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

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
Rich data is an enabler in some use cases but the lack of it can be a barrier in others.

**Problem type**

- Real-time optimization
- Strategic optimization
- Predictive analytics
- Predictive maintenance
- Radical personalization
- Discover new trends/anomalies
- Forecasting
- Process unstructured data

**Data richness**

- Low
- High

**Problem type**

- Automotive
- Manufacturing
- Consumer
- Finance
- Agriculture
- Energy
- Health care
- Pharmaceuticals
- Public/social
- Media
- Telecom
- Transport and logistics

*Source: McKinsey Global Institute analysis*
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

Proactive computing phases

Detect → Predict → Decide → Act

Proactive Computing model

- 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.

**Predictive Maintenance**

a) **MAINTENANCE INFORMATION VIEW - INPUTS-OUTPUTS**

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Monitoring Outputs</th>
<th>CBM Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CBM CONCEPTS IN THE CBM BASIC FLOW**

- **DATA TREATMENT**
  - Detection / CM
  - System State & Baseline data

- **DIAGNOSIS**
  - Failure Mode & Causes

- **PROGNOSIS**
  - Failure Mode Evolution

- **MAINTENANCE DECISION-MAKING**


**Proactive Computing**

- Detect
- Predict
- Decide
- Act

• 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
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
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

The information in this document is provided "as is", and no guarantee or warranty is given that the information is fit for any particular purpose. The consortium members shall have no liability for damages of any kind including without limitation direct, special, indirect, or consequential damages that may result from the use of these materials subject to any liability which is mandatory due to applicable law.

Copyright 2017 – 2020 by the UPTIME Consortium
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.

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 F/5/09/2017 projects UPTIME and 2/BRE4K, which have received funding from the European Union’s Horizon 2020 research and innovation programme.