

Smart Port



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1. **Concepts**
2. Smart City
3. Smart Region
4. Smart Port
5. Annexes





1.1 In the last years everything is **SMART**.....

Smart America		Smart Everything		Smart Port
Smart Band		Smart Food		Smart Region
Smart Bank		Smart Germany		Smart Services
Smart Building		Smart Glasses		Smart Shopping
Smart Car		Smart Gym		Smart SIM
Smart Card		Smart Home		Smart Tourism
Smart City		Smart Japan		Smart Traffic
Smart Computing		Smart Metering		Smart Transport
Smart Country		Smart Nation		Smart TV
Smart Defence		Smart Office		Smart UK
Smart Dress		Smart Phone		Smart Water
Smart Engineering		Smart Pistol		Smart Weapon
Smart Europe		Smart Planet		Smart Zone

1.2 In the last years everything is **SMART**.....



SmartWatch Sony



Sony SmartBand



Smartphone Png



Smart Glasses Google



APPLE – NIKE Smart Shoe



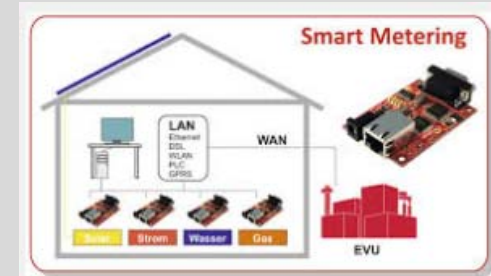
smartfood



1.3 In the last years everything is **SMART**.....



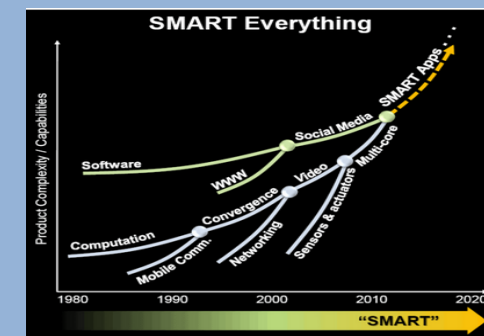
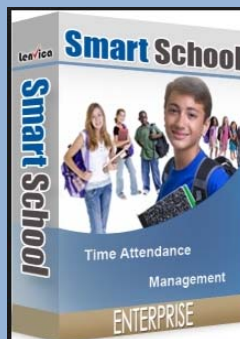
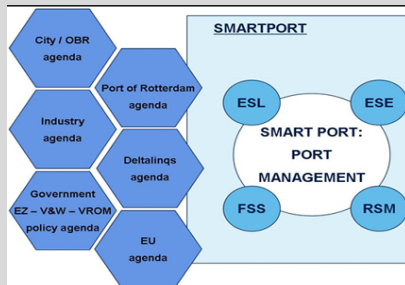
1.4 In the last years everything is **SMART**.....



Smart Tourism



1.5 In the last years everything is **SMART**.....





1.6 SMART problem :overexposure and abuse of the term

Current features	
Trendy	pertaining to the latest trend or style.
Fashionable	following the latest fashions; up-to-date or chic
Overexposure	To expose too long or too much a concept, idea or person
Abuse	improper or excessive use or treatment
Banalization	lacking force or originality; commonplace, trivial
Indistinguishable	impossible to distinguish clearly from something else
Burning-out	Progressive deterioration of a concept from the abuse or rubbing
Replacement	the act or process of replacing and old item by a new one



1.7 SMART meanings

Grammar	Smart
Adjective	clever
Noun	stinging
Verb	bite

Country	Smart
UK	elegant
US	clever

Combined forms

Smart Alec = smarty
 Smart aleck = pedantic
 Smart ass = bright spark
 Smart cookie = hustler
 Smart set = while people

Idioms

Look smart = good looks
 Be smart = have guts
 Very smart = having hanger



1.8 SMART meaning depends on the context and the Interlocutor



SMART for Economists means >>>> USERS

The SMART function is focused on the user's perspective. Because of the need to reach a broader base of community members, "Smart" serves better than the "intelligent" term, which is seen as more elitist. Smart is friendlier to use than intelligent...



SMART for Architects means >>> ENVIRONMENT

in the field of urban planning, SMART relates to Environment and it is treated as a normative concept. Being SMART in a City plan involves strategic development guidelines.



SMART for Engineers means >>> AUTOMATIC

The technologies focus on the commercial application of intelligent products such as artificial intelligence and robots. The SMART in the technology context stands for the automatic principle, for example : self-configuration, self-protection, self-healing and self-optimizing



SMART for Politicians means: >>> VOTERS

A SMART CITY Project does not replace a political program of government, but it looks like and focuses on fewer themes that can be prioritized and that are highly visible by the media, which generally translates into votes in the next election.

1.9 City meanings

City, Latin CIVITAS. A **geographical city** is an urban area which can be dominated either by industry and/or services. It differs from other urban concepts mainly by population density and legal status, but its definition varies between countries

A **political city** is defined in each country, according to its number of inhabitants. It is used to designate a particular political and administrative entity. The city in China starts from 200.000h. In Japan : 30.000 in the EU: 10.000h Chile: 5.000h, USA: 2.500h, Sweden 200h.

In 2015 in the world there are about 3 million urban entities, for a population of 7,000 million with 60% living in cities. China has 230,000 cities, 190,000 USA, Germany, 78,000, 39,000 India, Spain 29,000. However, if we focus only cities with at least 100,000 h. they are 3,158 cities, just over 1%.

Megalopolis

Set of Conurbations.
More than 40 MM hab. There are 13 in Asia, 5 in America and 2 in Africa.



Conurbation

Set of Metropolis
add between 20 MM Hab



Metropolis

Set of Cities
Totaling about 10 MM Hab



City




Urban areas with 5 MM to 10.000 Hab. They are classified into small, medium and large.



Town	<5.000h
Villa	<1.000h
Village	< 100h
Settlement	< 10h



1.10 City classifications

Demography	Geography	Economy	
• Megalopolis	• Coastal	• Administrative	
• Conurbation	• Inland	• Industrial	
• Metropolis	• Mountain	• University	
• City	• River	• Tourist	
• Town	• Lake	• Cultural	
• Villa	• Plain	• Religious	
• Village	• Valley	• Residential	
• Settlement	• Desert	• Military	

1.11 Smart City definitions

There is no universal definition of Smart City, as it is a new concept in evolution and that depends on the context in which it is used. However, there are 2 definitions that are most commonly used:

POLITICAL: Smart City is a **city** that follows a model of urban, economic, environmental and social development, where investments in human capital ,transport infrastructure and communication technologies promote sustainable economic development and a high standard of quality of life ...

TECHNICAL: ISO-37120/2014: Indicators for the Smart City services and quality of life, is applicable to any city, town or local government that is responsible for measuring their performance

ISO-37150/2014: intelligent Common Infrastructure, such as energy, water, transport, waste and information and communications technologies (ICT)



1.12 Smart Community definition

There are other entities that are not cities but they can also be SMART, in this case we talk **about Smart Community** that refers to two types of urban entities always smaller:

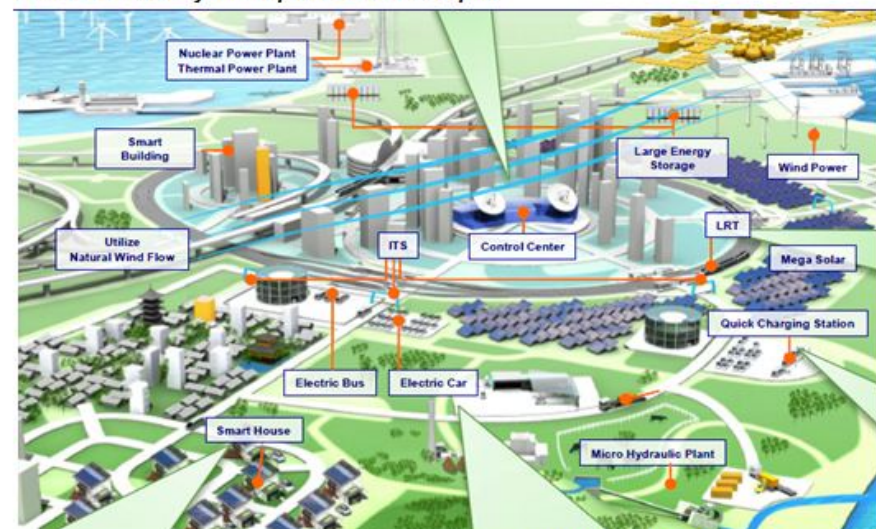
- Internal areas of a city
- Outside the City areas

There are Metropolis, Conurbations and even Megalopolis with projects to become a "Smart City". For example Tokyo, which exceeds 30 MM people or Shanghai 25 MM. The territorial organization into smaller units as the Prefecture, the District, County or Commune allowing them to approach the project in stages, dividing it into smaller entities, in Smart Communities.

This concept also includes extra-urban areas as a Technology Park, an area of logistics activities, a Port or Airport. This category includes projects such as Songdo, 60 km from Seoul in South Korea and Skolkovo, 20 km to Moscow-City projects are Technology Parks, or Heathrow Smart Airport with respect to London Smart City, or Hamburg Smart Port with respect to Hamburg Smart City.



Smart Community Conceptual Model in Japan



1. Concepts
2. **Smart City**
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SMART-CITY.












2.1 Smart City current models

	Axis	EU	WB	ISO	IBM	CITIES
1	Transport	X	X	X	X	X
2	Energy	X	X	X	X	X
3	ICT	X	X	X	X	X
4	Economy		X		X	X
5	Governance				X	X
6	People				X	X
7	Water			X		X
8	Environment					X
9	Sustainability					X
10	Climate change					X
11	Education					X
12	Culture					X
13	Heritage					X
14	Safety					X
15	Industry,.....others					X

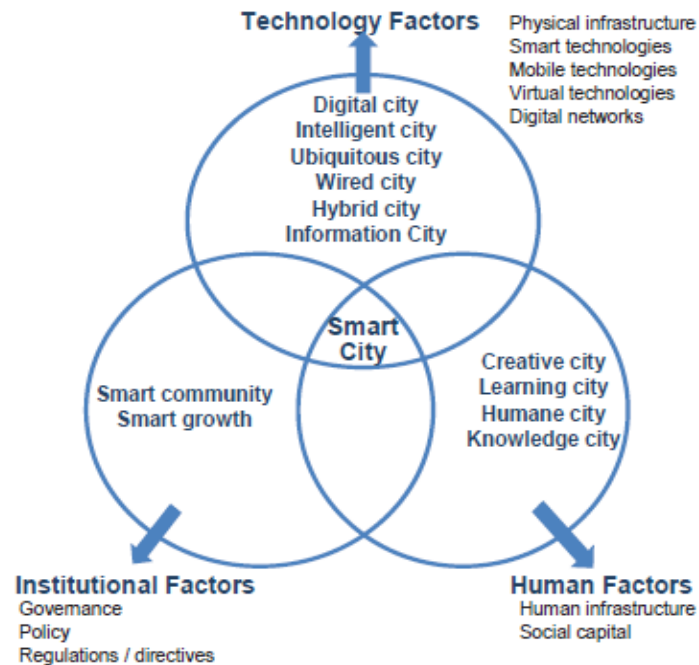
2.2 Smart City Refurbishment projects

1	Focus on ENERGY & ENVIRONMENT <ul style="list-style-type: none"> Sidney , Australia Malaga, España Stockholm , Sweden 	4.630.000 hab 1.640.000 900.000	EU-2014 33%	
2	Focus on TRANSPORT <ul style="list-style-type: none"> Oakland CA-USA Portland WA-USA Southampton - England 	1.550.000 hab 600.000 230.000	21%	
3	Focus on ICT <ul style="list-style-type: none"> Johannesburg, South Africa Houston, TX-USA Boise, CO-USA 	4.000.000 hab 2.150.000 210.000	14%	
4	Focus on GOVERNANCE <ul style="list-style-type: none"> Edinburg, Scotland Matosinhos, Portugal Syracuse, NY-USA 	500.000 hab 170.000 150.000	12%	
5	Focus on ECONOMY <ul style="list-style-type: none"> Kochi, India Manado ,Indonesia Valetta , Malta 	600.000 hab 420.000 250.000	11%	
6	Focus on PEOPLE <ul style="list-style-type: none"> Eindhoven , Netherlands Luxemburg, Luxemburg Issy le Molineux , France 	210.000 hab 100.000 65.000	9%	

2.3 Smart City New Building projects

1	DMIC project Delhi-Mumbai industrial Corridor 7 new cities on 1500 km	€ 66.000 MM 1.000.000 hab Dadri, Nemrana , Manesar, Pithampur	2010-2025 Public Partnership India-Japan	
2	DUBAI Central project New District in Dubai City	€ 38.000 MM 50.000 hab 400 Ha	2005-2020 PPP, based on previous project Internet City	
3	ECOCITY project New Chengdu quarter	€ 27.000 MM 80.000 hab 700 Ha	2012-2020 PPP. Chengdu ciudad 10 MM hab	
4	SONGDO project South Korea - Seoul	€ 27.000 MM 350.000 hab 675 Ha	2010 – 2030 Private Partnership and CISCO	
5	MASDAR project Abu Dhabi	€ 17.000 MM 50.000 hab 640 Ha	2008 – 2020 PPP : UAE , General Electric MIT.	

2.4 Key factors in a Smart City project



There are 3 factors that are essential in any project of Smart City, either by conversion or by construction:

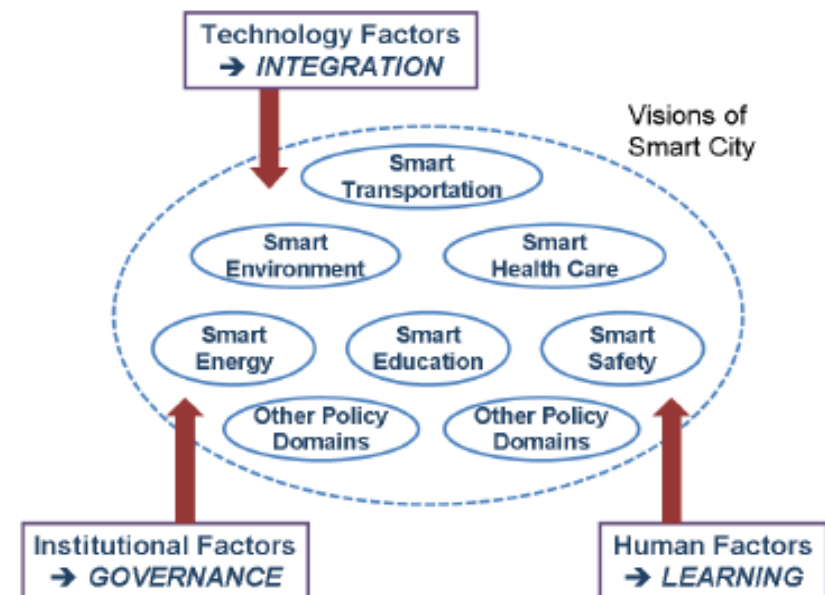
1st INSTITUTIONAL 1: Governance, political action, the regulatory framework, legislative framework

2nd HUMANS: Training, social capital, R & D centers, universities,, Cluster Platforms

3rd TECHNOLOGY: physical and logical infrastructure, info-structure, ICT, Wireless technologies, Big data ...

To build the set of common components in a Smart City Project, you will have to approach many previous concepts like – for example - Intelligent City or Digital City

The conceptual variants of Technology, Human and Institutional factors are interconnected so that the Smart City is located in the common area of the 3 factors.



2.5 European definition (2014)



<http://www.smartcities.at/assets/Publikationen/Weitere-Publikationen-zum-Thema/mappingsmartcities.pdf>

Box 1: Working definition of a Smart City

'A Smart City is a city seeking to address public issues via ICT-based solutions on the basis of a multi-stakeholder, municipally based partnership'.

<https://ec.europa.eu/digital-agenda/en/content/defining-smart-cities>

EC initiatives for Smart Cities focus on sustainable Transport , Energy and ICT networks
European Smart Cities have been characterized and defined by a number of factors including economic development and a high quality of life. Enhancing these factors can be achieved through infrastructure (physical capital), human capital, social capital and/or ICT infrastructure.



2.6 European model (2015)



EC Key axis		
TRANSPORT <ul style="list-style-type: none"> • Urban transport • Logistic services • ITS 	ENERGY <ul style="list-style-type: none"> • Renewable energies • Smart water • Sustainable environment 	ICT <ul style="list-style-type: none"> • Infrastructures • Network • Apps & services
Support axis		
ECONOMY <ul style="list-style-type: none"> • Competitiveness • Entrepreneurship • Internationalization 	GOVERNANCE <ul style="list-style-type: none"> • Citizen participation • transparent management • e-democracy 	PEOPLE <ul style="list-style-type: none"> • Quality of life • Lifelong Learning • Social cohesion
Cities Custom axis		
<ul style="list-style-type: none"> • CULTURE • PLANNING • Historical Heritage • TOURISM • HEALTH 		

2.7 European model (2015)



Axis	Population				
People					
Economy					
Governance				3.2	3.5
ICT		2.7	2.8		
Transport	1.9				
Energy					
	100.000	200.000	300.000	400.000	500.000+

Axis	ENE	TRA	ICT	GOV	ECO	PEO	Total
SC	200	125	85	71	67	52	600
%	33%	21%	14%	12%	11%	9%	100%



DIRECTORATE-GENERAL FOR INTERNAL POLICIES
POLICY DEPARTMENT
ECONOMIC AND SCIENTIFIC POLICY **A**



2.8 Smart City classifications

Origin	Evolution	Size	Axis
<ul style="list-style-type: none"> • New building • Refurbishment 	<ul style="list-style-type: none"> • Digital City • Intelligent City • Smart City 	<ul style="list-style-type: none"> • Small SC • Medium SC • Large SC • Very Large SC 	<ul style="list-style-type: none"> • ICT • Transport • Energy • Economy • Governance • People
			

2.9 Cybersecurity and Critical Infrastructure

ICT is the basis on which Smart City projects, either by building a new city or conversion of an old city were built. ICTs include among others: the Internet, radio, CCTV, Social Networks, Fiber Optics, GPS, Smart Phones, Tablets, sensors, wireless. NFC, Satellites, EV, Cloud Computing,

ICT are vulnerable to threats occurring in cyberspace. Malware like Stuxnet, Anonymous, botnets or denial of information, spoofing in bank accounts, or blackouts and other incidents in services that are essential today could jeopardize any project SC therefore cybersecurity is SC base. This is valid for critical infrastructure of Transport, Energy and Communications.



2.10 Regulatory Frameworks and KPI

	Key	Support
EU SCC-EIP 6 indicators	Transport Energy ICT	Financing Building Road-map
ISO - TC-268 ISO 37120/2014 ISO 37150/2014	Transport Energy ICT Water	Infrastructures Environment Climate change Sustainability
World Bank 22 indicators	Advanced : 8 PIB / IDH / LDP	Mid : 8 Basic : 6



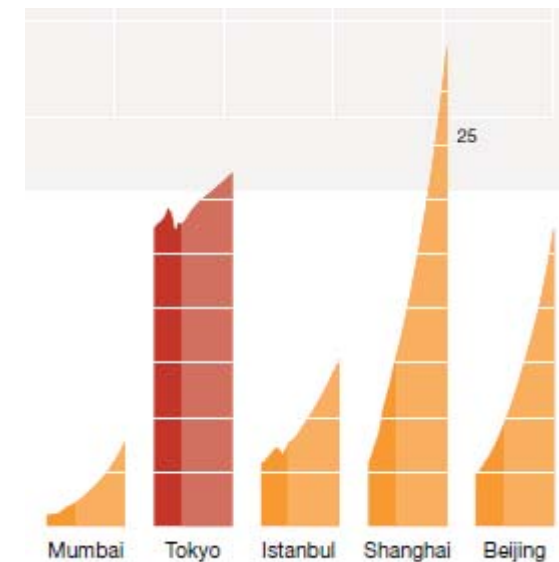
2.11 How many Smart cities there are in the World? : 1.100 in 2014



It is difficult to quantify how many SC are in the world, due to the lack of a general definition. A city with an Intelligent Street. Counts as Smart City ?. Or a city that focuses only on the energy management of public lighting. It is also a Smart City?

Cities with more than 100,000h. who could undertake projects SC are just 3,158 cities, the 0.1% of the 3 million cities in the World. There are two main factors to qualify for Conversion to SC: Population and Economic situation. IBM declared in 2013 a portfolio of 2,500 SC projects Worldwide. The SCC-EIP has registered 1,332 SC projects in Europe, but the EU recognizes only 600.

In any case, it seems that the concept of SC can be implemented only in a few cities in 2014 at the Barcelona Smart Cities Summit was estimated at about 1,100 worldwide, with the problem of different definitions of SC used in the different countries and its recognition as such.





2.12 How many Smart cities there are in the World? : 1.100 in 2014

NORTH AMERICA : 200

Albany, Arlington, Bristol, Cleveland,
Corpus Christi, Dakota, Dublin,
Miami, Riverside, San Francisco,
Salem, Ashland, Chattanooga ...(USA)
Calgary, Ottawa, Quebec, Toronto,
Vancouver, Winnipeg(Canada)

EUROPE : 600

Copenhagen (Dinamarca) Estocolmo
(Suecia), Ámsterdam (Holanda) ,
Viena (Austria), Paris (Francia), Berlín
, Múnich, Frankfurt (Alemania) ,
Londres (UK), Madrid, Barcelona
(España), Tallin (Estonia),.....

ASIA : 200

Bangalore (India), Chongqing , Hong
Kong, Shanghai , Beijing, Taipei ,
Tianjin (China) Doha (Qatar), Seoul ,
Suwon (Korea) , Tokyo, Ichikawa
Yokosuka (Japan), Singapore, Tel Aviv
(Israel) Kabul (Afghanistan),

SOUTH AMERICA : 50

Barceloneta (Puerto Rico) Medellin ,
Bogota (Colombia) , Santiago (Chile),
Curitiba, Parana, Piral , Port Alegre
(Brazil)

AFRICA : 25

Cape Town, Nelson Mandela (South
Africa) , Ghana (Ghana), Konza
(Kenya) , Atlantic City (Nigeria)

OCEANIA : 25

Baltarat, Gold Coast, Ilswich,
Queensland, Sidney, Victoria
(Australia)c



2.13 Smart City projects in USA

US cities with Smart City projects must prepare their financial plans without the assistance of the Federal Government. Besides the lack of federal grant programs, it puts the focus on local authorities and the private sector to secure funding for projects Smart City.

1. New York (22 MM inhabitants)

NY-SC project focuses on networks. The most ambitious initiative of NY-SC is the Hudson Yard project in an area of 28 acres to create a smart area.

2. Los Angeles (13 MM inhabitants)

LA-SC project focuses on Environment. The Trust for Public Land has partnered with the Municipality of Los Angeles to advance a strategy of "green corridors"

3. Chicago (9.5 MM inhabitants)

Chicago Smart City project focuses on transportation. Chicago is committed to building Smart Streets to ensure that pedestrians, transit users, cyclists and motorists - can travel safely and comfortably

4. Dallas (6.1 MM inhabitants)

Dallas Smart City project addresses two areas: Water and Transportation. A SCADA system improves efficiency and resilience to disruptions of water distribution system



5. Philadelphia (5.8 MM inhabitants)

The City of Philadelphia, in collaboration with the Philadelphia Industrial Development Corporation are the core of a PPP supporting Philadelphia Smart City project, supporting several areas of development: green economy, sustainability, entrepreneurship...



2.14 Smart City projects in China

China with a population of 1,350 MM in 2015, 50% in cities and 50% in the country. In 2040 is expected to live in cities the 67% of the population. China expects to have 100 Smart Cities, 200 Counties Smart, 1.000 Smart Districts and 10,000 Small Smart Cities in 2020: 11,300 of 230,000 cities. China dedicates to the SC projects, more money than Europe : € 113 bN against € 3 bN aprox...

1 - **DIGITAL CHINA** (MM 1,350 inhabitants)

Personal digital ID for Transport and Health services in Smart Cities.

2 - **SHANGHAI-SC** (23 MM inhabitants)

Biyun, and 14 other Smart Lujiazui District, based on Internet of Things

3 - **BEIJING-SC** (20 MM inhabitants)

Tongzhou district, centre of urban transport and water distribution

4 - **GUANGZHOU-SC** (15 MM inhabitants)

Sensor Model for Big Data. With 268,000 cameras, sensors, GPS,

5 - **CHENGDU-SC** (14 MM inhabitants)

Smart Internet City Chengdu proposes a district of 80,000 R & D scientists

6 - **TIANJIN -SC** (12 MM inhabitants)

Puerto Beijing, SC project with Singapore, with cloud computing.

7 - **WUHAN-SC** (10 MM inhabitants)

Shanghai logistics centre based on cloud computing, Internet of Things.

8. **HANGZHOU-SC** (6.3 MM inhabitants)

SC project dedicated to Tourism and Environment of US \$ 3.2 bn

9 - **NINGBO-SC** (2.2 MM inhabitants)

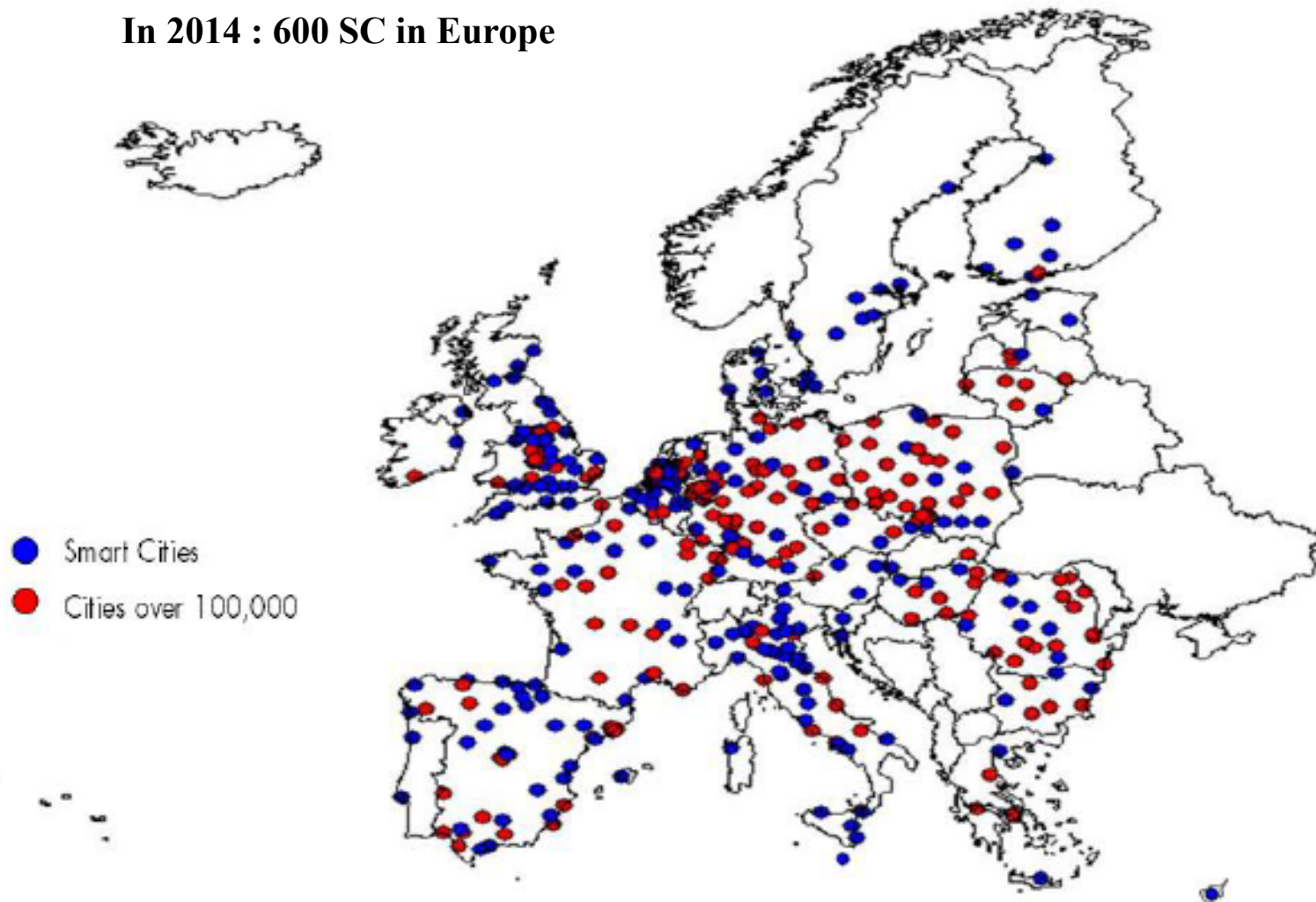
1st world port in cargo, has a project SC of US \$ 6.5 bn to create intelligent transportation services, energy, manufacturing and health.



2.15 How many Smart cities there are in Europe?



In 2014 : 600 SC in Europe



2.16 EU SC Ranking (2014) using 6-axis model

Nº	Smart City	Transport	Energy	ICT	Governance	People	Economy
1	Copenhagen	3	1	4	8	1	7
2	Stockholm	5	2	7	5	4	2
3	Amsterdam	1	3	5	7	5	6
4	Vienna	2	8	1	1	7	10
5	Paris	7	5	8	4	2	4
6	Berlin	6	4	6	6	9	1
7	London	10	6	9	3	3	5
8	Barcelona	4	7	10	2	6	8
9	Munich	8	9	2	9	10	3
10	Frankfurt	9	10	3	10	8	8





2.17 How many Smart cities there are in Europe?

			SMART CITY		MAJORS COVENANT		CORE NETWORK		Population
			1330		6353		531		MM/hab
1	Italy		369	27.7%	2730	51.5%	56	10.5%	59.8
2	Spain		267	19.9%	1457	27.5%	38	7.1%	46.9
3	France		82	6,20%	108	2.04%	47	8.8%	63.8
4	Portugal		65	4.87%	92	1.73%	10	1.8%	10.6
5	Germany		64	4.72%	55	1.03%	71	13.4%	80.6
6	Greece		62	4.57%	93	1.73%	20	3.7%	10.7
7	Sweden		42	3.15%	49	0.92%	16	3.0%	9.6
8	Romania		41	3.07%	58	1.09%	21	3.9%	19.8
9	United Kingdom		32	2.40%	33	0.62%	40	7.5%	64.2
10	Belgium		28	2.10%	104	1.96%	17	3.2%	11.1
11	Netherlands		24	78.7%	18	90,10%		62,90%	16.8
12	Ukraine		24		65				45.4
13	Croatia		22		59				4.2
14	Denmark		21		36				5.6
15	Poland		18		35				38.5
16	Bulgaria		16		34				7.2
17	Bosnia-Herzegovina		14		15				3.8
18	Switzerland		13		9				8.0
19	Turkey		13		6				76.2
20	Hungary		11		24				9.9

Europa : 1.330 smart cities registered at 30/05/2015
EU SC Mapping 2014 Study acknowledge only 600 SC



Smart Cities
and Communities



2.18 How many Smart cities there are in Spain ?

City	Population	Region
Catalonia	7565600	N.A.
Madrid	3265050	Madrid
Barcelona	1621540	Barcelona
Extremadura	1104500	N.A.
Valencia	809267	Valencia
Sevilla	703201	Sevilla
Zaragoza	701090	Zaragoza
Málaga	568507	Málaga
Murcia	442573	Murcia
Palma	401270	Baleares
Bilbao	353187	Vizcaya
Alicante	334329	Alicante
Córdoba	325453	Córdoba
Valladolid	313000	Valladolid
Rioja	308968	N.A.
Gijón	277559	Asturias
Hospitalet de Llobregat	258642	Barcelona
A Coruña	246746	Coruña
Vitoria - Gasteiz	239361	Álava
Granada	237929	Granada
Elche	230112	Alicante
Cartagena	217241	Murcia
Badalona	215329	Barcelona
Terrassa	210941	Barcelona
Jerez de la Frontera	207532	Cádiz
Sabadell	207338	Barcelona

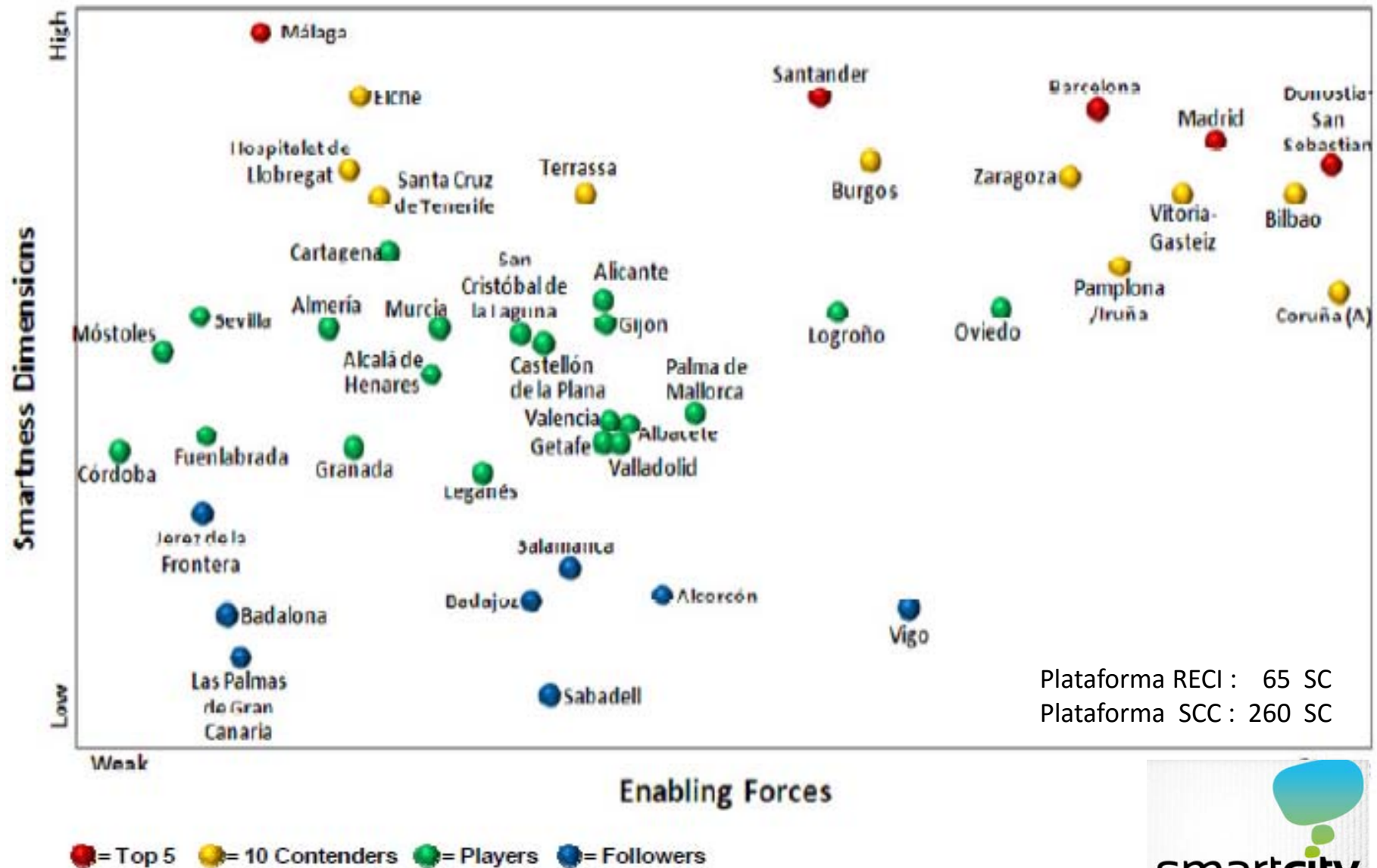
260 Self declares SC on 30/05/2015

Spanish SC over + 100.000hab	40	(RECI :65) Oct-2015
Below of demography criteria	220	
Total	260	

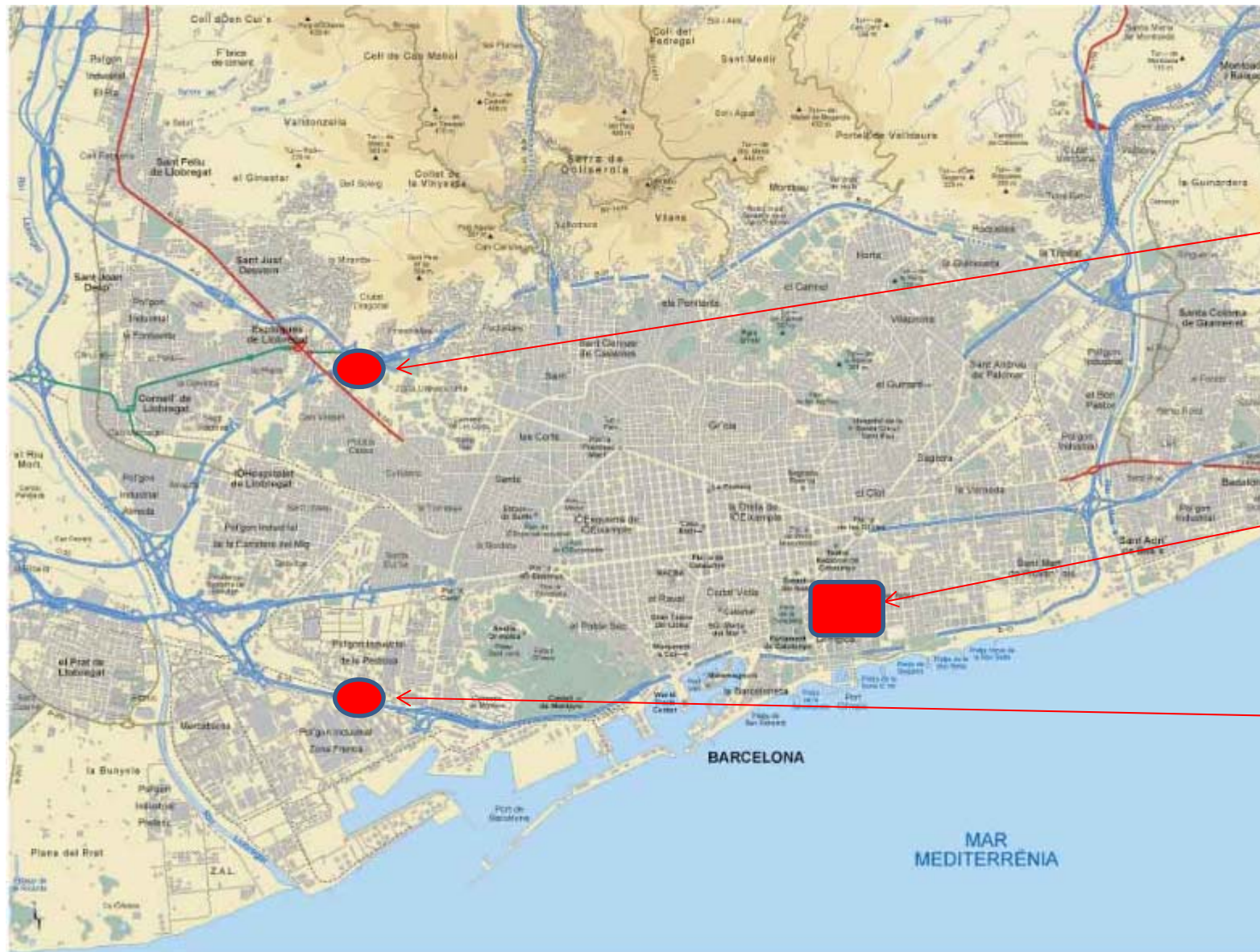
Analysis of Census 2010 Cities in Spain

Urban entities	8115	
<500 hab	3814	47%
500 a 2000	1217	15%
2000 - 20000	2686	33%
20000 - 50000	252	3%
50000 - 100000	83	1%
100000 - 200000	34	
200000 - 500000	23	0.77%
500000 - 1000000	4	63
+1000000	2	cities

2.19 SC outstanding projects in Spain: 65 Smart cities in 2015



2.20 Barcelona : Smart City or Smart Districts?



Ronda de Dalt
Passeig Valldaura
(500h)

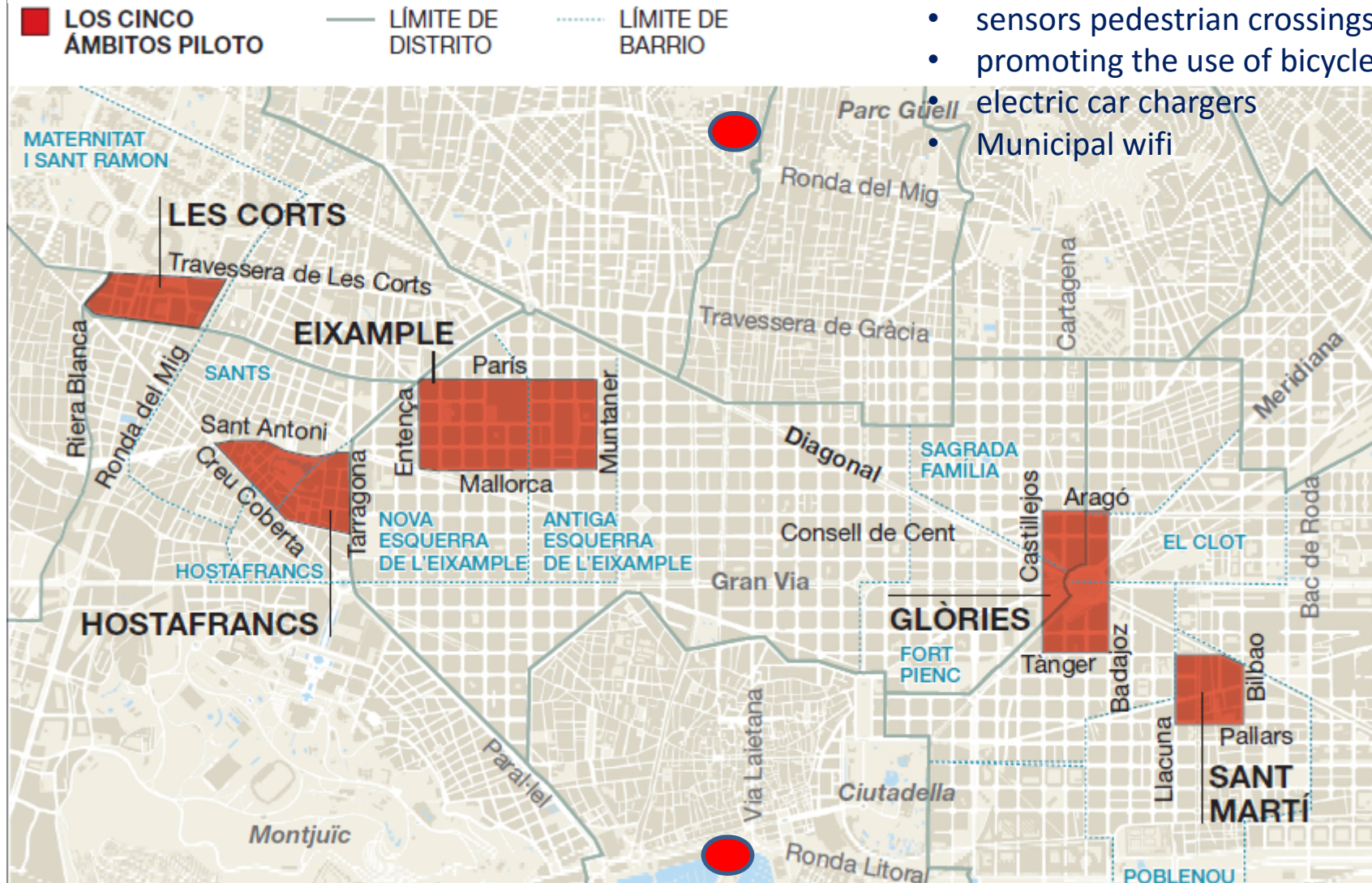
District 22@ Park
20 blocks
4x5 streets
(10.000h)

Ronda Litoral
c/Cristofol Moura
San Adrià de Besòs
(500h)

Barcelona City
1.650.000h
0.006%

2.21 Barcelona : Smart City o Smart Districts ?

2nd Phase : 5 super-quarters



- **SC Action Plan 2014-2020**
- LED public lightning
- Solar panels
- sensors pedestrian crossings
- promoting the use of bicycles.
- electric car chargers
- Municipal wifi

2.22 Strategy of Smart City Refurbishment projects in EU





2.23 Funding of Smart City Refurbishment projects in EU

Having clarified the technical aspects, models and other aspects of a Smart City project, those responsible must answer the basic question: who will pay the bills?

Like any project which covers the services that define a project of Smart City, are not free and someone must pay for products and services offered to citizens, despite the European trend of "total free" in public services..

Smart City projects, most of the time are simple industrial or development projects that municipalities are tagging as Smart City, in a period of economic crisis.

European funding has been supporting Smart City projects during 2007-2013, but in current Financial Framework 2014-2020, the EC is looking to promote PPP to obtain private support to public services.

SC funding basket	0	10	20	30	40	50	%
Private investment							13.6%
City budget							16.3%
Public-Private Partners							36.4%
European Funds							43.2%

2.24 Development of Smart City Refurbishment projects in EU

Axis	ICT	Energy	Transport	Economy	Governance	People
Level 3 Networked SC	ICT applications Focused on Stakeholders	ZEB Zero Energy Buildings Integrated energy / environment management	Persuasive public mobility	Industrial policy based on RIS-3 analysis	Social inclusion Cooperation between Administrations	Life-long learning
Level 2 Convergent SC	Share Public Information	Renewable energy intensive Smart Sensors Network	Urban traffic optimization platform	Cooperation with the private sector PPP	Citizen participation	Advanced social services Culture and social tourism
Level 1 Isolated SC	Online city data	Smart metering Smart grid CO2 reduction plan	City cycles Traffic Congestion Management	Entrepreneurship Municipal policy	Transparency	Multicultural education policy

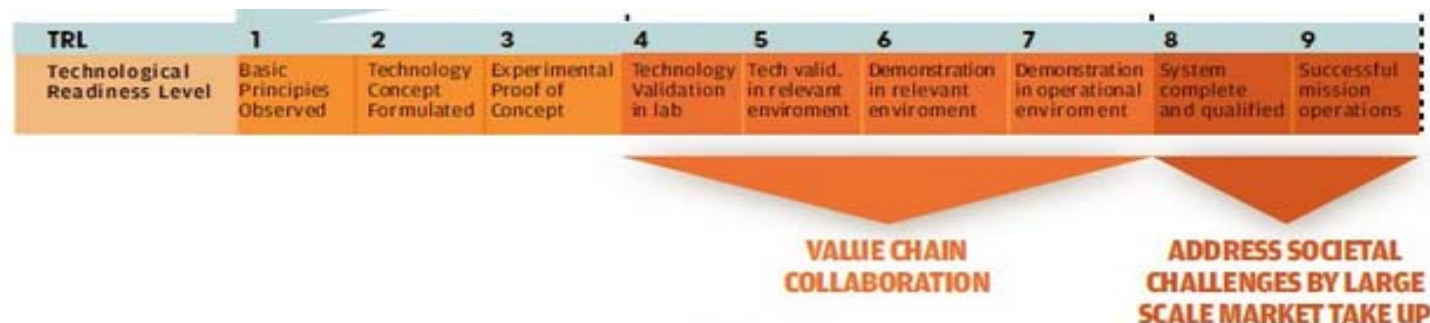


2.25 Technology Readiness Level scale

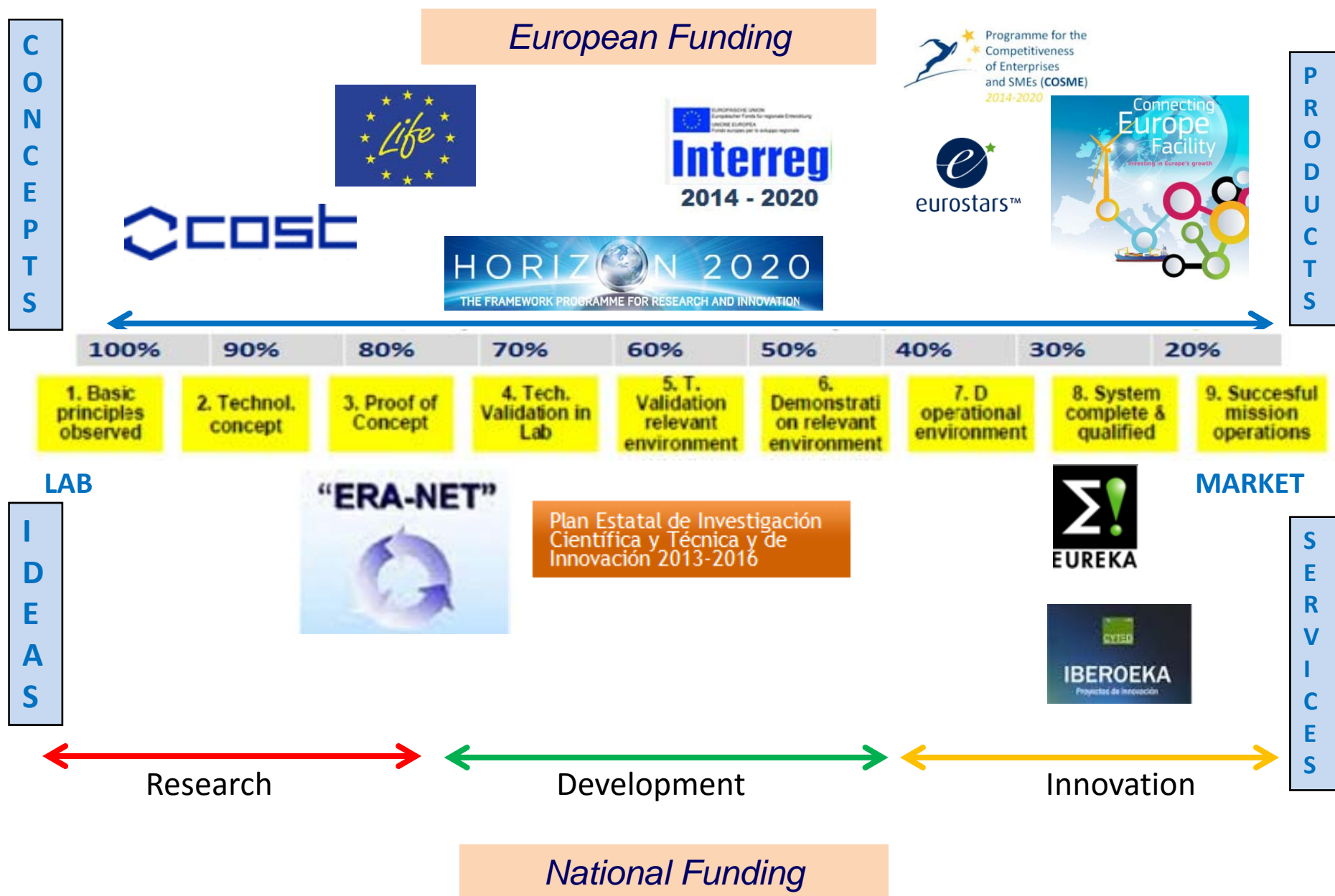
- TRL 1 – basic principles observed
- TRL 2 – technology concept formulated
- TRL 3 – experimental proof of concept
- TRL 4 – technology validated in lab
- TRL 5 – technology validated in relevant environment (*1)
- TRL 6 – technology demonstrated in relevant environment (*1)
- TRL 7 – system prototype demonstration in operational environment
- TRL 8 – system complete and qualified
- TRL 9 – actual system proven in operational environment (*2)

*1. industrially relevant environment in the case of key enabling technologies

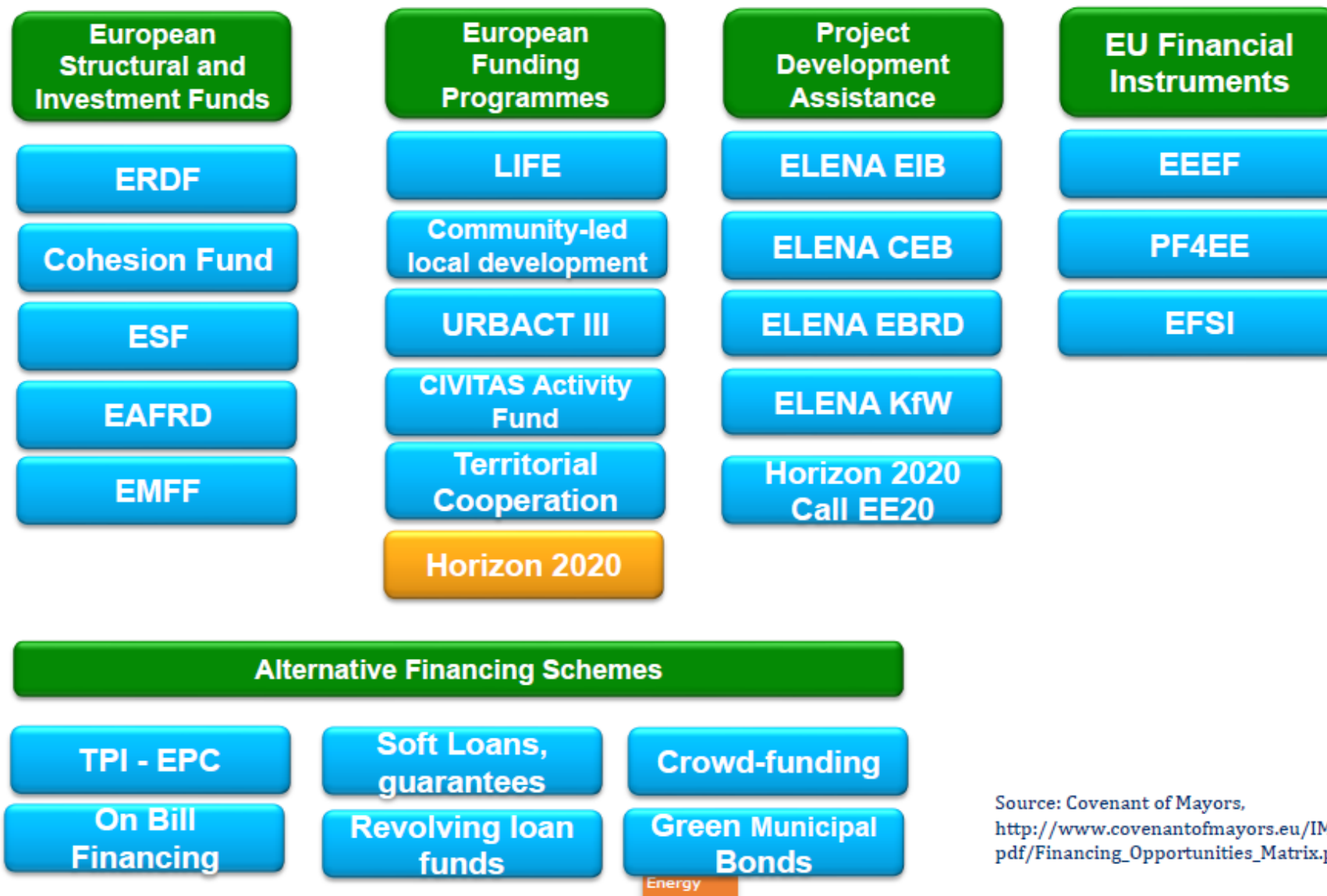
*2. competitive manufacturing in the case of key enabling technologies



2.26 European Programmes and TRL scale



2.27 European funds and Smart City projects



Source: Covenant of Mayors,
http://www.covenantofmayors.eu/IMG/pdf/Financing_Opportunities_Matrix.pdf

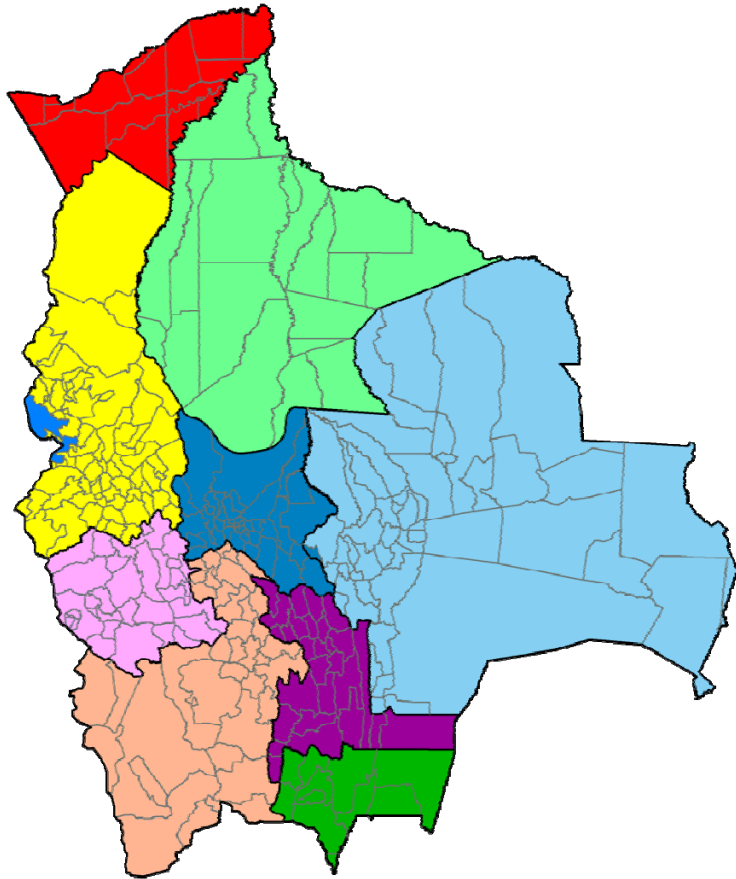
1. Concepts
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4. Smart Port
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SMART REGION



3.1 Region concept

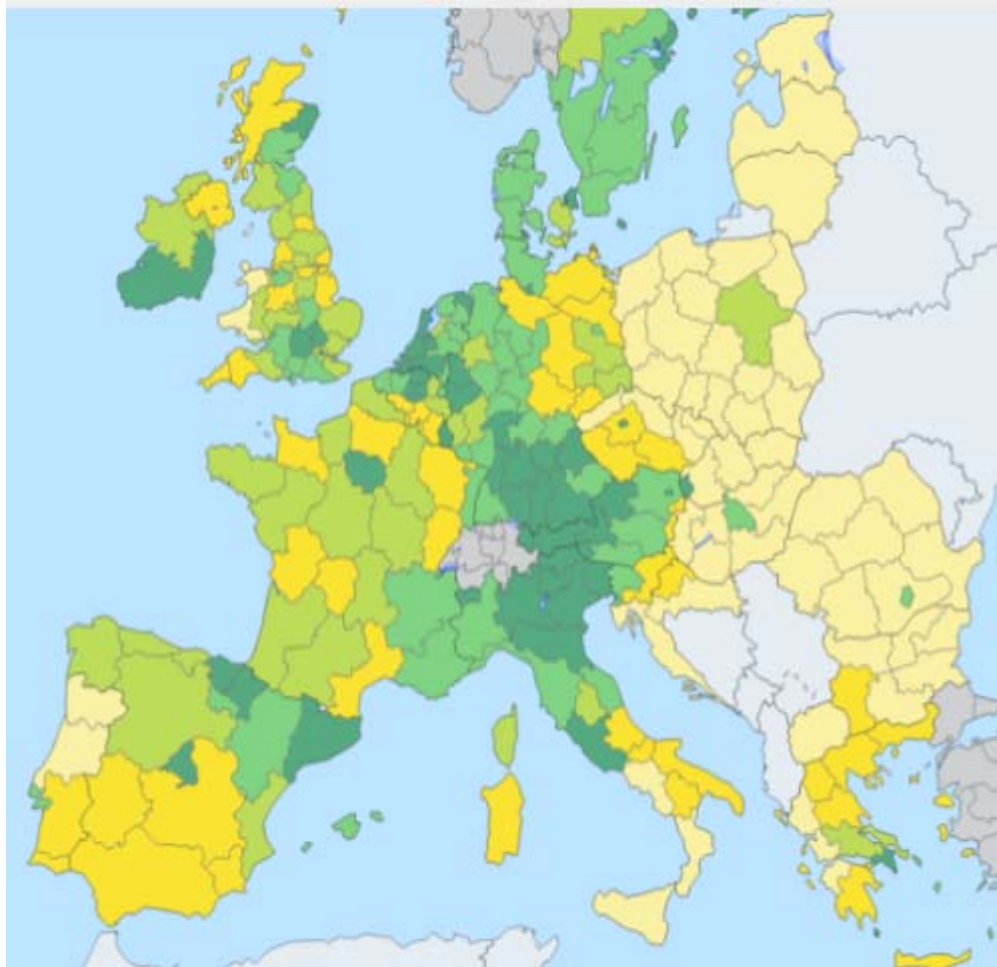


Region (Latin Regio) is a geographical term used in a number of cases, which generally defines a specific territory or area of land larger than the parties that form.

Depending on their context, it can be a continent such as Europe, Asia or America, or part of the continent: Central Europe, South East Asia or South America, a country, a group of countries in the same region: Baltic States, a basin, such as the Orinoco or the Danube or a ridge ..

Thus, the concept of region is linked to a geographic scale, so there are Regions of very different size, from supranational institutions such as the European Community, ASEAN and the Andean Pact to small regions of mountain valleys as Aran Valley in the Pyrenees

3.2 Political Region



It corresponds to the definition that each country makes of territorial units smaller than the own State category.

Usually corresponds to the Province in France, the County in England, the Lander in Germany, the Autonomous Community in Spain, the State in USA, or the Department in several countries.

But the Spanish Autonomous Communities are divided into Provinces, but these do not correspond to the same Province of France, which is equivalent to the Autonomous Community, which is divided in Department.

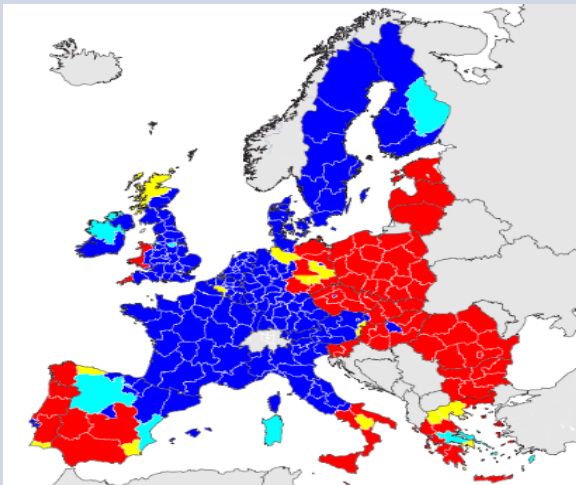
The territorial structure depends mainly on the geographical area and population. In the EU-28 there are 178 Political Regions, from Member States.

3.3 Geographic and Economic Regions



Geographic Region

It refers to the physical geography of an area that shows several common features such as climate, topography, natural vegetation, watersheds and others. That is why is also called natural region. It can be defined within a Country or within a Continent



Economic Region

It is a region of a country or a continent defined by its dominant economy factor, for example, oil, livestock, agriculture, industrial region, etc. The Corn Belt in the Midwest (agricultural and meat industries Region), the Cotton Belt in southern USA. EU-28 identifies 270 economic regions by GDP ...

3.4 Cultural and Historic Regions



Cultural Region

The cultures in the world result from the interaction of various sociological, historical, economic, linguistic, religious, environmental and political characteristics that develop over time with some independence from neighbouring regions, so it creates a differentiation caused by this isolation (absolute or relative) relative to said neighbouring regions.



Historic Region

A historical region is traditionally associated with a people, society or nation with specific features that are externalized cultural elements of the region, especially the language and architecture, and with which its inhabitants are identified. In some cases several historical regions coexist within a current state, for example, Catalonia, Galicia and the Basque Country in Spain, each with its own language, culture and history.

3.5 Urban and Social Regions



Urban Region

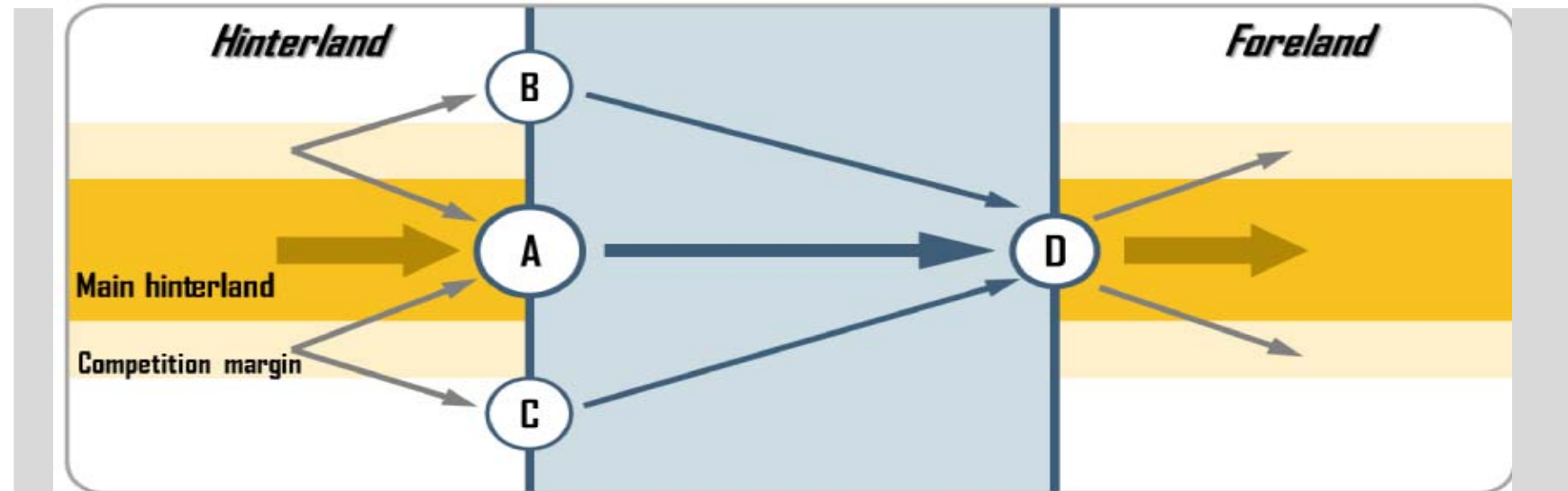
It is unit of higher level than a District or a Metropolitan area, with centre in a big city, metropolis or conurbation, subordinating her entire productive and tertiary activities, to its Urban unit. Normally the usual routes from nuclei and scattered areas of the central city and vice versa translate into a dense transport networks intertwine the territory.



Social Region

It is a concept of socialist origin that refers to the space built by a certain social relations of production. It is conceptually broader and more comprehensive than that of Cultural Region to involve economic, political and ideological aspects.

3.6 Hinterland and Foreland Regions



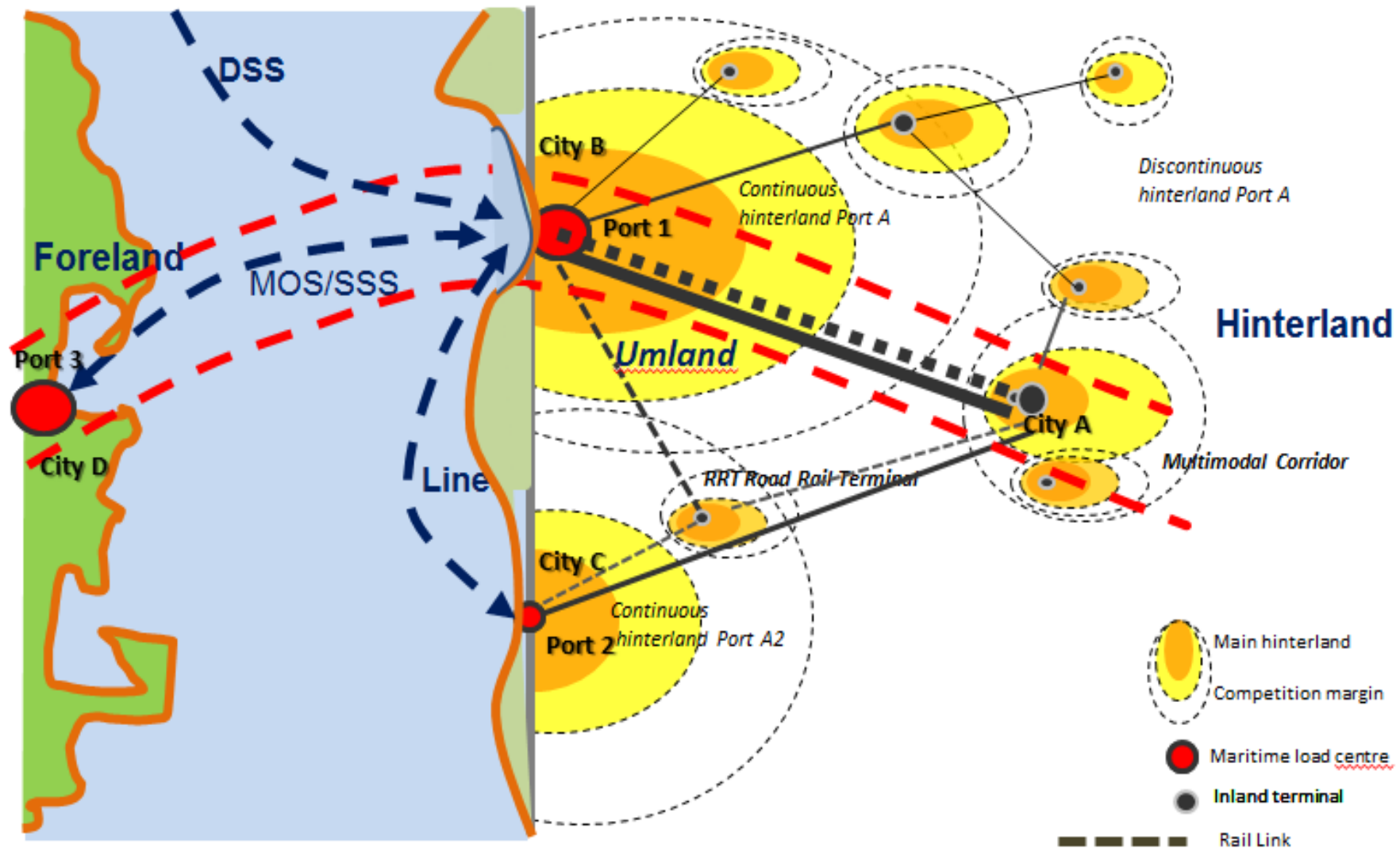
Hinterland

It is a logistic concept and defines a special type of Region linked to the Port activities within its influence area, which can reach beyond municipal, regional or even national limits. For instance, Rotterdam hinterland starts in the Netherlands, but goes until Germany.

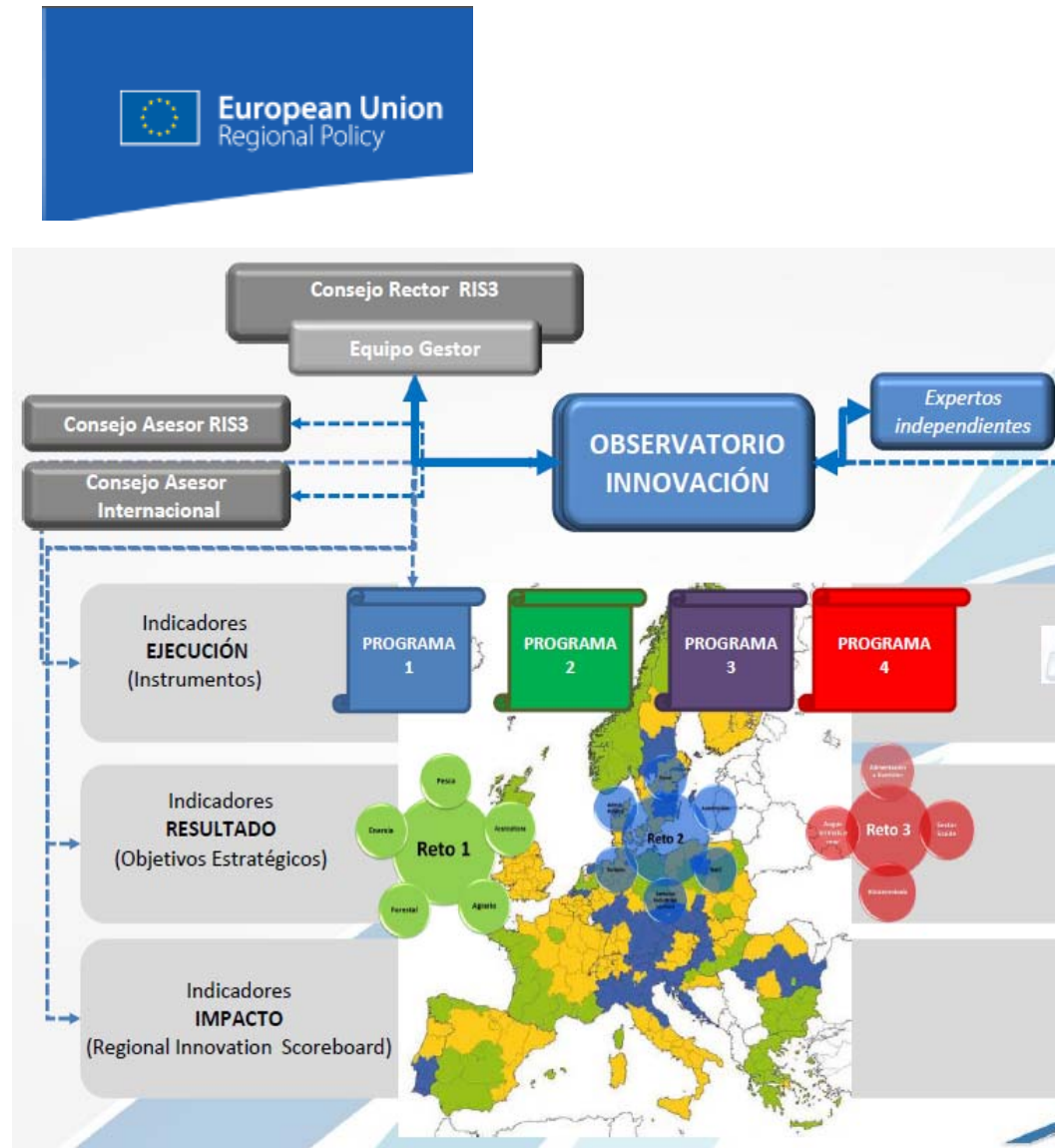
Foreland

It is also a logistic concept and defines the national and/ or international Ports connected by sea to a specific Port. Depending on Port size and customers, foreland can have a range in the same sea, or reach ports in other continents, connecting ports through international routes

3.7 Hinterland and Foreland Regions



3.8 RIS-3 : Research and Innovation Smart Specialization Strategy



RIS3 stands for Research & Innovation Smart Specialization Strategy and is an instrument that the EU has been preparing since 2010 to implement at the level of the Regions and through the ERDF Regional Development Fund, to guide the implementation of EU funds to related R & D activities and Renewable Energy & ICT, depending on the economic development level of each region, and minimize or just prevent European funds are spent only in public works cement.

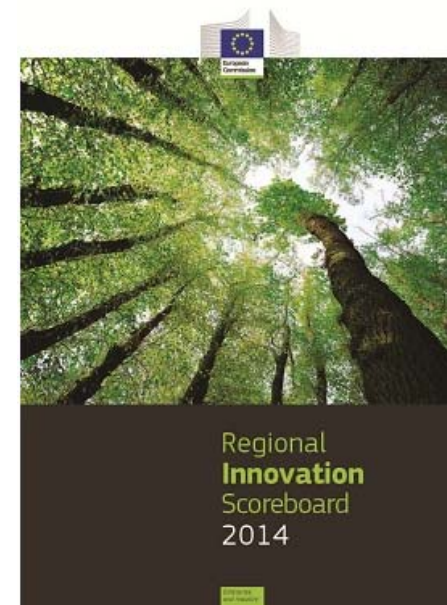
The RIS3 is carried out at National and Regional level in order to optimize European resources in the current MAFF 2014-2020.

3.9 IUS y RIS : National & Regional Innovation Scoreboard

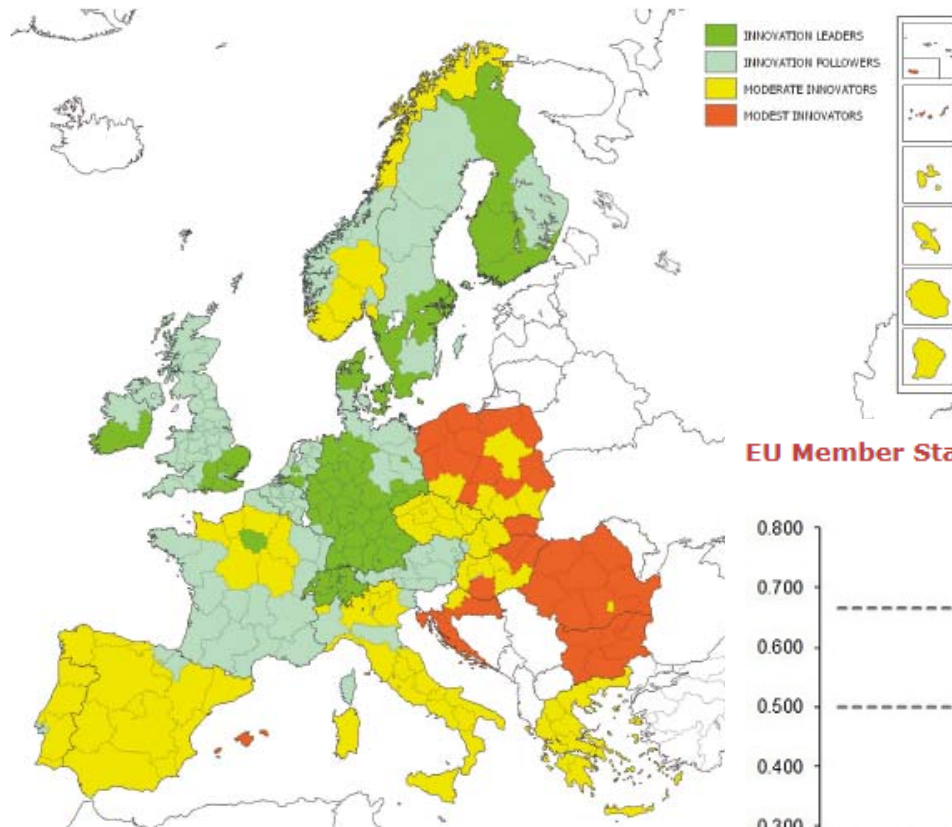


The IUS 2014 Report: Innovation Union Scoreboard offers a comparative assessment of the situation of R & D since 2010, in the 28 states of the EU by 25 key performance indicators that quantify the status of research and innovation level national. Both countries and their regions are classified into 4 levels in their intensity Innovation: Leader - Follower - Moderate – Modest.

The IUS 2014 Report accompanying the RIS-2014 report, which makes a comparative assessment of the situation of R & D in 190 Political Regions : 178 if EU plus 12 from Switzerland and Norway , through 11 KPI . Indicators are of type % GDP spent on R & D, number of researchers, patents, innovative companies, projects under R & D programmes ...

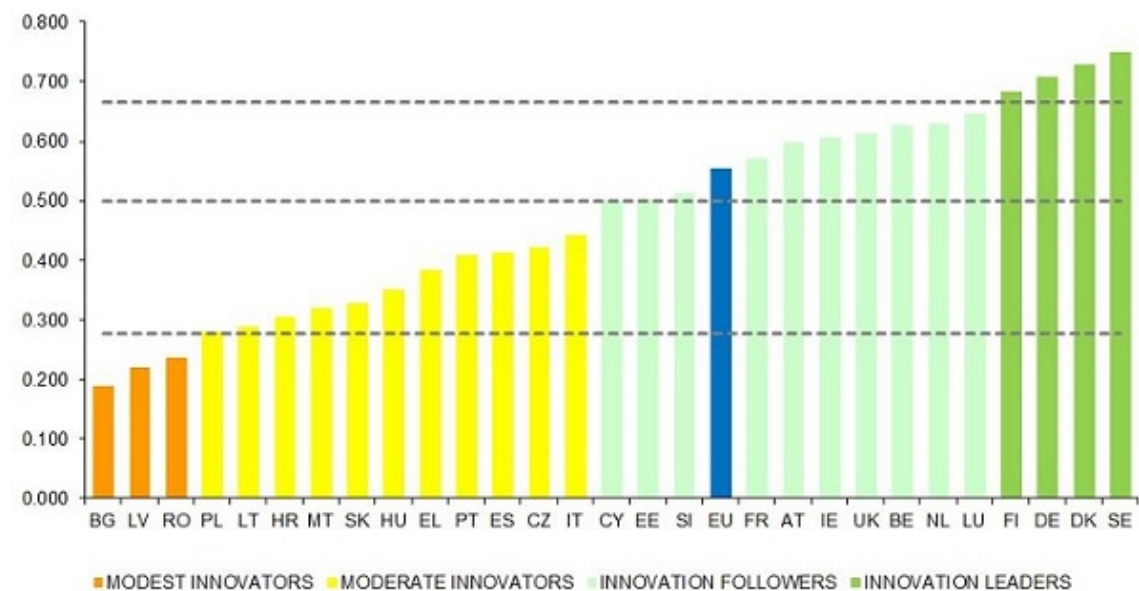


3.10 IUS – RIS 2014 : European National and Regional Innovation Scoreboard

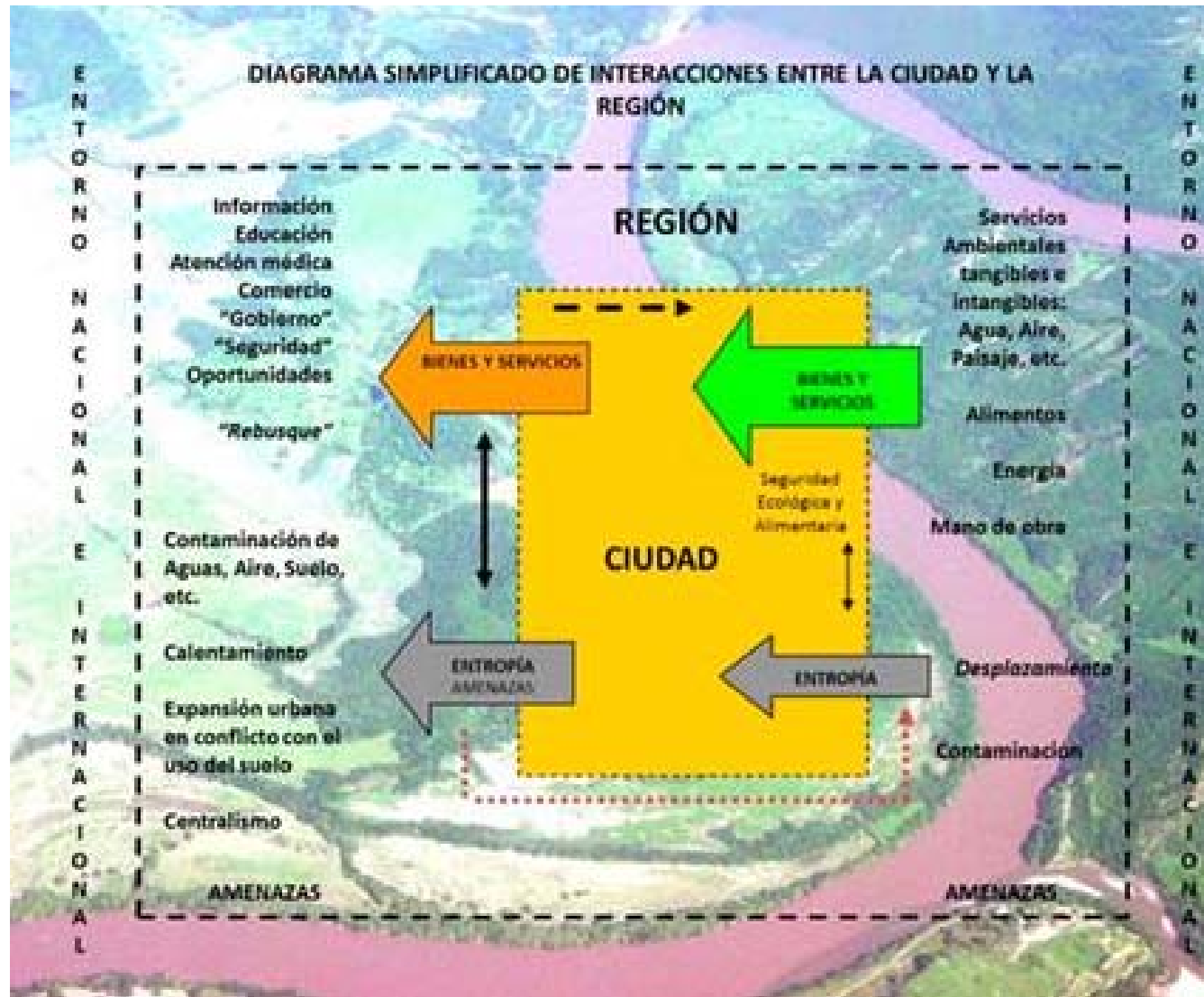


Level	States	Regions
Leader	4	34
Follower	10	57
Moderate	11	68
Modest	3	31
	28	190

EU Member States' innovation performance



3.11 City – Region relationship



Some City services as administration, information, education go to the Region mainly to form "citizens" in the most literal sense of the word.

The "health" (medical and hospital care), employment, business opportunities, and "government" and "security", words that should be enclosed in quotation marks to point the uncertainty about whether those services are delivered in the most appropriate manner possible from the City to, meet the needs of the Region

3.12 Proposal of a definition for Smart Region



Smart Regions should have a reference in a Smart City, Port or Community because they manage to establish a development model that balances environmental social, technological and economic drivers, to adapt to a complex and globalized context, and develop logistics and ICT instruments appropriate that connect them with Smart Cities and / or Ports





1. Concepts
2. Smart City
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4. **Smart Port**
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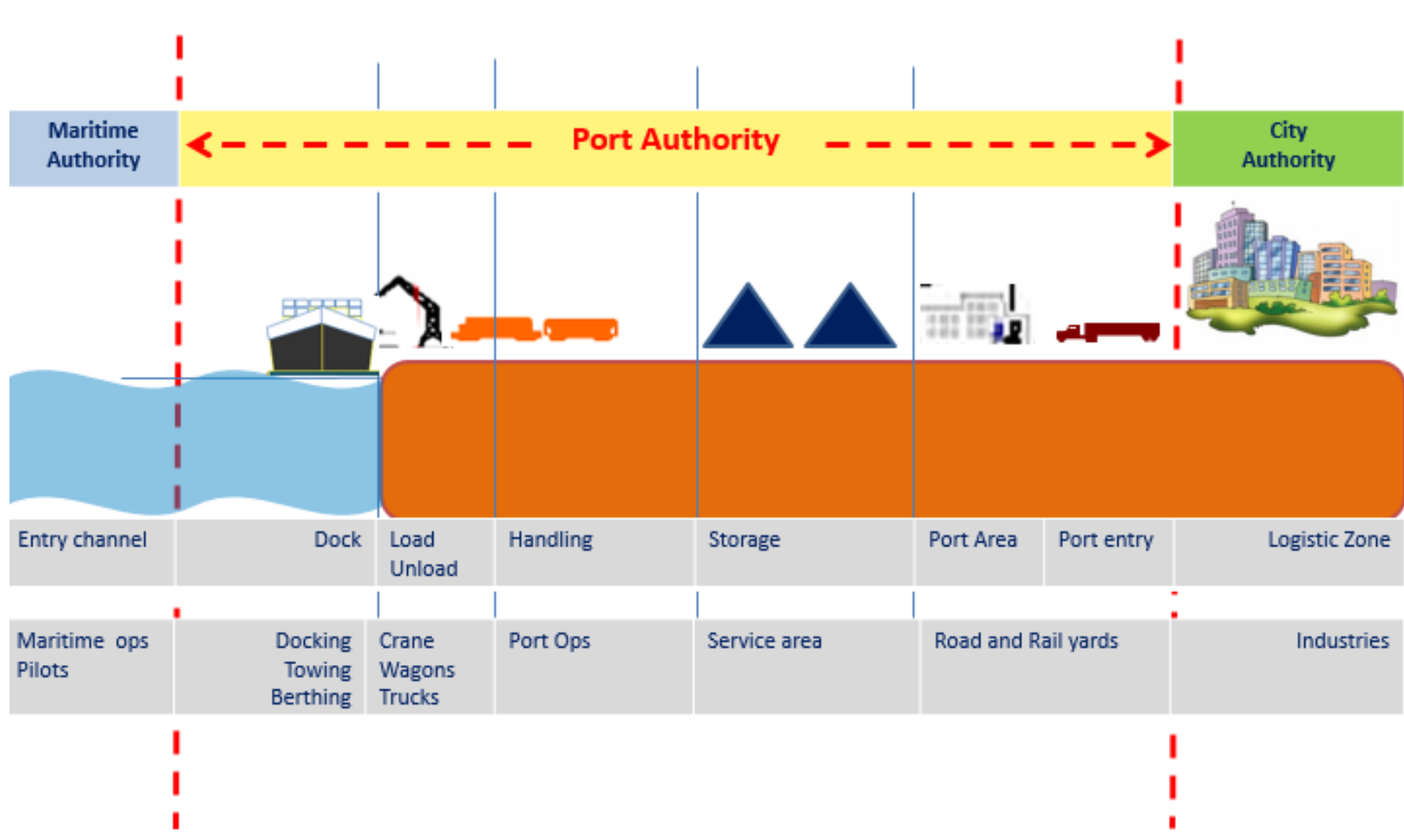
SMART PORT



4.1 Evolving definition of Port

Year	Instrument	Definition	
1923	Genève Convention	Ports are maritime ports serving oceanic vessels for international trade	
1989	Dictionnaire Juridique des ports maritimes	Ports are natural or artificial instalments to berth vessels	
2001	2 nd European Transport White Book Brussels	Ports are nodes to exchange transport mode in logistic supply chains	
2011	3 rd European Transport White Book Brussels	Ports are viewed as logistic platforms in relation to Comprehensive and Core networks	

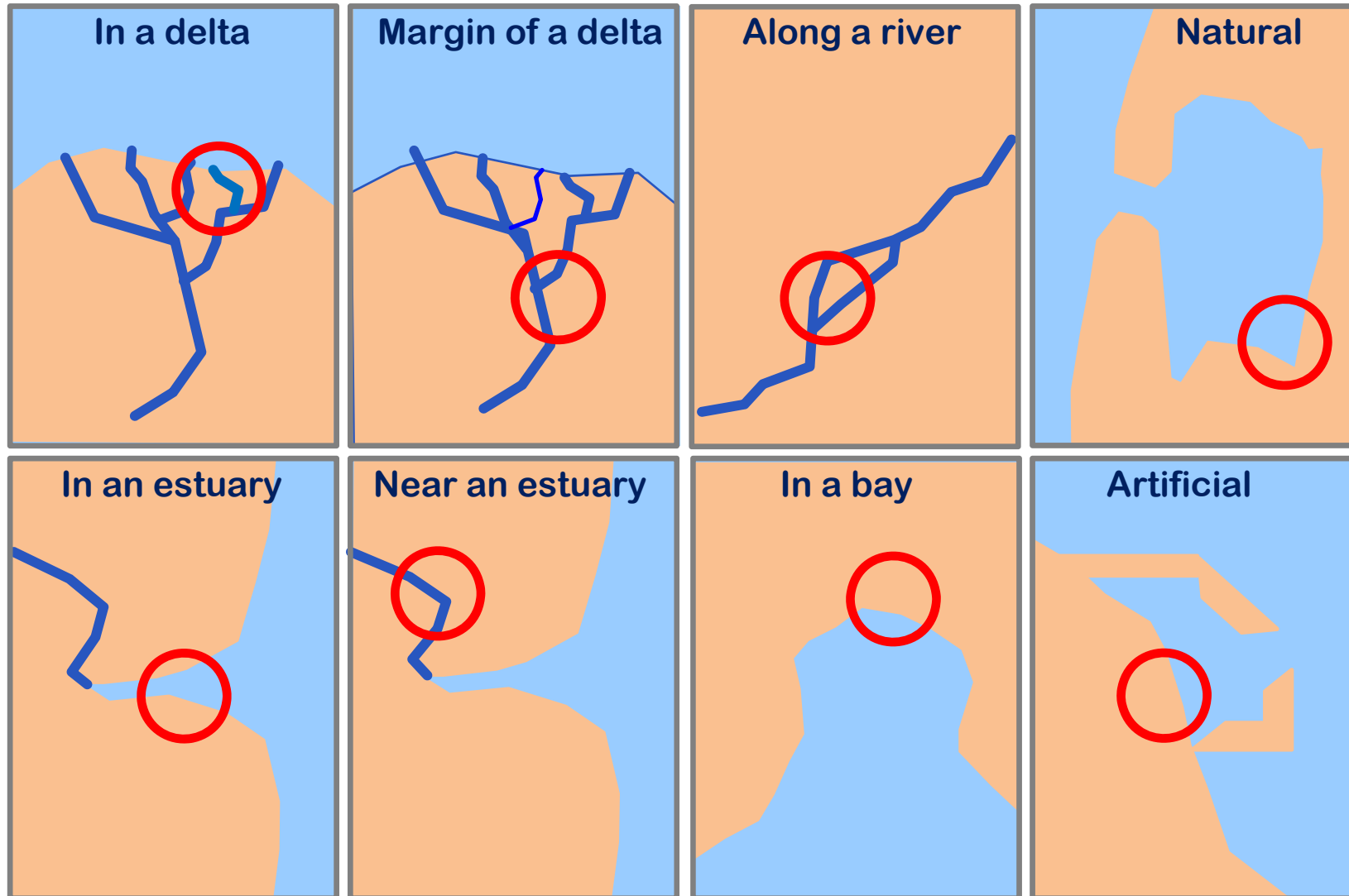
.4.2 Sea port cross-view



4.3 Port locations



1.3 Port sites



Source: adapted from National Geospatial-intelligence Agency (2005) World Port Index,

4.4 Port layout



1-Dike	5-Wharfs	9- Duque Wharf	13- Stores	17- Rail terminal	21- Storage silo
2-Breakwater	6-Pantalan	10-- Mouth	14- Sea access	18-Lighthouse	22
3-Counterdike	7-Dock	11-Warehouses	15- Land access	19- Dry dock	23
4-Estuary	8-Headboard	12-Wharf cliff	16- Logistic zone	20- Floating dock	24

4.5 World ports and coasts



World Port Source provides interactive images, maps and contact information for **4,570** maritime and fluvial ports in **196** countries around the world

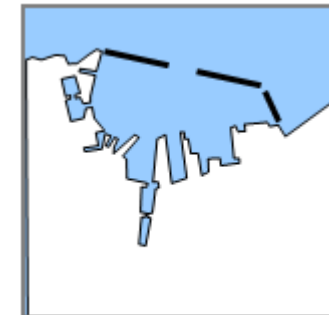
Maritime	3.408	75%
Fluvial	1.162	25%
Total	4.570	

	America	Europe	Asia	Africa + Aus
%Coasts	45.5%	10.5%	30.5%	13.5%
%Ports	26.9%	27.1%	23.2%	22.9%
average	248km	56km	193km	86km

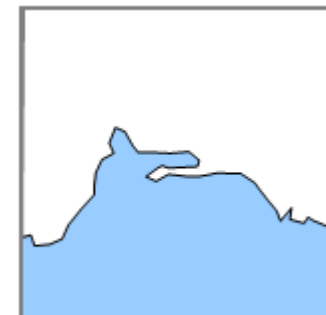
Region	Ports	Coasts
Europe	1.240	70.000
America	1.230	305.000
Asia	1.062	205.000
Africa+ Aus	1.048	91.000
Total	4.570	671.000

4.6 World ports : size and geography

size	Large	Medium	Small	Very Small
traffic	<50 MT/y	25 MT/y	5 MT/y	1 MT/y >
1. Coastal Natural	26	89	474	1596
2. Coastal Artificial	39	105	281	388
3. Coastal Tide gates	5	5	18	11
4. River Natural	25	59	248	518
5. River Basins	7	20	23	27
6. River Tide gates	7	14	12	14
7. Open Bay	18	17	97	450
8. Lake or Canal	3	6	26	32
Total :	4570	131	316	1181
100%	2.8%	6.9%	25.9%	64.4%



Coastal Artificial



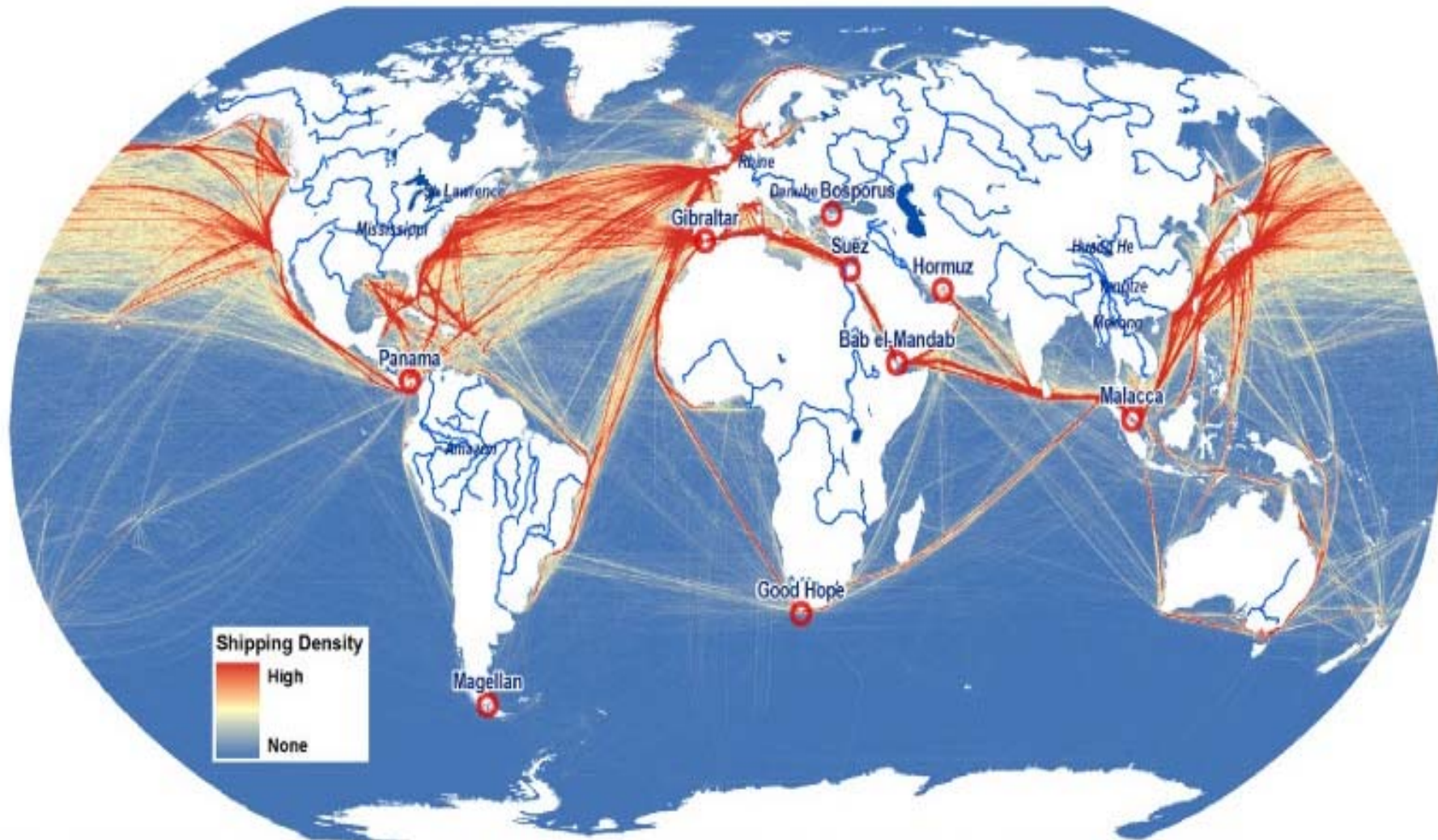
Coastal Natural



River Tide Gates

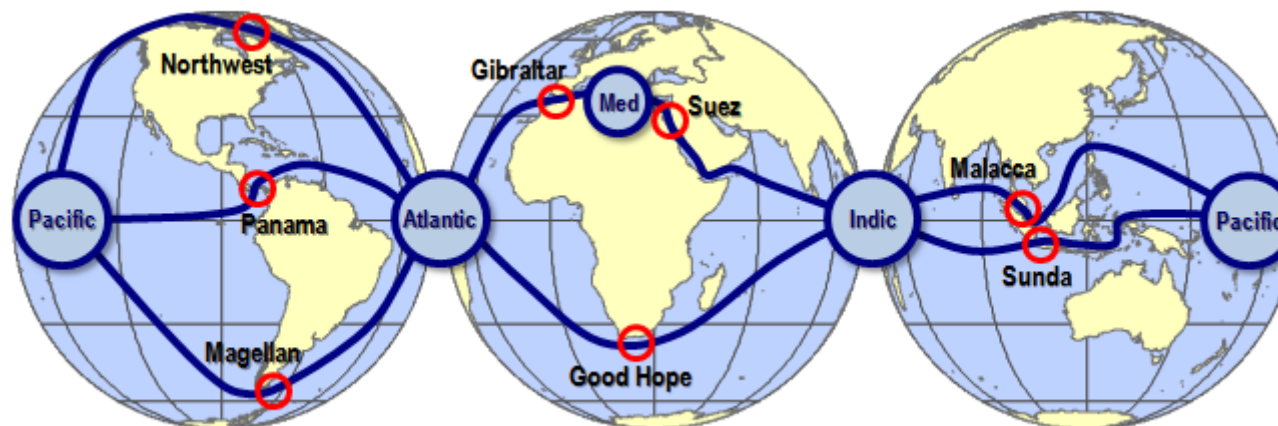
Source: adapted from National Geospatial-intelligence Agency (2005) World Port Index

4.7 World ports : density of maritime transport (2014)



Source: Shipping density data adapted from National Center for Ecological Analysis and Synthesis, A Global Map of Human Impacts to Marine Ecosystems.

4.8 Economy development and maritime transport



4.9 Port Business Model





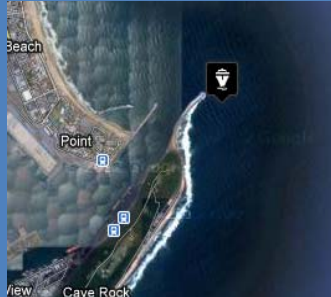


1.7 Ports classification : Business model per Continent

		EU	EE	US	LA	ASIA
1	Public	10%	50%	10%	5%	60%
2	Tool	20%	30%	30%	20%	30%
3	Landlord	63%	20%	55%	65%	5%
4	Private	7%	0%	5%	10%	5%



Model	Definition
Public	Public or Service ports have a predominantly public character. The number of service ports is declining worldwide-
Tool	In the Tool port model, the port entity owns, develops, and maintains the port infrastructure as well as the superstructure
Landlord	the landlord port is characterized by its mixed public-private orientation. Under this model, the port entity acts as regulatory body and services are private.
Private	In Private ports, land is privately owned and also services. This requires the transfer of ownership of such land from the public to the private sector.

4.10 Port classifications : Land property and Business model

				
New Orleans port	Shanghai port	Durban port	Panama port	New York port
1-Land Property	2- Business model	3- Cargo weight	4- Influence area	5- Telematic level
State port	Public port	Very small port	Local port	1 st Generation port
Regional port	Tool port	Small port	Regional port	2 nd Generation port
City port	Landlord port	Medium port	National port	3 rd Generation port
PPP port	Private port	Large port	Continental port	4 th Generation port
Private port		Very large port	Global port	5 th Generation port

4.11 Port classifications : Other criteria

				
Callao Port	Guangzhou port	Tripoli port	Alaska port	Lockroy port
6- Specialization	7- Geographical	8- Tax policy zone	9-Traffic type	10- Governance
Passengers port	Coast port	Custom port	Hub port	Conservator port
Industrial port	Bay port	Duty free port	Gateway port	Facilitator port
Military port	Estuary port	Free zone port	Terminal port	Entrepreneur port
Commercial port	River port	Free trade port		
Oil port	Fjord port			
Container port	Lake port			
General cargo port	Delta port			

4.12 Port classifications : combined criteria 2-4-10

Profile		Conservator	Facilitator	Entrepreneur
Business model	1- Public	Land manager	Co-investor broker	
	2- Tool	Rules applicator	Regional Agency	Enforcement of Rules
	3-Landlord	Concessions	PPP service provider	Specific port services
	4- Private		Training ,Promotion	Marketing, Lobbying
		Local	Regional	Global
		Geographical dimension		



Singapore Port



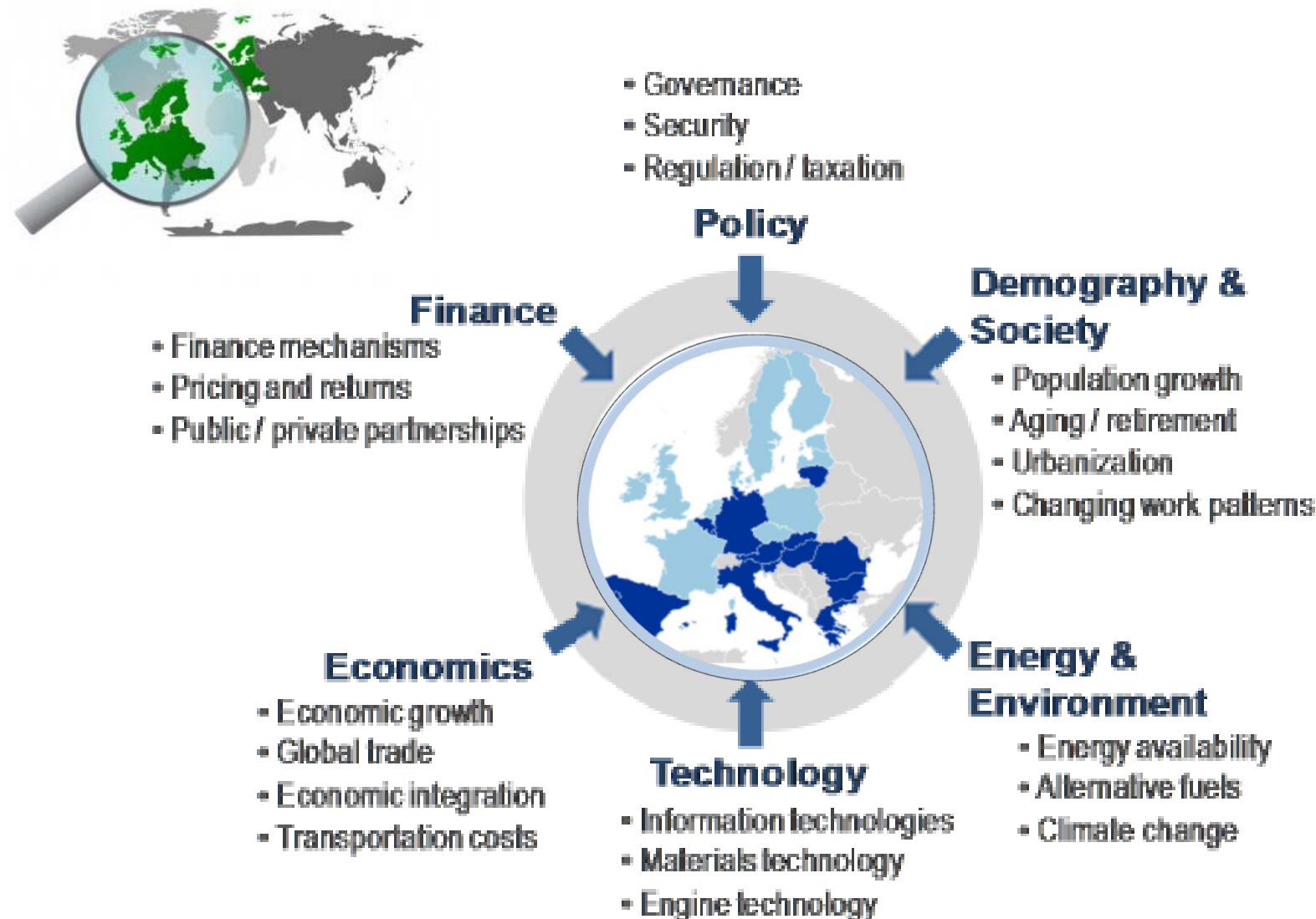
Zeebrugge Port



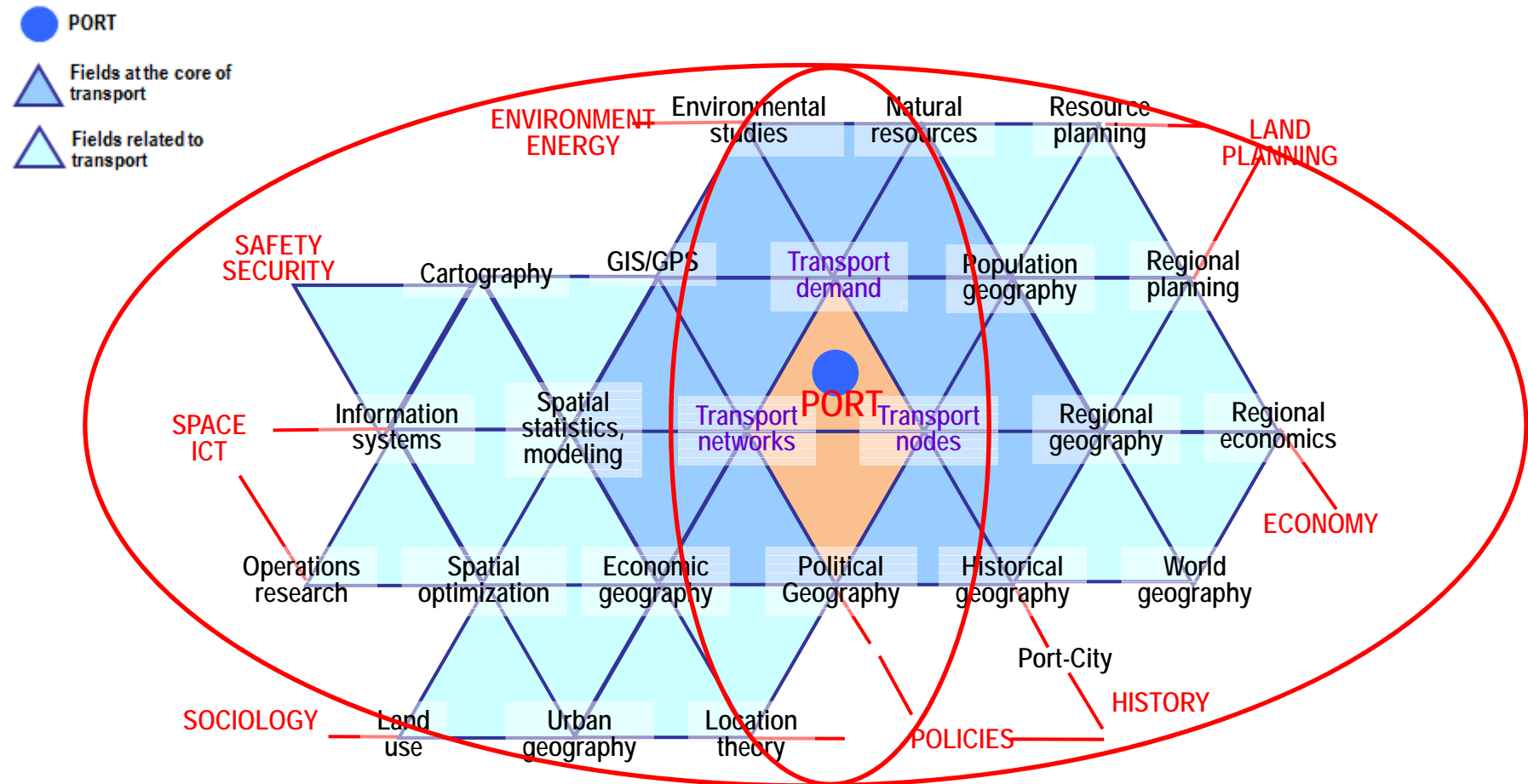
Thessaloniki Port

(source: Adapted from ESPO Port Governance Report, Verhoeven 2010)

4.13 Port Governance : main drivers

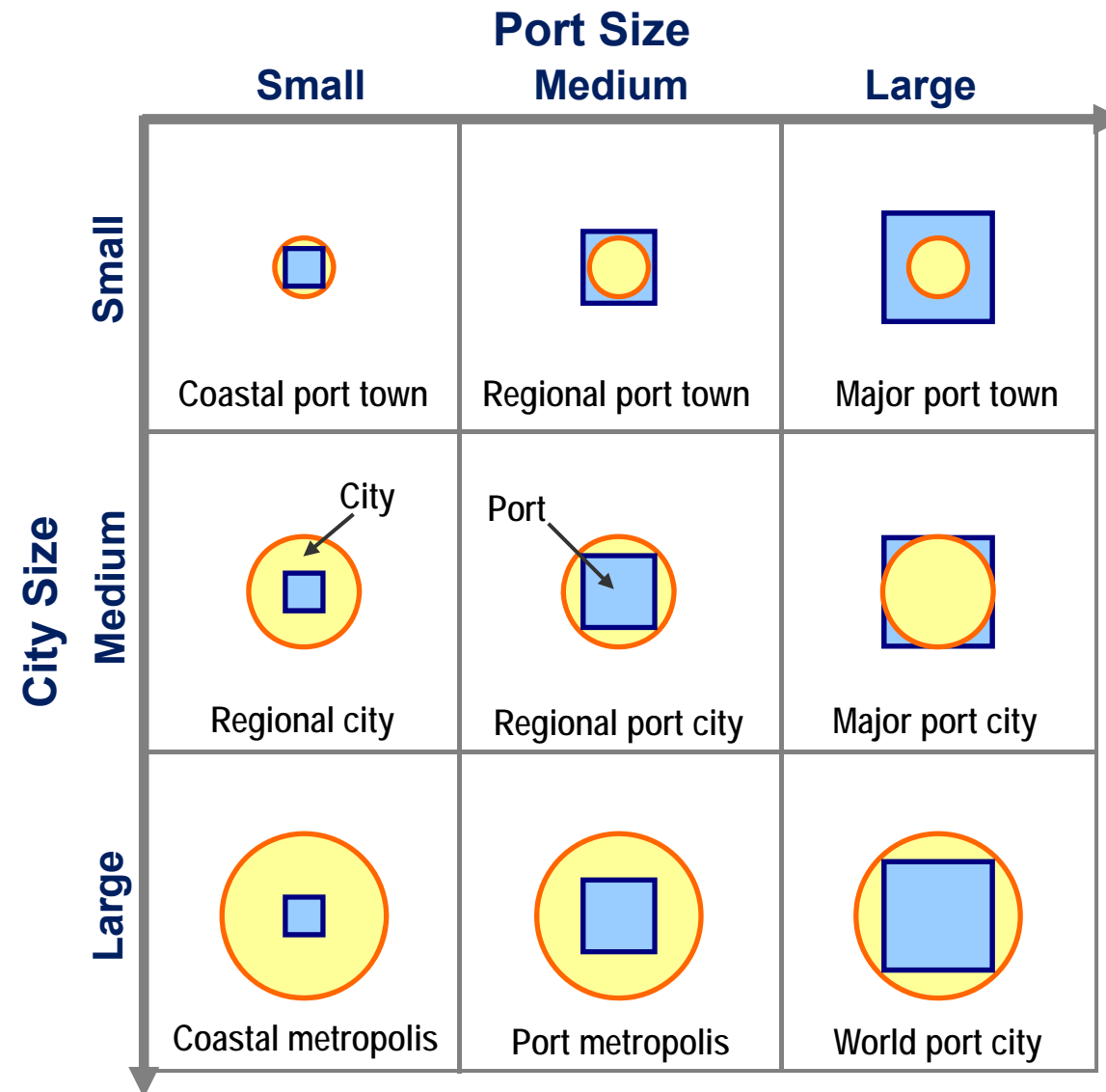


4.14 Port Governance : extended interest range



Source : Dr. Jean-Paul Rodrigue, Dept. of Global Studies & Geography, Hofstra University.

4.15 Port Governance : Port – City relationship



Volos port/city



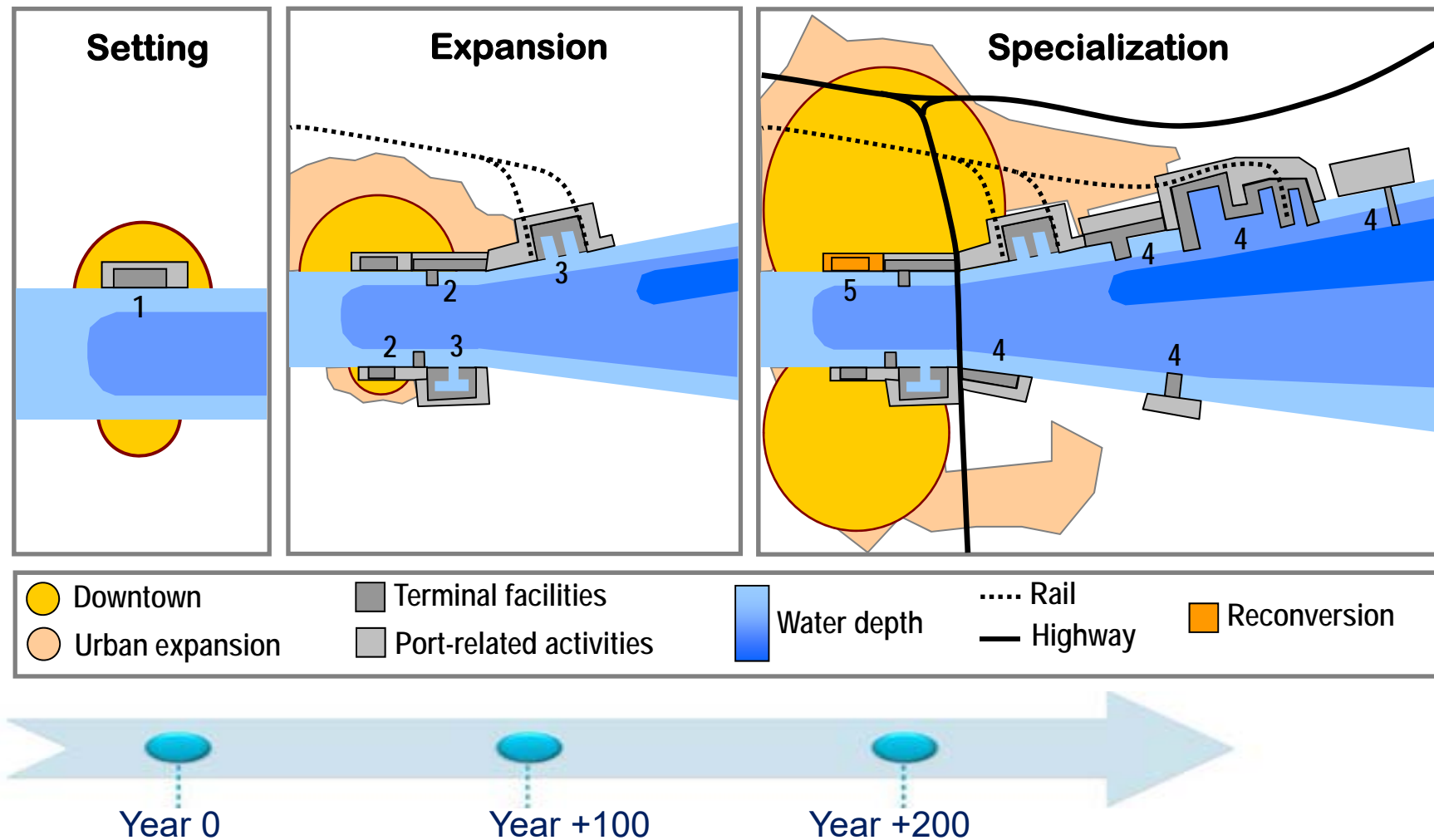
Gijon port/city



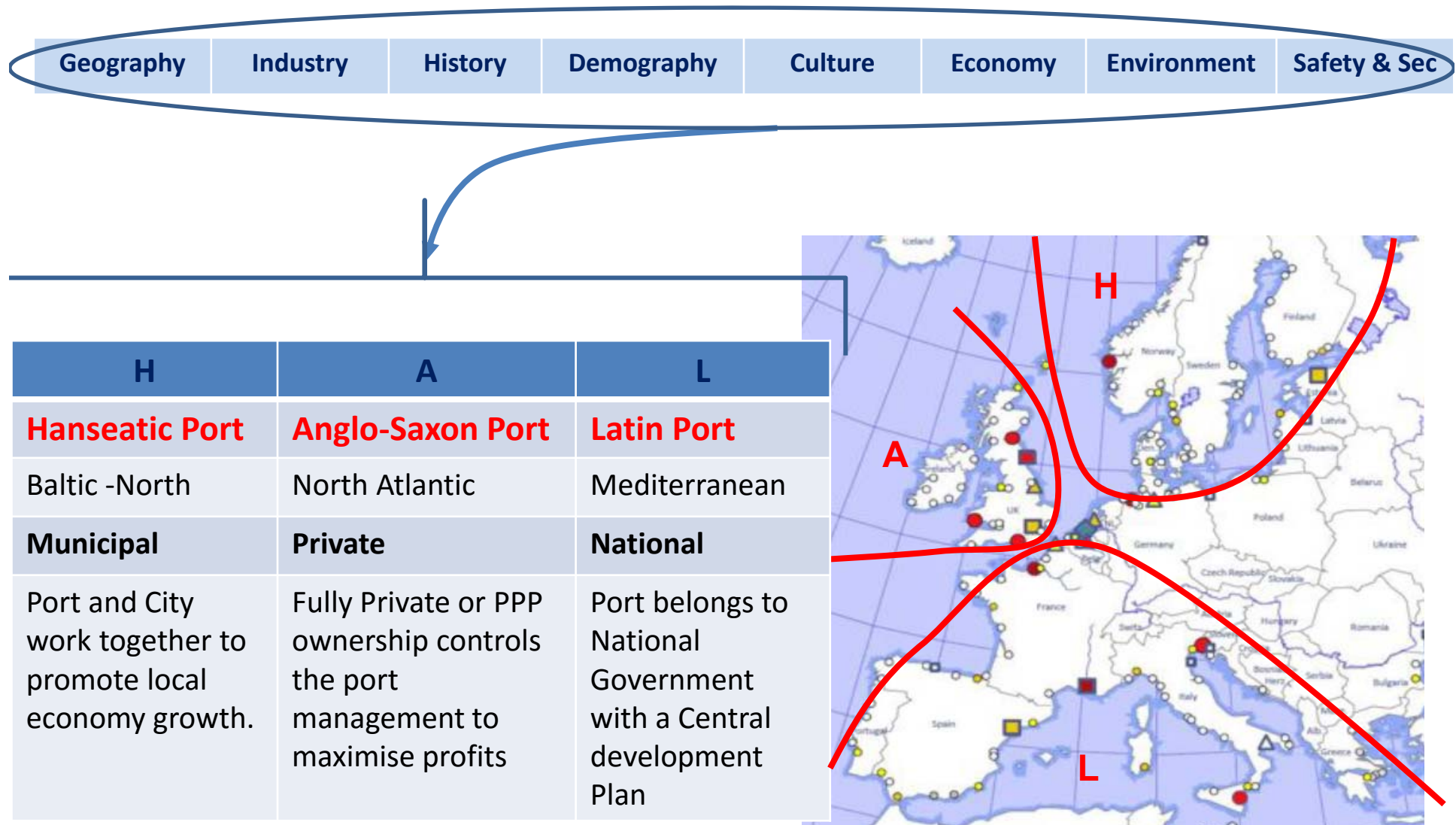
Rotterdam port/city

Source: adapted from Ducruet, C., (2007) "A metageography of port-city relationships",

4.16 Port Governance : Port – City evolution







4.17 Port Governance : European Models

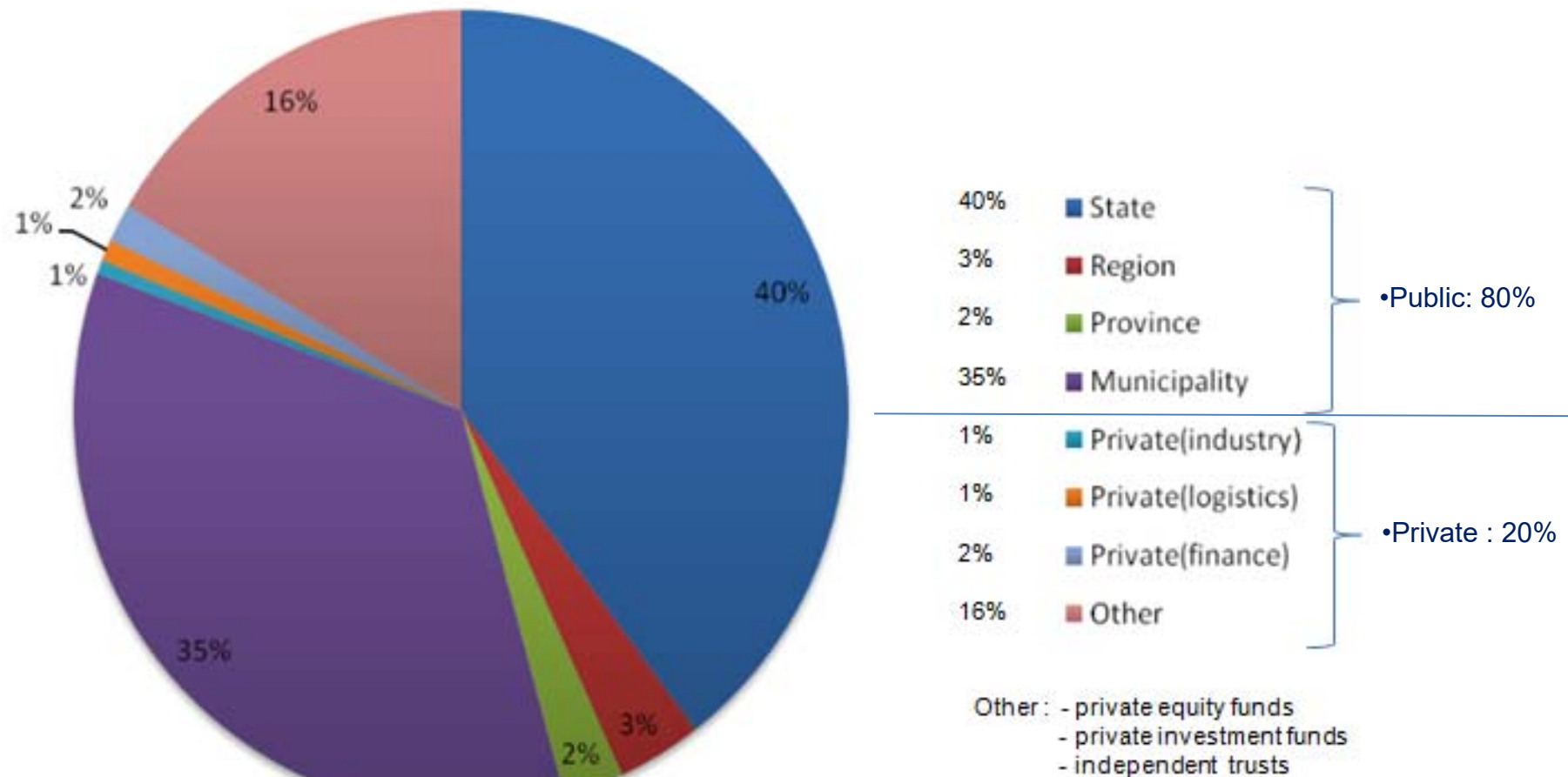


(source: ESPO Port Governance, Verhoeven 2010)

4.18 Ports ownership models

Public Models		Private Models	
<ul style="list-style-type: none">• Port Authority• Port Administration		<ul style="list-style-type: none">• Port Company• Port Society	
<ul style="list-style-type: none">• National Administration• Regional Administration• City Administration		<ul style="list-style-type: none">• PPP – Public Private Partnership• Joint Venture• Corporation	
<ul style="list-style-type: none">• infrastructure• superstructure• services			
			
Barcelona Port Authority (SP)		Leixoes Port Administration (PT)	
			
Cork Port Company (IE)		Southampton Port Society (UK)	

4.19 Port Governance : Ownership in European Port Entities



(source: ESPO Port Governance, Verhoeven 2010)

420 Port Governance : Property and Management European Models



		PROPERTY			MANAGEMENT		
		National	Regional	City	Govern Direct	Public Entity	Private Entity
H	Sweden			x	x	x	
	Denmark	x		x	x	x	x
	Finland			x	x	x	x
	Estonia	x				x	
	Latvia	x		x		x	
	Lithuania	x				x	
	Poland	x		x		x	
	Slovenia	x				x	
	Netherland	x	x	x		x	x
	Germany		x	x	x	x	x
	Belgium		x	x		x	
A	Ireland	x				x	x
	UK	x					x
L	Portugal	x				x	
	Spain	x	x			x	
	France	x	x			x	
	Italy	x				x	
	Greece	x		x		x	
	Cyprus	x				x	
	Malta	x				x	
		50%	10%	40%	20%	60%	20%

(source: ESPO Port Governance, Verhoeven 2010)

4.21 Smart Port ?

If SMART CITY is a new, emerging and evolving concept which rose the last years, SMART PORT is even newest, with no international accepted definition and with several parallel initiatives from both main international Ports and Sectoral Associations.

So this is a new land where nobody has the last word, so we will review the main current initiatives regarding Smart Ports and will offer the actual state-of –the art, as well as some emerging trends which should help to clarify concepts.






4.22 All World ports = Smart Ports ?

size	Large	Medium	Small	Very Small
traffic	<50 MT/y	25 MT/y	5 MT/y	1 MT/y >
1. Coastal Natural	26	89	474	(35%) 1596
2. Coastal Artificial	39	105	281	388
3. Coastal Tide gates	5	5	18	11
4. River Natural	25	59	248	518
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6. River Tide gates	7	14	12	14
7. Open Bay	18	17	97	450
8. Lake or Canal	3	6	26	32
Total :	4570	131	316	1181
100%	2.8%	6.9%	25.9%	64.4%

Usually Port Traffic is directly related to Port Profits, and money is the key factor to implement any Smart Port Project.

The problem in Smart Ports is the same than in Smart Cities : any isolated ICT, Environmental or Energy normal industrial project, is rapidly introduced as the first step to become a Smart Port, in Small and/or Very Small ports... but only Medium and Large Ports can support a feasible and credible Smart Port Project

4.23 UNCTAD Smart Port model

1st Generation	2nd Generation	3rd Generation	4th Generation	5th Generation
-----/1940	1960	1980	2000	2020
Mechanic Port	Container Port	EDI Port	Internet Port	Smart Port
Mechanical operation	Free Zone	International network	Global Network	ITS port
Handicraft works	Industrial area	Integrated centre	Port community	Logistic community
	Free tax port	Commercial area	Logistic area	Smart City
		EDI services	Intermodal services	Smart Hinterland
			Internet services	Multimodal services
				Sustainable port
				

4.24 IMO Smart Port model

The IMO is another agency of the UN, it has no official definition of Smart Port, but the IMO Convention are in line to define a de-facto Smart Port model that meets their diverse agreements that allow them to send or receive vessels in an regulated framework named e-navigation. Ports that do not meet their standards, will be excluded from the main maritime port traffic circuits. The key ports related Conventions are: MARPOL – ISPS – ISM – PSC – SECA.





4.25 EU Smart Port model

The European Union defined in 2014 it means for Smart City and Smart Community .Both definition we saw in the chapter on Smart Cities. As the Ports are considered a special case of a Smart Community, then they have to meet the same requirements that are asked for a Smart City, adapted to the port situation, European Smart Ports should be designed based on the following Regulations on Transport, Energy and ICT:

TRANSPORT	ENERGY	ICT
COM 2011(144) <ul style="list-style-type: none">• Roadmap to a Single European Transport Area	Directive 2013/33 <ul style="list-style-type: none">• Sulphur Emission Control Area	Directive 2010/40 <ul style="list-style-type: none">• Intelligent Transport Systems
Directive 2013/1315 Trans European Network <ul style="list-style-type: none">• Core Network• Core Network Corridors• Comprehensive Network	Directive 2014/94 <ul style="list-style-type: none">• Clean Power for Transport	Directive 2010/65 <ul style="list-style-type: none">• Electronic Single Windows

4.26 Ports Smart Port model



Like cities from the megalopolis to the rural village have embarked on projects called "Smart City" regardless of content or budgets Ports also follow a similar path, from large international ports to the smallest local port , labeling as "Smart Port" any initiative, project or service that has any content or technological support, if belonging to their normal field of operations.

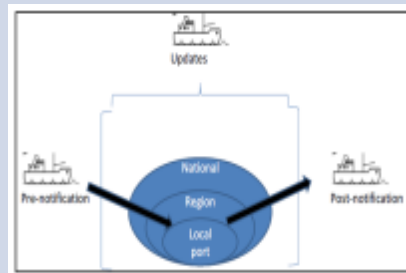
Many of the Smart Ports (projects) are in port cities, which in turn have a Smart City project that does not have included the port, focusing mostly in urban transport, but both projects should converge and cooperate where appropriate.

4.27 Smart Port internal services



PCS – Port Community System

Port Community System is an electronic trading platform A2A or A2B depending on the type of property and business of the Port Authority. It is a centralized Web services architecture to improve safety and reduce costs.



PSW – Port Single Window

Port Single Window. There are two definitions and other technical legal. The first refers to a type platform A2B or B2B transactions along the lines of property and business of the Port Authority. The second I defined in European Directive 2010/65



S&S– Safety and Security Services

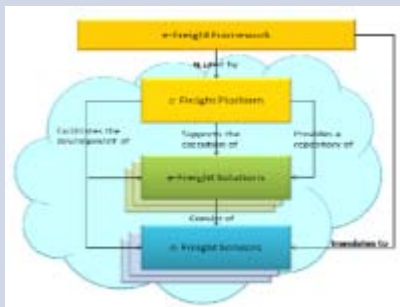
Infrastructure safety and security of people are two critical services in transport. IMO regulations as ISM or ISPS apply to maritime transport, or technical standards such as ISO-28000, to improve security in international supply chains. The IMO conventions are mandatory for Ports worldwide

4.28 Smart Port external services



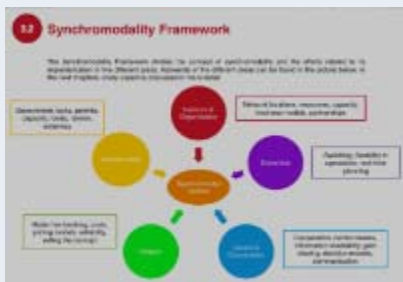
VTMIS : Vessel Traffic Management and Information System

It is the intelligent maritime traffic system, based on satellites, radar, AIS transponders and in Europe on LRIT, SSnet and CleanSeaNet, and related services such as e-maritime and e-navigation. It aim is to integrate all traffic management systems: VTMIS, ATM, ERTMS and RMS: sea, air, rail and road respectively.



e- freight

It was defined in 2007 in the Logistics Action Plan, as the result of the interaction of transport services with ICT and the Internet. It describes the processes, actors and data streams to allow exchange of information in electronic formats - paperless - in all modes of transport



Sincromodalidad

is the concept that defines the extensive use of Internet and tracking & tracing technologies to logistics and transport management : production, transport and distribution : 3 types of logistics are currently defined: manufacturing, transportation and delivery. All must be synchronized to avoid bottlenecks, excessive production, stocks break or shortages in industries or businesses

4.29 Smart Port models

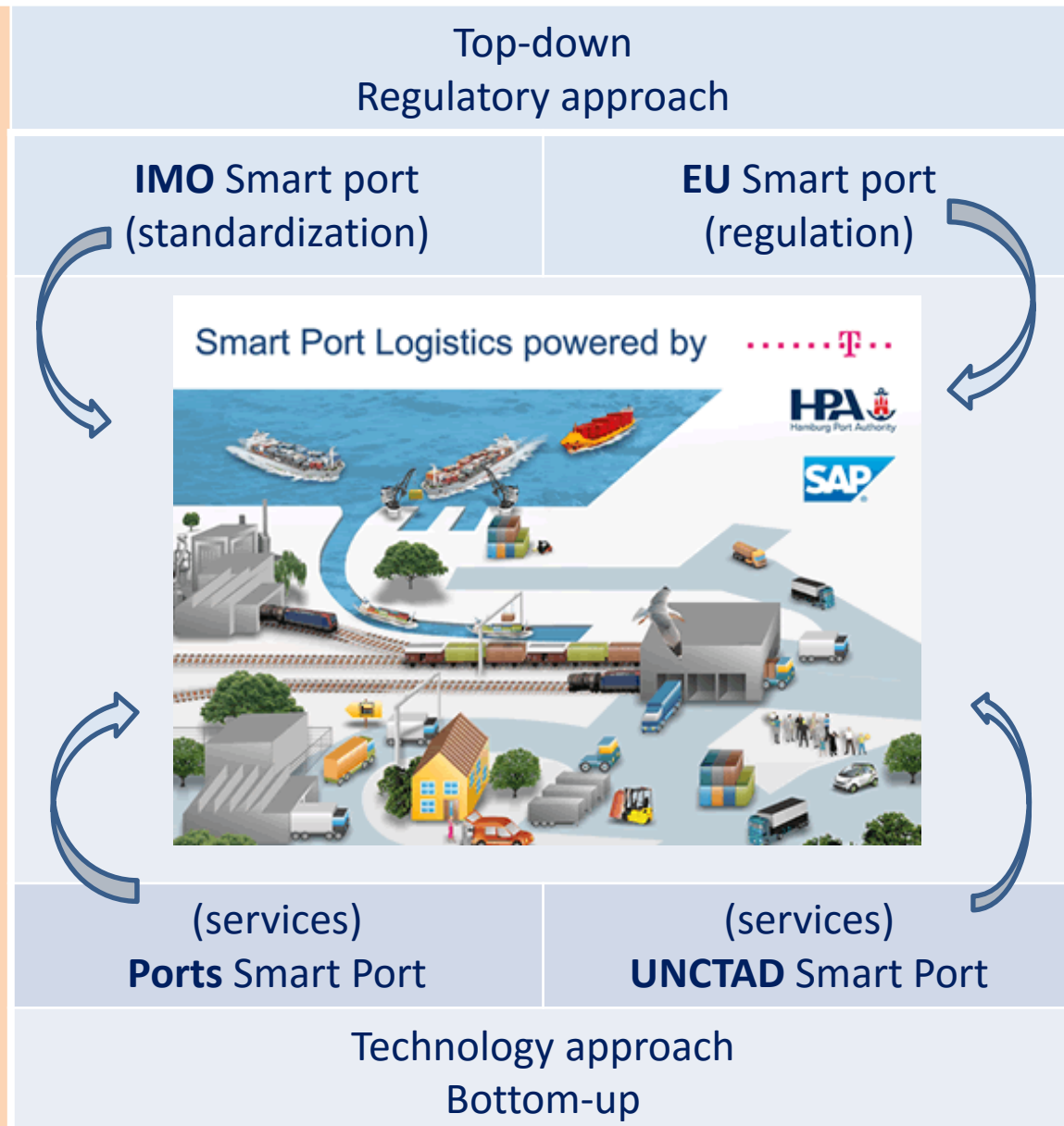
We can roughly identify 2 large approach to the Smart Port issue of emerging definition :

- Regulatory
- Technological

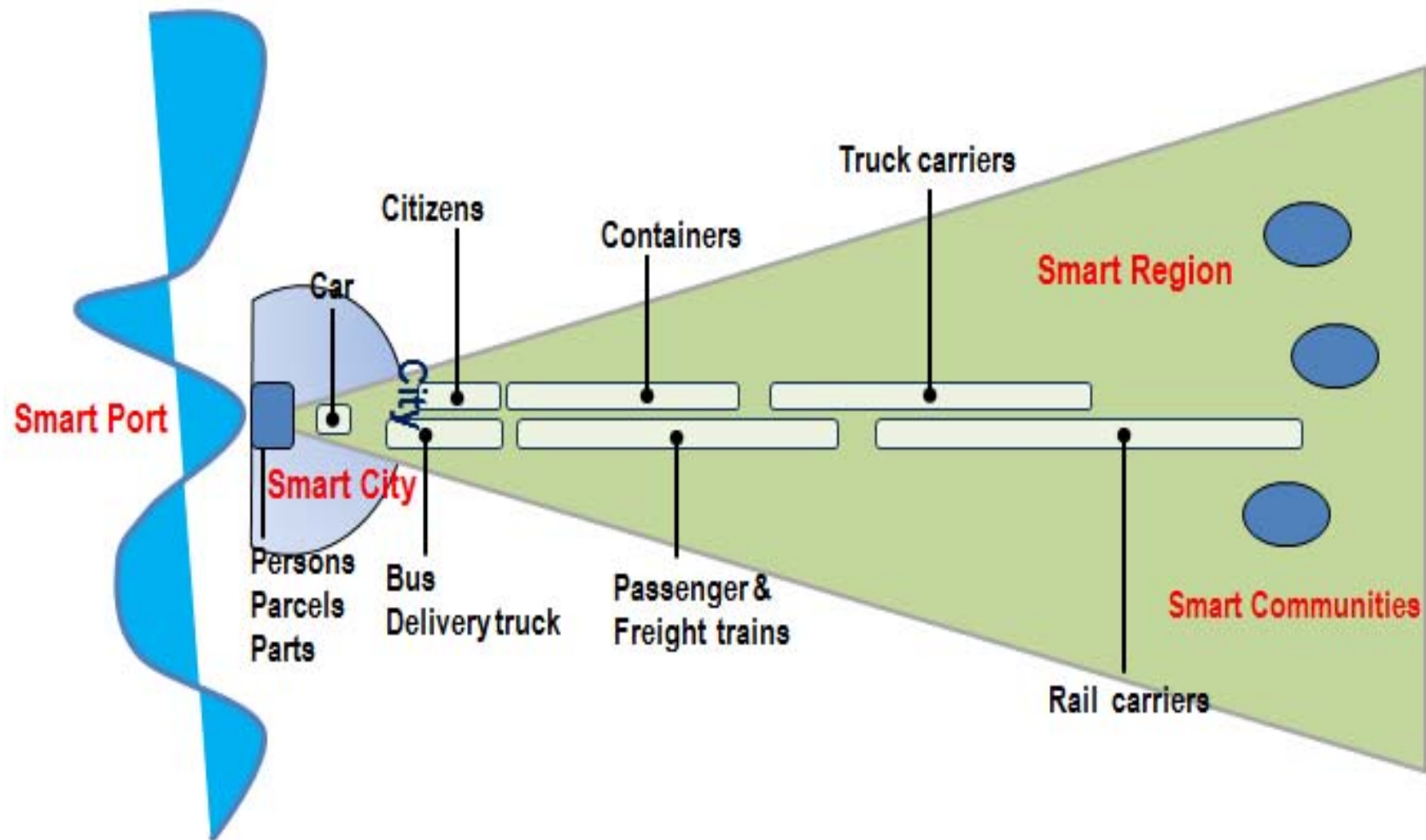
The first is based on policies supported by institutions such as IMO and EU, one issuing technical recommendations and the other with mandatory Directives.

The second is used by Ports itself and by the UNCTAD, both of them based on economy aims through the technology implementations.

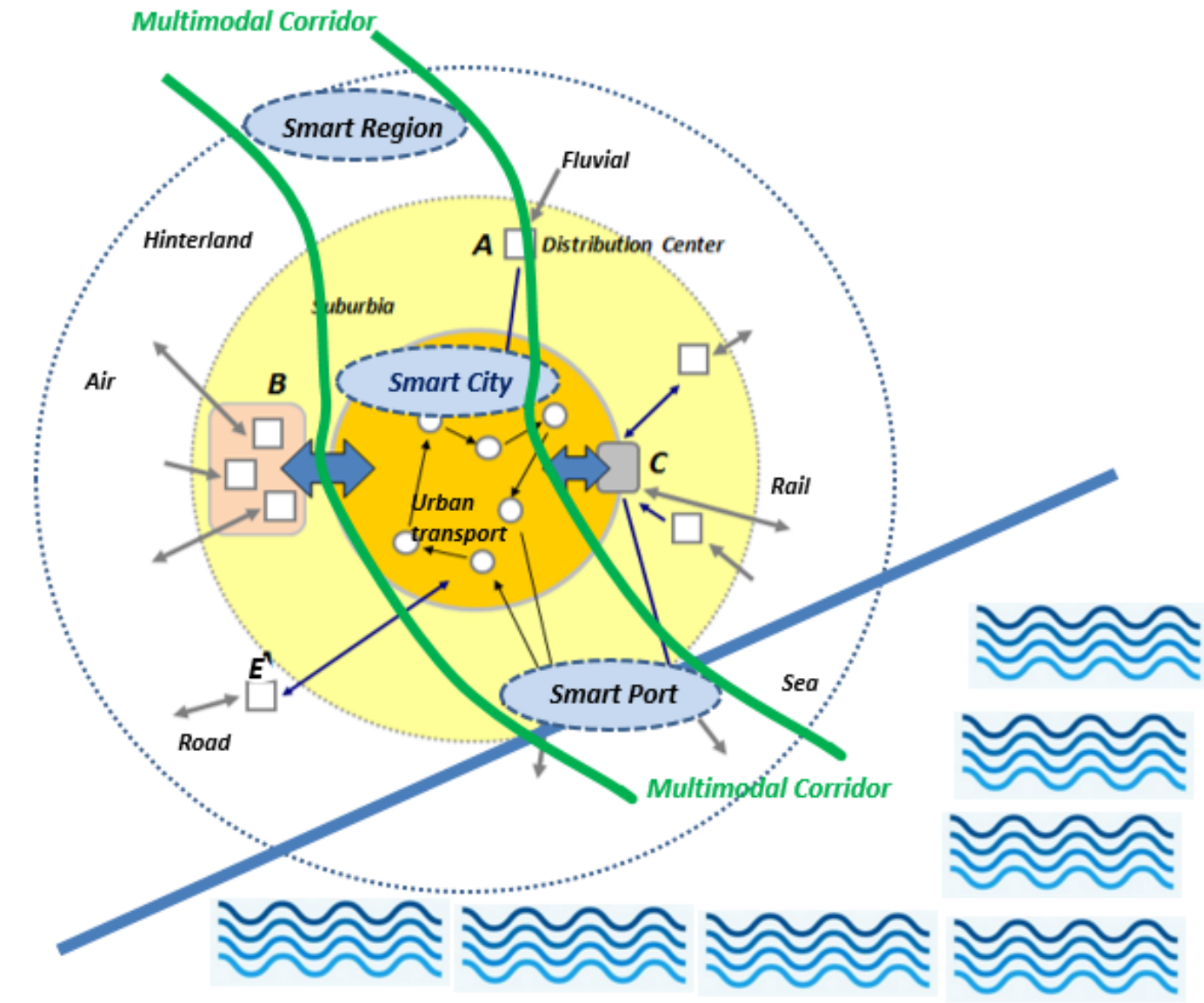
Surely they will create in the coming years a common area of concepts and definitions of what will be a Smart Port



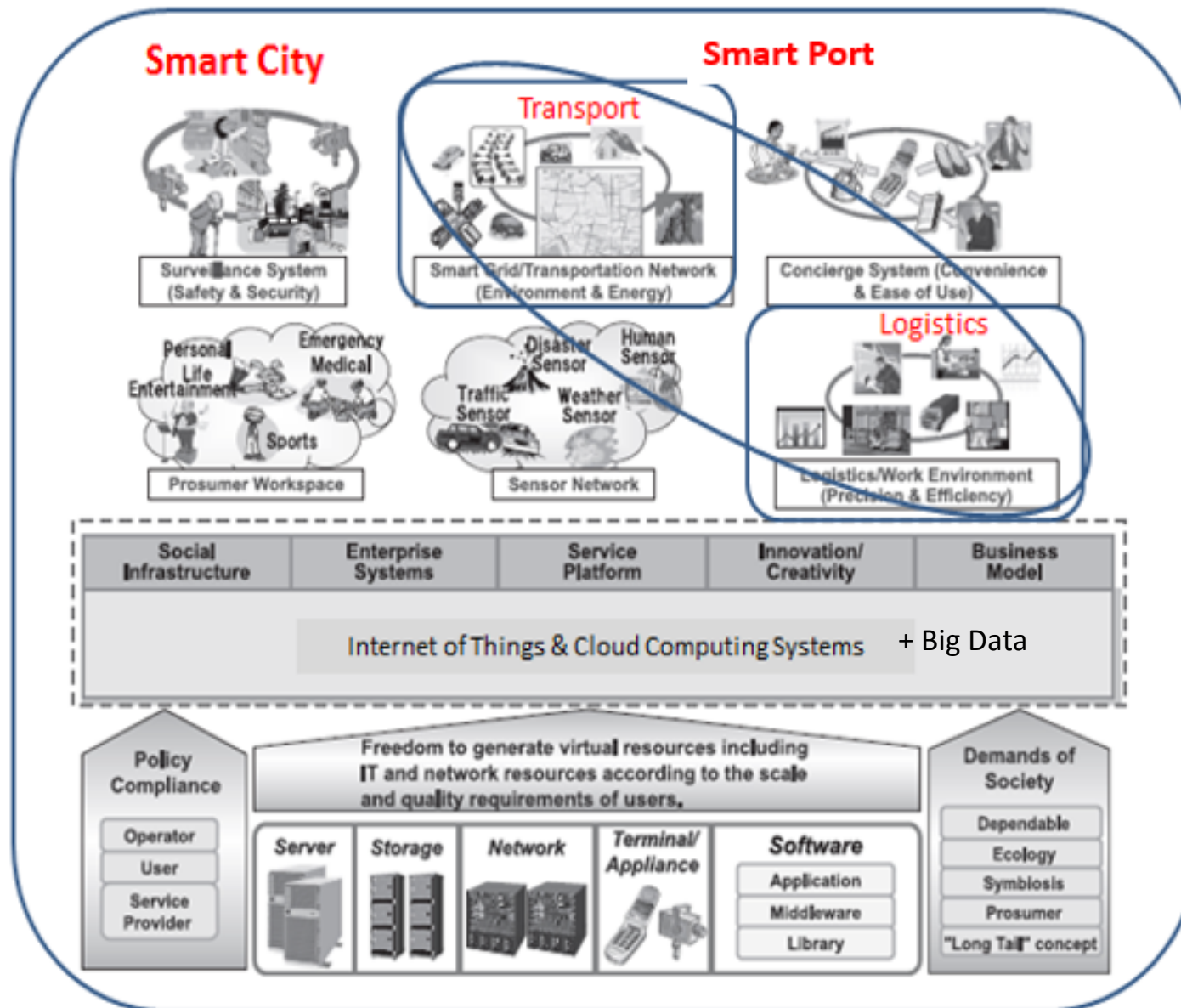
4.30 Relationship Smart City , Smart Region and Smart Port



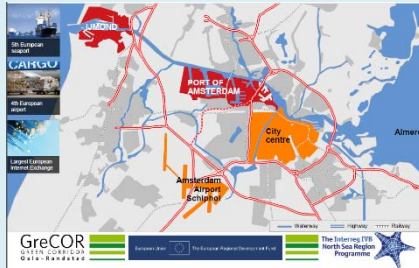
4.31 Relationship Smart City , Smart Region and Smart Port



4.32 ICT and key technologies



4.33 Smart Port projects



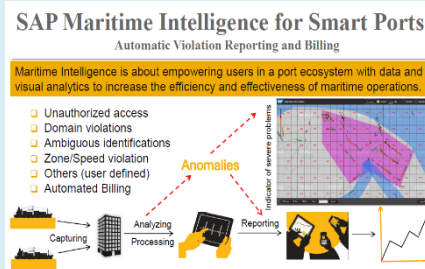
Smart Port AMSTERDAM

Amsterdam, a port that moves 90 MT/Y presents a model of "Smart Green Port" based on 3 axes: Environment, Intermodal and ICT. Its main business case, is the proximity to the airport Schipool, one of the largest in Europe, selling an interface port-airport, TO customers with mixed Dutch and German logistics services.



Smart Port HAMBURG

Hamburg is the 3rd European port for trafficS, with 130 MT/Y and has a model of Smart Port-based on logistics services offered to both foreland and hinterland. Its area of influence is beyond Germany and reaches around the Baltic. Hamburg Smart Port 2025 project relies heavily on an intelligent ICT infrastructure and logistic services based on them.



Smart Port SINGAPUR

Singapore, a port 550 MT/Y since dropped from No. 1 to No. 3 in the last 10 years, by the thrust of the Chinese ports of Shanghai and Ningbo. PSA have a plan to return to the first place and is called Smart Port Singapore. They know they have no terrestrial hinterland, but one maritime, hence its business case is the development of the Maritime Intelligence & Shipping

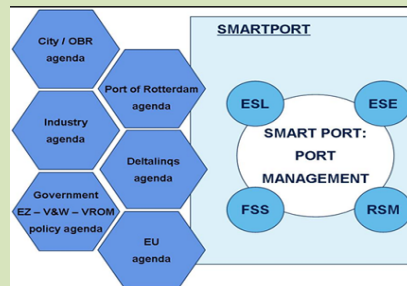
4.34 Smart Port projects



Barcelona, Smart Port

Smart Port BARCELONA

Barcelona port has 40 MT/Y, has made a re-interpretation of the services and ICT applications of last 15 years, and now presents them as a new model based on PORTIC, the Barcelona PCS, a A2B service that the Port Authority offers to its Port Community, to facilitate the formalities electronically, and adding any other technology based service.



Smart Port ROTTERDAM

Rotterdam is the 1st port by traffics in Europe, more than 400 MT/Y, but the 9th in the World, dominated the ports of China. Erasmus University and the Port of Rotterdam launched in 2010 the Smart Port Rotterdam Project, to connect knowledge management with new logistical services of the Port of Rotterdam. Sinchromodality began adding to port services The project is called "Rotterdam Port Quality 2025"



Smart Port KANSAS

KC SmartPort is the authority that manages the logistics services in the 18 counties of the State of Kansas moving 5 MT/Y. KC SmartPort promotes and enhances the status of the Kansas City region as a leading logistics center in USA. Their main argument is that Kansas business is the main logistics hub of Interior (inland port) at the junction of two river systems: Mississippi - Missouri, 4 interstate highways and the main rail hub of the Midwest USA.

Annex 1 : Smart City platforms



<http://eu-smartcities.eu>

Smart Cities and Communities provides a unique opportunity for participation by all stakeholders: municipalities, companies, organizations or individuals) in Europe to establish Roadmap Smart City in Europe



<http://setis.ec.europa.eu/>

The European Strategic Energy Technology Plan (SET-Plan) aims to increase, coordinate and concentrate EU support on key technologies of low carbon energy through the implementation of this plan, through the SETIS platform.



<http://www.covenantofmayors.eu>

leading European movement involving local and regional authorities, voluntarily committing to increasing energy efficiency and use of renewable energy sources in their cities ..near to 6,000 cities in 2015.



<http://www.eltis.org>

An initiative of the Intelligent Energy Programme 2007-2013. Platform for the exchange of information and experiences in sustainable urban mobility, to support urban transport systems that save energy and reduce pollution

Annex 2 : Smart Region platforms



<http://www.smartregions.net>

Project of IEE Programme "Intelligent Energy Europe" , the Directive on efficient energy use and services (ESD) establishes a 9% of energy saving target by 2016, and the EU has is aimed to reduce energy consumption in 20% by 2020.



<http://www.smartregion.eu>

Funding from of the Economic and Social Fund ESF. Smart Region is a EU project, with partners from three countries : Germany, Austria and Portugal, are working on developing new solutions to address demographic change in participating regions.



<http://s3platform.jrc.ec.europa.eu/>

Research & Innovation for Smart Specialization Strategy. It is no longer admits that all Regions are the best in everything and ask for money for any activity. RIS seeks to identify what is really good in a Region and in a Country, to avoid not fully justified funding



<http://www.smartstates.com>

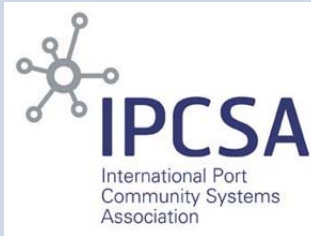
American initiative of Delaware, Maryland, New Jersey and Pennsylvania. STATES SMART Program is an initiative of Congress to regionalize the promotion on all issues of technology and disciplines within the Mid-Atlantic region.

Annex 3 : Smart Port platforms



<http://www.espo.be>

The European Sea Ports Organization was founded in 1993. It represents the port authorities, port associations and port administrations of the seaports of the Member States of the European Union and Norway. Has worked to develop a set p of Port KPI in Operations and Environment.



<http://www.epcsa.eu/>

IPCSA is the successor to the European Port Community Systems Association (ECPSCA) launched in 2011 by 6 I European-based Port Community System operators. IPCSA and its members play a vital role in global trade facilitation; the electronic communications platforms provided by Port Community Systems .



<http://www.iaphworldports.org/>

The International Association of Ports and Harbors (IAPH) adopted the new IAPH Vision and Mission Statements as well as the Objectives to achieve the Mission. The 2015 Conference held in Hamburg Port was dedicated to develop the Smart Port concept.



<http://www.aivp.org>

AIVP , the worldwide network of Port-Cities, is the international organization that since 1990 has been bringing together all the public and private development stakeholders in port cities. The Conference 2014 held in South Africa was dedicated to Smart Ports & Smart Cities.

Smart Port



University of Strathclyde
National Technical University of Athens
Universidad Politecnica de Madrid
Oceanfinance
UniGe



Circle
CIMNE
Regione Liguria
Magellan
Universidade Nova De Lisboa