



Laboratoire
Génie Civil
et géoEnvironnement
Lille Nord de France

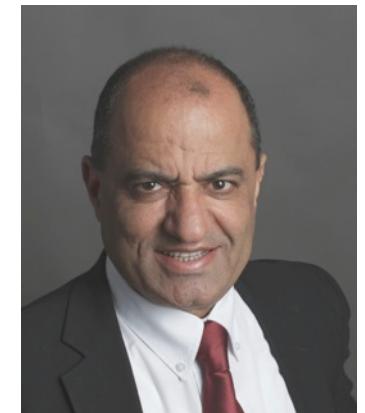


Université
Lille1
Sciences et Technologies

Sustainable and Smart City : *AUST Summer Course*

Chapter 3 : Introduction to Smart City

Professor Isam SHAHROUR
Isam.shahrour@univ-lille1.fr



The City Challenges

Financial & economic
Crises

Increase demand for life
quality & comfort

Gouvernance
participation

Poverty Slums

Society aging

Health & education

Housing

Traffic
congestion

Population Expansion
(Explosion)

Energy & water
consumption

Air, water
& soil pollution

Greenhouse emission
Climate Change



Statement :

We have to transform our city

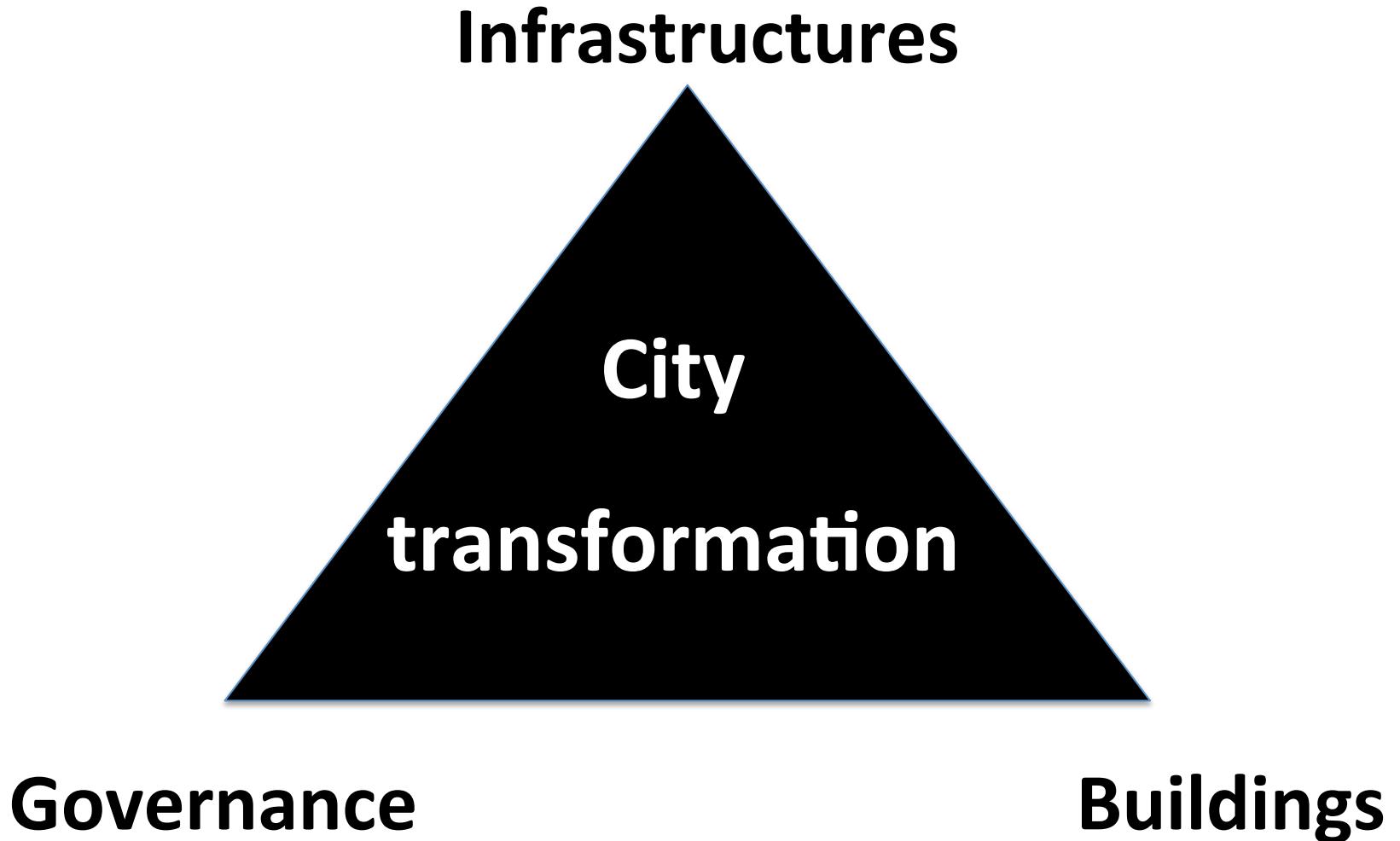
Infrastructure
Housing
Urbanization
Management
(governance)

**Huge Financial and
economic crises**

ble City
Env- responsible
Social -responsible

**Digital technology revolution
(Smart City Concept)**

Facing the 2th century challenges



Two strategies

Improve the buildings and infrastructure quality

Large investment, takes time..

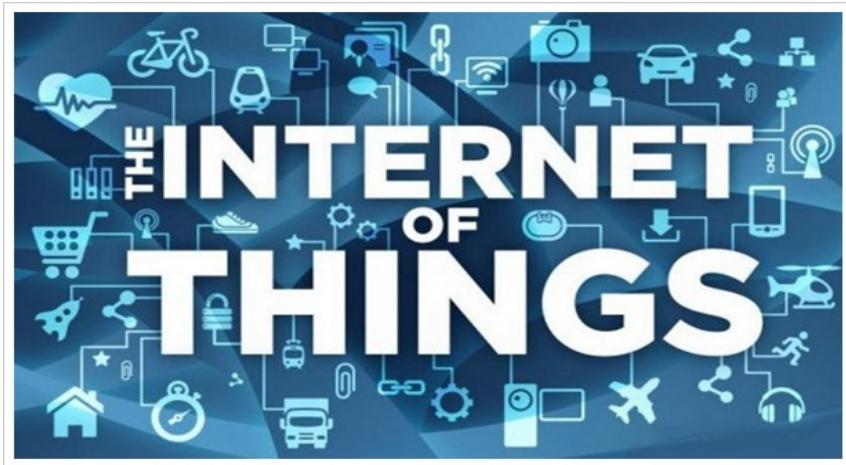
In Europe new buildings represent about 1% of the buildings stock annually

Improve the infrastructure management (Digital technology)

Low investment, rapid implementation

Digital Revolution

- Communication
- Social network
- Mobile
- Internet of things

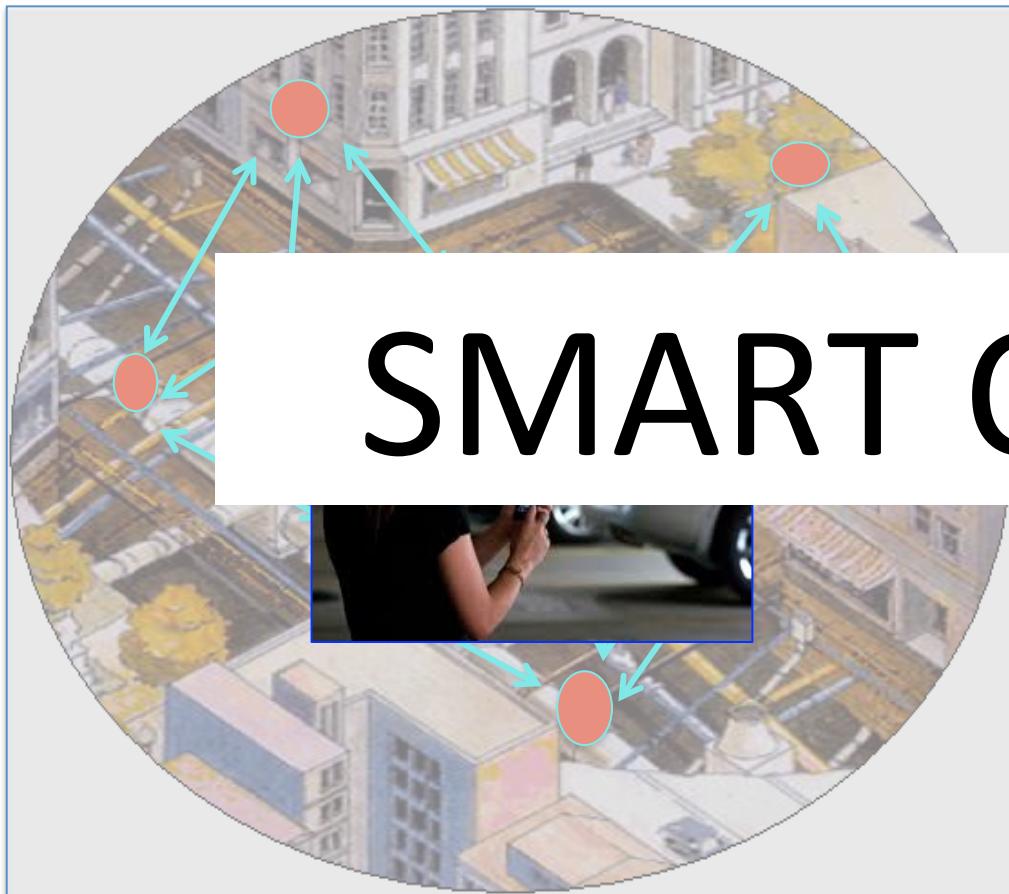


Smart sensors technology

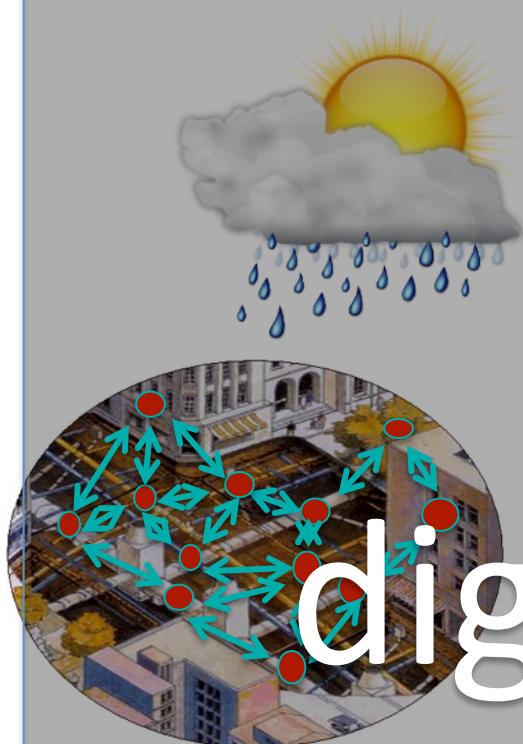


Smart Technology

Smart governance



More data



BIG DATA

digital, images,
movies, audios



Health, Education
Art, Culture



Smart city technology allows

- Real-time monitoring (Urban systems as well as other urban related data)
- Rapid action in the case of abnormal event (leakage, contamination, overload,..)
- Optimal management of resources
- Stakeholders implication and participation
- Development of predictive models

Smart City Technology movies

A3 Cisco Smart Grid - HD Version

A4 Alsthom Architecture of a Smart Grid

A5 Smart Grid Denmark - the intelligent power grid of the future

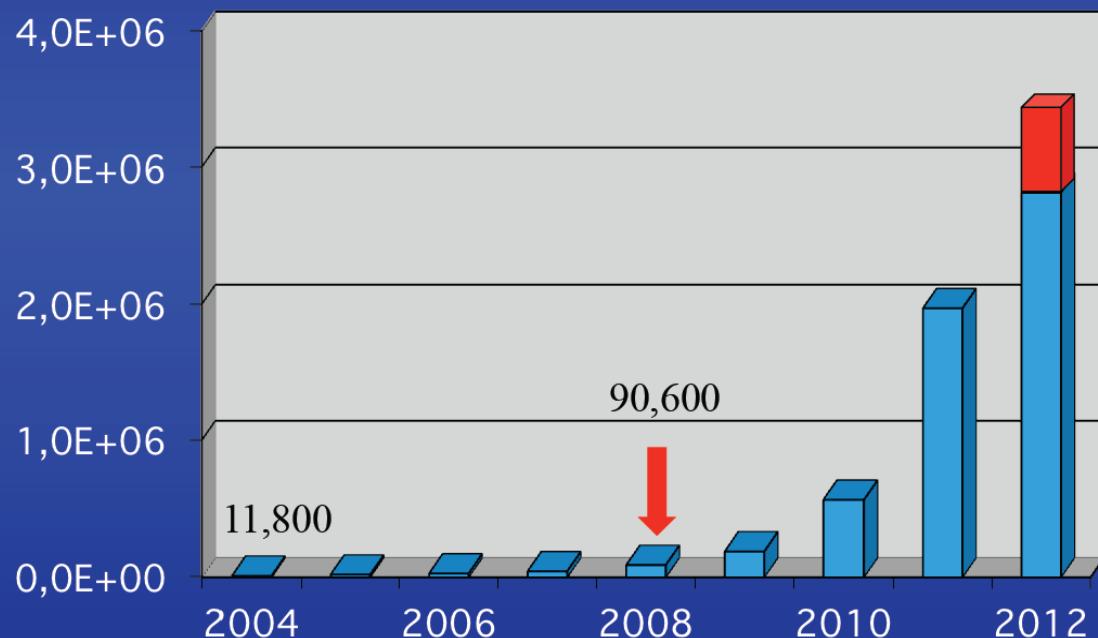
A6 Smart cities in the new urban world Peter Nijkamp at TEDxUdG

Smart City history

Smart Grid historical perspective

When was the *smart grid* notion born?

"Smart grid" entries in Google: 8,500,000 (September 12, 2012)



By date:

Last hour:	1,370
Last 24h:	33,000
Last month:	232,000
Last year:	3,260,000

By file types:

280,000	PDF
4,750	PPT
12,000	DOC

9,030,000 (December 10, 2012)

3.1 The earliest and largest Smart Grid

Installed by ENEL S.P.A of Italy, and completed in 2005, the Teleogestore project was highly different from other system in the utility world. Its general architecture integrates electronic meter, provides metering, and contracts management and PLC communication functions. The Automatic Meter management communicates by public telecommunication networks (such as GSM, GPRS, PSTN & satellite) with LV concentrators (CBT) installed in every MV substation. LV Concentrators are able to manage the communication in both directions: half-duplex communication between Remote Metering Central System and Electronic Meters. The Teleogestore project is widely regarded as the first commercial use of Smart Grid. It offers annual savings of 500 million euro at the cost of 2.1 billion euro[6].

Smart City International overview

Cities Strategy and vision

"Birmingham has set itself the ambitious carbon reduction target of 60% by 2026... [and] signing the Green Digital Charter allows us to emphasise and support the use of ICT for sustainability and carbon reduction."

Birmingham

"The City of Helsinki regards the Green Digital Charter as an opportunity to share experiences and best practices in energy-efficiency of ICT."

Helsinki

"Europe's climate targets will only be met through measures that help city governments to manage down their carbon footprint. The Green Digital Charter aims to be a catalyst for cities to work together to find creative and imaginative ways to become smart cities."

Francisco de la Torre Prado, Mayor of Malaga

SIEMENS report, 2010

SIEMENS

ICT for City Management

Using information and communications technology to enable, engage and empower city stakeholders

A research project conducted by the Economist Intelligence Unit
Sponsored by Siemens

Survey in 15 cities across the world

RESULTS.

To ascertain the opinions of each stakeholder group of the role of ICT in city governance, research for this paper involved surveys of public officials, residents and businesses in 15 cities across the world. The

15 CITIES

Cities surveyed					
City	Country	2010 population ^a	2025 estimated population (% increase from 2010) ^b	Area km ² ^c	% of national GDP, 2008 PPP ^d
Abu Dhabi	UAE	1.8m	2.1m (17%)	67,340	51.8%
Berlin	Germany	3.5m	3.5m (0%)	892	3.3%
Buenos Aires	Argentina	13.1m	13.7m (5%)	4,758	63.4%
Copenhagen	Denmark	1.1m	1.2m (9%)	456	24.2%
Delhi	India	22.2m	25.6m (15%)	1,484	5.0%
Dubai	UAE	1.8m	2.1m (17%)	4,114	24.3%
Istanbul	Turkey	10.5m	12.1m (15%)	1,831	18.4%
London	UK	8.6m	8.8m (2%)	659	25.9%
Madrid	Spain	5.8m	6.4m (10%)	607	15.9%
Mumbai	India	20.0m	25.8m (29%)	603	6.2%
Munich	Germany	1.3m	1.4m (8%)	310	2.2%
New York	USA	19.4m	20.6m (6%)	319	10.0%
Shanghai	China	16.6m	20.3m (22%)	6,340	2.9%
Singapore	Singapore	4.8m	5.4m (13%)	710	100%
Vienna	Austria	1.7m	1.80m (6%)	415	38.6%

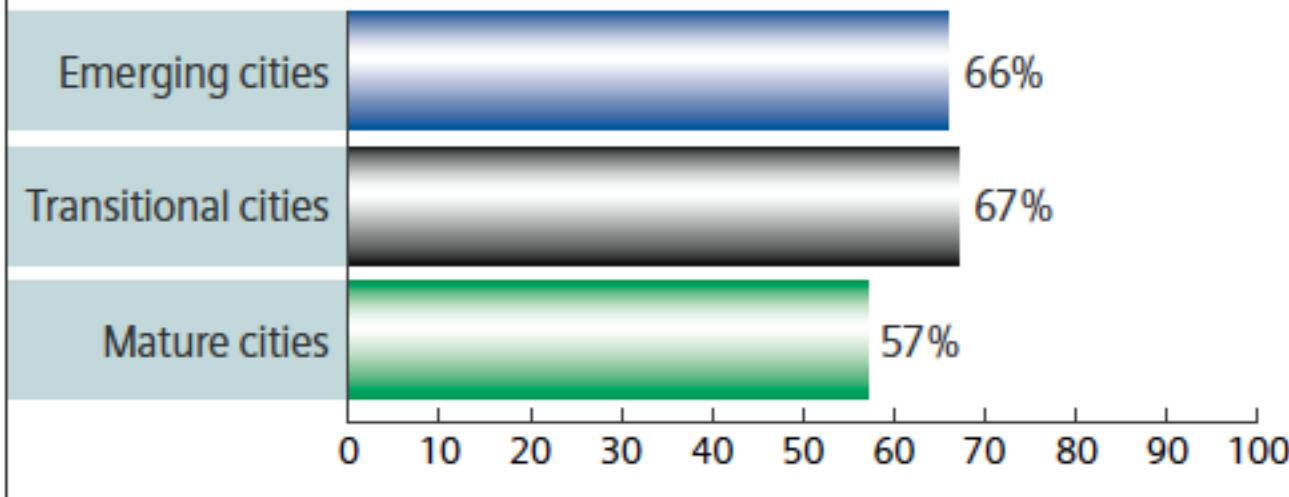
...
...

Cities Classification:

- Emerging cities: Population Growth 3 to 6 %
- Transitional cities : Population Growth 2 to 3 %
- Mature Cities : Population Growth 1 to 2 %

Figure 5

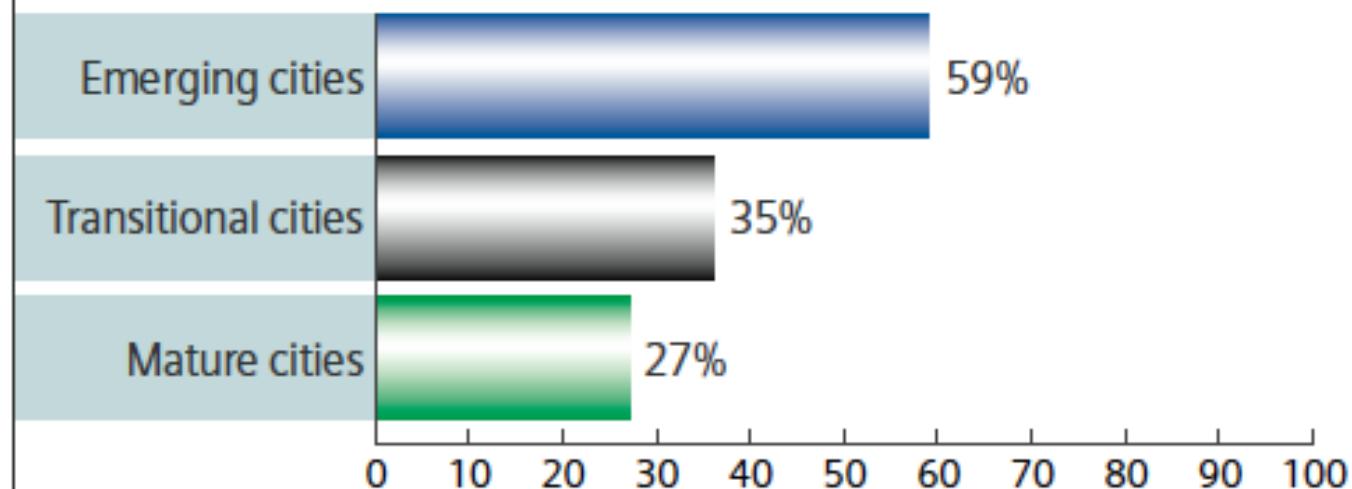
“Investing in ICT systems to manage infrastructure is as important as physical infrastructure itself”



* % public officials agreeing or
strongly agreeing with the statement

Figure 6

“Investment in roads, buildings and physical infrastructure should be prioritized ahead of ICT”



* % business respondents agreeing or strongly agreeing with the statement

Figure 8

“Public safety and security concerns should always be prioritized ahead of citizens’ privacy concerns”



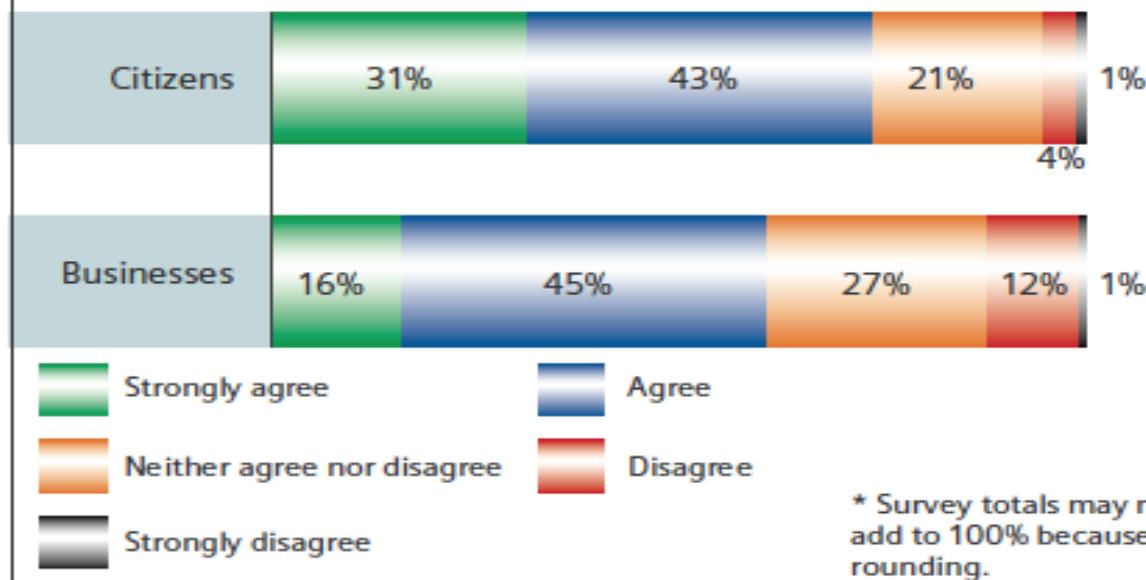
* % respondents agreeing or strongly agreeing with the statement

ICT for City Management

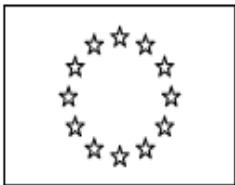
Using information and communications technology to enable, engage and empower city stakeholders

A research project conducted by the Economist Intelligence Unit
Sponsored by Siemens

**“We are likely to change our energy/
water consumption if given better access
to information about usage levels”**



Smart City in EUROPE



EUROPEAN COMMISSION

European Innovation Partnership on Smart Cities and Communities

Strategic Implementation Plan

14.10.2013

Why ?

Cities are becoming more and more a **focal point for our economies and society**, because of :

- On-going urbanization
- increasingly knowledge-intensive economies
- their growing share of resource consumption and emissions.

Why ?

To meet public policy objectives under these circumstances,

Cities need to change and develop,
but in times of **tight budgets** this change needs to
be achieved in a **smart way**:
our cities need to become 'smart cities'.

Triple bottom line gain for Europe:

- A significant improvement of citizens' quality of life,
- An increased competitiveness of Europe's industry
- Strong contribution to sustainability and the EU's 20/20/20 energy and climate targets

EU's 20/20/20 energy and climate targets

In 2020 (compared to 1990) :

- 20% reduction in CO2 emissions
- 20% coming from renewables
- 20% increase in energy efficiency.

Triple bottom line gain for Europe:

This will be achieved through :

*wide-reaching roll out of integrated, scalable,
sustainable Smart City solutions –*

specifically in areas where

- energy production, distribution and use;
- mobility and transport;
- and information and communication
technologies

are intimately linked.

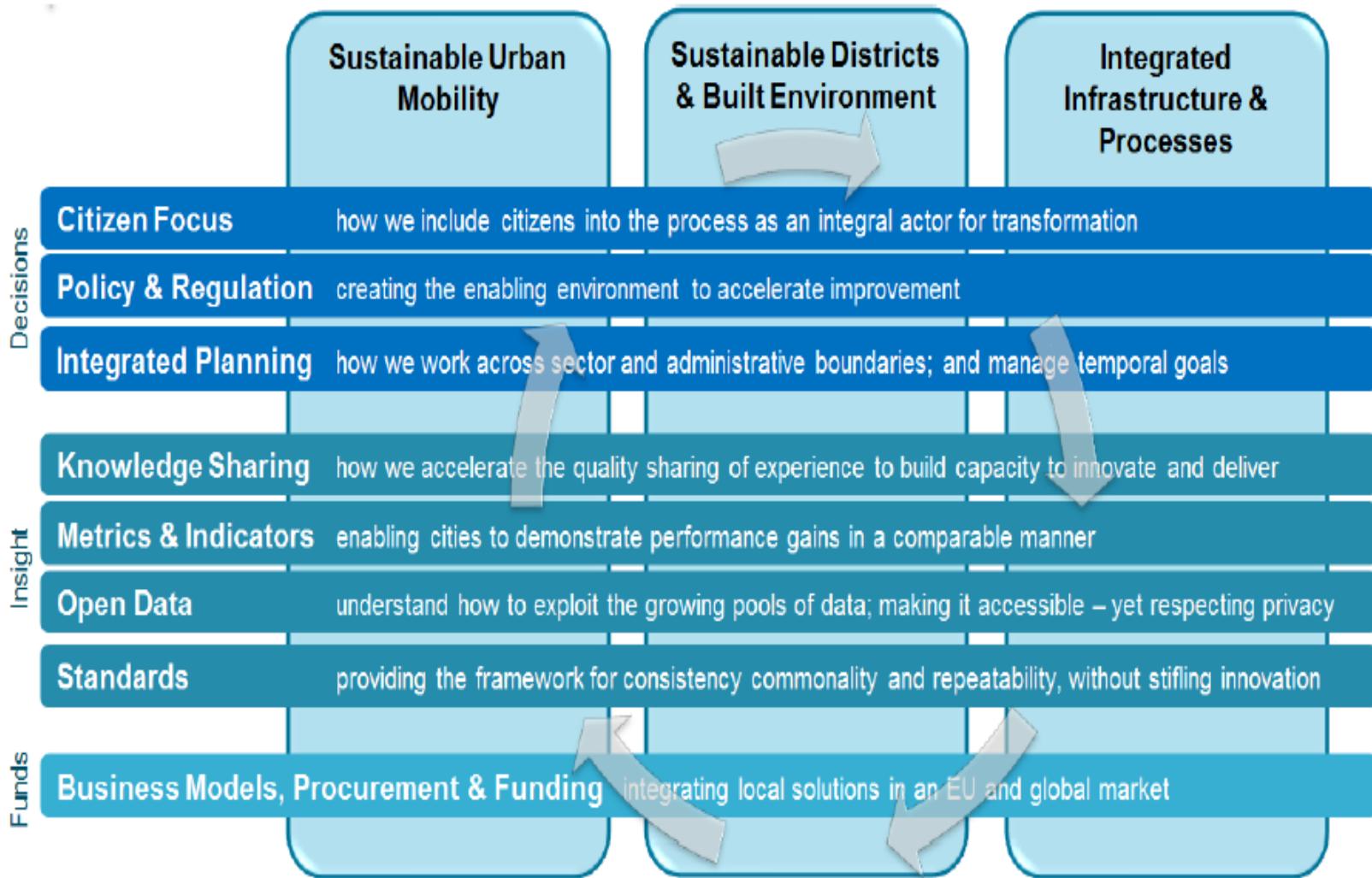


Figure 3: Priority areas

Mapping Smart Cities in the EU

2014

2.2. Smart City definitions

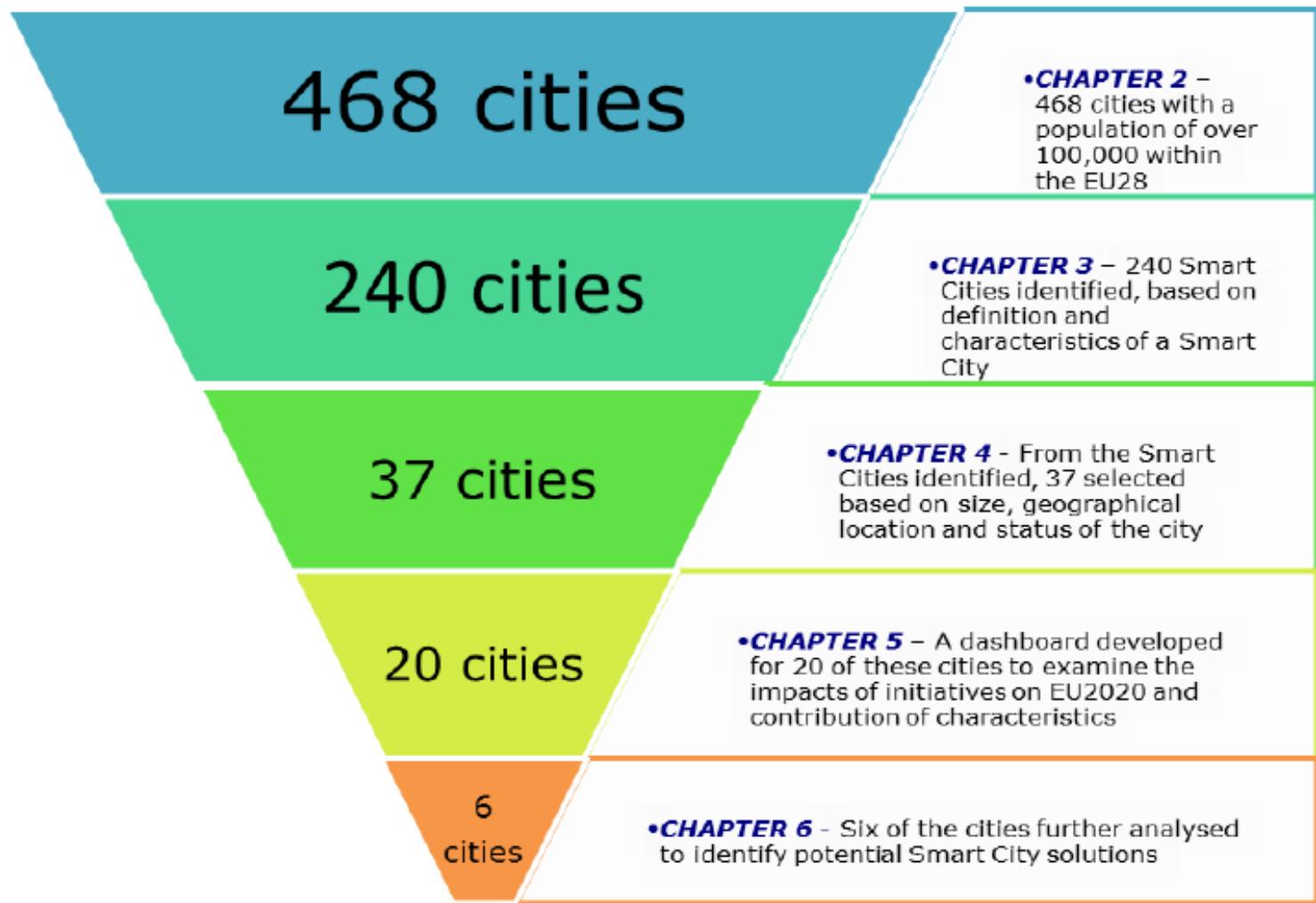
2.2.1. Problems of definitions

Examples of Smart Cities come in many variants, sizes and types. This is because the idea of the Smart City is relatively new and evolving, and the concept is very broad. Every city is unique, with its own historical development path, current characteristics and future dynamic. The cities which call themselves 'Smart', or are labelled as such by others, vary enormously.

The evolution of the Smart City concept is shaped by a complex mix of technologies, social and economic factors, governance arrangements, and policy and business drivers. The implementation of the Smart City concept, therefore, follows very varied paths depending on each city's specific policies, objectives, funding and scope.

- 'Intelligent City'
- 'Knowledge City'
- 'Sustainable City'
- 'Talented City'
- 'Wired City',
- 'Digital City'
- 'Eco-City'.

Figure 1: Sampling hierarchy of cities investigated in the report





Smart City Component



Smart City Characteristic



Smart City

ECO - Smart Economy
ENV - Smart Environment
GOV - Smart Government
PEO - Smart People
MOB - Smart Mobility
LIV - Smart Living

Figure 4 : The ratio of Smart Cities to Smart City initiatives across the EU

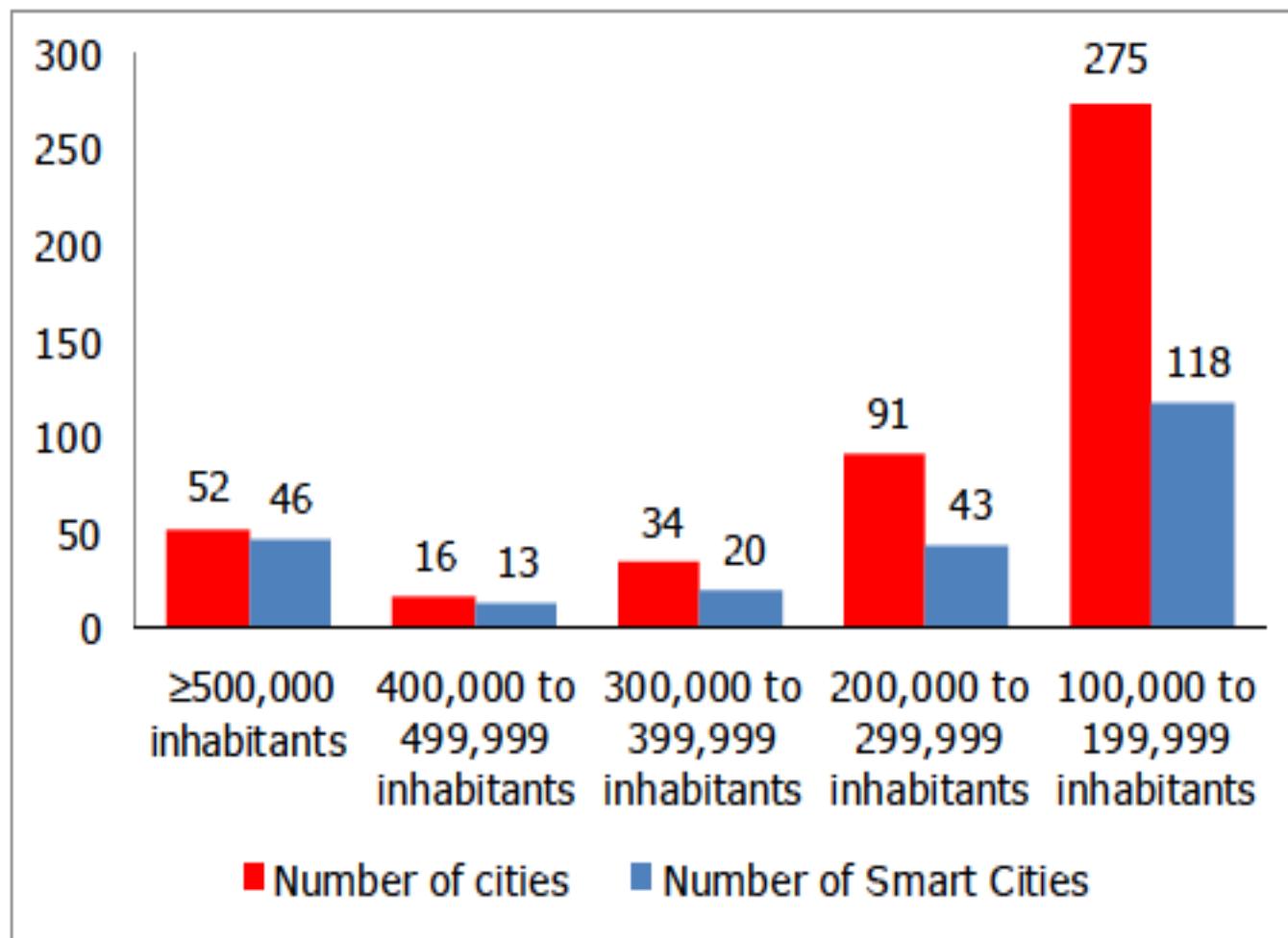
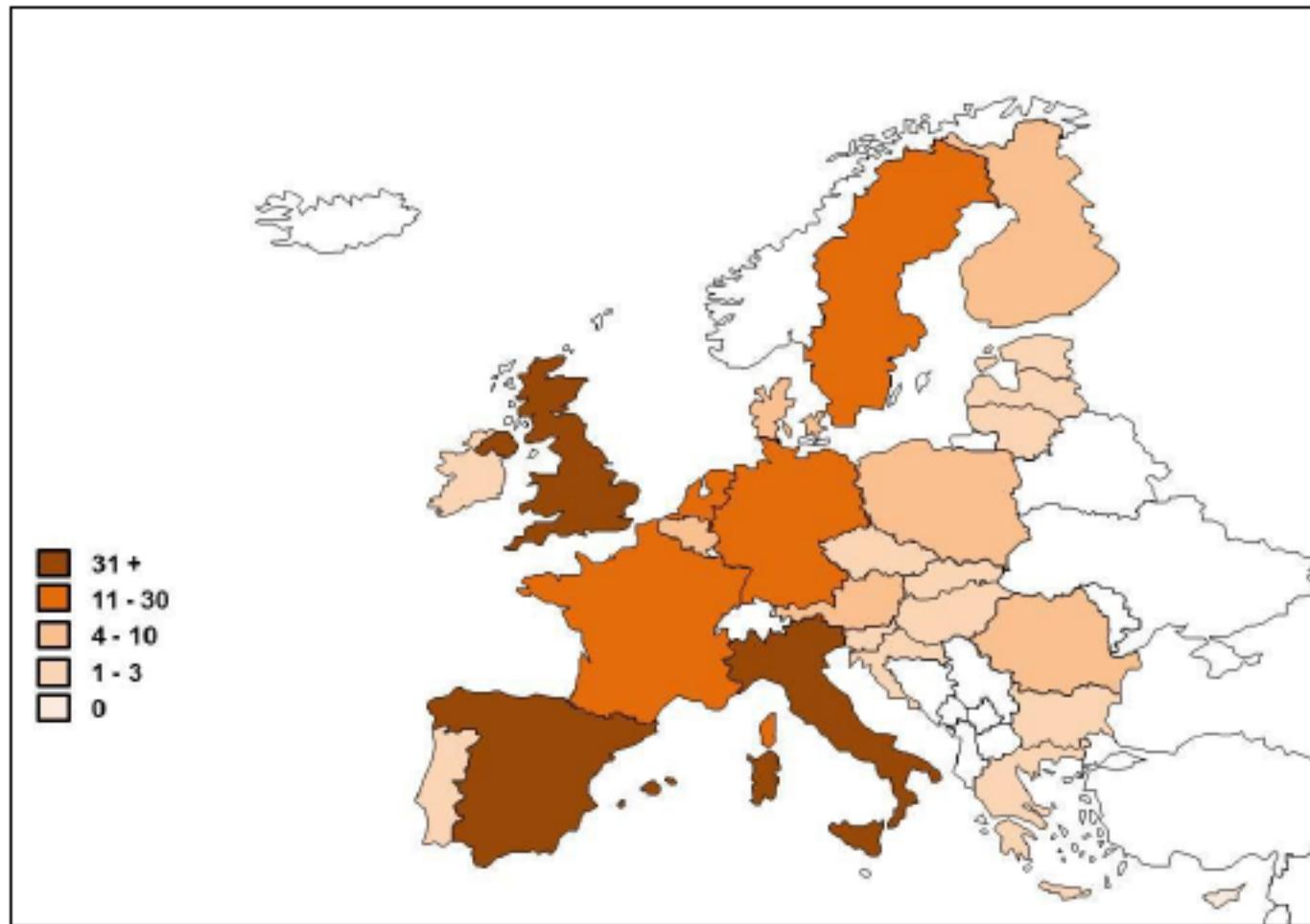


Figure 11 : The number of Smart Cities per country in Europe



ANNEX 9: THE CORRELATION BETWEEN SMART CITY CHARACTERISTICS AND BETWEEN SCORES

	ECO	ENV	GOV	PEO	LIV	MOB
ECO	100 %					
ENV	-10%	100 %				
GOV	38%	-81%	100 %			
PEO	7%	-53%	59%	100%		
LIV	31%	-18%	21%	-12%	100%	
MOB	9%	59%	-53%	-70%	-12%	100%

BIS RESEARCH PAPER NO. 136

**The Smart City Market:
Opportunities for the UK**

OCTOBER 2013

The Smart City Market: Opportunities for the UK

OCTOBER 2013

These questions aside, and taking the aggregate figure presented above of a \$408 billion global market in 2020, if UK industry were to aim to take a 10% share of the market, perhaps mostly in the UK's traditional strengths of product design,

management of demand and supply. The scale of the possible savings is significant. A recent survey of water utilities found that utility companies could save between \$7.1 billion and \$12.5 billion each year by using smart water solutions.

The UK's cities will be helped to get smart, thanks to the launch of the Department for Business, Innovation and Skills's new Smart Cities



It comes as a new report published today values the smart cities industry at more than \$400 billion globally by 2020, with the UK expected to gain a 10% share (\$40 billion).

“ The opportunity to develop new technologies for smart cities in the UK is massive. We want to make sure that we are at the forefront of this digital revolution so we can stay ahead in the global race designing new innovations in the UK and exporting them across the world.

With around 80% of the UK's population living in cities, we need to ensure that they are fit for purpose in the digital age. Through our information economy strategy we will support cities to improve energy efficiency, reduce carbon emissions and save money.”

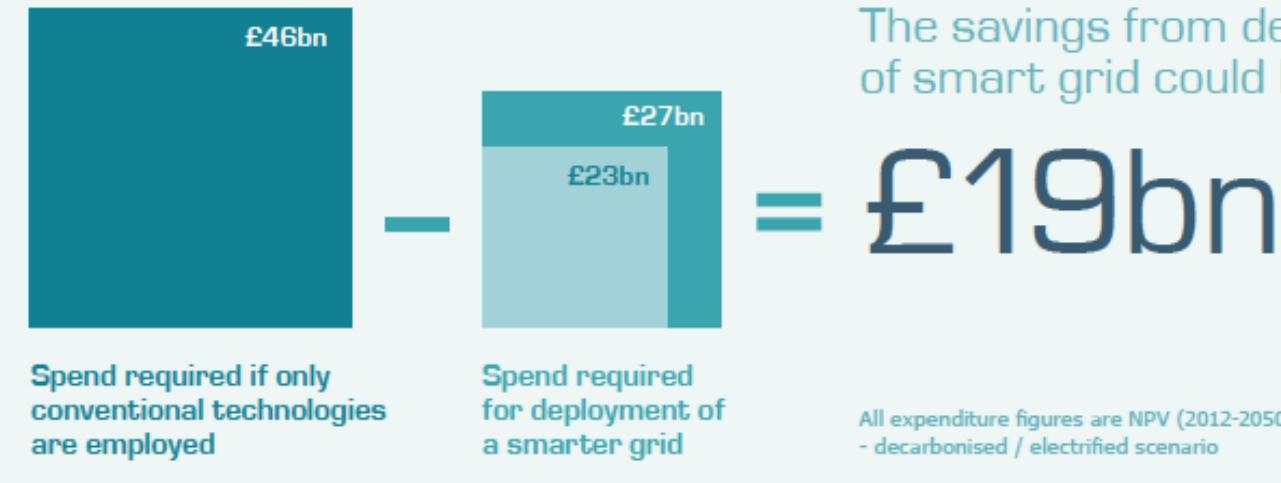
Smart Grid: a race worth winning?

A report on the economic benefits of smart grid

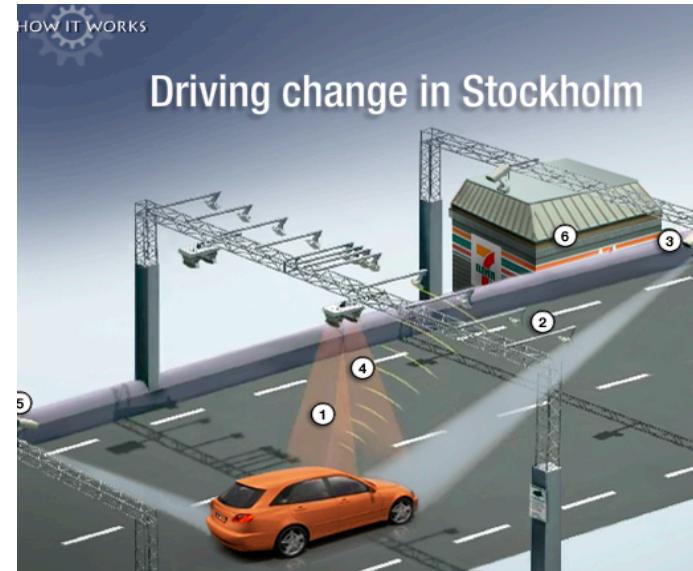
April 2012

SmartGridGB
For an intelligent future

ERNST & YOUNG
Quality In Everything We Do



Stockholm : Traffic Congestion



City traffic decrease by 18%
CO2 emission decrease 14-18 %

Smart City in United States

Smart Grid – NEMA Report (2011)

NEMA : Association of electrical and medical imaging equipment manufacturers (US)



Smart Grid
Building on The Grid

2
volume

Smart Grid – NEMA Report (2011)

Smart Grid is the solution we desperately need to solve many global energy problems. Like the printing press, automobile, and light bulb before it, Smart Grid will change the course of human history. It is changing the way we think about and interact with our electrical system.

Smart Grid – NEMA Report (2011)

The Smart Future is Here

Smart Grid seems to promise a lot:

- ❖ greater control of the grid by utilities
- ❖ cost-saving options for consumers
- ❖ fewer outages
- ❖ self healing capabilities
- ❖ across-the-board operational efficiencies
- ❖ access to renewable energy sources
- ❖ enhanced security and reliability

With these ideals in mind, it's only natural to ask, "When will we see these changes?"

Smart Grid – NEMA Report (2011)

NEMA's role in this future has several elements.

In short, we seek to:

- ❖ develop standards that advance the growth and commercialization of Smart Grid technologies and systems
- ❖ promote education on the advantages of Smart Grid technologies for U.S. and state government legislators and regulators, and consumers
- ❖ encourage private and public sector support for Smart Grid demonstration projects
- ❖ perform public advocacy on issues relating to the development and adoption of Smart Grid technologies and standards

NYC awards Columbia \$15 million for new data-science institute



L'université s'est engagée à lever au moins 80 millions de dollars dans le secteur privé et à recruter 75 nouveaux professeurs et assistants pour l'institut d'ici 2030. Ces derniers interviendront sur toutes les disciplines en dehors de l'ingénierie, à la recherche de solutions à des problèmes concrets via l'analyse de très grands jeux de données.

Une analyse de l'impact économique réalisée par l'Economic Development Corporation de New York projette que l'institut générera 3,9 milliards de dollars d'activités pour la ville au cours des trente prochaines années, rapporte la revue Columbia.



Novembre 2013

While standards and conformity assessment programs are well developed in many of these specific areas, a clearly delineated and integrated set of overarching standards and conformance programs is needed to achieve the vision of a smart and sustainable city. In March 2012, ISO established TC 268, *Sustainable Development in Communities*; in February 2013, ITU established a *Focus Group on Smart Sustainable Cities*; in June 2013, IEC formed a *Systems Evaluation Group on Smart Cities*, and this November ISO/IEC JTC1 will consider the formation of a study group on smart cities.

Smart City in INDIA



Latin America | Middle East | Business | V

July 18, 2014

Cities of the future? Indian PM pushes plan for 100 'smart cities'

Last week, Modi's government announced a \$1.2 billion investment in smart cities over the next year, with more funding coming from private investors and abroad.

SMART CITY in UK



**New initiative to support \$40 billion
smart cities in the UK**

October, 9, 2013

Smart City JAPAN

FINANCIAL TIMES

December 3, 2012 5:29 pm

Smart cities: Tsunami brings rethink on sustainability

By Sarah Murray



“Before Fukushima, the drive towards smart cities and towns was to catch up on the innovations in countries outside Japan and to strengthen core Japanese industries and their global market potential,” says Nobuko Asakai, who leads the sustainability practice in Japan for Accenture, the consultancy. The firm is working on projects in cities such as Yokohama, Fujisawa and Fukushima.

“The earthquake changed the agenda,” says Lluís Gomez, director of international business at the Smart City Expo World Congress and co-ordinator of the November 2012 event’s Japanese delegation. “They have to change the model.”

Rio de Janeiro Smart City

IBM, January 2011



Rio Operations Center (control room)

- Initial focus was floods, soil sliding and emergency
- The scope considerably extended to: transportation, water, weather and energy



Smart City in Africa

Deloitte.

2014

Africa is ready to leapfrog
the competition
Through Smart Cities
Technology

According to the African Development Bank Chief Economist Mthuli Ncube “it’s the middle class that drive demand in an economy,” as it is the middle class who have the greatest disposable income.

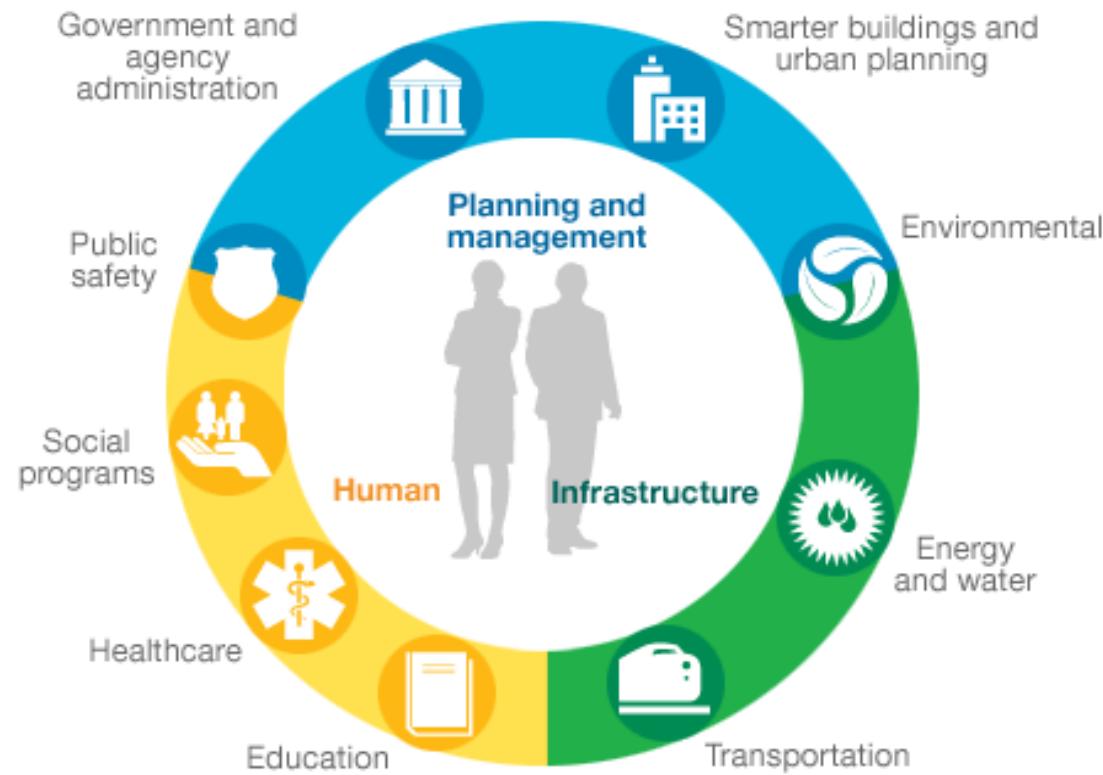
One could argue that the biggest driver launching the African continent into the twenty first century is the rise of the African middle class.

The past five years
have seen Africa
experience the fastest
telecoms growth
worldwide.

Due to increased access to connectivity and the associated predicted urbanization, African cities are going to have to start focusing on what the city of tomorrow will look like. African cities are well positioned to leapfrog into the mid-21st century. Without the successful adoption and appropriate selection of technology, African cities will indeed be left behind as more and more Africans look for brighter futures on other continents.

So if Africa is being referred to as “the next big market” by multinational IT companies, and it can immediately enhance the quality of life for the citizen, the private sector and the public sector alike, the question that begs an answer is why isn’t it happening faster?

IBM



ICT for Connected Urban Development

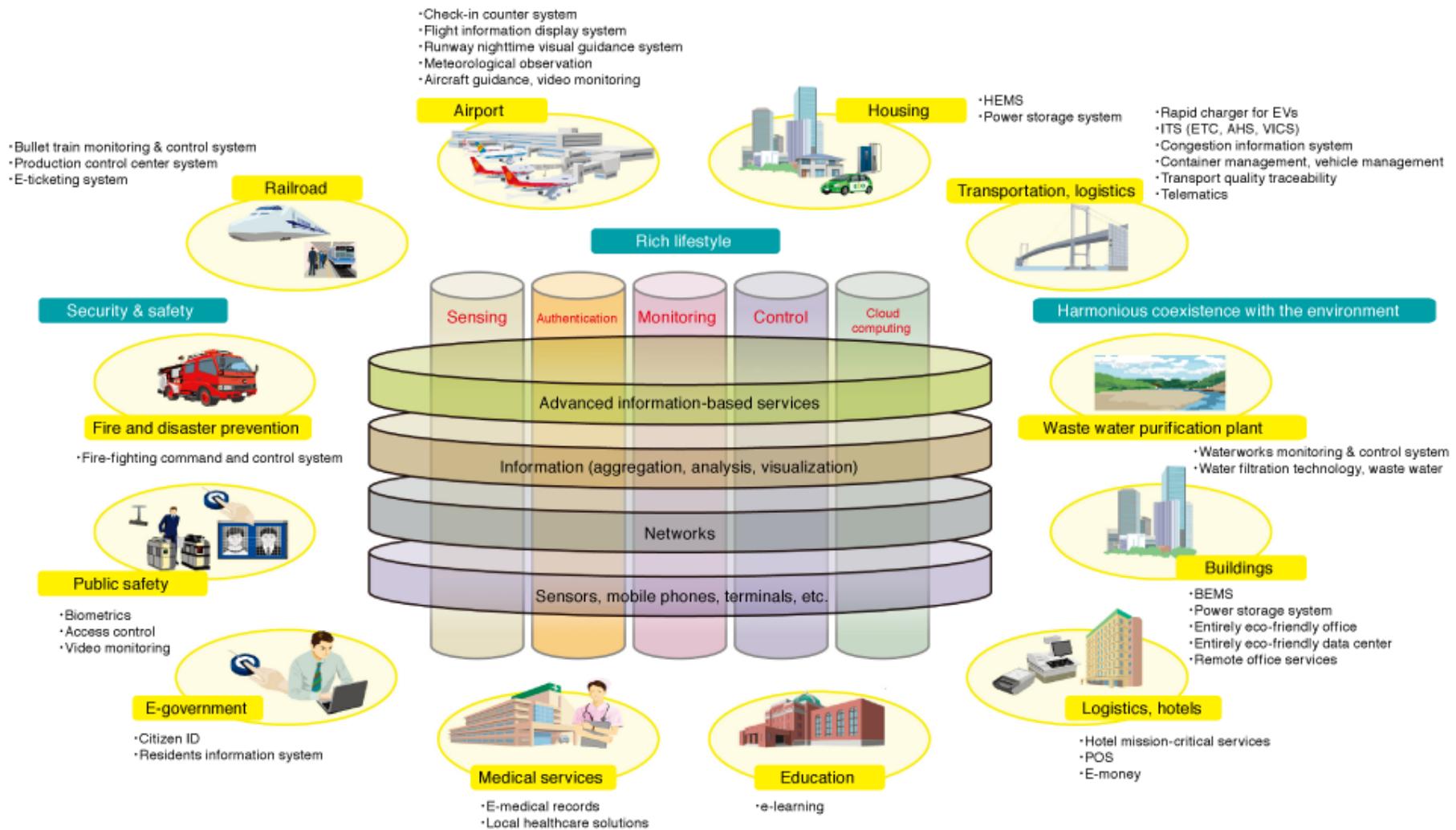
A CISCO Blueprint for Smart and Connected Communities



Broadband Platform

IP-Enabled Homes and Offices, Roads, Utilities, Workplace Design

NEC helps realize Smart Cities by offering five leading technologies:



www.forbes.com

June 19, 2014

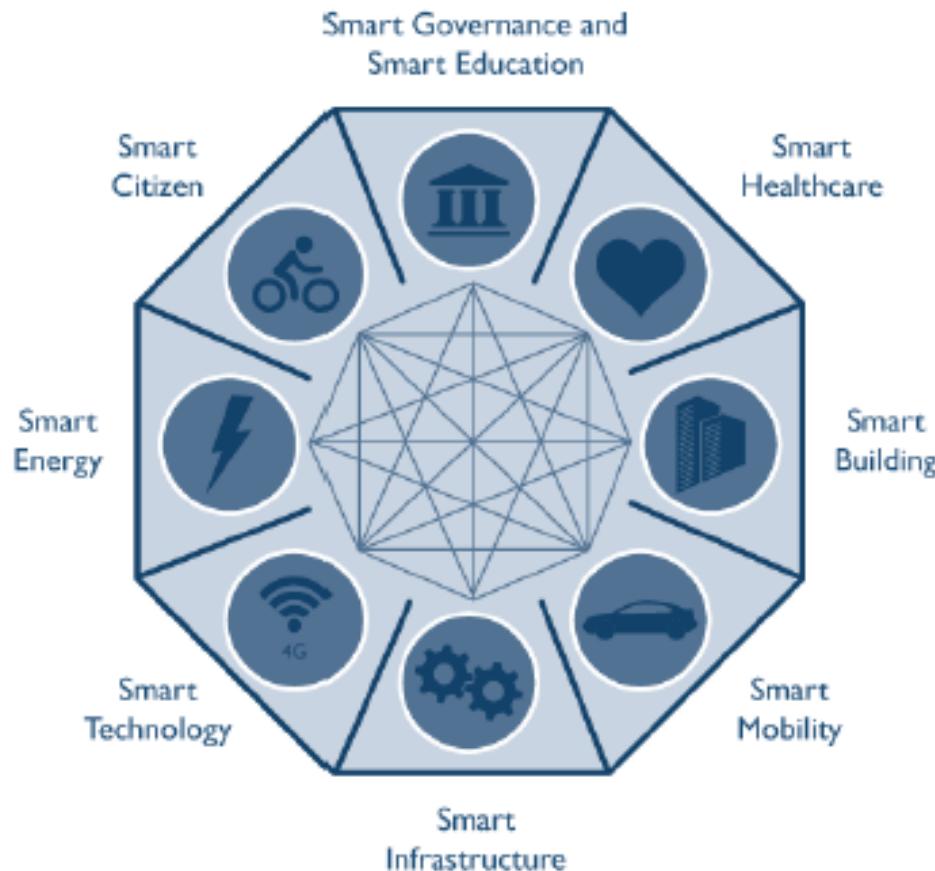
Sarwant Singh

AUTOS (/AUTOS) 6/19/2014 @ 5:07PM | 8 557 views

Smart Cities -- A \$1.5 Trillion Market Opportunity

<http://www.forbes.com/sites/sarwantsingh/2014/06/19/smart-cities-a-1-5-trillion-market-opportunity/>

SMART CITY CONCEPTS



There are several Smart City projects out there like Masdar (<http://www.masdar.ae/en/#city>), but these are too small in our definition to be termed as an actual city. In 2025, it is expected we will have around 26 global Smart Cities which will feature five of the eight aforementioned parameters. Around 50 percent of these will be located in North America and Europe.

The establishment of
a Smart City is not a
one stop process: it is
a journey.

Big Data and Smart City

Big data :

Set of technologies and practices to:

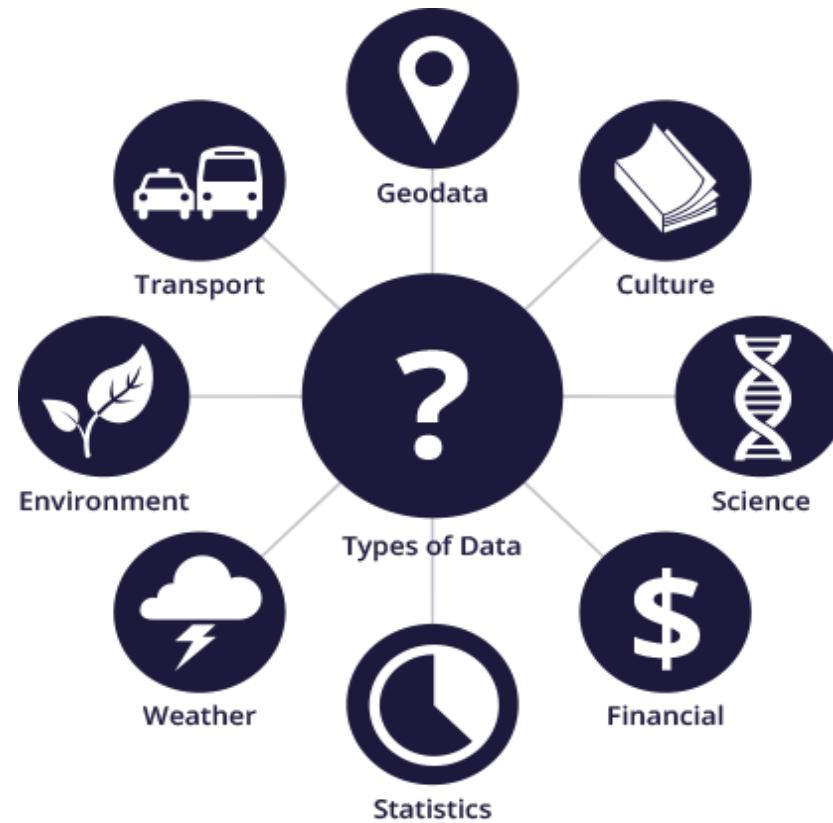
- Collect and store large amounts of data
- Analyze large and varied data very quickly.

Big data :

- **Enormous amounts of both structured and unstructured data,**
- **Difficult to manage with conventional storage solutions and treatment.**
- **They come from various sources and are (mostly) produced in real time.**

Open data :

Open data : data that can be freely used, shared and built-on by anyone, anywhere, for any purpose.



Requirements for open data

Legal openness: you must be allowed to get the data, to build on it, and to share it.

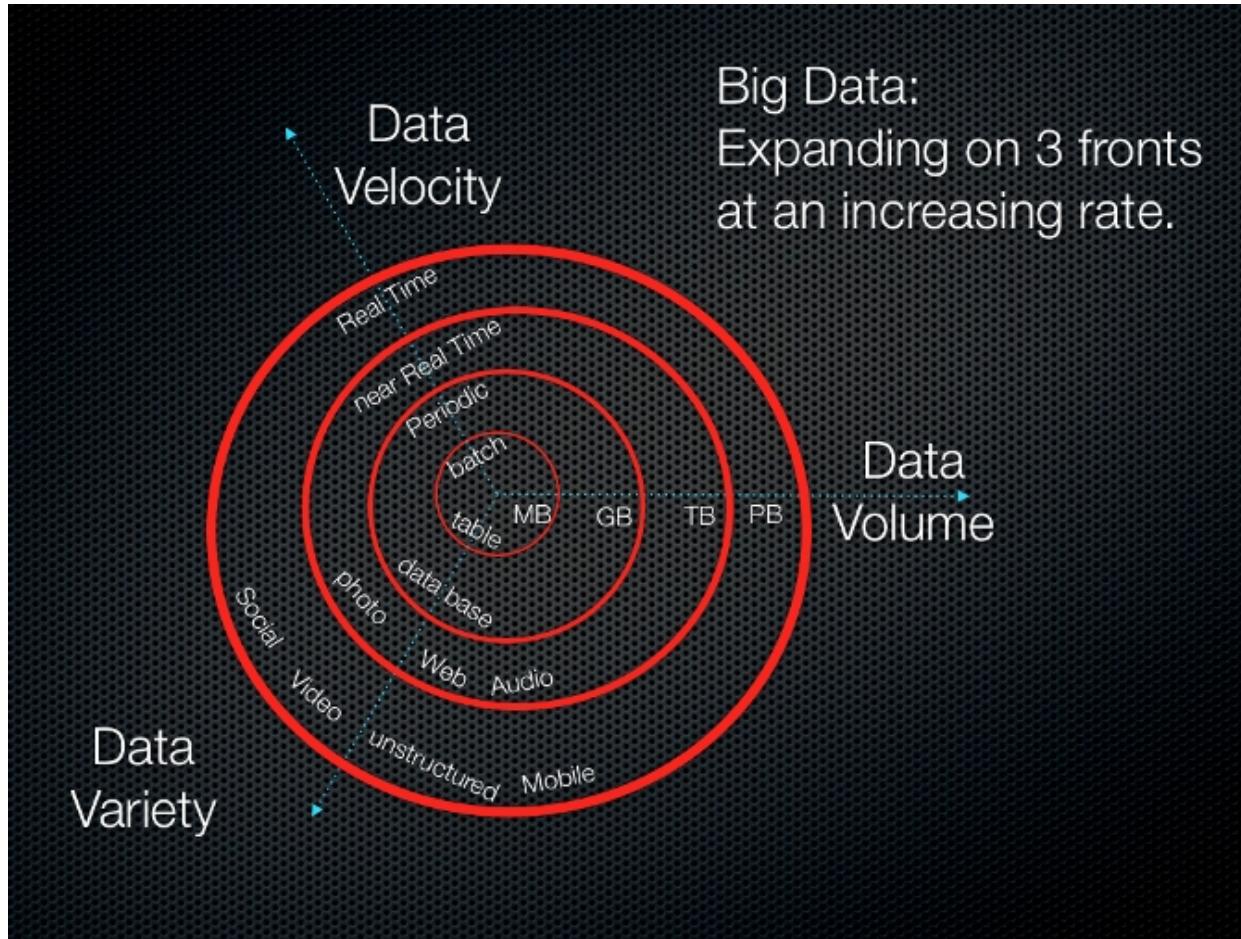
Technical openness: there should be no technical barriers to using that data (machine readable)

Big Data : major role in the society of tomorrow

- Research, Education,
- health
- Sustainable development, transport,
- security
- Marketing, customer services,

Big Data - the 3V :

Variety, Velocity and Volume.



4th "V" = Value

Big Data has an important societal or (and) economic value

Data Analysis of Big data

Objective:

- Understanding complex phenomena
(Research,...)
- Elaboration of socio-economic strategy
(health, education, transport, ...)
- Process optimization
- Understand customer expectations,
- Establish business strategies

Big Data Mining profession

Complex profession requiring:

- Group work (data providers, users, Math, info, Applied Sciences,...)
- Good scientific background,
- Knowledge of methods of data analysis,
- Good knowledge of computer technology
- Taste for "business" application

Personal data

EU Data Protection Directive (95/46/EC) :

« Personal data » : any information relating to an identified or identifiable natural person

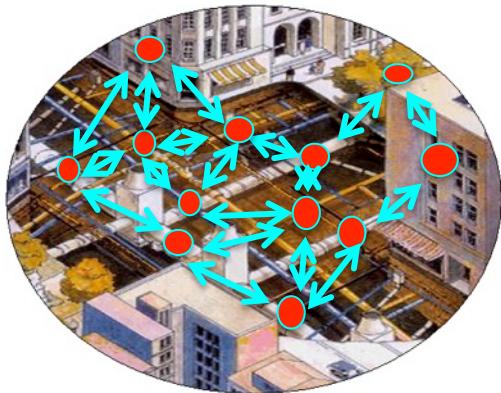
Identifiable person : who can be identified, directly or indirectly, in particular by reference to an identification number or to one or more factors specific to his physical, physiological, mental, economic, cultural or social identity.

Handbook on European data protection law



Big Data Movies : B1 to B5

Smart City Implementation



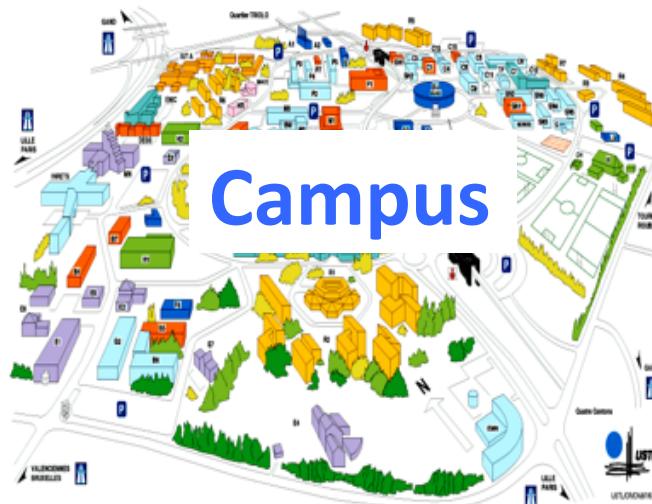
Health, Education
Art, Culture, commerce,



City Big Data



Implementation of the smart city ?



The establishment of
a Smart City is not a
one stop process: it is
a journey.

The Smart City implementation journey

Step 1: Establish the need and strategy

- Understand the need and the challenges of the city (urban system) and how the SC concept could respond to these challenges.
- Based on the diagnostic phase, establish a multi-phase strategy with milestones
- Establish a government model for the smart city

The Smart City implementation journey

Step 2 : Data collection

- Data concerning the physical urban infrastructures (Geographic Information System GIS)
- Smart Monitoring of urban infrastructures (*smart sensors and actuators*)
- Data concerning the urban environment as well as urban usages

The Smart City implementation journey

Step 3 : Communication

Build real time bi-directional communication with urban system as well as with the city stakeholders :

- Combining wired and contactless technology,
- Heterogeneous sensors and protocols,
- Reliability, Cyber security,
- Energy saving

The Smart City implementation journey

Step 4 : Data analysis

- Technology and software to store and analyse huge amount of data (Big Data) (real-time)
- Develop prediction model based on the historical and geo-localized data

The Smart City implementation journey

Step 5 : Protocols

Establish protocols for

- Optimal management,
- Crisis management,
- Implication of end-users
- New services (business)

The Smart City implementation journey

Strategy for policy-makers

- Use the data, analytics,... to establish urban development and investment strategy
- Innovate in the socio-economic model (taxes, private-public partnerships, social aid,...-

The Smart City implementation journey

Iterative procedure:

