Connected Intelligence in Smart Cities

Shared, engagement and awareness spaces 4 innovation

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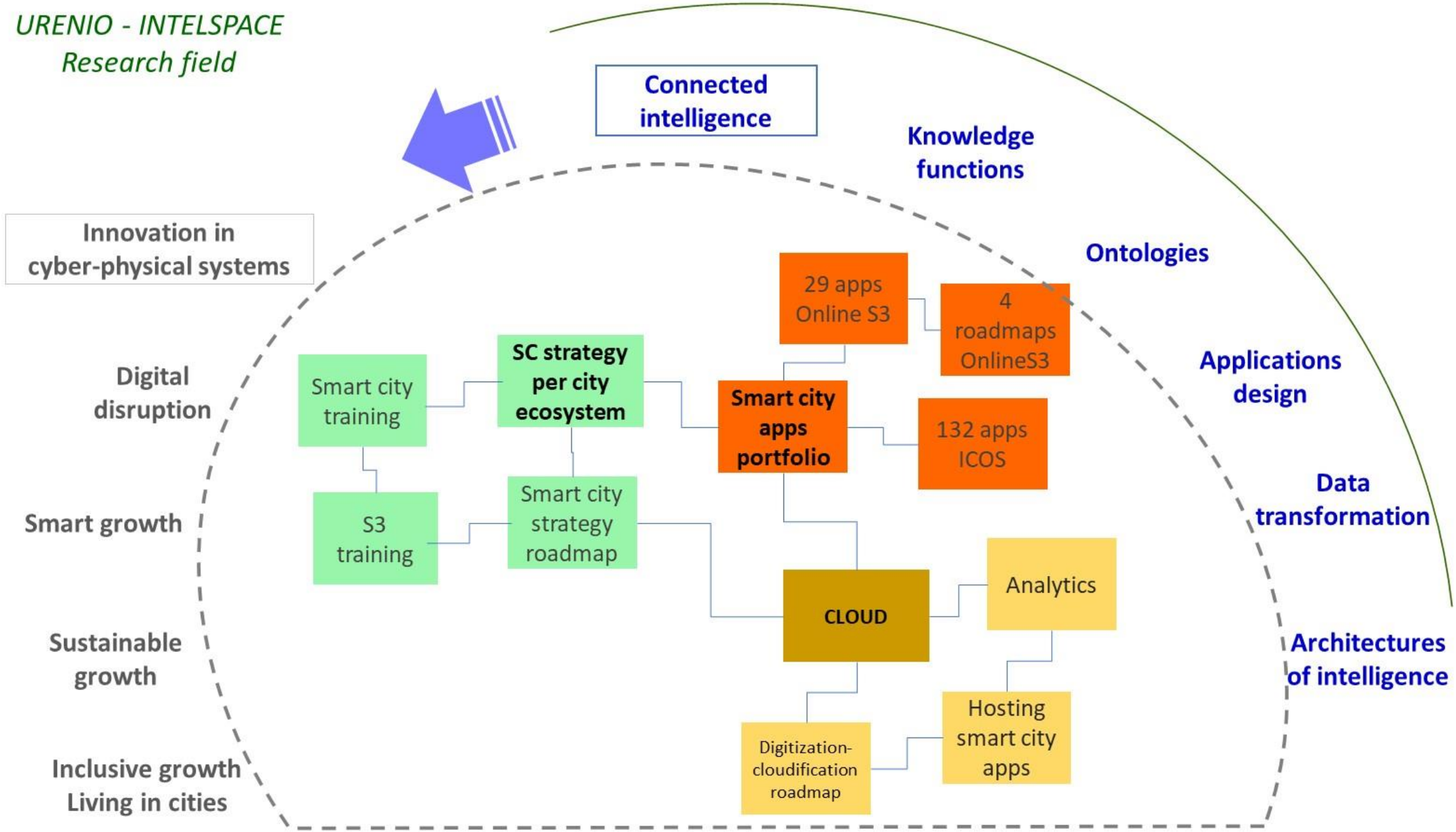
Cities4People - Smart cities and data analytics, JADS, April 18-20, ’s-Hertogenbosch, The Netherlands

URENIO – INTELSPACE RESEARCH

URENIO RESEARCH, ARISTOTLE UNIVERSITY

INTELSPACE INNOVATION TECH


URENIO - INTELSPACE
Research field
Connected intelligence
Knowledge functions
Innovation in cyber-physical systems
Ontologies
29 apps Online S3
4 roadmaps OnlineS3
Digital disruption
Smart city training
SC strategy per city ecosystem
Applications design
Smart city apps portfolio
132 apps ICOS
Smart growth
S3 training
Smart city strategy roadmap
Data transformation
CLOUD
Analytics
Sustainable growth
Architectures of intelligence
Digitization-cloudification roadmap
Hosting smart city apps
Inclusive growth Living in cities

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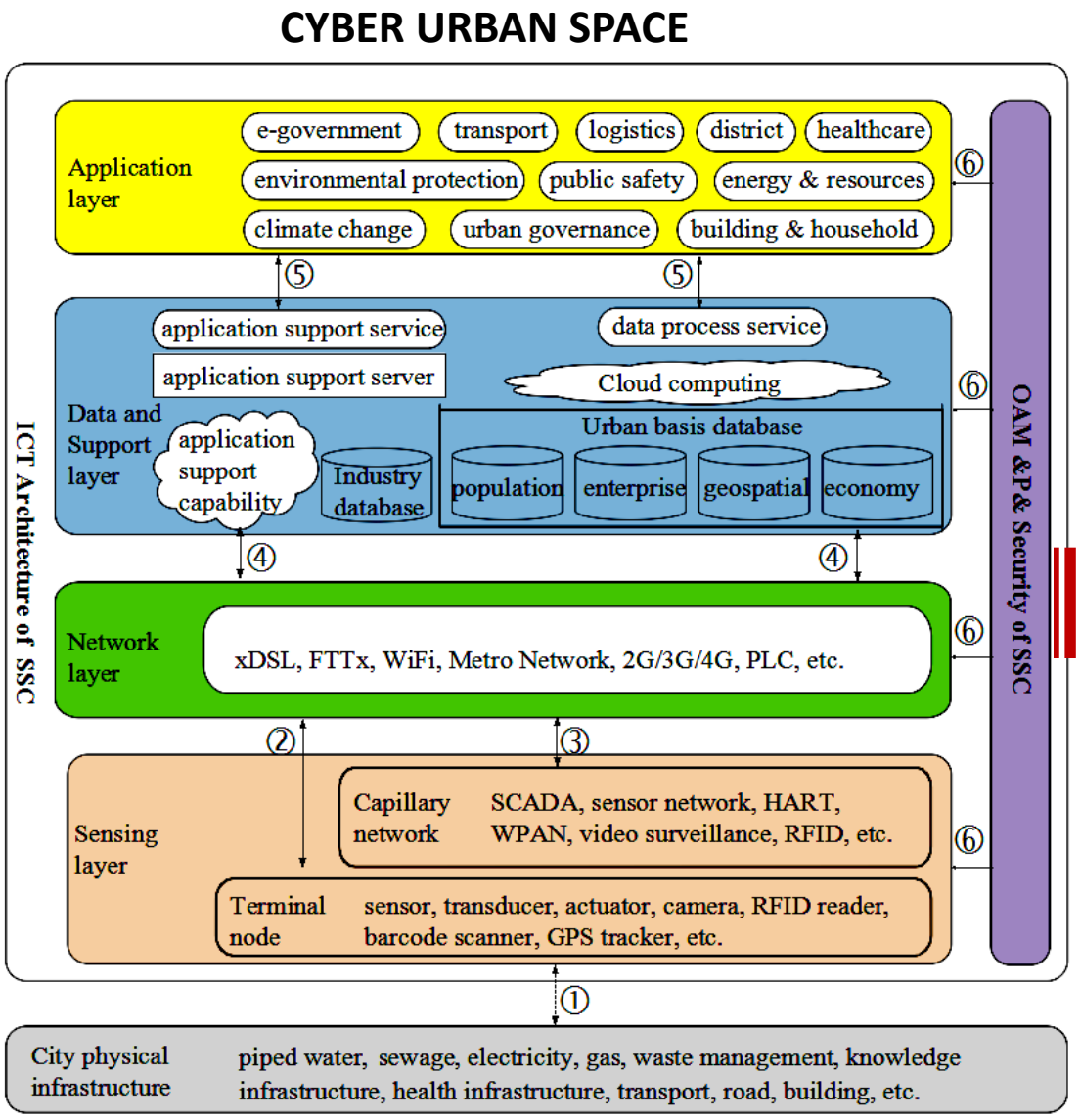
SMART CITIES or INTELLIGENT CITIES

CYBER SPACE improving / transforming CITY AND UTILITY ECOSYSTEMS



Source: ITU

Innovation economy ecosystems

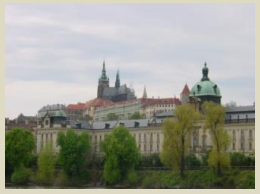
- City sectors / clusters / districts: manufacturing, commerce, business services, education, health, tourism, and other
- Marketplaces, shared platforms
- Crowdfunding, crowdsourcing platforms
- Research and innovation platforms, innovation hubs

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

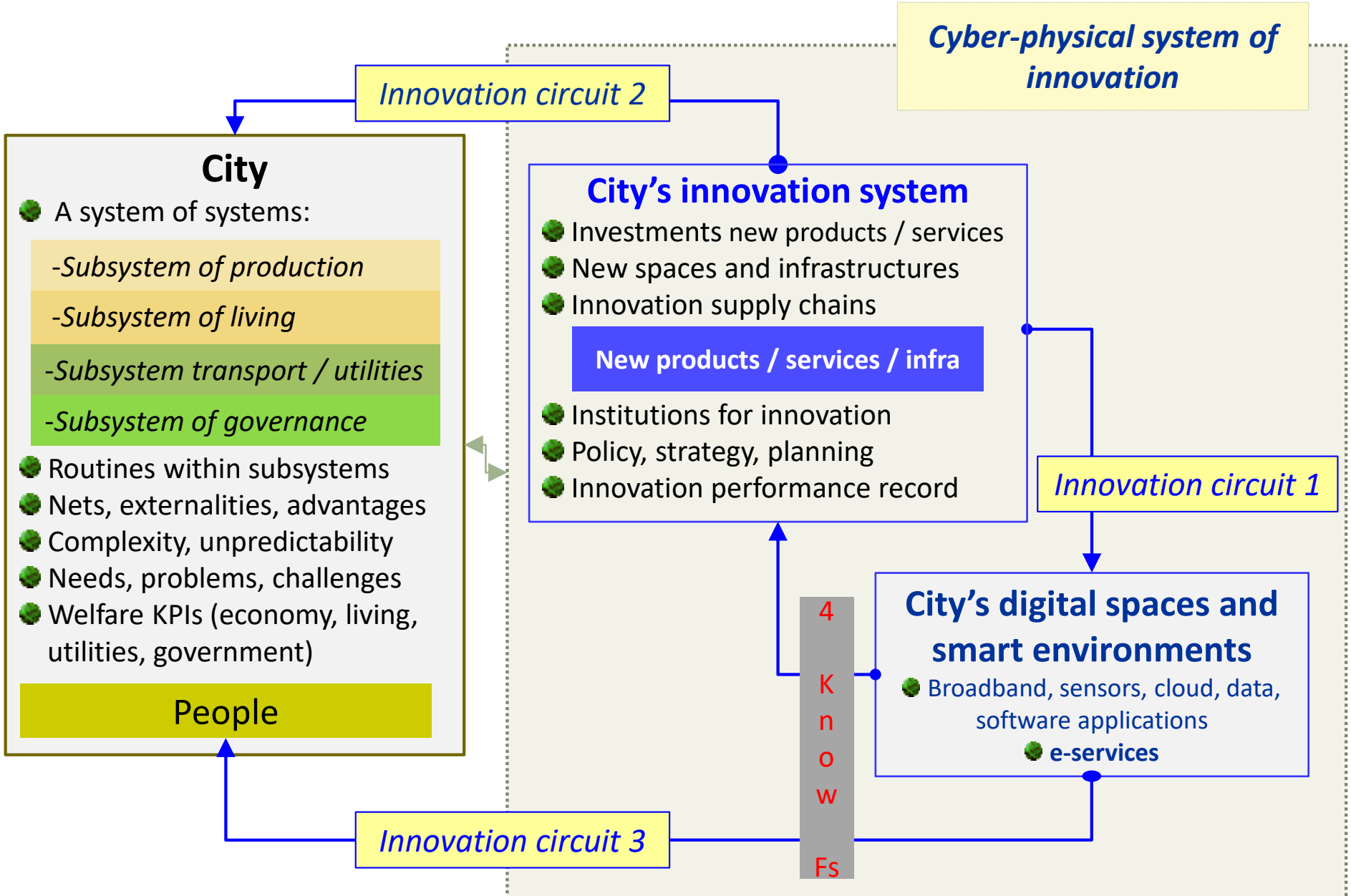


City governance

- 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



SMART CITIES

C1, C2, AND C3 correspond to CONSTITUTING ELEMENTS OF INTELLIGENCE

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

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

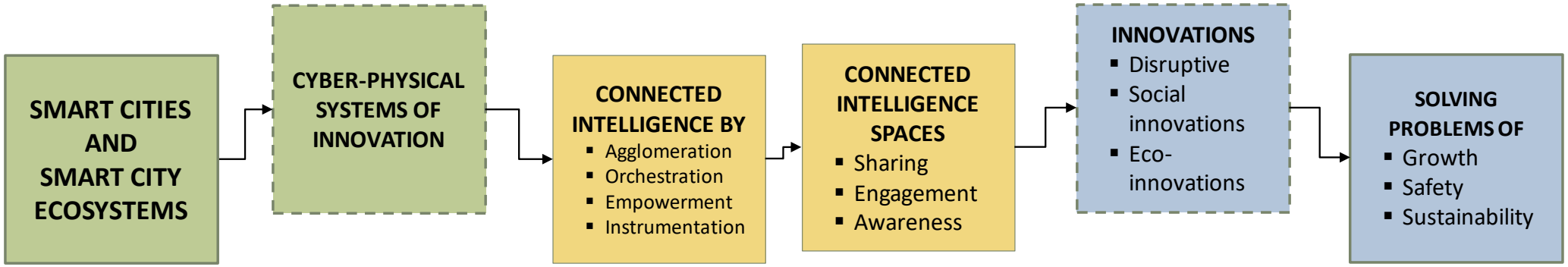
- Connected devices, connected people, connected institutions,
- Heterogeneous systems of people, institutions, and smart objects or machines

SMART CITIES

RESEARCH HYPOTHESIS

(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.

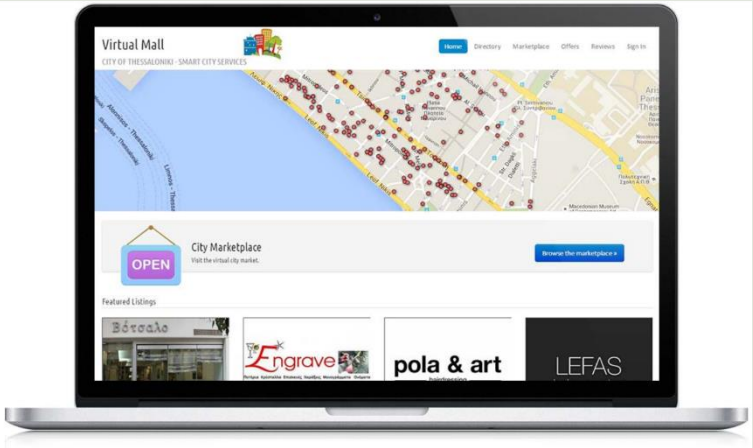
(2) **Connected intelligence spaces** (such as shared spaces, engagement spaces, and awareness spaces) generate different **types of innovation** and **problem-solving capabilities**



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

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

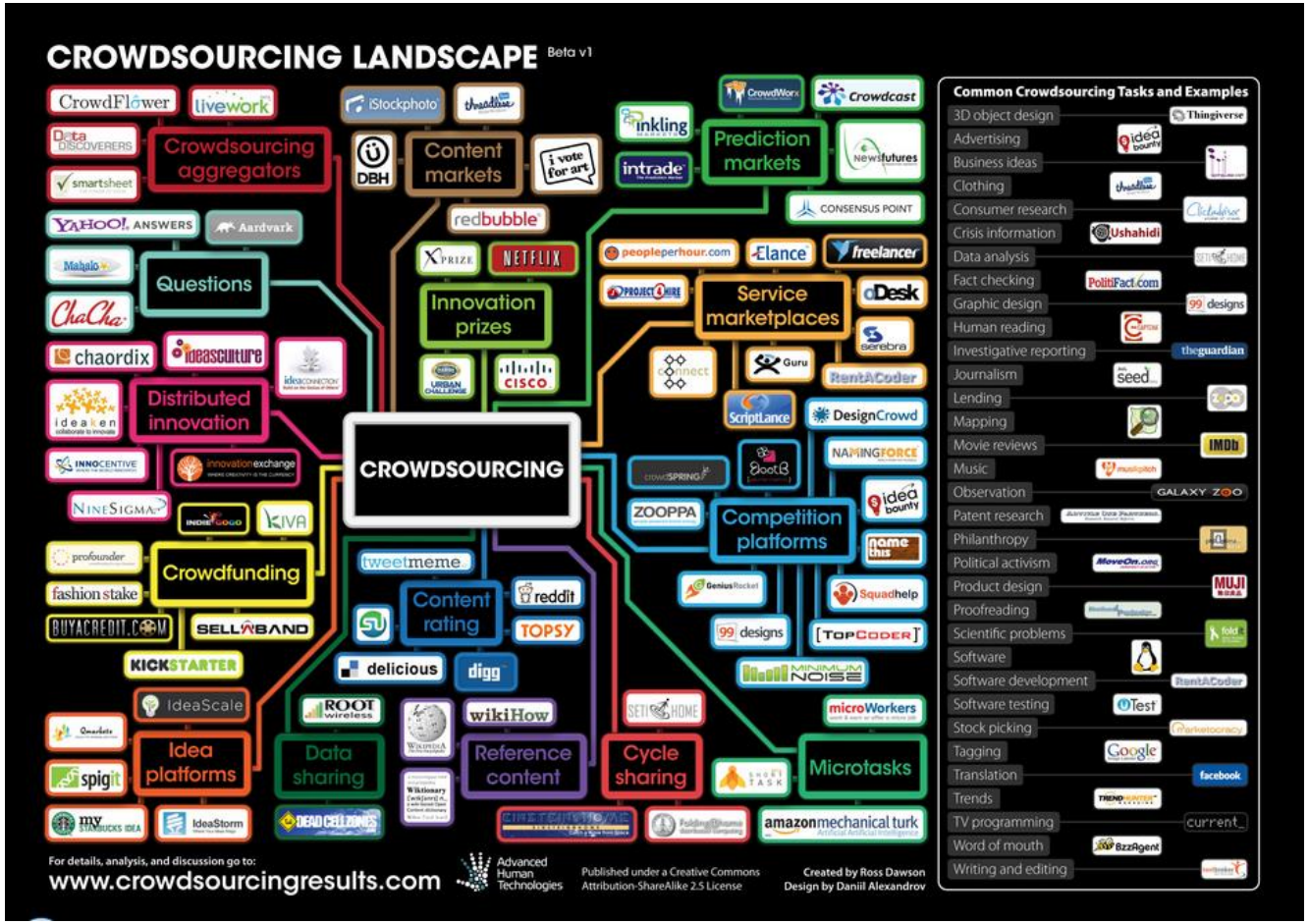
CITIZENS SHARE RESOURCES to create ADVANTAGES

MARKETPLACES	HOSPITALITY PLATFORMS	CAR POOLING, CAR SHARING, e-BIKES
		
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	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 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 CROWSOURCING

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.

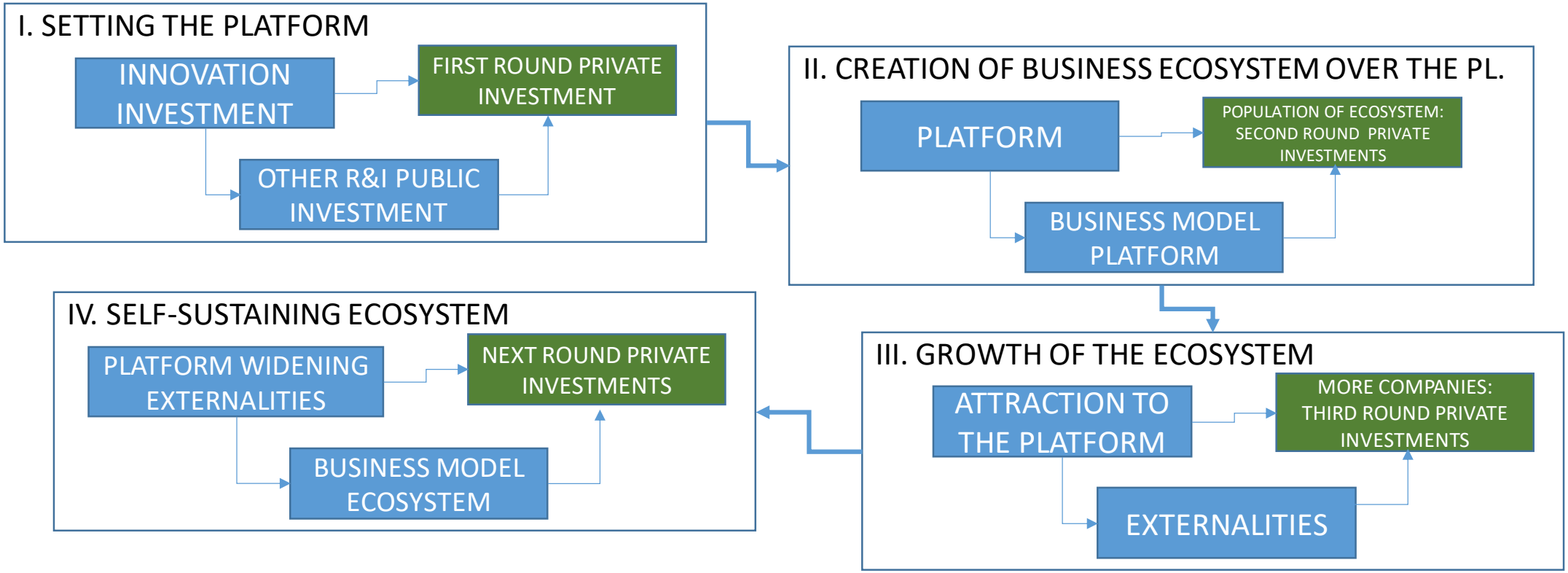
9. **Whenever users** can provide data, enable them.
10. User experience should follow a "complexity gradient."
11. Consider mobile users
12. Explicitly enable your users to co-develop the product.
13. Go to the user, don't only make them come to you.
14. The product should be spread around the Web by 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

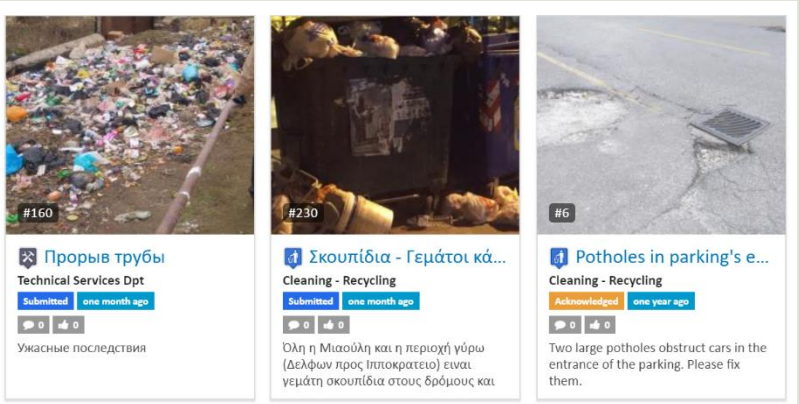


A multiyear research project on platform strategies identified (1) **Two major types of shared platforms**, (1a) proprietary platforms, having a single provider that solely controls its technology, and (1b) shared platforms with multiple firms collaborate in developing the platform's technology then 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	SOCIAL CARE RESPONSIBILITY	SAFETY
		
we-Governance is people-centered governance. Citizens report problems, propose solutions, and engage in city management. Extracting intelligence from data to optimize admin.	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	**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:

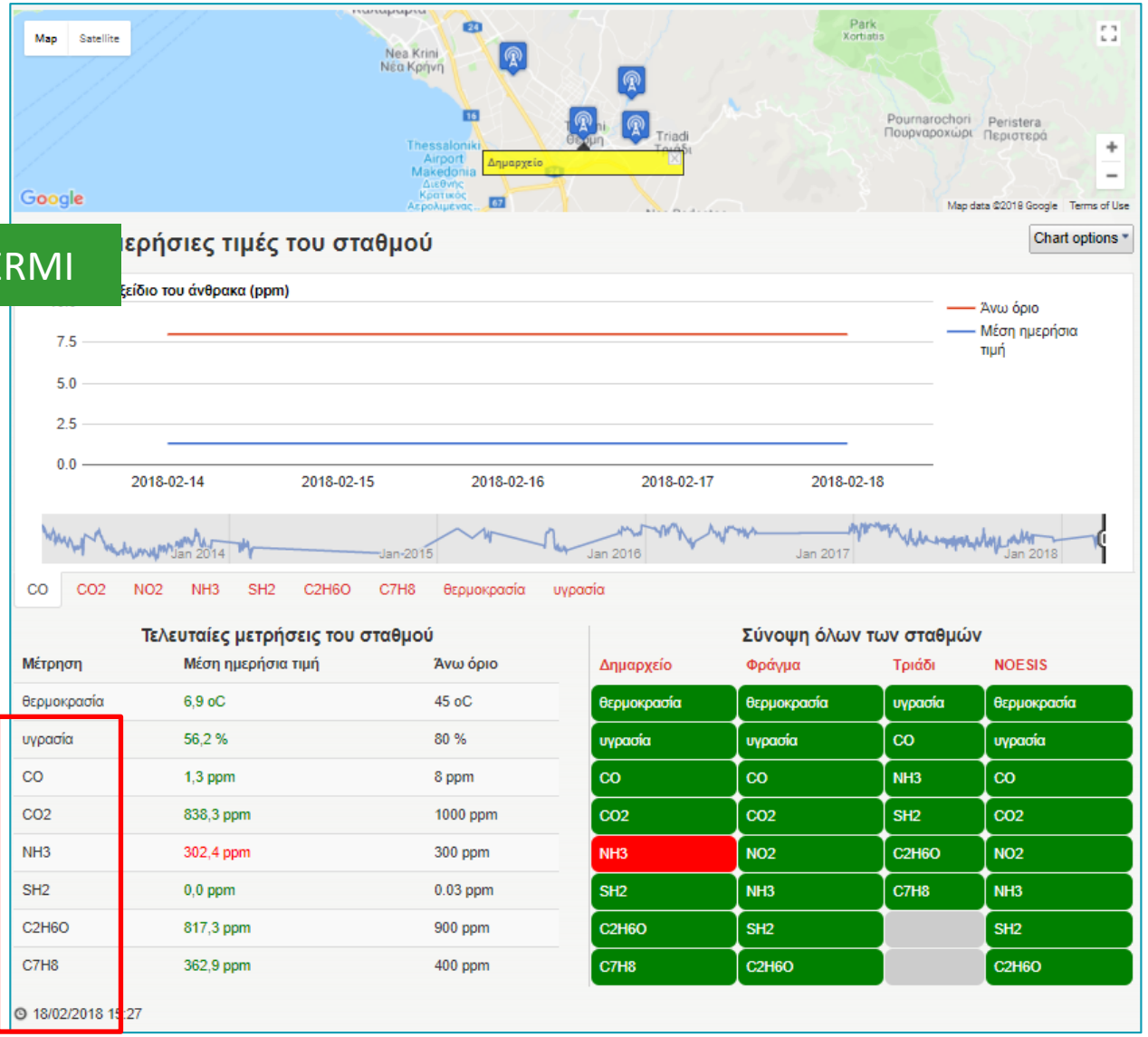
1. Open access solutions, open science, open source, diffusing know-how.
2. Online Living Labs in which users contribute to finding solutions.
3. Online Communities of Practice involving groups of users to share effective practices.
4. New ways of making, based on open design and manufacturing, 3D, free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

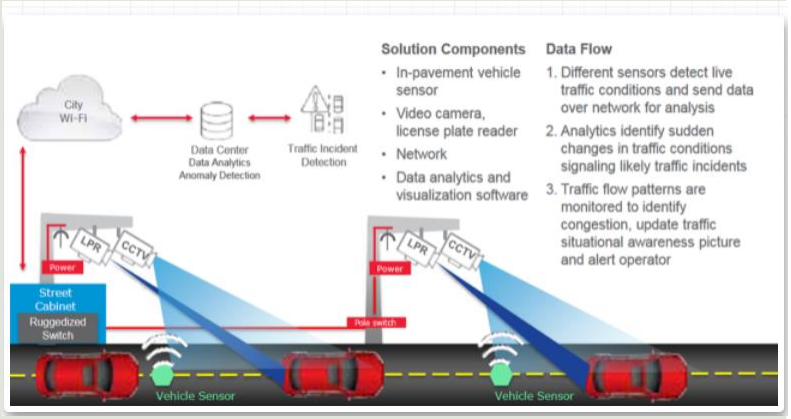
Hydrogen sulfide

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	AIR POLLUTION	TRAFFIC CONGESTION
	 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 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.	In Santader, 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 management solutions focus on (1) forecasting traffic congestion in order to provide route optimization advice, (2) inform about available parking and optimize search

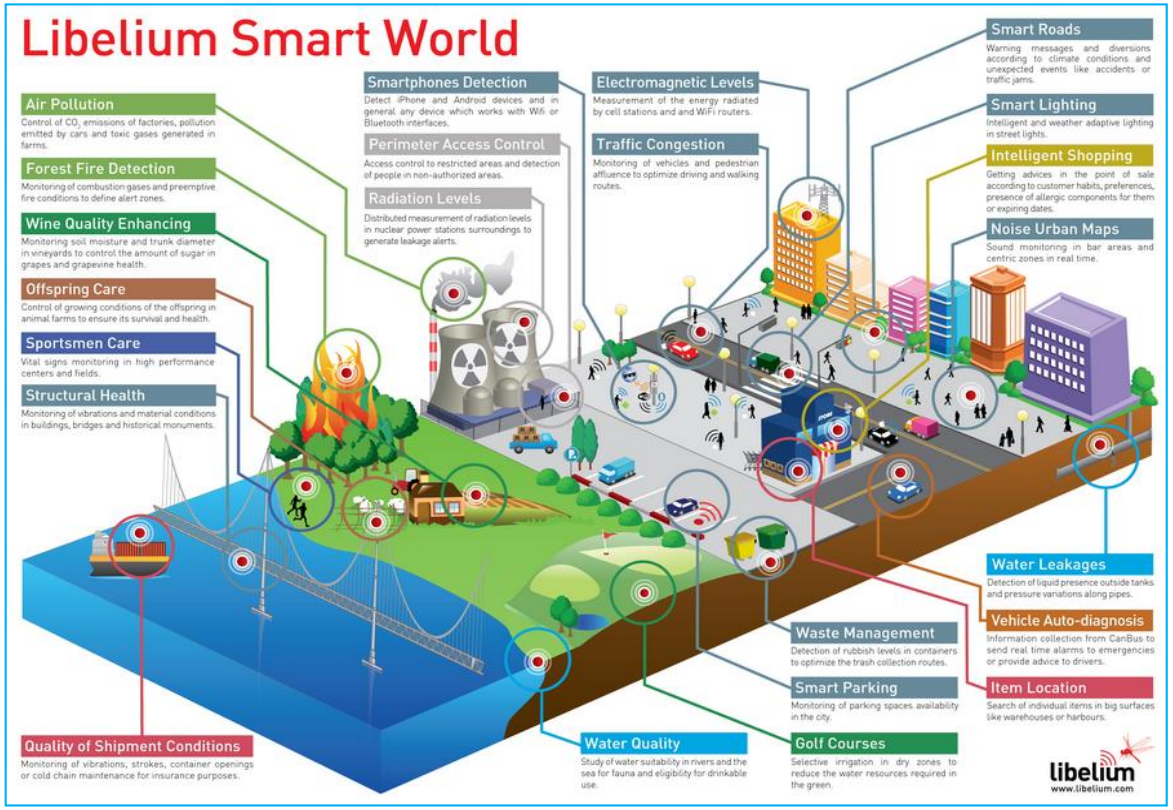
AWARENESS SPACES

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.

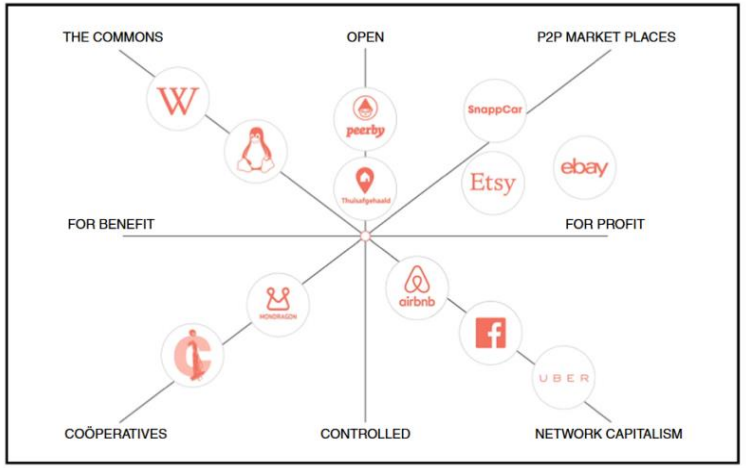
SENSOR NETWORK, SANTANDER



CONNECTED INTELLIGENCE SPACES

EMPIRICAL EVIDENCE that enable DIVERSE TYPES OF INNOVATION

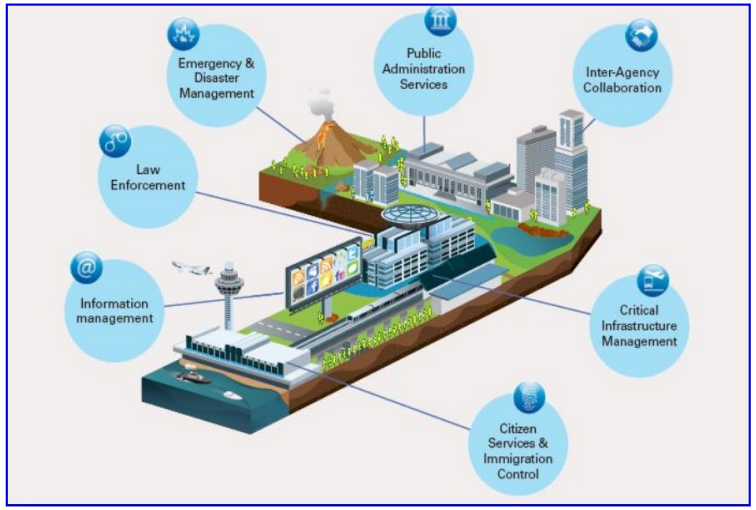
SHARED SPACES
Disruptive Innovation



Πηγή: Oskam, J., & Boswijk, A. (2016)

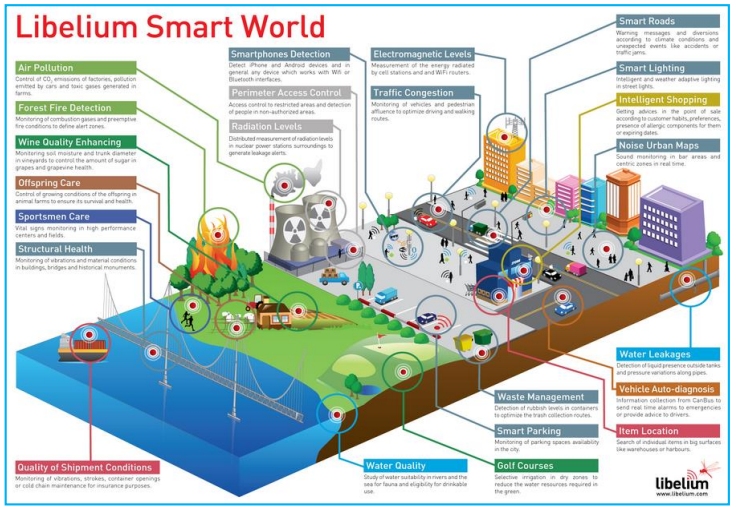
- **Sharing economy – Smart growth**
- Business growth platforms
- Business over Business
- P2P production, demand driven

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

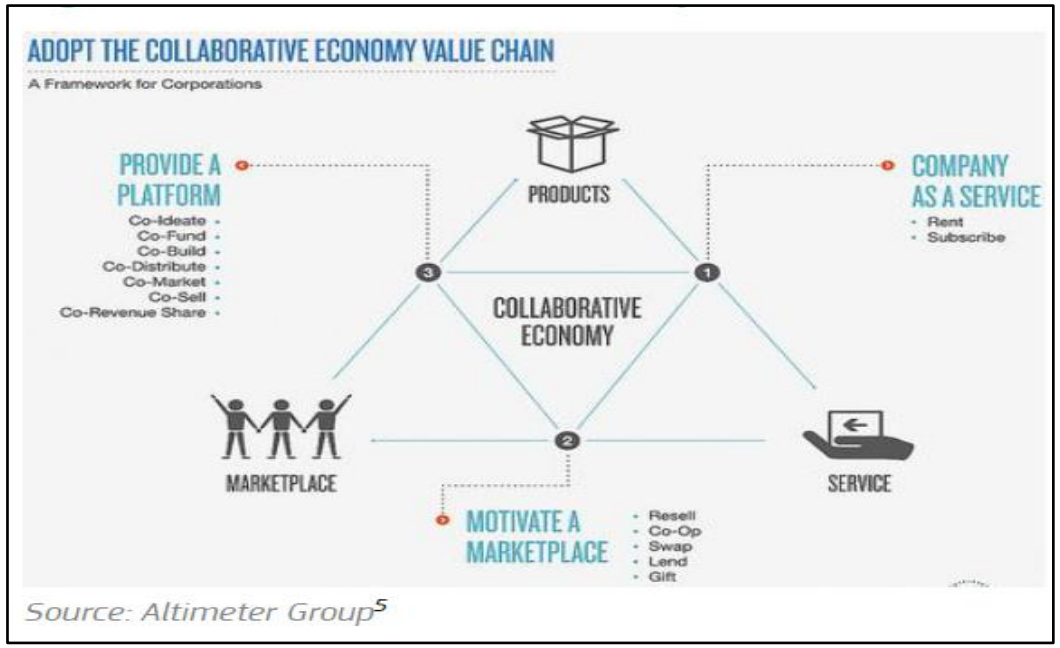


- **Sensor networks, real-time alert**
- Behaviour adaptation to external conditions
- Awareness and solutions about the environment, pollution, energy saving, CO2 emissions, climate change

3. Shared spaces and disruptive innovation

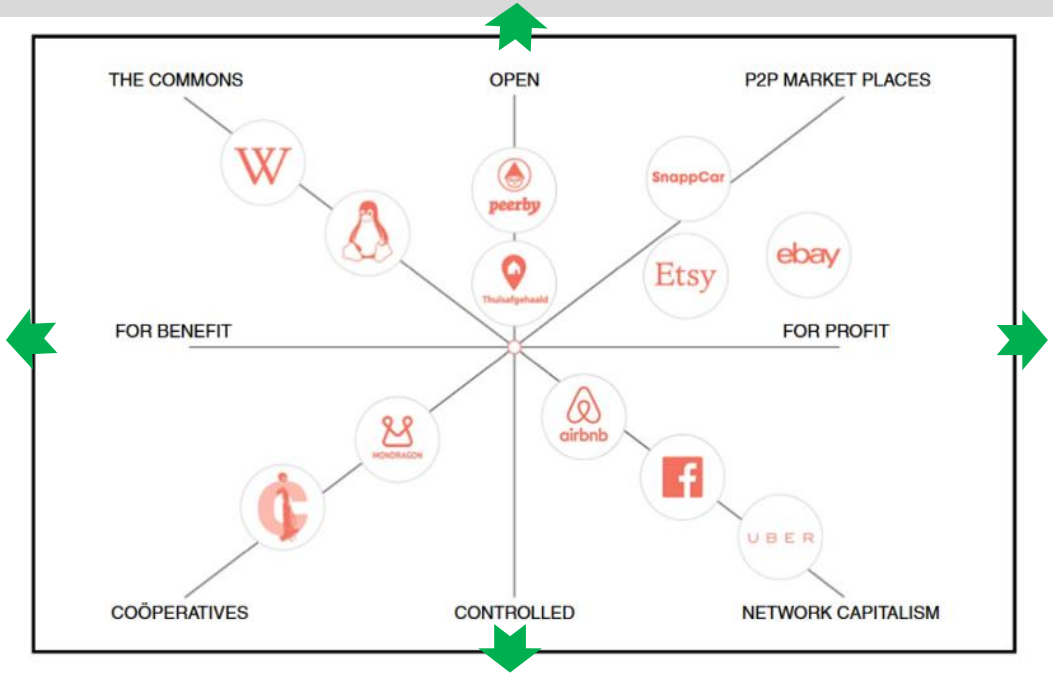
SHARED INTERNET SPACES AND PLATFORMS FOR GROWTH

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.

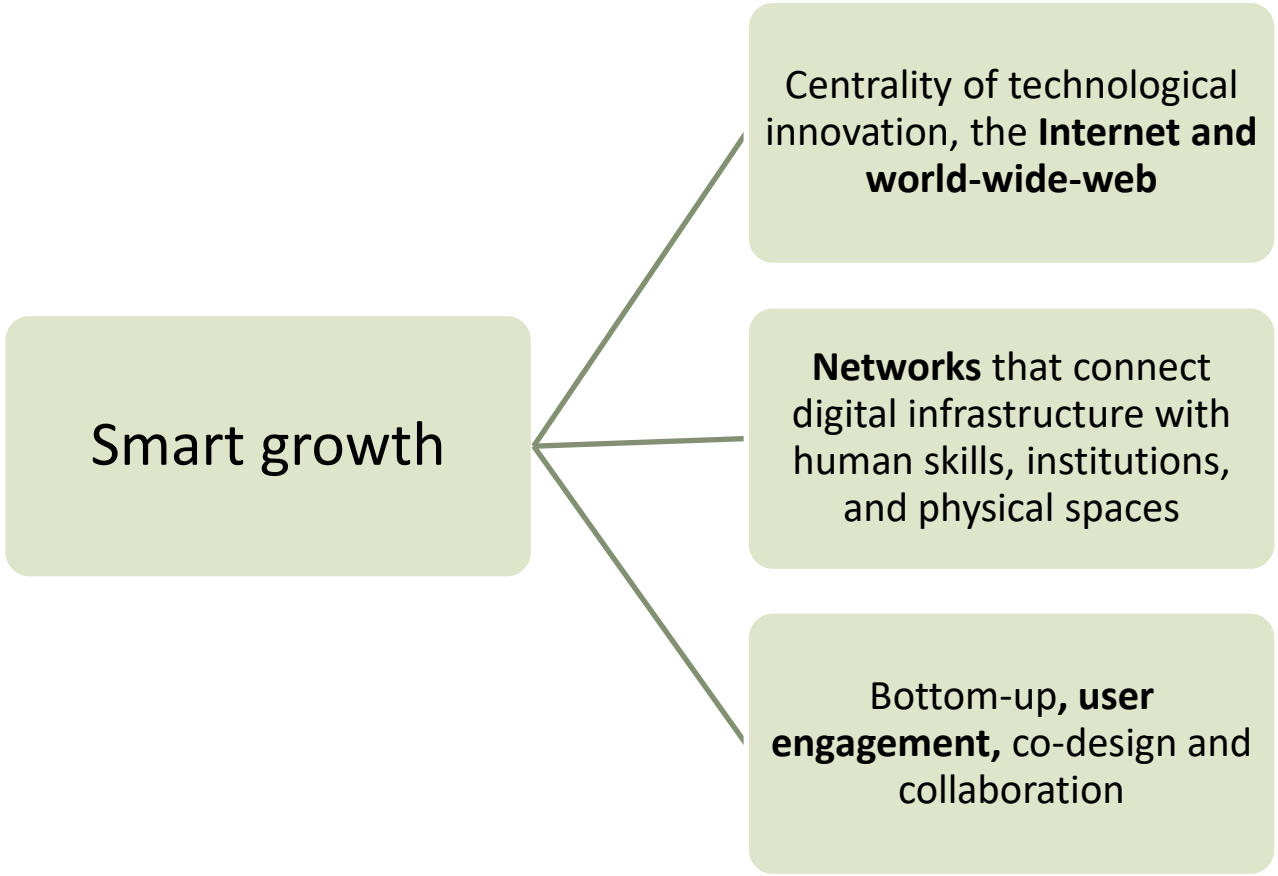
Left bottom: **collective**s that are characterized through a closed protected system.

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.

INTERNET PLATFORMS AND SMART GROWTH

SMART GROWTH



Source: Antonelli, G., and Cappiello, G. (eds.) (2016). *Smart Development in Smart Communities*. Taylor & Francis.

Multiple smart growth strategies

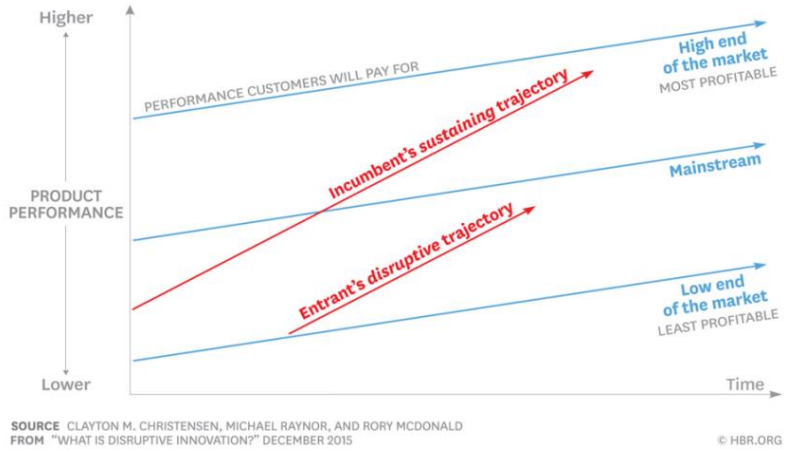
- Smart Specialisation Strategies (S3)
- Digital Growth Strategies
- Next Generation Networks plans
- Smart city strategies

Strategies are

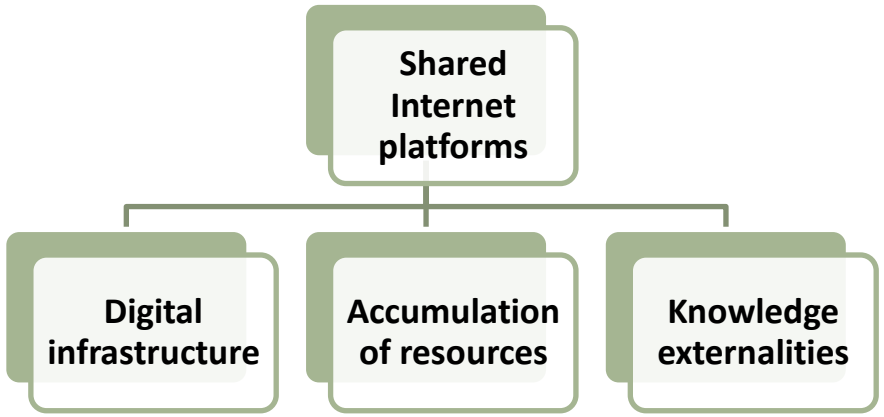
instances of the same approach that deploys digital technologies and smart environments (at different spatial scales) to sustain network-based externalities

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

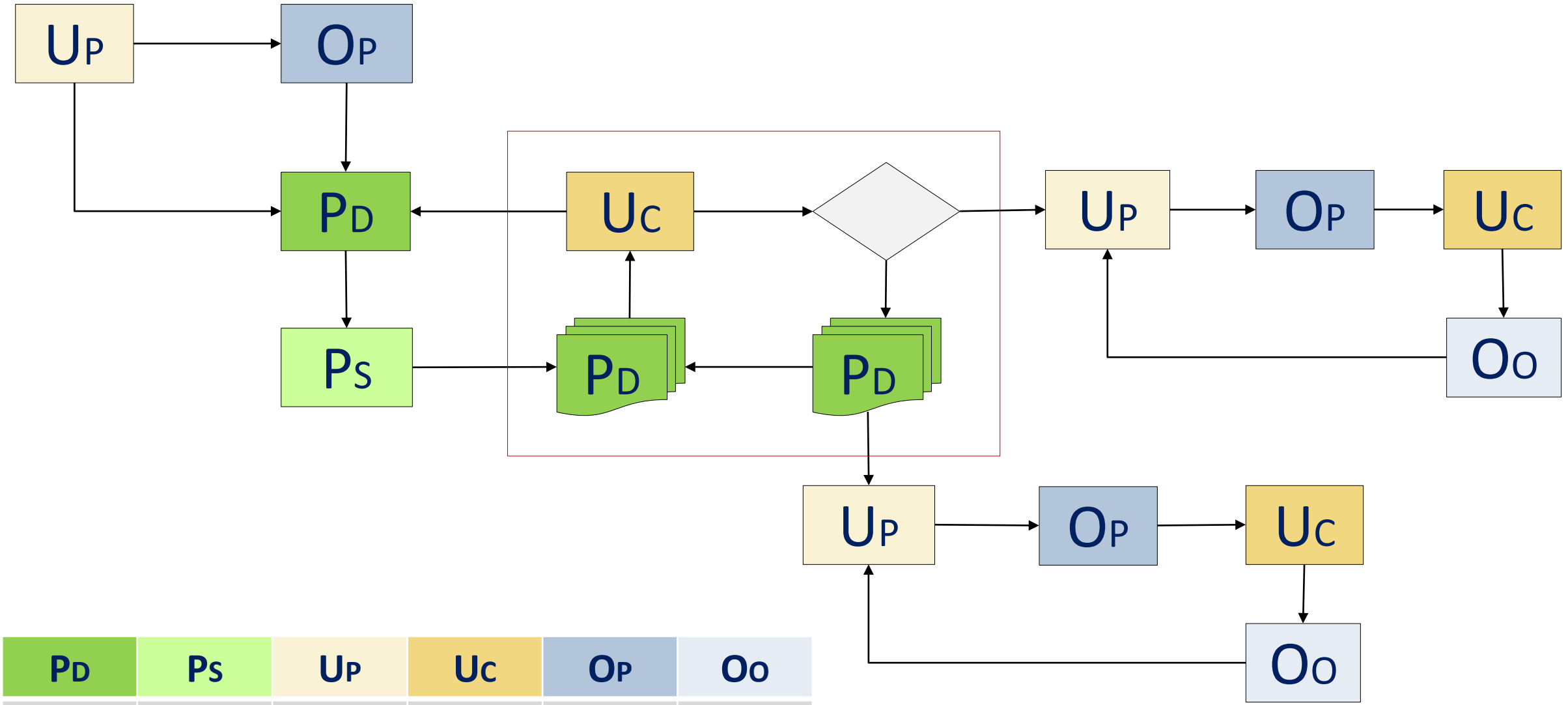
ENTITIES CONTRIBUTING TO DISRUPTIVE INNOVATION over SHARED SPACES

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