IOTHINGS WEEK

IOTHINGS GOES DIGITAL 17-27 MAY 2021

Whirlpool CORPORATION

"Miti e realtà della Manutenzione Predittiva nell'esperienza di una grande industria"

Pierluigi Petrali – Manufacturing R&D Manager

WHIRLPOOL CORPORATION

World's leading major home appliance company (NYSE:WHR)

Approximately **$20 billion** in sales in 2010

77 000 employees

$1 billion investment in capital and R&D centers annually

67 million products sold in more than 170 countries in the world

59 manufacturing and R&D centers

A LEADERSHIP POSITION

KitchenAid

KitchenAid Black Steel Collection

Whirlpool

Whirlpool SmartCook

INDESIT

Indesit Built-in Suite

KitchenAid Culinary Center

Whirlpool SupremeCare

Indesit Innex

BRANDS AND PRODUCT LEADERSHIP

EMEA

Whirlpool CORPORATION

Melano Italy

Comunanza Italy

Cassinetta Italy

Siena Italy

Carinaro Italy

Naples Italy

Yate UK

Wroclaw Poland

Łódź Poland

**Radomsko** Poland

Poprad Slovakia

Lipetsk Russia

Manisa Turkey
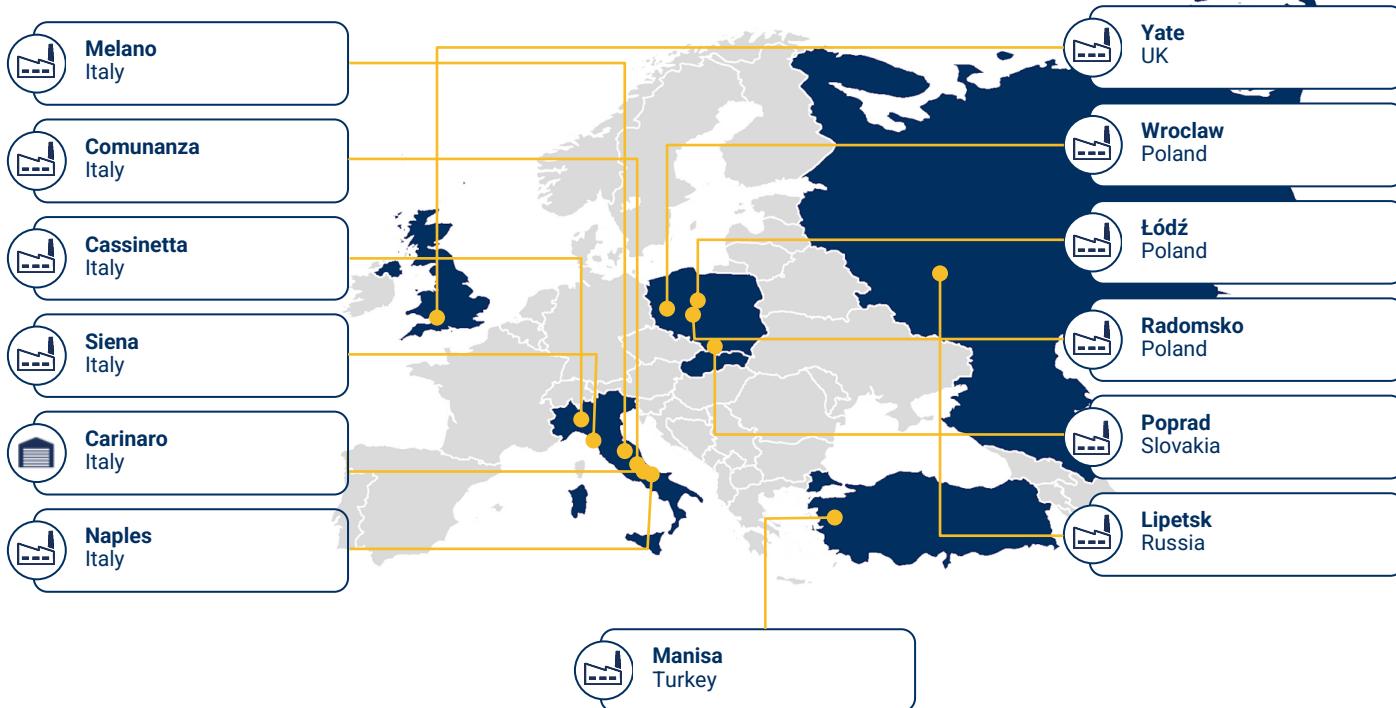
INDUSTRIAL FOOTPRINT

World Class Manufacturing TECHNICAL PILLARS
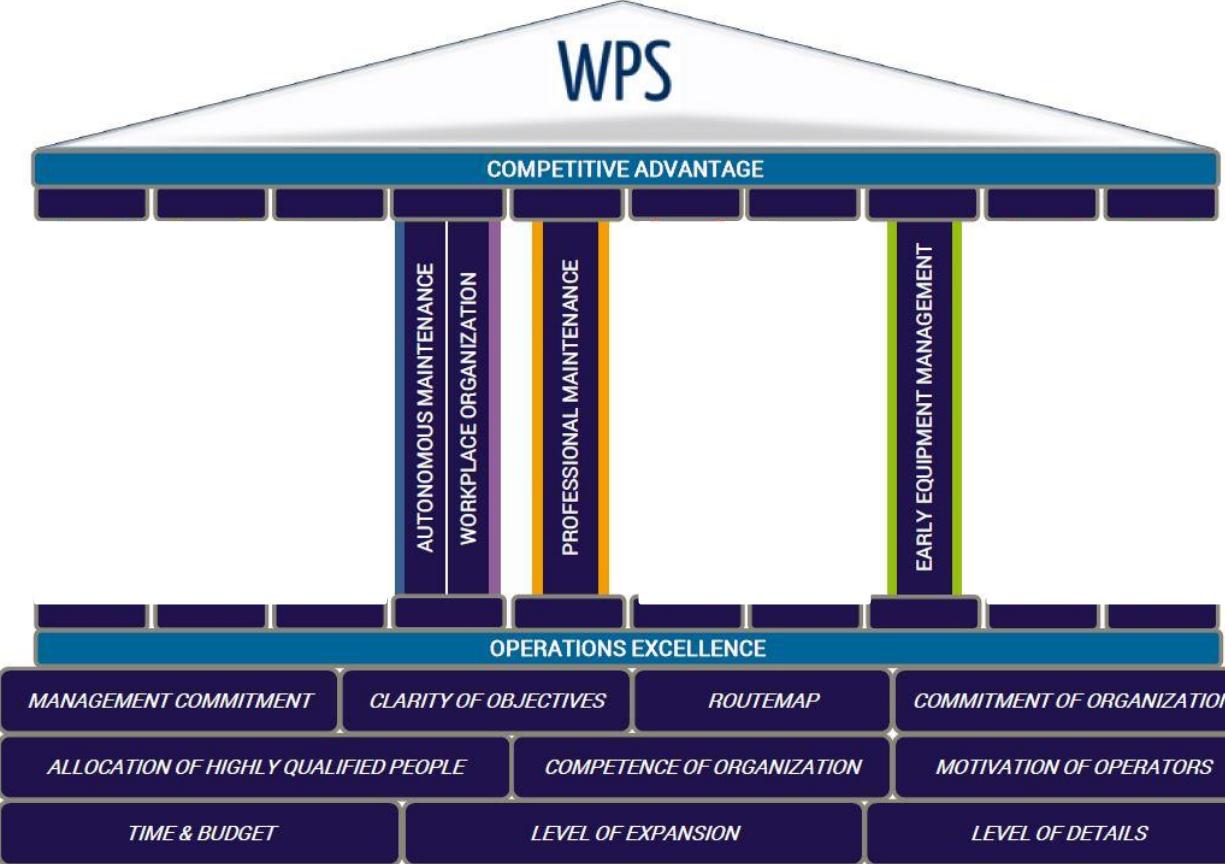
INTRODUCTION TO PROFESSIONAL MAINTENANCE

Vision

➢ Obtain and maintain high machine efficiency by
- Eliminating breakdowns
- Reducing component replacement frequency / costs

Needs

➢ To maintain efficient, breakdown free machines
➢ To continuously improve machine functionality

Objectives

➢ Zero Breakdowns
➢ Increase the technical availability
➢ Reduction of maintenance costs

7 STEPS OF PM PILLAR

STEP 0
Preliminary activities

STEP 1
Elimination and prevention of accelerated deterioration

STEP 2
Reverse deterioration (Breakdown Analysis)

STEP 3
Establishment of maintenance standards

STEP 4
Countermeasures against weak points of the machine and lengthened equipment life

STEP 5
Build a periodic maintenance system (TBM)

STEP 6
Build a predictive maintenance system (trend management) (CBM)

STEP 7
Maintenance Cost Management Establishment of a planned maintenance system

REACTIVE   **PREVENTIVE**   **PROACTIVE**

TYPE OF MAINTENANCE AND TYPE OF MACHINES

Maintenance Mix

- Corrective Maintenance
- Condition Based Maintenance
- Time Based Maintenance
- Breakdown Maintenance
- Autonomous Maintenance (Cleaning, Inspection, Lubrication, Refastening Activities)

Other Machines (B & C Class)

Key Machines (AA & A Class)

Predictive Maintenance: a (very much personal) definition
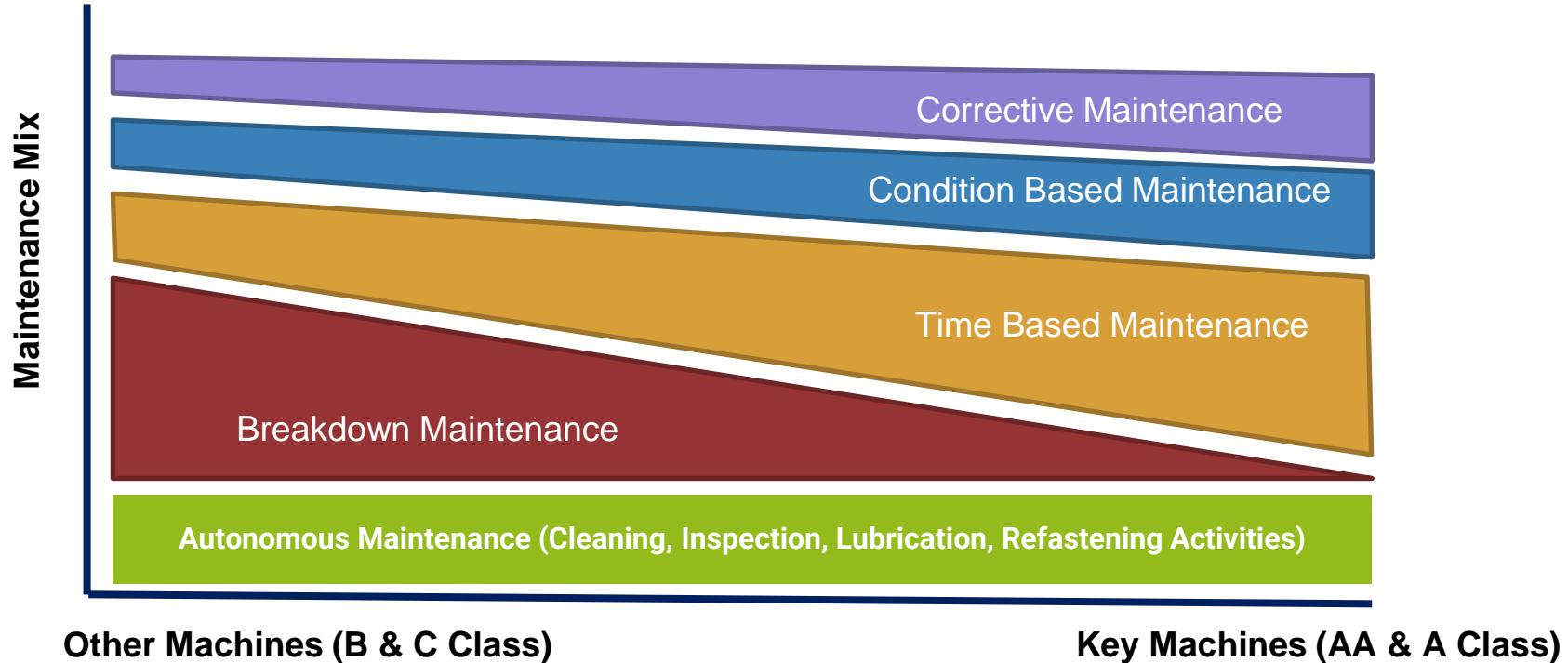
Predictive Maintenance is the **capability** of providing the maintenance organization the time based **suggestion** and the **indication** of what to do in order to **prevent a failure** or a **performance loss** on a **machine** within a **reasonable anticipation**. One example is the determination of **Remaining Useful Life** of a component based on its recent behaviour (**inferring stage**) as described by a proper set of **sensor data,** compared to its normal behaviour (**Machine Learning**)

General Information

- **Topic** FOF-09-2017

Novel design and predictive maintenance technologies for increased operating life of product system

- **Duration** 36 Months

- **Start** 01.09.2017

- **End** 31.08.2020

- **Total costs** €
  6,248,367.50

- **Max grant** €
  4,847,836.25

UPTIME

Feeding Line → Straightener → Hydraulic Punching → Automatic Buffer

Seaming → Flanging → Spokes Assembly → Drum Pre-Assembly

Flange Seaming → Dimensional Control → Unloading

● Part Gauge Sensors   ● Equipment Gauge Sensors
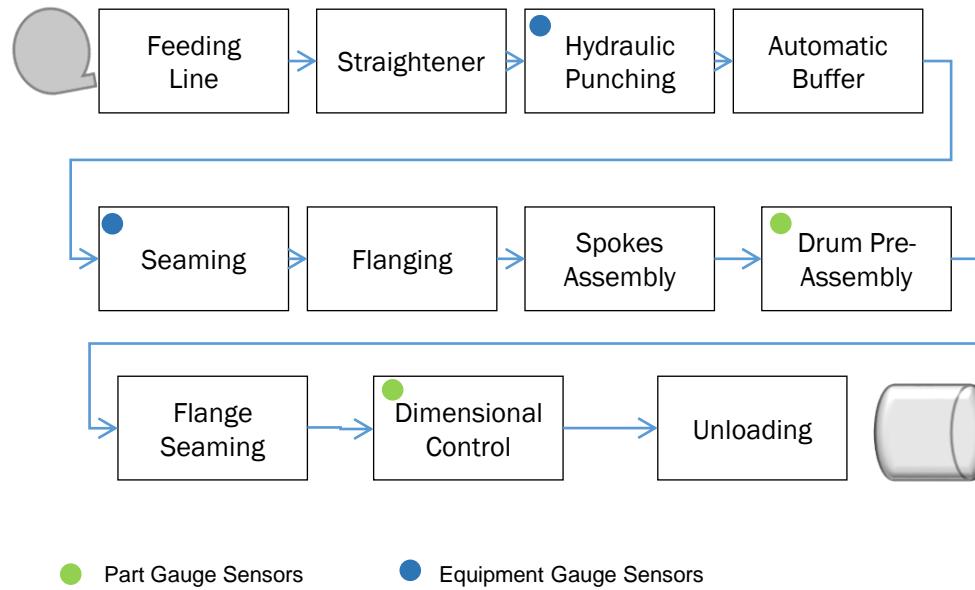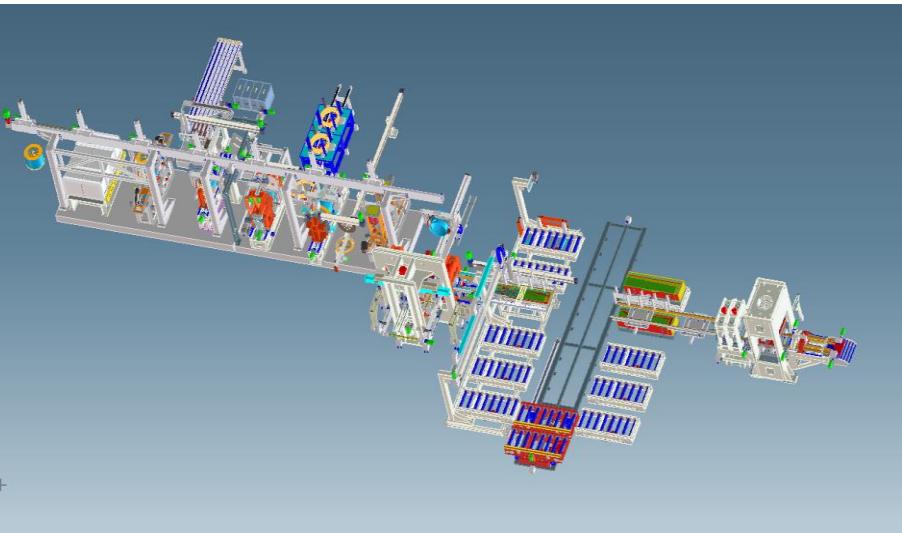
- Clothes dryer drum production line
- Installed in Q1 2018 in Lodz factory in Poland
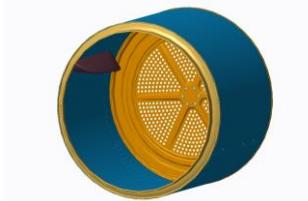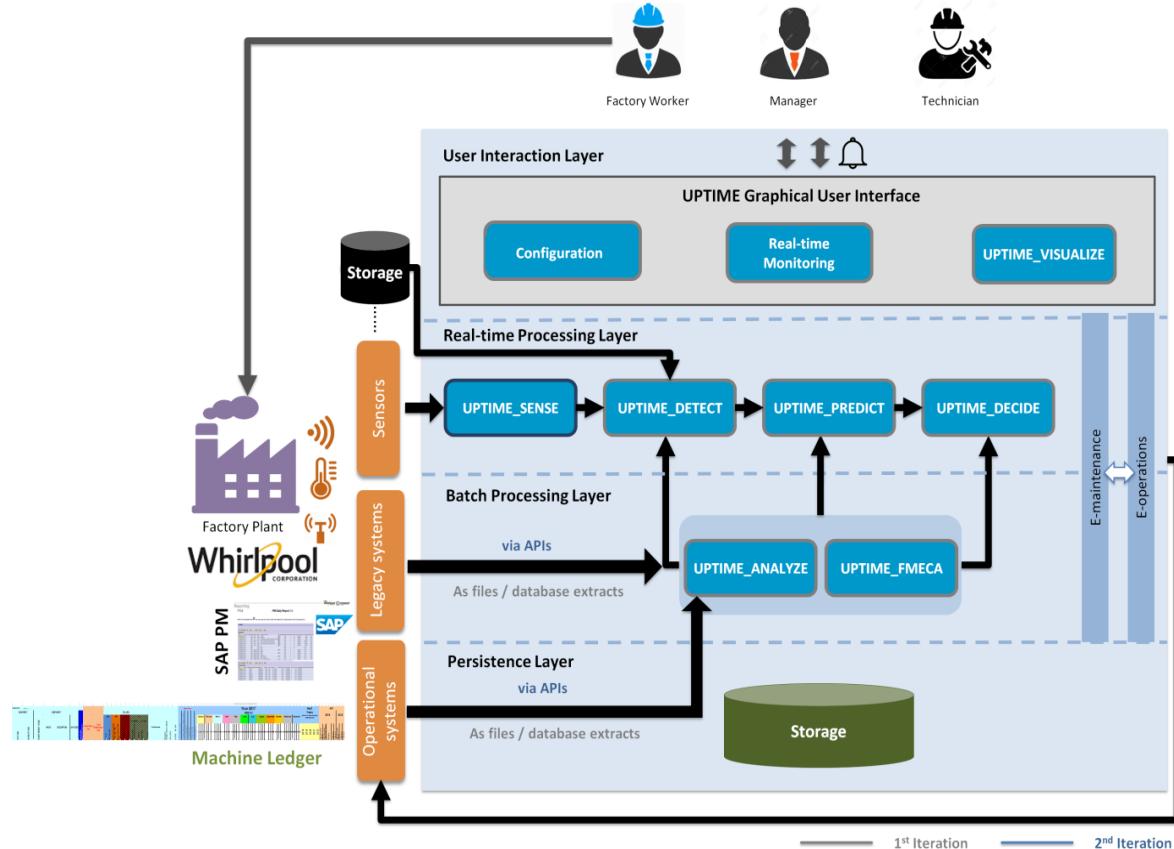
Participant No *	Participant organisation name	Country
1 (Coordinator)	COMAU S.p.A.	IT
2	Finn-Power Oyj	FI
3	VDL Weweler BV	NL
4	WHIRLPOOL EMEA SpA	IT
5	Kone Industrial Ltd	FI
6	Engineering Ingegneria Informatica S.p.A.	IT
7	OCULAVIS GmbH	DE
8	SynArea Consultants S.r.l.	IT
9	DELL EMC	IE
10	Laboratory for Manufacturing Systems & Automation	GR
11	Fraunhofer Gesellschaft zur Förderung der angewandten Forschung	DE
12	VTT Technical Research Centre of Finland Ltd	FI
13	TRIMEK S.A.	ES
14	Politecnico Di Torino	IT

- 14 partners, 7 EU member states, across Europe

| Pressure sensors | Temperature sensors | Flowmeter |

Isocyanate (MDI)

Polyol

Self Cleaning piston

| Pressure sensors | Temperature sensors | Flowmeter |

Factory SQL Database
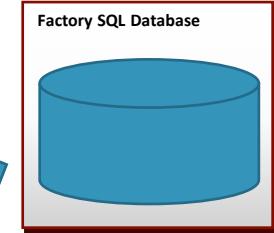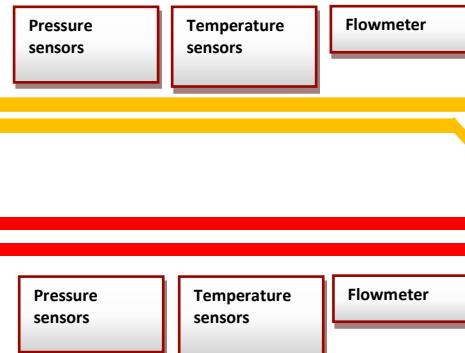
For each shot:
- Date (day, month, year, hour, minute, second)
- Machine number
- Machine total pour (set and actual)
- Head total pour (set and actual)
- Head number
- Program number
- Poured weight (set and actual)
- Ratio type (P/I or I/P)
- Ratio (set and actual)
- Iso and Pol outputs (set and actual)
- Iso and Pol temperatures (set and actual)
- Iso and Pol pressures (set and actual)
- Graphic display of foaming parameters

Alarms:
- Date (day, month, year, hour, minute, second)
- Machine number
- Alarm state (switched on, acknowledged, switched off)
- Alarm number

Production monitoring System (PMS)

Alarms

Factory SQL Database

Pressure sensors

Temperature sensors

Flowmeter

SCADA

Mechanical Sensors

- Breakdown
- Repair Time

SAP PM data

REST

SERENA Gateway

Linux Docker

Ingest/Digest Layer

nifi

Storage Layer

MariaDB

HDFS

SERENA Cloud

Spark

Analytics Layer
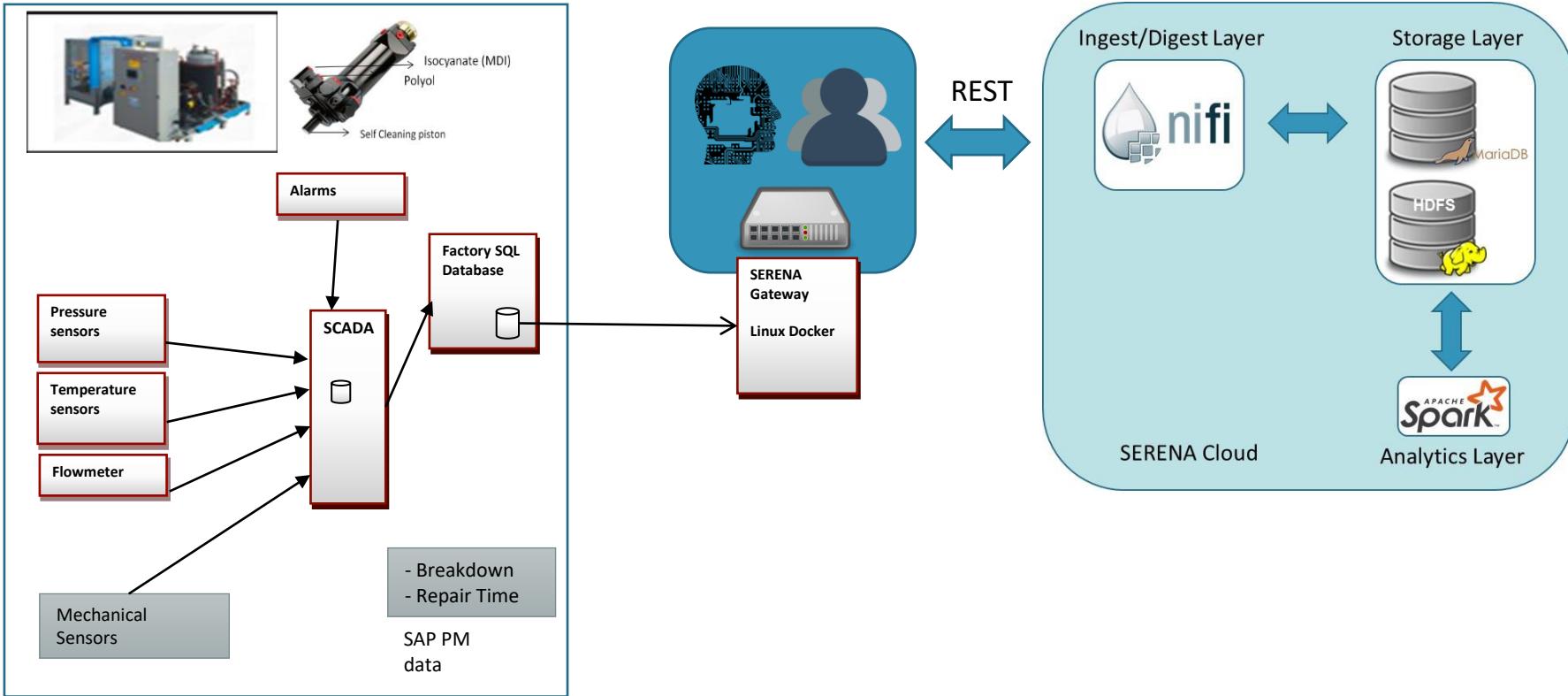
Predictive Maintenance learning and challenges

- Identify the right data to be used using FMECA or other analytical tool

- Act in advance: machine learning can require many months (years?) of data

- Define a standard, semantic data model

- Have an IT architecture to ease up data flow from sensor to storage to applications

- Set-up a system to ensure data flow robustness (monitor the flow and check data-quality)

- Provide mechanism to correlate different kind of data

- Find a way in which process expert and data scientist can effectively exchange information and knowledge

- Prediction must gain expert trust

- Enable the organization and business process to interact and work with PdM

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