


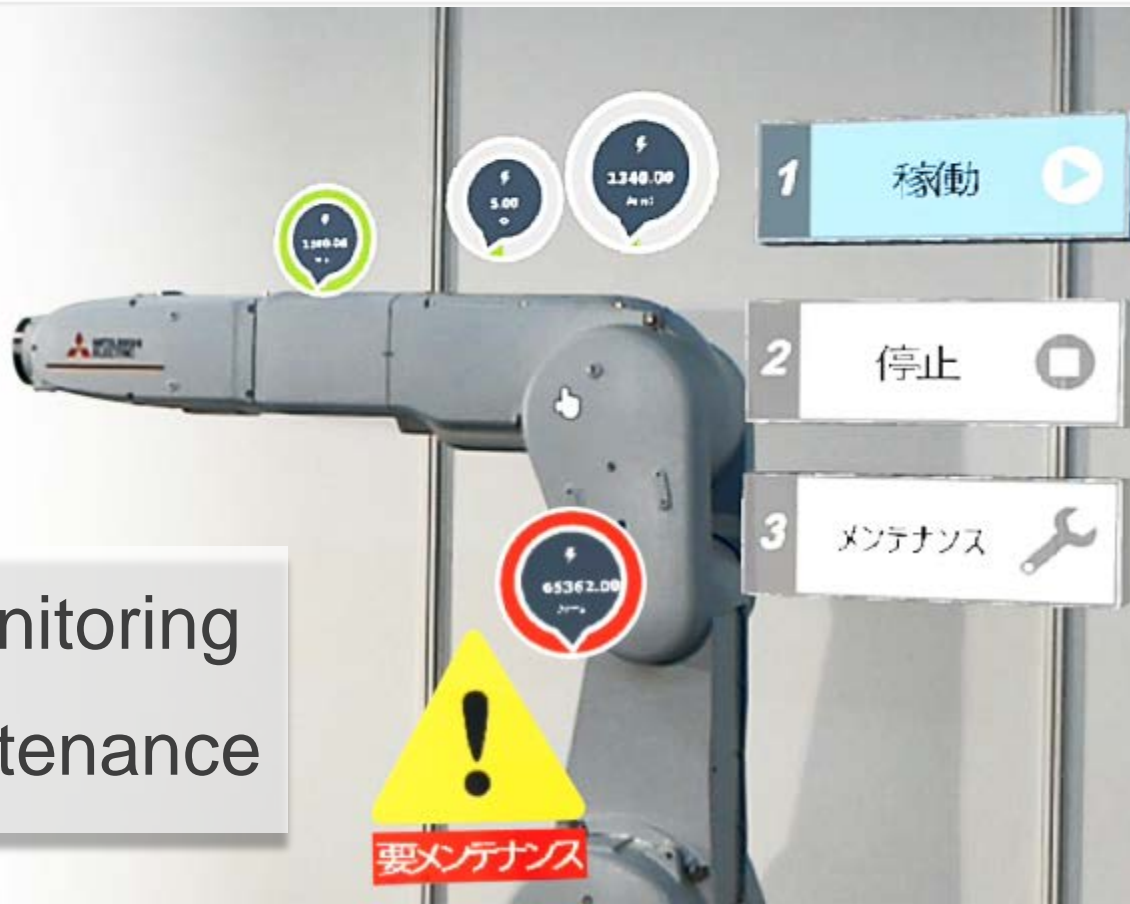
e-F@ctory

Condition Monitoring of Machines and Robots: by Cloud or by Edge Computing? - Profits, Saving and Practical solutions

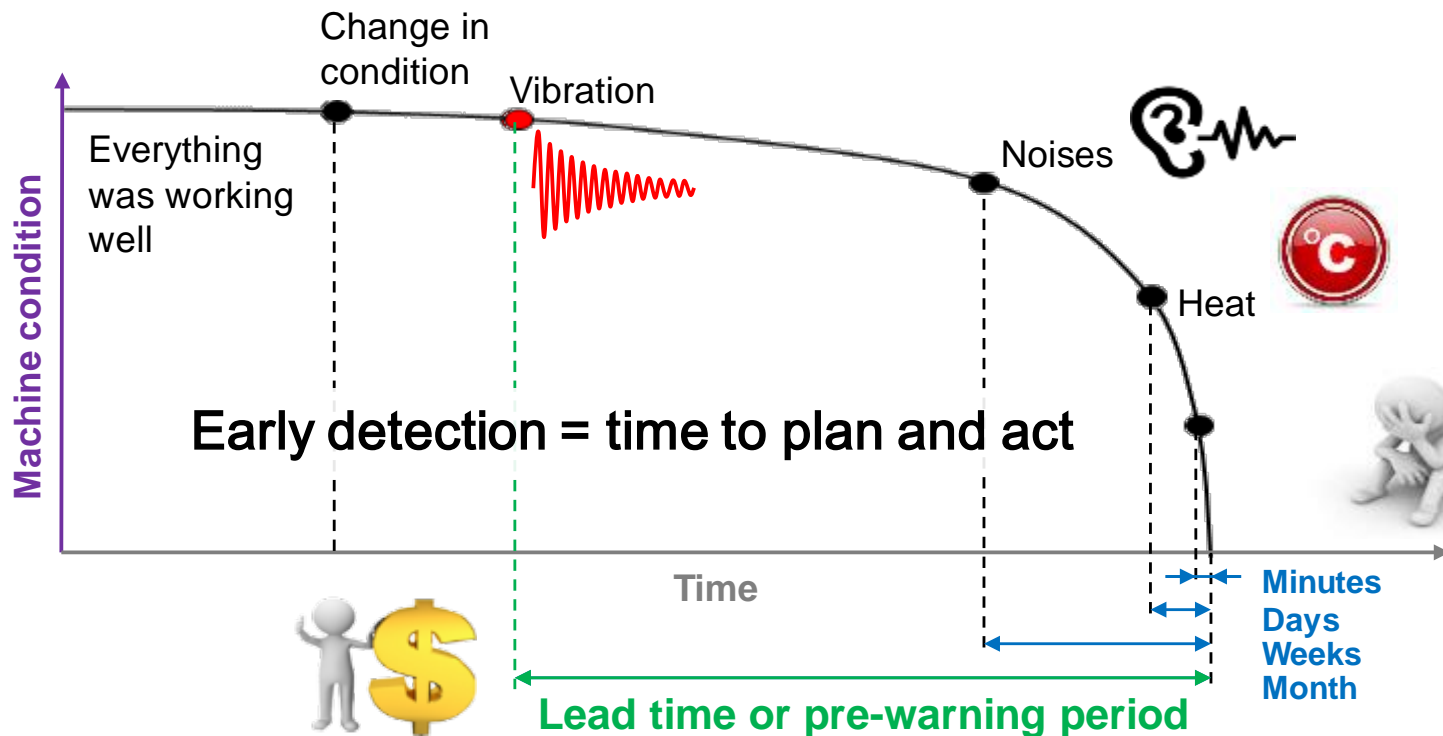
by Jakub Kwiatkowski 

e-Factory

IoT, Condition Monitoring & Predictive Maintenance



When it all goes wrong



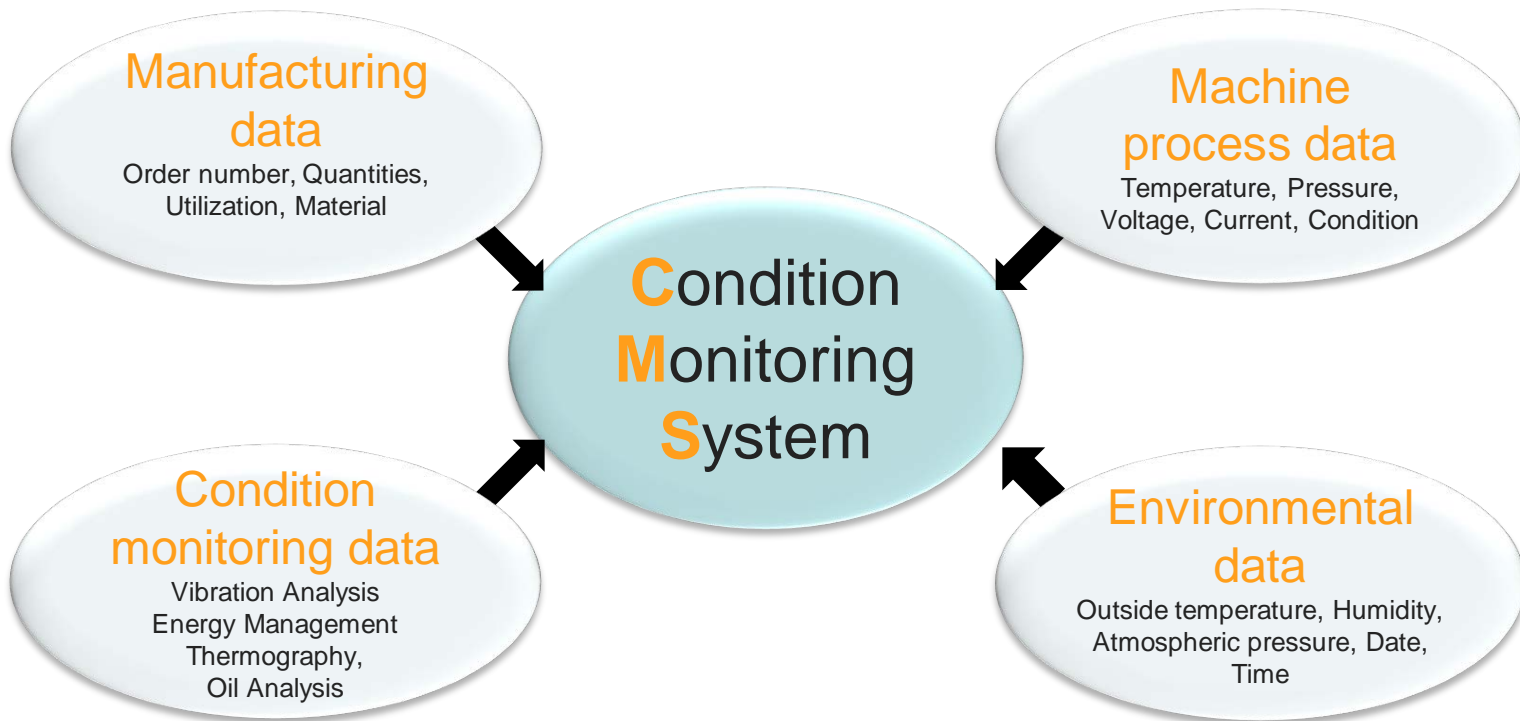


Condition Monitoring Systems

Your **24 Hour** Doctor



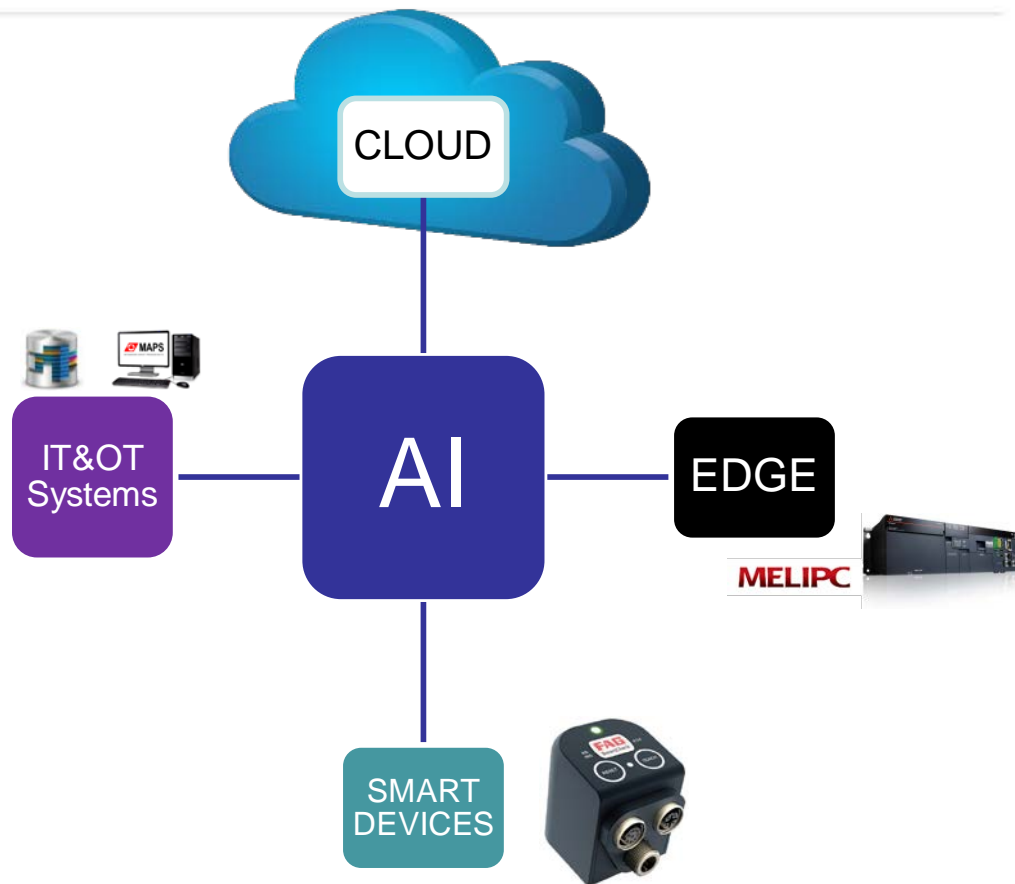
What is the CMS measuring?



Could this be
done by
AI?

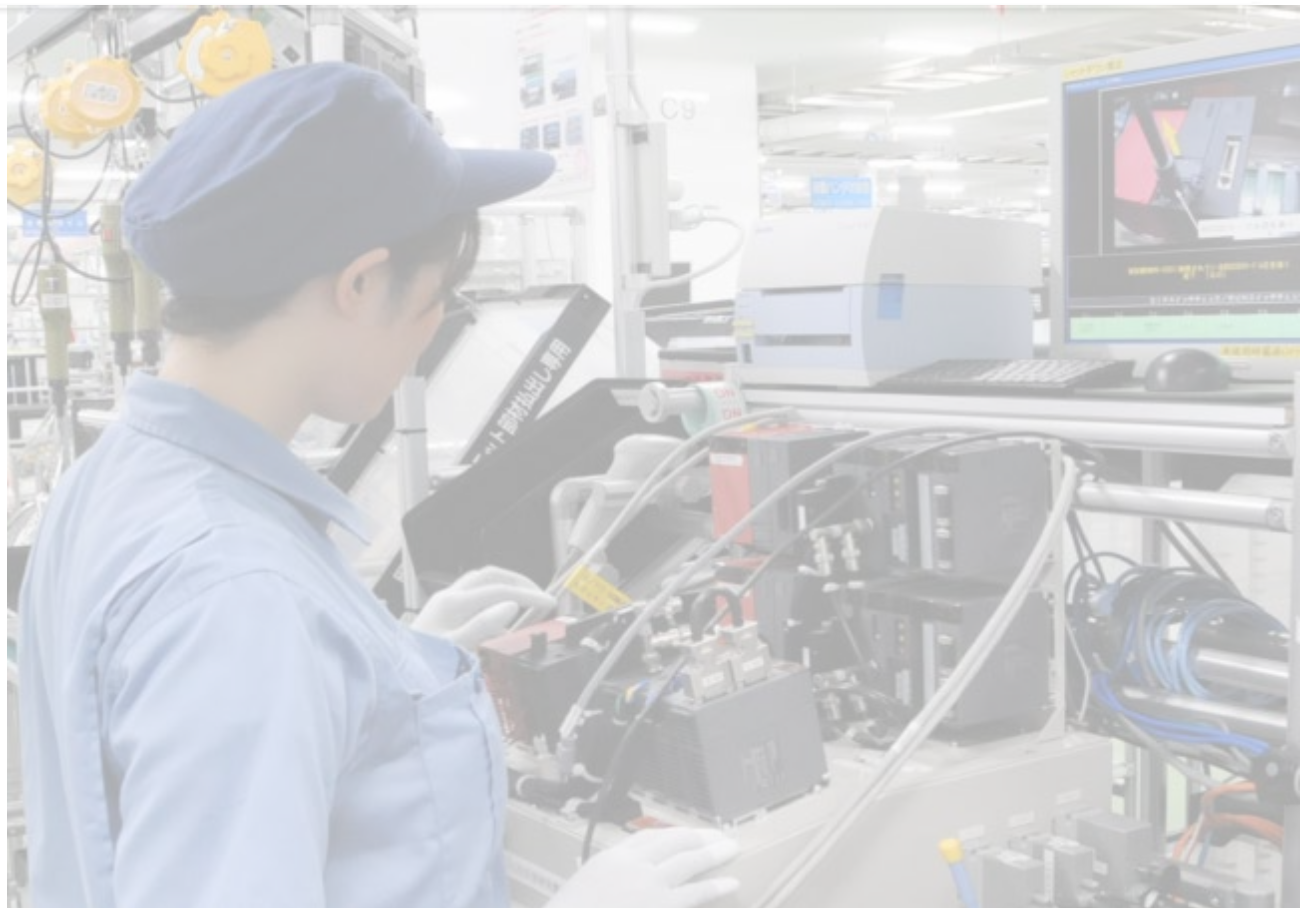


Where is CMS? Where is AI?



e-F@ctory

in action



CASE STUDY

Paper mill plant

Problem

Cooling fan stoppage resulting in damage to end products

e-F@ctory solution

Improved OEE:
Predictive with monitoring of motor power consumption.
Simple solution without additional sensors utilizing existing data

€10,500 savings on 3 lines plus no loss of service



Let's
go into
Detail

Company

Mitsubishi HiTec Paper Europe GmbH

Application

cooling system for paper mill producing coated thermo-sensitive paper

Processing

Speed: 1,730m/min (103.8 km/hr)

Paper roll: 9,000kg per roll (2.9m wide) (150,000,000 kg/yr)

Requirement:

No loss of service, aid planned maintenance, no machine damage

Configuration/system

Number of cooling fans: 26

Weight of 1 fan impeller: 100kg

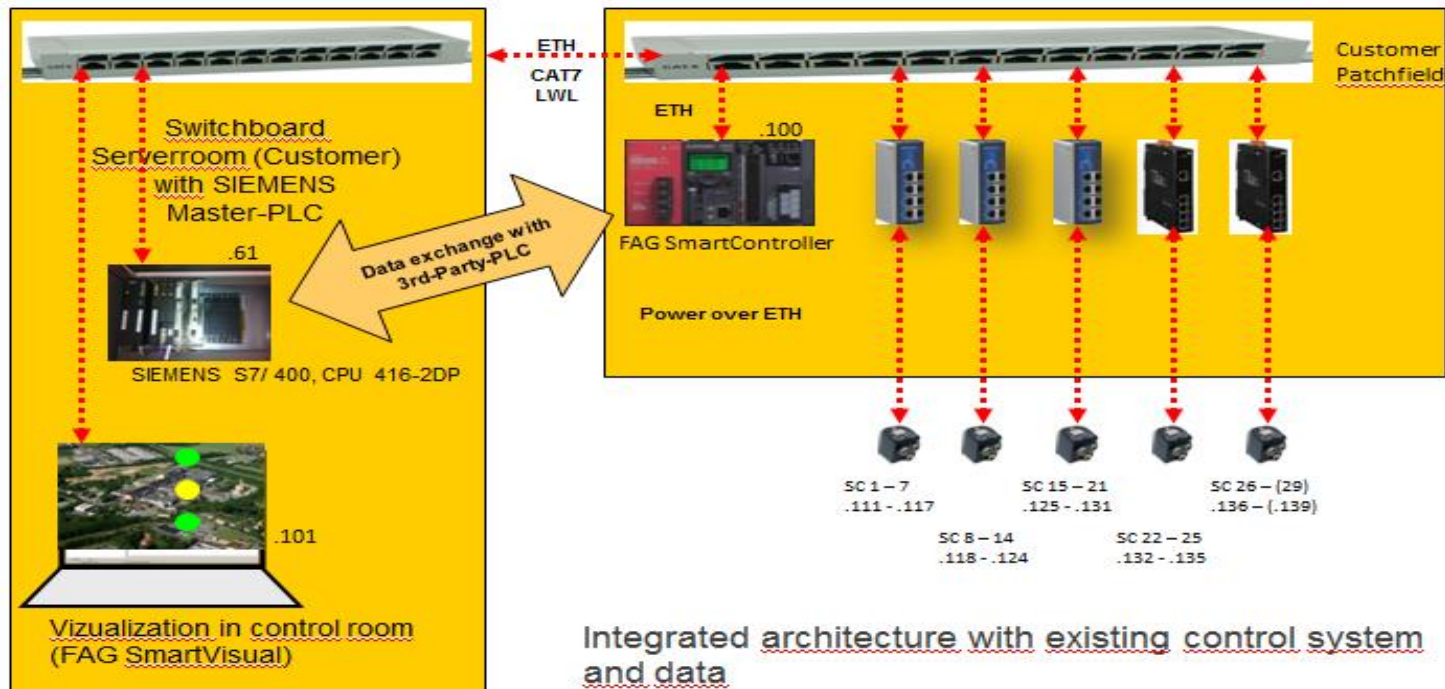
Impeller speed: 1500rpm

Target temperature: below 68 deg C (starting temp. 250 deg C)



**€10,500
SAVING**

System



Integrated architecture with existing control system and data

NO CMS vs CMS

Background cost analysis (€)				
	Case 1		Case 2	
CMS	None		Installed	
Materials	1 roll of paper production	12,000	CMS hardware	19,500
			CMS installation	6,000
Sub total		12,000		25,500

ROI case (€)				
3 rolls of paper production	Scrapped paper rolls x3	12,000 x3	CMS	25,500
ROI sub total		36,000		25,500

**€11,500
SAVING**
+ NO DOWNTIME

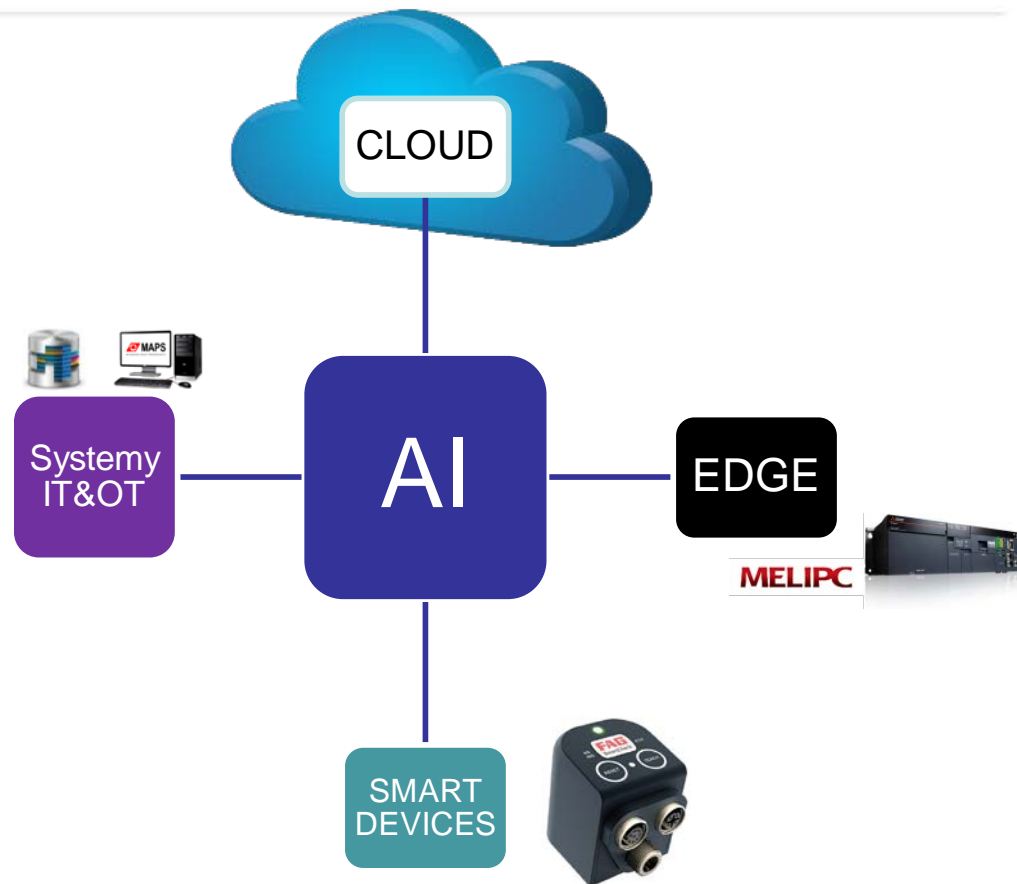
Solution delivery



Local SI: Carl Werthenbach
Konstruktionsteile & Co. KG
Sensor: Schaeffler
Hardware: Mitsubishi Electric

Result:
Achieved continuous running process, no machine damage, now utilizing planned maintenance/service
Solution rolled out to second plant.

Where is CMS?
Where is AI?



CMS on the ‘Edge’



Cloud computing VS Edge Computing

Cloud computing

- Developing knowledge



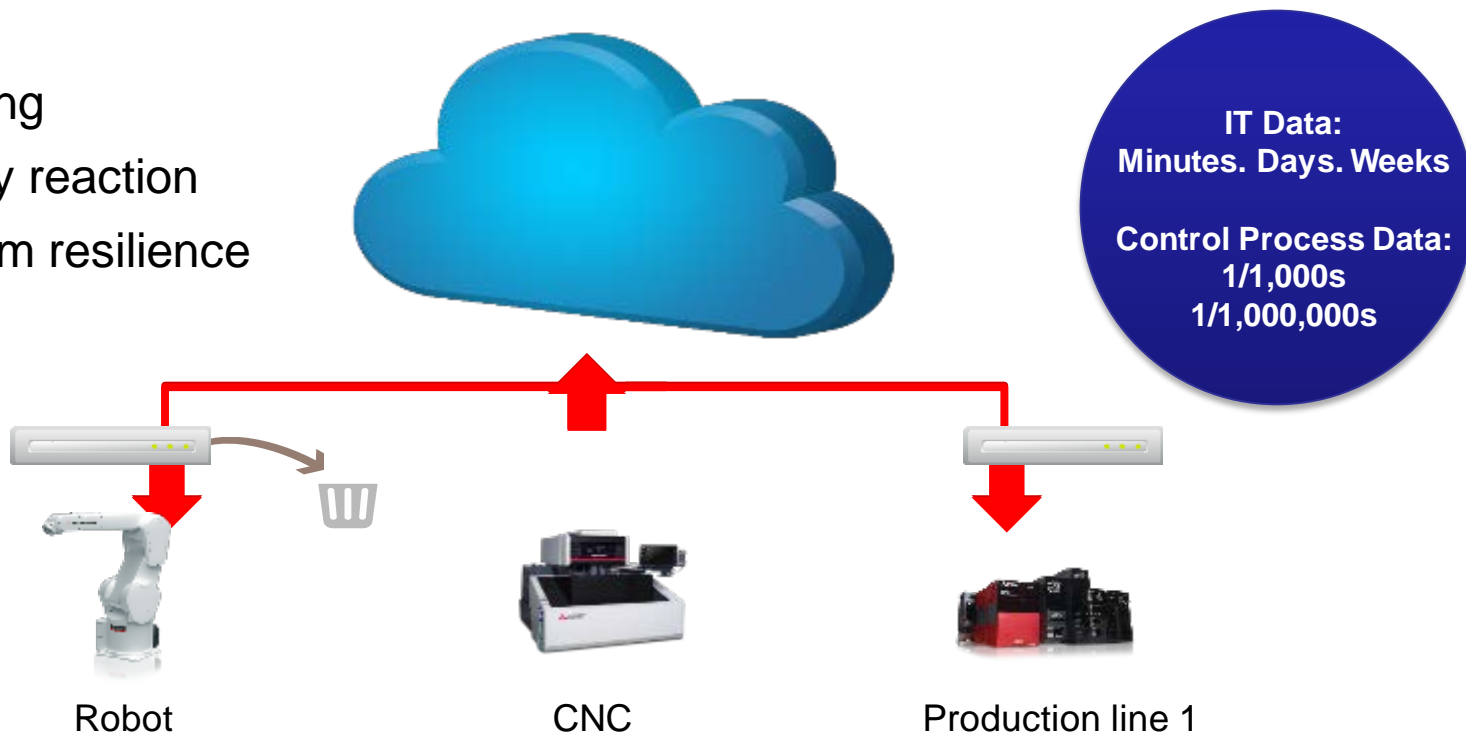
Edge computing

- Knowledge in action



Diagnostics on the “Edge”

- Filtering
- Timely reaction
- System resilience



Edge application

Real-time Data Analyzer



GT SoftGOT



iQ Edgecross

MAPS / MC Works64



Edgecross pre-installed Industrial PC MELIPC series

MELIPC



MI5000



MI3000



MI2000



MI1000

Data collectors

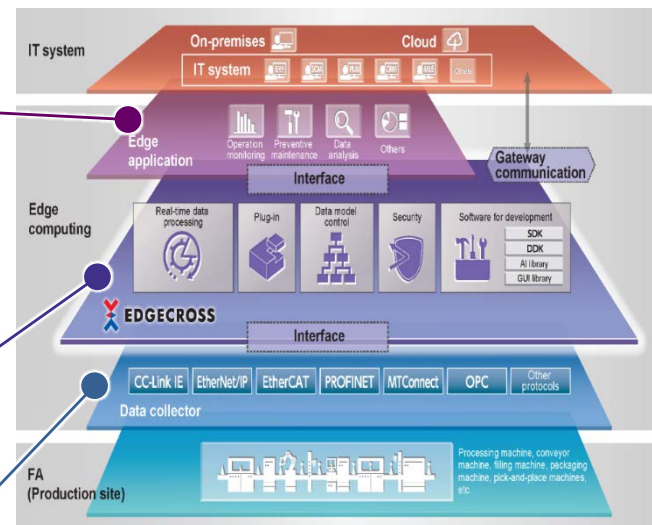
CC-Link IE Field

SLMP

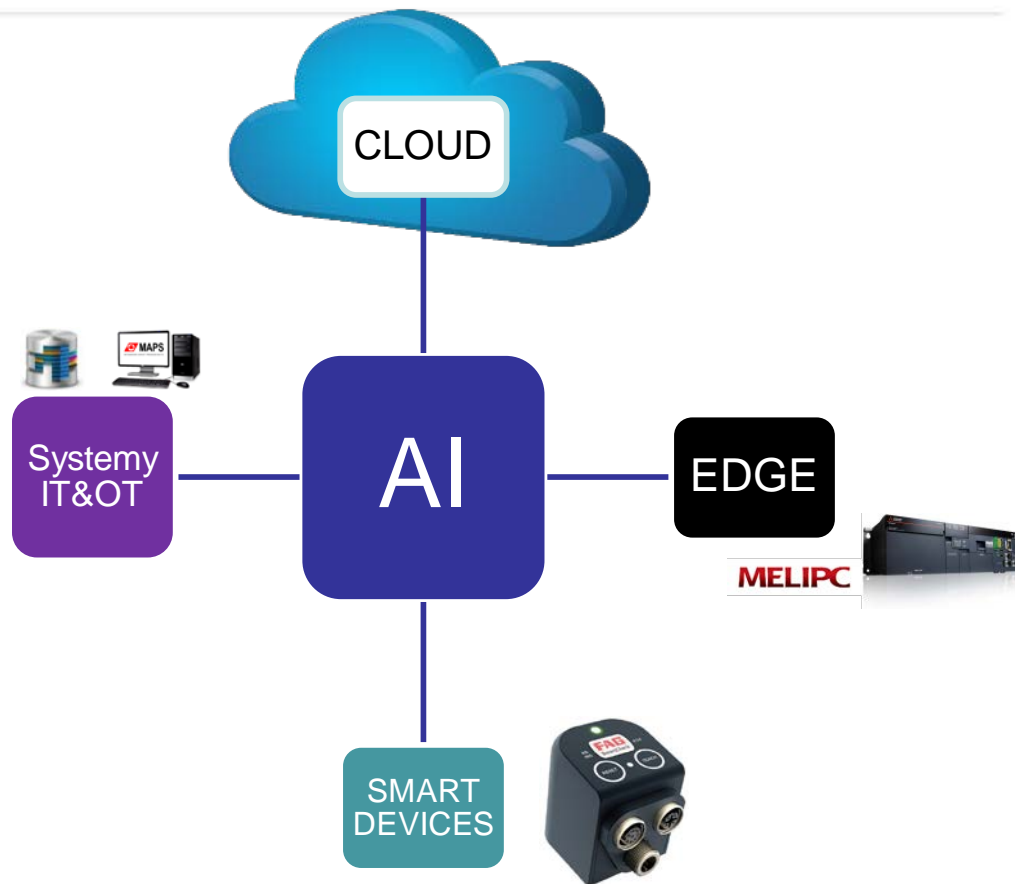
OPC UA

MTConnect

iQ Edgecross



**Where is CMS?
Where is AI?**

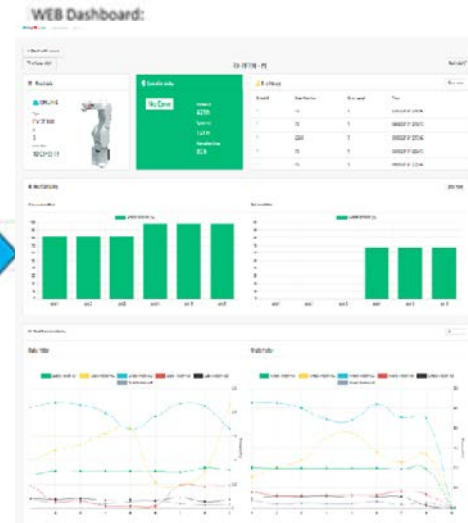
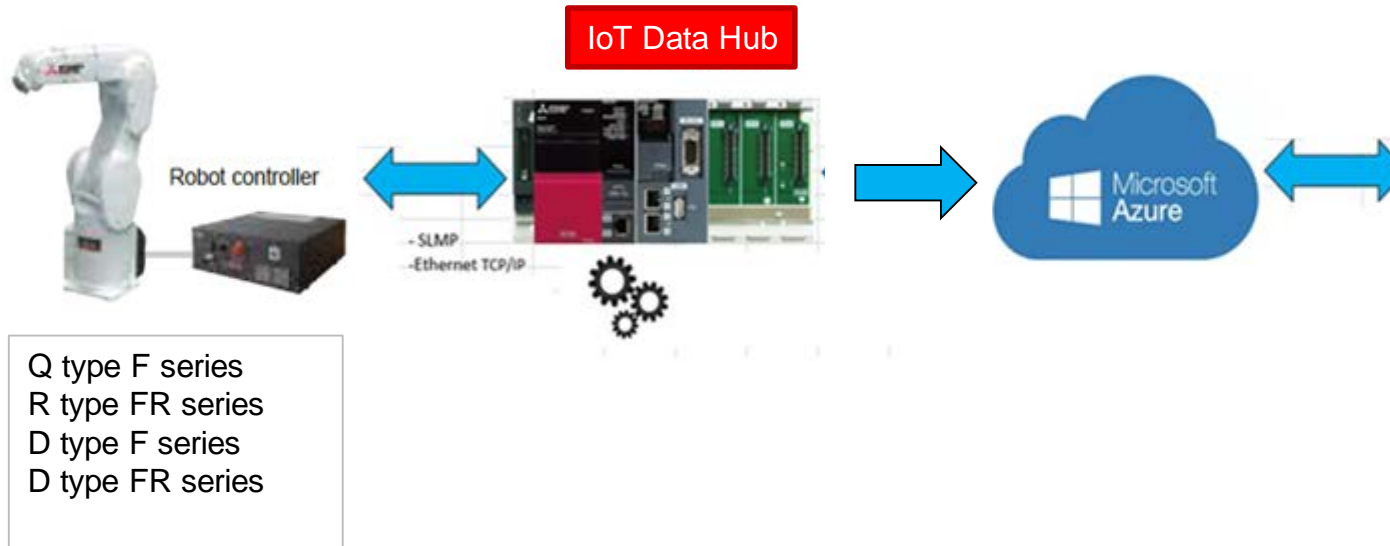


Robot Remote Monitoring & Maintenance



Robot Remote Monitoring & Maintenance

System structure

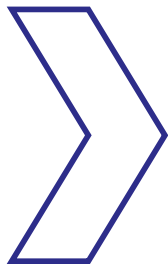


Robot Remote Monitoring & Maintenance

We require

Motor as a sensor

No need to install new sensor



We measure

Current wave



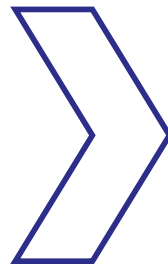
Speed wave



We analyze

Condition monitoring factors

Easy to analyze with function block



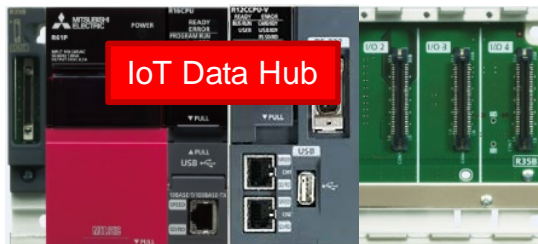
Robot Remote Monitoring & Maintenance



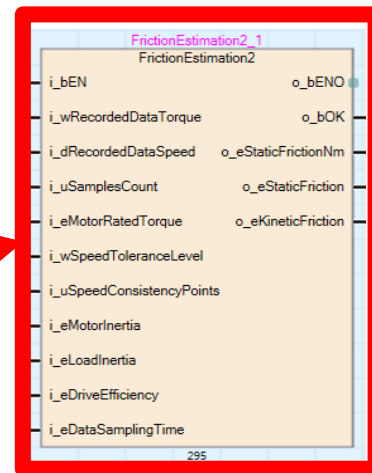
Q type F series
R type FR series
D type F series
D type FR series



PLC + C Application Server



Function block library



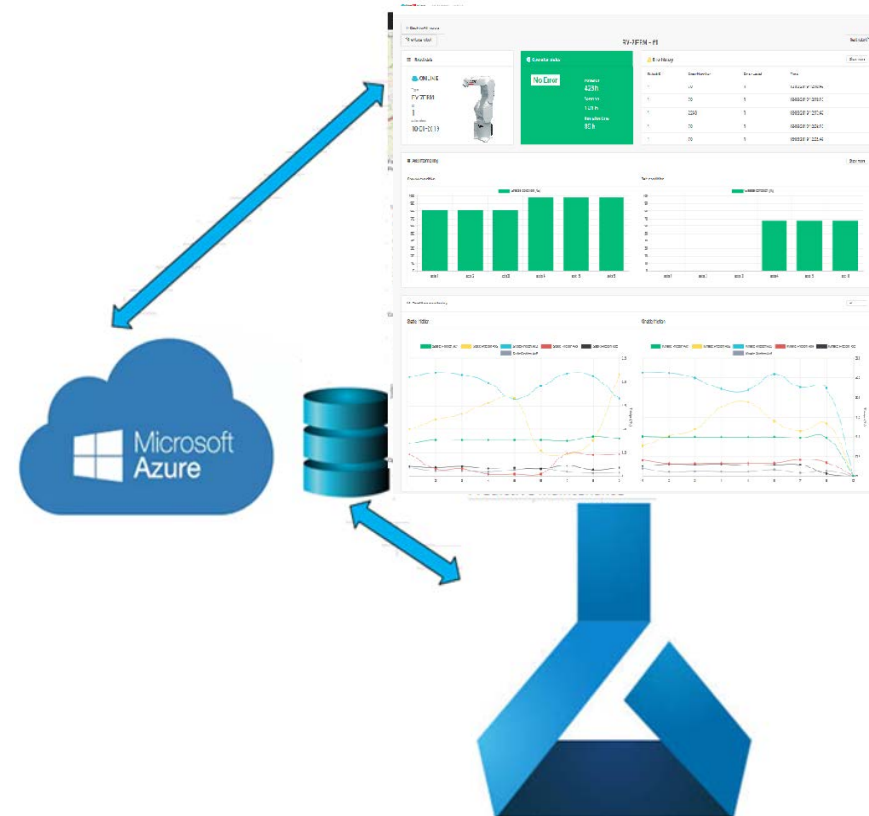
Computing on the edge:

- Real time data from robot recorded and analyzed on the shop floor
- Data compression by PLC library – limiting amount of data send to cloud
- Data compression – calculating condition monitoring factors for predictive maintenance purpose

Robot Remote Monitoring & Maintenance

Cloud application:

- WEB dashboard presenting monitoring data
- Application can send notifications to user and service
- Cloud based computing is enough powerful to add Predictive Maintenance algorithms
- Scalable cloud services (data read, store, analyze in back-end and present on front-end)



Dashboard elements

Connection status:

- Robot – PLC connection status
- PLC – Cloud connection status



All connected robots

 **ONLINE**
PingPong

ID

1

Type

RV-2FR

Sales date

10-01-2019



[Details](#)

 **OFFLINE**
PingPong

ID

2

Type

RV-2FR

Sales date

10-01-2019



 Error

[Details](#)

 **ONLINE**
Prazwy

ID

3

Type

RV-7RM

Sales date

10-01-2018

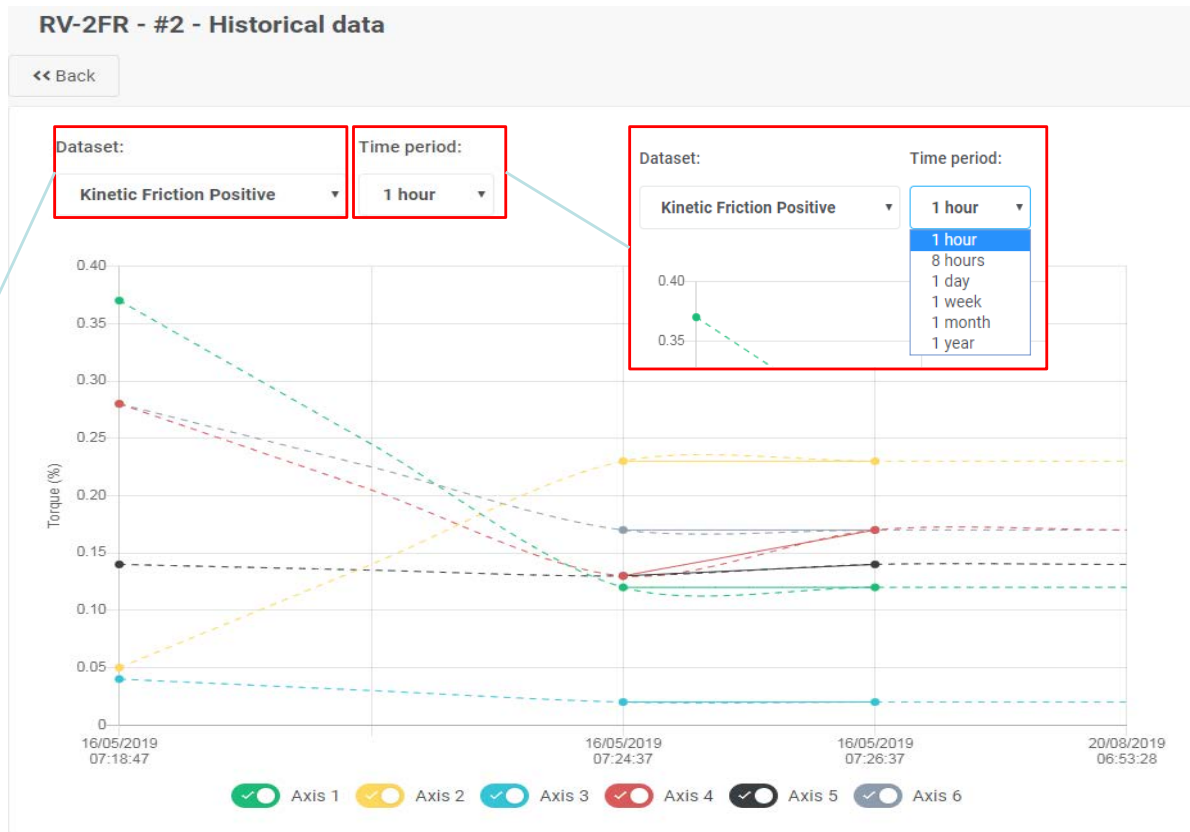
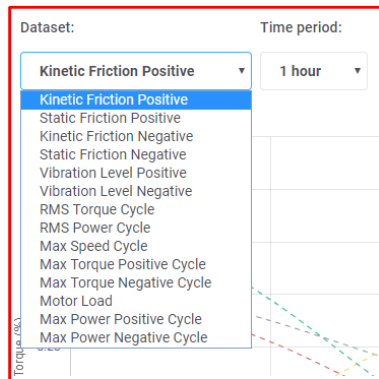
Image not available.

[Details](#)

Dashboard elements

Robot historical data:

- Possibility to check and analyze how robot parameters change in time
- Possibility to select different time ranges and axes of the robot



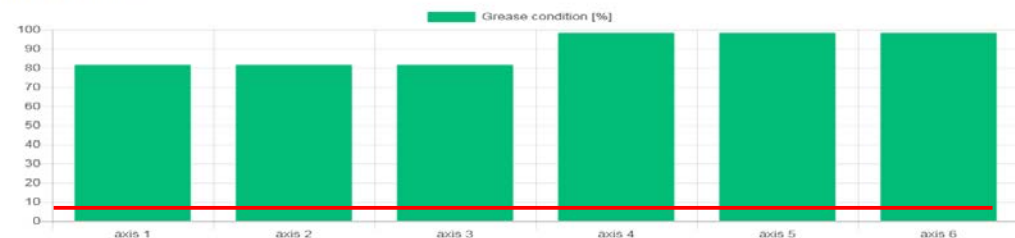
Email reports

If robot parameters exceed defined alarm levels, maintenance team will be informed about that fact by email message!




Axis monitoring

Grease condition



Sample e-mail message:





Śr 2019-07-17 15:20

Mitsu User <MitsubishiElectric@mpl.mee.com>

Robot worn out status

Do ☒ Piwowarczyk, Krzysztof; ☐ Mitsu User

 W przypadku problemów ze sposobem wyświetlania tej wiadomości kliknij tutaj, aby wyświetlić ją w przeglądarce sieci web.



Robot Warning

Robot at Budapest, Albertirsai ut 10, robot id: 1 is asking for maintenance!

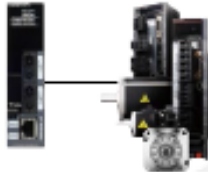
Battery remaining time is: 0
Grease remaining time Ax1 is: 5504

Greetings
Your RV-2FR

Call service

Robot Remote Monitoring & Maintenance

- We are starting from robots, but it is possible to extend to Servo based, INV, CNC and FAG based monitoring.
- Tool is dedicated for End Users (asset monitoring), but is providing data also to service and sales (time to maintenance, working hours ect).



Robot Remote Monitoring & Maintenance

System structure



Pumping Station Remote Monitoring & Maintenance

ME2Pump All Machines Device information About

All pumps (1) [Hide all](#) [Refresh](#)

ONLINE

Test pump

Type
PumpBlue2

Sales date
01-01-0001



Output frequency

50/50 Hz

Input power

11 kW

Operation speed

3,000 rpm

Output power

10 kW

Details

ME2Pump All Machines Device information About

efactory Logout

← Back to All pumps

← Previous device

PumpBlue2 - #1

Live connection on

Next device >

Pump info

ONLINE

Test pump

ID
Type
PumpBlue2

Sales date
01-01-0001

Main inverter info

OFFLINE

Central pump

ID
Type
FR-A800

Sales date
01-01-0001



Output voltage
0 V

Load meter
60

Output current
0 A



Output frequency
50/50 Hz

Operation speed
3,000 rpm

Input power
11 kW

Output power
10 kW

All FAG sensors (1) [Hide all](#)

OFFLINE

Central pump

ID
Type
Fag

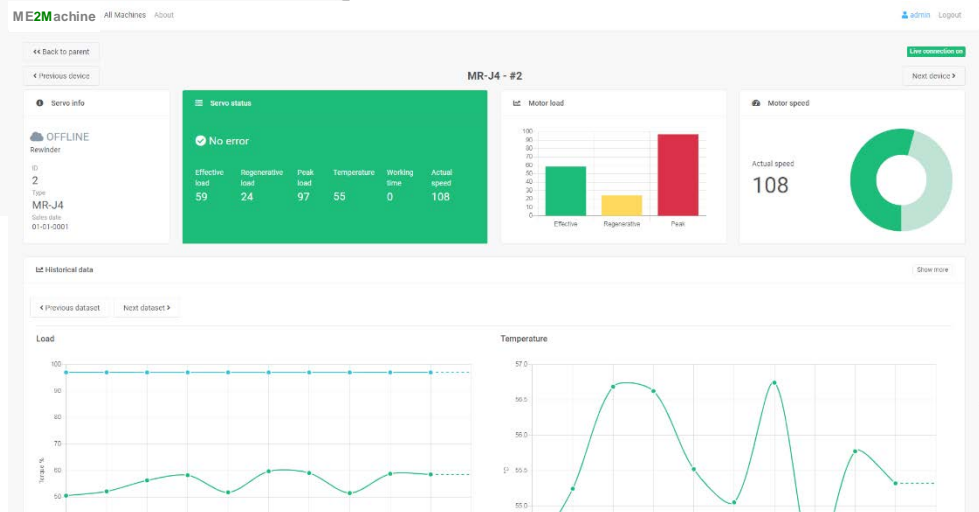
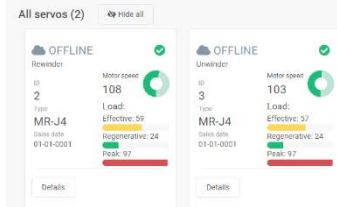
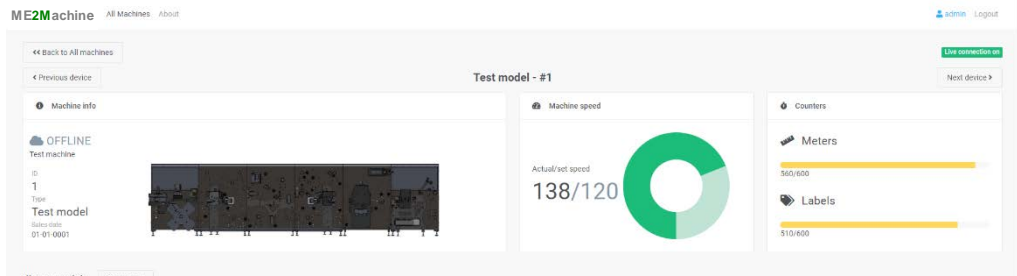
Sales date
01-01-0001

Details

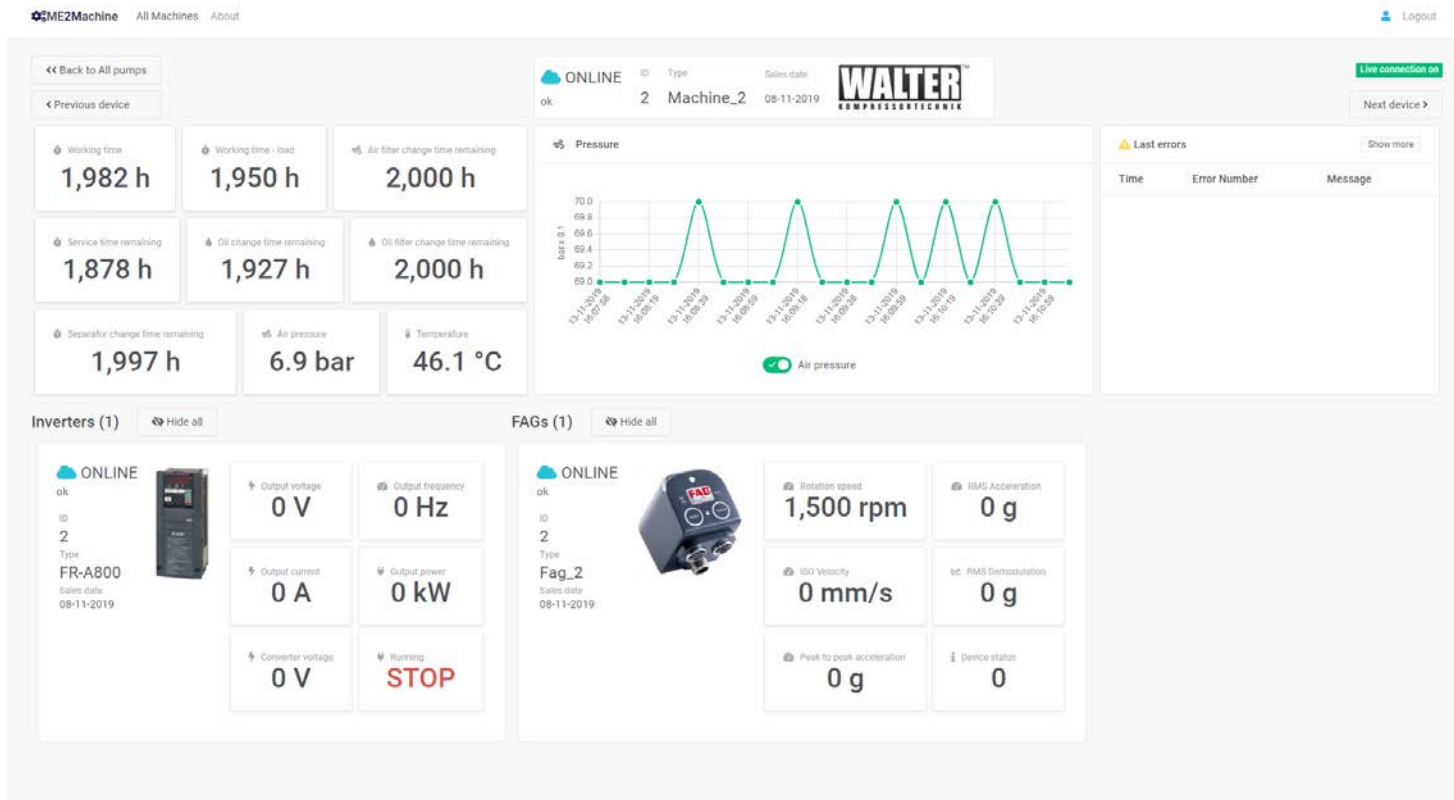
Web application:

- WEB authorized access to robot data
- Preventive data, condition monitoring data available

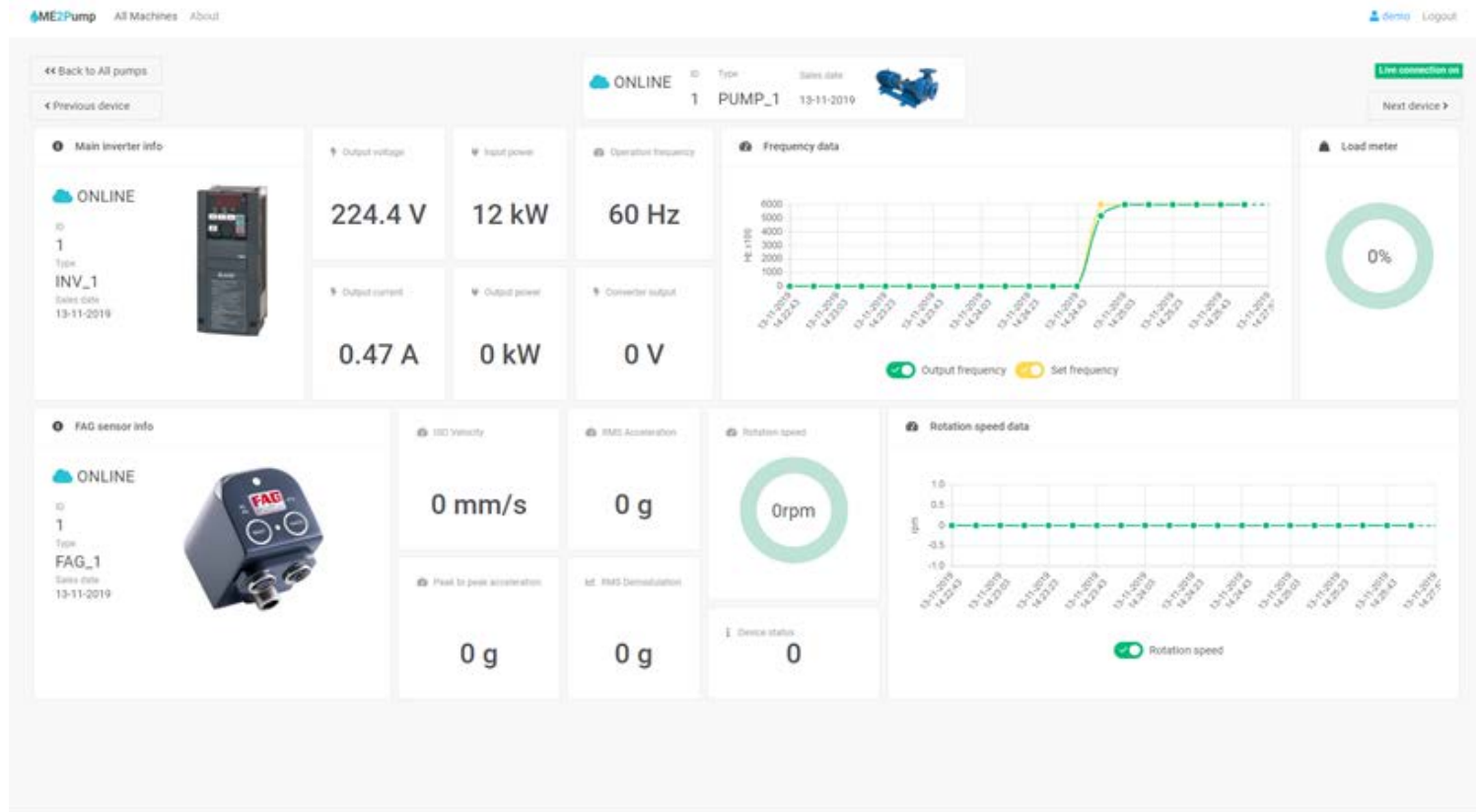
Machine Remote Monitoring & Maintenance



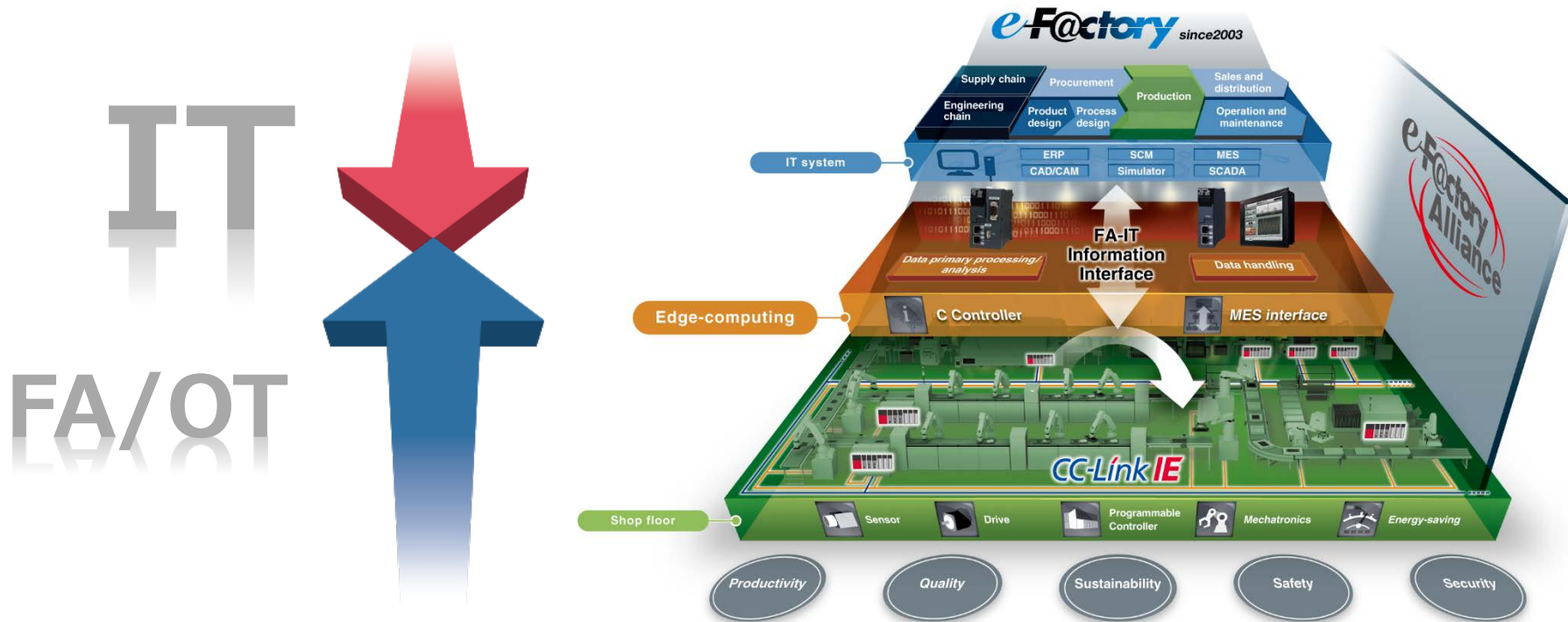
Machine Remote Monitoring & Maintenance



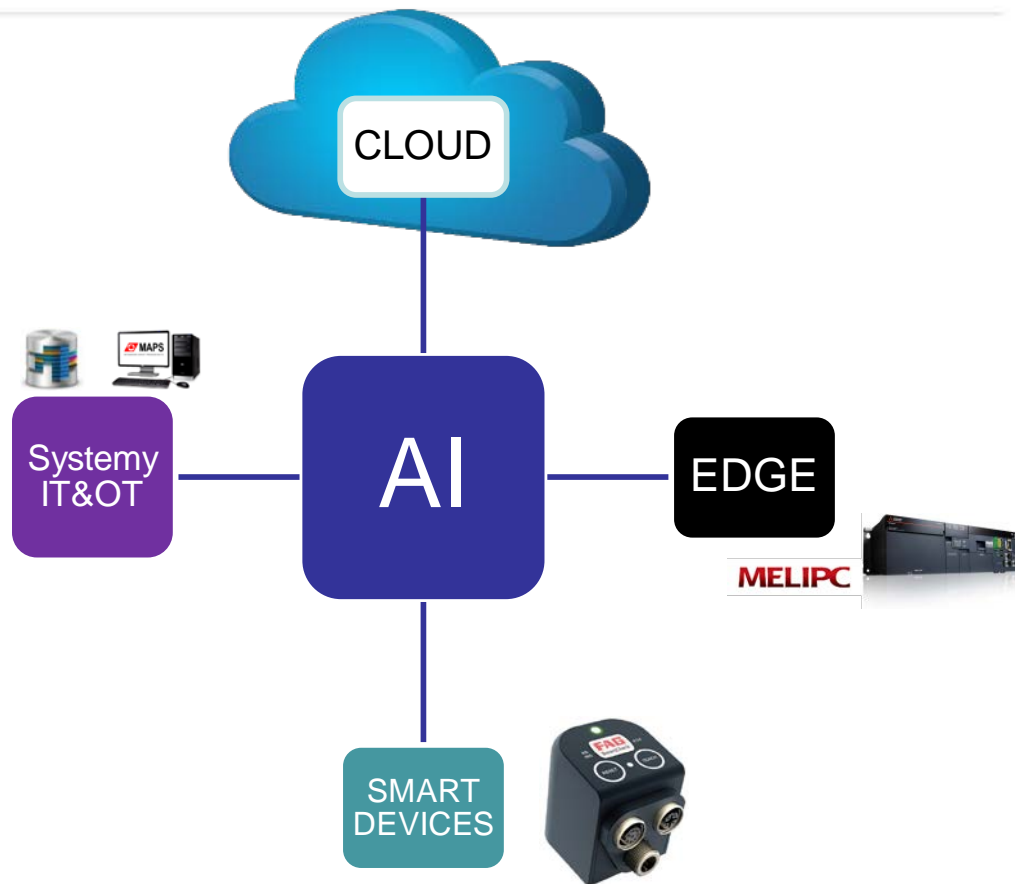
Machine Remote Monitoring & Maintenance



Bringing the world together



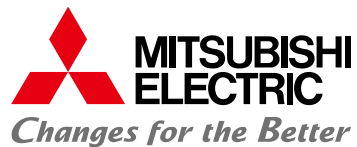
Where is CMS? Where is AI?



Terry Pratchett



„Real stupidity beats artificial intelligence every time.”



Jakub Kwiatkowski

Solution Development Team Manager

+48 601 310 816

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