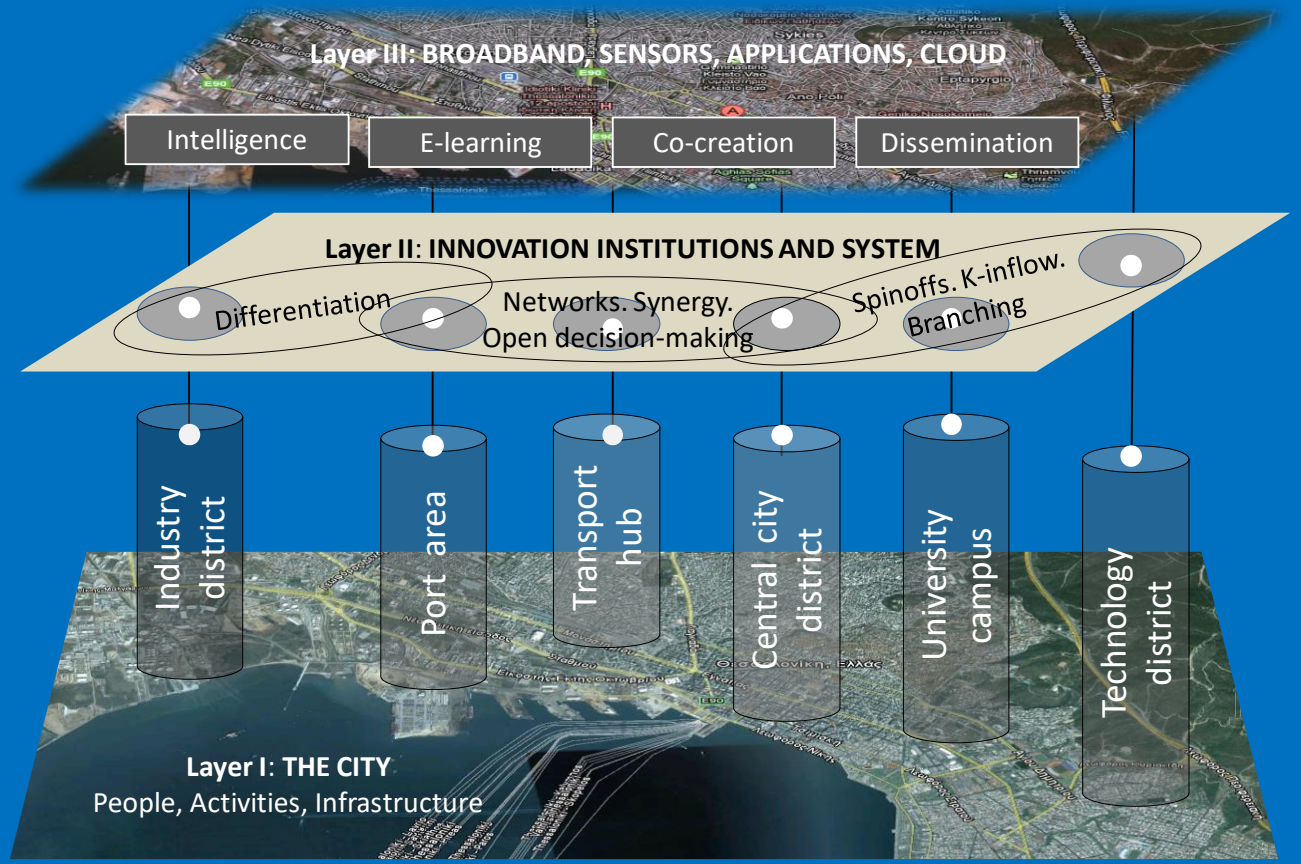
Projects for intelligent and smart cities:

drivers and barriers of cities transformation with digital technologies



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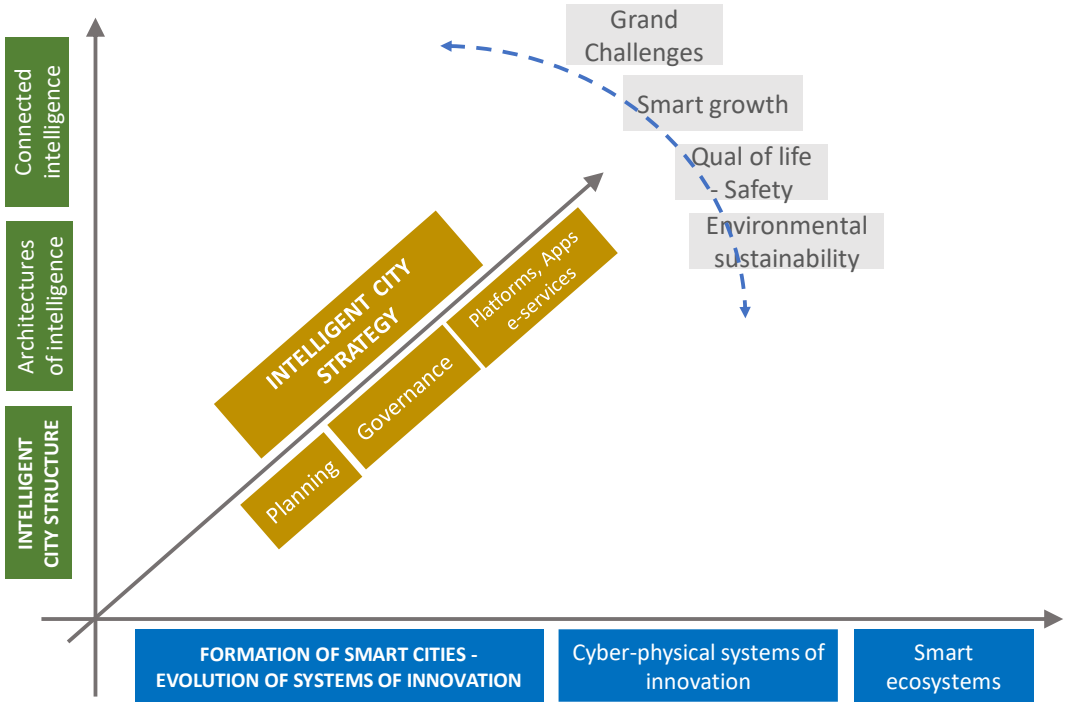
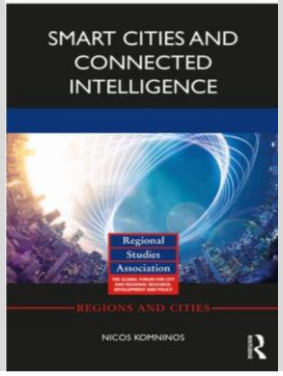
URENIO research

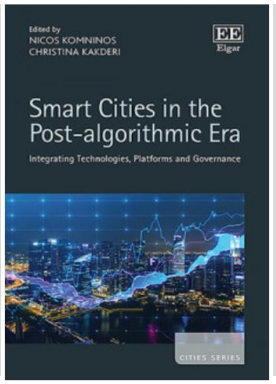
URENIO: Research field (1) “intelligent / smart cities”



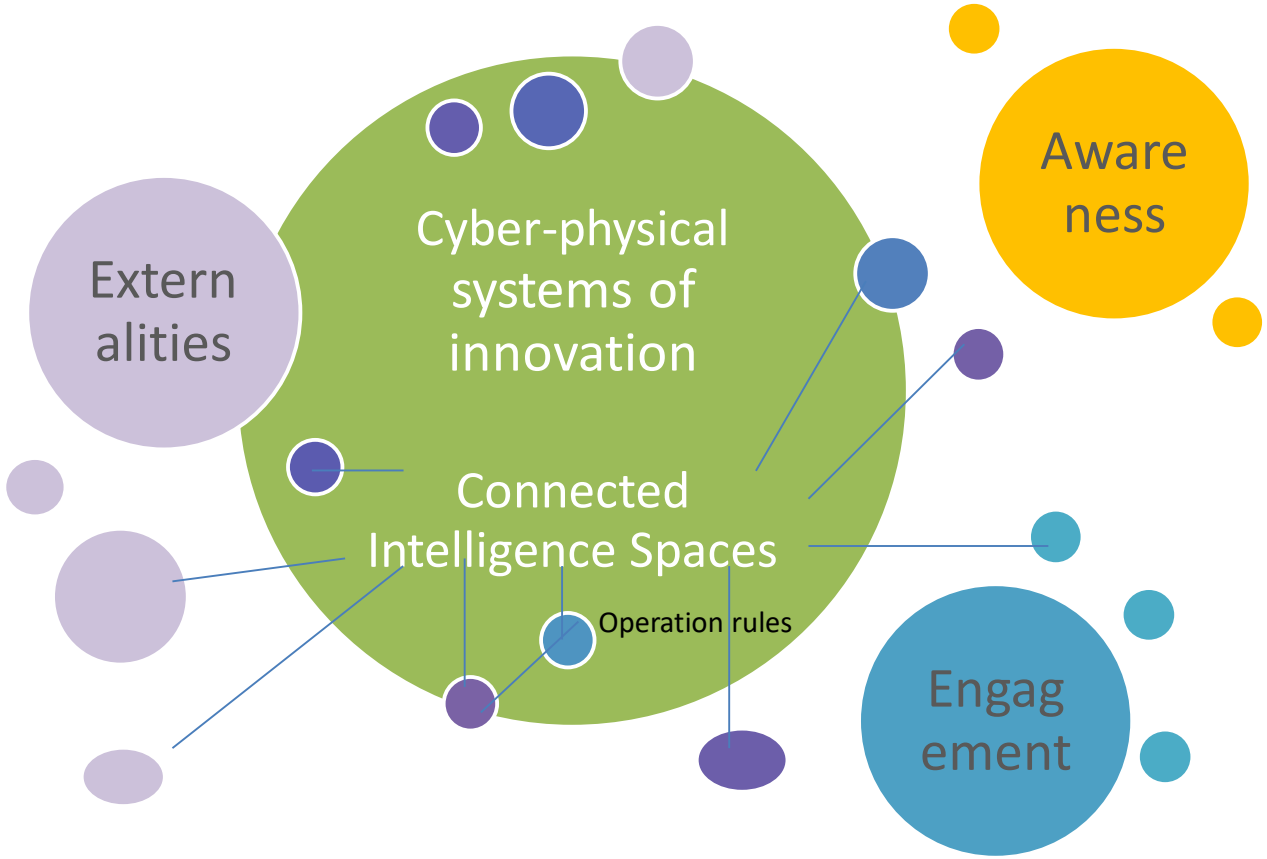
Recent research:

- ***Connected intelligence:*** platforms integrating human, collective, and machine intelligence
- ***Universal architecture*** of connected intelligence across city ecosystems
- Two recent books on ***connected intelligence in smart cities***





Research field (2): “hybrid systems of innovation”



RQ: What happens to systems of innovation (routines & operation) when complemented by digital nodes and agents?

Which transformations are taking place at the supply and demand side of innovation?

Recent research:

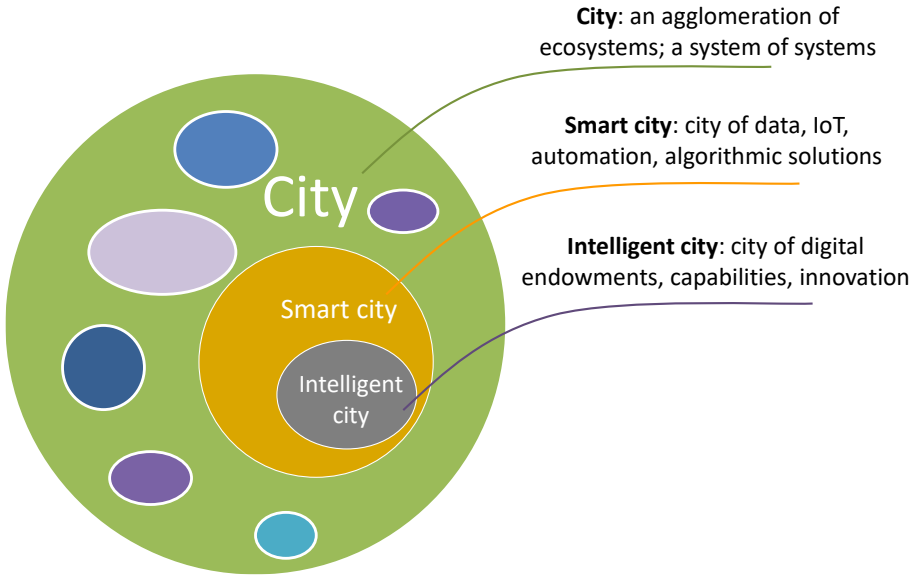
- Research and Innovations Strategies for Smart Specialisation (RIS^3).RIS^3 and EDP (Entrepreneurial Discovery Process). Governance of RIS^3
- Digitally assisted RIS^3, cyber-physical systems of innovation, smart ecosystems through connected intelligence spaces
- ONLINE S3: Facilitate RIS^3 by 28 online apps and 4 roadmaps. RIS^3 2.0 (2021-2027)

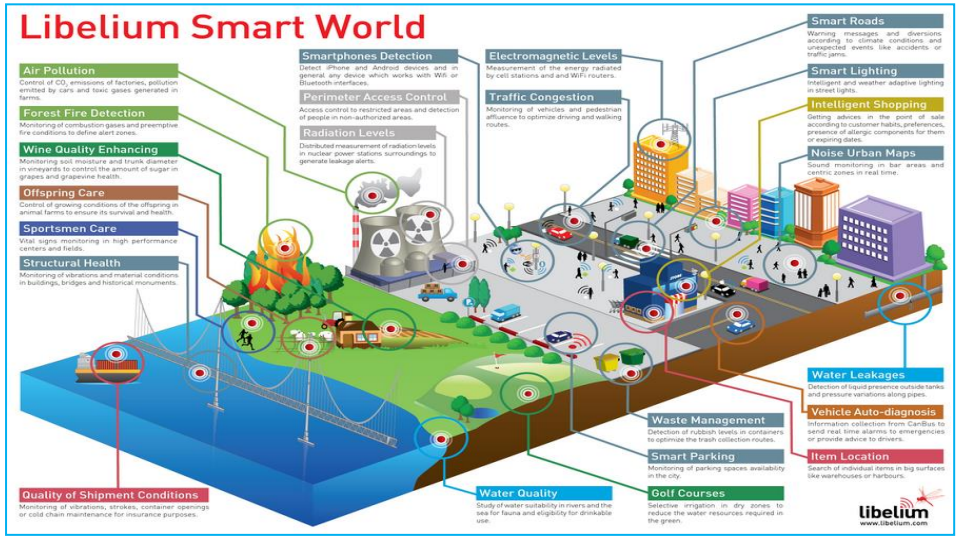
1. Introduction: The paper

- **Projects for making intelligent/smart cities**
- **An inquiry** on the typology of SC projects, their digital-institutional-physical dimensions, the city ecosystems under transformation, the type of impact, and success and failure factors.
- **Understanding** the size of effort and resources for the transformation of cities with digital technologies

Some clarifications about the terms: city, intelligent city, smart city:

- **City, intelligent city, smart city** are entities of the physical / social world. However, at present, IC and SC refer mainly to planning than geography
- **Differences between IC and SC** concern the technologies used and the way 'intelligence" or "smartness" is produced, with SC using mainly algorithmic solutions and IoT
- Beside the differences, we use the terms alternately as denoting the same phenomena of city innovation through digital technology

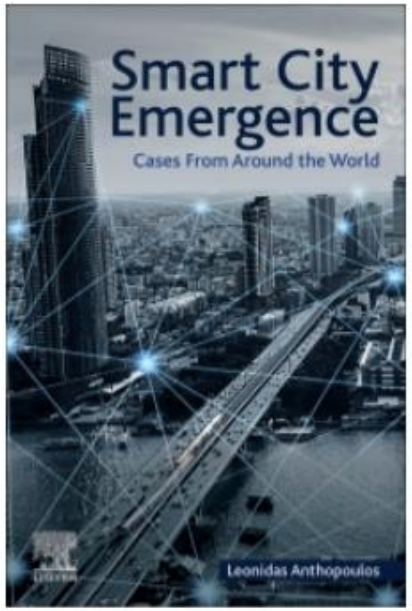




The survey on SC projects

- Based on case studies described in the book “Smart City Emergence” edited by L. Anthopoulos
- 20 case studies from Europe, US, south America, Asia, Africa. 17 cases included in the survey, offering a clear description of smart city projects
- Additional online resources per case
- Data available at

  https://www.komninos.eu/wp-content/uploads/2021/04/IDEAS-Smart-city-projects-from-around-the-world.pdf



Smart City Emergence

1st Edition

Cases From Around the World

☆☆☆☆☆ Write a review

Editor: Leonidas Anthopoulos

eBook ISBN: 9780128165843
Paperback ISBN: 9780128161692

Elsevier, Smart City Series
Editors: Tan Yigitcanlar, Nicos Komninos, Mark Deakin

2. The ecosystem is the main organising entity of SC projects

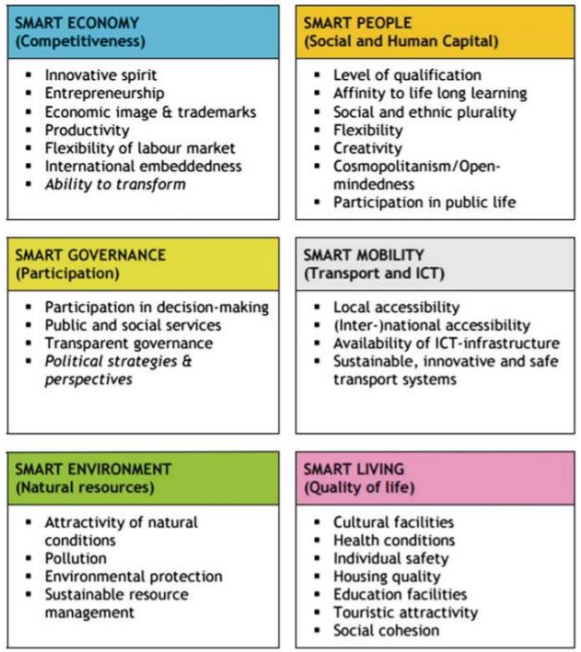
SC projects per sector of activity or city ecosystem

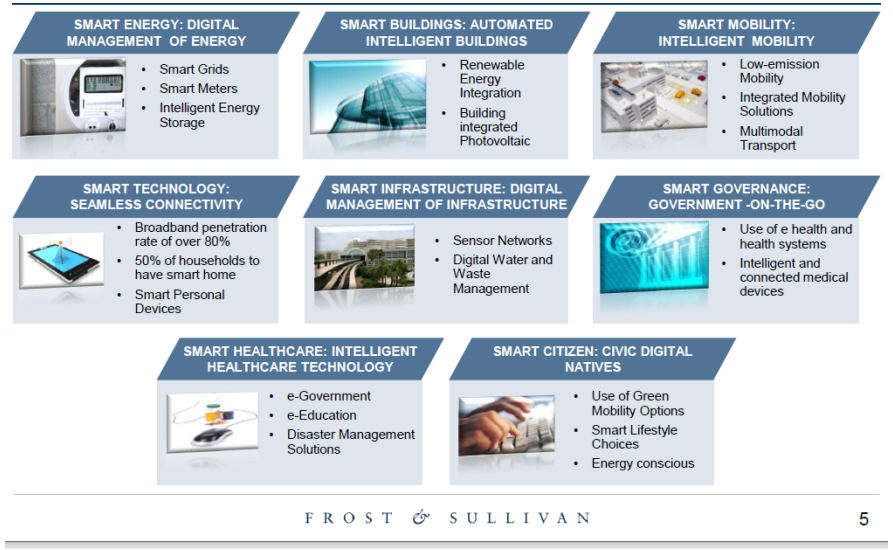
Type of ecosystem	City ecosystems	Frequency in sample cities	
		No of cities	*%*
Area-based ecosystems (3.49% of all ecosystems)	1. District renewal-Multi-use districts	1	5.88
	2. Hub district (port / rail / airport)	1	5.88
	3. City centre	-	-
	4. Technology district	-	-
	5. University campus	1	5.88
	6. Housing	-	-
	7. Public space / natural ecosystem	-	-
Activity-based ecosystems (45,35% of all ecosystems)	8. Governance	11	64.70
	9. Health	6	35.29
	10. Startups, innovation, skills	5	29.41
	11. Safety	5	29.41
	12. Living, quality of life	5	29.41
	13. Education	4	23.53
	14. Tourism, hospitality, shopping	3	17.65
	15. Manufacturing	-	-
	16. Culture, recreation	-	-
Network-based ecosystems (51,16% of all ecosystems)	17. Telecom, broadband	17	100.00
	18. Mobility	10	58.82
	19. Energy	8	47.05
	20. Environment	4	23.53
	21. Water	3	17.65
	22. Circular economy, recycling, waste	2	11.76

- A very clear message from the case studies is about the setting of smart city projects and solutions per ecosystem
- The Table shows the **city ecosystems** in which projects are implemented: 86 ecosystems in 17 cities. On average 5 ecosystems per city.
- 16 different ecosystems were identified, classified per (a) areas, (b) activities, and (c) networks.
- These **three types of ecosystems** have quite different locational behaviour: area-based ecosystems cluster spatially to form city districts, activity-based ecosystems spread throughout the city, and network-based ecosystems locate along the axis and transport networks.
- **Most frequently** projects fall into ecosystems related to networks (broadband, mobility, energy, etc.) (51.16%); then follow ecosystems related to activities (economy, health, safety, etc.) (45.35%); and a few only cities work with area-based ecosystems, such as district renewal, port and university campus renovation (3.49%).

How many ecosystems can we define in a smart city?

A 1943 map showing how London would look based on 'social and functional analysis', which Patrick Abercrombie helped to draw up





Abercrombie: a few area-based	Giffinger et al. (2007): 6 activity based	Frost & Sullivan: 8, most network based

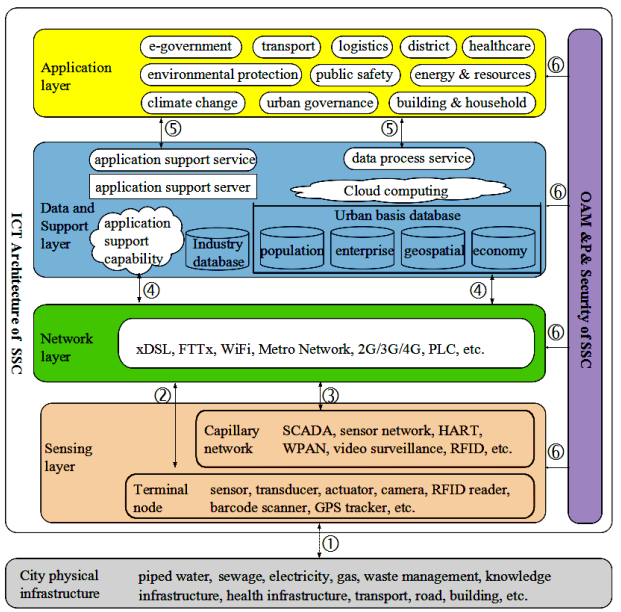
At least 20 for any city. The number scales up if we consider digital ecosystems also

Area-based ecosystems, defined by districts & neighbourhoods	1. *City centre* 2. *Marketplace* 3. *Housing* 4. *Public space / recreation* 5. *Natural ecosystems* 6. *Hub (port / rail / bus)*	**Vertical ecosystems,** defined by activities	7. *Manufacturing* 8. *Food production* 9. *Education* 10. *Tourism, hospitality, etc.* 11. *Culture and branding* 12. *Public services & safety* 13. *Government*	**Network-based ecosystems**, defined by utility and other networks	14. *Transportation* 15. *Energy* 16. *Water* 17. *Waste* 18. *Telecom, broadband* 19. *Recycling* 20. *Environment, emissions*

2. Projects per ecosystem: intelligence depends on innovation than technology

Standardisation of smart city projects per ecosystem

Smart city governance projects	Smart city energy projects
1. Online administrative services to citizens	1. Smart metering in buildings, energy control and saving
2. Co-design of public services	2. Energy integrated: retrofitting, PV panels, RES, etc.
3. Citizen reporting, complaints, request to city administration	3. Smart grid and use of renewable energy
4. Citizen database and profile platform	4. District cooling and heating
5. Open data, data sharing with citizens and entrepreneurs	5. Smart public lighting
6. GIS data centre	6. Public electric vehicle charging
7. Digital payments	7. Energy-related platform and transactions
8. Integrated city management system, command centre	8. Data collection, mapping, and modelling of the energy system



Source: FG-SCC, I. T. U. T. (2015). Setting the framework for an ICT architecture of a smart sustainable city. *Focus Group Technical Specifications*, 49.

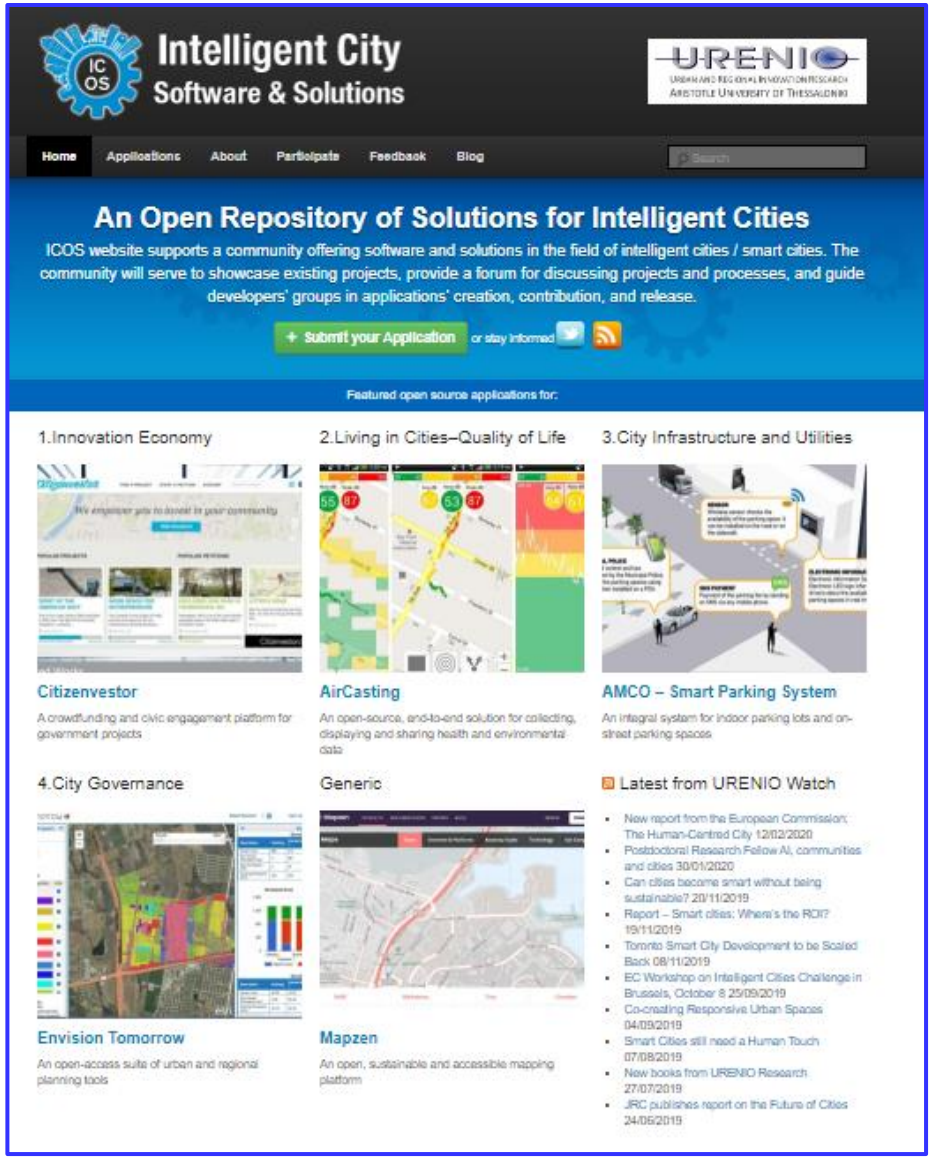
- There is **high diversity** of smart city projects across ecosystems. **However, inside an ecosystem, the diversity is low** and similar projects are to be found in across cities, regardless of the geography, size, or wealth
- The significance of this observation is paramount: The **same digital techn**ologies deployed in two different ecosystems **lead to totally different projects and solutions** for digitalisation or optimisation.
- The **diversity of context**, actors, physical infrastructures, and social processes **prevail** over the homogeneity of **digital technologies.**
- The challenge for smart city projects inside each ecosystem is on **the side of project design and innovation rather than on the use of technology**

Projects and applications per ecosystem

- At URENIO we classified smart city solutions / applications per city ecosystem
- ICOS is a repository of software. 190 applications in 5 fields / 20 subfields
  - Innovation economy
  - Living / quality of life in cities
  - City infrastructure
  - City governance
  - Generic
- Open repository, anyone can submit an application
- Available at https://icos.urenio.org/

View applications for:

- 1.Innovation Economy
  - Commerce
  - Entrepreneurship
  - Funding & crowdfunding
  - Tourism & entertainment
- 2.Living in Cities–Quality of Life
  - Environment & green spaces
  - Health & social care
  - Safety & security
- 3.City Infrastructure and Utilities
  - Energy saving & renewable energy
  - Mobility & parking
  - Waste management
  - Water management
- 4.City Governance
  - City planning & city management
  - Decision making & citizen participation
  - Government services to citizen
- Generic
  - City functions related
  - Data related
  - Sensors related



2. Impact: type of projects / type of impact on activity routines

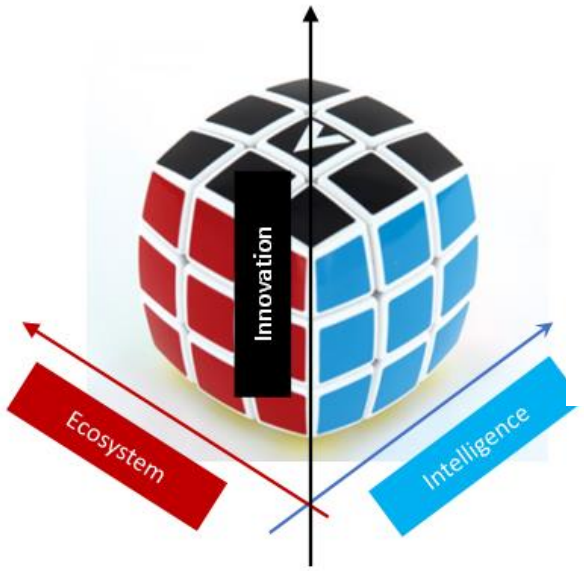
Project type

Project type	No of cases	%
Creation of e-services	96	46,06
Data creation, monitoring, analytics	28	13,59
Complex cyber-physical projects	82	39,81
Total	206	100

Impact level

Digitalisation	Many projects just transfer activities from the physical to the digital space. Online transactions and e-commerce usually do this. This is the lowest level of innovation that can be achieved.
Optimisation *(Digitalisation & improvement of activity routines)*	**D**igitalisation, automation, and sharing lead to optimisation in the use of resources. Sensors and smart metering allow for saving energy and mobility. Sharing can optimise the deployment of effort, capital, and infrastructure.
Innovation *(Digitalisation and replacement of activity routines)*	More complex, cyber-social-physical projects, integrating digital and non-digital technologies, can change radically the operation model or the activity routine of an ecosystem. Such cases are the **2-sided platforms** for hospitality, real estate, financial services; city governance with forms of direct democracy; **Mobility-as-a-Service** (car sharing, carpooling, self-driving cars); **Zero energy districts** with the deployment of distributed renewable energy, and other.

3. Conclusion: (a) typology of intelligent/smart city projects

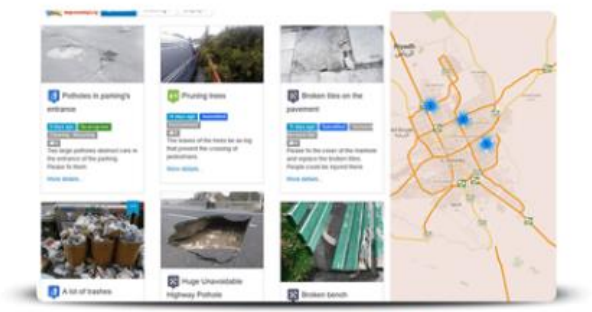


Intelligent City Cube classifying smart city projects

Ecosystem:	•area-based	•activity-based	•network-based
Intelligence:	•data-based	•e-service-based	•cyber-physical-social
Innovation:	•digitalisation	•optimisation	•innovation

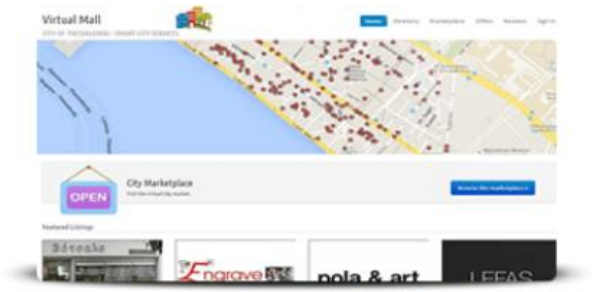
- The identification of driving conditions suggests that major dimensions of smart city projects are those of the (1) ecosystem of reference, (2) the drivers of intelligence, and (3) the impact with various degrees of city routines transformation.
- This allows for defining a typology of smart city projects by those three dimensions. The outcome is the “Intelligent City Cube” in which projects are classified per these dimensions and three properties per dimension
- 27 types of projects show the complexity and the size of effort for the transformation of cities with digital technologies

3. Conclusion: (b) Projects implementation barriers



Improve My City

CloudFunding



Virtual City Market

- The analysis of projects we have developed reveals some **major barriers** to the success and impact of smart city projects.
- ***Most barriers are organisational, legal, and institutional:*** This can be explained by the social and institutional inertia of the urban system against new solutions, especially when innovation and radical change of the existing operation routines take place. Technology is the easiest part.
- ***Change management*** should be a permanent companion of smart city projects implementation, and the modification of routines should be clearly defined and considered already at the design phase of the project.
- ***User engagement and agreement*** is important. In one case we have implemented, the opposition of residents against the controlled parking system in a housing district has forced the authorities to revoke its application.

Thank you