

# The ARCHITECTURE of INTELLIGENT CITIES

Integrating human, collective and artificial intelligence  
to enhance knowledge and innovation

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**Portal: Innovation, Environments of Innovation, Intelligent Cities & Regions**

**A “Digital Korea” Tour Itinerary**



The Digiens@u-City blog has a great post that outlines a 7-day tour itinerary for “digital Korea” that is a good way to get acquainted with both the top-down and bottom-up sides of Korea’s emerging digital/broadband culture. [Continue reading...](#)

Posted at 3 July 2006 in [Digital Cities](#)

**Innovation lessons from new IT trends**



While I was reading the last article by Ephraim Schwartz, InfoWorld on ecommercetimes.com, and combining it with Kathy Sierra new proposed discussion on the best model of innovation, I have been wondering how those two main streams can be connected or related? [Continue reading...](#)

Posted at 28 June 2006 in [Innovation](#)

**Municipal WiFi Networks for the Citizens**



On his last article Gene J. Koprowski in [www.TechNewsWorld.com](http://www.TechNewsWorld.com), which is part of the ECT News Network, mentioned a new study which

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# Outline

*I. Intelligent cities: Concept and cases*

*II. Core processes: Innovation systems*

*III. Core processes: Digital cities*

*IV. Emerging structure: Innovation + digital cities*

*V. Building blocks of intelligent cities*

# I. *Intelligent Cities: The concept*

At least four different descriptions of what an intelligent city is can be found in the literature:

1. **Digital representation of cities:** Metaphorical use of the term to characterize cyber cities, virtual cities, digital cities, information cities, wired cities, telecities, etc. (*various authors + MIMOS*)
2. **Smart Growth** for creating wealth and employment: A Smart Community is a community that has made a conscious effort to use information technology to transform life and work within its region in significant and fundamental ways (*World Foundation for Smart Communities, California Institute at San Diego State University*)
3. **Environments with embedded information and communication technologies:** Physical environments in which information and communication technologies and sensor systems disappear as they become embedded into physical objects and the surroundings in which we live, travel, and work (*IE*)
4. **ICT supported territorial innovation systems:** Territories that bring innovation, knowledge work force and ICTs within the same locality (*Intelligent Community Forum*)

# I. *Intelligent Cities: The concept*

The latest concept correspond to a literal than metaphorical use of the term, since it highlights a fundamental character of intelligence: novelty.

'Intelligence bears on doing something one has never done before..... intelligence is what you use when you don't know what to do. This captures the element of novelty, the coping and groping ability needed when there is no 'right' answer, when business as usual isn't likely to suffice' (Calvin, W. H. 1998, *How Brains Think. Evolving Intelligence, Then and Now*).

Consequently, speaking literally and not metaphorically, the term 'intelligent city' should be given to a territory:

- with developed knowledge-intensive and innovation-based activities;
- with embedded routines of social co-operation allowing knowledge and know-how to be acquired and adapted;
- with a developed information and communication infrastructure, digital spaces, and knowledge management tools; and
- with a proven performance to innovate, (Oslo M., EIS) manage and resolve problems that appear for the first time, since the capacity to innovate and manage uncertainty are the critical factors for characterizing intelligence.

# *I. ICF: Innovation and Broadband for characterizing Intelligent Communities: It takes more than being wired*



## **The Top Seven Intelligent Communities of 2005**

Selected by the Intelligent Community Forum  
[www.intelligentcommunity.org](http://www.intelligentcommunity.org)

Five assessment criteria for selection intelligent communities:

- Significant deployment of **broadband communications** to businesses, government facilities and residence of a community.
- Government and private-sector programs that promote **digital democracy** by bridging the Digital Divide.
- Effective economic development marketing that leverages the **community's broadband to attract** new employers.
- Effective education, training and workforce development that builds a labor force able to perform "**knowledge work.**"
- **Innovation** in the public and private sectors, ranging from e-government initiatives and efforts to create economic "clusters".

# I. Selected cities as 'Intelligent Communities' by the ICF 2001-06

Asia – Australia (11)	North & South America (9)	Europe (3)
<ul style="list-style-type: none"> <li>■ Bario, Malaysia</li> <li>■ Singapore</li> </ul>	<ul style="list-style-type: none"> <li>■ LaGrange, Georgia US</li> <li>■ Nevada, Missouri, US</li> <li>■ New York, UA</li> </ul>	<ul style="list-style-type: none"> <li>■ Ennis, Ireland</li> <li>■ Sunderland, UK</li> </ul>
<ul style="list-style-type: none"> <li>■ Bangalore, India</li> <li>■ Seoul, S. Korea</li> </ul>	<ul style="list-style-type: none"> <li>■ Calgary, Alberta, CA</li> <li>■ Florida, high tech corridor, US</li> </ul>	
<ul style="list-style-type: none"> <li>■ Taipei, Taiwan</li> <li>■ Victoria, Australia</li> <li>■ Yokosuka, Japan</li> </ul>	<ul style="list-style-type: none"> <li>■ Spokane, Washington, US</li> </ul>	
<ul style="list-style-type: none"> <li>■ Mitaka, Japan</li> <li>■ Tianjin, China</li> </ul>	<ul style="list-style-type: none"> <li>■ Pirai, Brazil</li> <li>■ Toronto, CA</li> </ul>	<ul style="list-style-type: none"> <li>■ Issy-les-Moulineux, FR</li> </ul>
<ul style="list-style-type: none"> <li>■ Gangnam District Seoul</li> <li>■ Ichikawa, Japan</li> </ul>	<ul style="list-style-type: none"> <li>■ Cleveland, Ohio US</li> <li>■ Waterloo, Ontario, CA</li> </ul>	

# ***I. ICF top Intelligent Community 2006: On June 9, Taipei was chosen as Intel Community of the year***

**Among the achievements cited by ICF** were Taipei's 88 technology incubators, which continue to produce new businesses, products and technologies for the global market. Last year, over 2,000 new businesses have been launched. In addition, the community has 45 R&D centers, including the Taipei Technology Corridor, which consists of two major science and technology parks, with a third one in development, that currently employ more than 85,000 knowledge workers in 2,200 companies. The most significant industry continues to be ICTs and nearly 400,000 jobs have been created in the past 24 months in telecommunications and science and technology services.

Taipei is also one of the world's top three cities for broadband deployment, with PCs in 88% of homes and 77% of households connected to ADSL service. 90% of all wireless access points are made in and around Taipei. The government's M-Taipei initiative continues to stimulate all important applications for mobile phones, laptops and other devices. It has successfully reinforced a 'culture of use' among citizens. Taipei also has focused on areas of human service, where modernized health care, media and banking systems sustain an increasingly prosperous citizenry. It is providing free Internet training and service to 2,000 students affected by the Tsunami disaster. With the support of broadband policies that ICF calls "Digital Democracy" has continued to emerge. The "Mayor's Mailbox," provides citizens with a direct voice to their government. Nearly 5,000 cases are handled on-line each month.



# *I. Intelligent Cities: The concept*

## **Definition:**

Intelligent cities and regions are territories with high capacity for learning and innovation, which is built-in the creativity of their population, their institutions of knowledge creation, and their digital infrastructure for communication and knowledge management.

Two **contemporary movements** converge in the making of intelligent cities and regions:

- Innovation, systems of innovation, clusters, technology districts, and
- Digital community spaces, digital cities, broadband deployment.

which we will discuss in the next sections:

## II. Core processes: Innovation systems

The ground of intelligent cities and regions is made by systems of knowledge-intensive and innovative organizations forming districts, poles, zones, and clusters.

*'Innovation is the implementation of a new significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations' (Oslo Manual, Third Edition, 2005)*

Today, the mainstream view for innovation is that it is systemic:

- the traditional Schumpeterian model, regarding innovation as an internal activity of the firm, and
- the linear innovation model of stages-gates have been found inadequate.

Innovation is increasingly regarded as a collaborative and evolutionary process taking place within **clusters** enhancing discovery and idea generation and selecting the most plausible innovations.

## II. Core processes: Innovation systems

Two sets of causes explain the trend of innovation towards clustering:

- (a) The regional embeddedness of innovation.** Kaufmann and Todtling identified five major mechanisms of path-dependence:
- Many of the preconditions of innovation, such as qualifications of the labor force, education, research institutions, knowledge externalities and spillovers, are **immobile**.
  - Industrial clusters are localized giving rise to **specific innovation patterns** within networks and industry sectors.
  - A common technical culture may develop through **collective learning** taking place into a regional productive system.
  - University-industry links and **knowledge spillovers** are region specific.
  - **Regional policy** is playing an active role in innovation providing support through institutions and agencies.

## *II. Core processes: Innovation systems*

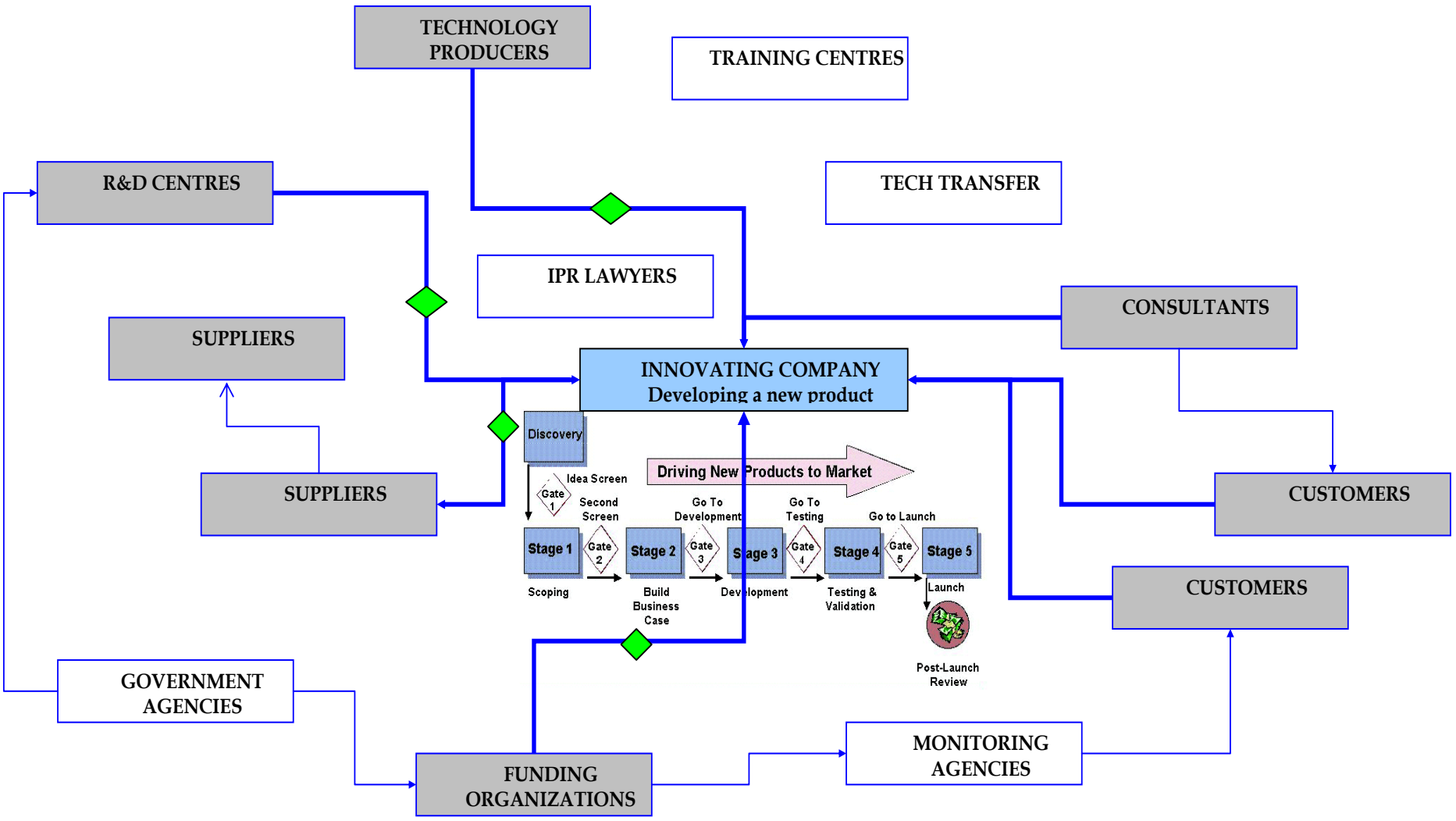
### **(b) The conversion of tacit to explicit knowledge.**

- Nonaka and Takeuchi draw on the Japanese corporate experience in new product development (Nonaka and Takeuchi, 1995) and attribute innovation to the transformation of tacit knowledge (knowledge which has a personal dimension that makes it hard to formalize and transmit in other ways than personal communication) into explicit knowledge (that is transmittable in formal languages, codified and captured in libraries, archives and databases).
- Because tacit knowledge circuits demand person-to-person communication, clustering becomes a precondition of innovation.

Path-dependence and tacit knowledge networks explain why innovation appears mainly within communities, clusters, local systems, technology districts, and other forms of agglomeration.

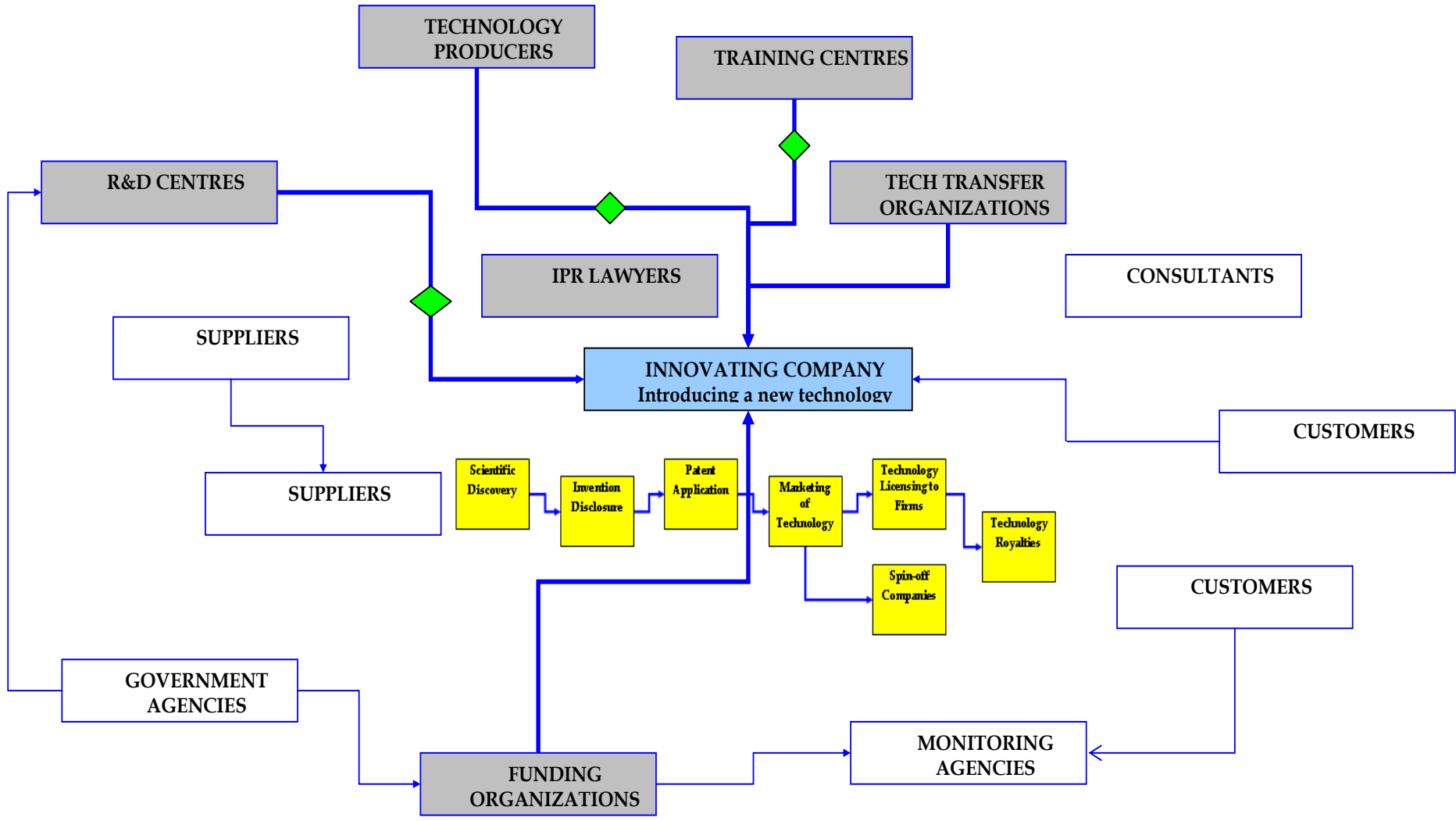
# II. Core processes: Innovation systems

## ➤ Clusters of knowledge networks in product innovation



# II. Core processes: Innovation systems

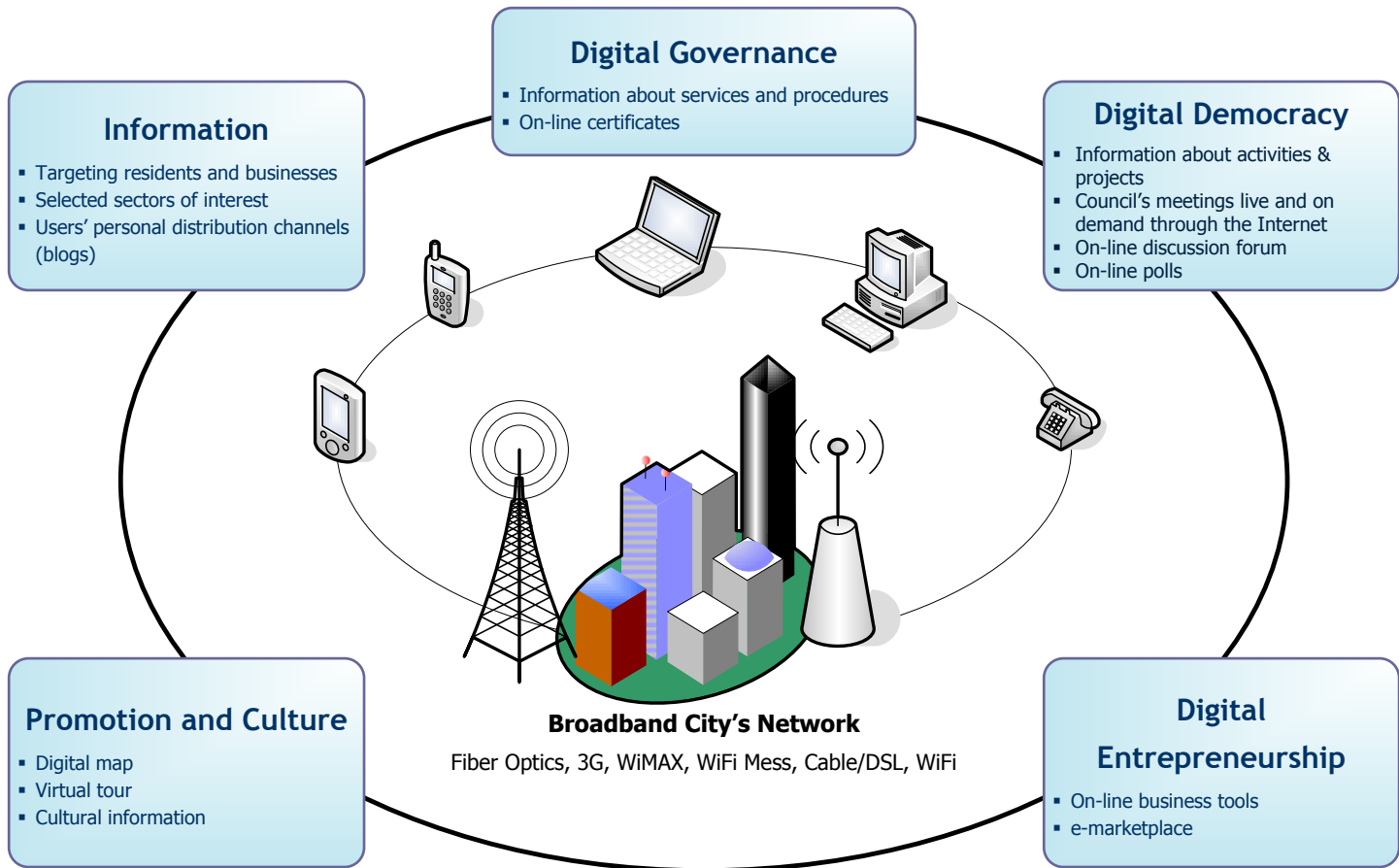
## ➤ Clusters of knowledge networks in process innovation



# III. Core processes: Digital cities

The digital city is the dominant form of community space corresponding to a territory.

Digital cities cover a very wide range of digital networks and software applications facilitating multiple aspects of the social and economic life of cities: commerce, transactions, health, education, work, leisure, transport.



# III. Core processes: *Digital cities*

## *A metaphor?*

Two very important publications:

*Digital Cities: Experiences, Technologies and Future Perspectives (2000)*

*Digital cities (2002)*

consider that a digital city is a metaphor:

‘As a platform for community networks, information spaces using the city metaphor are being developed in worldwide’

‘It is evident that “digital city” is a metaphor. Metaphors (from Greek metaphora – transfer) serve to create new meanings by transferring the semantics of one concept into the semantics of another concept. Metaphors are habitually used to interpret an unknown “world” (perception, experience, etc.) – the target – in terms of a familiar world – the source.’

‘digital city is a metaphor called to denote a complex digital product with properties structurally similar to the ones of physical cities’

How accurate is this description?



### *III. Core processes: Digital cities*

It is common knowledge that a digital city is structurally different from the physical city of reference.

- ✦ Not all elements of the physical city have their equivalent digital representation. Imaginary elements may also take part in the digital construction.

- ✦ Proximity in terms of distance and time is deformed.

- ✦ Even in simulations, 2D in the case of urban transport applications and 3D in the case of reconstruction of historical spaces and city buildings, similarity does not go beyond the form of the city.

- ✦ The functional aspects of the city are poorly represented through extreme simplification; social and economic relations are not represented at all.

### *III. Core processes: Digital cities*

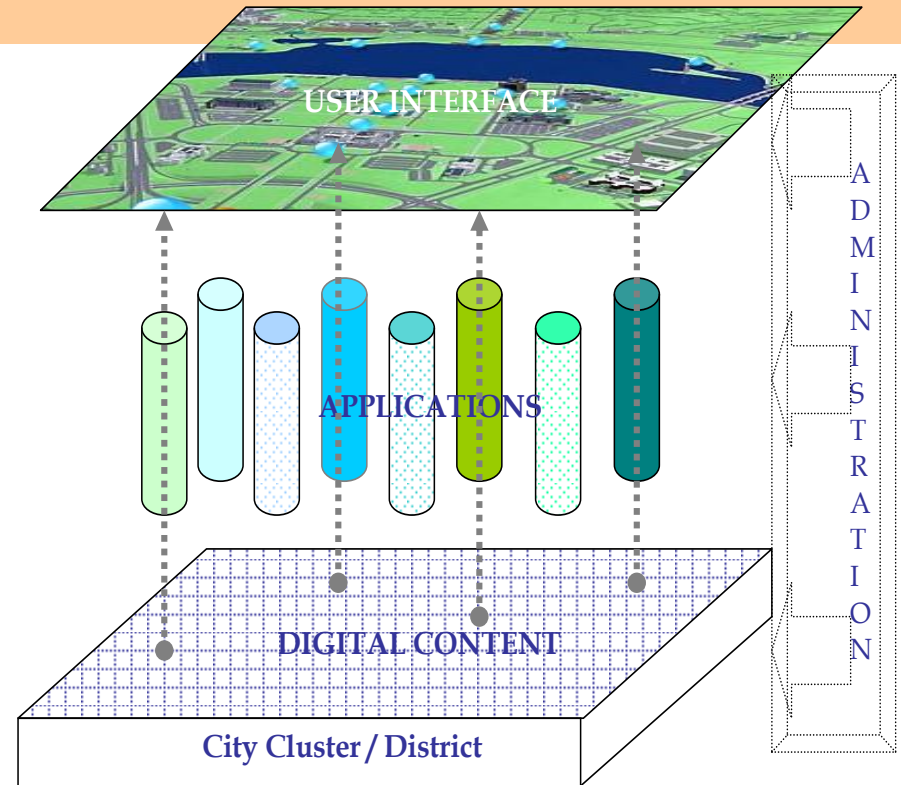
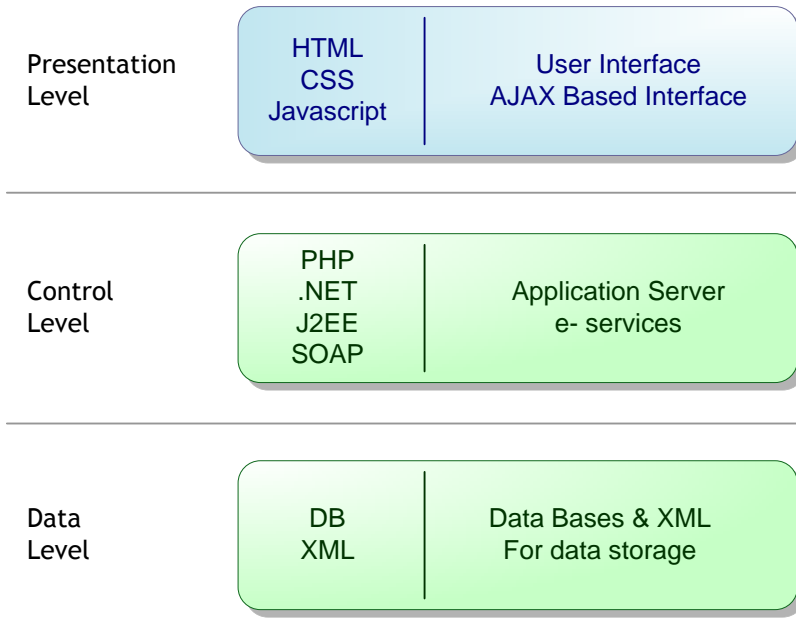
#### *A digital community space*

Instead of considering the digital city as metaphor we would argue that digital cities are **community / collaborative spaces** build as **networks of distorted representations** of the city.

✿ The digital representation of the city is distorted for two reasons. First, it represents a city partially and not accurately; and second, it may include virtual elements non-existent in the physical space.

✿ The community space is network-based because each element of the digital city is linked to an element of the physical city, and to other digital elements of the community space. Limitless relationships and dynamic combinations between its constituting digital elements are possible.

# III. Core processes: Digital cities Architecture

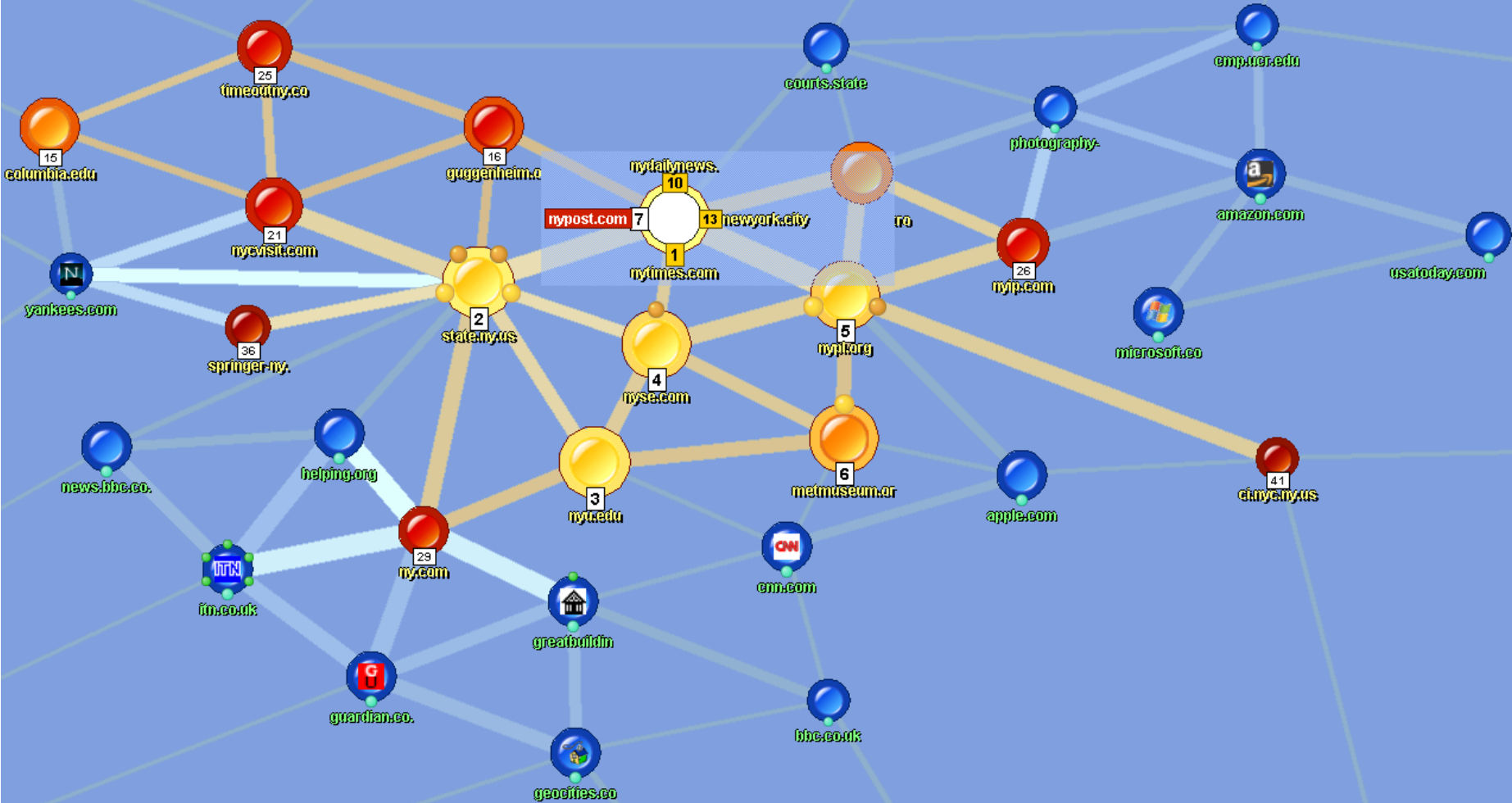


The architecture of digital cities may be described by a four level structure:

- ✦ *The information storehouse, including all digital content: texts, images, video, multimedia.*
- ✦ *The applications level, which structure the digital content and provide online services: information, commercial, and governmental services.*
- ✦ *The user interface, the web pages that users visit in order to get the services provided.*
- ✦ *The administration, a tool for managing user rights to the applications and the digital content.*

# III. Core processes: Digital cities

## A digital city is not a web site!



A digital city (New York) as sum of websites of the city organizations  
Source: <http://search.mapstan.net/en/splan.jsp?planId=&q=New+York&Resu>

## *IV. Emerging structure: Innovation + digital cities*

Intelligent cities emerge from collective and uncoordinated action: from the union of innovative clusters and digital community spaces (digital cities) with the purpose to enhance knowledge application and innovation.

The connection is based on two objective conditions:

- (1) innovation and digital cities are both cluster-based processes, and
- (2) innovation and digital cities are both knowledge-based processes.

Innovative clusters make the **core** of intelligent cities, while digital community spaces and digital cities act as **facilitators** of innovation processes.

Collaborative digital spaces enhance all stages of the innovation process, from conception to commercialization. Lets describe four important stages of this connection.

# IV. Emerging structure: Innovation + digital cities

## Strategic intelligence

A field of innovation which has enormously profited from collaborative digital spaces is strategic intelligence.

Digital cities may provide a particular form of strategic intelligence, 'collective strategic intelligence', in which **information collection** is based on a network of 'authors', **information assessment** is based on a network of 'evaluator', and **dissemination** focuses on a defined target group.

The screenshot shows the Textile Intelligence website. At the top, there is a navigation bar with links for MyTI, Market Intelligence, Business Floor, Products & Services, Trade Resources, and Corporate. Below this is a secondary navigation bar with News, Market Intelligence Report, Buy, Sell, Market Development, and TextileExcellence. The main content area is divided into several sections: Member Login (with fields for User Name and Password), Market Intelligence (with links to Mkt. Intelligence Home, Latest MIR, and Archive MIR), Make Posting (with links for Spun Yarn, Staple Fiber, and Filament Yarn), Business Floor (with links for Business Home, View Sell Offer, View Buy Enquiry, Make Sell Offer, Make Buy Enquiry, Make Sample Request, and Manage My Business), and News Categories. The central section features 'Latest 5 Articles' with a list of articles including 'FLAME RETARDANTS IN TEXTILES', 'Russian Textile: Redemption post Redemption post disintegration', and 'NanoTechnology : A closer look and its uses in textiles'. Each article includes a brief description, a date, and a price (Euro €) with a 'Free for' note for paid members. There are also links for 'More', 'Table of Content', and 'Login to View or ORDER NOW'. On the right side, there is a 'PUBLICATION' section with a 'See all issues' link and a 'MARKET DISCOVERY' section with a 'Details' link. The website also features a 'Click to Subscribe' button and a 'Login MIR Contact Home' link in the top right corner.

*Digital space for cluster intelligence*

# IV. Emerging structure: Innovation + digital cities

## Technology transfer, acquisition of technologies

Knowledge networks in technology transfer are substantially enhanced by digital community spaces.

Technologies are stored into databases and online marketplaces of technology for license are created.

Technology marketplaces are coupled with online services : consulting services assessing a portfolio of intellectual property; evaluation; legal assistance through the deal-making process.

The screenshot shows the miod website interface. At the top right is the miod logo and the text 'sistema madri+d'. Below the logo is a navigation bar with links: CONTACTO, AYUDA, MAPA, REGISTRO, SUSCRIPCIÓN. A search bar is located on the left with a search button labeled 'IR'. Below the search bar is a sidebar with categories: 'Actividades de los grupos de investigación', 'QUÉ ES MADRI+D', 'INFORMACIÓN I+D+I', 'INNOVACIÓN TECNOLÓGICA', 'CIENCIA Y SOCIEDAD', and a 'buscador miod' section listing 'investigadores, empresas, noticias, ...'. Below this are links for 'El experto le asesora', 'Foros', 'Documentos', 'Convocatorias', and 'Indicadores', followed by statistics: 16364 Investigadores, 5141 Grupos de Investigación, 13874 Proyectos I+D, 98 Tecnologías, 1920 Empresas, 6350 Profesionales Inscritos, and 1305 Ofertas de Empleo. At the bottom of the sidebar are 'oficinas miod' and buttons for 'I+D en España' and 'Socios Europeos'. The main content area is divided into '+ NOTICIAS I+D+I' and '+ DESTACADOS'. The news section shows articles from 4/7/2006 and 3/7/2006. The featured section includes 'PHOTOESPAÑA 2006', 'Plan de Ciencia y Tecnología CM 2005-2008', 'Novela y Ciencia: Ilotas a Fritz', 'La Globalización de la I+D', and 'Ayudas para Contratos de Personal Investigador de Apoyo'. On the right, there is an '+ AGENDA' section with dates and event titles like '2nd Congress of European Microbiologists' and 'Plataforma Tecnológica Española de Química Sostenible'. At the bottom right, there is a video player for 'VIDEO: Madrid, un lugar para la Ciencia y la Tecnología' and a mention of 'PRIMER FINALISTA del Premio a la Excelencia'.

Collaborative space for tech transfer

# IV. Emerging structure: Innovation + digital cities

**Collaborative innovation is another field of integration**

Collaborative environments for innovation based on community spaces, are expert systems that may lead to problem resolution step-by-step, for instance through the stages of problem solving; may also include advanced NPD methodologies and tools; as well as learning and experimentation through simulation.

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### Technology Watch




**Easy and fast access** to research results and technology information, increasing the potential of successful innovation.

[Details](#)

[Thessaloniki Technology Park, Greece](#)

### Networking



**Enables** the communication / cooperation in groups facilitating Transfer of Technology within clusters and consortiums.

[Details](#)

[OuluTech Ltd., Finland](#)

### Marketing Innovation




**Offers** an implementation guide for successful introduction of innovative products in to the market.

[Details](#)

[Technologiepark Ostfalen, Germany](#)

### Technology Assessment



**Facilitate** decision makers of your company to improve the process of choosing technologies through Cost Benefit Analysis (CBA) tool, which provides means for systematic comparing the value of outcomes with the value of resources required for achieving the outcomes.

[Details](#)

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### Technology Audit




**Create** your company's technology report in an easy to use and practical way. Technology leads socio-economic development. Every organization uses technology in order to achieve its goals, while its dependence on technology is related to the nature of its activities.

[Details](#)

[H.T.T.C. S.A., Greece](#)

### Financing Innovation



**Financing of Innovation Guide**  
A step by step guide focused on identifying sources of finance for your case and helping you to choose the appropriate ones and approaching the investors.

**Business Plan Tutorial**  
A tutorial to introduce you to Business Plan Concept through a Basic approach and a Case Study. Here you can also find a Advanced approach with a more detailed structure that will be used in the "Business Plan Tool" section.

**Business Plan Tool**  
A tool to help you to build your own Business Plan allowing you to fill in a blank document with your own business description and details and to integrate it with

### How to use NewVentureTools.net

**Discussion Forum**  
Share your experiences, problems and solutions with other SMEs users! Visit the NewVentureTools.net Discussion Forum

*Virtual Technology Park*



# IV. Emerging structure: Innovation + digital cities

## Promotion of clusters, products and services

Marketing, promotion and e-commerce are mainstream functions of digital cities. It is the area that most digital cities are active.

Digital promotion take multiple forms: direct marketing, attraction of people and investments, procurement and purchasing, auctions, community and e-government services.

The image shows a screenshot of the website [www.inparma.it](http://www.inparma.it) with the tagline "The whole city in a click!". The website features a navigation menu with categories: HOME, ABOUT US, ADVERTISING, HELP, JOIN US, and ITALIANO. Below the navigation, there are several menu sections:

- Immobili**
- TURISMO**
  - Virtual Tour
  - Guida al turista
  - Parma in tavola
  - Ristoranti
  - Alberghi
  - Parma by night
- VIVERE A PARMA**
  - Cinema
  - Teatro
  - Musica
  - Arte
  - Incontri
  - Libri
  - Fiere
  - Il culto a Parma
  - Per i piu piccoli
  - Feste e sagre
  - Sport
  - Fitness
  - Parma notizie
- SERVIZI**
  - Servizi di utilità
  - Link della città
  - Altri link
  - Numeri utili
  - Finanza on-line
  - Assicurazioni
- INPARMA**
  - Chi siamo
  - Pubblicità
  - Help
  - Collabora con noi
  - Copyright

Below the website screenshot is a virtual tour of a clothing store. The store has a sign that says "afa adorni". The store interior features a wooden counter with a large potted plant and a pink bag. In the background, there are shelves with folded clothes. The store is decorated with various brand logos and text, including "No.Lita north little italy N.Y.C.", "MASON'S WOMAN RITES", "CIVIDINI CASHMERE", "Belstaff", "MONCLER GRENOBLE", and "MICHIKO KOSHINO". The name "Cristiano Fissore" is written in a cursive font at the bottom right. At the bottom of the image, there is a red banner with the text "Digital City of Parma" and "Via XXII Luglio, 2/B Parma - Tel. 0521237982".

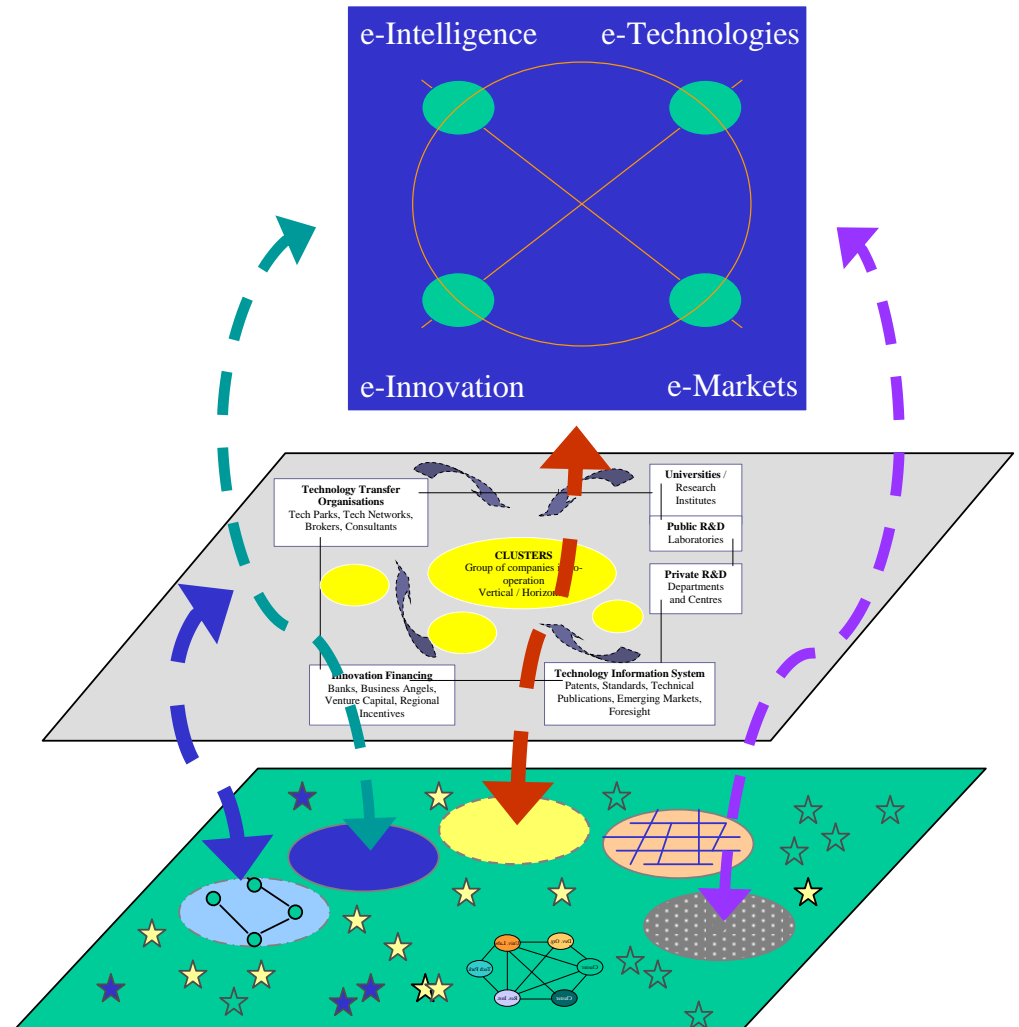
# V. Building blocks of intelligent cities

The integration of innovative clusters and digital cities determine the building blocks of an intelligent city.

**An intelligent city** is a multiplayer territorial innovation system, integrating

- ☀ knowledge-intensive activities,
- ☀ institutions for cooperation and distributed innovation, and
- ☀ digital communication infrastructure and tools to maximize the innovation and knowledge management capability.

**It is a 3-level structure:**



## *V. Building blocks of intelligent cities*

**L1:** The basic level of an intelligent city is the city's **innovative clusters**, in manufacturing and services. This level gathers the creative class of the city made by knowledgeable and talented people, scientists, artists, entrepreneurs, venture capitalists and other creative people, determining how the workplace is organized and how the city is developing.

**L2:** A second level is made of **institutional mechanisms** regulating knowledge flows and co-operation in learning and innovation. This level gathers institutions enhancing innovation: R&D, venture capital funds, technology transfer and training centers, intellectual property, spin-off incubators, technology and marketing consultants.

**L3:** The third level is made up by **information technology and communication** infrastructures, digital tools and spaces for learning and innovation. These technologies create a virtual innovation environment, based on multimedia tools, expert systems, and interactive technologies, which facilitate market and technology intelligence, technology transfer, spin-off creation, collaborative new product development, and process innovation.

## *V. Building blocks of intelligent cities*

The first level relates to people in the city: the **intelligence, inventiveness and creativity of the individuals** who live and work in the city.

The second, relates to the **collective intelligence** of a city's population. Collective intelligence is defined as “the capacity of human communities to co-operate intellectually in creation, innovation and invention” This is the institutional dimension of the city that creates wealth and prosperity through cooperation in knowledge and innovation.

The level relates to **artificial intelligence embedded into the physical environment** of the city and available to the city's population. This is a public communication infrastructure, digital spaces, and public problem-solving tools available to the city's population.

## *V. Building blocks of intelligent cities*

Four functions emerge out of the integration of human creativity, institutional capacity, and digital networking:

**F1: Intelligence:** Systematic collection, analysis, understanding and diffusion of information concerning new product announcement, technologies, industrial statistics, performance indicators, market shares, price trends, etc.

**F2: Technology absorption,** based on licensing agreements for the transfer of intellectual property rights, cooperative R&D or contract R&D, and spin-offs creation.

**F3: Collaborative innovation:** bridging separate technology fields and enhancing complementary roles and skills along the innovation chain.

**F4: Promotion of clusters and localities,** reducing costs in all forms of transactions: logistics in the supply chain; marketing and advertising; information on policies, regulations, technical standards, and incentives; finding partners, buyers, sellers, and services.

## *V. Building blocks of intelligent cities*

Intelligent cities are still in their early days.

To date, most applications are being developed with respect to innovative clusters and technology parks, as intelligent clusters, intelligent technology districts, and technology parks. In these islands of innovation, the innovation system is being enriched by communication infrastructure, expert systems, and knowledge management tools, creating an integrated physico-virtual innovation system.

Their architecture, as described, includes three levels (physical, institutional, digital) and four functions (intelligence, technology transfer, innovation, and promotion). Within the physico-digital innovation environment, human and institutional factors predominate. Digital spaces and the online expert tools act as **facilitators** of human and collective intelligence.

*Thank you very much for your attention*