

# LAAS-CNRS

Laboratoire d'analyse et d'architecture des systèmes du CNRS



## About On-going Research in CPS and IoT at LAAS-CNRS and Some Links to Dependable and Secure Computing

Jean Arlat



Laboratoire  
conventionné avec  
l'Université de Toulouse

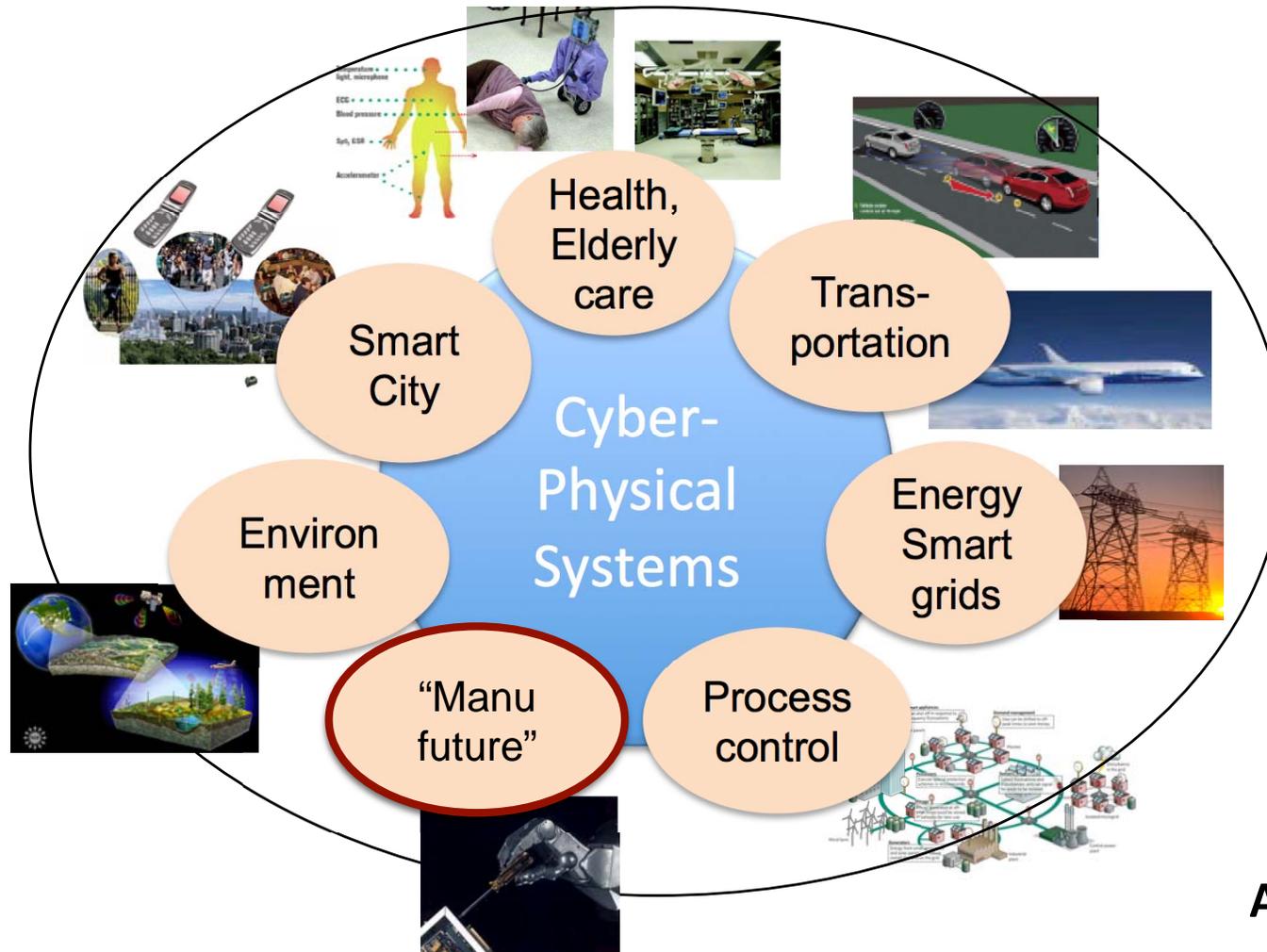
68th IFIP WG 10.4 Meeting — Buzios, RJ, BR — June 26-28, 2015



# Moving Towards a New Paradigm: CPS (Cyber-Physical Systems)

- **Embedded Systems with Some “Extensions”:**
  - **Strong Interaction between the Information/Data and Physical Resources levels:** Intensive deployment of smart objects (sensors, actuators) to build up/enhance **Context Awareness**.
  - **Openness: Communication, Mobility,...**
  - **XXL Data Sets: Storage, Processing, Decision, Optimization,...**
  - **Autonomy: All-in-one (monitoring-decision-control) Systems: Robot**
  - **Dependency, Acceptability, Trust:** Strong requirements in dependability/resilience, security & privacy

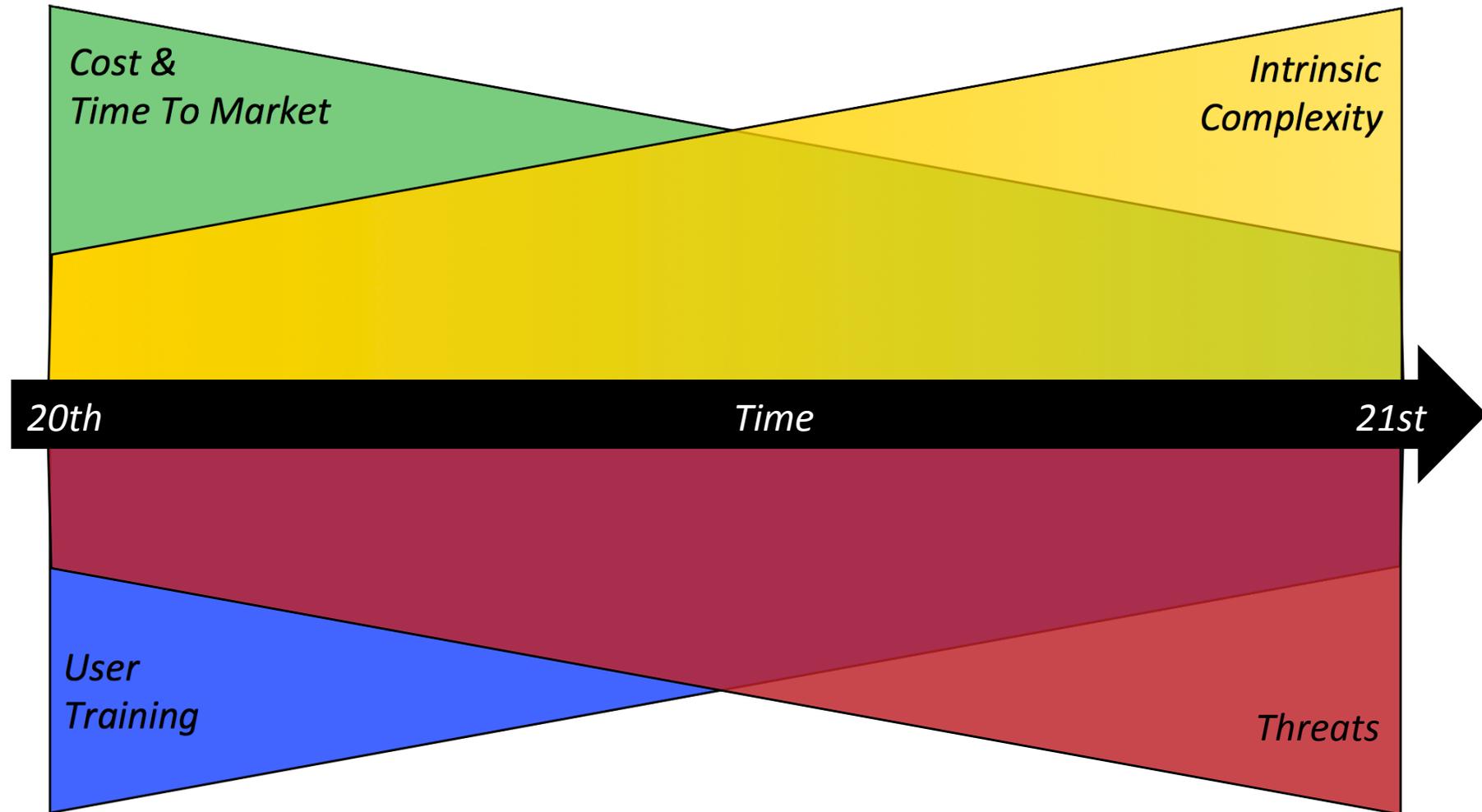
# Deployment in Many Applications Domains



**Threats  
are to be  
Expected**

**An Even More  
Challenging  
Context ...**

# An Ever More Challenging Context



See also:

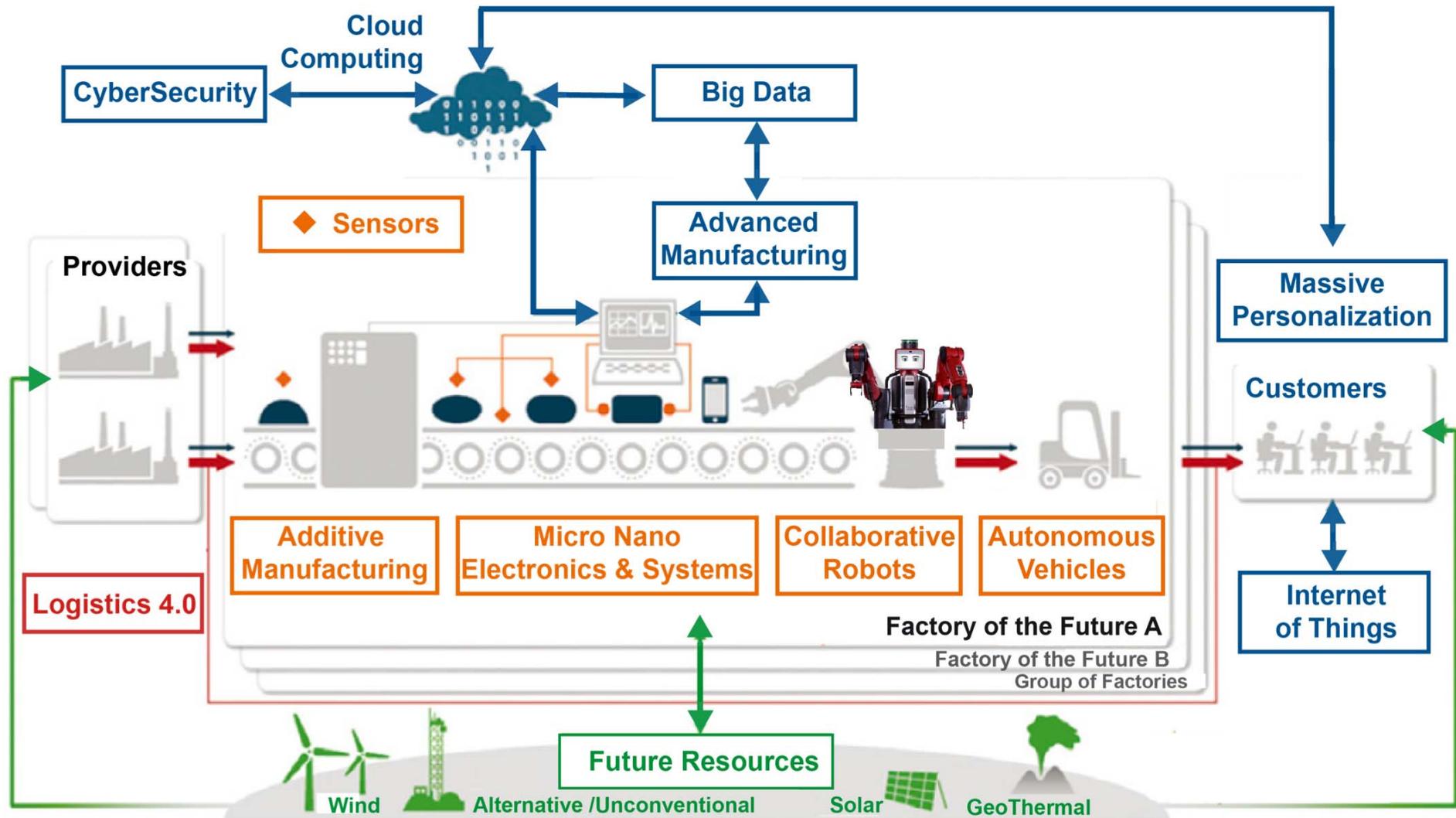
D. Siewiorek, R. Chillarege, Z. Kalbarczyk

**Reflections on Industry Trends and Experimental Research in Dependability**

*IEEE TDSC*, Vol. 1, No. 2, April-june 2004, pp. 109-127

# About Factories of the Future

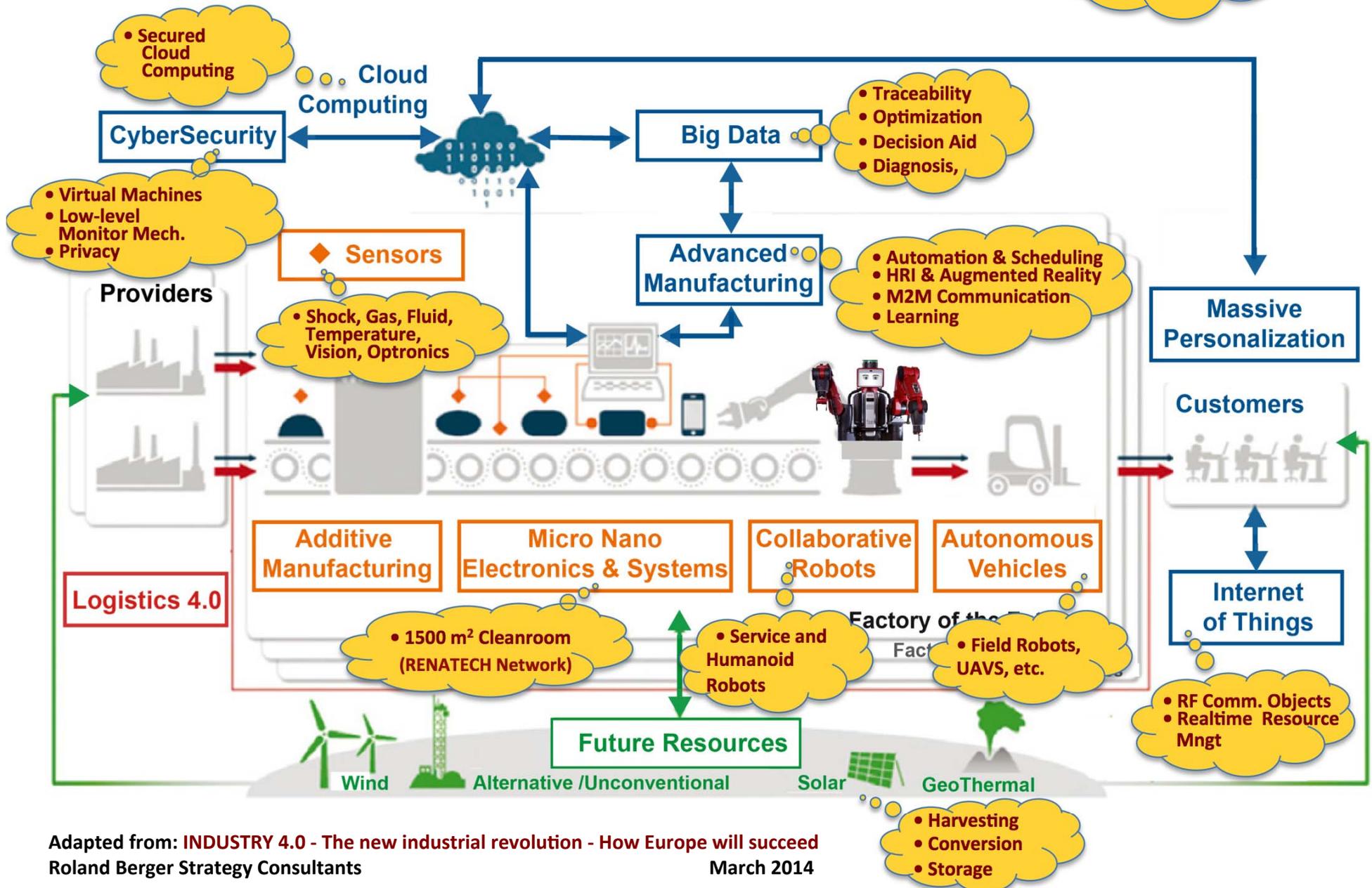
A Real Multidisciplinary Challenge



Adapted from: **INDUSTRY 4.0 - The new industrial revolution - How Europe will succeed**  
 Roland Berger Strategy Consultants  
 March 2014

# About Factories of the Future

Related Activities @ LAAS-CNRS



Adapted from: **INDUSTRY 4.0 - The new industrial revolution - How Europe will succeed**  
Roland Berger Strategy Consultants March 2014

# Several Initiatives

- France:

*Programme Investissements d'Avenir (PIA)*



Carnot Supported Project Targeting SMEs

**IMP Project (*Industries Mécaniques et Procédés*)** –  
incl. Factory of the Future

- Europe:



European Institute of  
Innovation & Technology

Knowledge and Innovation Communities (KICs)

**Added Value Manufacturing Consortium**

# More About LAAS

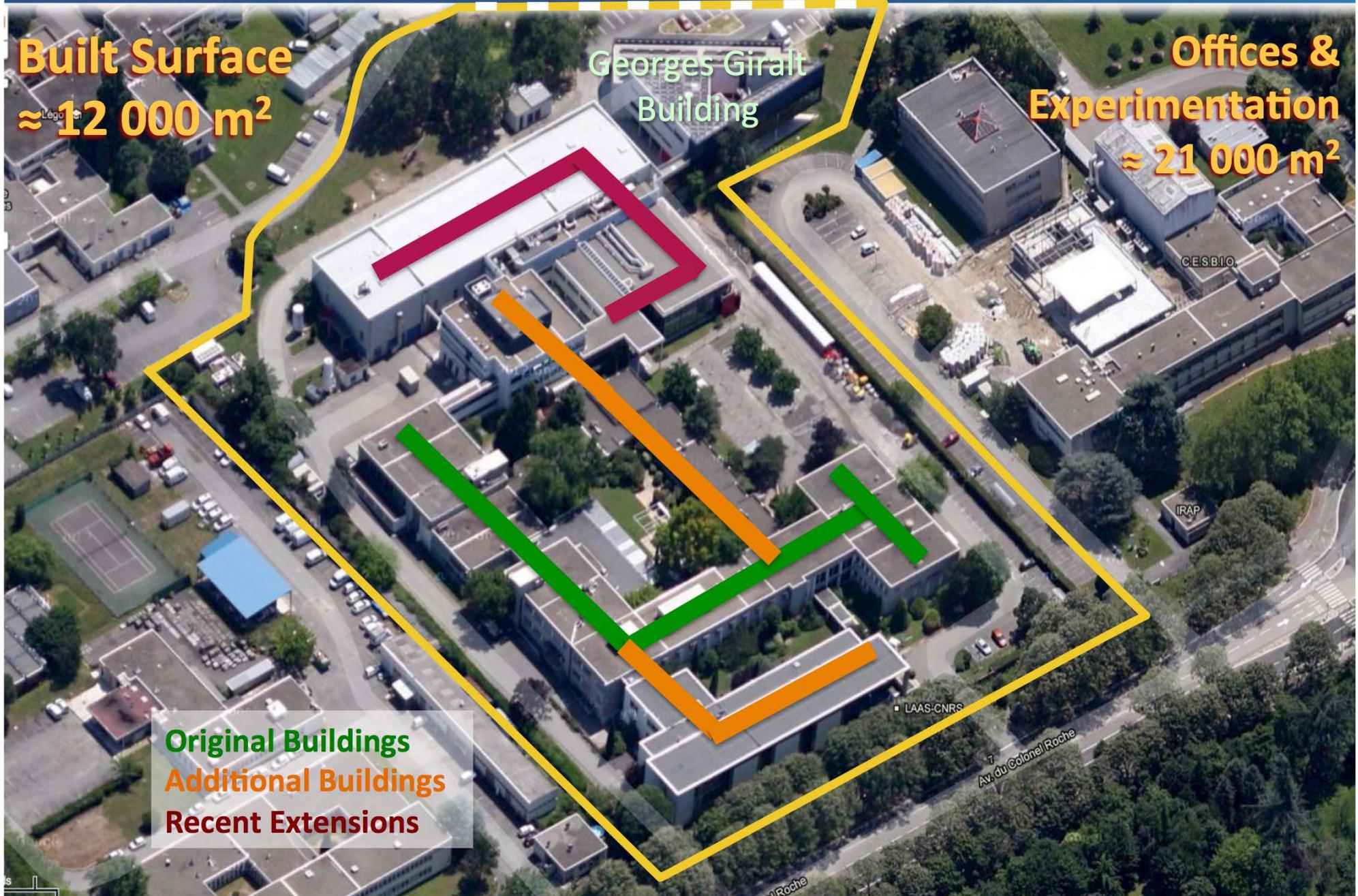
≈ 4 Ha

**Built Surface**  
≈ 12 000 m<sup>2</sup>

**Offices & Experimentation**  
≈ 21 000 m<sup>2</sup>

Georges Giralt  
Building

**Original Buildings**  
**Additional Buildings**  
**Recent Extensions**



# Technological Facilities and Platforms

## Micro-Nano Systems



Design & Simulation

RENATECH (Clean Room)

Characterization Electrical, RF, Thermal, EMC



Bio & Chemical Analysis

“Macro-Mini” Systems

Robotics



Networking



Photovoltaic Energy

Instrumented Building



# Robotics Fleet



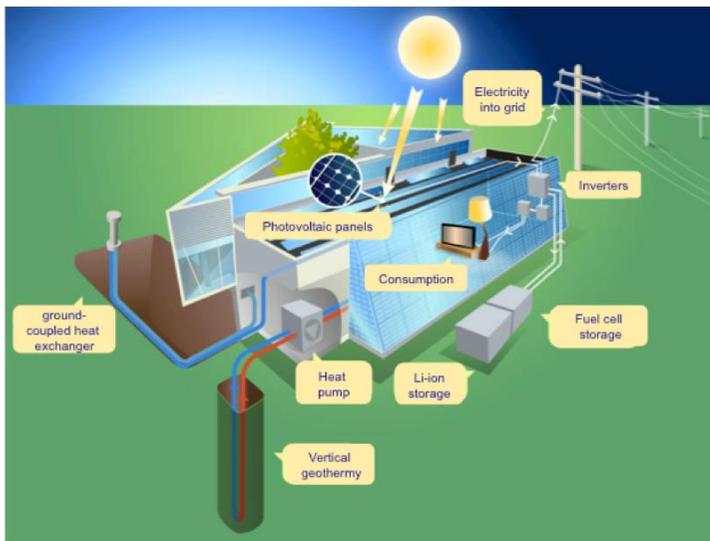
Most recent  
crew member

**ROMEO!**

# Multi Platform Experimentation Building



Energy Optimized Building



- **500 m2** Technical Platforms (IoT, Ambient Intelligence, Energy, Robotics) — **700 m2** Offices
- Electricity (**500** data collected):
  - Production (photovoltaic)
  - Storage (Lithium-ion batteries and Super Capacitors) being installed this year
  - Consumption (area, usage)
- Heating, Air Conditioning, Geothermy, Meteo base (**650** measurement and regulation points)
- Lightning (**3700** measurement points): Motion, light intensity sensors, regulation per areas according to ambient light, time period, and usage
- Database exploitable for “Big Data” studies



# The Georges Giralt Building

Bâtiment  
Georges GIRALT

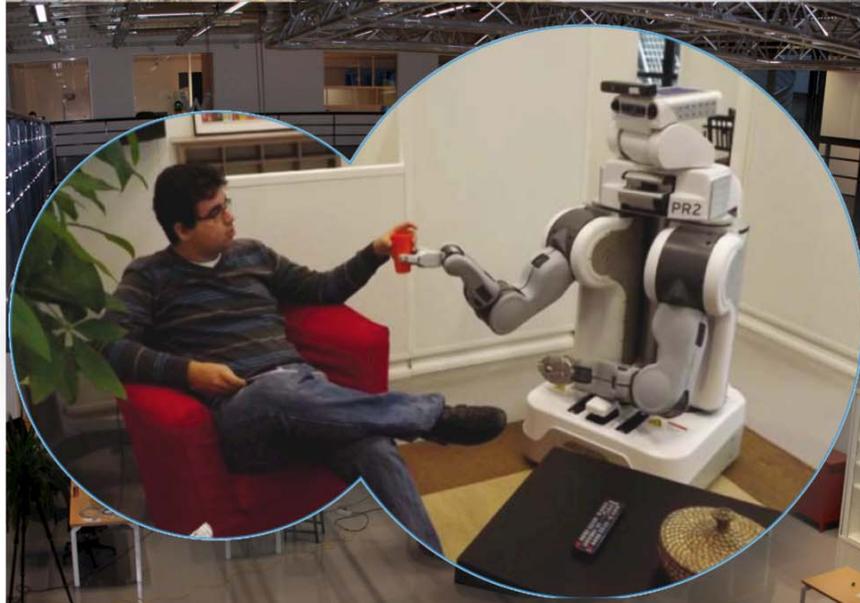


Dedicated on October 28, 2013

[www.laas.fr/ADREAM](http://www.laas.fr/ADREAM)

*Flexible Experimentation  
Environnements*

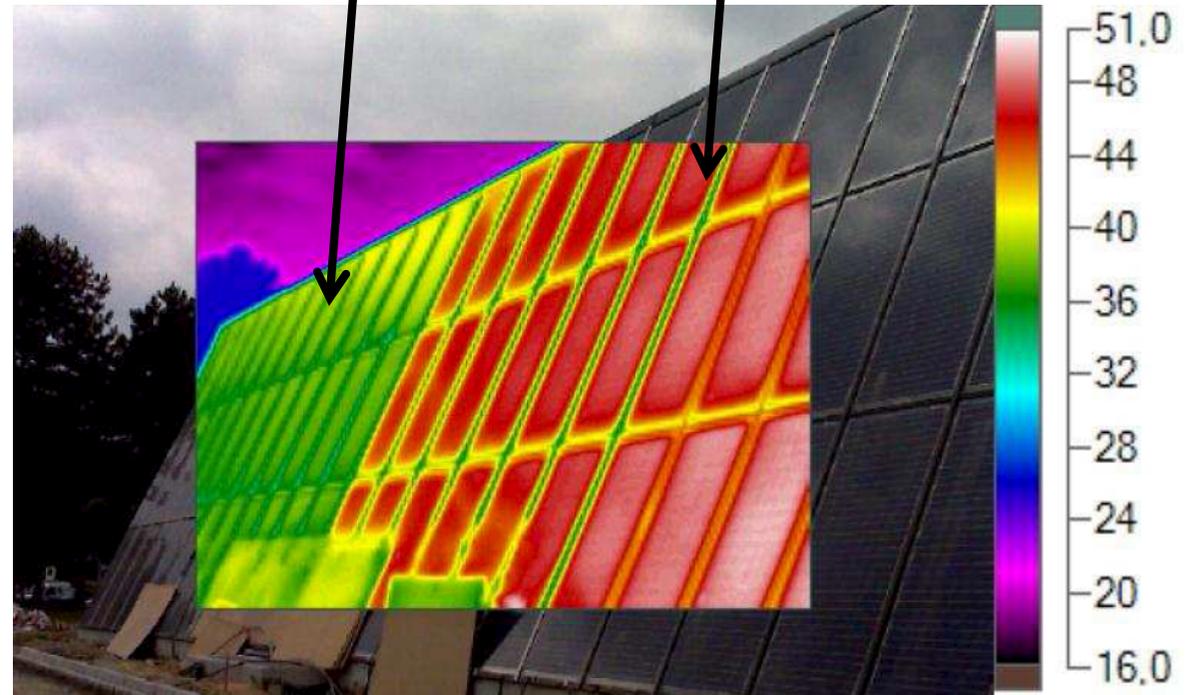
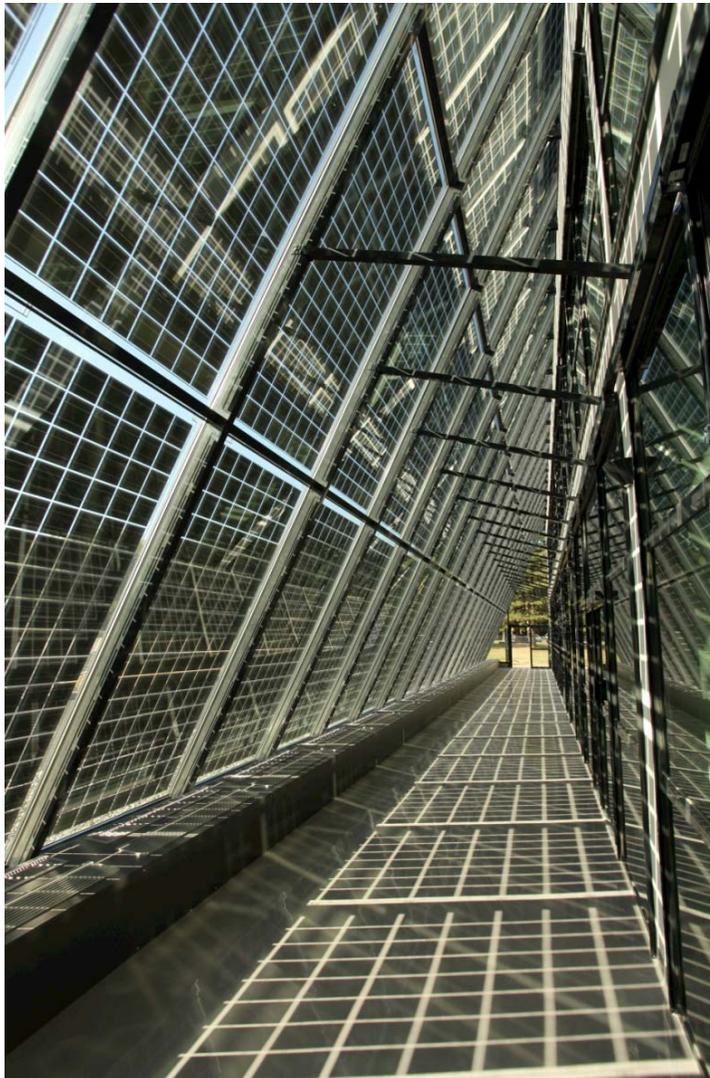
*Energy Optimized  
Instrumented Building*



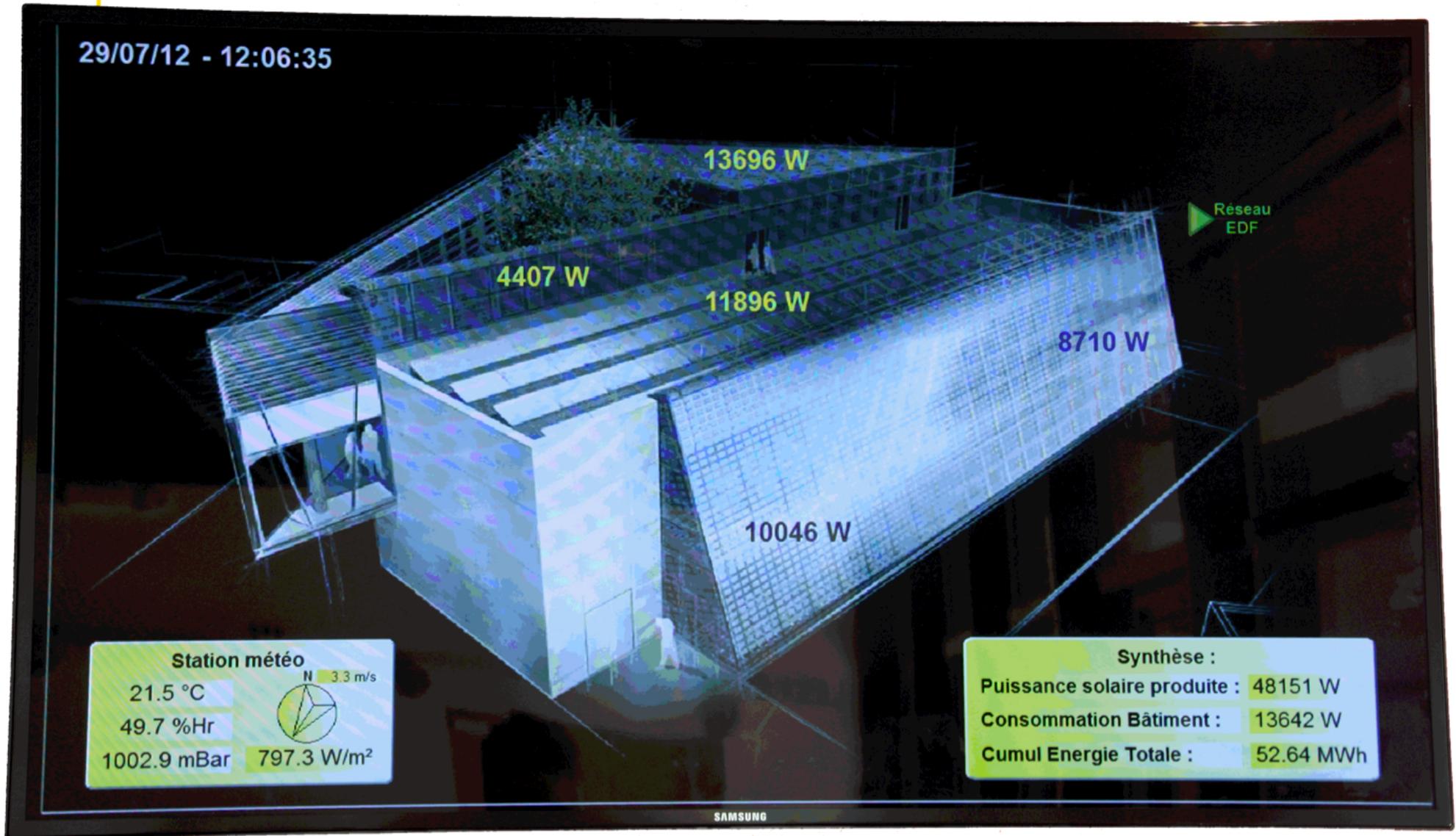
- **Sensor Networks**
- **M2M: Open Source ETSI-Compliant M2M Platform Supported by ECLIPSE**
- **PV Electrical Energy Management**
- **Robot Fleet (assistance robots, rovers, manipulation, drones)**
- **Resilience, Quality of Service, Security and Privacy**

# Facade: PV Cells Window-Coating

## Dual vs. Triple



# Electricity Consumption, Instantaneous & Cumulated PV Production



# Some On-going Research Projects

- **Micro and nano sensors**
- **Autonomic ubiquitous computing systems**
- **Localization, navigation, robotics and mobility**
- **Automatic control: distributed and cooperative robust control**
- **Electrical energy management systems and optimization**
- **Security and privacy issues**
- **Formal development and assessment of adaptive mobile systems**
- **System co-simulation and co-validation environments**

# Laboratoire d'Analyse et d'Architecture des Systèmes



## Questions?

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