

# Connected Intelligence in Smart Cities



## Shared, engagement and awareness spaces 4 innovation





Nicos Komninos  
URENIO Research, Aristotle University

Cities4People - Smart cities and data analytics, JADS, April 18-20, 's-Hertogenbosch, The Netherlands

# URENIO – INTELSPACE RESEARCH

## URENIO RESEARCH, ARISTOTLE UNIVERSITY

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**Areas of Expertise**

- Smart & intelligent cities
- Innovation ecosystems
- Cyber innovation platforms

**RESEARCH**

- Smart & intelligent cities
- Innovation ecosystems
- Cyber innovation platforms


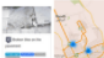

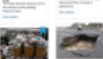

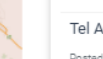


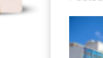
**STRATEGY**

- Strategies for smart cities & regions
- Strategic planning methods and e-tools
- Assessment and metrics


**APPLICATIONS**

- ICOS. Intelligent cities software repository
- URENIO apps portfolio
- Cloud for apps

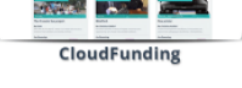
### CLOUD FOR CITY APPS

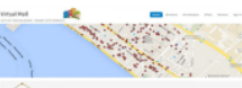
**Improve My City**



**CloudFunding**




**Virtual City Market**



**Watch: Intelligent Cities - Smart Cities - Innovation Ecosystems**

With the growth of smart cities, how do we build smart citizens to match?

Posted at 29 March 2018 in [Collective Intelligence](#)




People involved in creating the world's smart cities might think everyone knows what a smart city is. But in reality, only 18% of people have heard of the term 'smart city', let alone understood what it means. Moreover, emerging technologies such as AI, play a key role in smart city projects; even so, they are alien to most of the public.

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**Tel Aviv offers 6 lessons for Smart Cities**

Posted at 27 March 2018 in [Intelligent / Smart Cities Solutions](#), [Intelligent Cities / Smart Cities](#)




Tel Aviv was voted as the "Best Smart City in 2014" at the Barcelona Smart City expo, beating 250 other cities from around the world to the title. This distinction was based mainly on DigiTel, a personalized digital communications network.

[Continue Reading](#)

**Knowledge-based development of cities and urban innovation precincts**

Posted at 26 March 2018 in [Knowledge Economy](#)




This chapter by Tan Yigitcanlar is the introductory part of a book about knowledge-based urban development in the Middle East and elaborates conceptual aspects of knowledge-based urban development, as well as the formation of prosperous knowledge community precincts and knowledge cities.

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**Book Chapter: The Transparent Smart City**

Posted at 23 March 2018 in [Intelligent Cities / Smart Cities](#)




This book chapter by M. R. Johannessen and L. Berntzen (2017) explores the concept of *Transparent Smart City* providing useful insights on how city councils and city administrations can apply smart technology for increased transparency. The authors also provide an overview of available technologies from a case study in Norway.

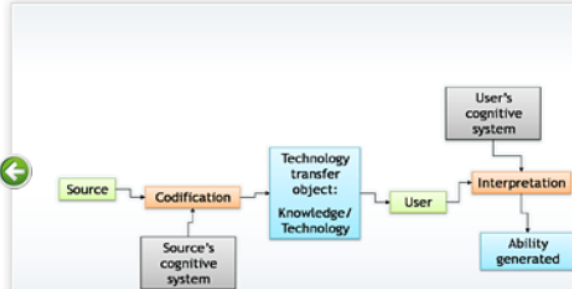
**Watch: Categories**

- INTELLIGENT CITIES
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- Intelligent / Smart Cities Strategy
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- Knowledge Economy
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- PLATFORMS – APPLICATIONS
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- Collaborative Innovation
- Dissemination – Promotion

## INTELSPACE INNOVATION TECH



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graph LR
    Source[Source] --> Codification[Codification]
    SourceCS[Source's cognitive system] --> Codification
    Codification --> TTO[Technology transfer object: Knowledge/Technology]
    TTO --> User[User]
    User --> Interpretation[Interpretation]
    UserCS[User's cognitive system] --> Interpretation
    Interpretation --> Ability[Ability generated]
    
```

### Collaborative Innovation

Collaborative innovation software enables a step-by-step solution of different innovation related problems. It may be used to resolve new product development problems, spin-off and new company creation, training, and any problem which may take a step-wise solution















### INTELSPACE S.A.

INTELSPACE offers engineering, IT, and consulting services in the field of intelligent / smart cities. The company specializes in the design and development of physical spaces and virtual environments sustaining key knowledge and innovation processes of intelligent cities, such as strategic intelligence, technology transfer networks, collaborative innovation, and online marketing and product promotion.

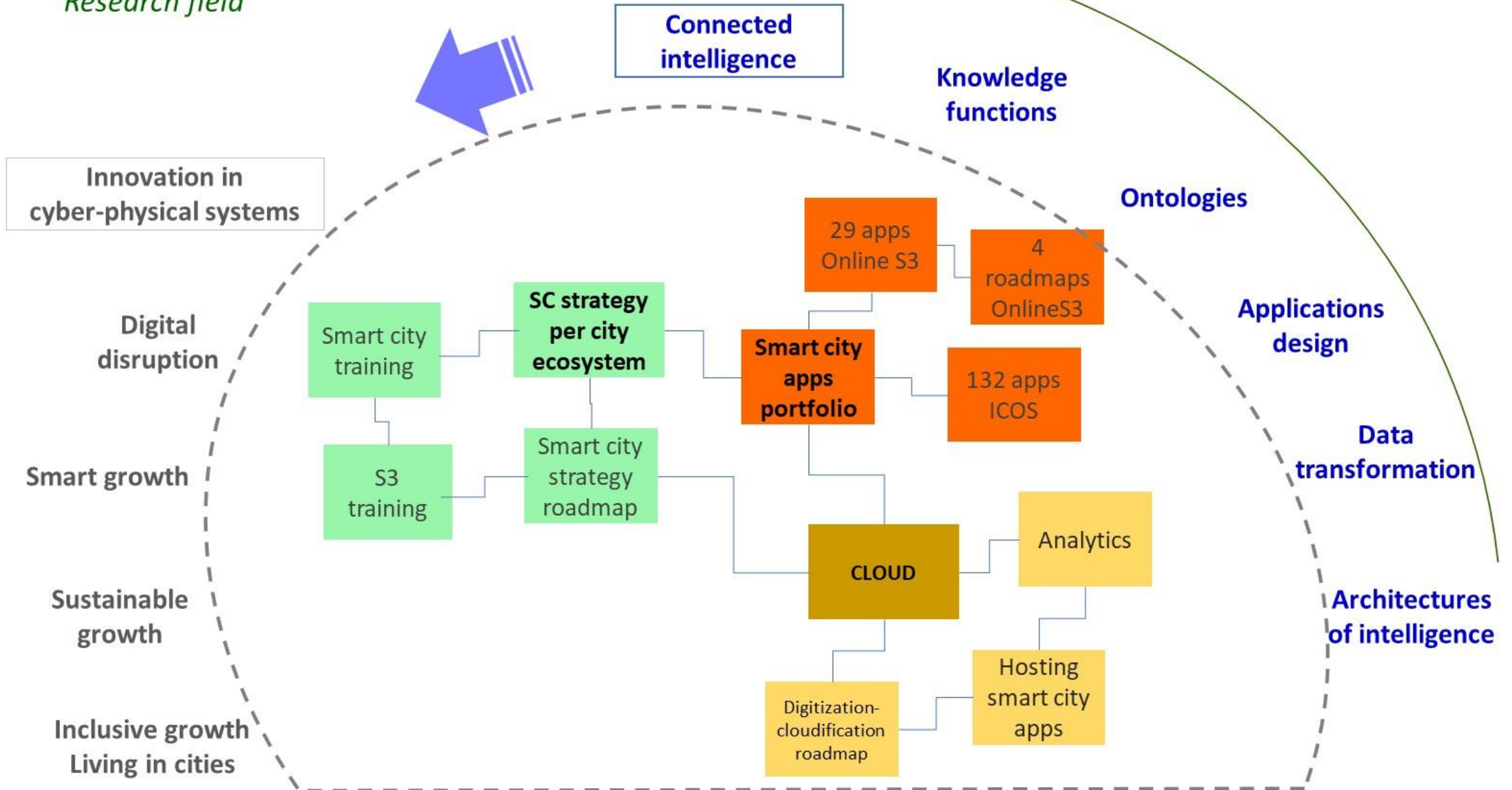
Intelligent cities have the power to integrate three critical dimensions of urban development: creative populations and knowledge-intensive businesses and clusters; institutions for cooperation in knowledge and innovation enabling to acquire, adapt, and advance knowledge and know-how; broadband infrastructure, digital spaces, and e-services for online collaboration and citizens participation.

INTELSPACE working with interdisciplinary teams brings together expertise in the above fields of city development and planning, knowledge and innovation management, and information and communication technologies.

### Latest news from URENIO Watch

-  [With the growth of smart cities, how do we build smart citizens to match?](#)
-  [Tel Aviv offers 6 lessons for Smart Cities](#)
-  [Knowledge-based development of cities and urban innovation precincts](#)
-  [Book Chapter: The Transparent Smart City](#)
-  [Book Chapter: Co-producing Smart City Services](#)
-  [Building a smart neighborhood in Toronto](#)
-  [Japan's Smart Cities](#)
-  [Benchmarking innovation diffusion in the Intelligent Transport Systems sector in Europe and the US](#)
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-  [Smart Cities save 125 hours per year for each Citizen](#)
-  [Governing the Complexity of Smart Data Cities: Setting a Research Agenda](#)
-  [Data-driven dashboards for transparent and accountable decision-making](#)

URENIO - INTELSPACE  
Research field



# Contents

*1. Smart cities: Problem-solving with connected intelligence*

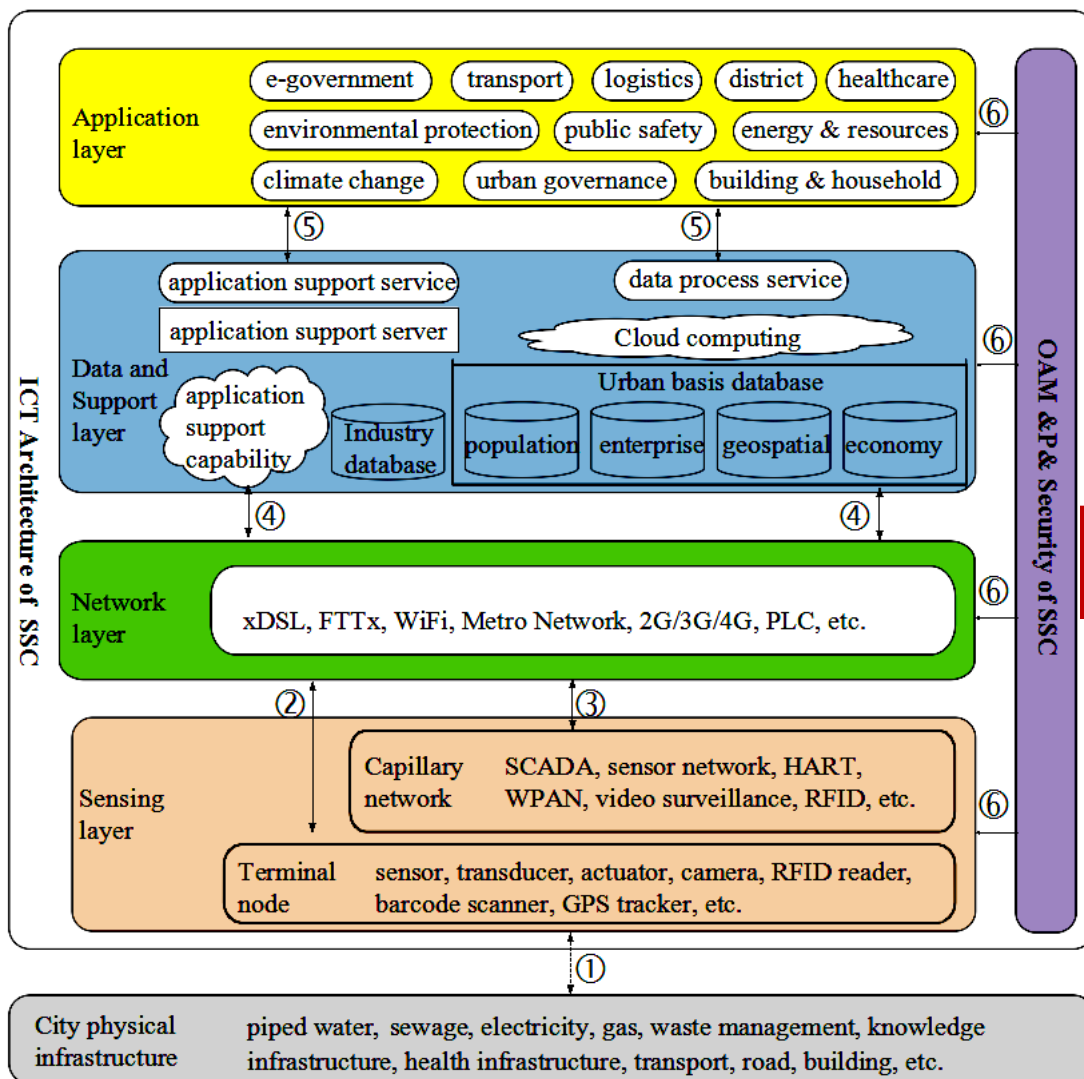
*2. Spaces of connected intelligence: shared, engagement, awareness*

*3. Shared spaces and disruptive innovation*

# SMART CITIES or INTELLIGENT CITIES

## CYBER SPACE improving / transforming CITY AND UTILITY ECOSYSTEMS

### CYBER URBAN SPACE



### Innovation economy ecosystems

- City sectors / clusters / districts: manufacturing, commerce, business services, education, health, tourism, and other
- Marketplaces, shared platforms
- Crowdfunding, crowdsourcing platforms
- Research and innovation platforms, innovation hubs



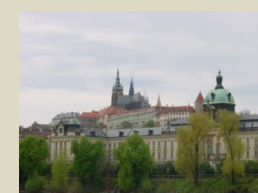
### Living in the city

- Housing
- Health and social care
- Safety and security
- Environment
- Recreation and sports



### City infrastructure – Utility ecosystems

- Mobility, transport and parking
- Energy saving, smart grid, and renewable energy
- Water management and saving
- Waste management and recycling
- Broadband, wired and wireless

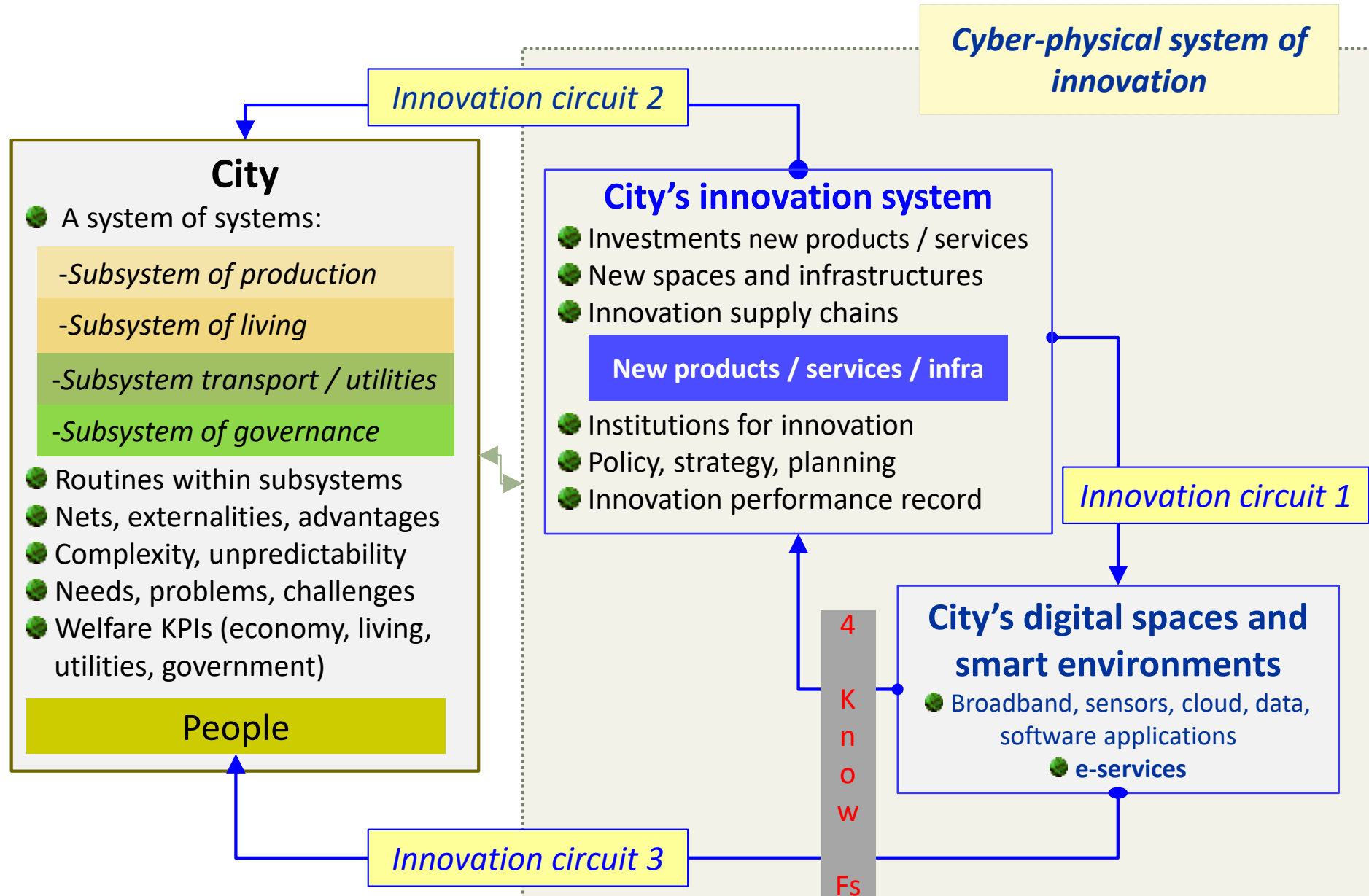


### City governance

- Decision making / citizen participation / democracy
- Government services to citizens
- City planning / city management
- Monitoring and benchmarking

# SMART CITIES

## HOW IT IS DONE? THREE CIRCUITS OF INNOVATION AND PROBLEM-SOLVING



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### A Collection of Definitions of Intelligence

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15 June 2007

#### Abstract

This paper is a survey of a large number of informal definitions of “intelligence” that the authors have collected over the years. Naturally, compiling a complete list would be impossible as many definitions of intelligence are buried deep inside articles and books. Nevertheless, the 70-odd definitions presented here are, to the authors’ knowledge, the largest and most well referenced collection there is.

#### Contents

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and share many common features. If we scan through the definitions pulling out commonly occurring features we find that intelligence:

- Is a property that an individual agent has as it interacts with its environment or environments. (communication)
- Is related to the agent’s ability to succeed or profit with respect to some goal or objective. (problem-solving)
- Depends on how able the agent is to adapt to different objectives and environments. (behaviour adaptation)

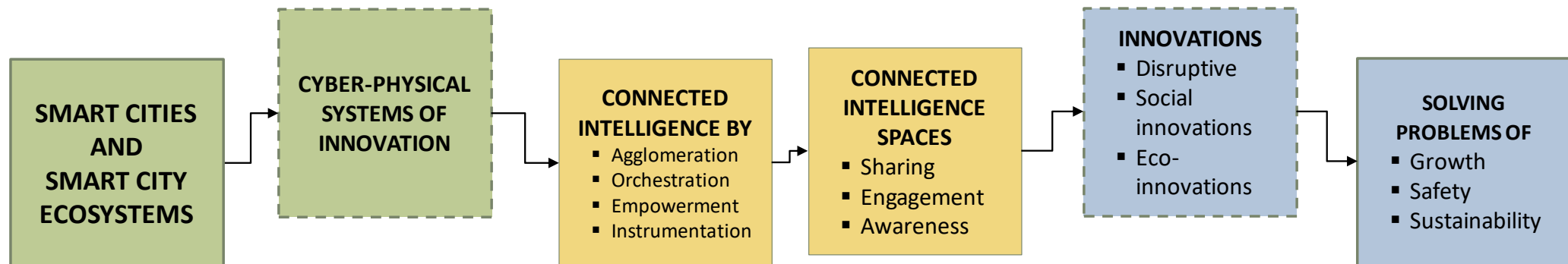
When the entities, the abilities and agencies of intelligence are distributed, we may speak about **CONNECTED INTELLIGENCE**.

A form of intelligence emerging from

- Connected devices, connected people, connected institutions,
- Heterogeneous systems of people, institutions, and smart objects or machines

(1) **CONNECTED INTELLIGENCE is a space:** a collection of relations between objects / entities. It brings together people, knowledge institutions and intelligent machines to solve a problem collaboratively. It is a distributed system having communication and problem-solving capabilities.

(2) **Connected intelligence spaces** (such as shared spaces, engagement spaces, and awareness spaces) generate different **types of innovation** and **problem-solving capabilities**



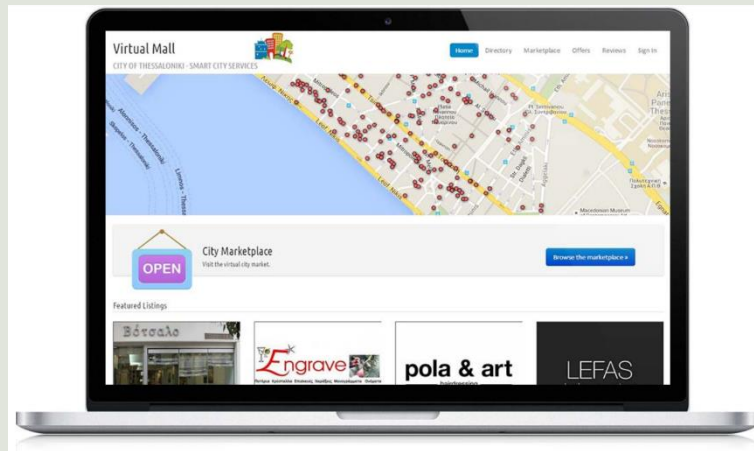


## *2. Spaces of connected intelligence: shared, engagement, awareness*

# Type I. SHARED SPACES: problem-solving through collaborative partnerships

**CITIZENS SHARE RESOURCES to create ADVANTAGES**

## MARKETPLACES



Every commercial enterprise located in the city can create its own virtual shop. The marketplace enables customers to access a variety of retailers using a shared site.

ADDED VALUE: SHARE WEB SPACE

## HOSPITALITY PLATFORMS



Online hospitality platform and premises to lease or rent short-term lodging.

Airbnb does not own real estate; it is a broker that receives fees with every booking.

ADDED VALUE: SHARE PREMISES

## CAR POOLING, CAR SHARING, e-BIKES



Car pooling, car sharing, e-Bikes sharing over a platform privately-owned cars, rented cars, and city-owned bikes.

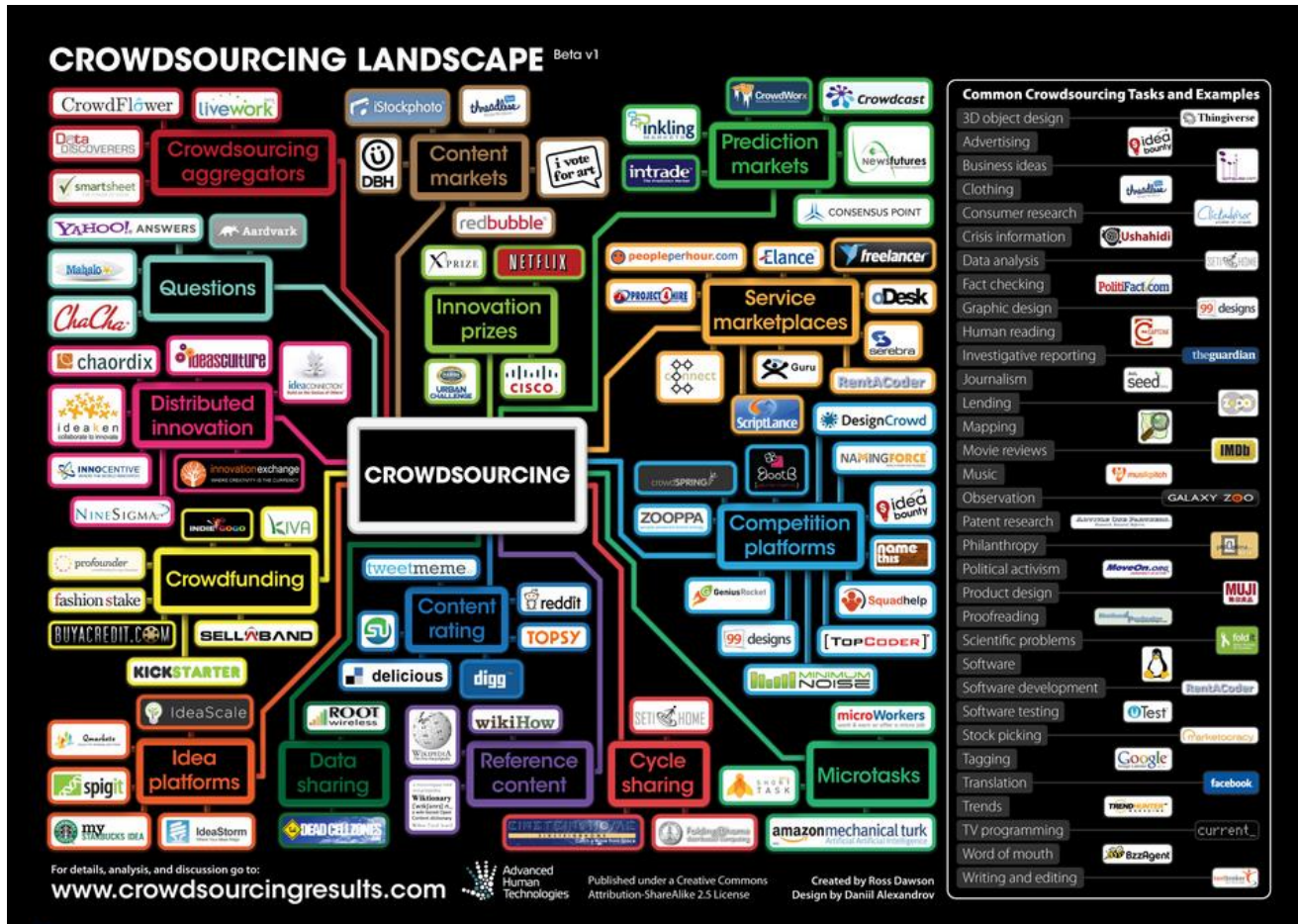
ADDED VALUE: SHARE OBJECTS OR INFRASTRUCTURE

# SHARED PLATFORMS

## MOST COMMON SHARING PRACTICE IS CROWDSOURCING

### Strategies for successful Web 2.0 platforms

1. Create prototypes as early as possible.
2. Get people on the network to work with prototypes.
3. Release early and release often.
4. Gather usage data from your users and input it back to NPD.

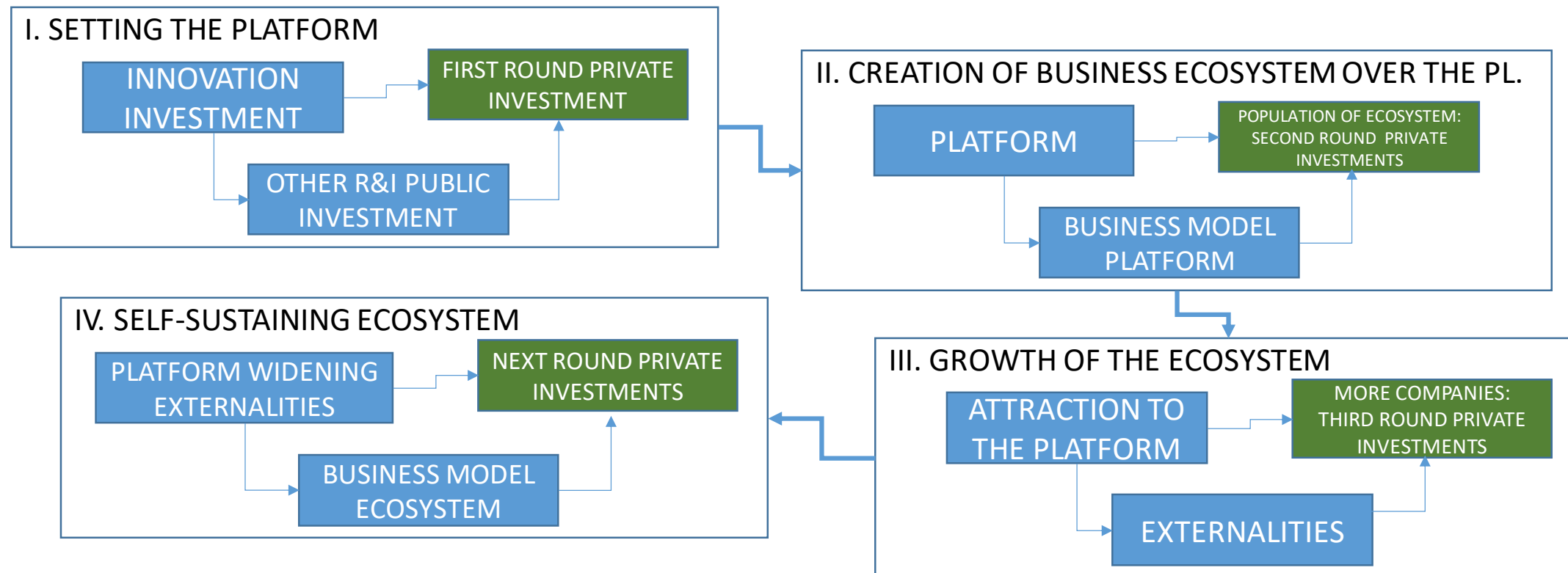


5. In technologies, consider current skill sets and staff availability.
6. First comes functionality, choose technologies later.
7. Testing is part of the software development process.
8. Have an open source strategy.
9. Whenever users can provide data, enable them.
10. User experience should follow a "complexity gradient."
11. Consider mobile users
12. Explicitly enable your users to co-develop the product.
13. Go to the user, don't only make them come to you.
14. The product should be spread around the Web by users
15. Create an online user community and nurture it.
16. Design your product to build a **strong network effect**.
17. Know the popular Web standards and use them.
18. Build on the shoulders of giants; don't make what can be found
19. Know the Web 2.0 design patterns and business models.
20. Integrate a coherent social experience into your product.

Source: Dion Hinchcliffe, <http://web2.wsj2.com/>

# SHARED SPACES

## PRODUCTION: TOWARDS SELF-SUSTAINING BUSINESS ECOSYSTEMS



A multiyear research project on platform strategies identified (1) **Two major types of shared platforms**, (1a) proprietary platforms, having a single provider that solely controls its technology, and (1b) shared platforms with multiple firms collaborate in developing the platform's technology then compete in offering compatible versions of the platform, and (2) **Three stages of the platform life cycle**, (a) platform design, (b) network mobilization, and (c) platform maturity.

Eisenmann, T.R. (2008). *Managing Proprietary and Shared Platforms*, *California Management Review*, 50(4)

# Type II. ENGAGEMENT SPACES: problem-solving through motivation for action

**CITIZENS** become **MOTIVATED AND ENGAGE IN SOCIAL ACTIVITIES**

## we-GOVERNANCE



**we-Governance** is people-centered governance. Citizens report problems, propose solutions, and engage in city management. Extracting intelligence from data to optimize admin.

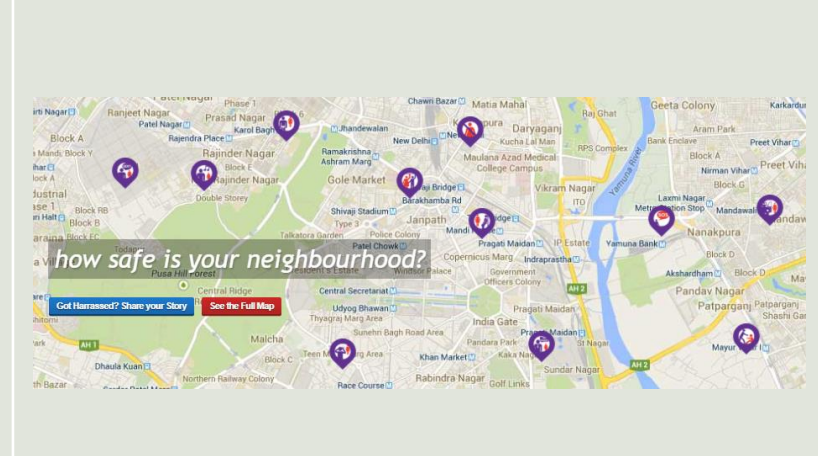
## SOCIAL CARE RESPONSIBILITY



A complex system for **ZERO fatal traffic accidents**, combining

1. Mapping high risk network
2. Citizen engagement
3. City-measures
4. Digital technology
5. Engineering solutions
6. Monitoring and assessment

## SAFETY



**Safecity** is a platform in which users report personal stories of sexual harassment and abuse in public spaces. Anonymous data are aggregated as hot spots on a map indicating trends at a local level. Communities can identify factors and behavior that leads to violence and deploy strategies for solution.

# ENGAGEMENT SPACES

## PRODUCTION by DIGITAL SOCIAL INNOVATION

**Social innovation:** innovations which are social in both their ends and their means, primarily aimed at improving well being (migration, unemployment, inclusion, poverty, ageing, safety and security).

**Three types of SI:** (1) grassroots social demands not addressed by the market, (2) challenges in which the boundary between 'social' and 'economic' blurs, (3) fundamental changes in attitudes and values of the society as a whole.

**Digital Social Innovation** surveys have identified many areas of SI by digital means:

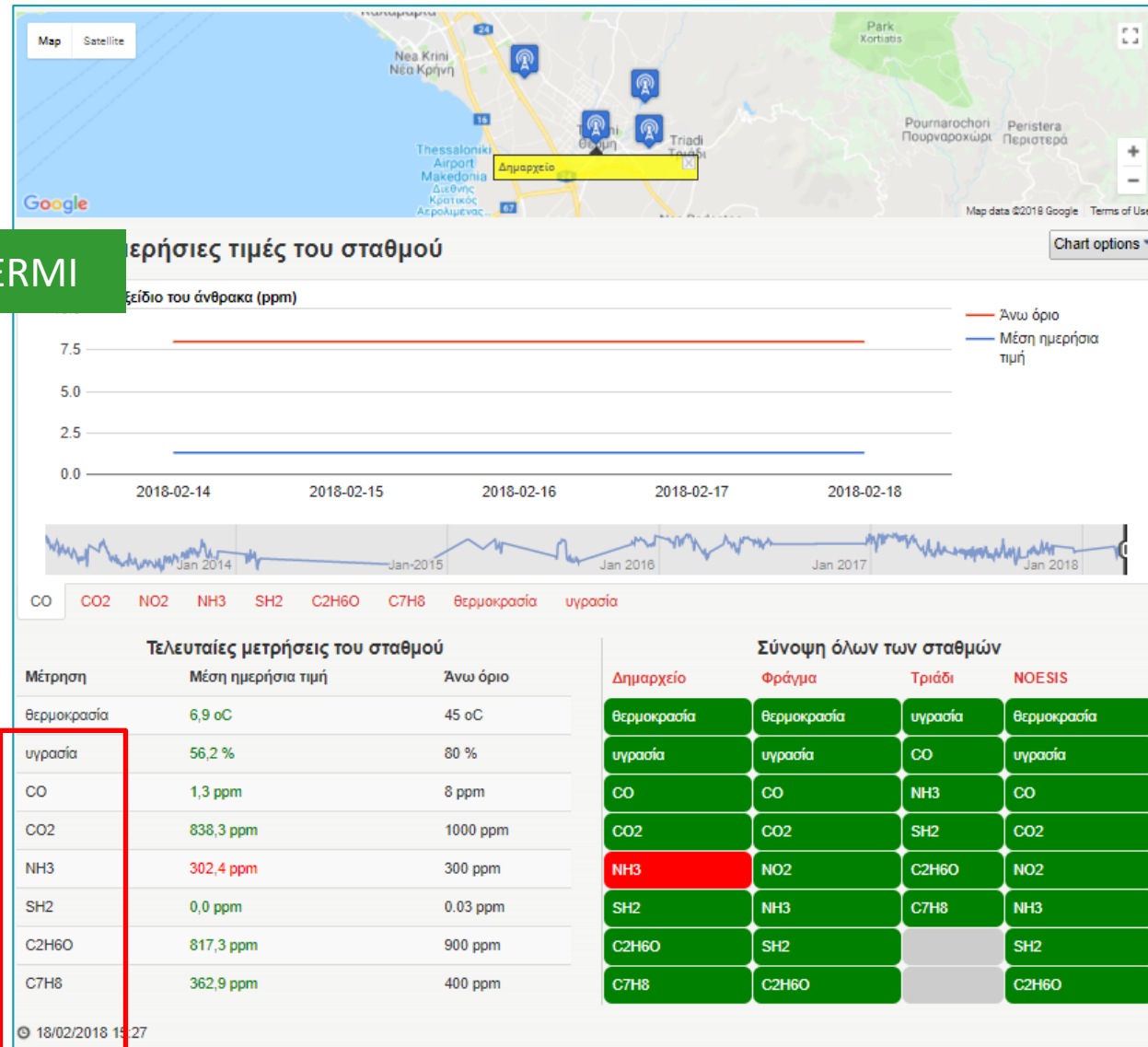
1. Open access solutions, open science, open source, diffusing know-how.
2. Online Living Labs in which users contribute to finding solutions.
3. Online Communities of Practice involving groups of users to share effective practices.
4. New ways of making, based on open design and manufacturing, 3D, free CAD-CAM.
5. Open democracy and decision-making platforms.

**Drivers:** Interactions between individuals. **Motivation** to participation. The **involvement of stakeholders**. **Integrated care model**, in which traditional services for health and social care are coordinated by user's informal network and community resources. **Technology and ICT** offering basic services to ageing population

# Type III. AWARENESS SPACES: problem-solving through raising awareness

## IN THE SIMPLEST FORM: SENSOR ALERT

THERMI



Vehicle  
fleet air  
pollutant

Amonia

Hydrogen  
sulfide

Toluene

- Sensors **capture** and monitor a series of environmental conditions.
- Applications and urban objects **visualize** and transfer this information to citizens.
- Citizens **adapt their behaviour** to conditions of the environment and sources of pollutants.

# AWARENESS SPACES

## MORE ADVANCED PREDICTION AND OPTIMISATION OF INFRASTRUCTURES

### WATER LEAKAGES



In cities the quantity of water wasted due to water leakages in pipelines ranges from 15%-50% of water loss. Pressure sensors may alert and identify the leak point.

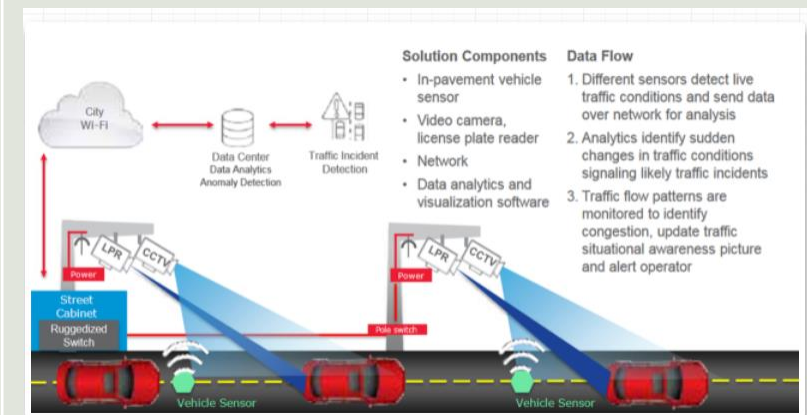
### AIR POLLUTION



Santander, Spain's sensors measure everything from the amount of trash in containers, to the number of parking spaces available, to the size of crowds on the sidewalks. *Flickr/FreeBird*

In Santander, Spain, algorithms has been used for modelling with monitored learning (prediction, classification). Conclusions about the behaviour of pollution variables, and prediction with 1-hour, 2-hour, 4-hour, 8-hour and 24-hour forecast horizons. The models have been trained by machine learning algorithms such as M5P, IBk, linear regression, Regression by Discretization, RepTree, Bagging with RepTree, etc.

### TRAFFIC CONGESTION



Traffic management solutions focus on (1) forecasting traffic congestion in order to provide route optimization advice, (2) inform about available parking and optimize search



# AWARENESS SPACES

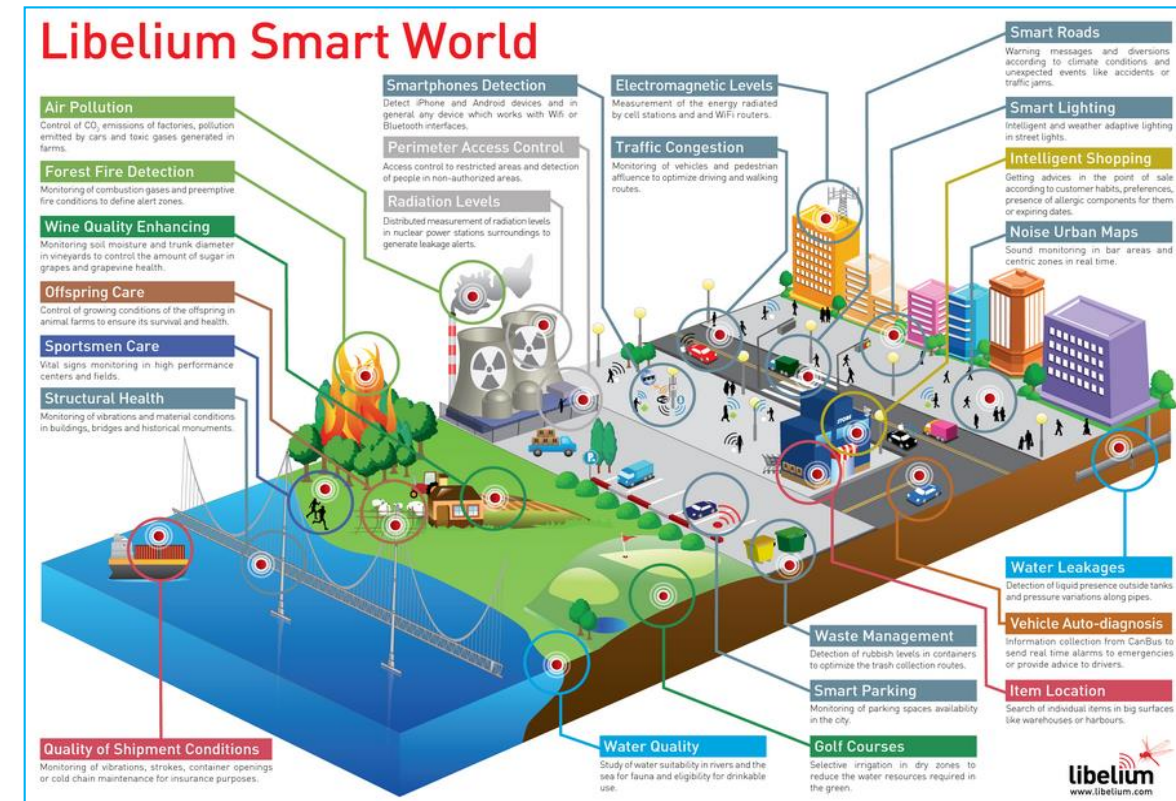
## PRODUCTION OF

by

1. Deployment of sensor networks across city districts , neighborhoods, utilities that collect and distribute information and raise awareness.
2. Users get motivated to adopt more sustainable behaviours because of (1) direct gain, (2) understanding long-term profit, (3) various gaming and reward systems.
3. Public authorities may follow more sustainable practices to save resources.
4. Impact is measured, disseminated, and actions for sustainability are improved.



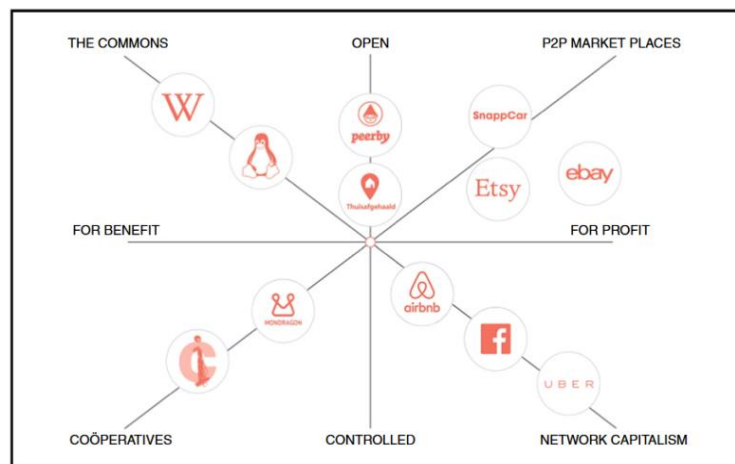
SENSOR NETWORK, SANTANDER



# CONNECTED INTELLIGENCE SPACES

## EMPIRICAL EVIDENCE that enable DIVERSE TYPES OF INNOVATION

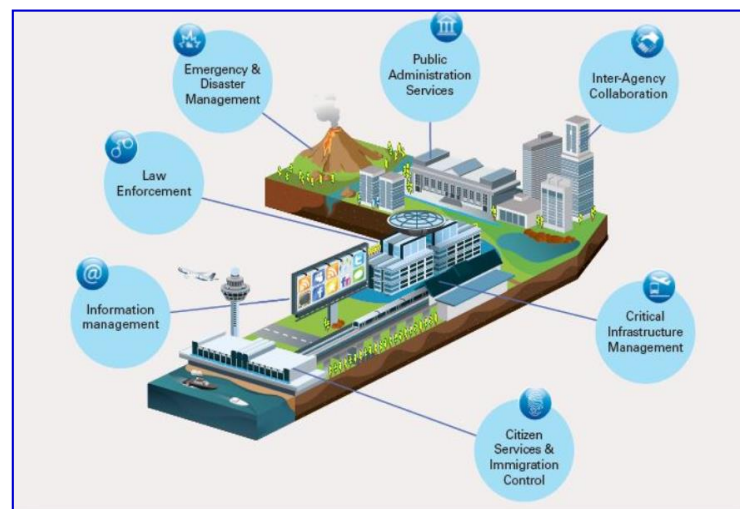
### SHARED SPACES Disruptive Innovation



Πηγή: Oskam, J., & Boswijk, A. (2016)

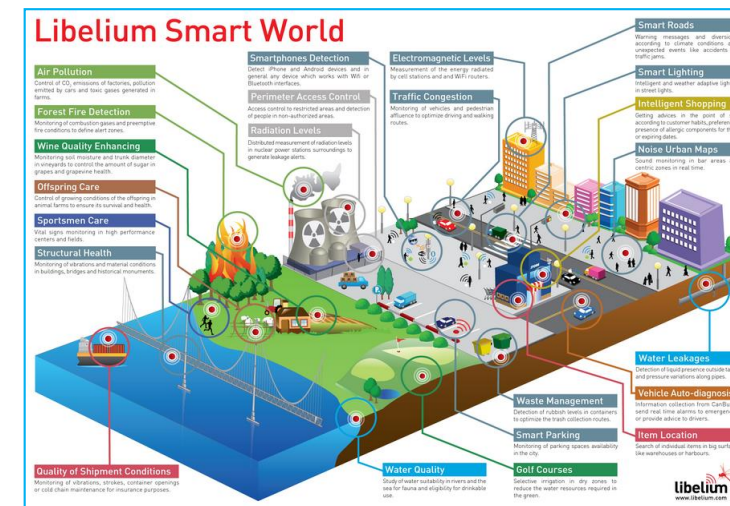
- **Sharing economy – Smart growth**
- Business growth platforms
- Business over Business
- P2P production, demand driven

### ENGAGEMENT SPACES Social Innovation



- **Social innovation and citizen non-profit networks**
- Mapping and motivation for participation and change
- Real-time safety and security systems in the public space of cities

### AWARENESS SPACES Innovation for Sustainability

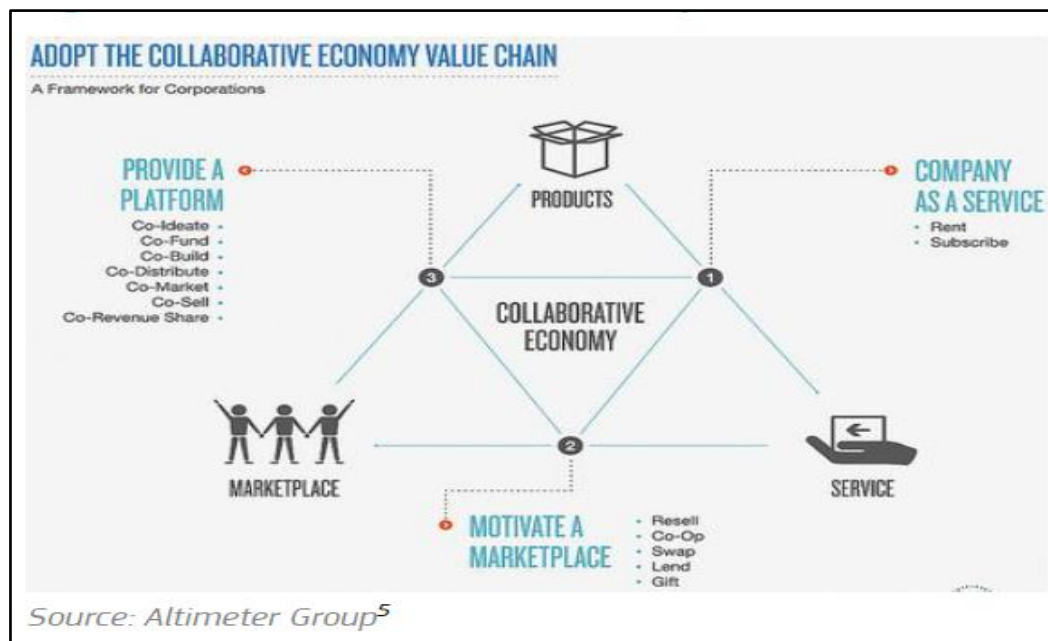


- **Sensor networks, real-time alert**
- Behaviour adaptation to external conditions
- Awareness and solutions about the environment, pollution, energy saving, CO2 emissions, climate change

### *3. Shared spaces and disruptive innovation*

# SHARED INTERNET SPACES AND PLATFORMS FOR GROWTH

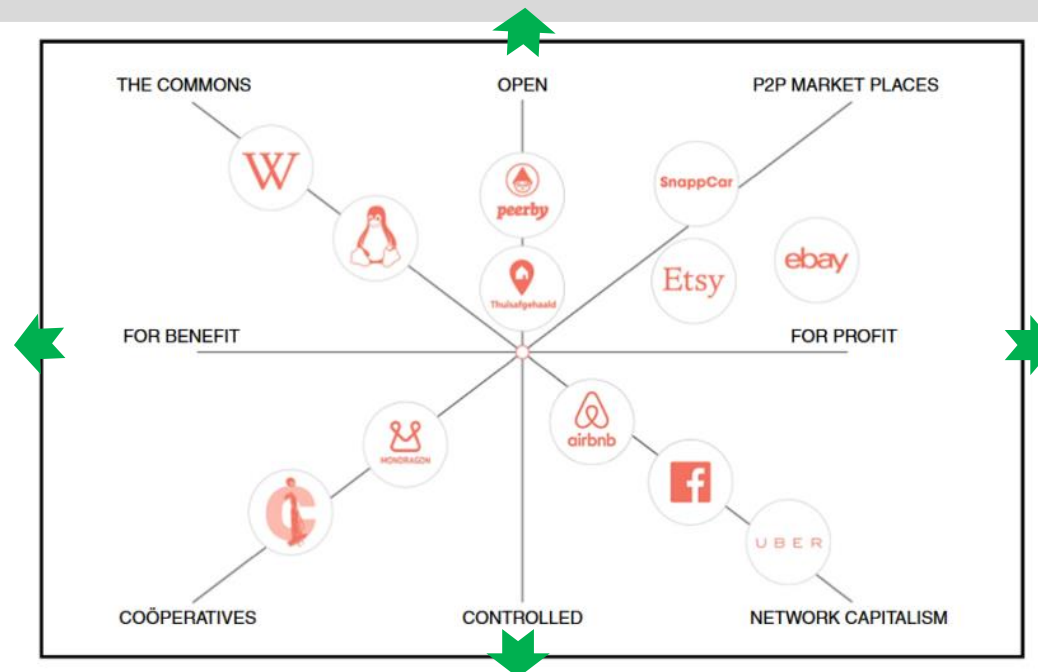
## RISE OF COLLABORATIVE ECONOMY



- ▶ **The collaborative economy value chain:** a space that involves internet-based technologies to connect people in order to optimize the use of resources, goods, services, and skills.
- ▶ Entails the collaboration of groups or **networks of individuals** to design, produce or distribute goods.
- ▶ It is related to the idea that the **network / community drives** production and services.

Probst, L., Frideres, L. Pedersen, B. and Lidé, S. (2015).

Collaborative Economy. EC, DG Internal Market.



### Typology of shared spaces

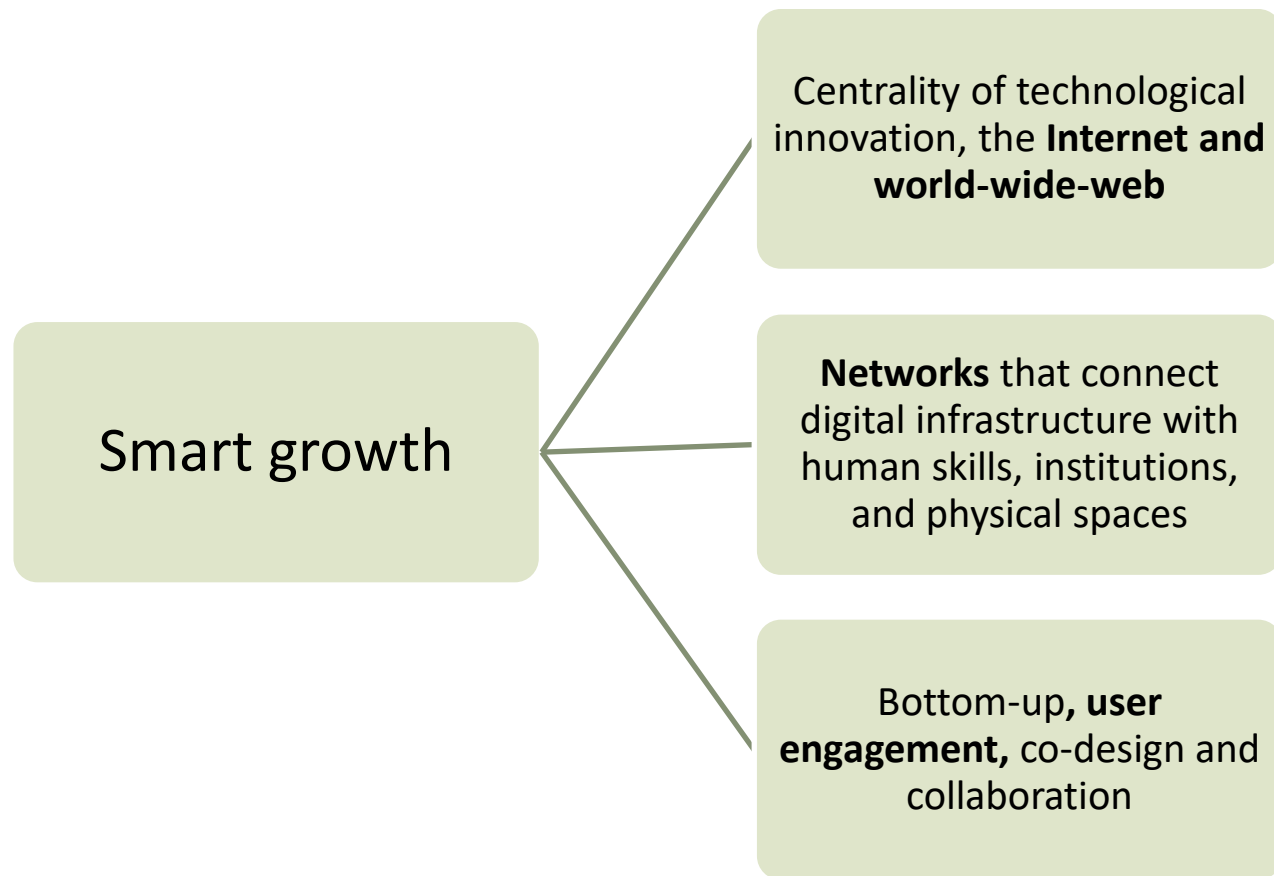
Upper left: **open and not for profit systems**. Co-created P2P value. The public benefit is central

Upper right: **P2P social market places** based on open systems with distributed market function.

Left bottom: **collectives** that are characterized through a closed protected system.

Bottom right: **network capitalists**, hyperconnected and distributed platforms with a commercial goal.

Oskam, J., & Boswijk, A. (2016). Airbnb: the future of networked hospitality businesses. *Journal of Tourism Futures*, 2(1), 22-42.



### Multiple smart growth strategies

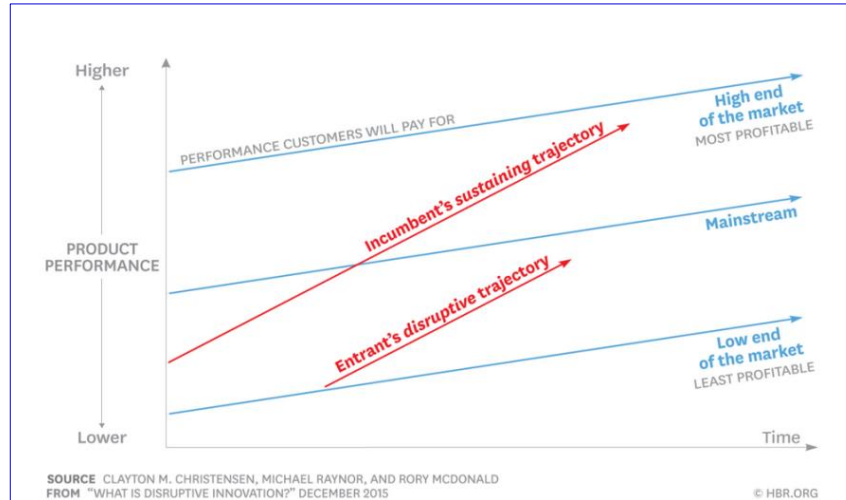
- Smart Specialisation Strategies (S3)
- Digital Growth Strategies
- Next Generation Networks plans
- Smart city strategies

### Strategies are

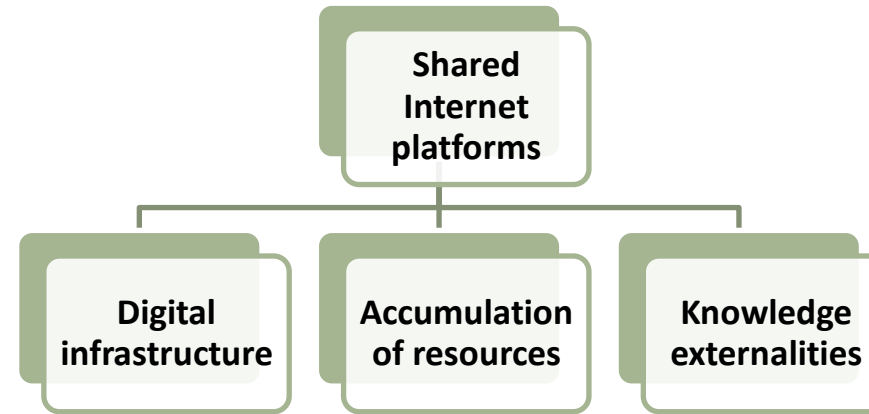
instances of the same approach that deploys digital technologies and smart environments (at different spatial scales) to sustain network-based externalities

# SHARED SPACES

## ENABLE DISRUPTIVE INNOVATION



“**Disruption** describes a process whereby a smaller company with fewer resources is able to successfully challenge established incumbent businesses”  
*Christensen et al. (2015)*



**Shared Internet platforms** enable disruptive business trajectories by sharing infrastructure, knowledge, and collaboration externalities

## NETWORKED BUSINESS DEVELOPMENT

- Platform-based business models
- Business over business
- The customer (operation over the platform) manages its own value chain
- Consumers become co-creators of value.
- Demand-driven production
- Dominant model in transport, hospitality, insurance, real-estate

# CONNECTED INTELLIGENCE

## ENTITIES CONTRIBUTING TO DISRUPTIVE INNOVATION over SHARED SPACES

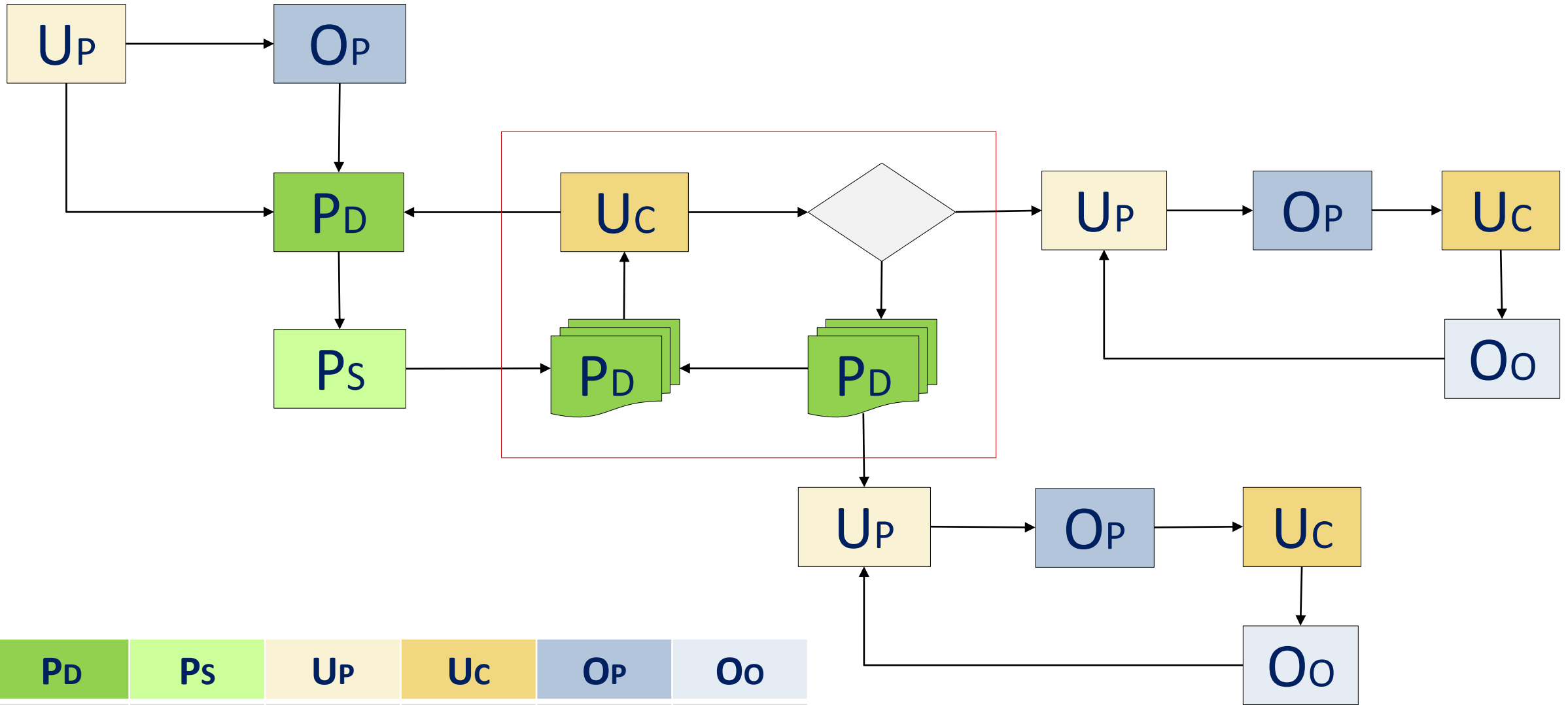
| SHARED SPACES / PLATFORMS  |  | USERS  |  | ORGANISATIONS   |  |
|--|--|--|--|---|--|
| DATA   | SOFTWARE   | PROVIDERS  | CONSUMERS  | PLATFORM ORG  | OTHER ORG  |
| Context<br>-Web<br>-Sensors<br>-Open public<br><br>Advertisement | Hosting<br>-storage, broadband, computing<br>CSM<br><br>Algorithms<br>-Visualisation<br>-Benchmarking<br>-Time series<br>-Competitive offers<br>-Clustering<br><br>Dynamic pricing | Data<br>-Offers products / services<br>-Profiles<br>-Prices<br>-User interaction<br><br>Objects<br>-Infrastructure<br>-Products/ services<br>-Support services | Market<br>-Revenue<br><br>Data<br>-Assessments<br>-Profile | Trust<br>-Rules of agreement<br>-Payment transaction<br>-Dispute resolution | Support<br>-Transactions<br>-Agreement frameworks<br>-Dispute resolution |

### Six types of connected intelligence entities

|      |                |                 |              |               |       |
|------|----------------|-----------------|--------------|---------------|-------|
| DATA | INFRASTRUCTURE | DATA & SERVICES | FUNDS & DATA | TRUST & RULES | RULES |
|------|----------------|-----------------|--------------|---------------|-------|

# CONNECTED INTELLIGENCE

## RELATIONSHIPS AMONG ENTITIES: THE CENTRAL POSITION OF CONSUMER & PLATFORM



| PD            | PS                | UP            | UC            | OP                    | OO                 |
|---------------|-------------------|---------------|---------------|-----------------------|--------------------|
| Platform data | Platform software | User provider | User consumer | Organisation platform | Organisation other |



# CONNECTED INTELLIGENCE IN SMART CITIES

## SOME CONCLUSIONS

- Connected intelligence spaces are ***cyber-physical spaces*** (not digital spaces): heterogeneous systems setting networks among people, infrastructure, city objects, organisations, trust, money, data, algorithms, software, and other digital and non-digital entities.
- In such spaces, ***data comes with a purpose*** defined by the overall cyber-physical system.
- The connection of these entities generates multiple ***utility functions***, such as combining resources, raising awareness, creating motivation to action. Utility functions depend on networking.
- This conclusion corroborates the hypothesis: different connected intelligence spaces enable different ***types of innovation*** and problem-solving capability.

*Thank you*