UPTIME
UNIFIED PREDICTIVE MAINTENANCE

UPTIME Project Overview

Digital Platforms in Manufacturing
Brussels, 5-6 Feb. 2018

Horizon 2020
European Union Funding
for Research & Innovation

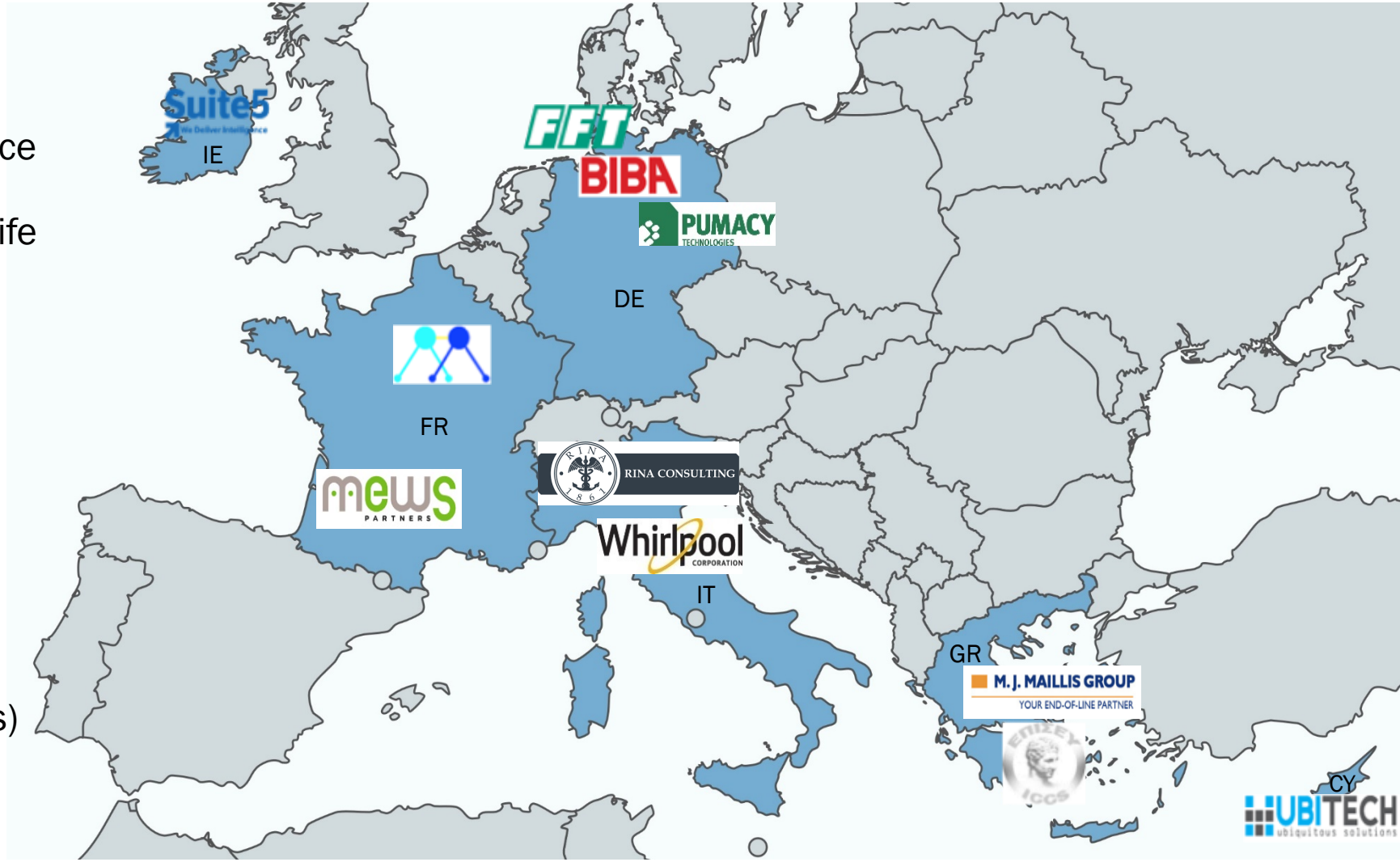
Prof. Gregoris Mentzas, ICCS

General Information

- Topic: FOF-09-2017

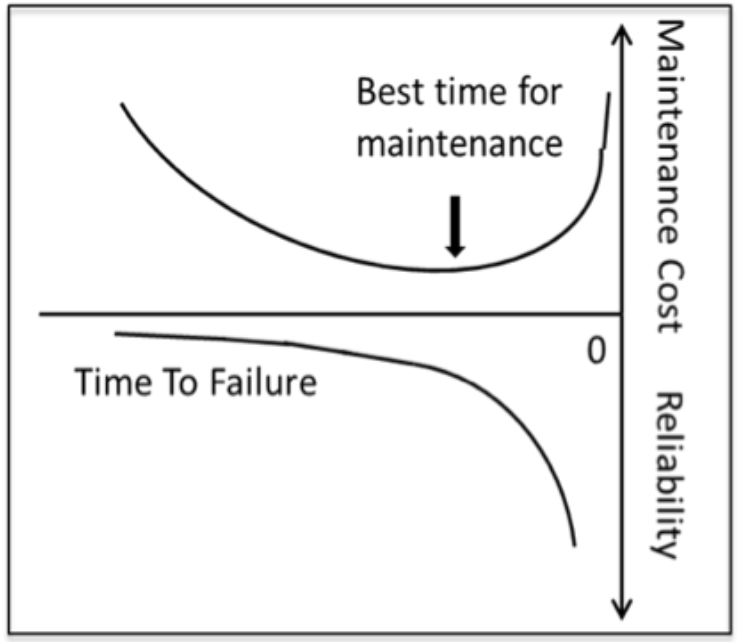
  Novel design and predictive maintenance technologies for increased operating life of product systems
- Type: IA
- Duration: 36 Months
- Start date: 01.09.2017
- End date: 31.08.2020
- Project cost: € 6,248,367.50
- Max grant: € 4,847,836.25

  (77.59% of total costs)



Criticality of Maintenance

- Existing maintenance strategies can be broadly distinguished in 3 categories:
  - (a) breakdown maintenance;
  - (b) time-based, preventive maintenance;
  - (c) condition-based, predictive maintenance
- Condition monitoring is increasingly realized with equipment-installed sensors
  - such as vibration analysis, thermography, acoustic emissions, etc.



- Sensors have the capability of measuring with high frequency a multitude of parameters leading to processing and storage of a huge amount of data
- Recent developments lead to a new predictive maintenance approach providing powerful capabilities for physical understanding of the useful life of a system
  - through dynamic pattern recognition in various available data sources

The vision of UPTIME

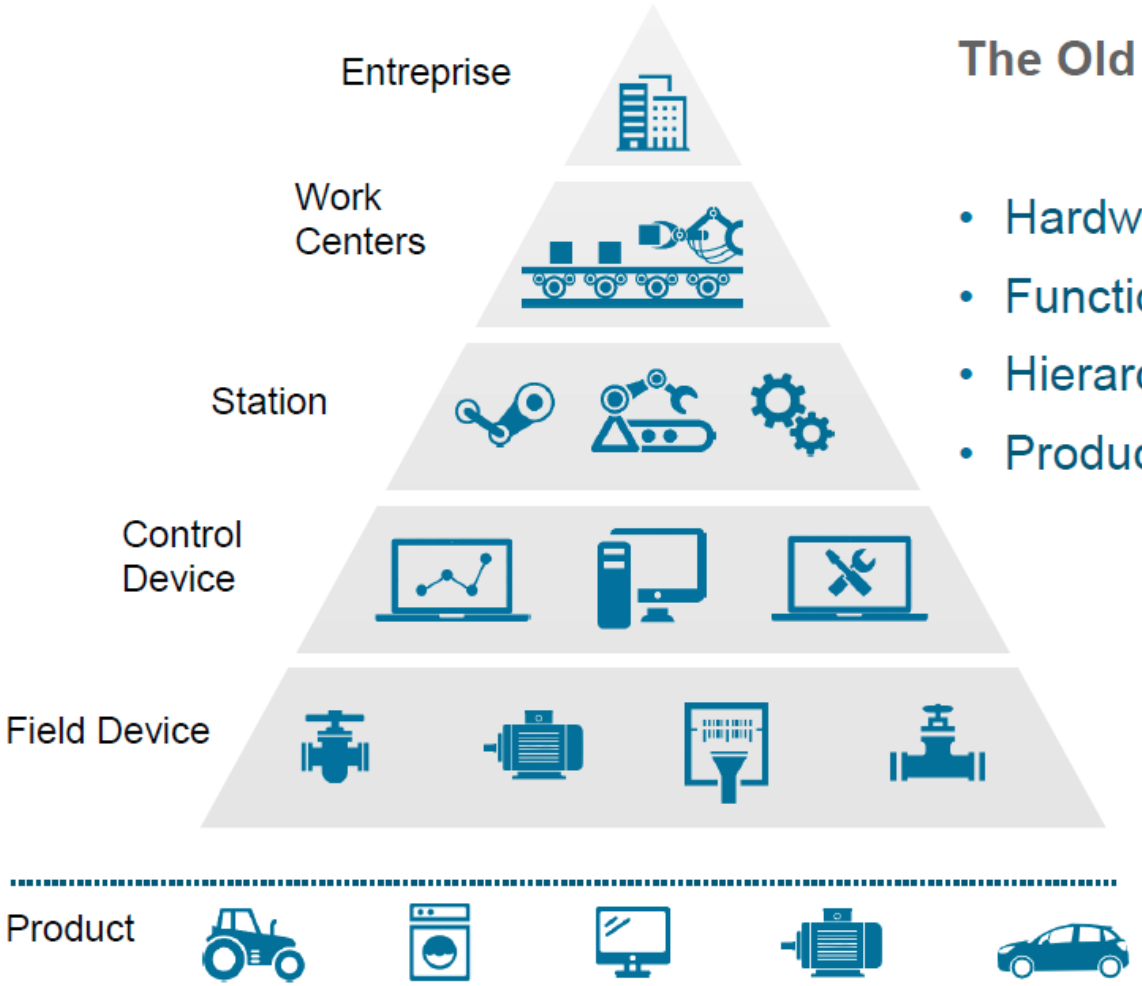
- To reframe predictive maintenance strategy in a systematic and unified way by exploiting research advances in three main areas:

- Industry 4.0:
  - I4.0 paves the way for extensive use of physical and virtual sensors generating a multitude of data.

- Big Data processing
  - Availability of big data leads to a strong demand for data-driven, real-time systems incorporating efficient processing technologies in order to get meaningful insights about business performance.

- Proactive Computing
  - Proactive event-driven computing is referred to the use of event-driven systems for mitigating future undesired events or for taking advantage of future opportunities.

Industry 4.0: From the “old” industry...



The Old World: Industrie 3.0

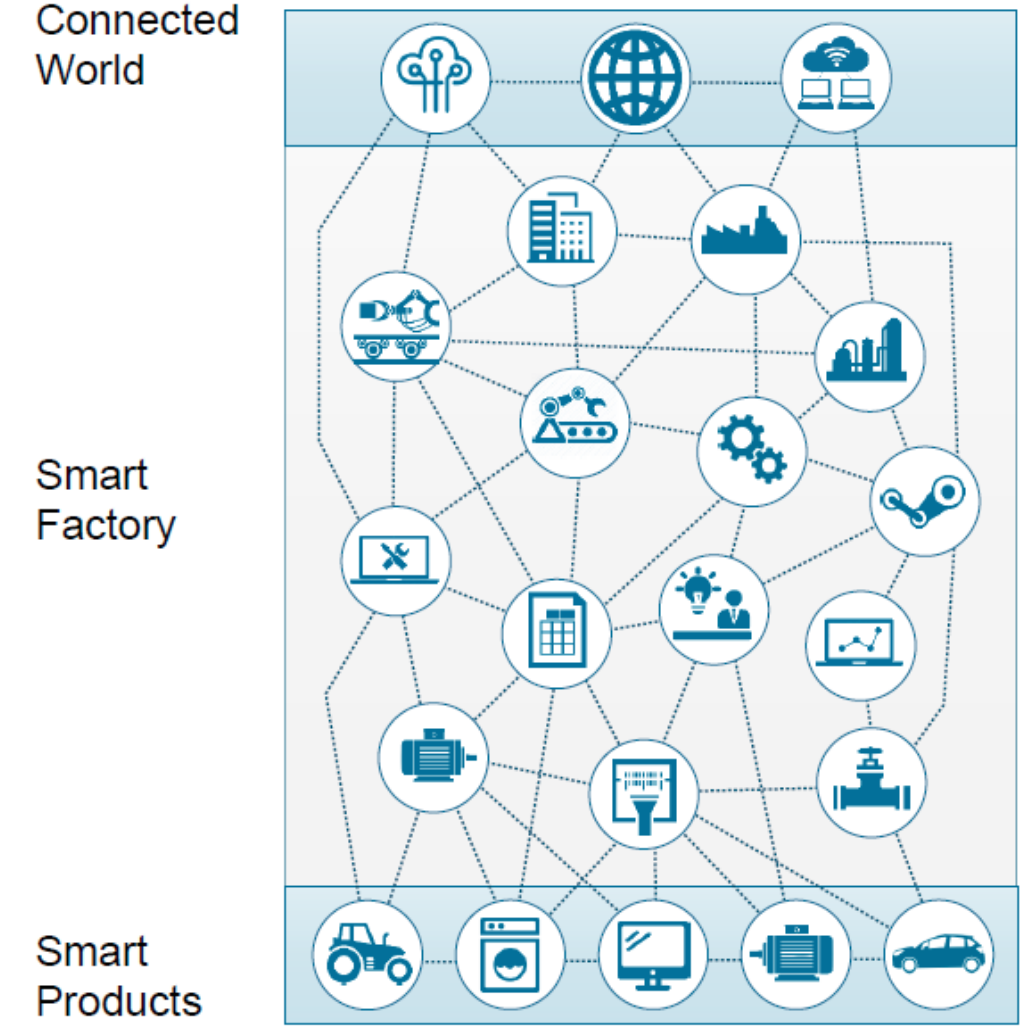
- Hardware-based structure
- Functions are bound to hardware
- Hierarchy-based communication
- Product is isolated

Source: Plattform Industrie 4.0

Industry 4.0: … to the “new” industry

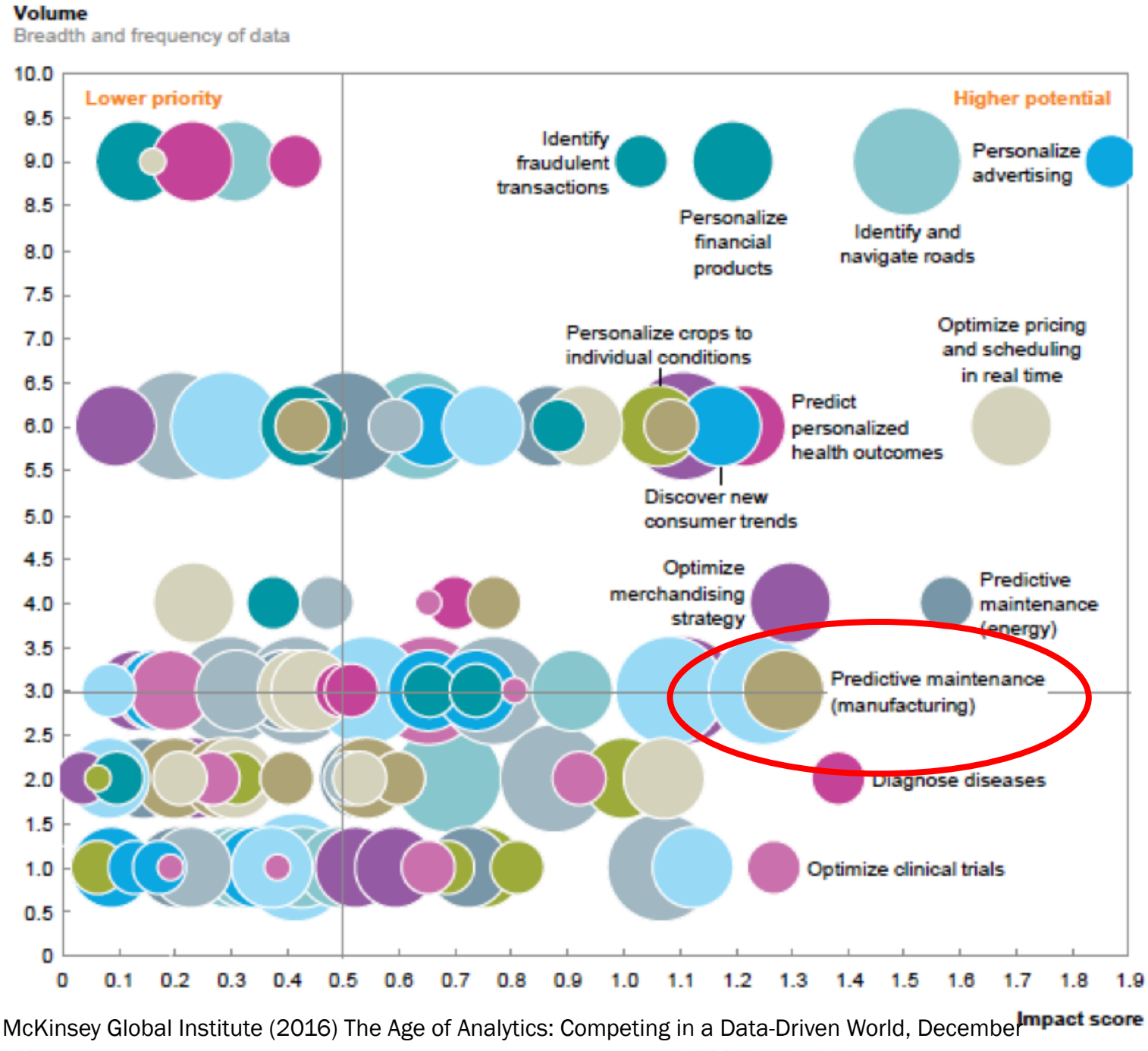
The New World: Industrie 4.0

- Flexible systems and machines
- Functions are distributed throughout the network
- Participants interact across hierarchy levels
- Communication among all participants
- Product is part of the network



Source: Plattform Industrie 4.0

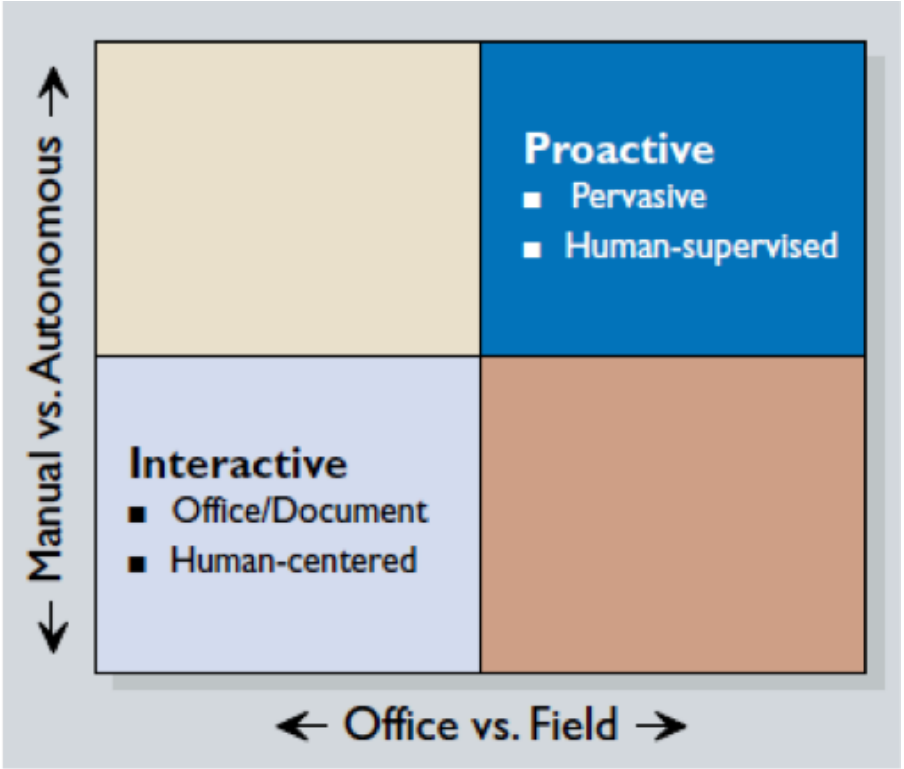
Big Data: Potential in manufacturing



McKinsey Global Institute (2016) The Age of Analytics: Competing in a Data-Driven World, December

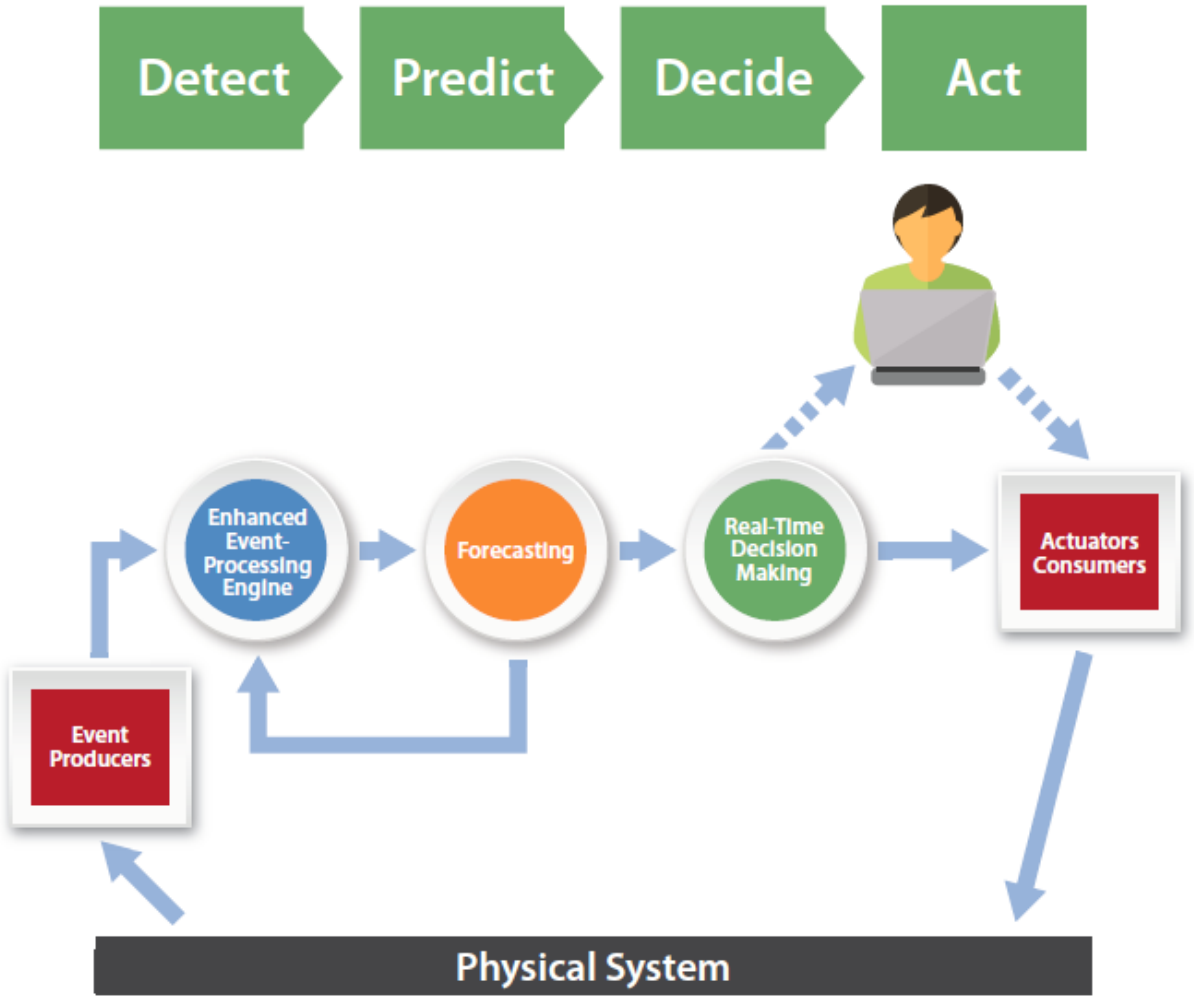
Proactive Computing: The basics

- Getting **physical**
  - Proactive systems will be intimately connected to the world around them
    - using sensors and actuators to both monitor and shape physical surroundings
- Getting **real**
  - Proactive computers will routinely respond to external stimuli
    - at faster-than-human speeds.
- Getting **out**
  - Interactive computing deliberately places human beings in the loop
  - New proactive modes of operation put humans “above the loop”, into supervisory and policy-making roles



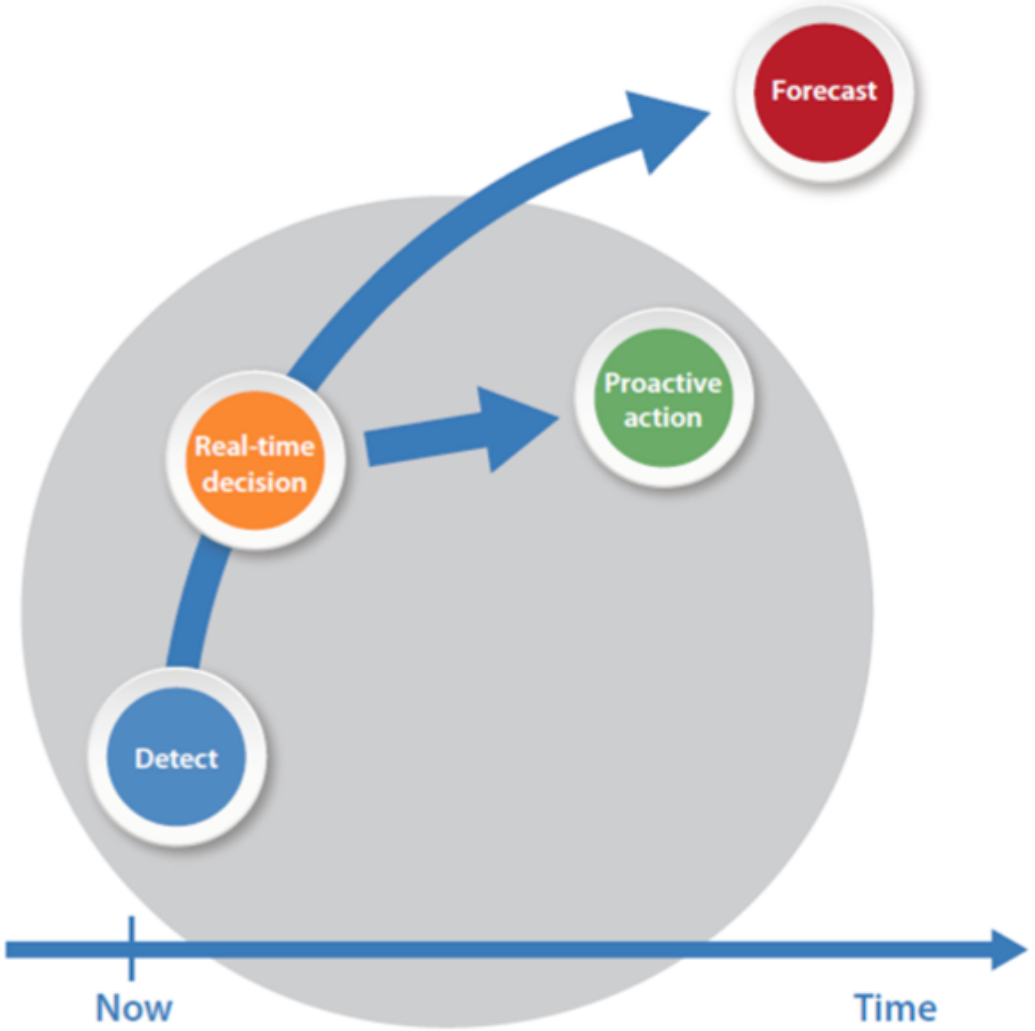
Tennenhouse, David. "Proactive computing." *Communications of the ACM*43.5 (2000): 43-50.

Proactive computing phases



Source: Etzion O. (2016). Proactive Computing: Changing the Future. RTInsights.

Proactive Computing model

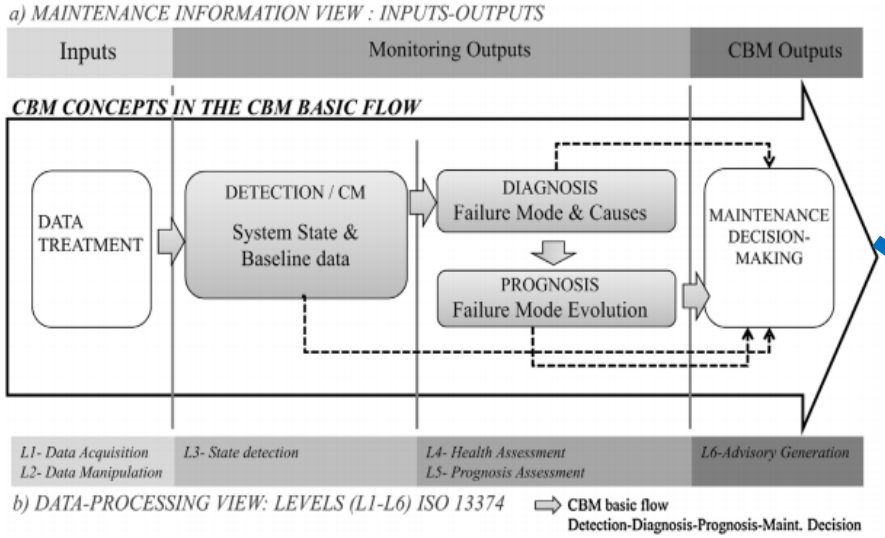


Source: Etzion O. (2016). Proactive Computing: Changing the Future. RTInsights.

- Proactive information systems aim to enable business analysts to create and configure decision method instances for mitigating a future undesired event, which lays outside the desired states space.
- Based on the predictions for undesirable situations derived on the basis of streaming data, decision methods instances are enacted online to generate mitigating action recommendations and optimal time of action implementation.

The UPTIME Approach

Predictive Maintenance

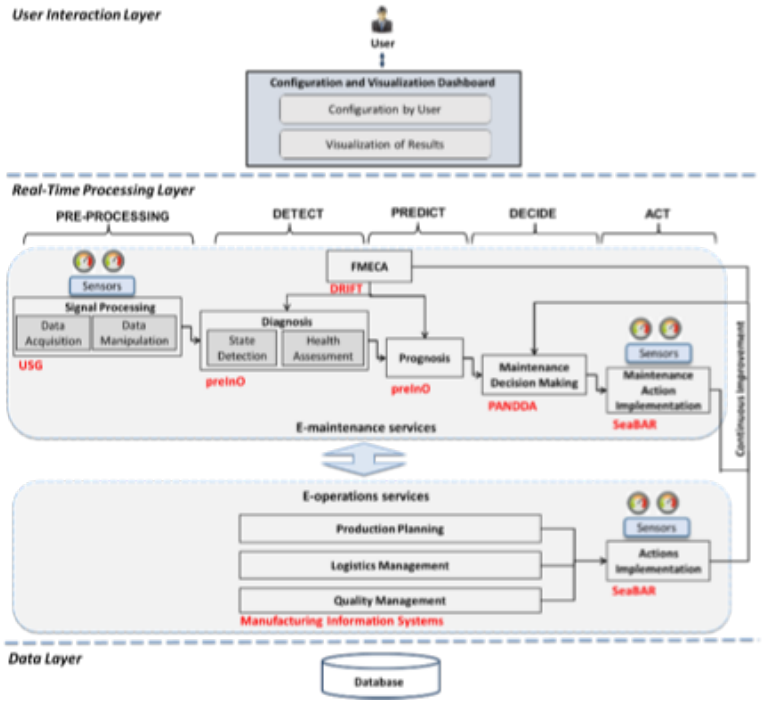


Guillén, et al (2016). A framework for effective management of condition based maintenance programs in the context of industrial development of E-Maintenance strategies. Computers in Industry, 82, 170-185.

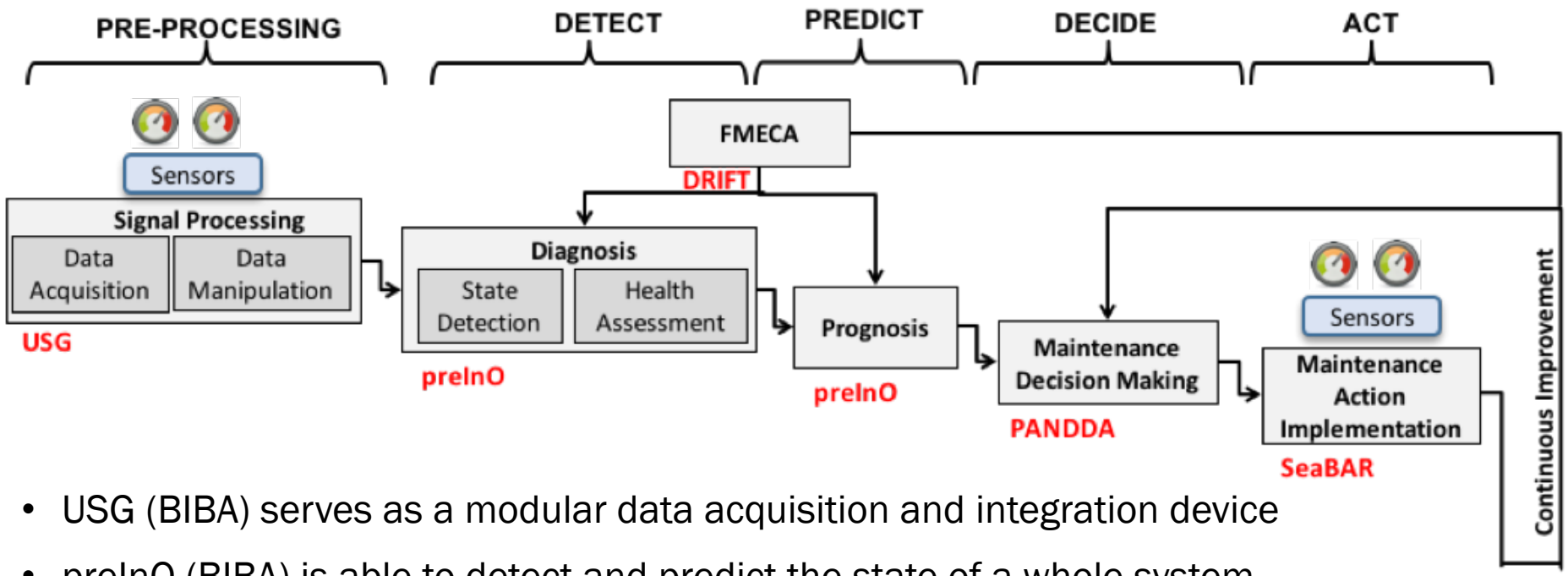
Proactive Computing

Engel, et al (2012). A basic model for proactive event-driven computing. In Proceedings of the 6th ACM international conference on DEBS (pp. 107-118). ACM.

The UPTIME Approach



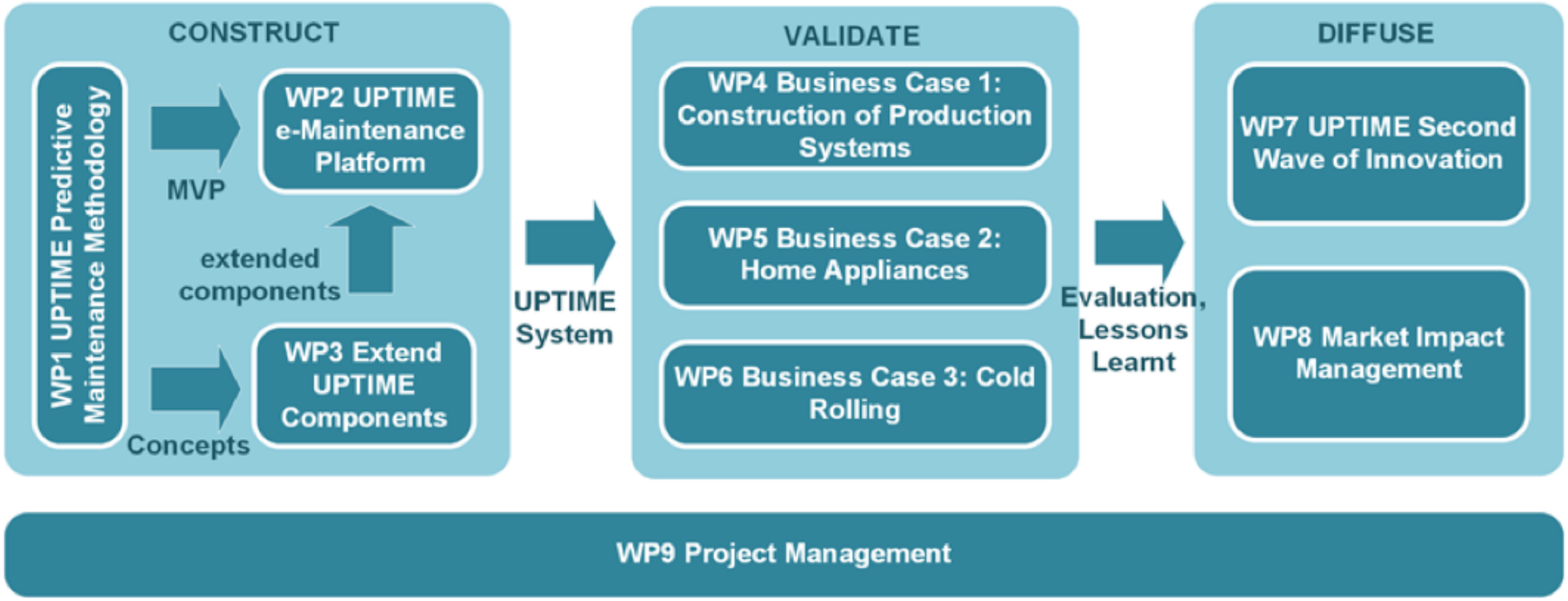
UPTIME: Integrating five research results



- USG (BIBA) serves as a modular data acquisition and integration device
- preInO (BIBA) is able to detect and predict the state of a whole system
- PANDDA (ICCS) provides proactive recommendations about maintenance actions and the time for their implementation
- SeaBAR (PTA) supports end users by means of data aggregation, data analysis and visualization
- DRIFT (DAPP) uses data to identify what are the Failure Modes, Effects and Criticalities

Objectives and Implementation Approach

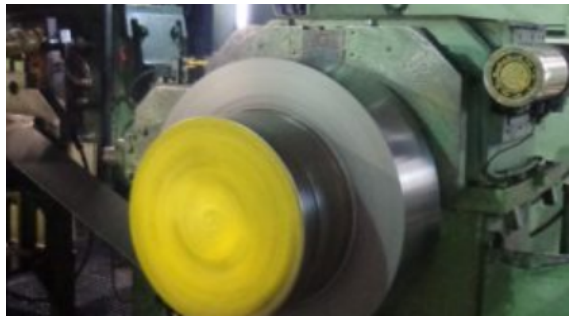
- **OBJ1:** Extend and unify the new digital, e-maintenance services and tools in order to exploit the full potential of a predictive maintenance strategy with the UPTIME solution
- **OBJ2:** Deploy and validate the UPTIME solution in manufacturing companies
- **OBJ3:** Diffuse the UPTIME Solution in the manufacturing community



Business Cases

Home Appliances /
White Goods:
Automatic Drum Line

Steel Industry:
Cold Rolling Mill Lines



Construction of production systems:
Intelligent Maintenance of tools, jigs and fixtures

Thank You!

This project has received funding from the European Union's Horizon 2020 research and innovation programme *under grant agreement No 768634*

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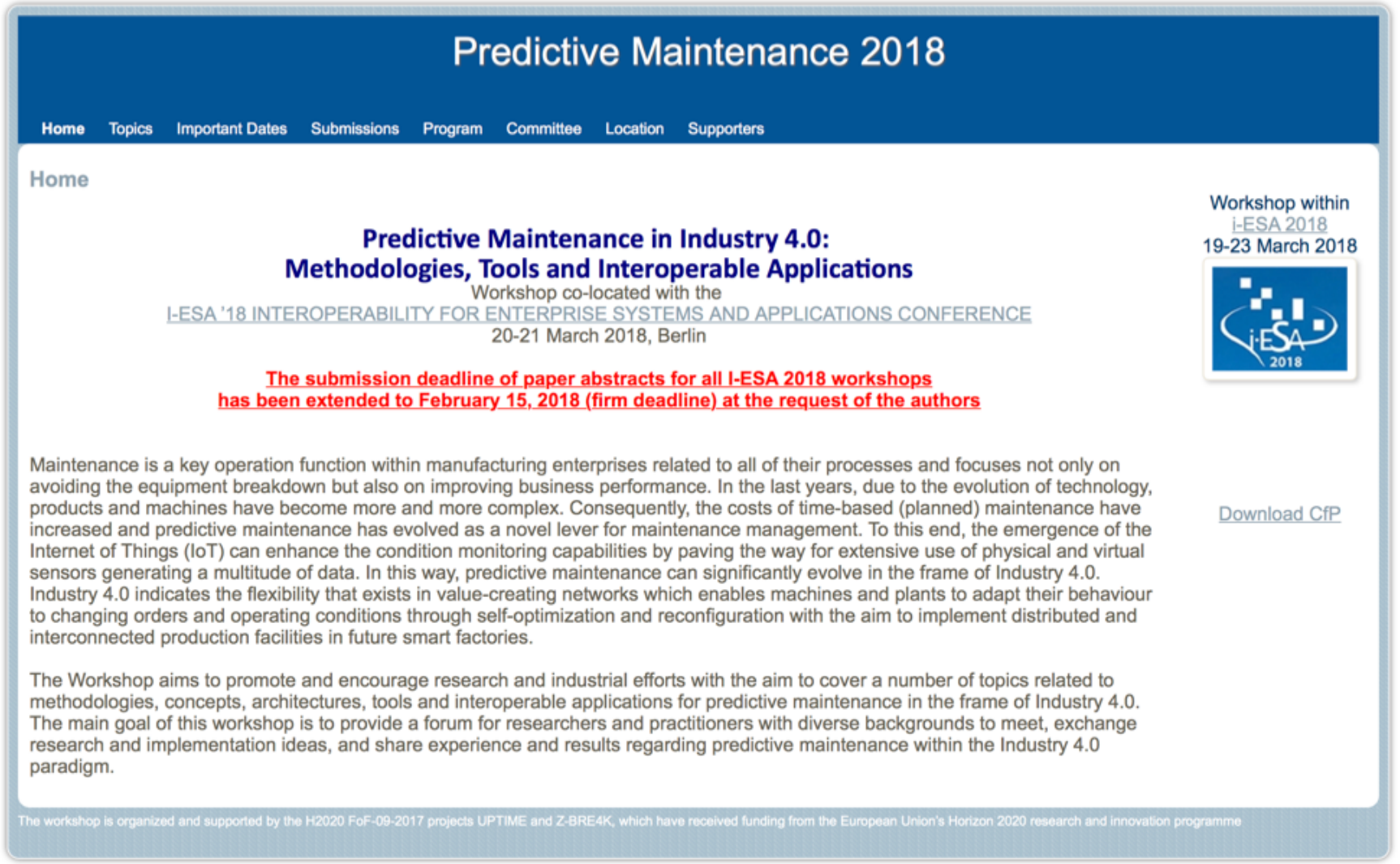
- **Objective:** Novel design and predictive maintenance technologies
- **Topic:** FoF-09-2017
- **Call:** H2020-FOF-2017
- **Lead:** BIBA – Bremer Institut für Produktion und Logistik GmbH
- **Duration:** 36 Months
- **Start:** 2017/09



Predictive Maintenance 2018

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Workshop within
i-ESA 2018
19-23 March 2018

Predictive Maintenance in Industry 4.0: Methodologies, Tools and Interoperable Applications

Workshop co-located with the
I-ESA '18 INTEROPERABILITY FOR ENTERPRISE SYSTEMS AND APPLICATIONS CONFERENCE
20-21 March 2018, Berlin

The submission deadline of paper abstracts for all I-ESA 2018 workshops has been extended to February 15, 2018 (firm deadline) at the request of the authors

Maintenance is a key operation function within manufacturing enterprises related to all of their processes and focuses not only on avoiding the equipment breakdown but also on improving business performance. In the last years, due to the evolution of technology, products and machines have become more and more complex. Consequently, the costs of time-based (planned) maintenance have increased and predictive maintenance has evolved as a novel lever for maintenance management. To this end, the emergence of the Internet of Things (IoT) can enhance the condition monitoring capabilities by paving the way for extensive use of physical and virtual sensors generating a multitude of data. In this way, predictive maintenance can significantly evolve in the frame of Industry 4.0. Industry 4.0 indicates the flexibility that exists in value-creating networks which enables machines and plants to adapt their behaviour to changing orders and operating conditions through self-optimization and reconfiguration with the aim to implement distributed and interconnected production facilities in future smart factories.

Download CfP

The Workshop aims to promote and encourage research and industrial efforts with the aim to cover a number of topics related to methodologies, concepts, architectures, tools and interoperable applications for predictive maintenance in the frame of Industry 4.0. The main goal of this workshop is to provide a forum for researchers and practitioners with diverse backgrounds to meet, exchange research and implementation ideas, and share experience and results regarding predictive maintenance within the Industry 4.0 paradigm.

The workshop is organized and supported by the H2020 FoF-09-2017 projects UPTIME and Z-BRE4K, which have received funding from the European Union's Horizon 2020 research and innovation programme