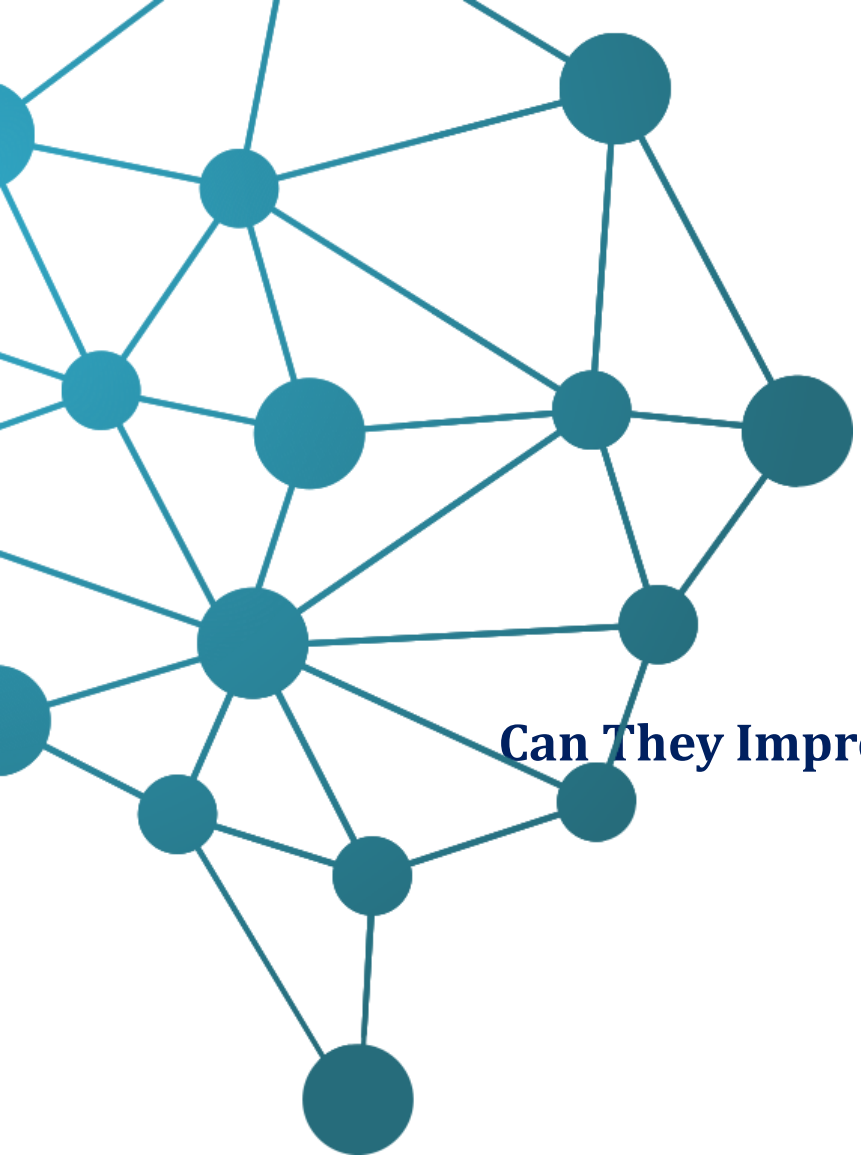

smartEIZ

Smart City Indicators: Can They Improve Governance in Croatian Large Cities?

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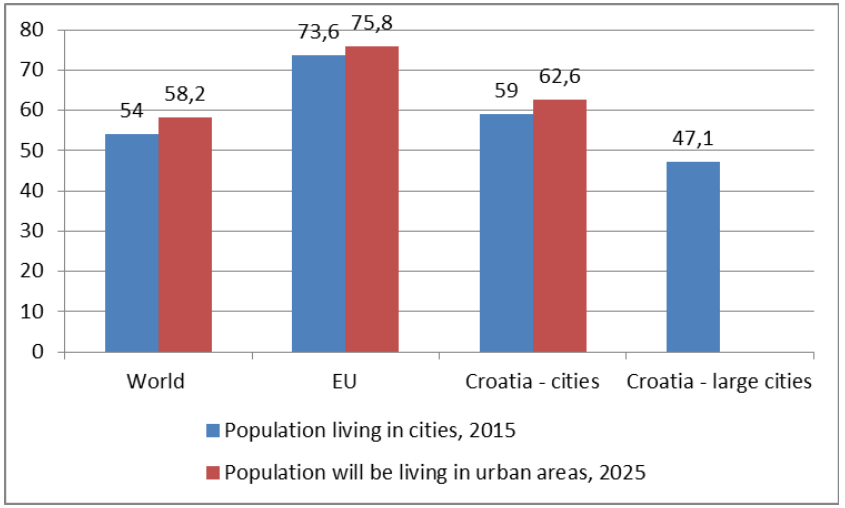
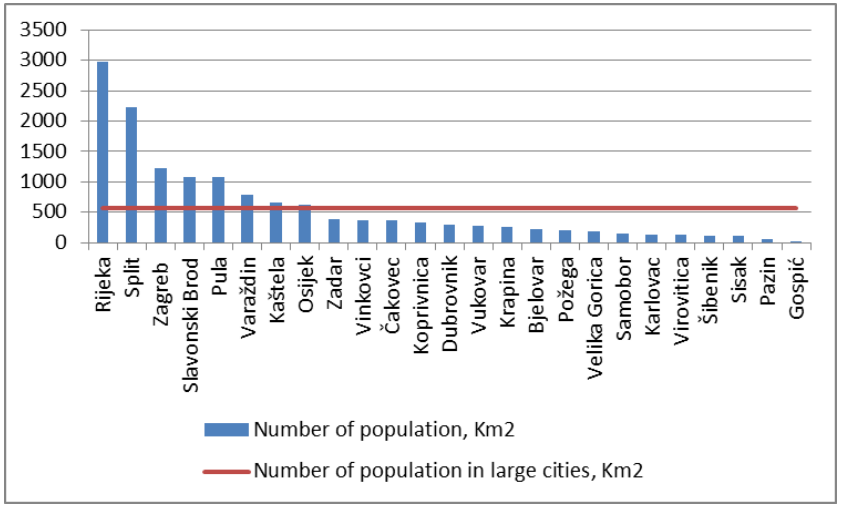
SmartEIZ Conference
"Smart Specialization Strategies: Contemporary Challenges of its Design and Implementation"
25th –26th September, 2018, The Institute of Economics, Zagreb at Hotel Dubrovnik, Zagreb

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 692191.

Motivation

- More than half of the world's population live in cities and 76.6 percent of EU inhabitants live in urban areas (EC and UN-HABITAT, 2016)
- Cities, as highly density places, are faced with constant need to increase energy consumption, transportation, buildings and public spaces, etc. (OECD, 2015)
- This is a reason for the creation of „smart" solutions that ensure economic prosperity and social wellbeing for citizens
- The most efficient way to achieve that is by mobilizing a city's resources and actors using new technologies and policies **- Smart City model**





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What presentation covers?

- The **smart city concept** and the development of **smart city indicators for twenty-five major Croatian cities** are being explored
  - Smart city indicators are developed in six dimensions of the smart city model: economy, people, governance, mobility, environment and living
  - Their purpose refers to the making strategic decisions for a better life of citizens and the creation of appropriate working conditions for entrepreneurs
- Available data from **public and freely available sources** are used and data obtained by surveys and interviews of city authorities
  - Key indicators for a reference model for monitoring the success of Croatian large cities have been prepared
  - **Twenty-nine indicators** were compiled for comparing twenty-five large Croatian cities and assessing their comparative advantage in six dimensions of the smart city model
- The research results provide **an assessment of the smart urban development index** and **ranking of cities based on this index**
  - Out of twenty-five cities, **only eleven cities** have the positive values of a smart urban development index
  - City policy makers are proposed appropriate measures to encourage smart and locally driven development

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Previous experience of applying a smart city model in Croatia 1

- Smart City model - a scientific project in Austria in 2007 (Giffinger et al., 2007)
- There are five Croatian cities with a **Smart Management Strategy**:
  - Dubrovnik, Kastav, Karlovac, Rijeka, Zagreb
- Thirty cities have developed **smart projects** in different sectors:
  - Smart parking and solutions for environmental monitoring and control – Dubrovnik
  - Urban mobility and public bicycles - Slavonski Brod, Koprivnica, Karlovac, Osijek, Gospić, Senj, Otočac, Karlobag and other cities
  - Possibility of car sharing or driving – Zagreb
  - Solutions for monitoring public transport - Zagreb, Osijek
  - Island service management (parking lot monitoring system, waste management records, etc.) - the city of Krk and the municipalities on the island of Krk
  - Overview of traffic and tourism trends - Zagreb, Osijek, Rijeka, Velika Gorica, Koprivnica, Pula
  - Solutions for energy efficiency in cities - Sisak and Labin
  - Solutions to support entrepreneurial climate and transparency of city administration; openness to entrepreneurs - Pula and Ivanec
  - Sustainable communal infrastructure - Umag

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Previous experience of applying a smart city model in Croatia 2

- Examples of good practices, such as modernized waste management records, analytical review of traffic and tourism trends, e-mobility, digital city-based business services (e-invoice) and parking, traffic and energy efficiency of cities are visible in **Zagreb, Split-Dalmatia and Dubrovnik-Neretva County**
- The Dubrovnik-Neretva County was the first to move towards the establishment of **a smart region** as a strategic prerequisite for attracting investment
- The City of Dubrovnik officially became **the first innovation**, testing, reference and sales center of Smart City HT
- All these are projects that have a clear vision of raising the quality of life of citizens and generating savings in local budgets

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Reasons for introducing smart city indicators?

- Today's practice in Croatian cities
- Development decisions
  - without strategic thinking
  - based on the established ad hoc objectives, activities and measures for their realization
- Development
  - is not considered long-term
  - not all relevant stakeholders are involved
  - is neglected to address key development challenges
  - goals, activities and measures are established without relying on key indicators
- Developing of the smart city model
  - there is not such model in many Craotian cities
  - they are already starting to use smart solutions to address urban, environmental and city administration issues
- The consequence of such development planning
  - inadequate quality of public goods and services
  - unnecessary waste of public funds

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Croatian large cities

>35,000 inhabitants
43.2% Croatian population (Census 2011)

1.	Zagreb	790.017
2.	Split	178.102
3.	Rijeka	128.624
4.	Osijek	108.048
5.	Zadar	75.062
6.	Velika Gorica	63.517
7.	Slavonski Brod	59.141
8.	Pula	57.460
9.	Karlovac	55.705
10.	Sisak	47.768
11.	Varaždin	46.946
12.	Šibenik	46.332
13.	Dubrovnik	42.615
14.	Bjelovar	40.276
15.	Kaštela	38.667
16.	Samobor	37.633
17.	Vinkovci	35.312

County centers
3.9% Croatian population (Census 2011)

18.	Koprivnica	30.854
19.	Vukovar	27.683
20	Čakovec	27.104
21.	Požega	26.248
22.	Virovitica	21.291
23.	Gospić	12.745
24.	Krapina	12.480
25.	Pazin	8.638

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Literature review

- **Concepts**:
  - Smart city (Giffinger et al., 2007; Giffinger and Gudrun, 2010; Giffinger, 2015; Lazaroiu and Roscia, 2012)
  - Intelligent city (Komninos, 2002)
  - Digital city (Jong et al., 2015)
  - Smart sustainable cities (ITU, 2015)
- **Indexes**:
  - ICT development index (ITU, 2016)
  - Index system of smart city (ISO, 2012)
  - City prosperity index (UN-Habitat, 2013)
  - European indicators (EU, 2015)
  - Global city indicators (Fox, 2013)
  - European system of social indicators (Berger-Schmitt and Noll, 2000)
  - Networked society city index (Ericsson, 2013)
  - European green city index (Siemens, 2009)

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Smart city model 1

- Defining indicators and data for planning and monitoring development decisions in six dimensions of the smart city model:
  - **Smart economy**
  - **Smart people**
  - **Smart management**
  - **Smart mobility**
  - **Smart environment**
  - **Smart living**

  with a view to monitoring and directing the development of large cities based on smart city indicators and optimal use of public funds

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Smart City model 2

- **smart economy -** innovation, entrepreneurship, trademarks, productivity and flexibility of the labour market and the integration in the national and international market
- **smart people -** the level of education of the citizens, the quality of social interactions regarding integration and public life and the openness towards the world
- **smart governance -** political participation, services for citizens and functioning of the city's administration
- **smart mobility -** local and international accessibility, the availability of information and communication technologies, modern and sustainable transport systems
- **smart environment -** natural conditions (climate, green space etc.), pollution, resource management and efforts towards environmental protection
- **smart living -** quality of life in different areas as culture, health, safety, housing, tourism etc.

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Methodology and data 1

- **Collecting data to develop smart city indicators**
  - Web scraping technique for collecting publicly available data
  - Surveys and interviews with city officers
- **29 most important indicators for describing six dimensions of smart city model**: smart economy, smart people, smart management, smart mobility, smart environment, smart living for:
  - An assessment of the comparative advantages of cities in the achievement of smart urban development
  - Cities ranking according to the smart urban development index
  - Comparison of cities towards components of smart urban development
- **z-transformation** was used **to standardize all indicators**
- **Smart urban development index for Croatian large cities**
- **Collaboration of researchers and city experts** in research activities and creation of new knowledge in strategic decision-making

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Methodology and data 2

- The most recent amendments to Croatian legislation resulted in a new definition of large cities:
  - urban settlements with more than 35,000 inhabitants (17)
  - county centres (8)
- Data sources:
  - Urban Audit
  - FINA - Annual Financial Reports (2017)
  - Croatian Bureau of Statistics, http://www.dzs.hr/
  - Court Register, https://sudreg.pravosudje.hr/registar/f?p=150:1
  - Croatian Pension Insurance Institute, http://www.mirovinsko.hr/default.aspx?id=4298
  - Zagreb Stock Exchange, http://zse.hr/default.aspx?id=26474
  - Database, different Croatian cities (survey, interviews)

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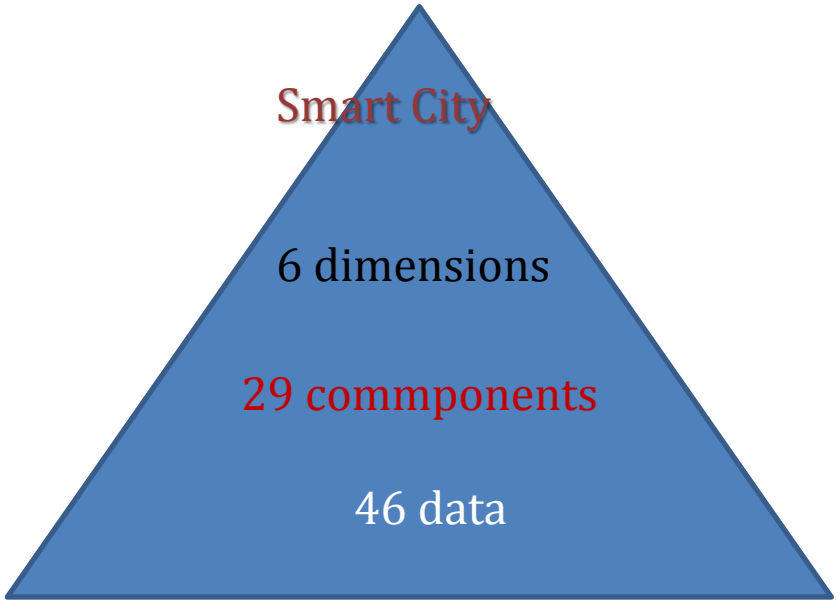
Smart City methodology 1

- This research is based on the methodology developed under the European Smart Cities project (Smart cities: Ranking of European medium-sized cities, http://www.smart-cities.eu/download/smart_cities_final_report.pdf)



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Smart City methodology 2

Smart Economy (Competitiveness)	**Smart People** (Social and Human Capital)	**Smart Governance** (Participation)	**Smart Mobility** (Transport and ICT)	**Smart Environment** (Natural resources)	**Smart Living** (Quality of Life)
R&D expenditures, plant and equipment	Students and universities	Participation in decision-making	Local accessibility	Sunshine hours	Cultural facilities
Knowledge-intensive industries	Companies whose business is a foreign language	Public and social services and transparent government		Green space	Hospital beds
Patents applications	Net migration			Municipal waste	Doctors
Entrepreneurship	People working in creative industries			Use of water	At- risk-of-poverty rate
Trademarks	Voters turnout at European elections			Use of electricity	Housing quality
Productivity	Voters turnout at local elections				Quality of population
Employment and flexibility of labour market					Aging of population
International presence					Touristic attractivity

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Implementation of Smart City methodology for Croatian large cities 1

Smart Economy (Competitiveness)		
Component	**Indicator**	**Definition**
R&D expenditures, plant and equipment	R&D expenditure	Share of R&D in total assets of all companies registered in the city
	Plant & equipment expenditure	Share of R&D, patents and investments in equipment in total assets of all enterprises in the city
Knowledge-intensive industries	Share of employment in knowledge-intensive sectors	Share of employees in knowledge-intensive industries in total number of employees in the city
Patents applications	Patent applications per inhabitant	Patent applications per inhabitant
Entrepreneurship	Self-employment rate	The share of self-employed in total number of employees in the city
	Rate of newly businesses registered	The share of newly registered enterprises in total number of companies in the city
Trademarks	Number of international trademarks	Total number of international trademarks
Productivity	Productivity	The ratio between added new value and number of employees in all companies in the city
	Share of paid employees who are working part-time	The share of paid employees who are working part-time and total number of employees in total number of companies in the city
Employment and flexibility of labour market	Unemployment rate	Unemployment rate
	Employment intensity	Relationship between employed and unemployed
International presence	Number of companies listed on the Zagreb Stock Exchange	Companies with HQ in the city quoted on national stock market
	Export intensity	The share of export revenues in total revenues of all companies that have their headquarters in the city.
	Foreign capital intensity	The ratio of enterprises income with a share of foreign capital greater than 49% and total income of all companies with headquarters in the city.
	Foreign direct investments	The value of foreign direct investments is the product of changes in the share of foreign capital and the value of capital at the level of companies that have their headquarters in the city.

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Implementation of Smart City methodology for Croatian large cities 2

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Smart people (Social and Human Capital)		
Component	**Indicator**	**Definition**
Students and universities	Number of subjects for higher education	The number of institutions of higher education located in the city.
	Students enrolled in university study	The number of students enrolled in university studies located in the city.
Companies whose business is a foreign language	Number of companies whose business is a foreign language	The number of companies whose business is a foreign language located in the city.
Net migration	Number of emigrated people	The difference between the population that settled in and emigrated from the city.
People working in creative industries	Share of employees in cultural industries	The share of employees in cultural industries located in the city in relation to the total population of the city.
Voters turnout at European elections	Voter turnout at European elections	The share of voter turnout at European elections in the city.
Voters turnout at local elections	Voter turnout at local elections	The share of voter turnout at local elections in the city.

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Implementation of Smart City methodology for Croatian large cities 3

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Smart Governance (Participation)		
Component	**Indicator**	**Definition**
Participation in decision making Public and social services and transparent governance	Number of city council members per 1,000 inhabitants	The number of city council members per 1,000 inhabitants in the city.
	Proportion of women council members to the total number of city council members	The proportion of women council members to the total number of city council members.
	Number of political parties per 1,000 inhabitants	The number of political parties per 1,000 inhabitants in the city.
Public and social services and transparent governance	Share of children in nurseries and kindergartens in the total number of children aged 0 to 6 in the city	The share of children in nurseries and kindergartens in the total number of children aged 0 to 6 in the city.
	Total expenditures in city budget per capita	The total expenditures in city budget per capita.
	Budget transparency in 2017	Budget transparency in 2017 measured by the number of key budget documents published on the official city websites.

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Implementation of Smart City methodology for Croatian large cities 4

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Smart Mobility (Transport and ICT)		
Component	**Indicator**	**Definition**
Local accessibility	Number of city bus lines in the city	Number of city bus lines in the city in relation to the number of inhabitants in the city.
	Number of bus stations in the city	Number of bus stations in the city in relation to the number of inhabitants in the city.
	Length of bicycle trails in the city in kilometer	Length of bicycle trails in the city in kilometer in relation to the number of inhabitants in the city.

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Implementation of Smart City methodology for Croatian large cities 5

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Smart Environment (Natural resources)		
Component	**Indicator**	**Definition**
Sunshine hours	Sunshine hours	Sunshine hours per year. Sum of average monthly values (average in the period 1872–2016).
Share of green spaces	Share of green spaces	The share of green areas in total area of the city. Green areas include parks and grassy area.
Mixed municipal waste	Mixed municipal waste	Produced mixed municipal waste per inhabitant. Quantity of waste (kg) in 2016 in relation to the population of the city.
Use of water	Use of water	Water supplied to all users (m^3 per capita)
Use of electricity	Use of electricity	Electricity delivered to households (MWh per capita)

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Implementation of Smart City methodology for Croatian large cities 6

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Smart Living (Quality of Life)		
Component	**Indicator**	**Definition**
Cultural facilities	Theatre attendance per inhabitant	The number of theatre visitors in the city in 2016/2017 in comparison to the number of inhabitants in the city.
	Cinema attendance per inhabitant	The number of cinema visitors in the city in 2016 in comparison to the number of inhabitants in the city.
	Museum visitors per inhabitant	The number of museum visitors in the city in 2015 in comparison to the number of inhabitants in the city.
Hospital beds	Hospital beds per 1,000 inhabitants	The number of hospital beds in 2016 in the city in comparison to the number of inhabitants in the city.
Doctors	Doctors of medicine per 1,000 inhabitants	The number of medical doctors in 2016 in the city in comparison to the number of inhabitants in the city.
At-risk-of-poverty rate	At-risk-of-poverty rate in 2011	The estimated risk-of-poverty rate in 2011 was calculated at 19.2 percent of annual income for a single-member household (the income criteria).
Housing quality	Residential area per capita in m^2	The size of residential area per capita in m^2 in the city.
Quality of population	Life expectancy	The share of the population over 65 in the total number of inhabitants in the city.
Touristic attractivity	Number of tourists compared to the number of inhabitants in the city	The number of tourists compared to the number of inhabitants in the city.
	Number of overnight stays in relation to the total number of inhabitants in the city	The number of overnight stays in relation to the total number of inhabitants in the city.

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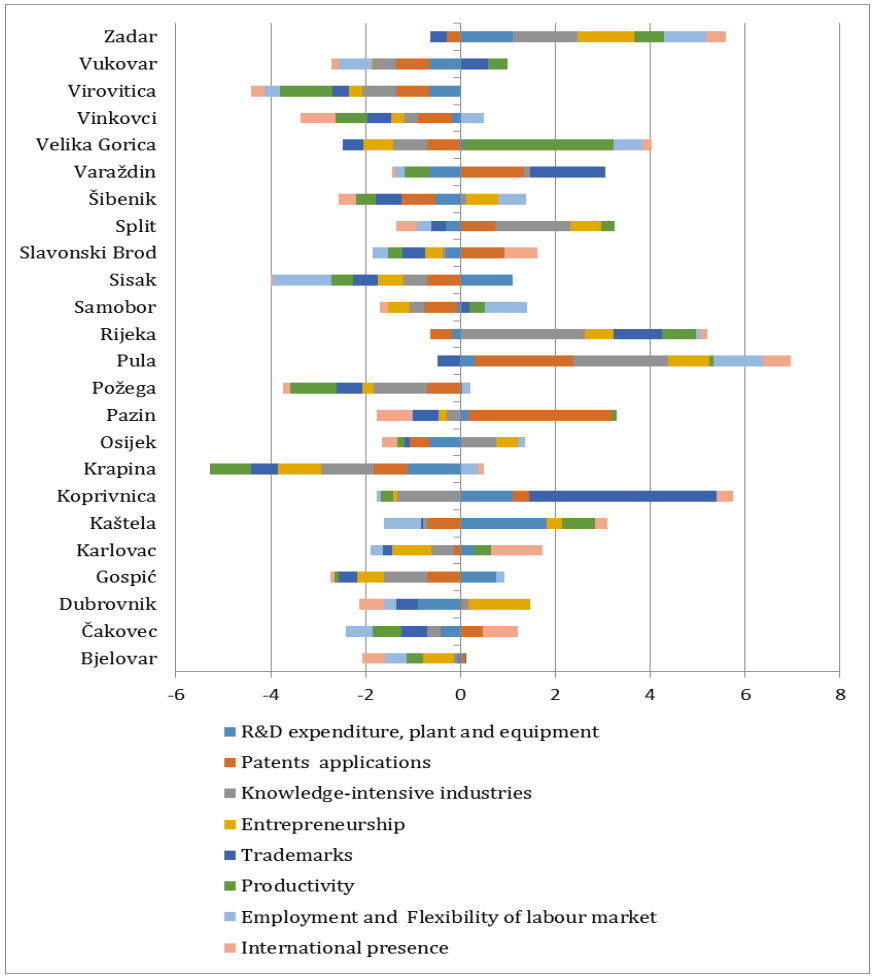
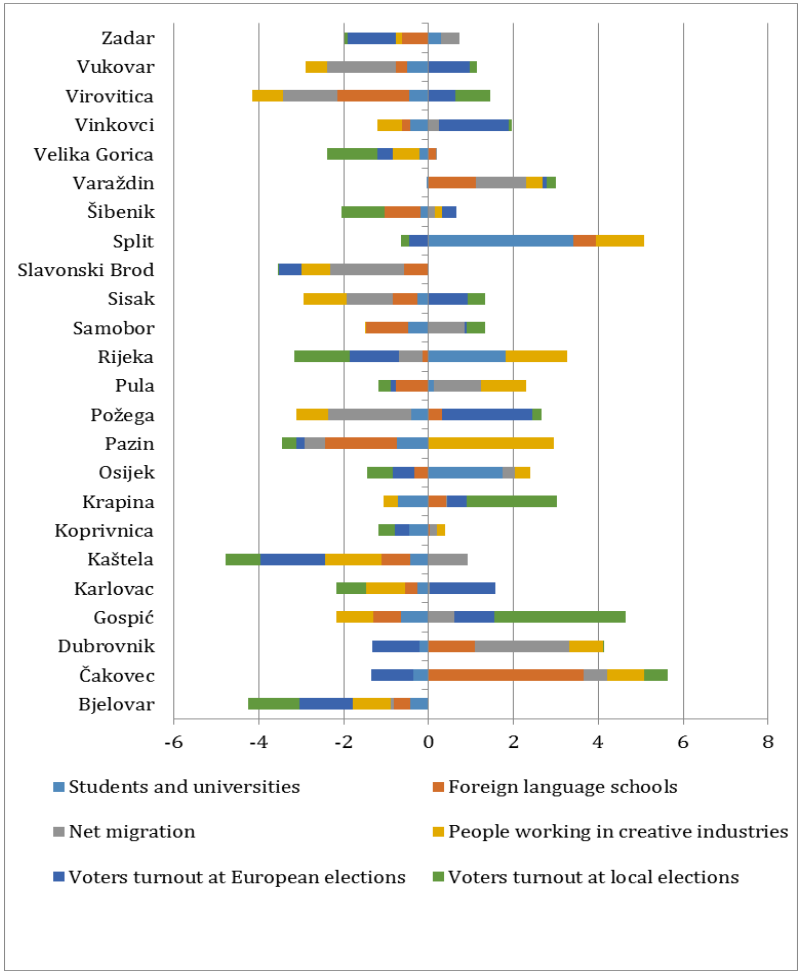
Smart economy



Smart people



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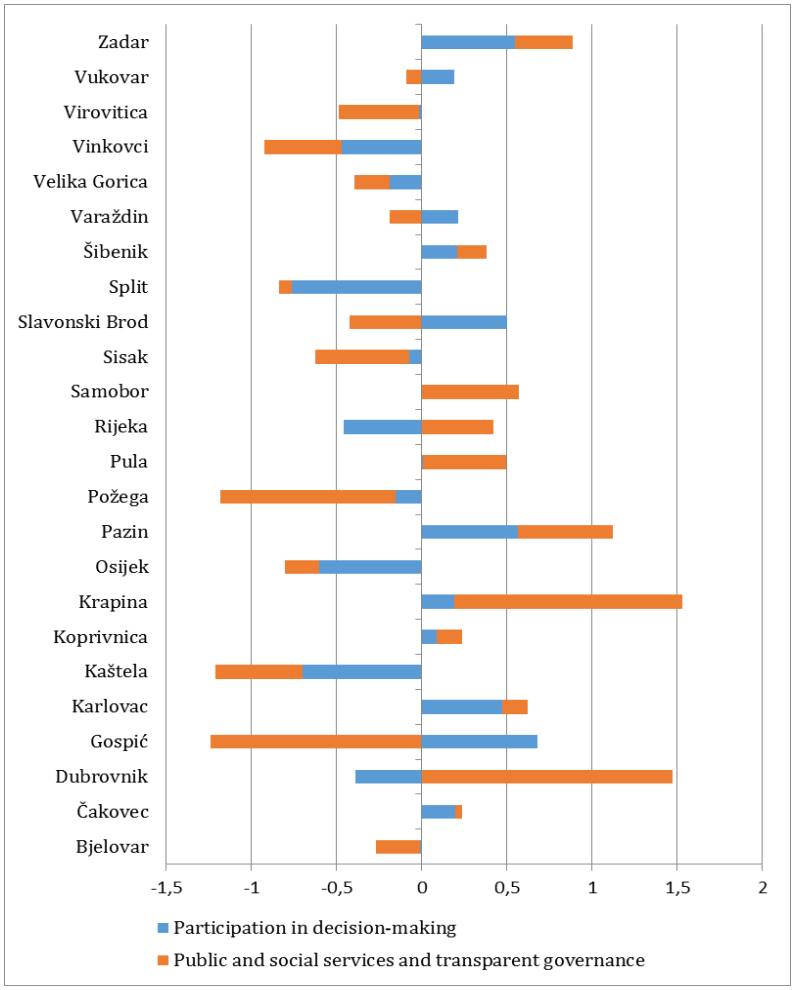
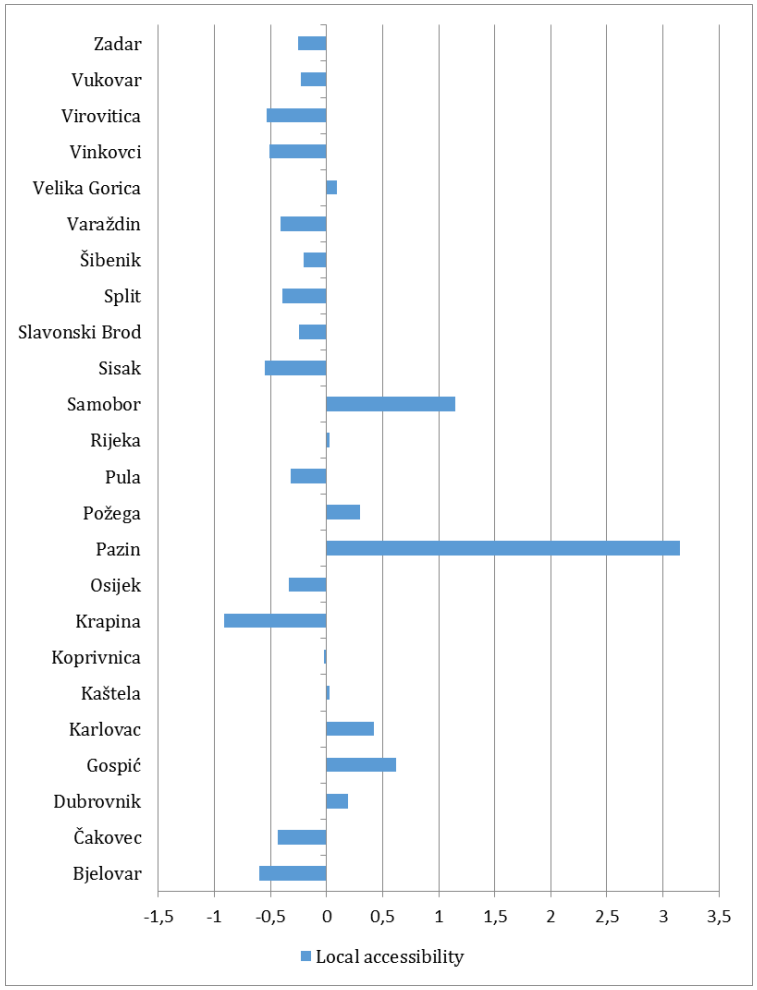
Smart governance



Smart mobility



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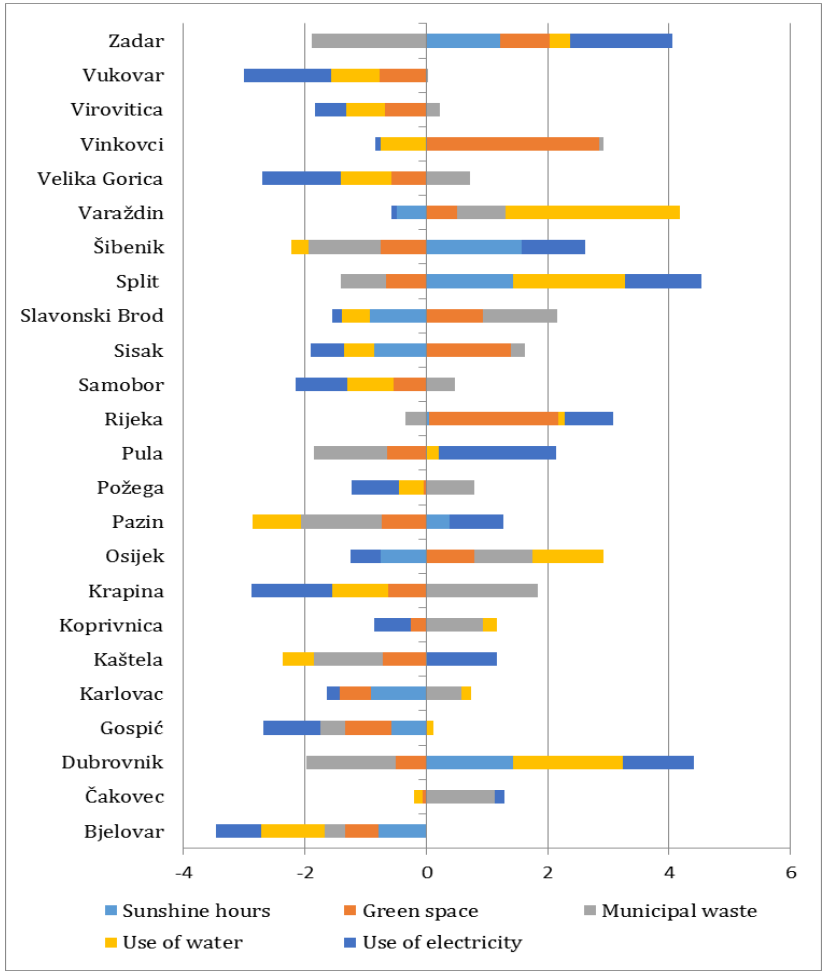
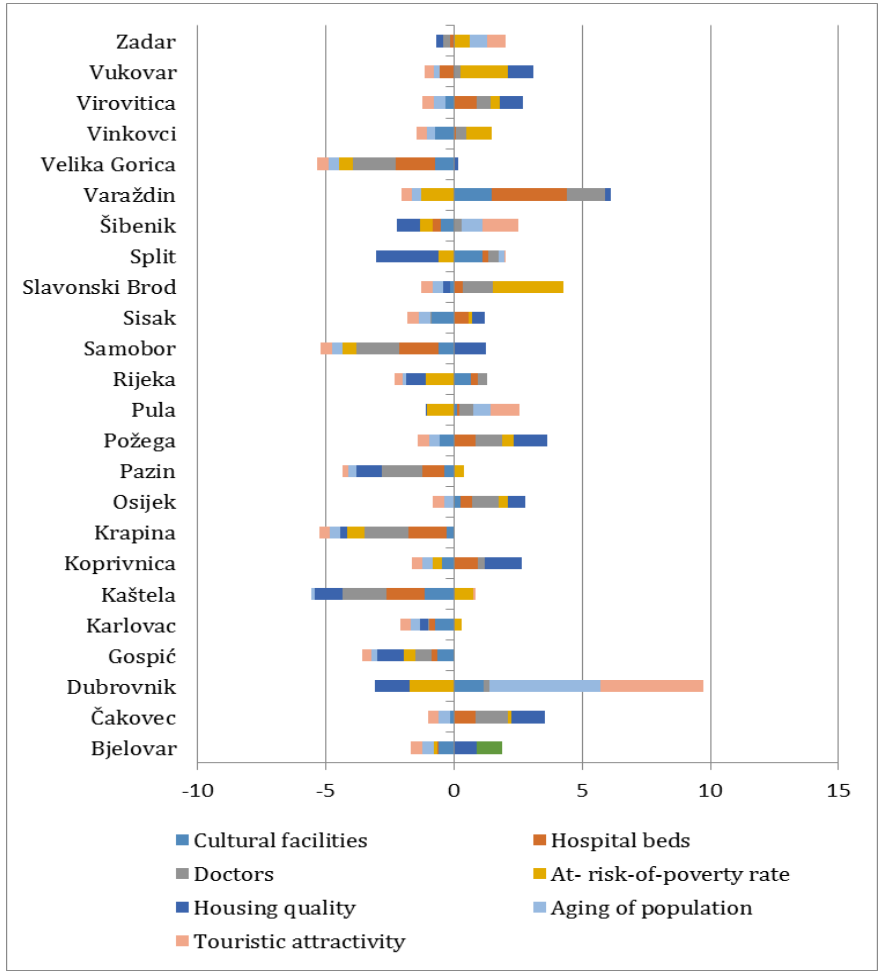
Smart environment



Smart living



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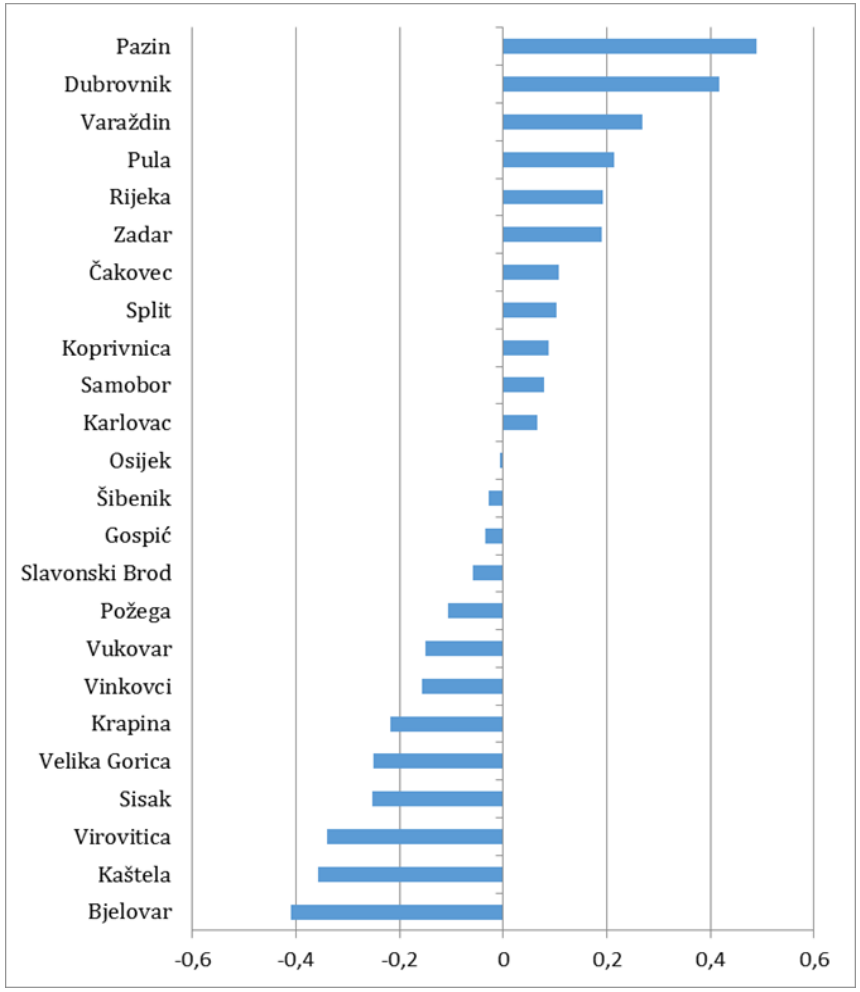
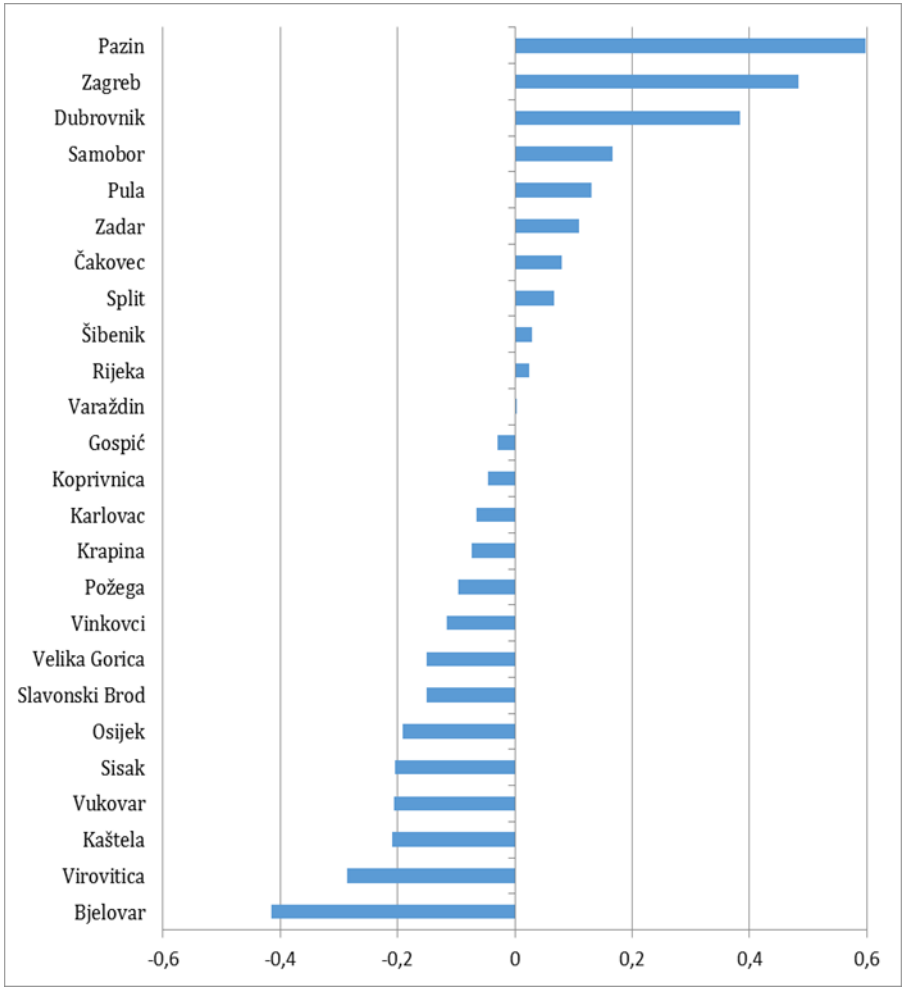
Smart urban development index

without the City of Zagreb



with the City of Zagreb



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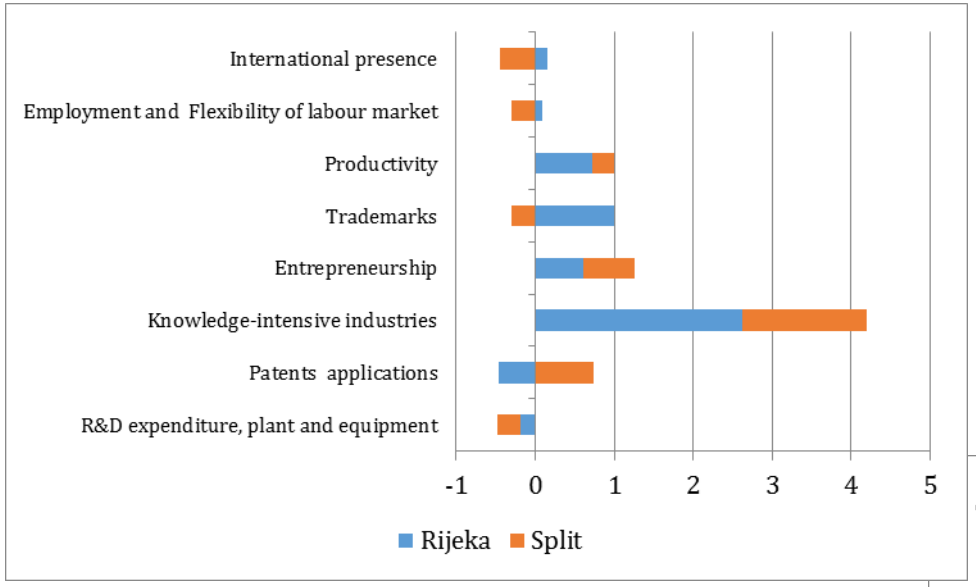
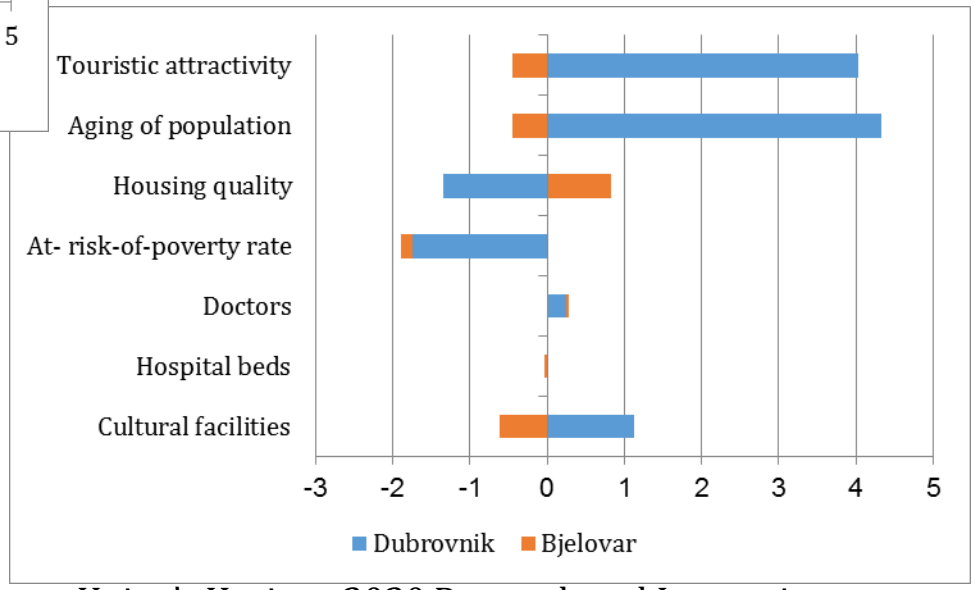
Comparison of cities



Smart economy

Smart living



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Conclusion / Further research 1

- Formulation of the smart city indicators is rare in Southeastern Europe
- **First research on the implementation of a smart city methodology for large Croatian cities** based on the methodology developed in the European Smart Cities project (Giffinger et al., 2007)
- Web scraping techniques have been used to collect, clean up and synchronize annual city data with surveys and interviews with representatives of large cities
- **Smart urban development index** with six dimensions and a series of components was developed
- Smart urban development index clearly shows the **heterogeneity of Croatian large cities** in all six dimensions of the smart city
- Comparison of the competitiveness of Croatian large cities is achieved by ranking cities according to the smart urban development index
  - outline of strengths and weaknesses of Croatian large cities
  - ranking of Croatian large cities by different indicators and factors
  - city profile by different indicators and factors
  - comparison between cities by different indicators and factors

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Conclusion / Further research 2

- **Eleven Croatian large cities have positive values of smart urban development index - Pazin, Dubrovnik, Varaždin, Pula, Rijeka, Zadar, Čakovec, Split, Koprivnica, Samobor, Karlovac**
- Based on the smart urban development index, it is possible for city decision makers to propose concrete measures to promote smart city development and enable rational use of public funds
- Continuation of research for all Croatian cities, extension of the number of indicators and data
- Web application (in Croatian and English) for mayors and other decision-makers in cities for the use of available data and indicators in the preparation and implementation of strategic and development decisions and budget planning
- Urban development is complex process in many dimensions
- Smart City indicators can help decision-makers in making strategic decisions at local level

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Thank you

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