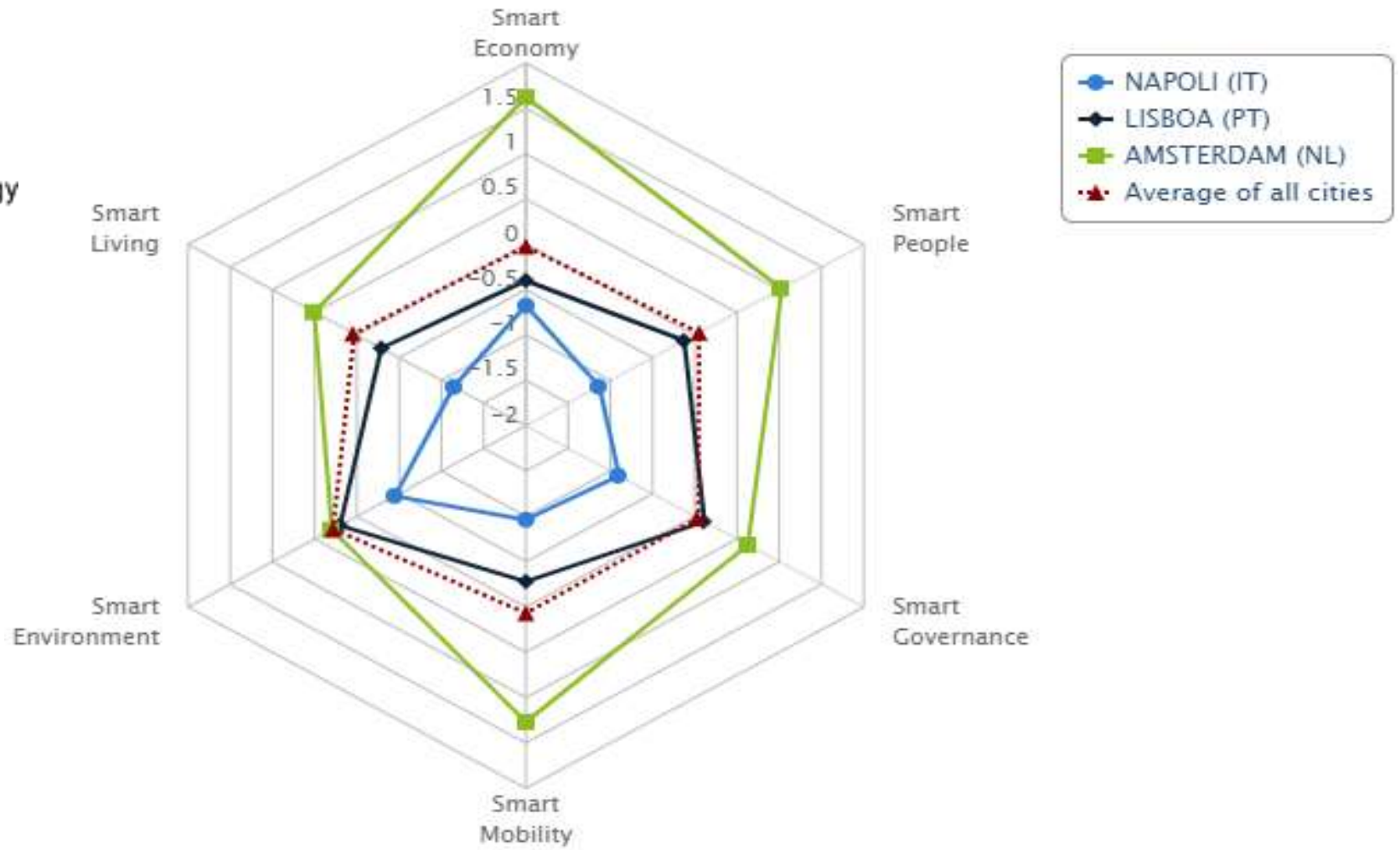


3 APPLICATION

Application

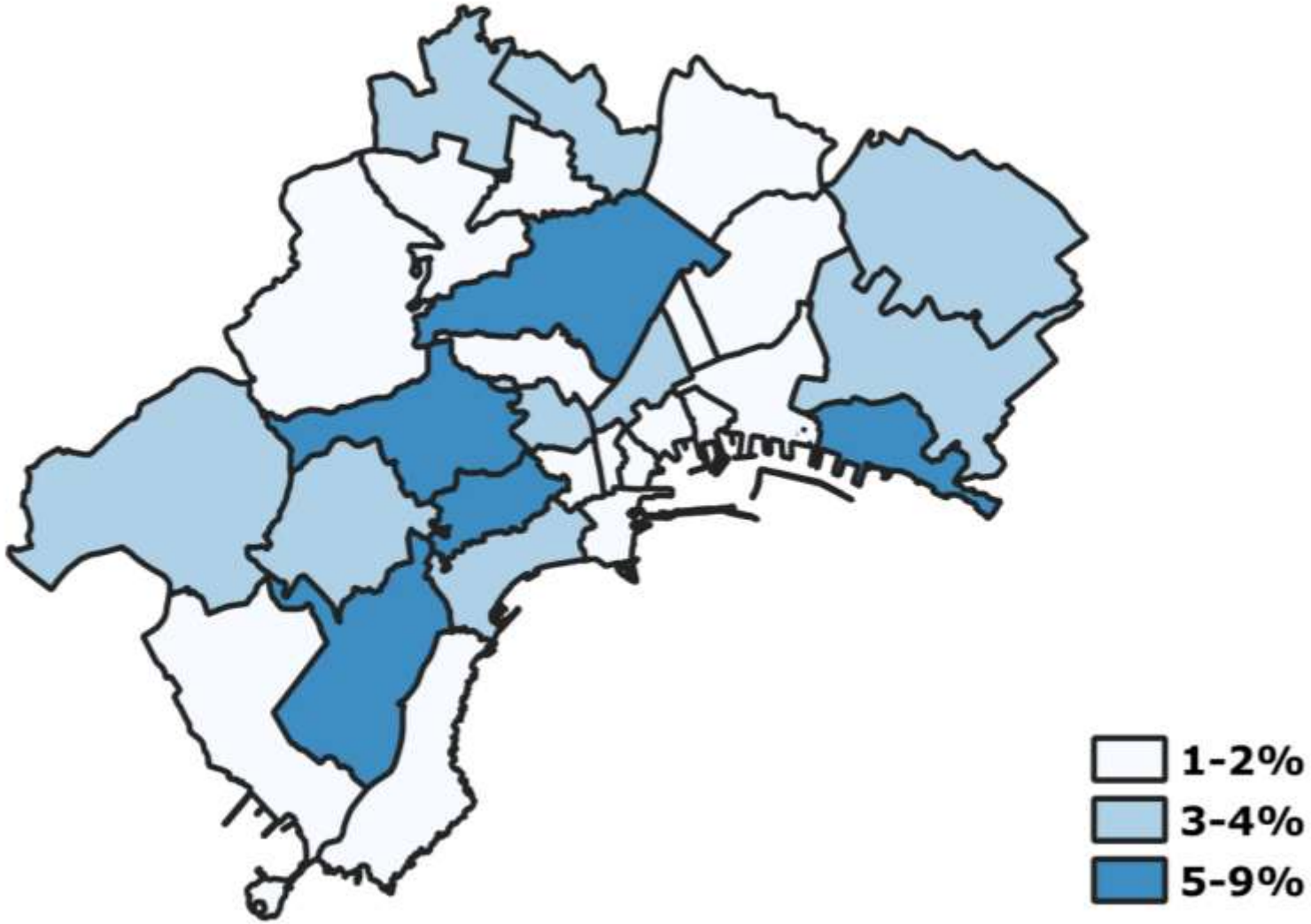
Naples and Lisbon Smart City

TECHNISCHE UNIVERSITÄT WIEN
Vienna University of Technology



Application

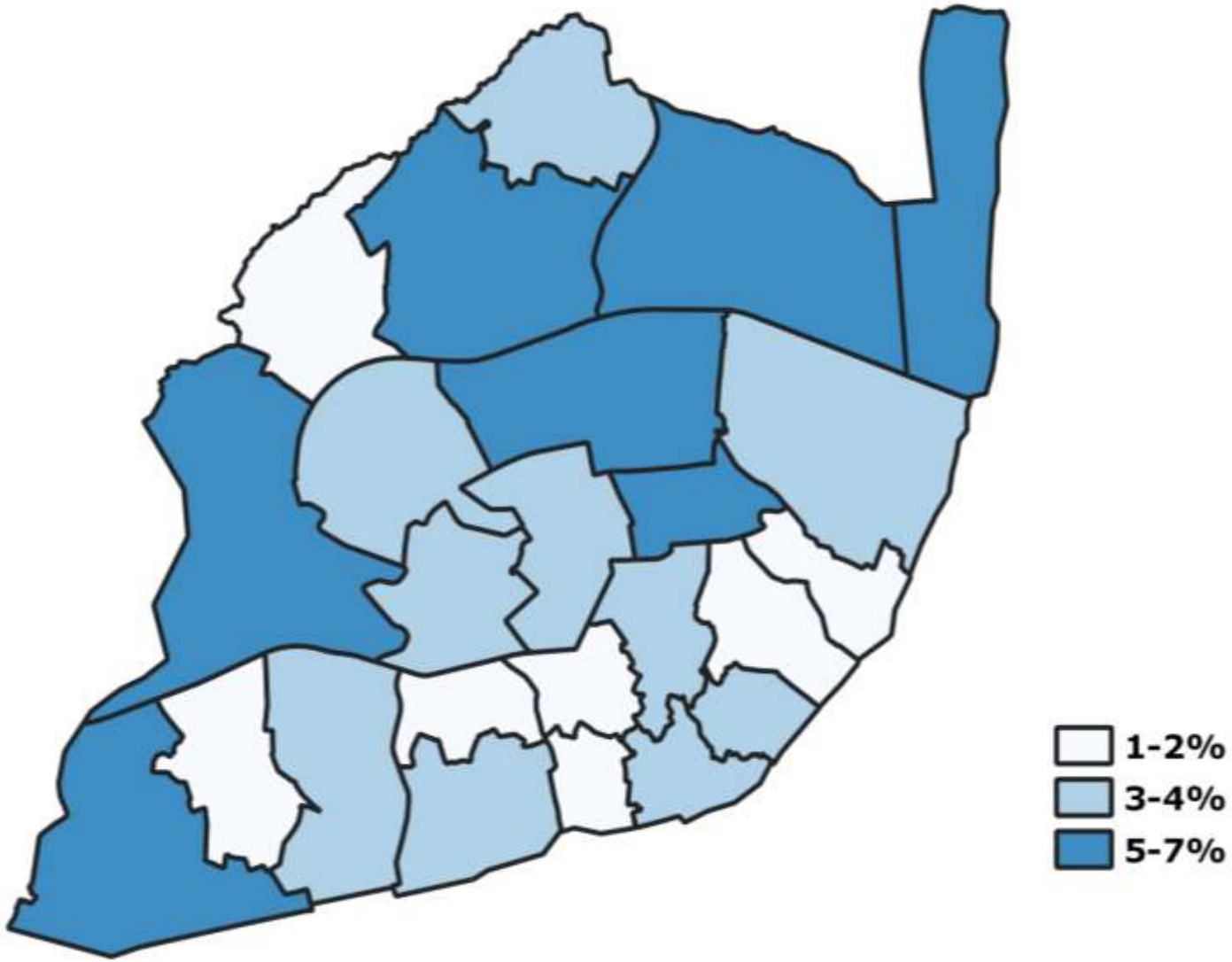
Case of Naples



- **Population increase over65** from 2001 to 2011: 11.20%
- **Total population:** 962.003
- **Tot over 65**: 172.337
- **Neighborhoods with higher numbers of elderly**: Arenella, Fuorigrotta, San Carlo d'Arena, Vomero

Application

Case Study of Lisbon



- **Population increase over 65** from 2001 to 2011:7.69%
- **Total population:** 547.733
- **Tot over 65**: 143.105
- **Neighborhoods with higher numbers of elderly**: Alvalade, Arroios, Penha de França

Application

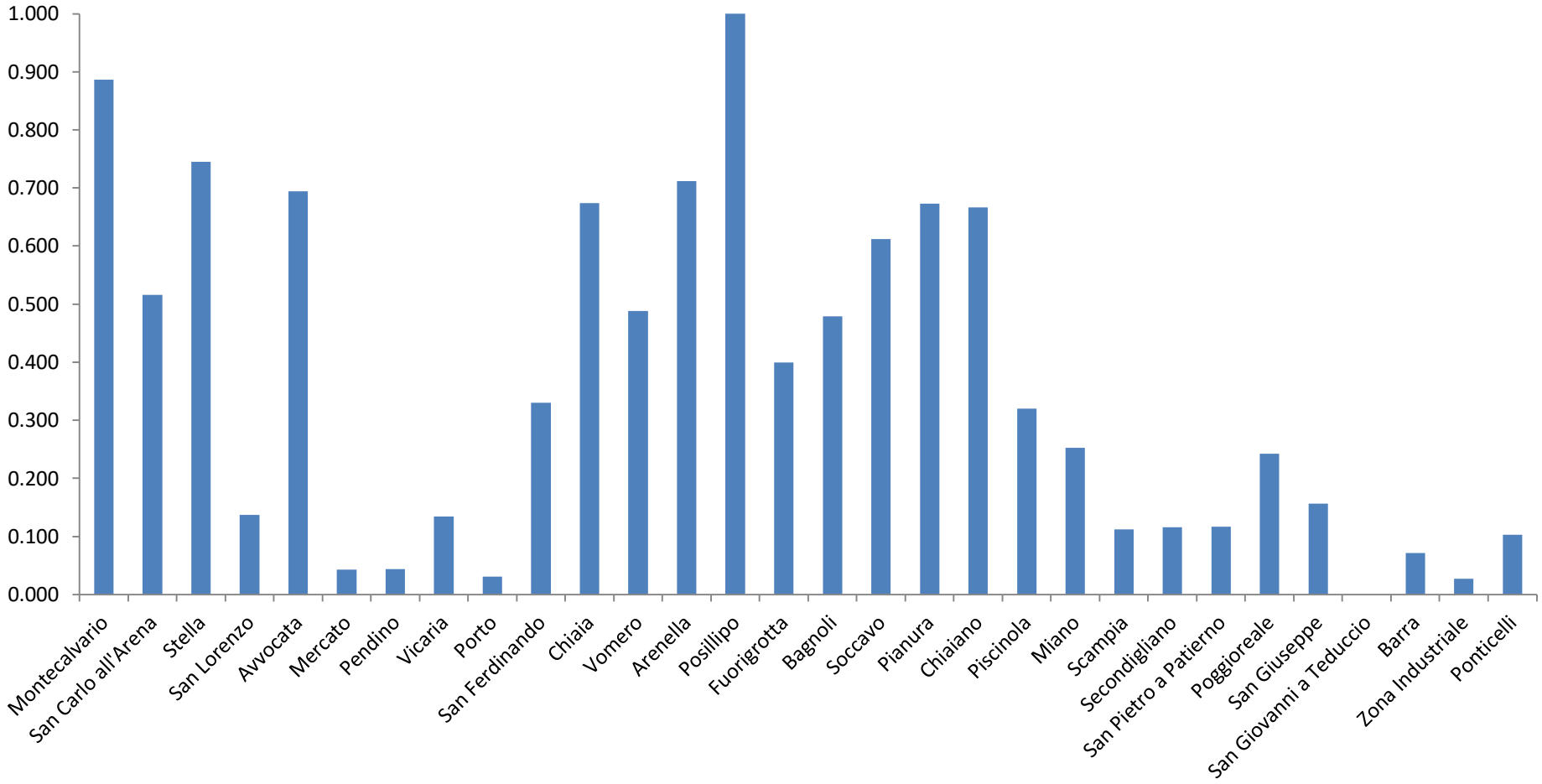
Indicators for Naples and Lisbon

Category	Indicator	Source for Naples	Source for Lisbon
Environment	Green planning	ISTAT	INE
	Road slope	GIS	GIS
	Recycling	ASIA	INE
Mobility	Pedestrian Area	ISTAT	INE
	Railway Stations	ISTAT	INE
	Bus Stop Density	Street View	Street View
	Traffic Light Systems	Street View	Street View
Living and People	Cultural Centre	Street View	Street View
	Life expectancy over 65	ISTAT	INE
	Hospitals and Clinics	Street View	Street View
	City Market	Street View	Street View
	Pharmacies	Street View	Street View
Governance	Voluntary Associations	ISTAT	INE
	Health service	ISTAT	INE
	Facility Technology	ISTAT	INE

METHODOLOGY

Example of Environment indicator For Naples

Road Slope



$$S = \left(\frac{Lt * e}{A}\right) * 100$$

Lt = total length of the contour lines;

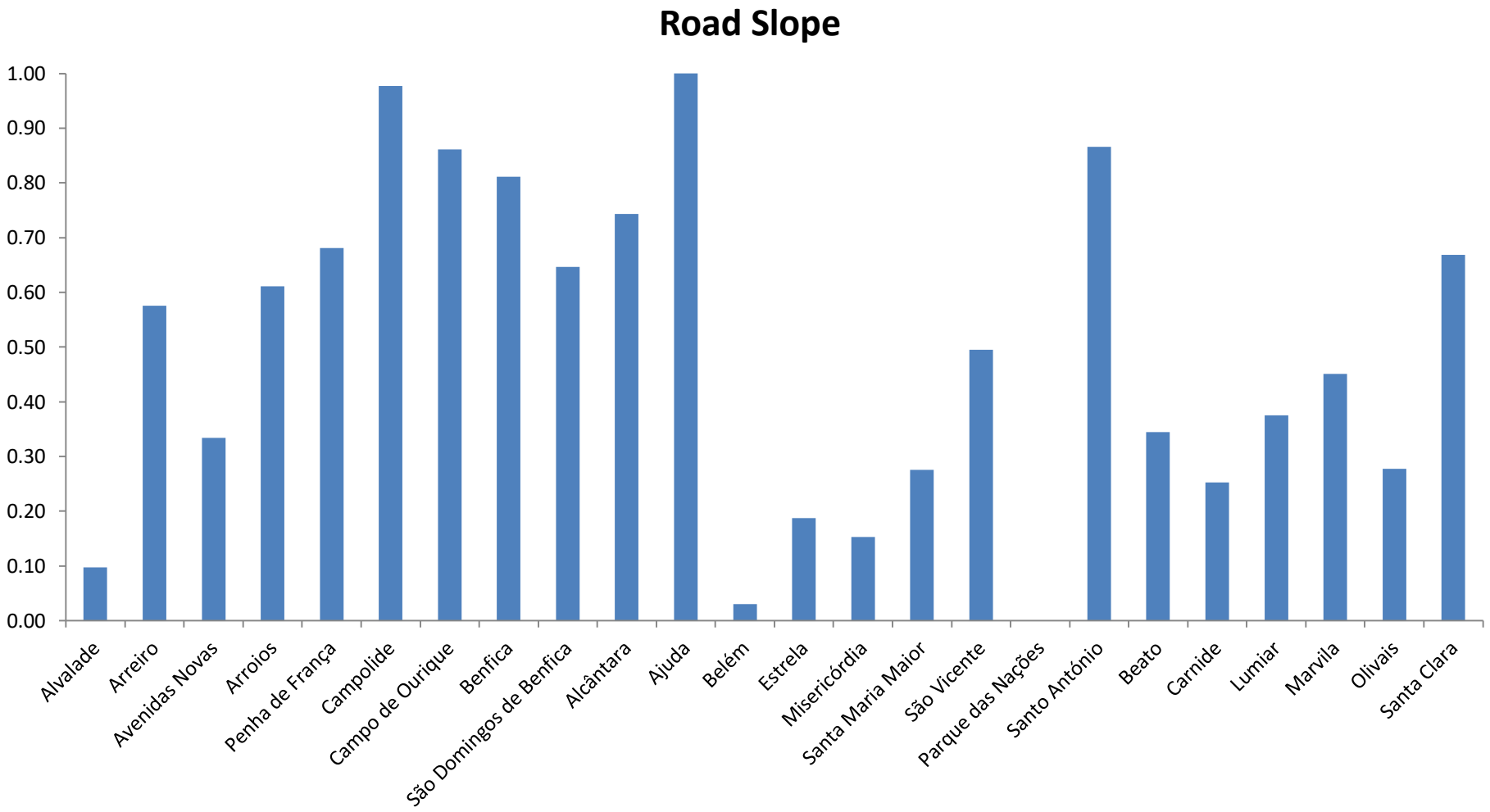
e = equidistance level curves (step);

A = area occupied by the neighbourhood.

City Centre → **Outskirts**

METHODOLOGY

Example of Environment indicator for Lisbon

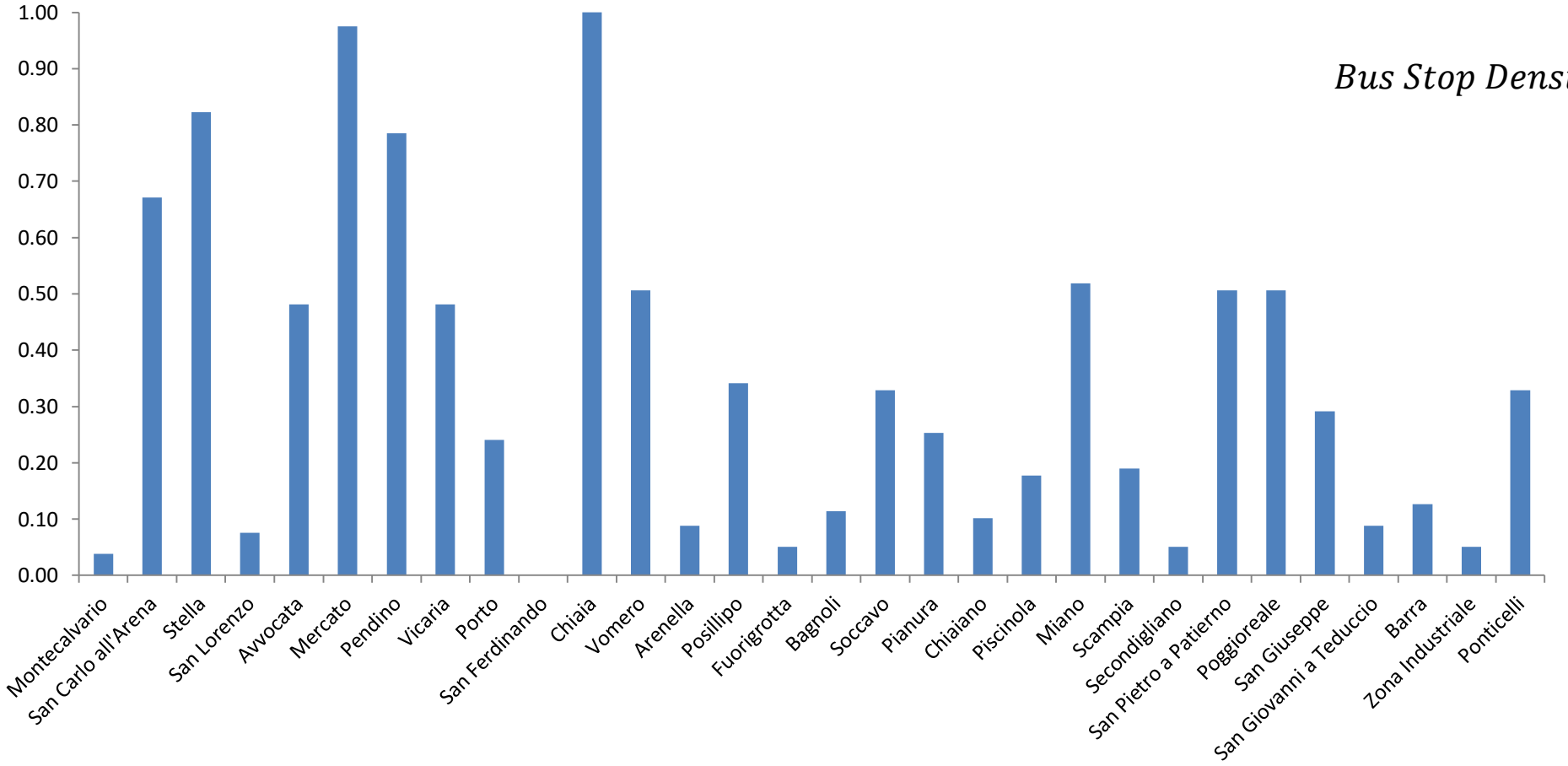


City Centre → **Outskirts**

METHODOLOGY

Example of Mobility indicator for Naples

Bus stop density

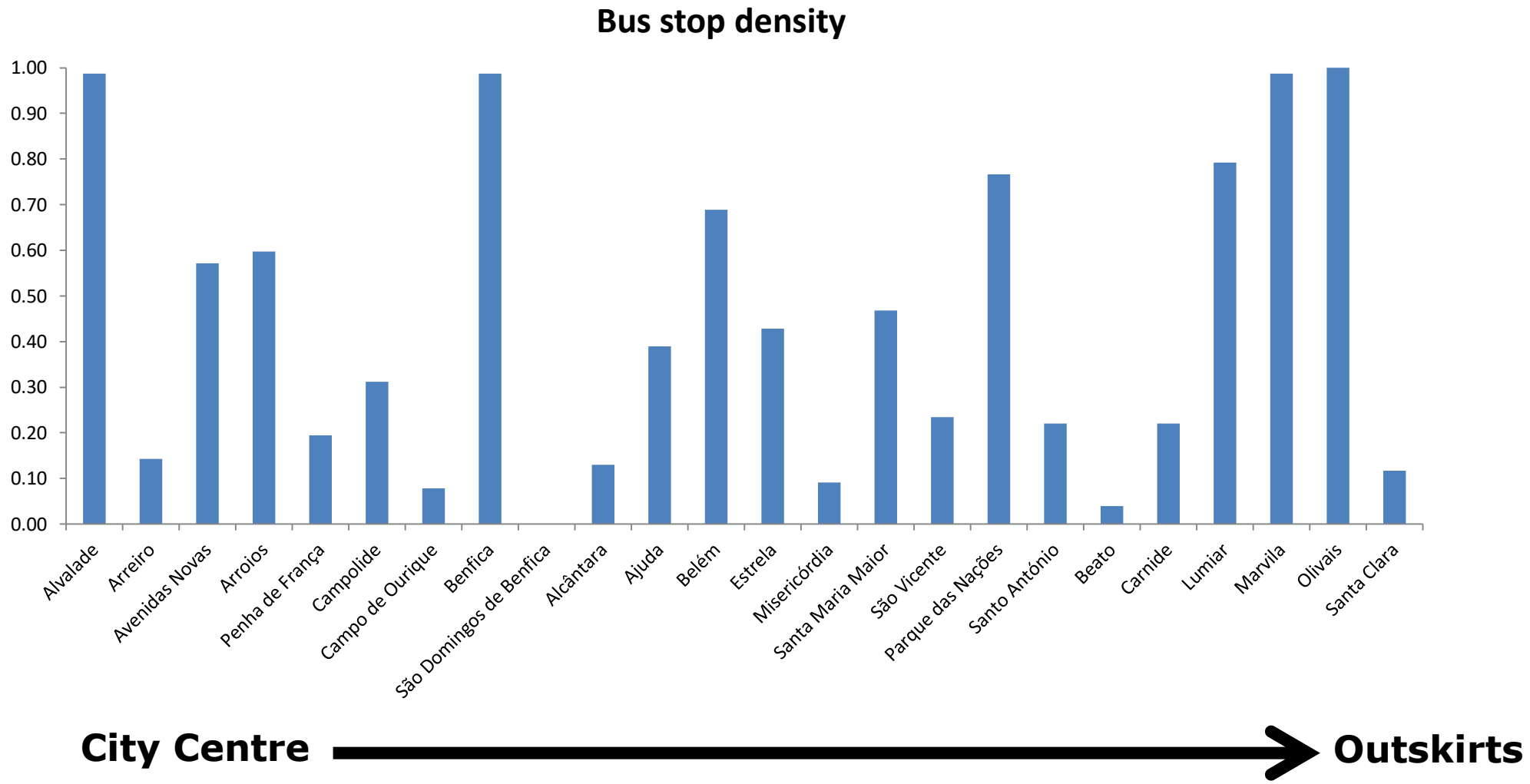


$$Bus\ Stop\ Density = \frac{Number\ of\ stops\ in\ the\ district}{Area}$$

City Centre → **Outskirts**

METHODOLOGY

Example of Mobility indicator for Lisbon



City Centre → **Outskirts**

Application

Cluster Analysis Results for Naples

	Indicators	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Average Value
		17	1	6	2	2	1	
ENVIRONMENT	Green Incidence	0.13	0.29	0.08	0.58	0.34	0.17	0.27
	Ecologic Island	0.12	0.39	0.17	0.67	0.67	0.33	0.39
	Road Slope	0.80	0.25	0.91	0.50	0.40	0.60	0.58
MOBILITY	Railway Station	0.29	0.12	0.00	0.21	0.36	1.00	0.33
	Traffic Light sistem	0.08	0.04	0.15	0.09	0.14	1.00	0.25
	Bike Parking	0.09	0.16	0.59	0.31	0.17	1.00	0.39
	Bus Stop Density	0.21	0.27	0.29	0.82	0.32	0.37	0.38
LIVING AND PEOPLE	Pedestrian Area	0.07	0.22	0.84	0.48	0.13	0.00	0.29
	Super market	0.18	0.11	0.23	0.14	0.95	0.82	0.41
	Pharmacy	0.08	0.15	0.09	0.23	0.82	0.09	0.24
	Cultural Centre	0.10	0.29	0.26	0.92	0.53	0.21	0.39
	Hospitals with departments for the elderly	0.06	0.13	0.61	0.06	0.28	0.33	0.25
	Over 65	0.20	0.36	0.28	0.32	0.82	0.94	0.49
GOVERNANCE	Voluntary Associations for the Elderly	0.10	0.44	0.50	0.17	0.33	0.00	0.26
	Health District(ASL)	0.37	0.58	0.38	0.50	0.25	0.50	0.43
	Facility Technology for the Elderly	0.06	0.11	0.67	0.50	0.00	0.00	0.22

Cluster 1: Areas with insufficient services;

Cluster 2: Neighborhoods with Health District;

Cluster 3: Areas with limited accessibility to means of transport;

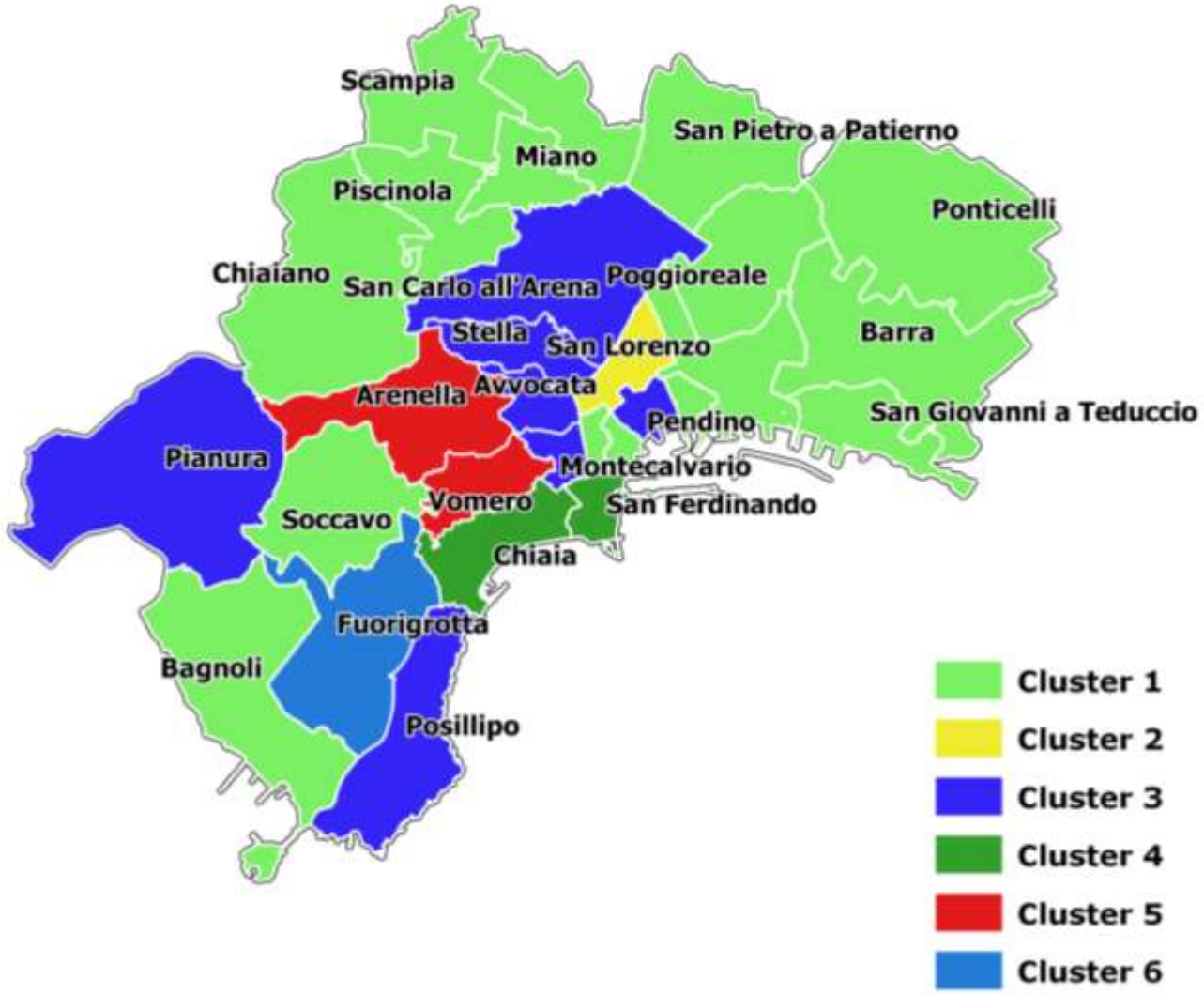
Cluster 4: Areas with higher quality of urban service

Cluster 5: Neighborhoods with environmental facilities

Cluster 6: Safe accessibility area.

Application

Cluster Analysis Results for Naples



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Cluster 4: Areas with higher quality of urban service

Cluster 5: Neighborhoods with environmental facilities

Cluster 6: Safe accessibility area.

Application

Cluster Analysis Results for Lisbon

	Indicators	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7	Average Value
		2	3	5	1	2	1	10	
ENVIRONMENT	Green Incidence	0.26	0.45	0.64	0.96	0.38	0.62	0.00	0.47
	Ecologic Island	0.25	0.35	0.73	0.50	0.73	0.36	0.09	0.43
	Road Slope	0.65	0.34	0.25	0.42	0.47	0.65	0.28	0.44
MOBILITY	Railway Station	0.20	0.42	0.26	0.77	0.50	0.23	1.00	0.48
	Traffic Light sistem	0.13	0.20	0.41	0.16	0.77	0.32	0.31	0.33
	Bike Parking	0.09	0.40	0.46	0.12	0.69	0.12	0.50	0.34
	Bus Stop Density	0.18	0.51	0.93	0.84	0.58	0.00	0.47	0.50
LIVING AND PEOPLE	Pedestrian Area	0.06	0.09	0.05	0.09	0.07	0.10	1.00	0.21
	Super market	0.10	0.15	0.20	0.25	0.86	0.32	0.59	0.35
	Pharmacy	0.10	0.12	0.19	0.15	0.28	0.14	0.24	0.17
	Cultural Centre	0.15	0.09	0.18	0.38	0.32	0.21	1.00	0.33
	Hospitals with departments for the elderly	0.10	0.00	0.33	0.00	0.00	1.00	0.50	0.28
	Over 65	0.25	0.38	0.58	0.83	0.70	0.77	0.01	0.50
GOVERNANCE	Voluntary Associations for the Elderly	0.10	0.30	0.00	0.00	0.75	0.50	0.00	0.24
	Healt District(SNS)	0.15	0.00	0.50	0.75	0.25	1.00	0.00	0.38
	Facility Technology for the Elderly	0.12	0.55	0.27	0.14	0.27	1.00	0.36	0.39

Cluster 1: Areas with limited accessibility to means of transport;

Cluster 2: Areas with reduced smartness;

Cluster 3: Low quality residential suburban areas

Cluster 4: Areas with higher quality of urban services

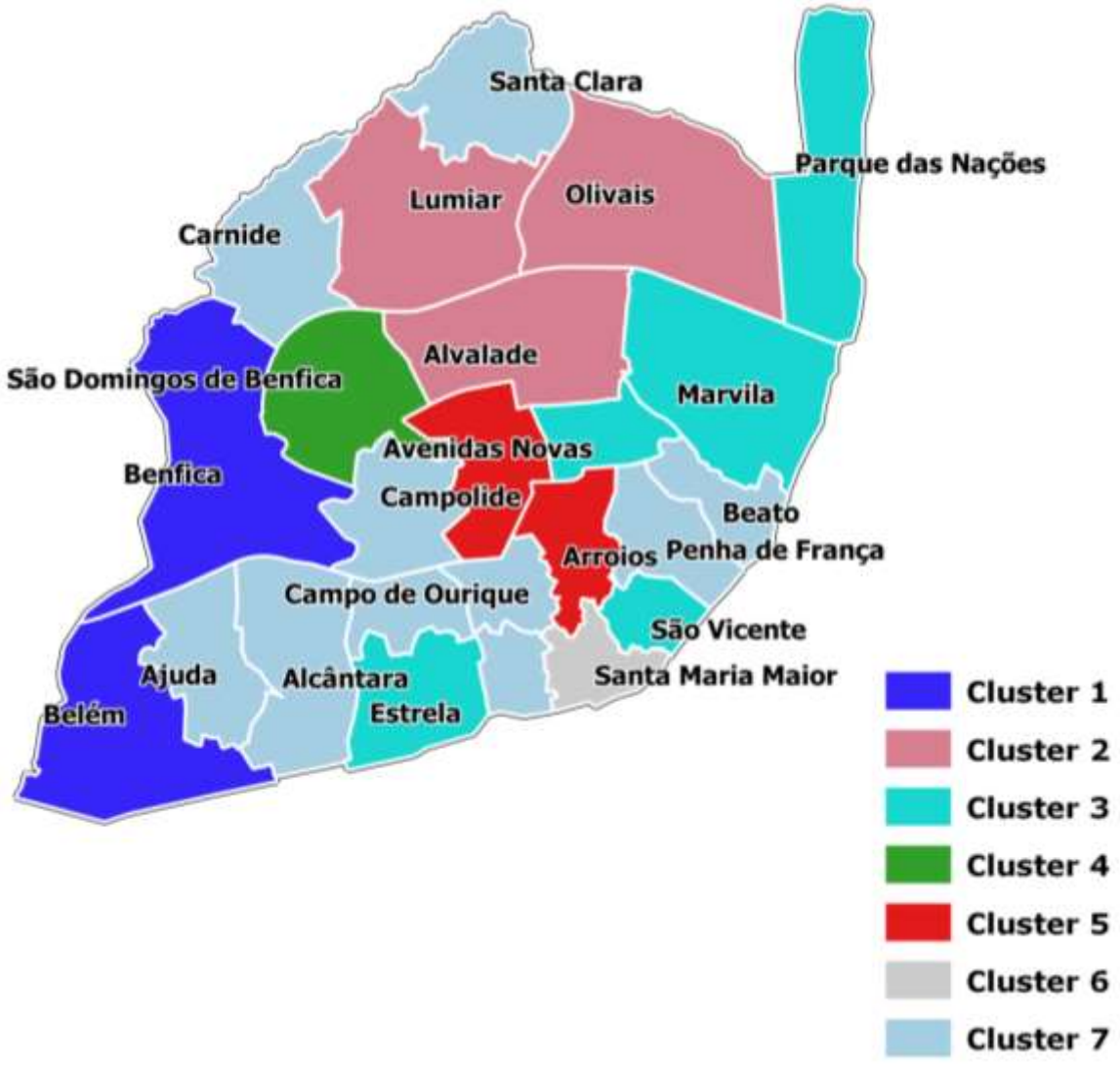
Cluster 5: Safe accessibility area.

Cluster 6: Areas with a hight urban services

Cluster 7: Areas served by health services

Application

Cluster Analysis Results for Lisbon



Cluster 1: Areas with limited accessibility to means of transport;

Cluster 2: Areas with reduced smartness;

Cluster 3: Low quality residential suburban areas

Cluster 4: Areas with higher quality of urban services

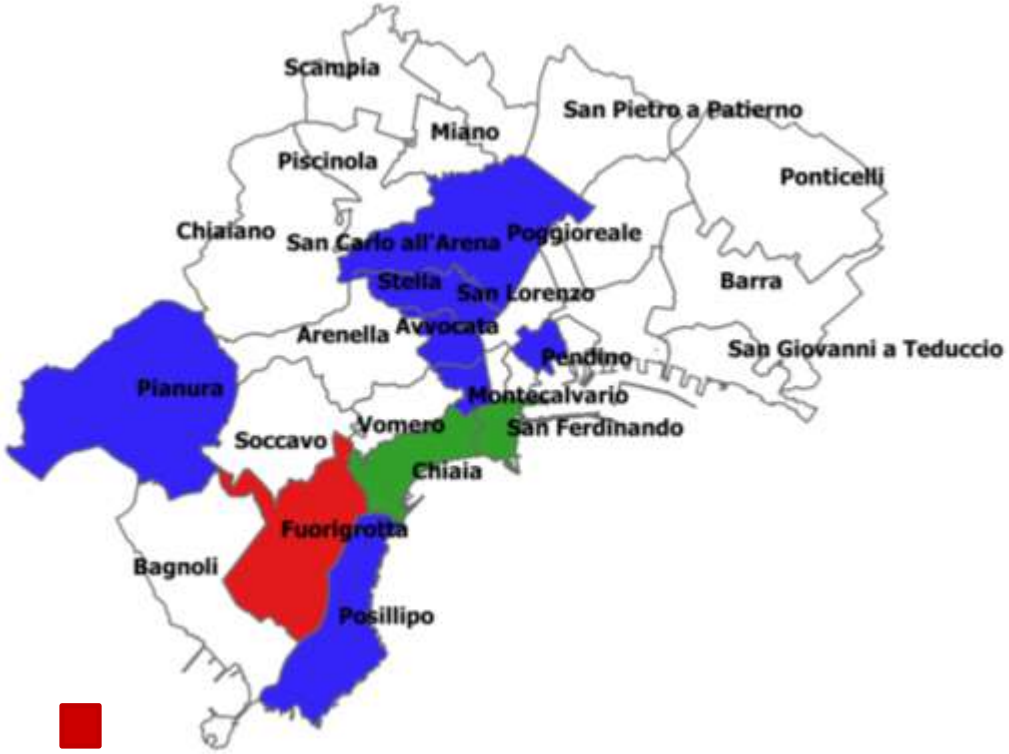
Cluster 5: Safe accessibility area.

Cluster 6: Areas with a hight urban services

Cluster 7: Areas served by health services

Application

Naples-Lisbon comparison



Areas with a higher urban services

Areas with limited accessibility to means of transport

Areas with higher quality of urban structure

CONCLUSIONS

- The presence in the literature of numerous **articles concerning the smart city**, and in particular the smart city for the elderly, has meant that a certain number of **quantitative characteristics** could be identified, such as to be able to describe what are the characteristics of a **smart city for elderly**.

- The evaluation of the methodology has defined **a decision support system**, applicable to any European urban context. In particular, through the use of a classification software it is possible to divide the **municipality into different categories**, depending on the predominant characteristics.

- The application of the methodology to the case studies has brought two very important results. The first is the presence of some **neighborhoods compared to others of a greater age friendly**, and moreover a **correspondence** has been identified **between the cities of Naples and Lisbon**, which have presented many neighborhoods with the same characteristics.