

SmartCities

WHAT MAKES CITIES SMART ?

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The Inter-IVB
North Sea Region
Programme



SC Conference, Edinburgh 30 June 2011





Contents

1. City challenges and spatial intelligence of cities

2. Variable geometries of spatial intelligence of cities

3. Planning intelligent cities at URENIO



Major contemporary city challenges



Cities in developed countries

A public consultation on the priorities of European urban and regional policy has identified three major urban and regional objectives for the coming years (European Commission 2008).

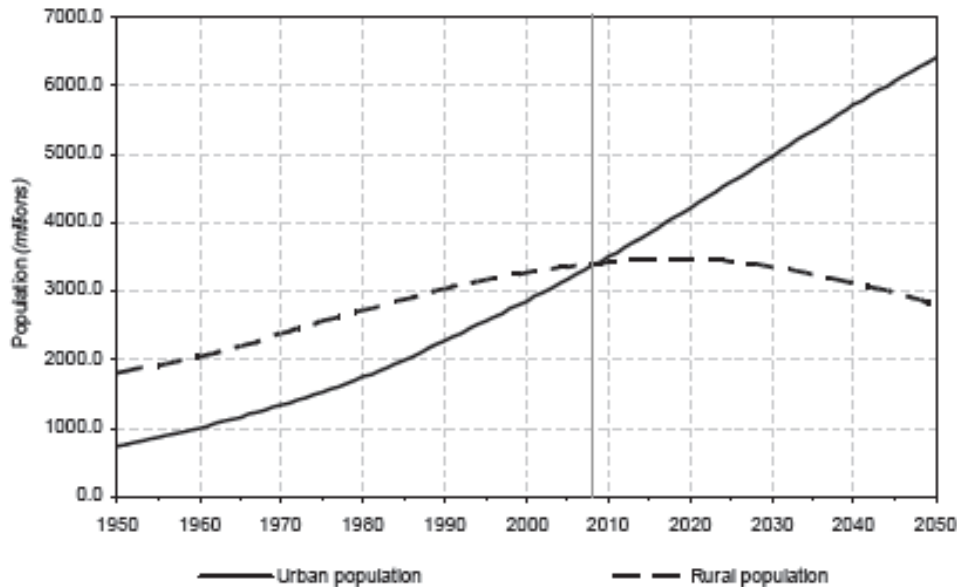
- **Competitiveness** will continue to be at the heart of European regional policy, sustained by research, innovation and upgrading of skills, which altogether drive towards a knowledge economy.
- Active **labour markets which sustain employment** and reduce the risk of poverty are also a high priority; to a large degree poverty is a consequence of job losses.
- The third objective is **environmental sustainability**; coupled with the need to save energy, use alternative energy sources, ensure lower CO₂ emissions, reduce the carbon footprint of cities and buildings, and sustain living ecosystems.



Major contemporary city challenges



Figure I.1. Urban and rural populations of the world, 1950-2050



Population (billion)

	1950	1975	2007	2025	2050
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Urban population

World.....	0.74	1.52	3.29	4.58	6.40
More developed regions....	0.43	0.70	0.91	0.99	1.07
Less developed regions.....	0.31	0.82	2.38	3.59	5.33

Cities in developing countries

- Rapid urbanization and city growth. Increasing demand
- Shortage of infrastructure. Do more with less
- Poverty
- Health and mortality
- Sustainable development, CO2 reduction, energy and water saving

Source: Millennium Goals, UN



Smart cities addressing city challenges



Smart / intelligent cities are expected to contribute to these challenges and provide more efficient solutions:

- Sustain the knowledge economy in developed countries
- Offer solutions to rapid urbanisation in developing countries

The questions are:

- 🌐 How they do it?
- 🌐 Which resources smart cities mobilize to address city challenges?
- 🌐 Which processes enable the intelligence of cities to emerge?

It becomes urgent to understand **the sources and drivers of city intelligence** that assure a **higher efficiency** in addressing wicked problems of contemporary urban agglomerations.



Key concept: Spatial intelligence of cities



Spatial intelligence of cities refers **to informational and cognitive processes** - such as information collection and processing, real-time alert, forecasting, learning, collective intelligence, distributed problem solving - which characterize "intelligent" or "smart" cities.

🌿 The concept allows unifying those of intelligent city and smart city under a common field of study focusing on their fundamental cognitive processes.

🌿 Emphasis on the "spatial" dimension denotes that urban space and the agglomeration are preconditions of this form of intelligence.

🌿 The concept refers also to the combined deployment of ICTs, institutional settings for knowledge and innovation, and physical infrastructure of cities to increase the problem-solving capability of a community.



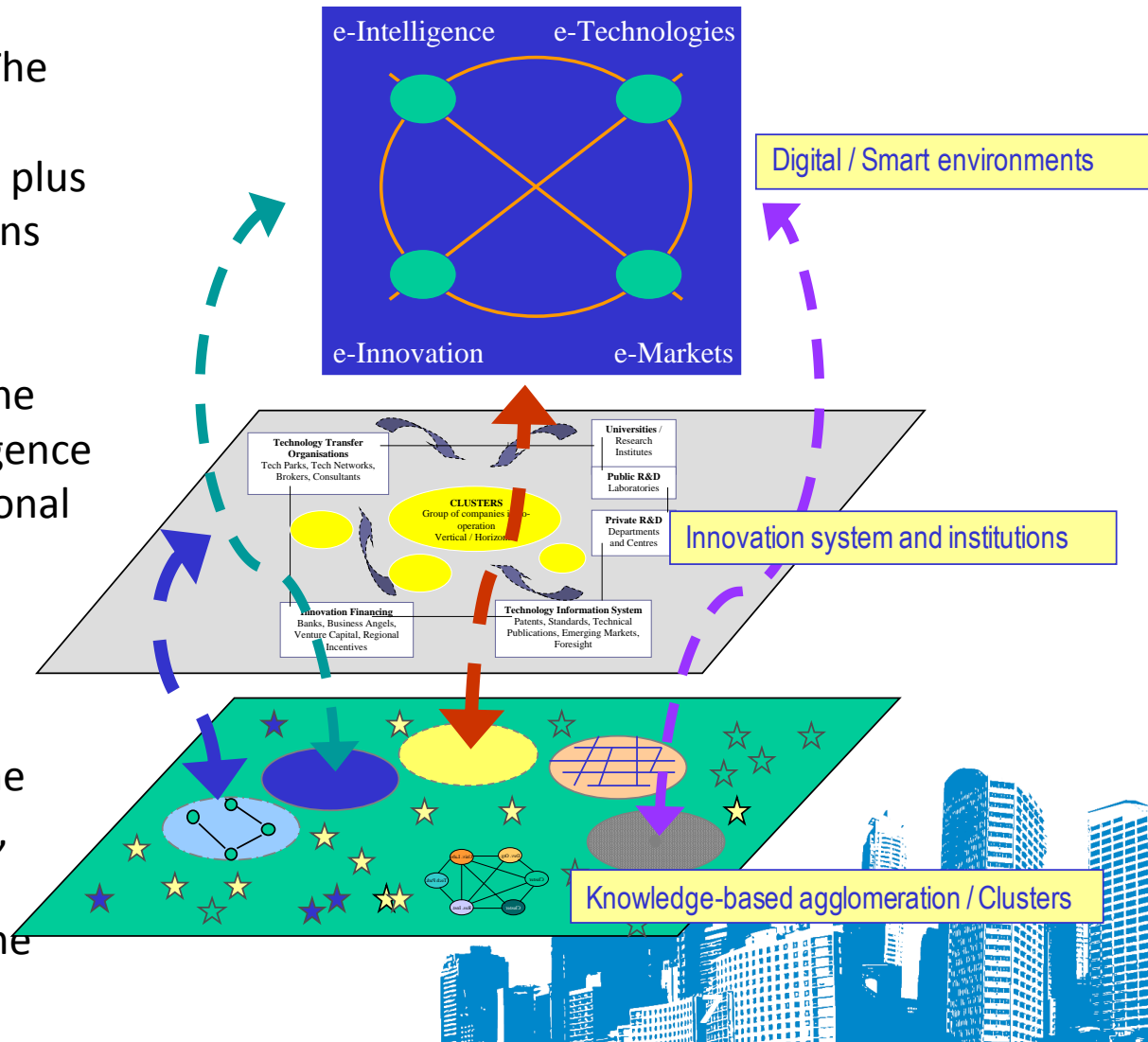
Spatial intelligence of cities involves all layers /dimensions of a city:



The digital space and the artificial intelligence embedded into the physical environment of the city. The public broadband communication infrastructure, wired and wireless, plus digital technologies and applications sustaining e-services.

The institutional space of cities, the social capital and collective intelligence of a city's population, the institutional mechanisms for knowledge development and co-operation in learning and innovation.

The physical space of cities and the people in the city; the intelligence, inventiveness and creativity of individuals who live and work in the city.





2. Variable geometries of spatial intelligence of cities



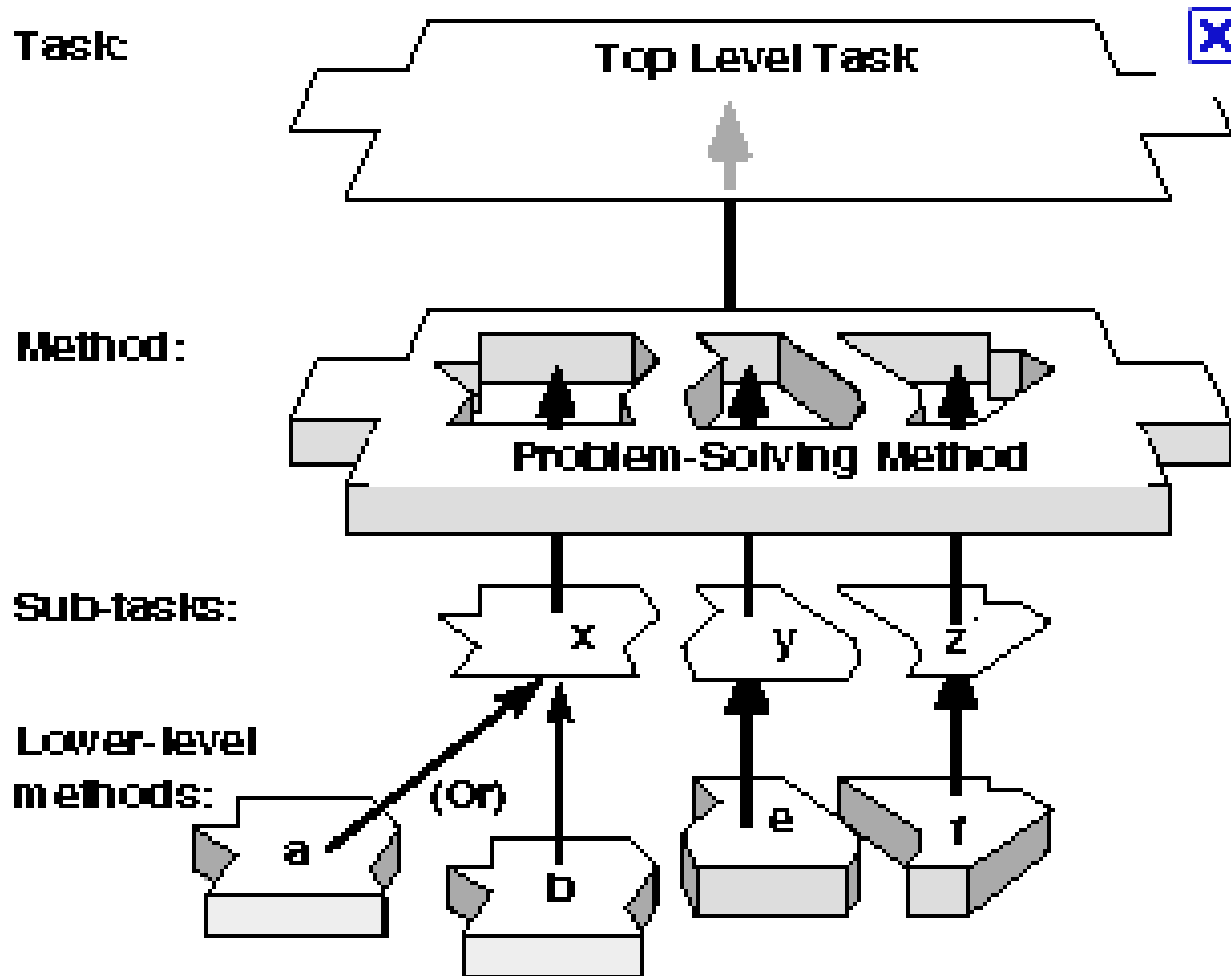
Multiple trajectories of spatial intelligence



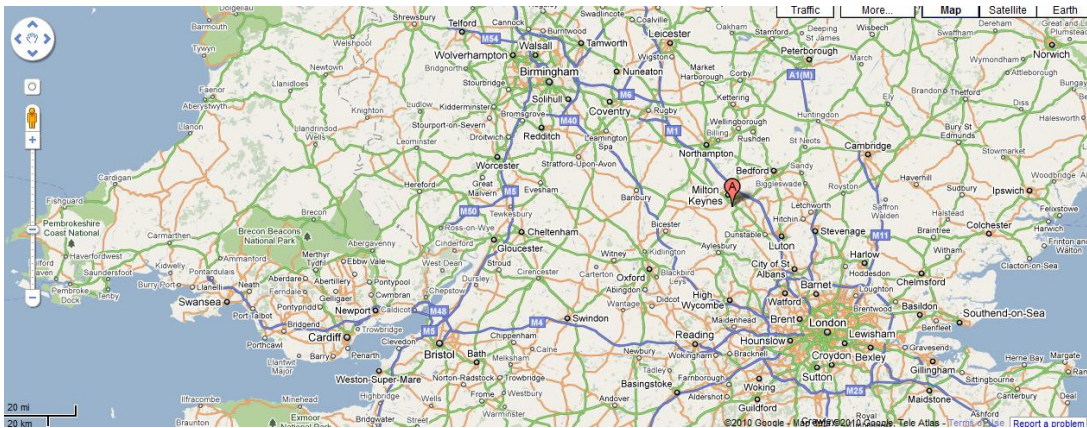
	ASIA - AUSTRALIA	USA - CANADA	EUROPE
2001	-Bario, Malaysia * Singapore	-LaGrange, Georgia, US -Nevada, Missouri, US -New York, US	-Ennis, Ireland
2002	-Bangalore, India * Seoul, S. Korea -Singapore	* Calgary, Alberta, CA -Florida, high tech corridor, US - LaGrange, Georgia, US	-Sunderland, UK
2003-04	* Taipei, Taiwan -Victoria, Australia -Yokosuka, Japan	-Spokane, Washington, US -Western Valley, N. Scotia, CA	* Glasgow, UK - Sunderland, Tyne & Wear, UK
2005	* Mitaka, Japan -Tianjin, China -Singapore	-Pirai, Brazil -Toronto, Ontario, CA	-Issy-les-Moulineux, France Sunderland, Tyne & Wear, UK
2006	- Taipei, Taiwan - Tianjin, China -Gangnam District Seoul -Ichikawa, Japan	-Cleveland, Ohio, US *Waterloo, Ontario, CA	-Manchester, UK
2007	- Gangnam District	-Ottawa-Gatineau, Ontario, CA -Sunderland, Tyne & Wear, UK - Waterloo, Ontario, CA	-Dundee, Scotland, UK - Issy-les-Moulineaux, FR --Tallinn, Estonia
2008	*Gangnam District Seoul	-Fredericton, New Brunswick, CA -Northeast Ohio, US -Westchester, New York, US -Winston-Salem, N. Carolina, US	-Dundee, Scotland, UK -Tallinn, Estonia
2009		-Bristol, Virginia, US - Fredericton, New Brunswick - Moncton, New Brunswick, CA	-Eindhoven, Netherlands - Issy-les-Moulineaux * Stockholm, Sweden - Tallinn
2010	* Suwon, South Korea	- Arlington County, VA - Dublin, Ohio, US - Ottawa, Ontario, CA	- Dundee, Scotland -Eindhoven - Tallinn, Estonia



I. Orchestration intelligence: Organized innovation workflow within a community



Bletchley Park: Oldest orchestration intelligence



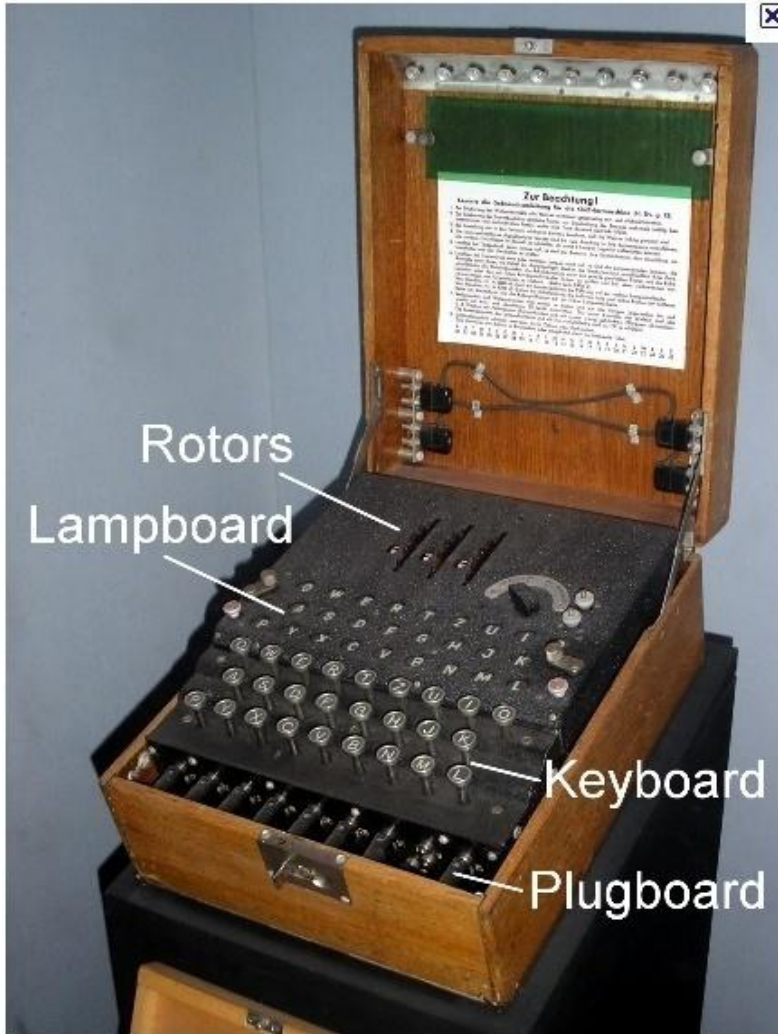
Bletchley Park regeneration



Business Park



Enigma machine



Rotors: $26 \times 26 \times 26 = 17.576$
3 rotors = 6 positions, $17.576 \times 6 = 105.456$
5 rotors = 60 positions, $17.576 \times 60 = 1.054.560$
Wiring: Each rotor condition
 $26! / 7! \times 12! \cdot 2^7 = 1.305.093.289.500$ connections
In total: **1,37¹⁸** possible connections

III V IV GAH
CX AZ DV KT HU LW GP EY MR FQ

Code breaking: Organized community workflow



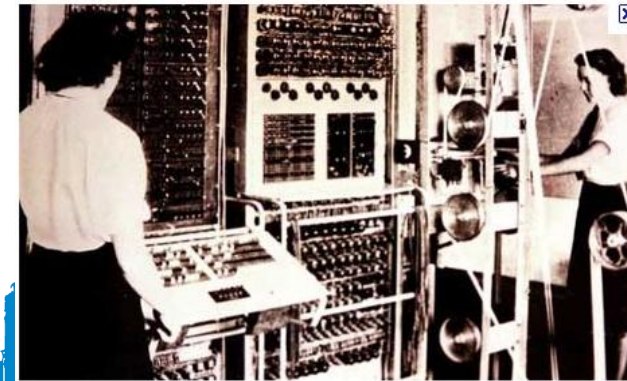
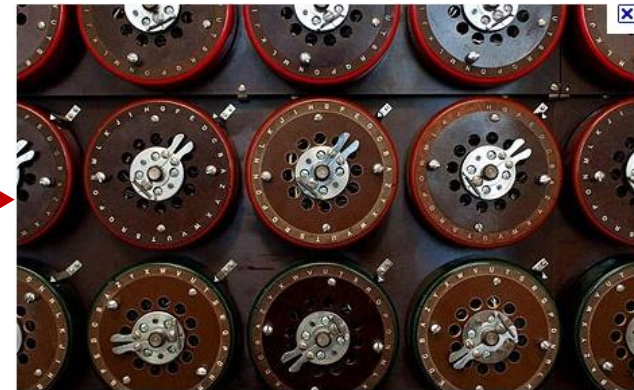
Community

- 1939 relocation of Government Code & Cipher School
- Code breaking experts, Cambridge Mathematicians, A. Turing, military personnel, civilians, women.
- Personnel selection by competition
- From 50 to 10.000 people
- Bletchley Park + close towns

Collective intelligence

- Mission: Find the daily settings of the Enigmas. 100.000 Enigmas.
- Collect all messages of the day / analyse them comparatively
- Represent the entire GA classification, maps, acronyms
- Make assumptions (cribs) about meanings
- Send cribs to machines. Test solutions
- Decoding, analysis, intelligence reports, dissemination

Networks & Machines



Orchestration intelligence: Network-based innovation workflow of people and machines within a community



Network architecture:

⊕ Nodes and connections: horizontal and vertical

Nodes:

- 🌿 Human skills or clusters of skills
- 🌿 Machines, expert systems, agents

Connections:

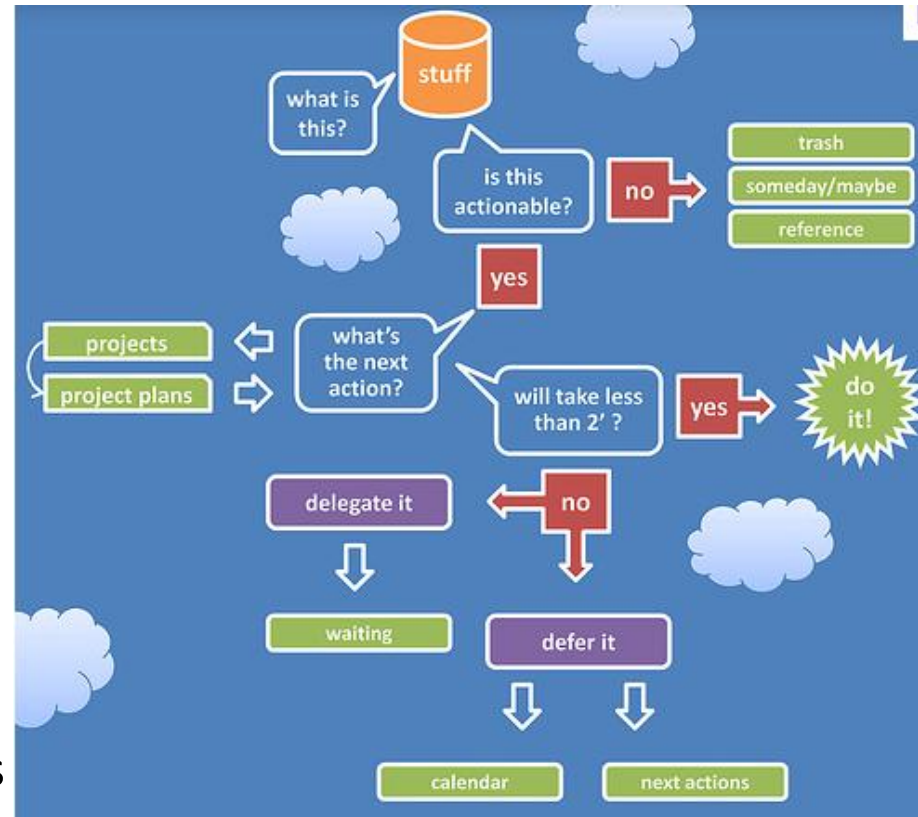
- ✗ Operations, processes
- ✗ Workflows linking nodes, people, clusters, and machines

Rules:

- 🌿 Administration, rights
- 🌿 Conflict resolution, sustainability models





Results:

- 🌟 Distributed problem solving, KPIs



II. Amplification intelligence: Strengthening the components of an innovation ecosystem



Innovation ecosystem 	Inventors 	Intellectual powerhouses (like MIT, Oxford, HP Labs) that conduct basic research and design products and services that result in patentable inventions.
	Transformers 	Multifunction production and marketing companies (like Dell, IBM, Infosys) that convert inputs from Inventors and other Transformers into innovations.
	Financiers 	Funding sources (VCs, Vulcan, ICICI Bank) for Innovation Network service providers especially Inventors and start up Transformers.
	Brokers 	Market makers (yet2.com, InnoCentive) that find and connect Innovation Network service providers, buying and selling or enabling service delivery.



Cyberport Hong Kong



Google Earth

File Edit View Tools Add Help

hong kong, china

Ruler

Line Path

Length: 0,82 Kilometers

Mouse Navigation Clear

Cyberport Rd

Bel-air Ave

Bel-air Rise

Victoria Rd

© 2009 MapKing
Image © 2009 DigitalGlobe
Image © 2009 GeoEye

©2006 Google

22°15'19.58" N 114°07'56.10" E

Jan 7, 2007

Eye alt 708 m

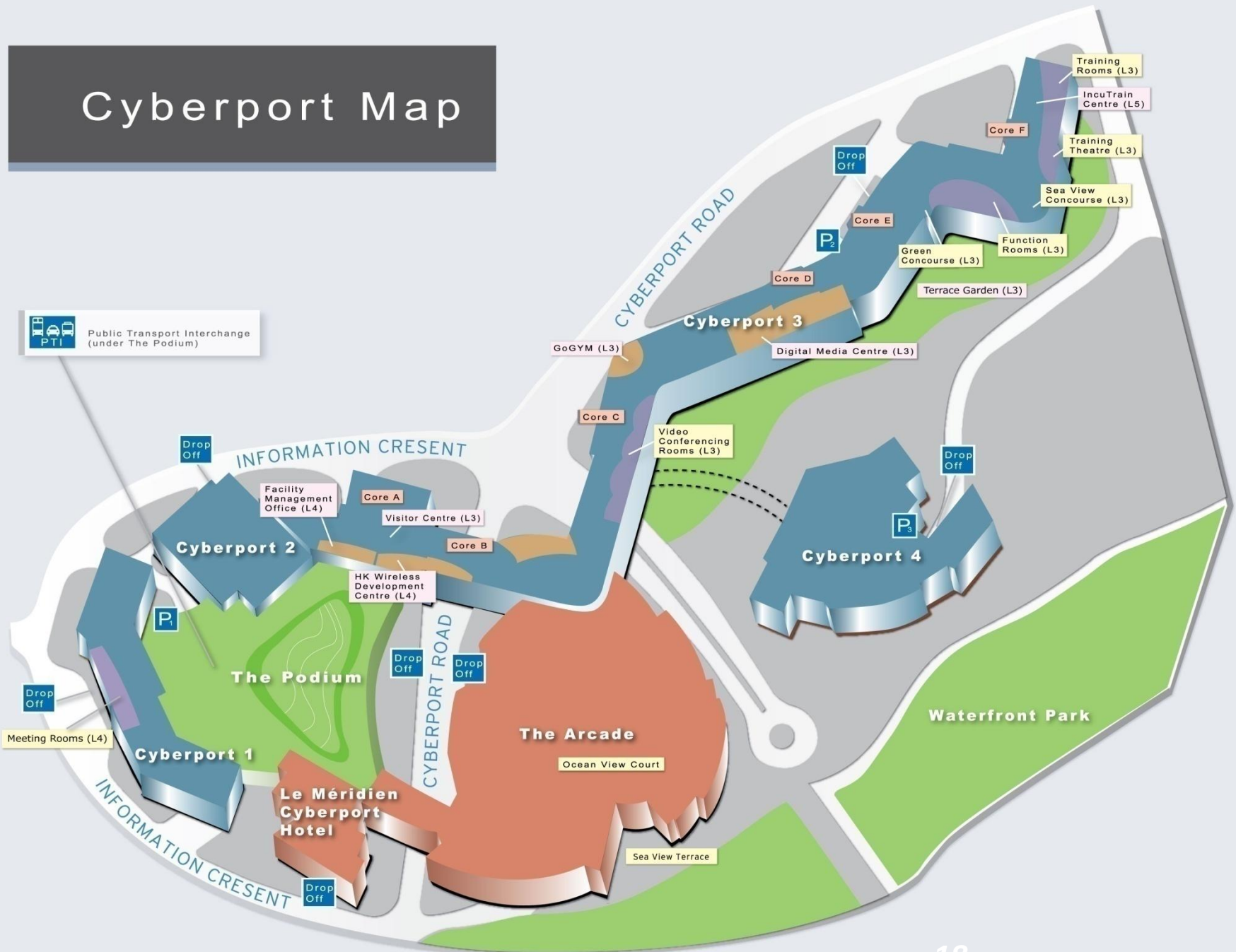
Google Earth

EN

8:24

A screenshot of the Google Earth application. The main window displays an aerial view of Cyberport in Hong Kong. A yellow path is drawn across the site, and a ruler window is open in the top-left corner, showing a length of 0,82 Kilometers. The ruler window has tabs for 'Line' and 'Path', and a 'Mouse Navigation' checkbox that is checked. The interface includes a search bar with 'hong kong, china', a toolbar with various navigation tools, and a status bar at the bottom showing coordinates, date, and altitude. An inset map in the top-right corner shows the location of Cyberport within the larger context of Hong Kong.

Cyberport Map

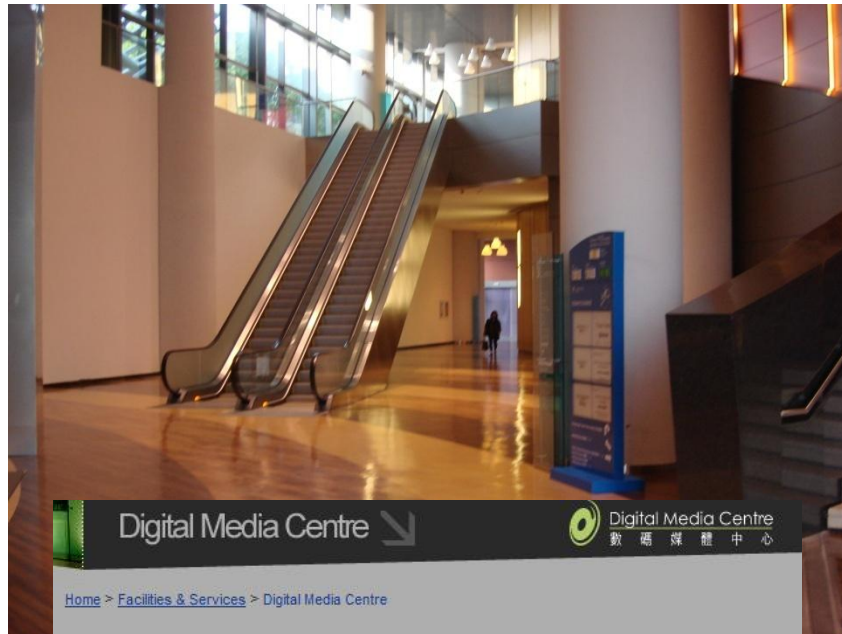


Public Transport Interchange (under The Podium)

TECHNOLOGY ZONE – CY 1, 2, 3, 4



Open Platforms – Digital media learning



Digital Media Centre

Digital Media Centre
數碼媒體中心

[Home](#) > [Facilities & Services](#) > Digital Media Centre

Digital Media Centre (DMC) is a unique state-of-the-art digital multi-media creation facility located at the Cyberport. It is established to spearhead the growth and development by providing services, software and hardware support to content developers, multimedia professionals, small & medium enterprises and students interested in the digital entertainment industry.



Opening Video



I/O Center

Facilitate with SD/HD video recorders, encoders and backup systems on a common routing fabric which provide comprehensive services to the client.



Video Studio

HD cameras are equipped with trackers, allowing navigation of the virtual scene from corresponding viewpoint in real-time.

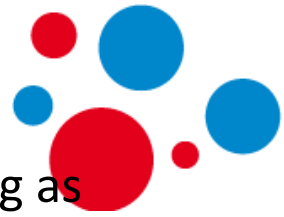


Control Room

A live broadcasting-grade video studio is equipped with the newest virtual set system to facilitate video production using 3D computer-generated virtual background.



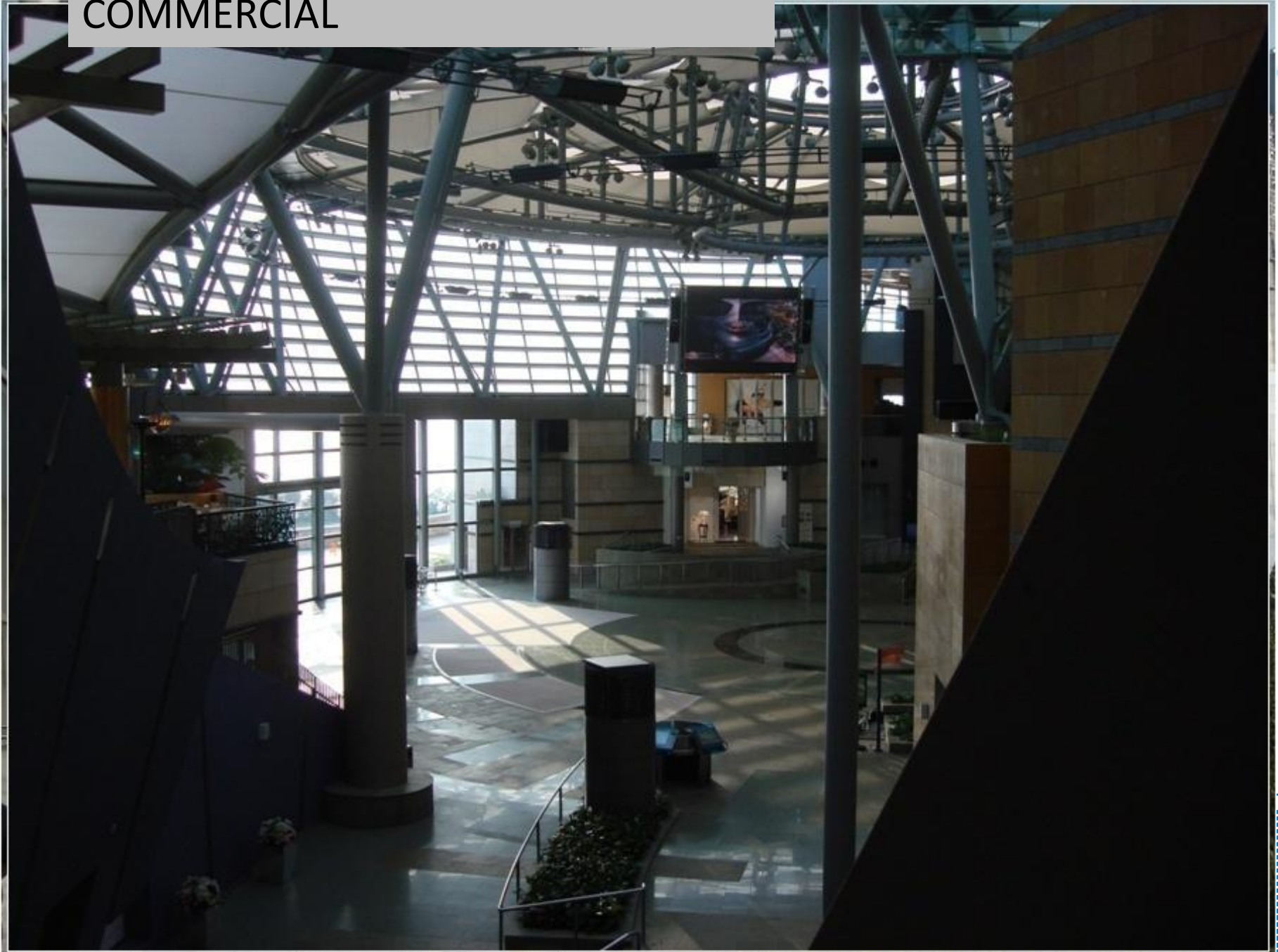
Open Platforms – Digital media learning



- *The Digital Entertainment Incubation and Training*, is a platform having as objective to build and promote entrepreneurship and skills in the digital entertainment industry, focusing on business skills, games, animation and digital entertainment, and enhance networking with industry.
- *Digital Media Centre*, is a unique state-of-the-art digital multimedia creation facility, having as objective to offer software and hardware support to content developers, multimedia professionals, small and medium enterprises.
- *The iResource Centre*, is a digital content storage platform, which serves as a trusted marketplace and clearing house for the aggregation, protection, license issuance and distribution of digital content.
- *The Testing and Certification of Wireless Communication Platform* is a centre that provides continuous mobile communication service and coverage of mobile phone signal (3G, GSM, CDMA and PCS).
- *The Cyberport Institute* was established by the University of Hong Kong to introduce and , run IT courses for talented people and support various IT development and related businesses in Hong Kong.

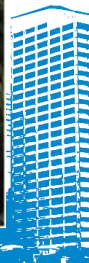


COMMERCIAL



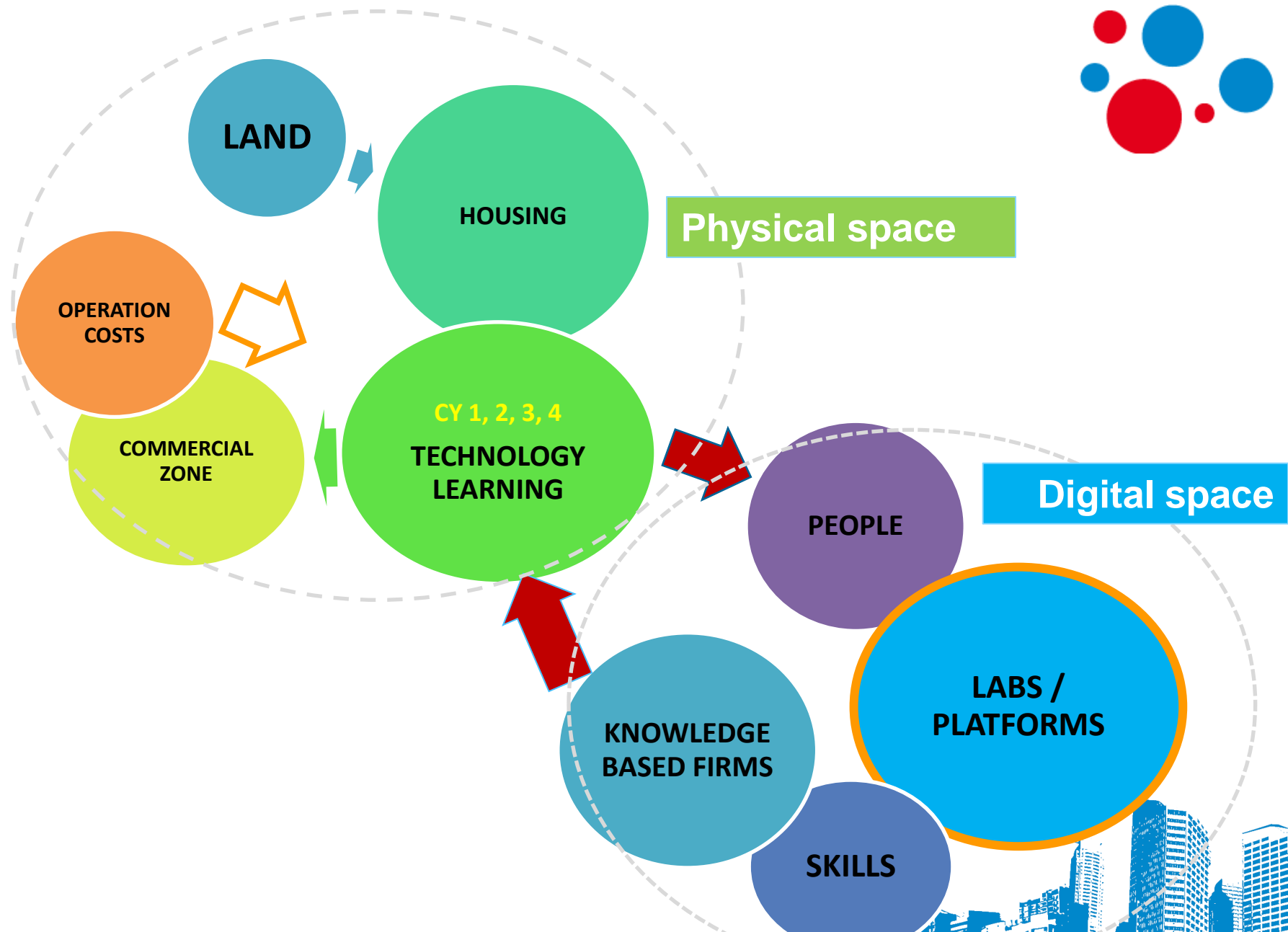


CENTRAL PARK



HOUSING COMPLEX



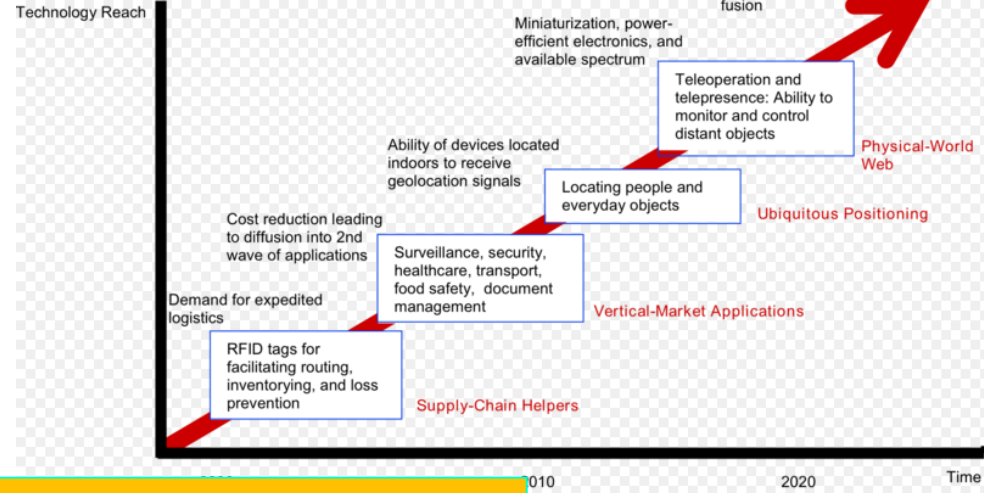


Amplification intelligence: Double loop

III. Instrumentation intelligence

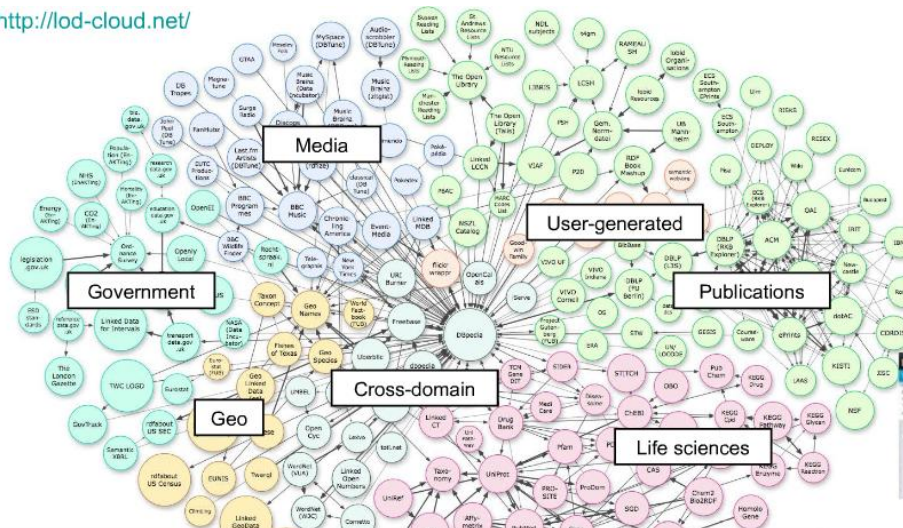


TECHNOLOGY ROADMAP: THE INTERNET OF THINGS



Future Internet + Embedded Spaces

<http://lod-cloud.net/>



Over 200 open data sets with more than 25 billion facts, interlinked by 400 million typed links, doubling every 10 month!

From the Web to the Web of Data



With RDFa markup:

```
<div xmlns:v="http://rdf.data-vocabulary.org/#" typeof="v:Review-aggregate">
  <span rel="v:itemreviewed">
    <h1 property="v:name">Drooling Dog Bar B Q</h1>
    
    <em>based on <span property="v:count">15</span> reviews</em>
  </span>
</div>
```

With Microformats markup:

```
<div class="hreview-aggregate">
  <span class="item vcard">
    <h1 class="fn org">Drooling Dog Bar B Q</h1>
    
    <em>based on <span class="count">15</span> reviews</em>
  </span>
</div>
```

Πηγή: Linked Data Search: Thomas (Google Inc, Ger)

IBM instrumentation intelligence

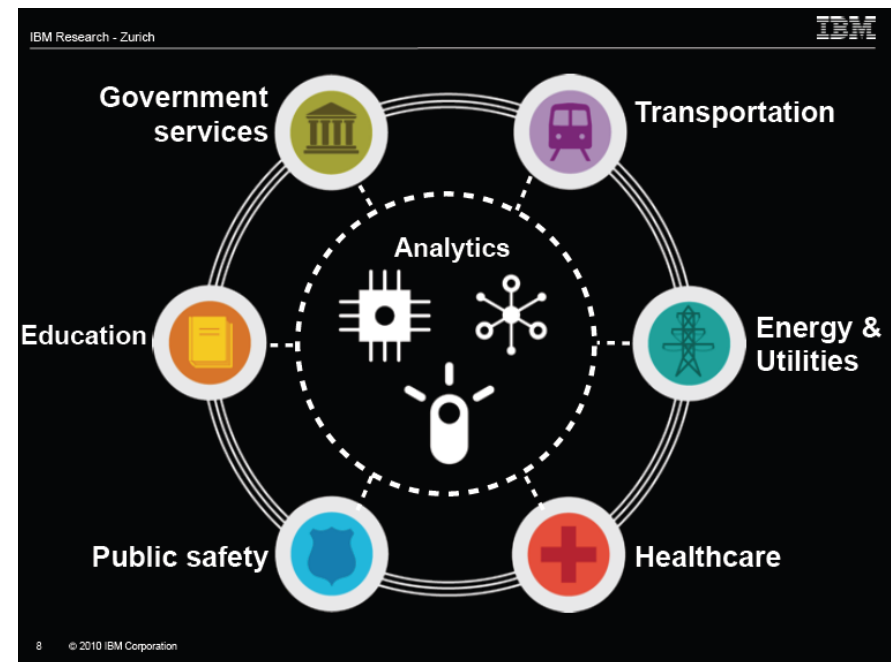


The IBM smart cities concept: (1) interconnected, (2) instrumented, and (3) intelligent.

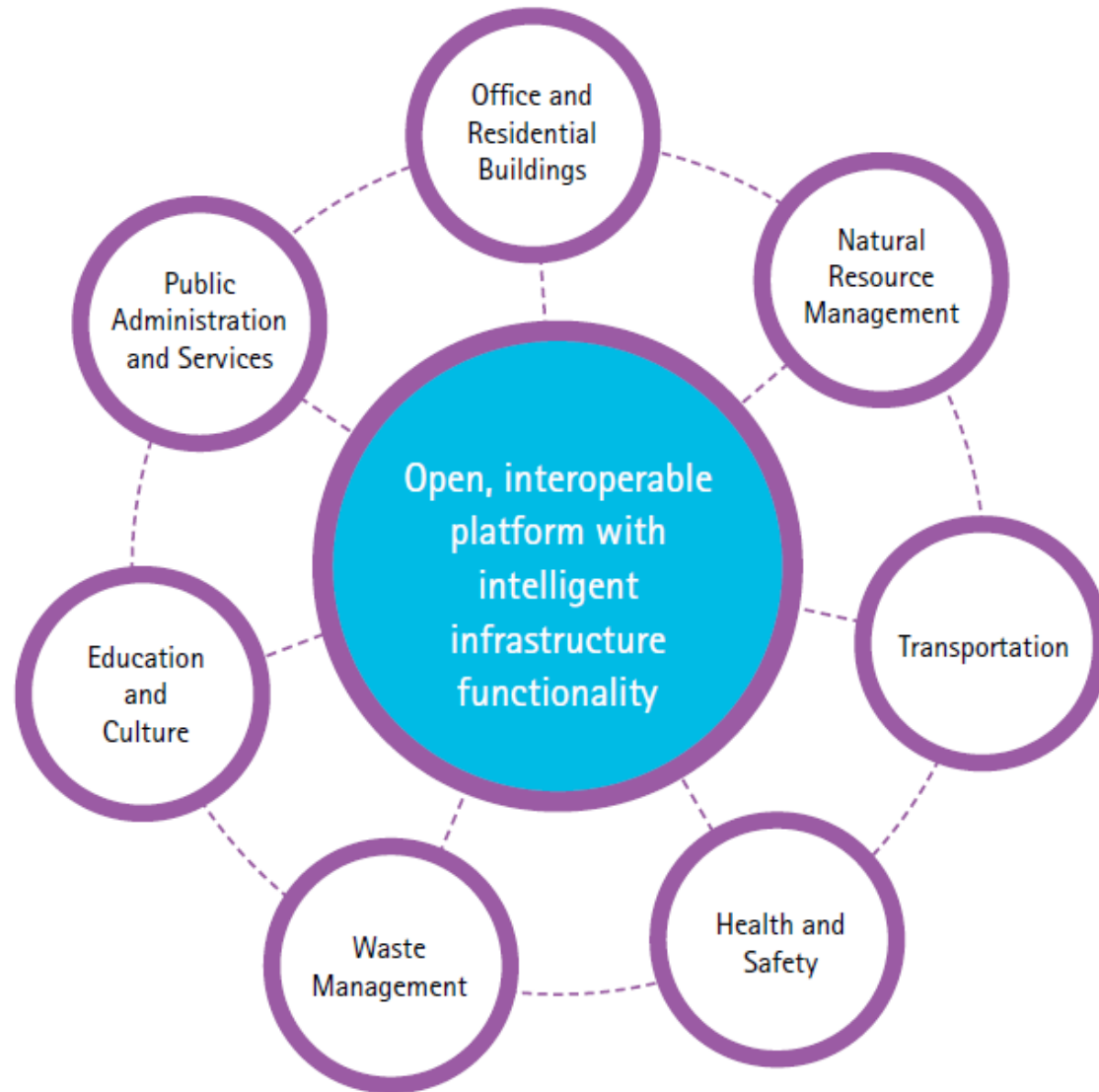
■ **Interconnection** means that different parts of a core system can be joined and communicate with each other, turning data into information.

■ **Instrumentation** of a city's system means that the workings of that system are turned into data points and the system is made measurable with instruments and smart meters.

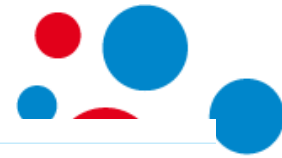
■ **Intelligence** refers to the ability to use the information to model patterns of behaviour, develop predictive models of likely outcomes and translate them into real knowledge, allowing better decision making and informed actions



Accenture: Intelligent city infrastructure



Smart city Amsterdam



Smart projects

- #01 Geuzenveld
- #02 West Orange
- #03 eManagement Haarlem
- #04 Onze Energie
- #05 Smart Challenge
- #06 ITO Tower
- #07 Monumental Buildings
- #08 Decentral Generation: Fuel Cell Technology
- #09 Zuidas Solar Challenge
- #10 Online Monitoring Municipal Buildings
- #11 Ship to Grid
- #12 Moet je Watt
- #13 Klimaatstraat
- #14 Smart Schools Contest
- #15 ZonSpot
- #16 Swimming Pools



Intelligent grid management



I amsterdam.

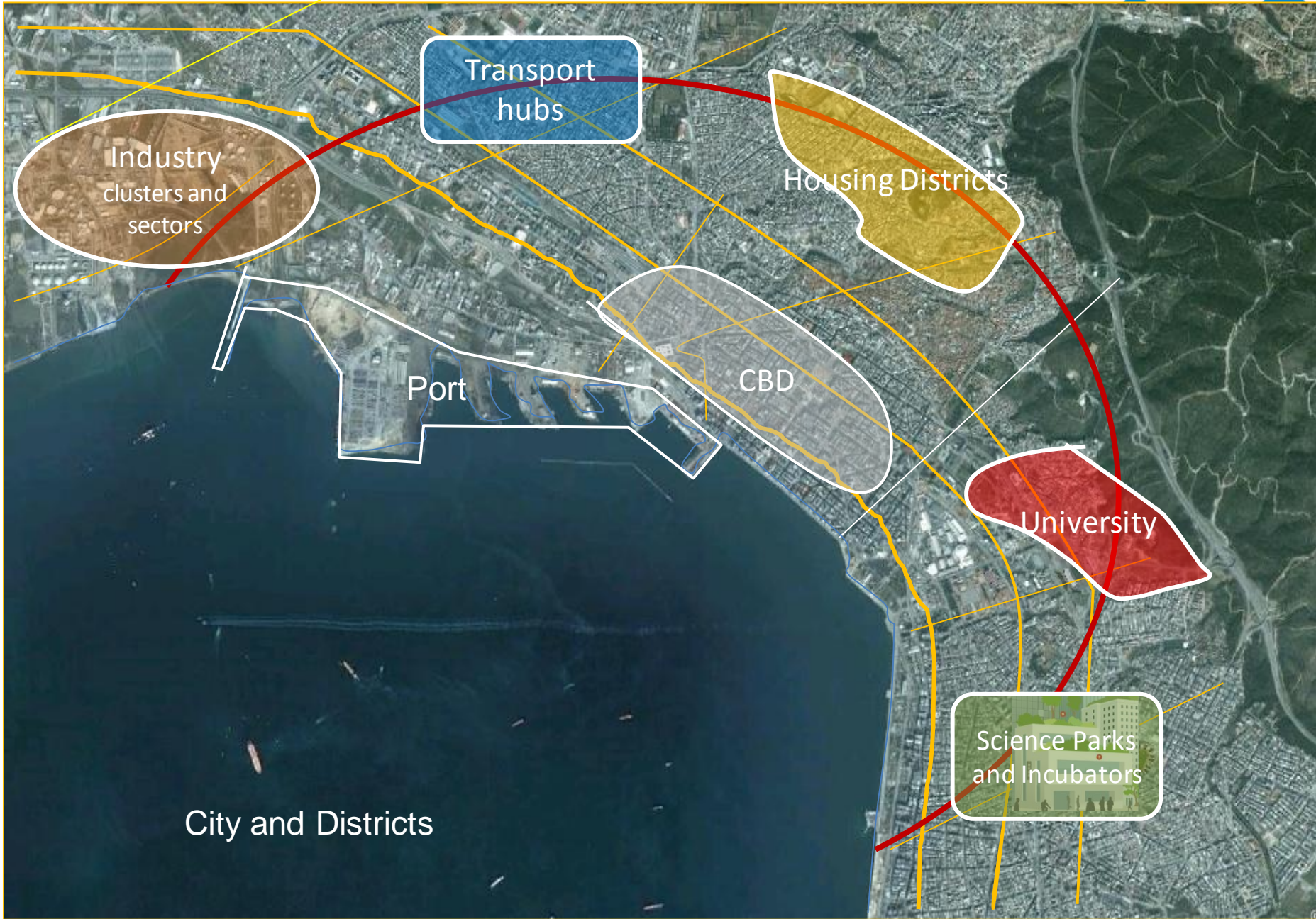




3. Planning intelligent cities at URENIO



City and Districts



Intelligent City Districts

Layer 3: APPS + EMBEDDED SYSTEMS + SOCIAL MEDIA
4 TYPES OF APPLICATIONS

INTELLIGENCE

E-LEARNING

CO-CREATION

MARKETPLACE

Layer 2: INNOVATION ECOSYSTEMS OF DISTRICTS
4 FUNDAMENTAL PROCESSES: WATCH – LEARN – INNOVATE – MARKET

Industry

Port

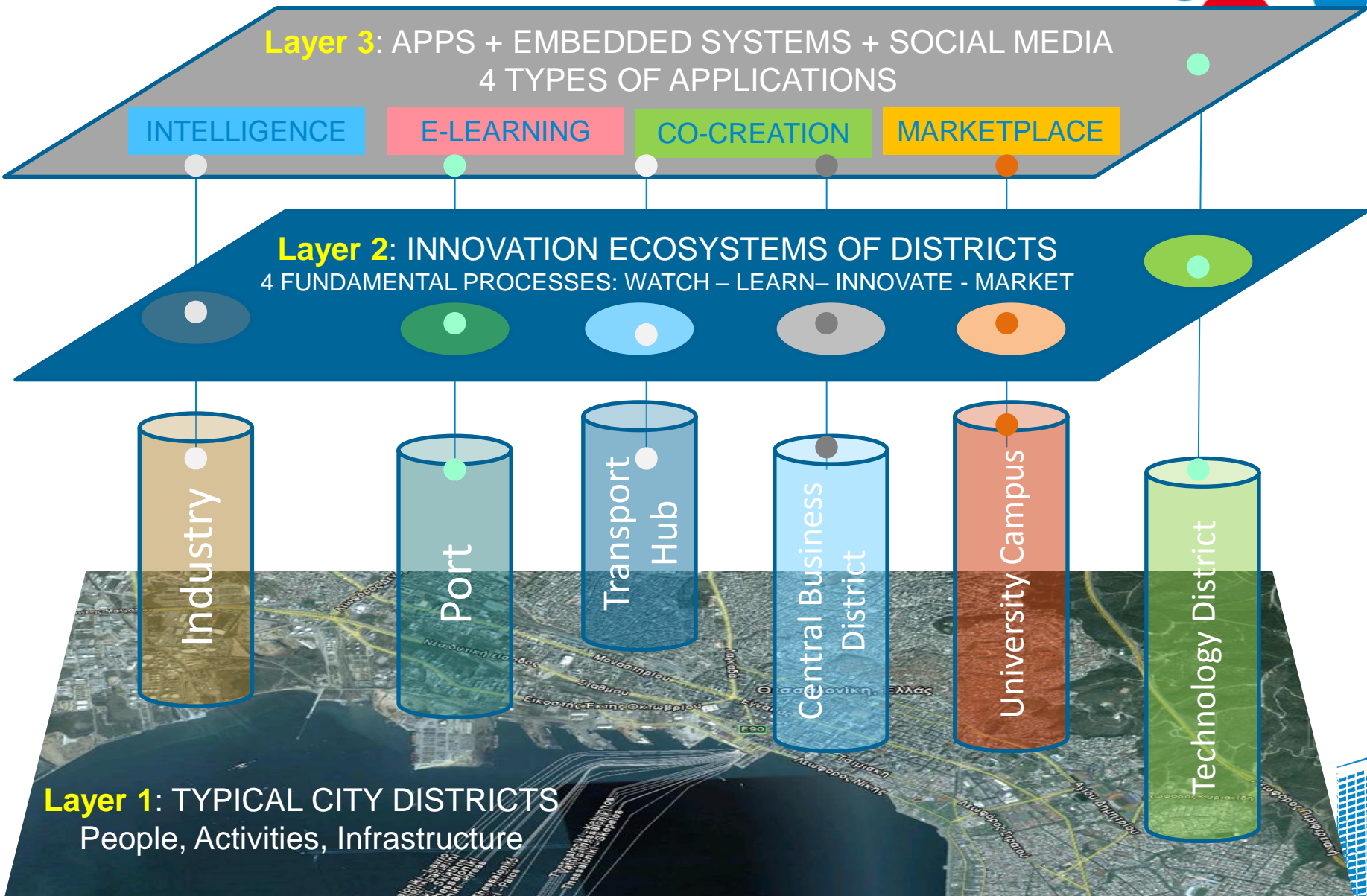
Transport
Hub

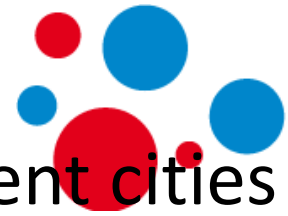
Central Business
District

University Campus

Technology District

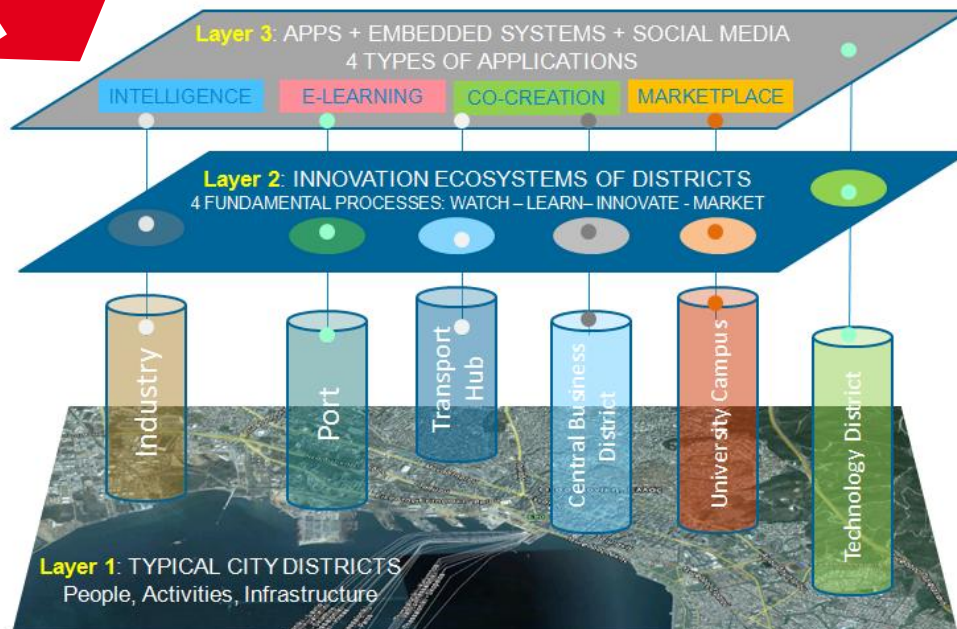
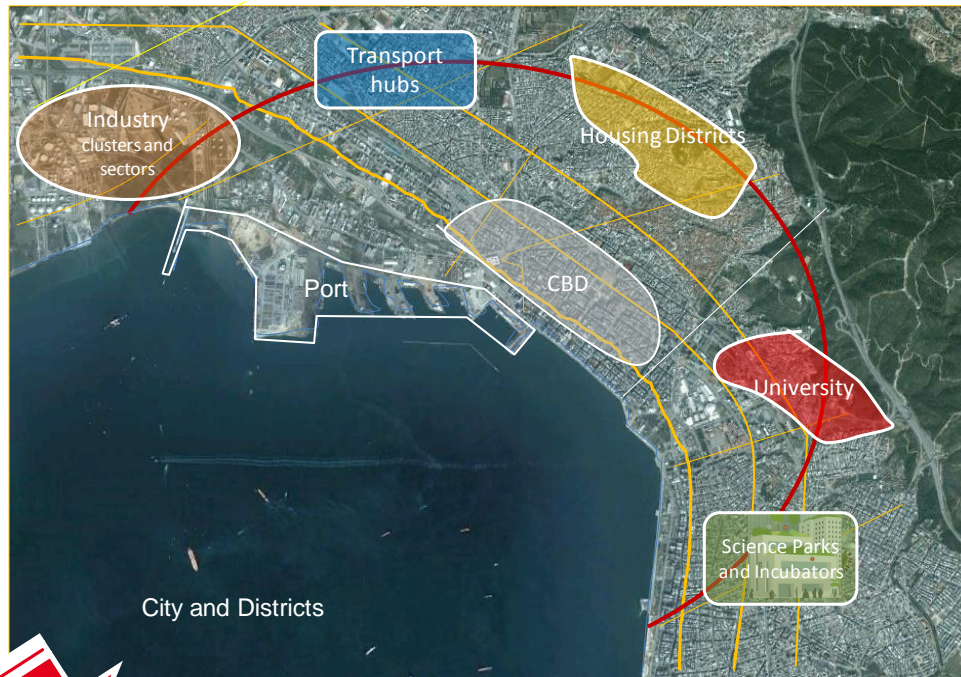
Layer 1: TYPICAL CITY DISTRICTS
People, Activities, Infrastructure





Planning intelligent cities

1. **L1- City:** Description of the city or district – CHALLENGES or PROBLEMS TO ADDRESS
2. **L2-Innovation ecosystem:** Information and knowledge processes related to districts and challenges
3. **L3- Digital spaces, smart environments:** web, web 2.0, crowdsourcing, social media, cloud, mobile apps suitable for L1 and L2
4. **L1-L2-L3 integration:** Knowledge services - Spatial intelligence- Solution to challenges
5. **Measurement:** KP Indicators for L1, L2, L3 and new services assessment
6. **Business models** for new services sustainability



Intelligent City Platforms integrating L1-L2-L3



Home Strategic Intelligence Technology Dissemination Collaborative Innovation New Company Incubation Virtual Tour & e-Market

Intelligent City Platforms



Intelligent cities are **systems of innovation** combining innovative clusters, technology learning institutions, and digital innovation spaces. The platforms enable the creation of digital spaces facilitating five key innovation processes.

Intelligent City Platforms

- Strategic intelligence**, allowing to gather, analyze and disseminate information about technologies, markets, and competitors;
- Technology dissemination**, allowing to acquire and adapt existing knowledge;
- Collaborative innovation**, for creating networks of product design and new product development;
- New company creation**; and
- Online marketing** of products, promotion and delivery of services.

Strategic intelligence

The Platform: The Strategic Intelligence Platform supports information monitoring, its structured according to strategic intelligence priorities, and enables this collection, site analysis, and dissemination. Available:

- Monitoring
- AI/ML/Textmining
- Data visualization, charts, graphs
- Infrastructures

Services: The SI Platform enables the provision of nation and technology watch services. Nation and technology watch is the systematic follow up of emerging trends in different strategic sectors. The service is important for collection, managing and providing industries, sectors, and business activities. Nation and technology watch is based on the collection of information on science, technology, new products, leaders, companies, etc. Data is analyzed and reports are sent to recipients.

Technos on the Platform:

- Mining for nation and technology watch
- Data source
- Monitoring of different fields of data
- Industry sector
- Companies and sectors
- Communication and data
- Mapping performance
- Feed back to the users
- Reports, updates and dissemination
- Monitor user

Potential Users:

- Countries of products and companies
- Industry sector associations
- Sector
- Cities and regions

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Technology Dissemination

The Platform: In the market form, the Technology Dissemination Platform supports the dissemination of information about R&D and technologies. It can be used to present and R&D centers to make known their research and technological achievements.

Services: The Platform facilitates the dissemination, marketing and promotion of R&D results and technologies. It can be used to present and R&D centers to make known their research and technological achievements.

Technos on the Platform:

- Digital content
- User Office, Companies University of People

Potential Users:

- Universities, Research Centers and labs
- Science associations
- R&D learning modules
- Centers of innovation and industry
- Cities
- Science and technology parks
- Training organizations
- Technology transfer centers
- Innovation centers

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Collaborative Innovation

The Platform: The Innovation Hubbing is a solution enabling to help to the solution of different industrial related problems. It can be used to resolve new product development problems, sell-off and new company creation, buying, and any problem which may arise when they work together.

Services: Platform facilitates online cooperation in different areas of innovation:

- Cooperative new product development
- Cooperative new product design
- Cooperative concept development
- Sell-off creation
- Management of intellectual property

Technos on the Platform:

- Product task
- Content analysis
- User feedback mechanism
- Management
- Access engineering
- Industrial design
- Feed back strategy

Potential Users:

- Innovation existing start-ups
- Innovation centers, existing institutions
- Innovation and technology centers
- Training companies and organizations
- New companies starting a new company
- Companies developing and producing new products
- Companies willing to develop a new product based on their research

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New Company Incubation

The Platform: The New Company Incubation Platform helps users to resolve problems that arise during the creation of a new company. It provides a full toolbox for guiding the user in studying business plans, marketing plans, and undertake cost benefit analysis, technology audits, and market research.

Services: Creating business plans for new companies or new products. Marketing planning plans for new companies or new products within established companies. Market research studies and audits. Technology audits for the appraisal of technology capabilities and weaknesses. Cost benefit analysis comparing cost and status of different technology or production solutions.

Technos on the Platform:

- Business Plan
- Marketing Plan
- Cost Benefit Analysis
- Technology Audit
- Market Research

Potential Users:

- Entrepreneur starting a new company
- Innovation planning or entering into new markets
- Incubation existing facilities or new product development
- Established companies being developed a new product or service
- Innovation centers
- Technology based companies

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Virtual Tour & e-Market

The Platform: The Virtual Tour Platform supports the creation of digital tours and the provision of online services in various fields of user life, such as government, education, entertainment, education, e-business.

Services: Virtual Tours: Presentation of sites, monuments, and arts, objects or products. Virtual Marketing and promotion of products or services. E-commerce: Provision of various e-B2B services, such as e-procurement, e-learning, e-infrastructure, e-health, and other services in the domain of a facility, city or region.

Technos on the Platform:

- Virtual tour
- Information services
- Virtual social stories
- Online government services

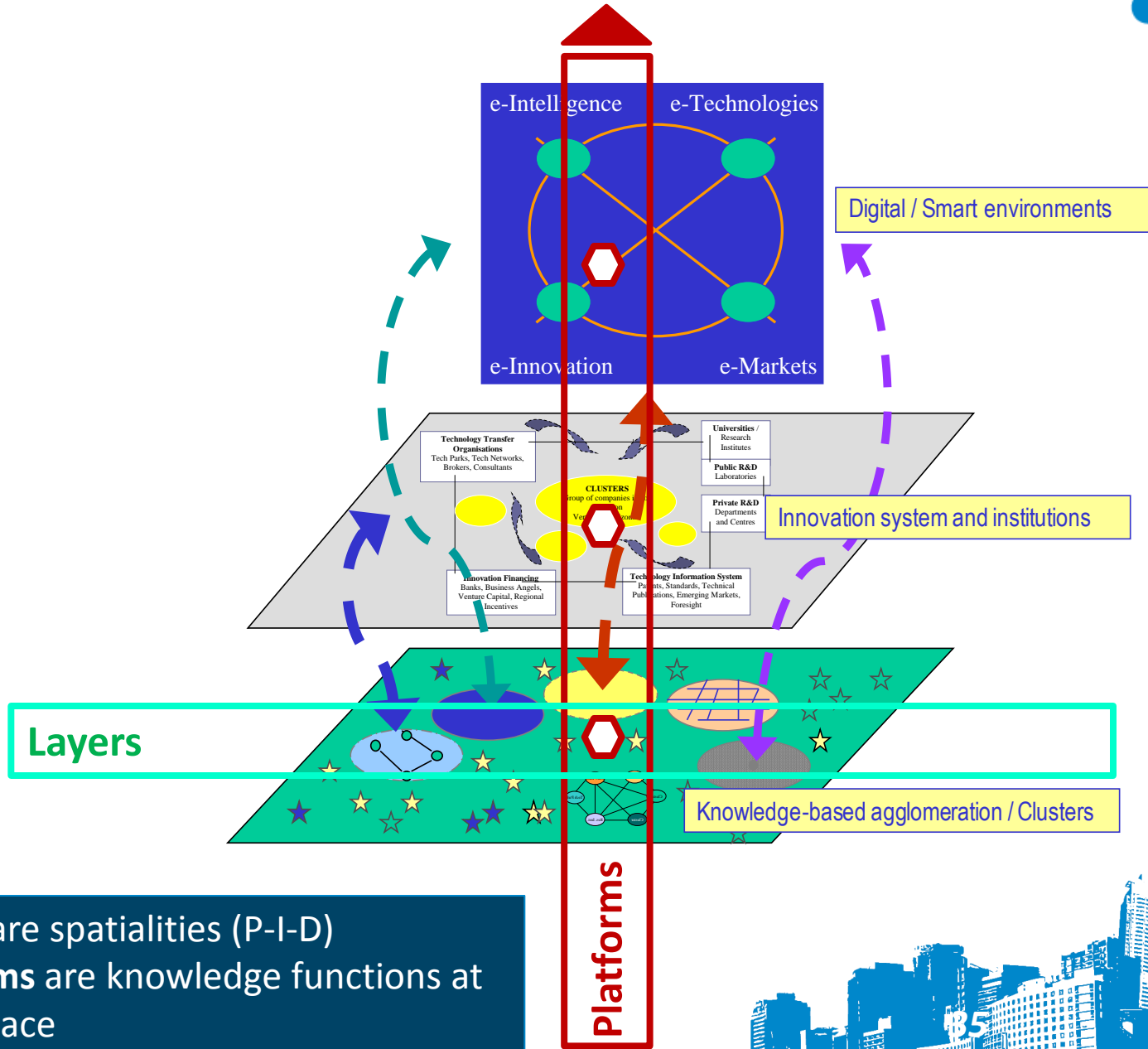
Potential Users:

- Companies and cities willing to promote their facilities or the internet
- Tourism organizations for their marketing campaigns
- Local and regional authorities for their marketing and attraction strategies
- Local institutions and companies willing to market their products

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Intelligent City Platforms integrating L1-L2-L3



- Layers are spatialities (P-I-D)
- Platforms are knowledge functions at P-I-D space



PLATFORM 1: Strategic intelligence



A strategic information system based on (i) people of a community, (ii) rules for information management, and (iii) business intelligence tools

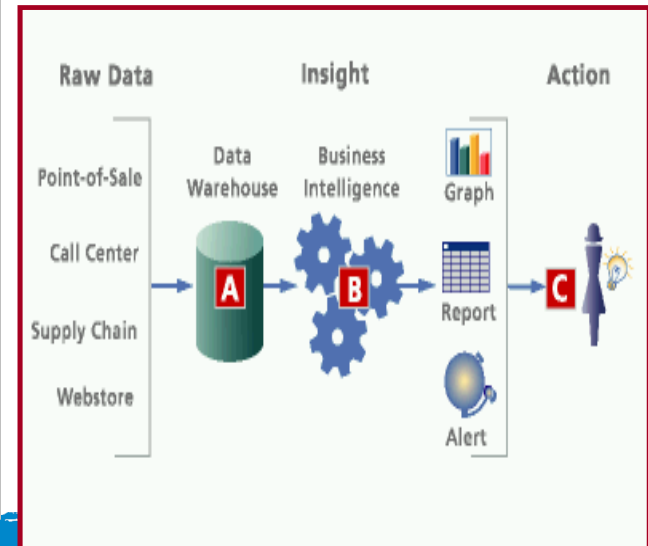
Community + Space

- Population of the community
- Geographic area of reference / Physical space
- Social group of reference / type of cluster
- Human network of information gathering and elaboration
- Data from sensors
- Network-based information collection, dissemination, feed back

Rules - Agreements

- Rules concerning the collection of information
- Sources of information and validation procedures
- Rules concerning the community of dissemination
- Users' rights and privileges
- Information analysis – Knowledge model
- Sustainability of information services

BI tool / e-services



PLATFORM 2: Technology learning / absorption



A technology transfer system based on (i) a community of technology providers, (ii) institutions of technology management, και (iii) intellectual property management tools and e-services

Community

- A community of technology providers
- University Labs
- Research fields
- Technology district
- Network of technology providers
- Network of technology recipients

Institutions

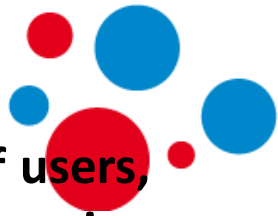
- IPR management rules
- Technology transfer / licensing agreements
- R&D valorization and commercialization agreements
- Spin-offs
- Technology dissemination rules
- Technology demonstration

Digital space

The screenshot shows the InterValue Platform website. At the top, there is a navigation bar with links for Platform Home, R&D Repository, Valorisation Plans, and IP Agreements. Below the navigation bar, the main content area features a central section titled "Collaboration for the Valorisation of R&D" with a diagram of people interacting. To the right of this section is a circular diagram with people icons. Below the main section are three columns: "R&D Repository" (with a lightbulb icon), "Valorisation Plans" (with a star icon), and "IP Agreements" (with a target icon). Each column has a brief description and a "Learn more" link.



PLATFORM 3: Collaborative innovation



Living labs for people-driven innovation based on (i) a community of users, (ii) institutions for collaborative innovation, and (iii) crowdsourcing applications and e-tools

Community

- Innovation community
- Living Lab
- R&D providers
- Global technology providers
- Government institutions
- End users – large number
- Citizens
- Real life environments

Working rules

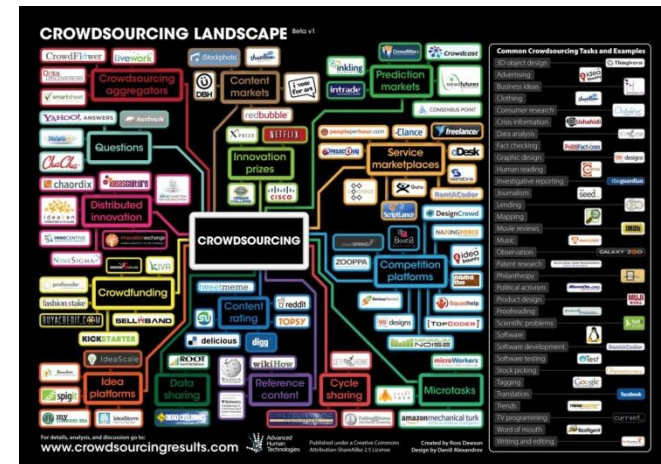
Co-Creation, bringing together technology push and application pull

Exploration, engaging all stakeholders, especially user communities, at the earlier stage of the co-creation process,

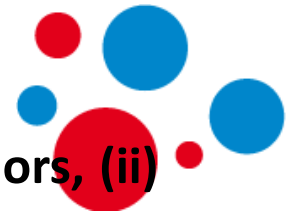
Experimentation, implementing the proper level of technological artifacts to experience live scenarios with a large number of users, and

Evaluation of new ideas, innovative products, technological artifacts in real life situations.

Digital space



PLATFORM 4: Dissemination / Promotion



Marketplaces based on (i) physical spaces and a community of vendors, (ii) market operation rules, and (iii) online marketplaces and social media

Community + Space

- Commercial community
- Local vendors
- CBD marketplaces
- Peripheral marketplaces
- End users / consumers
- Trade associations
- Citizens
- Accessibility facilities
- Environmental conditions

Institutions

- Information dissemination
- Promotion of products and services
- Promotion rules
- Marketing plans
- Marketing alliances
- Global supply chains
- Innovation diplomacy

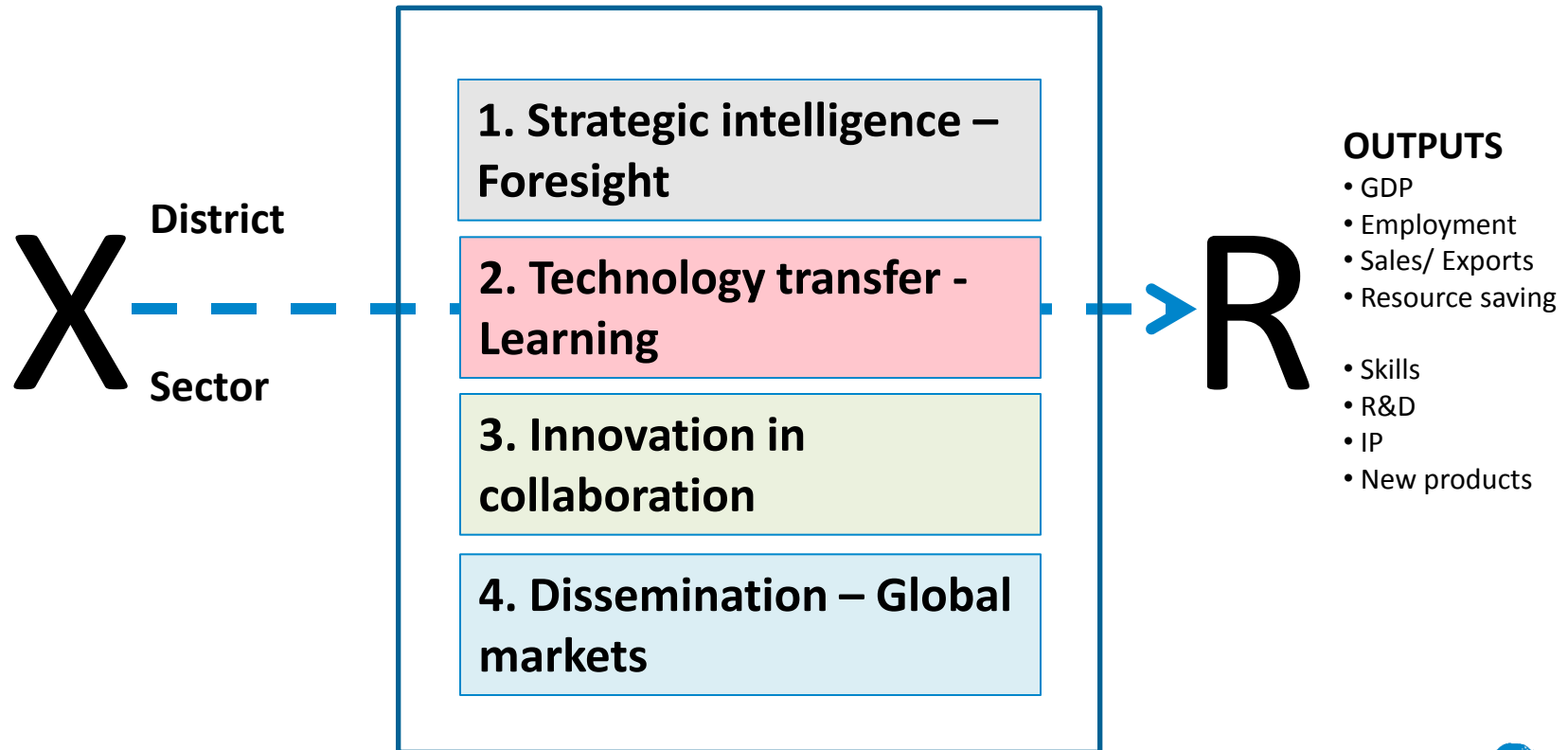
Digital Marketplaces



Intelligent City Platforms at any city district



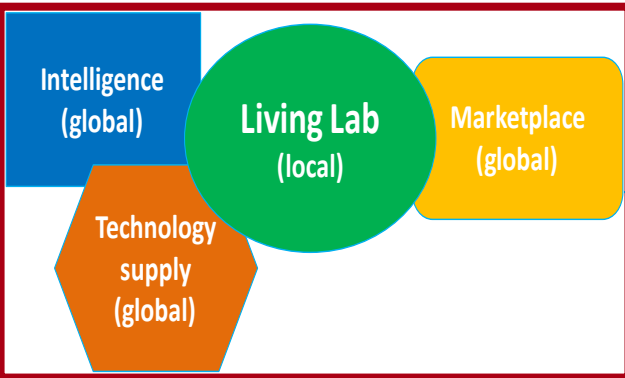
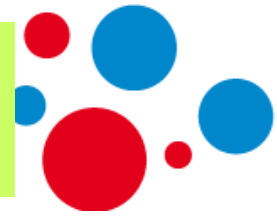
PLATFORMS – KNOWLEDGE FUNCTIONS



Measurement Scoreboard



Intel cities: 4 core processes at 3 spatial levels amplifying all the ecosystems of cities



Innovation Economy

- 1- Intelligent city sectors: manufacturing, commerce, business services, education, health, tourism
- 2- Intelligent city districts: CBD, techno park, mall, university campus, port area, airport city
- 3- New companies creation / intelligent incubators



City Infrastructure – Utilities

- 4- Smart transport and parking
- 5- Broadband, wired and wireless
- 6- Energy saving , smart grid
- 7- Water management and saving
- 8- Environment monitoring, real time alert and safety



City Governance

- 9- Government services to citizens
- 10- Decision making / participation / democracy
- 11- City Planning and monitoring





Related publications

Komninos, N. (2011) "Intelligent cities: Variable geometries of spatial intelligence", From Intelligent to Smart Cities, Mark Deakin and Husam Al Waer (eds), *Journal of Intelligent Building International*, Vol. 3, pp. 1-17.

Komninos, N. (2009) "Intelligent cities: Towards interactive and global innovation environments" *International Journal of Innovation and Regional Development*, Vol. 1, No. 4, 337–355.

Komninos N. (2008) *Intelligent Cities and Globalisation of Innovation Networks*, London and New York: Routledge.

