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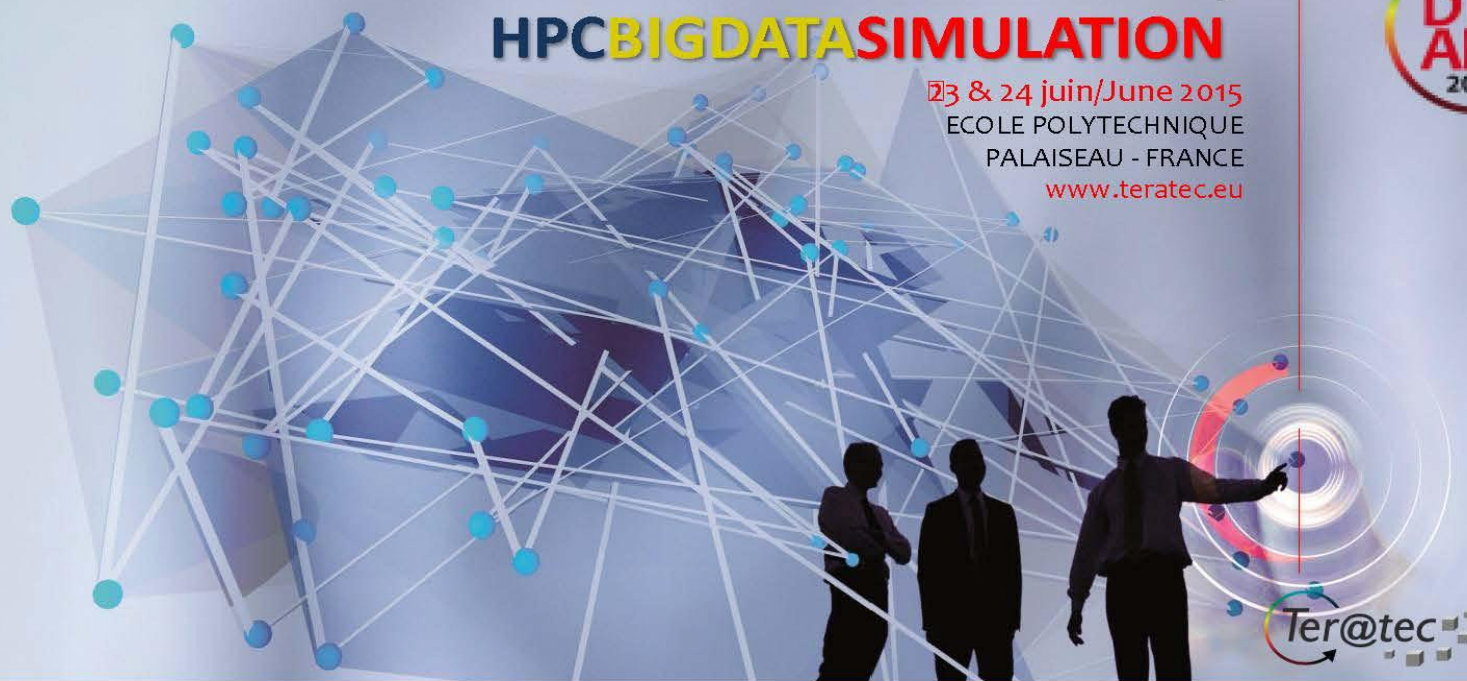
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Modélisation et données pour les Systèmes Urbains
Big Data for Urban Systems
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A view on some key innovative digital technologies for the future European smart cities

Une introduction à des technologies numériques clefs pour les villes intelligentes Européennes de demain

Alain ZARLI - CSTB - Information Technologies and Knowledge Dissemination



Aim & outline

- *This presentation is an introduction to the conditions to transform European cities into more sustainable places by reducing energy use, carbon emissions, congestion, etc. – considering unavoidable trends towards knowledge-intensive societies and economies. Such a transformation fundamentally relies on Information and Communication Technologies (ICT), and will require managing massive sets of data and information, as well as the appropriate underlying technological frameworks. The presentation will further introduce to one of the key instruments put in place at European level so as to more collaboratively encompass the challenges raised by smart cities, namely the EIP SCC - European Innovation Partnership for Smart Cities and Communities - launched by the European Commission in 2013. It will continue with some insights of key added-value technologies in the frame of future smart districts and cities, introducing to the brainstorming achieved in the EIP SCC around open data, and the need for urban platforms and digital mock-ups – with presentation of such one urban platform currently under development within CSTB, which is a software toolkit to manipulate BIM models at building and district scales, interface GIS/BIM standards and interface them with sectorial urban simulation engines (for energy, environment, noise, air quality...) – allowing to support, via a multi-criteria dashboard, urban sustainability during conception, decision, consulting and communication, for urban stakeholders.*
- **Presentation outline**
 - (quick introduction to) CSTB
 - Smart city: targets, ICT challenges, data management, Big data & IoT...
 - The EIP SCC (European Innovation Partnership on Smart Cities & Communities)
 - Urban digital mock-up
 - Conclusion



CSTB: the Scientific and Technical Center for Building

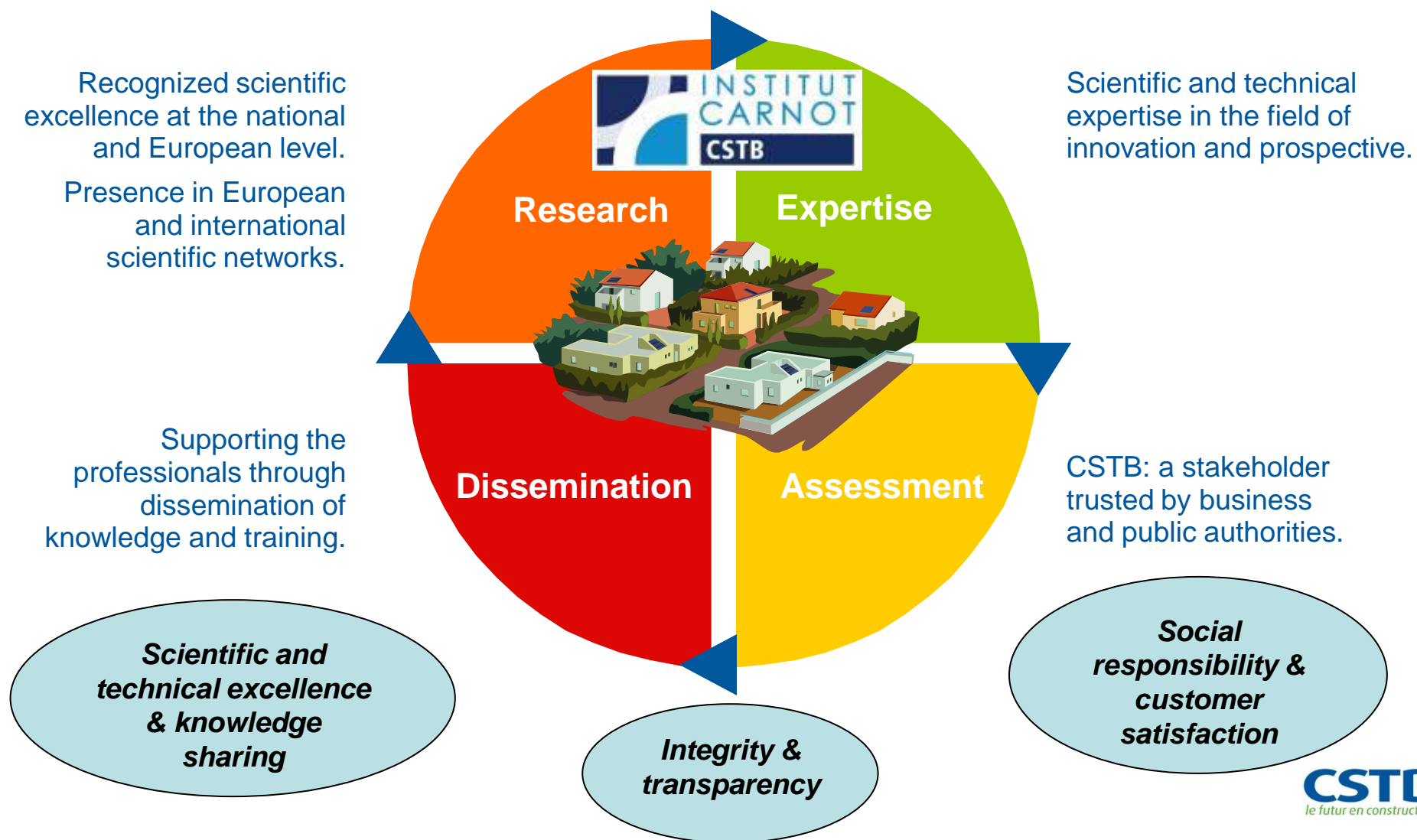
The CSTB mission is to gather, develop and share with construction professionals the scientific and technical knowledge crucial for improving the quality and safety of buildings and their environment.

Its professional support role is a priority, and the work it does is organized in such a way as to be accessible to all construction industry stakeholders and partners.

Building the future

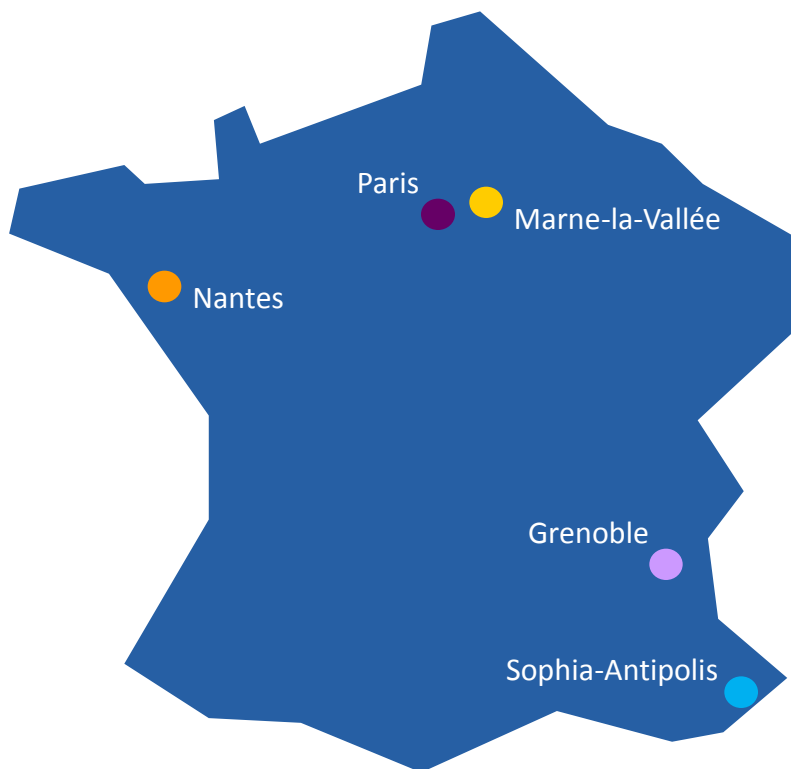
CSTB: 4 key activities with 3 values at the heart

=> Answering to ecological and energy transition challenges



CSTB Premises

Multi-disciplinary teams on the whole territory



Marne-la-Vallée

Head office

- Energy-Environment
- Health-Comfort
- Envelope and Roofing
- Insulation and Cladding
- Safety, Structures, and Fire performance
- Hydraulics and Sanitary Equipment
- Information Technologies and Knowledge Dissemination
- OQAI (Indoor Air Quality Observatory)

Bâtiment Bienvenüe

- Economics and Social Sciences

Paris

- Professional training centre
- Certivéa, Céquami, Cerway, subsidiaries of CSTB group

Nantes

- Climatology, Aerodynamics, Pollution and Purification
- Health-Comfort (lighting)

Grenoble

- Energy-Environment
- Health-Comfort (acoustics, lighting, electromagnetism)
- Insulation and Cladding
- Envelope and Roofing
- Information Technologies and Knowledge Dissemination
- Acoustb, subsidiary of the CSTB group

Sophia-Antipolis

- Information Technologies and Knowledge Dissemination
- Envelope and Roofing
- Energy-Environment

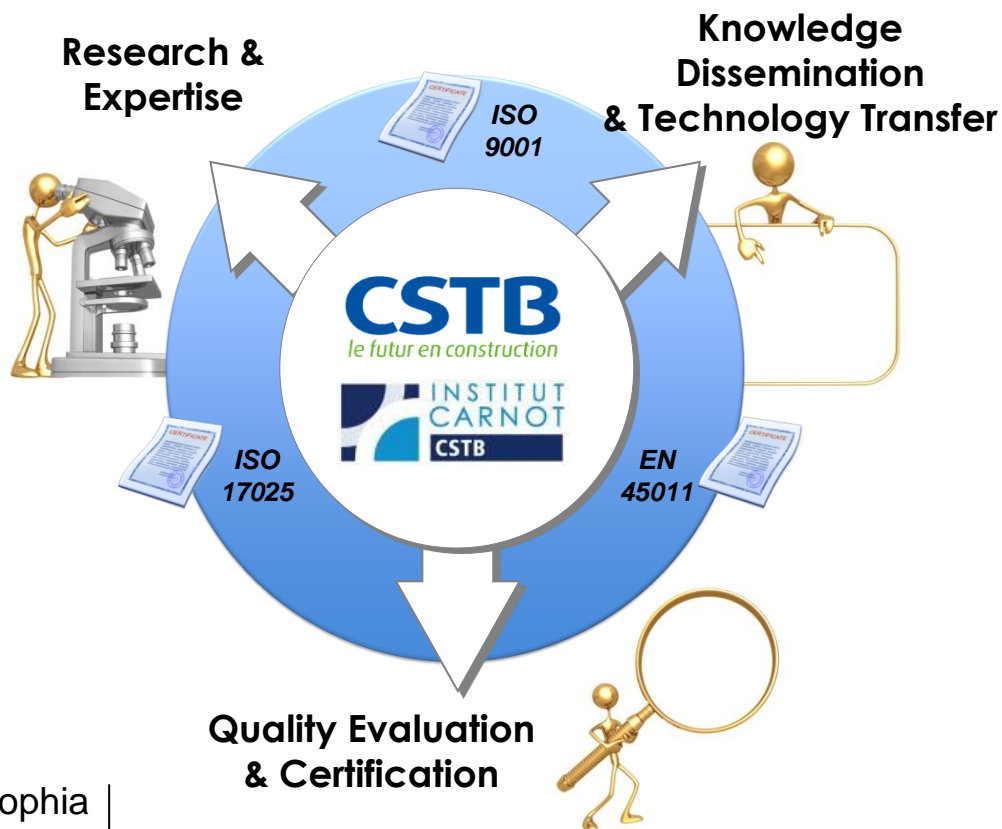
CSTB know-how, expertise, large-scale facilities...



Nantes



Sophia
Antipolis



Champs
sur Marne
(Paris)



Grenoble





Energy-efficient neighborhoods, districts & cities

– *do we have some common definitions?*

- ❑ Object – what is exactly the considered spatial dimension?
 - *Neighbourhood: scale at level of a group of adjacent buildings;*
 - *District: integrates a set of connex buildings, public spaces, roads, vehicles, undergrounds, and networks (in a broad sense) + inhabitants, users (e.g. commuters), and administrators / managers;*
 - *City: a network of connected districts – with potential interfaces...*
- ❑ Potential factors to be considered
 - *Spatio-temporal synergies inferred by a usage mix (including mutualisation of energy production and recovery);*
 - *Physical interaction – direct (e.g. umbrage common wall) or indirect (through any kind of network) – inter-buildings;*
 - *Energetic expenses related to public spaces (e.g. urban lighting);*
 - *Energetic retro-actions district / environment;*
 - *Mobility.*
- ❑ Objectives for EE districts/cities – *from an ICT point of view*:
 - To develop, integrate and deploy ICT tools:
 - *gathering & analysing **data & information** and supporting **decision-making** (e.g. through simulation) specifically for the district / city scales*
 - *contributing to “decarbonate” the balance energy / greenhouse gases with respect to:*
 - *operating the district;*
 - *transforming the district.*



Smart districts & cities: key (ICT) challenges

■ *Need for:*

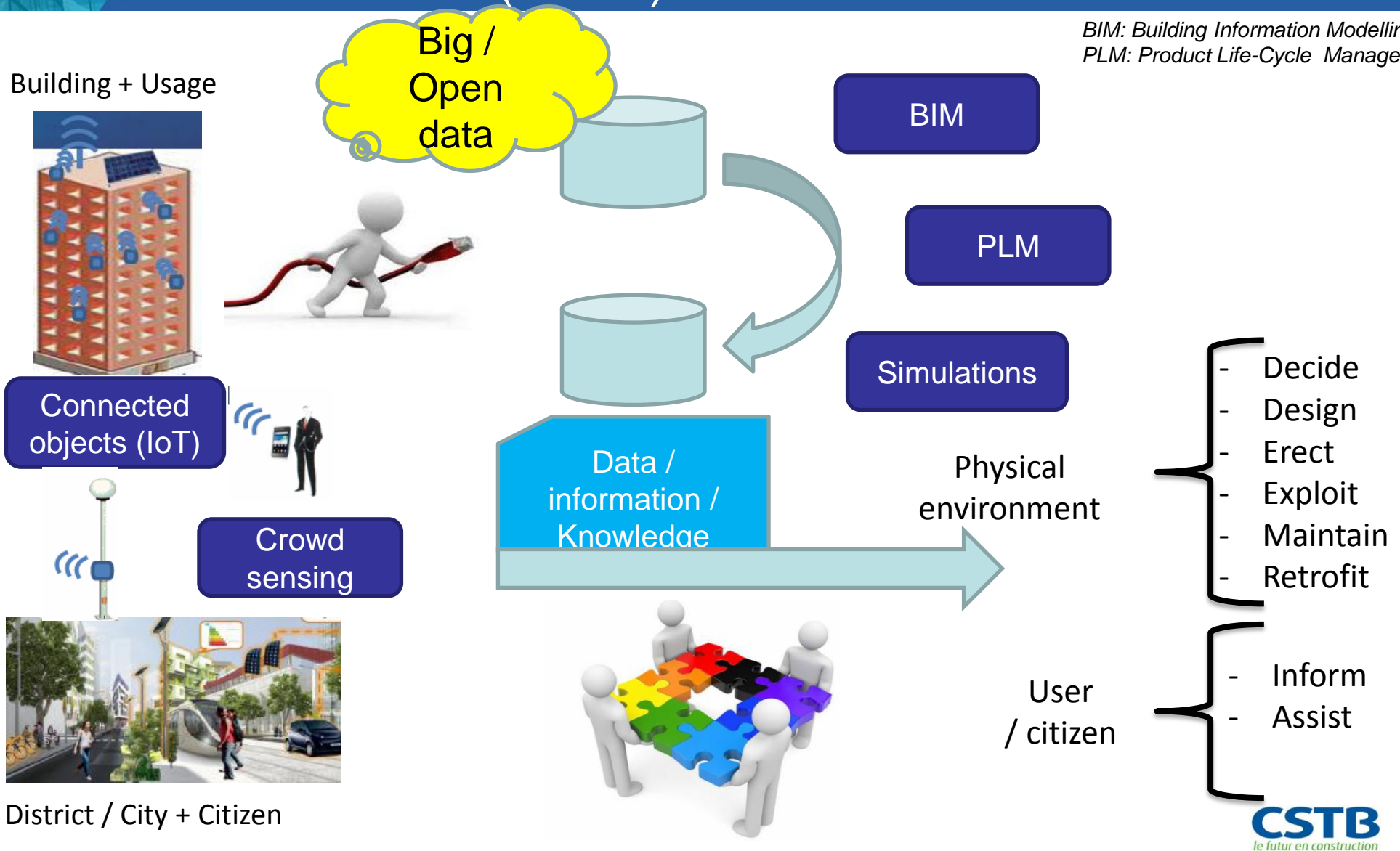
- Having an integrated modelling of the district / city
- Acquiring, analysing, managing (huge sets of) data / information

■ *Requires:*

- Collecting but also structuring and sharing the information (data)
 - e.g. between different city services → *support to decision making*
- Delivering interoperability between the various services and systems
- Providing with the ability to deal with:
 - Data “mass phenomenon” (Big Data)
 - Data access (along with data storage systems)

Smart districts & cities: data management for (smart) built environment

BIM: Building Information Modelling
PLM: Product Life-Cycle Management





Big Data for smart cities – WHY?

- ▶ Enormous amount of data in the public / private sector being of high value for:
 - ▶ better understanding the (complex!) dynamics in a city,
 - ▶ developing new families of value-added services & applications that directly reach out various business sectors and the (critical mass of) citizens,
 - ▶ new generation of decision-support & monitoring systems which in turn helps to govern fast changing, dynamic & mobile society.
- ▶ And as a key resource for:
 - ▶ New assets for cross-cutting innovation nurturing & co-creation for multiple services domains of the (smart) cities – integrating data at all levels (local, regional, national and EU...)
 - ▶ New ways towards cities, customers and companies engagement

Smart districts & cities: Big data & IoT (1/2)

■ Garbage Data

- Big Data *not necessarily* Better or Best data...
- Unlock **value** from the vast quantity of data being generated by the smart devices permeating our homes, buildings, factories, & cities
- IoT can generate device connectivity + big data, but key aspects are:
 - Data description (ontologies, rules...)
 - Data granularity
 - Accuracy of the data
 - Actionning the data

Data qualification

Intrinsic

Correlated

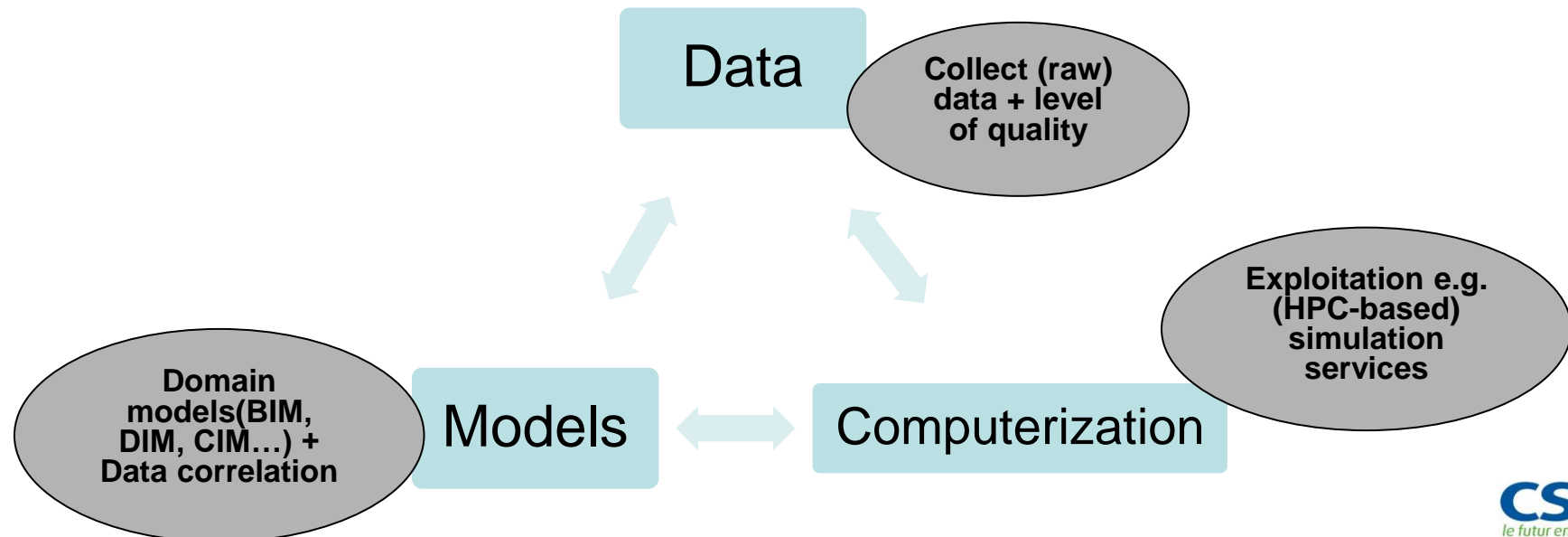
[...]

Auto-correlation
 $V + t$

Inter-correlation
 $V_1 + V_2 \dots + V_n$

Smart districts & cities: Big data & IoT (2/2)

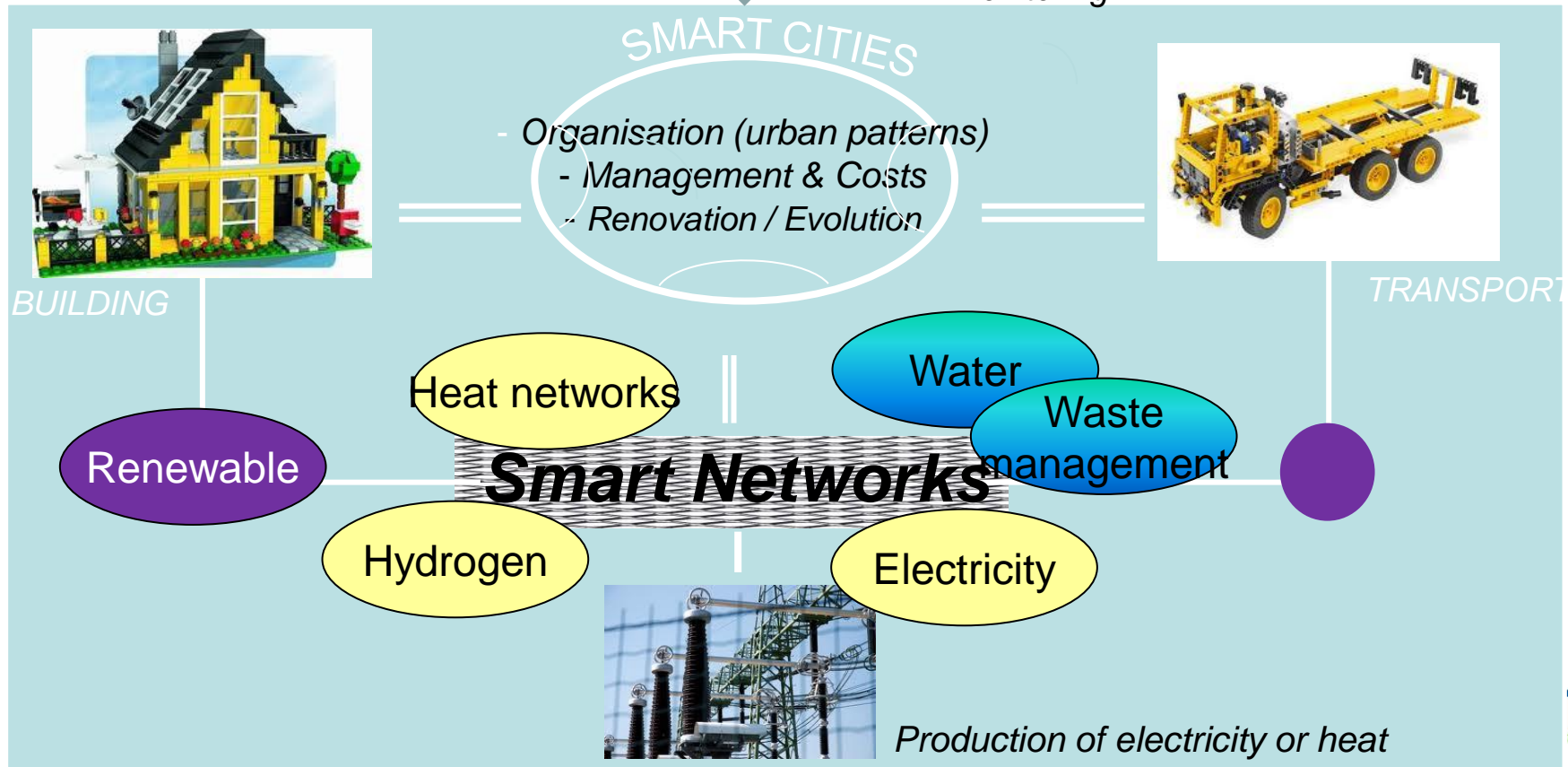
- Management of static & dynamic Data / Information from **various & heterogeneous sources** (BIM, GIS, Web services, IoT, Big / Open data, crowd-sensing, ...crowdsourcing?...) to deliver value-added apps and services
- **Data contextualisation** for decision-making re. customer demand for smart buildings & districts – e.g. demand/supply, assessment of (building & district) performance,...



Smart city: integration of technologies

- Modeling & simulating complex systems
- Models of USAGE
- Models of TRANSITION
- Data / information standardisation & openness
- New business and financial models, public-private partnerships...

- Infrastructure / interoperability – including data security
- Scalable integrated design, simulation and multi-criteria optimisation - Decision making-support – Supervision
- Interfaces (to all users) / Dashboards
- Indicators framework for system evaluation / monitoring



EIP SCC - European Innovation Partnership on Smart Cities and Communities

- An initiative supported by the European Commission (DGs ENER, MOVE & CONNECT) coping with innovation deployment in (European) cities & facilitation of partnerships:
 - Sustains active collaboration of all relevant actors alongside the value chain, including city authorities, public utilities, companies, and research institutions
 - Aims at Cities being pioneers in developing new forms of partnerships & innovate in procurement and finance, planning and management processes along the way.
- A stakeholder-driven initiative:
 - Its steering body is a High-Level Group comprising key European stakeholders from cities, the ICT, energy & transport sectors as well as civil society & research
 - Supported by Commissioners for the Digital Agenda, for Transport, for Energy
 - Adoption of:
 - An **EIP Strategic Implementation Plan (SIP)** in October 2013, defining the overall goal: a significant improvement of citizens' quality of life, an increased competitiveness of Europe's industry & innovative SMEs together with a strong contribution to sustainability and the EU's 20/20/20 energy/climate targets
 - An **EIP Operational Implementation Plan** – detailing the SIP & preparing for Commitments.

EIP SCC – a SIP with 11 Action areas

- For now, the EIP focuses on solutions integrating ICT, energy and transport and mobility sectors in the urban context → *the EIP SIP has identified 11 focus areas and recommended actions in each of these so as to achieve mentioned objectives*





Big Data for smart cities – key challenges

- ▶ Acquisition models & pertinence of Big Data
 - *Big Data exhaustiveness, quality & trust*
- ▶ Processes to make data accessible in a transparent way whilst fully respecting privacy and security
 - *Big Data IPR & regulation*
- ▶ Standards & APIs for Smart Cities Big Data
 - *Big Data integrated portals & frameworks*
- ▶ Business models to incentivise Big / Open Data in *data service delivery*
 - *Data reward (not just mere data ownership)*
 - *KPIs on availability, quality, and added-value*

The *Digital Mock-up* to support sustainable cities - Context

- **City scale = systemics approach**
- **Sustainability = multicriteria approach**
- **Confusion of decision-makers**
 - Too many criteria to manage
 - Trust / reliability in OpenData, BigData ?
 - Participative (OpenStreetMap...) ?
- **Expectations**
 - A need for reliable data
 - A need for integrative expertise
 - A need for complexity management
 - A need for communication / participation
 - *A need for partnering the whole set of required expertise*

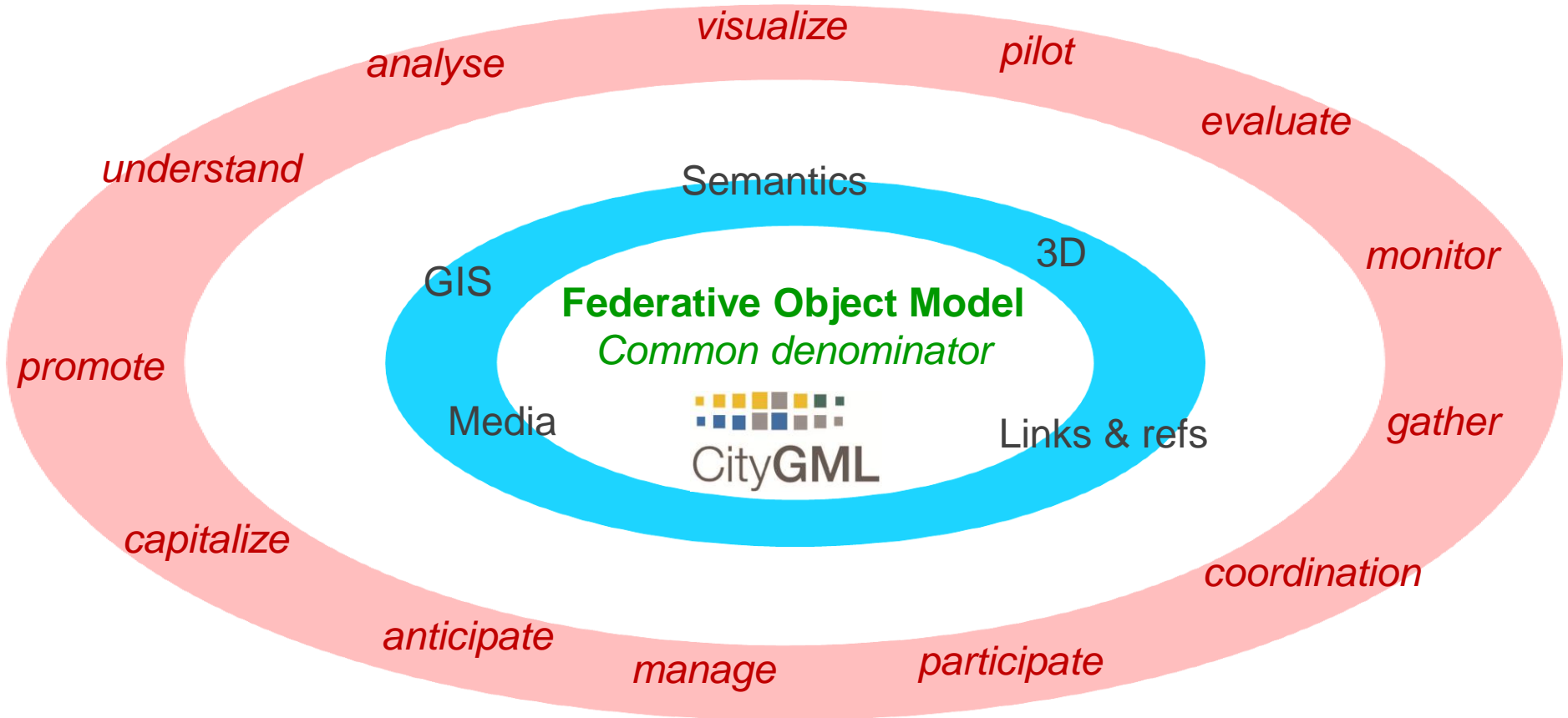




The *Urban Digital Mock-up* to support sustainable cities – A vision by CSTB (1/2)

- Digital city (mock-up) to support sustainable city
 - An intuitive and modern way to understand things
 - A reference tool to *store, promote, visualize, simulate, analyse, compare, evaluate, manage, participate, interact, monitor ...*
- A common denominator for multi-criteria expertise
 - Unified model between 3D, GIS and sectorial semantics
 - Gather actors and expertise: less duplication in public processes
- Extending the BIM concept to the urban scale
 - The BIM is a proven example that systemic usage of models leads to more efficient exchange and speeds up collaboration between projects.
 - Not the same actors...
- An accepted and standard open format: CityGML (OGC)
 - Open Format for geographics and semantics
 - Capability of domain extensions (ADE)
 - 5 Levels of details to manage with the complexity (LOD 4 = inside building)

The *Urban Digital Mock-up* to support sustainable cities – A vision by CSTB (2/2)



Step-by-step creation of the urban digital mock-up

LOD – Level of Details



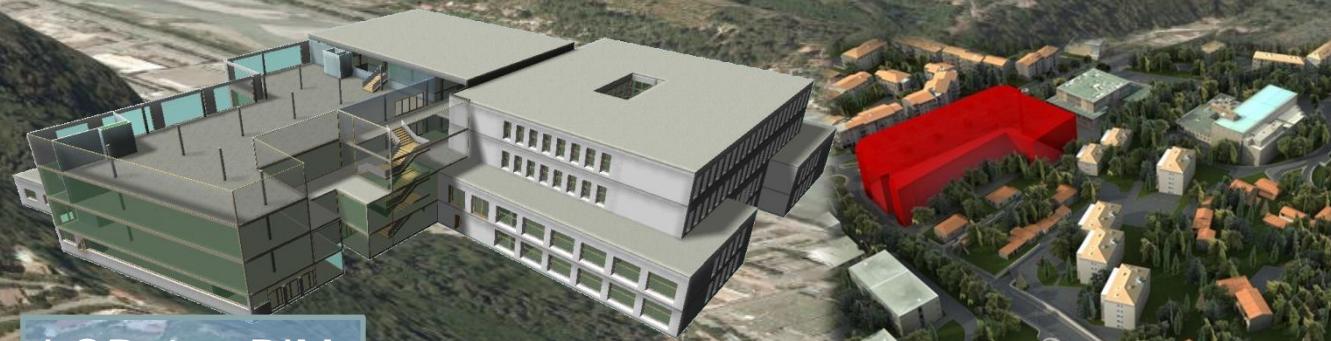
LOD 1 : "Semantics 2,5D"



LOD 2: "simple geometry"



LOD 3: "realistic geometry"

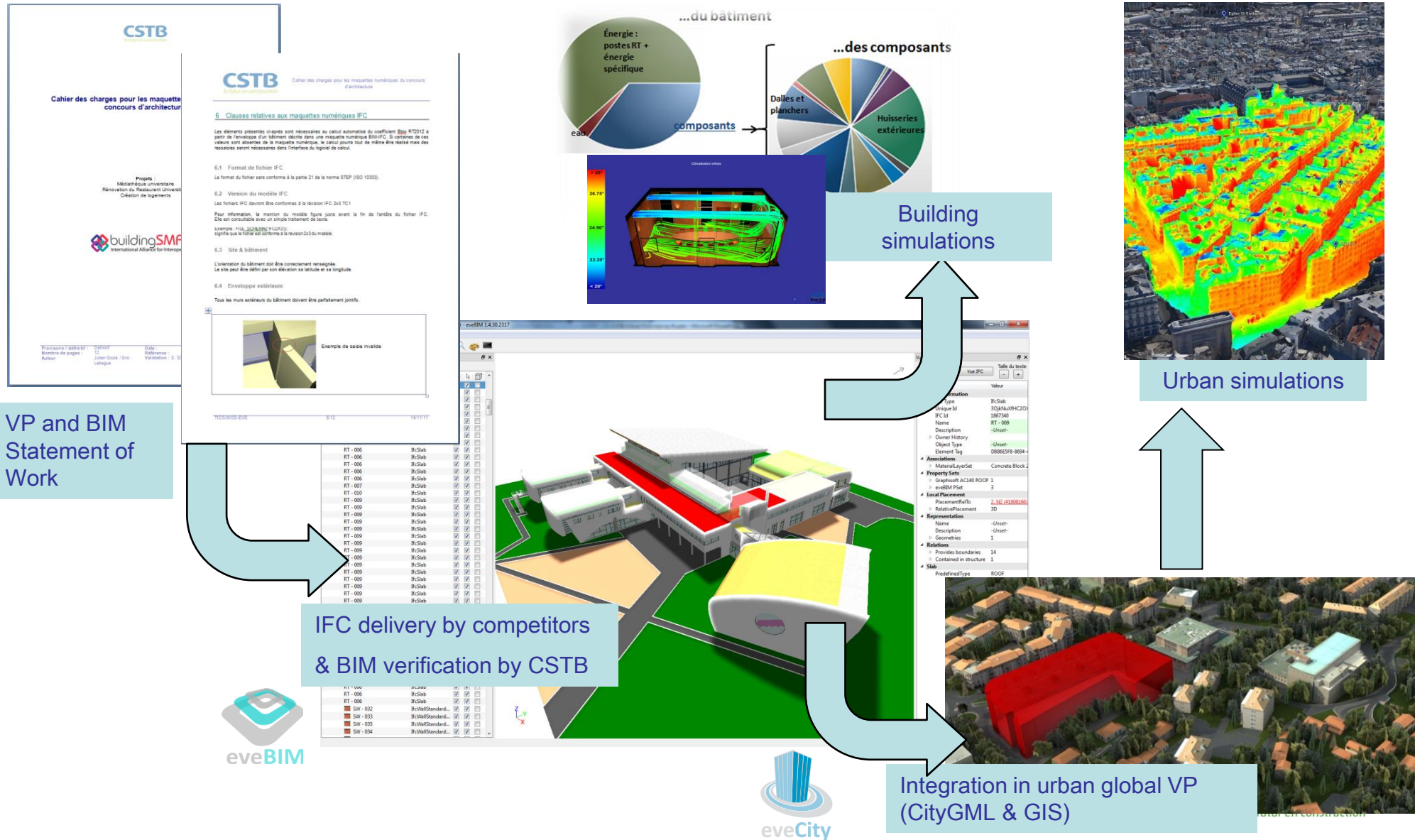


LOD 4: ~ BIM

Project insertion

LOD 0: "Digital Elevation"

Towards an integrative multi-scale process



The CSTB “eveCity” Software

■ Objectives

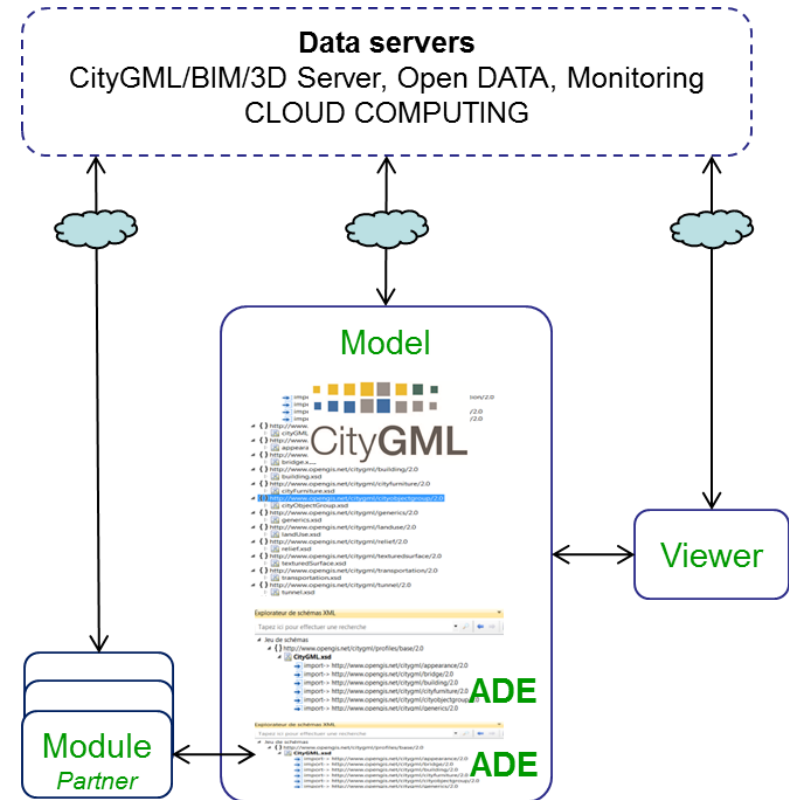
- Prototyping R&D
- Hosting innovative tools
- Multi-domain evaluation
- 3D dashboard

■ Viewing capabilities

- 3D interactive navigation

■ Coupled simulations

- Through CityGML mock-up
- Experts Modules
- Real-time capabilities



The *Urban Digital Mock-up* as a support for “Urban information services”

■ **Organize urban information**

- Ensure reliability
- Understand sources, standards, quality, access...
- Harmonize information within CityGML standard

■ **Democratize digital mock-up for all**

- Automate production and semantization
- Enhance representation, understanding and user experience

■ **Towards the iCity**

- Monitor and pilot the city
- Simulable city to support political decision

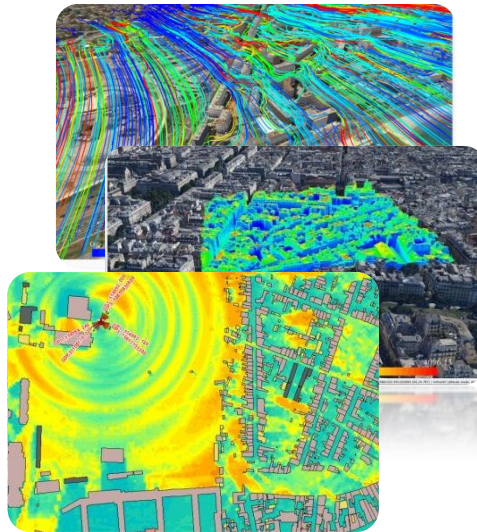
■ **Develop a digital platform of urban services**

- Tool dedicated to supporting and piloting a sustainable city
- Coherence and interoperability for multi-criteria evaluation



An innovative service for sustainable territories and cities: **DECISION 3D** - *From 3D City to simulated city*

Products (data & software)



3D blocks (250m x 250m)

Simulation results

- Solar potential
- Noise impact
- Pollution spreading
- Natural ventilation

Services



Training
Diffusion
AMOA, AMOE

Specific Production

- 3D blocks
- Simulations
- Developments



- Developments

DECISION3D

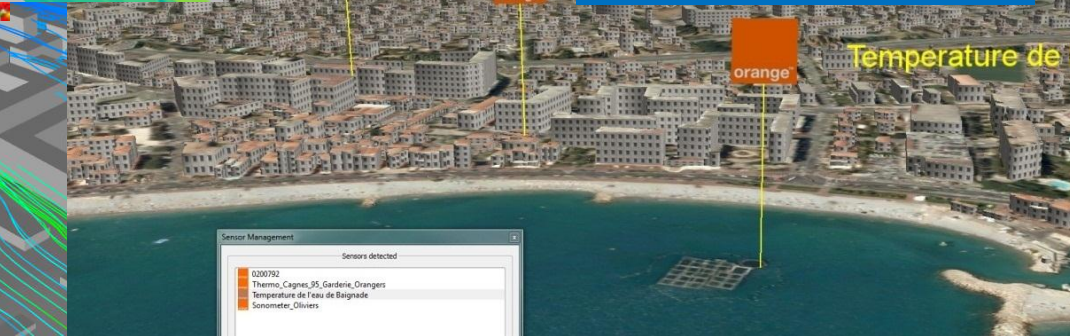
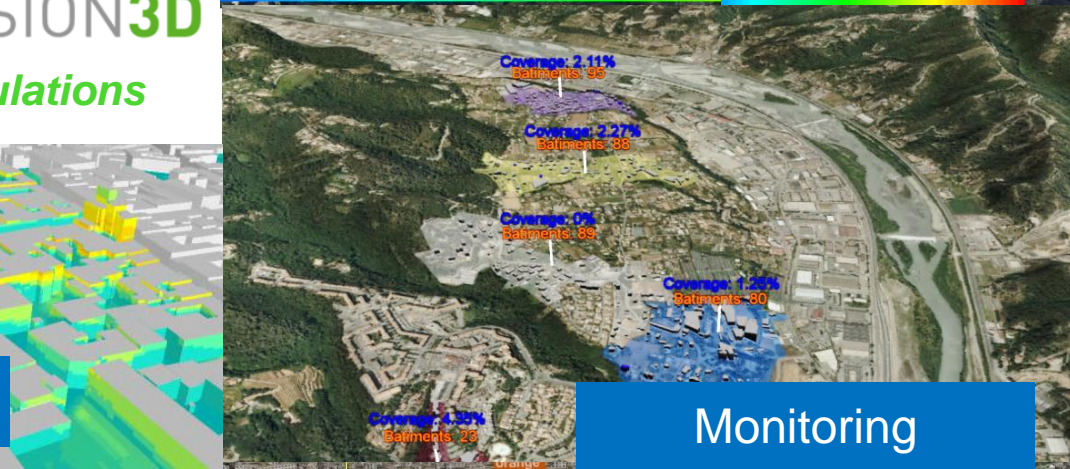
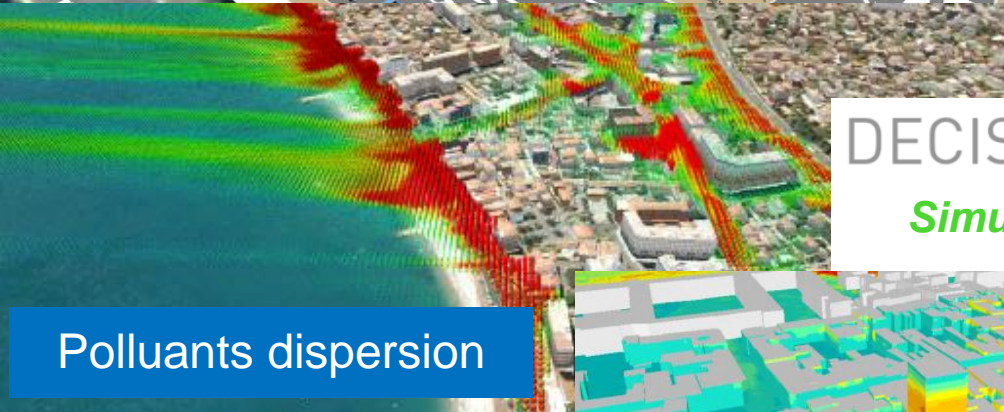
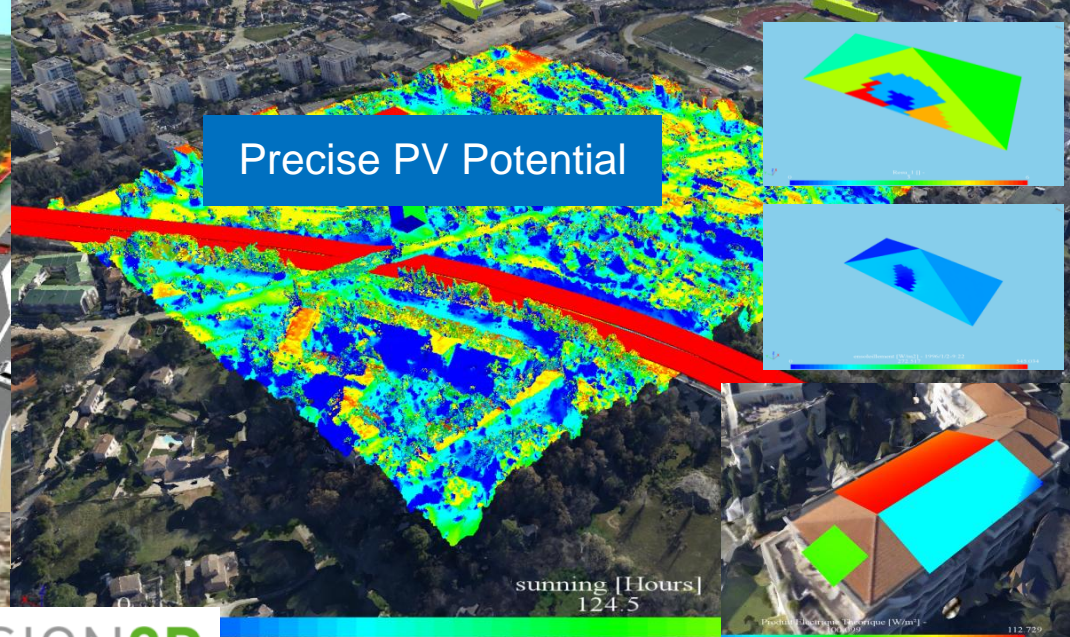
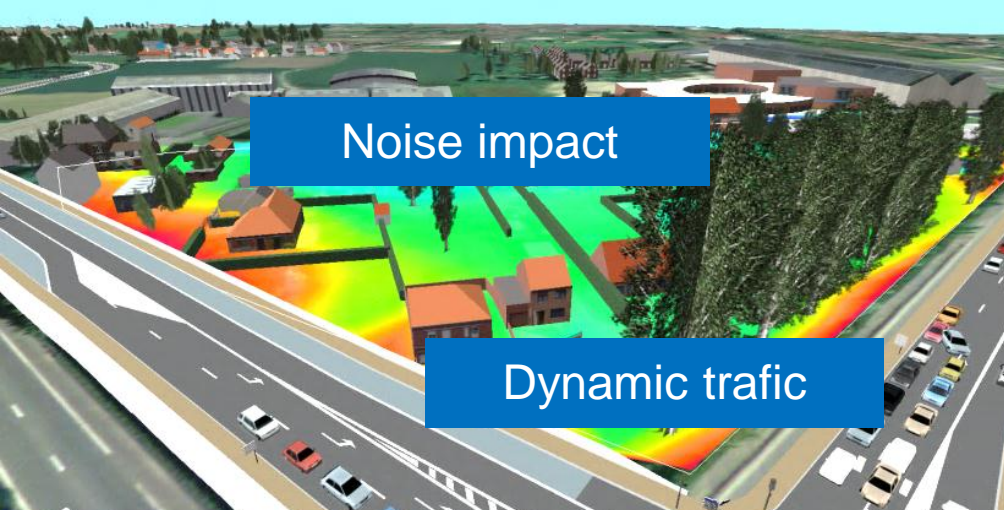
www.decision3D.com

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AERIAL DATA ACQUISITION





Conclusion

■ Information systems

- *Systemic approach*: system-of-systems, Holonic systems,...
- *Models & frameworks*: BIM (and CIM!), CityGML, IoT,...
- *Information*: massive data storage and manipulation, Open data,...
- *Technologies*: Cloud, Urban monitoring, Serious gaming,...
- *Algorithms*: sensitivity, global optimisation methods, multi-criteria simulations...

■ Need for integration & experimentation

- Experimentation of innovative tools & systems by *Local Authorities* – in the context of the enhancement of activities, missions and services provided by the cities
- Live large-scale experimentations – with front runners cities / urban areas as potential (“in-vivo”) living labs

■ Key game changing actions / radical innovation

- Data models interoperability (integration) and aggregation (levels of districts, communities, cities, regions, region clusters, etc.)
- Data models transformation for visualisation with a citizen value

Thank you for your attention!

Questions...

Want to get
MORE INFO?



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