High-Impact Initiative on

Smart Digital Industry

Industry 4.0 and beyond

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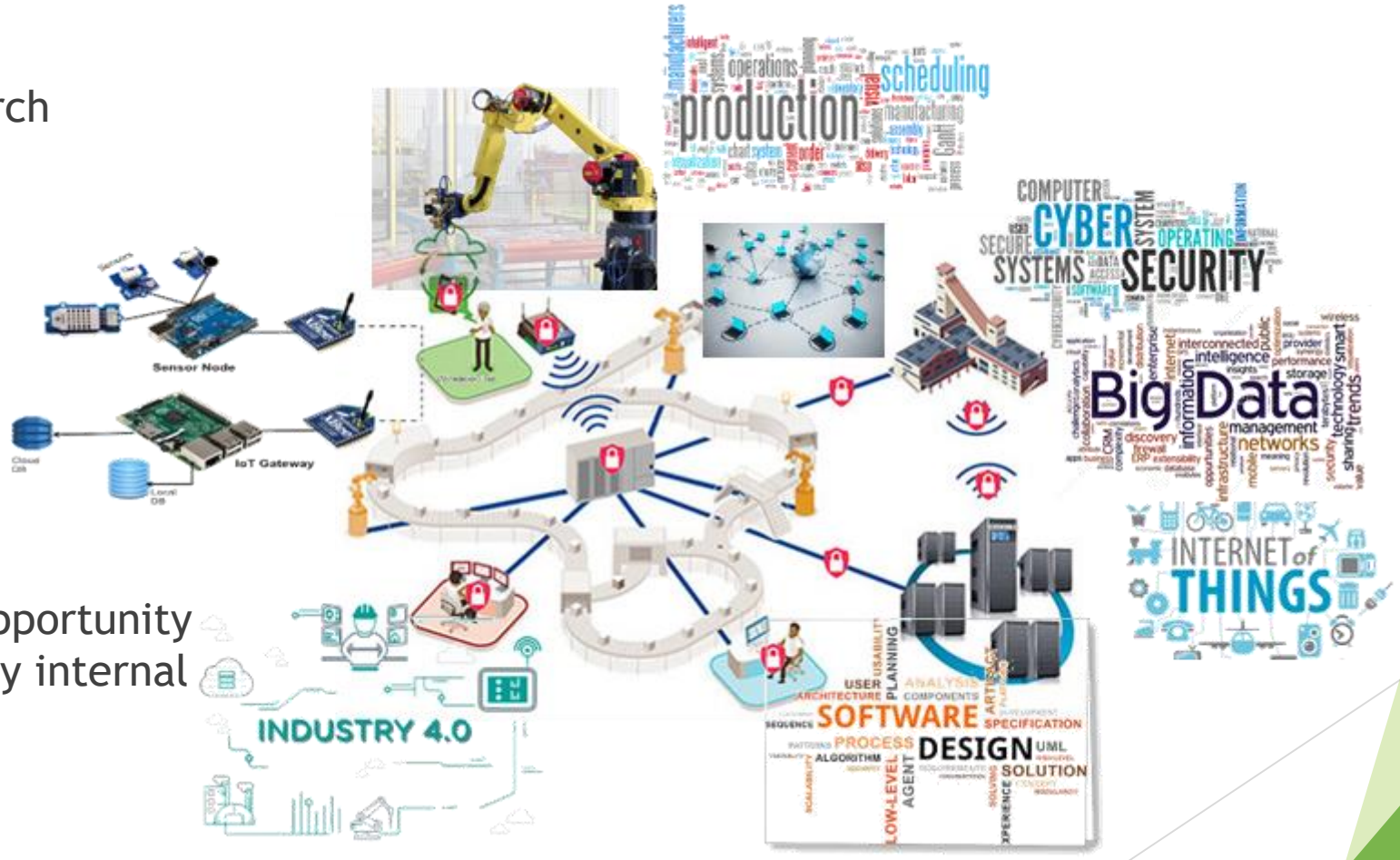
Fondazione Bruno Kessler
Center for Information and Communication Technologies

- More than 260 people
- Historically organized in research units
  - More than 20 research units, directly reporting to Director
  - Characterized by research theme
  - Data and Knowledge Management, Intelligent Interfaces and Interaction, Speech Technology, Natural Language, Data Science, ...
- In 2018, activities organized into High-Impact Initiatives
  - Characterized by application area
  - Aggregate Research units towards common goals
  - Health and Well Being, Smart Cities and Communities, *Smart Digital Industry*

Smart Digital Industry
An interdisciplinary challenge

Promising research directions



… and a great opportunity to leverage many internal assets

HII on Smart Digital Industry Research Units

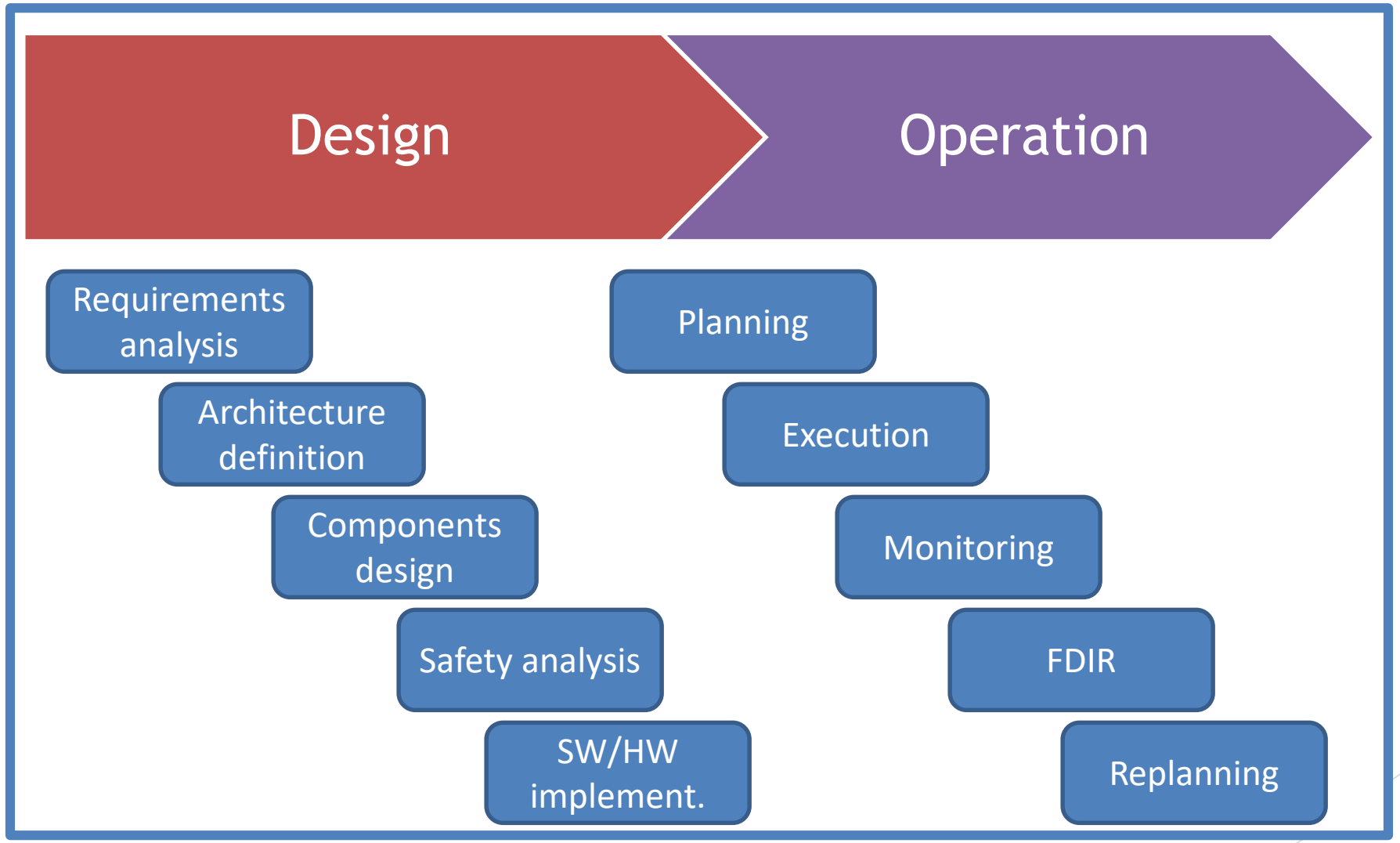
- **Software Engineering**
  - Requirements engineering
  - Testing
- **3D Optical Metrology**
  - Metrology
- **Technologies for Vision**
  - Vision, Augmented reality
- **Embedded Systems**
  - Formal Verification
  - Planning

- **Budget**
  - Costi 3.1 MEU
  - Ricavi 1.9 MEU
  - Autofinanziamento 63%
- **Personale**
  - 70 (staff, postdocs, RA, PhD)
  - 21 staff
- **ASN**
  - 4 Seconda fascia
  - 6 Prima fascia

HII on Smart Digital Industry Reference Application Domains

- **Safety-Critical Systems**
  - Complex domains where design flaws and runtime errors may have fatal consequences, certification procedures.
- **Adaptive Autonomous Systems**
  - Systems able to adapt to changing environmental conditions, and to autoomously plan and execute suitable course of actions to achieve run-time objective.
- **Advanced Perception Systems**
  - Modules to support industrial process operations with leading-edge research techniques (DSP, vision, model-predictive control…)
- **Diagnostic and Predictive Systems**
  - Integrated platforms for big data analytics for diagnosis, prognosis, and predictive maintenance

Life Cycle of Complex Systems



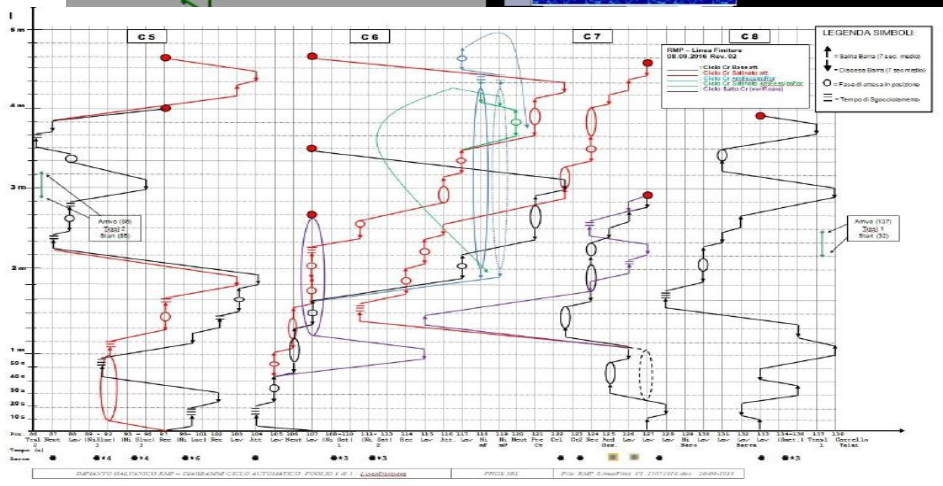
Model-Based Design for Critical Applications

- Methods and tools to design and certify critical applications
- Design, validation, commissioning of (safety) critical systems
- Avionics, space, oil and gas, railway, renewable energy sectors
- Support to building correct systems

- Integrated technological platforms supporting the design, deployment and certification of complex processes and systems
  - SCADE, Matlab/StateFlow/Simulink
  - COMPASS, TASTE, CHESS (AADL, SysML)
  - MathSAT, nuXmv, OCRA, xSAP (SMT-based model checking, CBD)

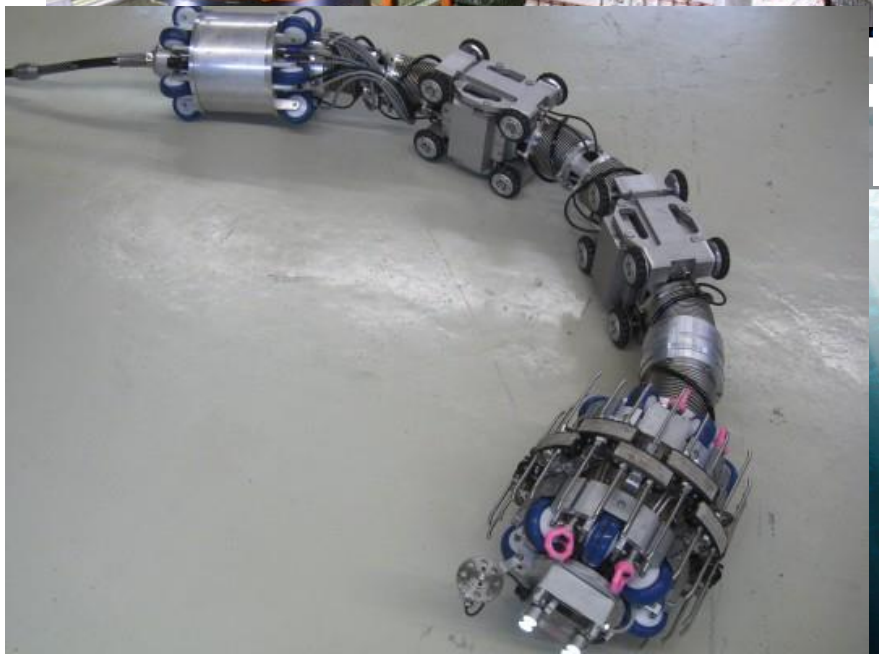
Smart Adaptive Operation

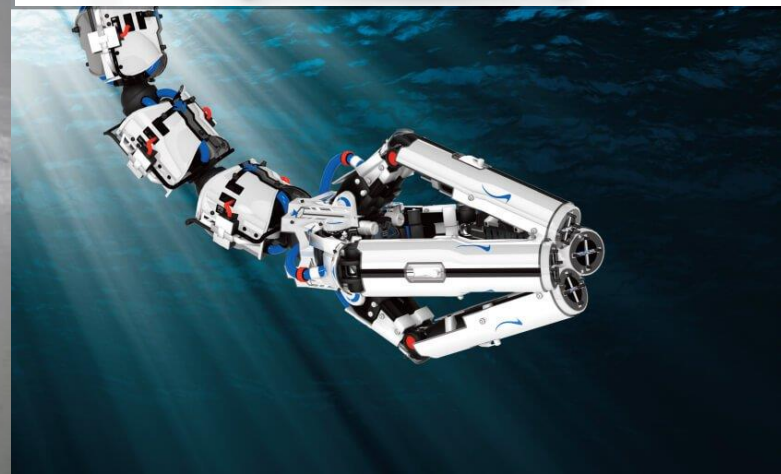
- Control flexible production
  - Adapt to changing conditions
  - Fault detection and management
- Changes in production requests
- Applications: automated factory
- Industrial partners: SAIPEM, PHOX
- Adaptive architectures
  - Smart manufacturing
  - Investigate techniques for run-time adaptation



Autonomous Systems

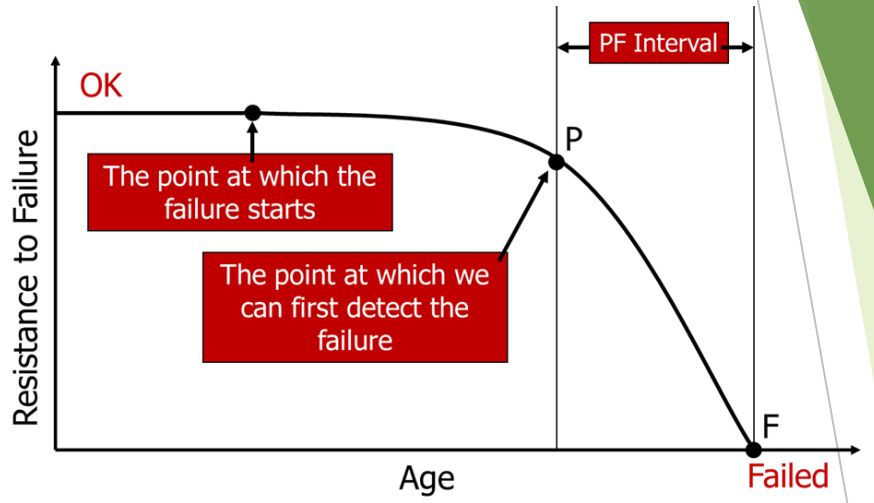
- Architectures for Autonomy
  - drones/AUV/rovers
- Applications
  - Space applications
  - Underwater vehicles
  - Drones for agritech
  - Railways surveillance
- Industrial Partners
  - SAIPEM
  - RFI
- Research: model-based validation of intelligence





Predictive maintenance

- Understand failures before they occur
- Beyond data-driven prediction
  - Models @ run-time
  - Leverage models developed at design time
  - Representation of background knowledge
- To enhance data-driven learning



- Reduce training efforts
  - Obtain higher quality results
  - Explain what has been learnt!

- Made to Serve: better estimate of provided service
- Improve operational capacity, increase availability
- Improve models based on runtime data