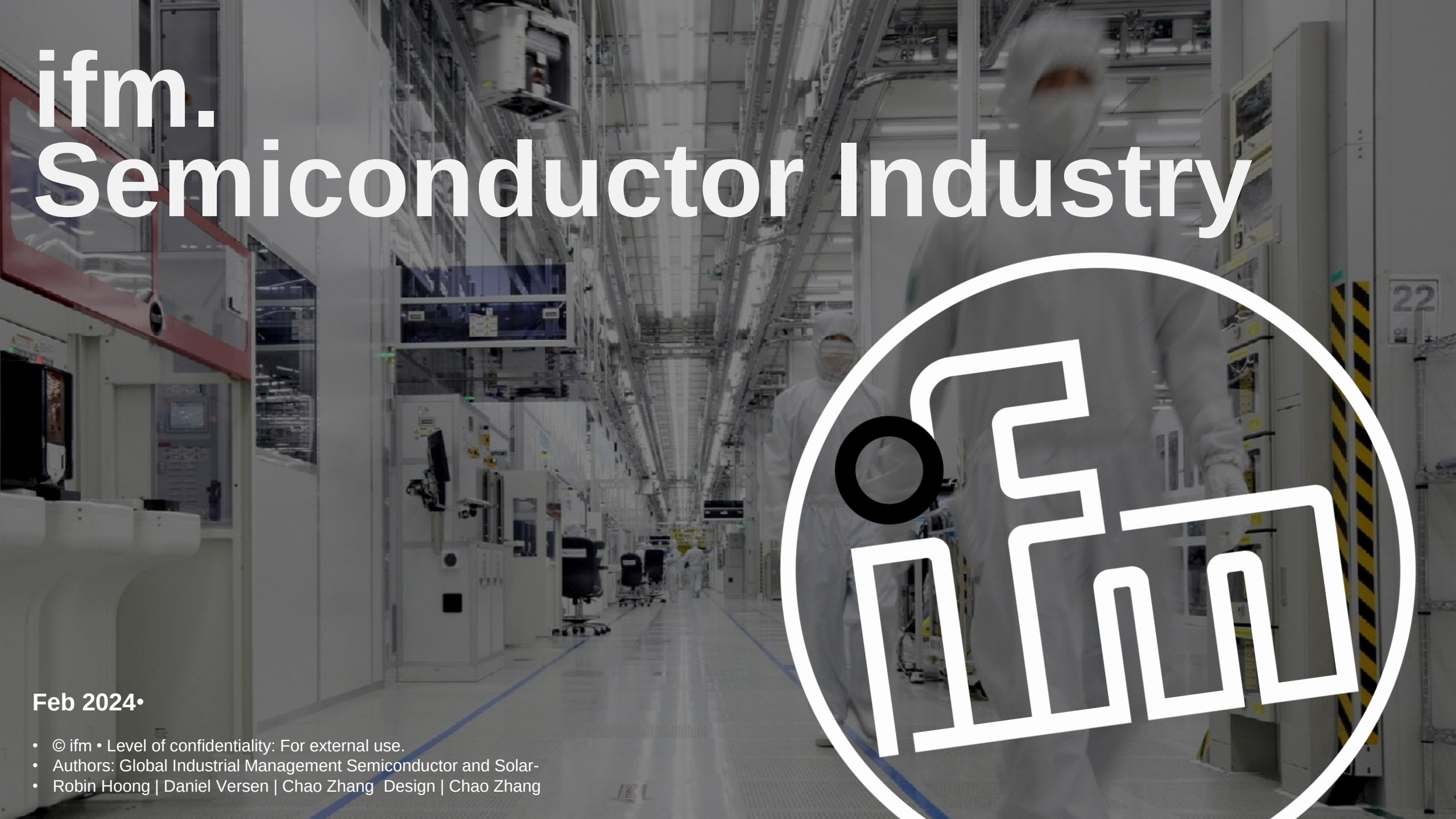
ifm.
Semiconductor Industry



Feb 2024•

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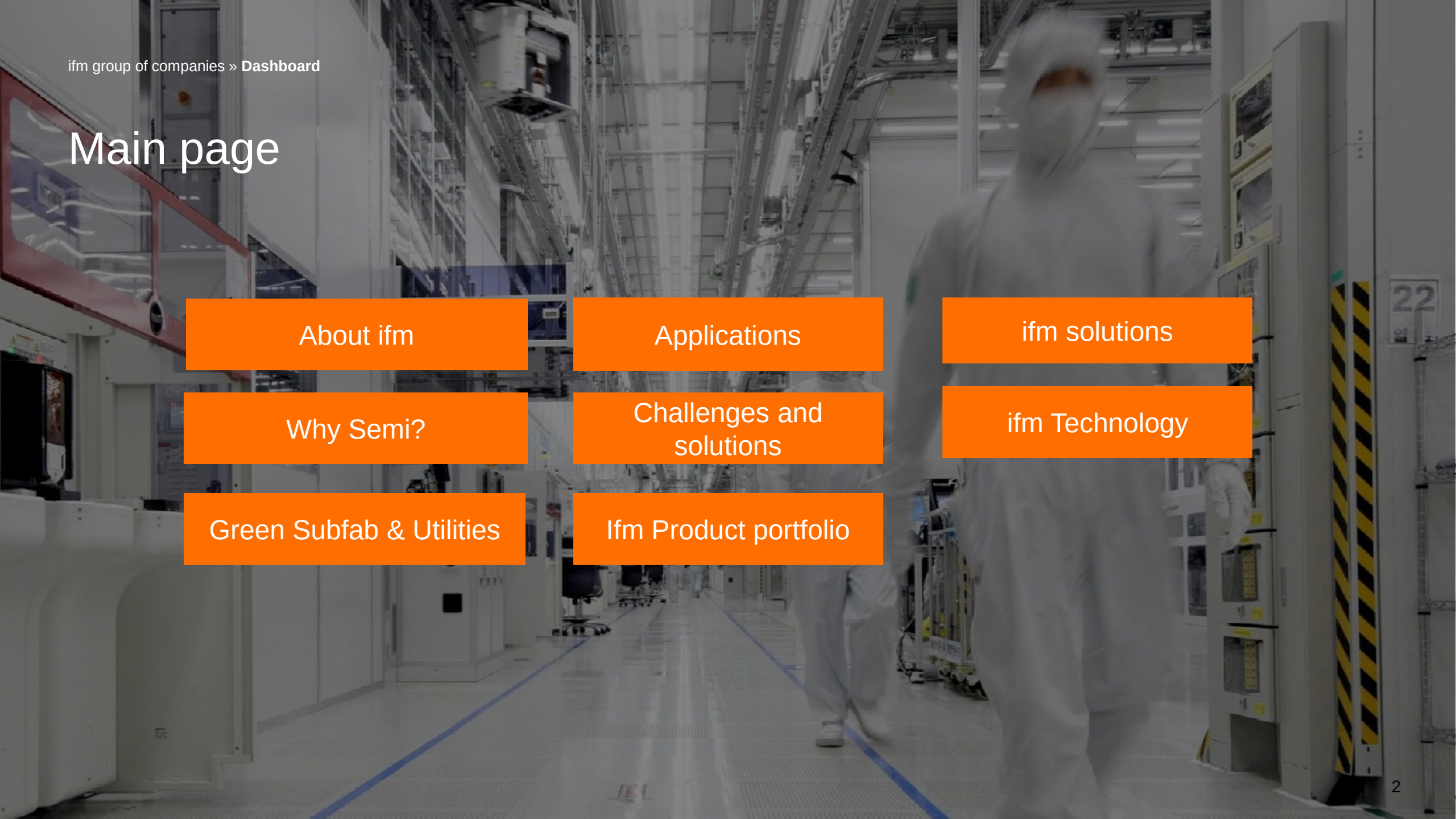
Main page



About ifm

Applications

ifm solutions

Why Semi?

Challenges and solutions

ifm Technology

Green Subfab & Utilities

Ifm Product portfolio

ifm.
At a glance

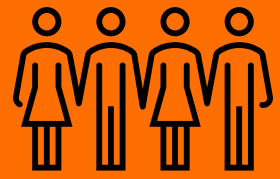
The ifm group of companies is a global industry leader for innovative sensors, controllers and systems for industrial automation and digitalisation.

We combine the flexibility and individuality of a family-owned company with the quality and professionalism of a corporate group.

8,100
employees

1,252
million euros in sales

1,140
patents



1.780
Consulting sales engineers

96,5 %
product availability on the customer's requested date

1969
founded in Essen

In 180
Countries – distribution of products and services

161,000
customers worldwide

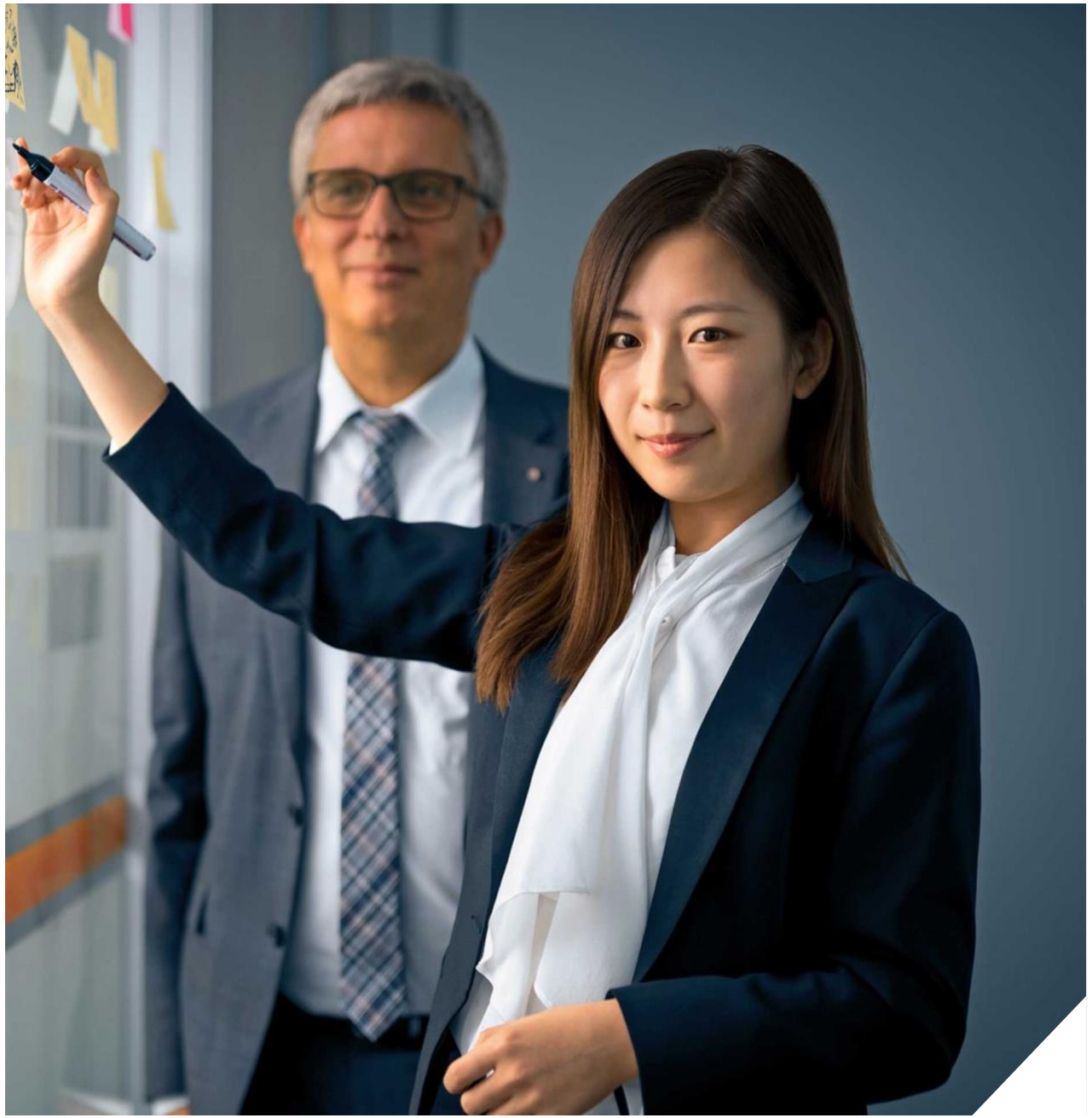
*preliminary sales

ifm.

close to you – to be the right choice for our customers when it comes to innovative automation and digitization technologies.

With automation technologies, ifm contributes to improving the living and working conditions of all people.

ifm products, services and software help protect the environment around the world and reduce CO_2 emissions, energy consumption and material use.



ifm. **Solutions**

Goals. data. analyse. action
Transparency. history. data science. improve
Productive. efficient. autonomous. sustainable

Digitalization - IIOT
Transparency for better decision

Automation
Reliable and consistent actions

Safety
Protect life and equipment

Maintenance
Towards prescriptive maintenance – Data Centric

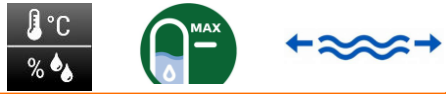
Energy management
Reduce cost and sustainable

Overall equipment effectiveness
World Class Manufacturing

Trace and trace
Where, when and what/who

Quality
Material, process and assembly

Process
Cooling, Thermal, Consumption



Motion
Position, Distance, speed, angle

Wireless

Connectivity
Open, simple and modular

Importance of Semiconductor industry

Semiconductors are essential building block of technologies advancement.

"*Technologies can help make our world fairer, more peaceful, and more just. Digital advances can support and accelerate achievement of each of the 17 Sustainable Development Goals – from ending extreme poverty to reducing maternal and infant mortality, promoting sustainable farming and decent work, and achieving universal literacy.*"

Source: UN article

As the industry continue to innovate and grow, it's essential that we do so responsibly. By prioritizing sustainability, we can ensure that our technological advancements do not come at the cost of our planet. This approach will not only help preserve our environment for future generations but also lead to more efficient and cost-effective manufacturing processes, in other words sustainable growth, in the long run.

In line with our corporate vision, ifm is contributing to a sustainable manufacturing ecosystem by developing innovation automation technology and digitalization solutions.

Go to solutions
Go to applications

Challenges & Solutions Semi-manufacturing

1

Manpower

Transparency of machine operation and health allow automated documentation and better management of resources

Solution

2

Sustainable

Sustainability for people, profit and planet

Solution

3

Availability

Optimized maintenance strategy aid by data to increase MBTF/MTTF of equipment and reduce MTTR

Solution

ifm's approach

Solutions for Predictive Maintenance, Energy & resources management, Track and track, Safety

Maintenance – Data centric for better decision making, early fault detection

Energy and resources mangement -digitatsation, sustainable and green manufacturing

Transparent and visibility of production and process flow in real time.

Process and equipment – performance in real time, increase productivity and efficiency

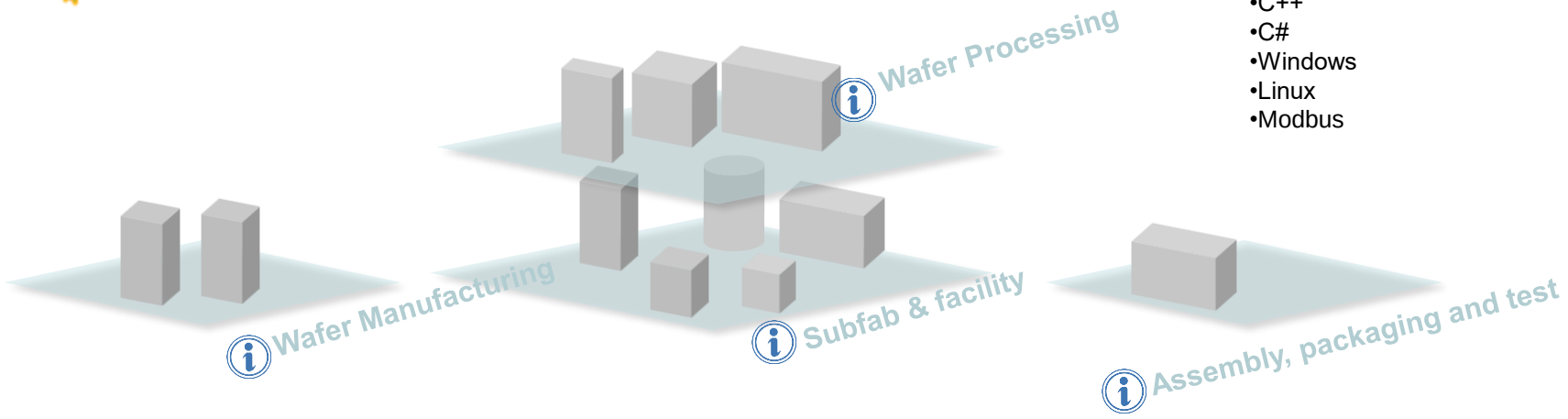
Go to solutions
Go to applications

Transparency and visibility of Subfab Utilities

From data collection to intelligent remote service

IoT Flexibility
- Remotely visualized data
- Achieve efficient visual all-plant management
- Private cloud /local EDGE Gate away

Connectivity Flexibility of VSE Utilities
•Beryl (Python)
•C++
•C#
•Windows
•Linux
•Modbus



Process Optimization

Data analysis

Data collection

Achieving sustainability with digitalization and automation

Proven solutions for Green Subfab & Utilities

Water Recycling (precisely and costeffectively water quality monitoring) and gas Emission reduce (air consumption monitoring) are main topics.

With ifm RTM solution, the customer can keep an eye on all individual consumptions and, thanks to the Calculated Values function, simultaneously combine them into an overall result. This enables the customer to identify deviations from the ideal condition individually for each consumer and thus initiate targeted maintenance or optimization measures.

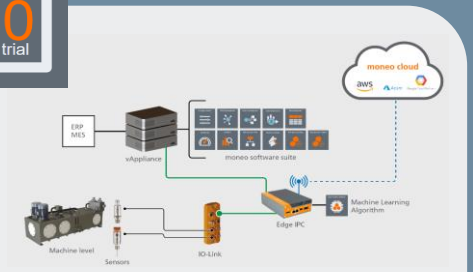
The investment in the IoT solution was thus also an investment in a more efficient use of resources, resulting in sustainable cost reductions.

From data collection to intelligent remote service Ifm protect your fab with full system solution

Ifm’s intelligent remote service product portfolios serve **data acquisition**, **machine condition monitoring**, and **machine level management** requirements. The data can be sensed, collected and managed from machine level at remote sites.

With ifm's **IIoT solutions** such as switches, routers, and gateways, information can be successfully transmitted to servers to perform further analysis using **SCADA software such as WebAccess/SCADA** for supervisory **control, data analysis and visualization**.
These comprehensive solutions from field to cloud ensure **machine efficiency, stability, and scalability**. They help improve product quality, as well as management capabi emiconductor manufacturers and equipment builders

30 day trial



Unlock the potential of your machines with digital communication

ifm. **Product portfolio**

More than 12,000 proven products for your digitalisation and automation your application needs.


Position sensors


Sensors for Motion Control


Industrial image processing


Safety technology


Process sensors


Industrial communication


IO-Link


Identification systems


Condition monitoring systems


Systems for mobile machines


Connection technology


Power supplies


Accessories


IIoT Gateways and Appliances


IIoT software

ifm. **System architecture**

ifm.
Industry 4.0

Digitisation is unique and individual.
We support our customers, concretely and step by step. Scalable. Simple.

ifm offers companies of all sizes and industries **products, services** and **software** for the way from sensor parameter setting to the smart factory.

We make production processes transparent:

» **Increase in plant efficiency**

» **Avoidance of standstills**

» **Optimisation of processes**

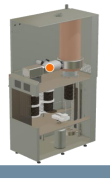
ifm. **Semiconductor application in value chain**

Fabrication. Assembly and Test.
Critical sub-systems. Facilities management.

Abatement POU - Scrubber

Vacuum systems

CMP Polisher

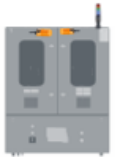


Furnace

Assembly and packaging

Water treatment/ wastewater treatment

Ingot growing



Chemical and gases systems

Test Handler

Cooling system UPW/DI

Multi wire saw Equipment

Dicing

Moulding

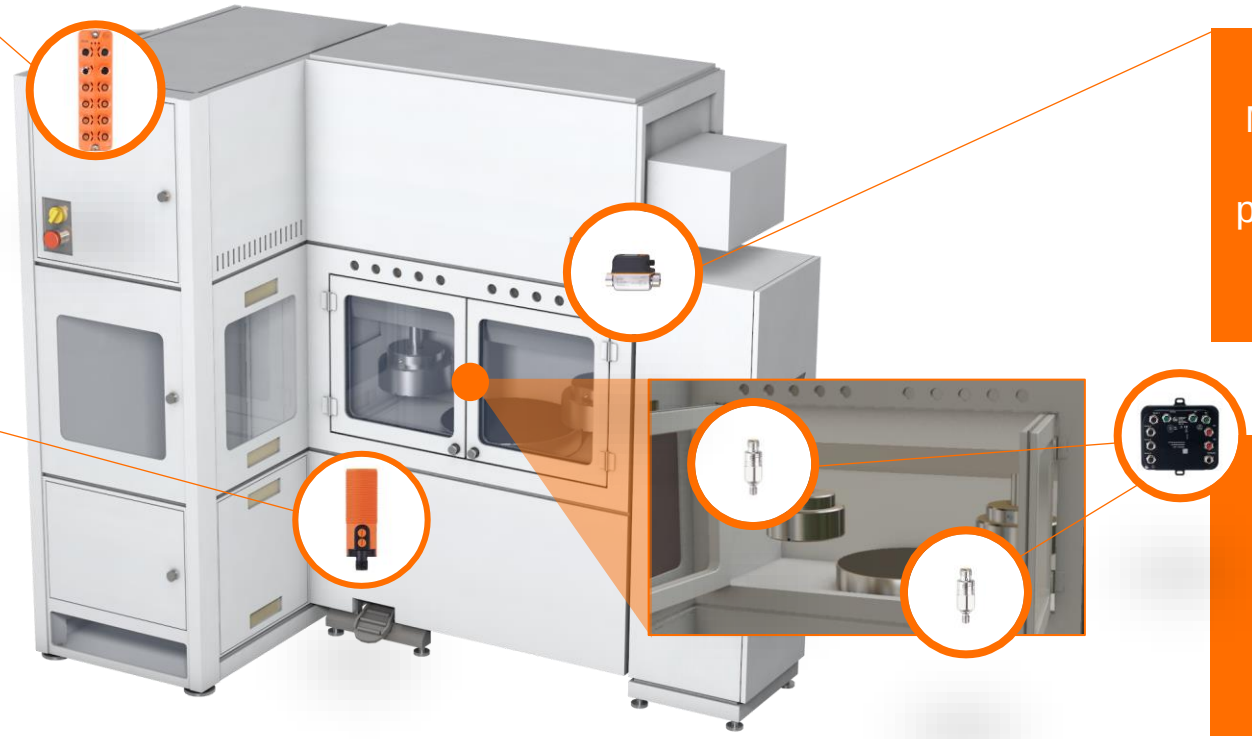
AMHS & EFEM

Back to solutions
Back to applications

CMP Polisher

Simply connection and reduce wiring and commissioning time

Reliable measurement of slurry level, to eliminate false indication



Monitoring of DI water and slurry mixture for polishing the surface of wafer

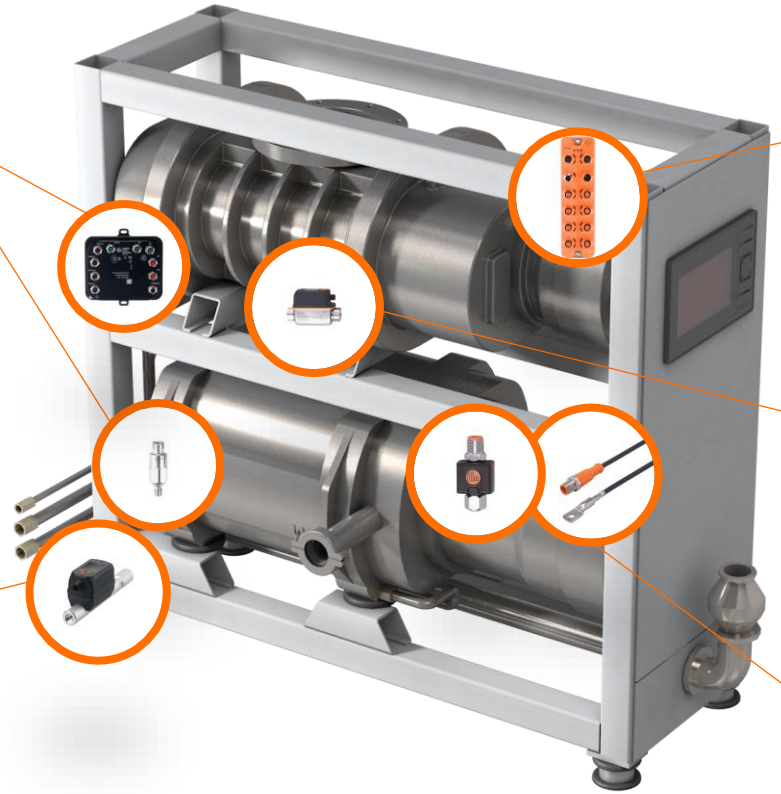
Condition based monitoring - reduce unplanned downtime

Back to solutions
Back to applications

Vacuum pump

Condition based monitoring - reduce unplanned downtime

Nitrogen purging



Simpfy connection and reduce wiring and commissioning time

Cooling flow

Condition based monitoring (pump temperature)

Vacuum pump study case

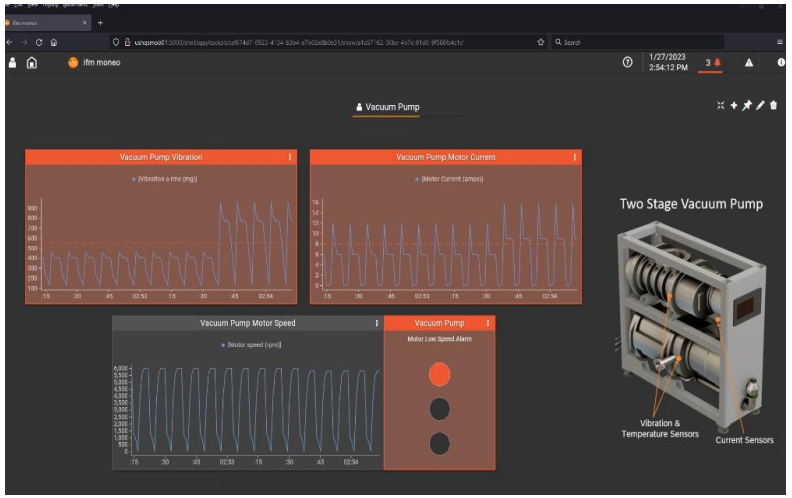
- **IoT Flexibility**

Using ifm VSEUtilities (SDK), customer has the flexibility to stream Raw Signal Data (Time Domain) and post-processed data (FFT, trend history, specific frequencies of interest) all to analytics platform!

- **Daisy chain power & communication**

Challenge:
1. Reduce UDT
Lost production time due to pump change out (4-6hours)
2. Reduce wafer scrap cost
Wafer scrap ($500k - $3m depending on process) , unknown wafer defects (multi million $)

Solution:
IIoT solution for 24/7 pump monitoring, pump predictive maintenance, to achieve Subfab Reliability
VSE's collected data from pumps throughout the duration of entire PM lifecycles, with aRMS value the pump status can be diagnosed.



Edge computer Device

FFT + Raw Data Feature Extraction

Central MQTT Server

GE Digital

statmath

Stream Data Processing

FDC

SPC

Tool sensor | Gateway | Data Broker | Fab Automation Systems

Benefits: lower total cost of ownership, 24/7 monitoring, and pump predictive maintenance.

Pump design:
Booster pump: Rotary Lobe
Dry pump: Screw
Failure Mode:
Rotor/screw seizure due to dimensional growth from deposition plating

Back to solutions
Back to applications

Scrubber

Machine status light

Condition based monitoring

Simpfy connection and reduce wiring and commissioning time

Level monitoring through non-metallic vessel and pipes

Conductivity of circulating water

Level monitoring for circulating water tanks

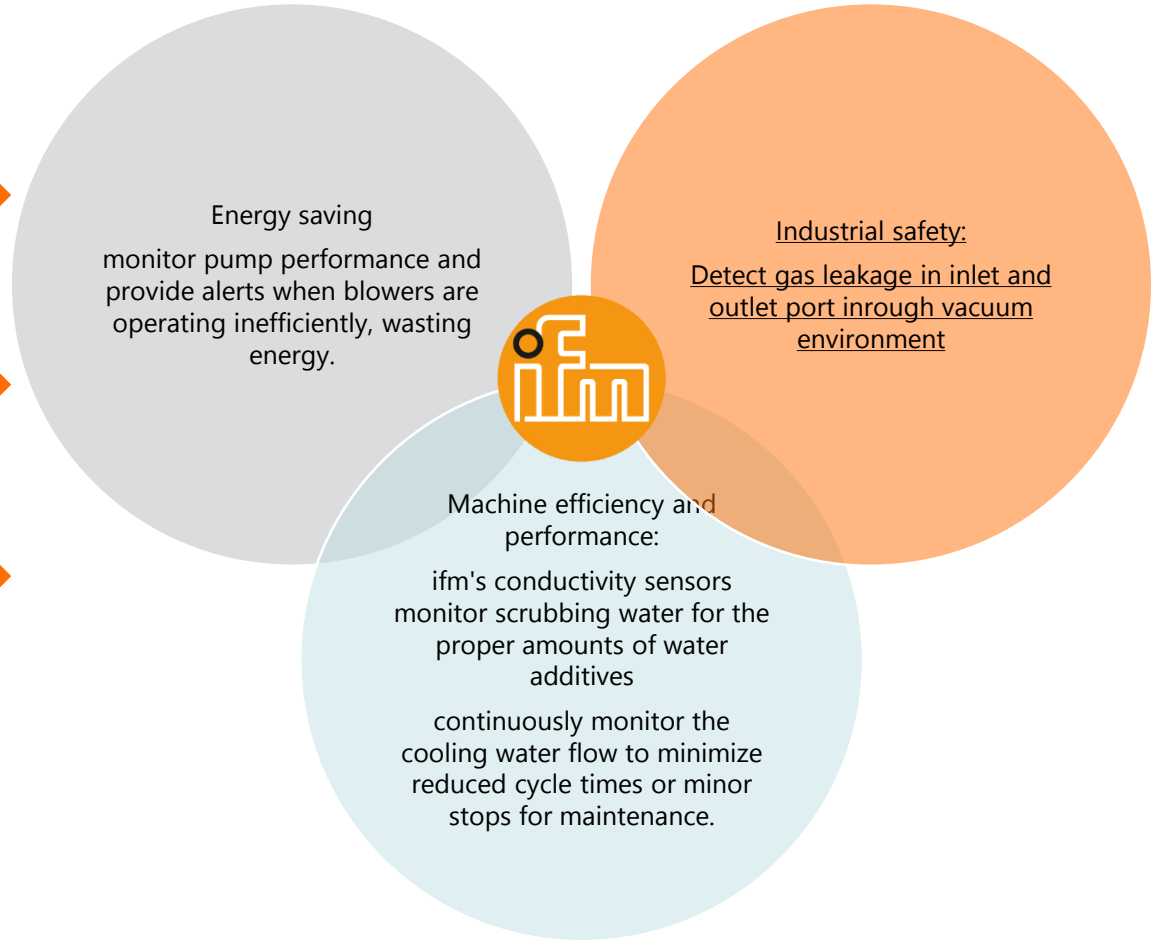
More about scrubber

A local scrubber is a device that uses water or other liquid to remove harmful substances from the exhaust gas of semiconductor processes.

Challenge:

- To reduce water consumption ➔ reduce energy consumption(carbon footprint) -**25%**
- Simplified maintenance and improve safety
- Improve reduction efficiency
- Transparency of efficiency, performance and resources management for audits
- Reduce total cost of ownership – maintenance and CO2 emmission

Solutions:



CDS – Chemical delivery system

Point / continuous level monitoring

Piping Leakage monitoring

Machine status light

Door monitoring
Protects personnel and equipment

Pneumatic pressure monitoring for air operated pump

Simply connection and reduce wiring and commissioning time

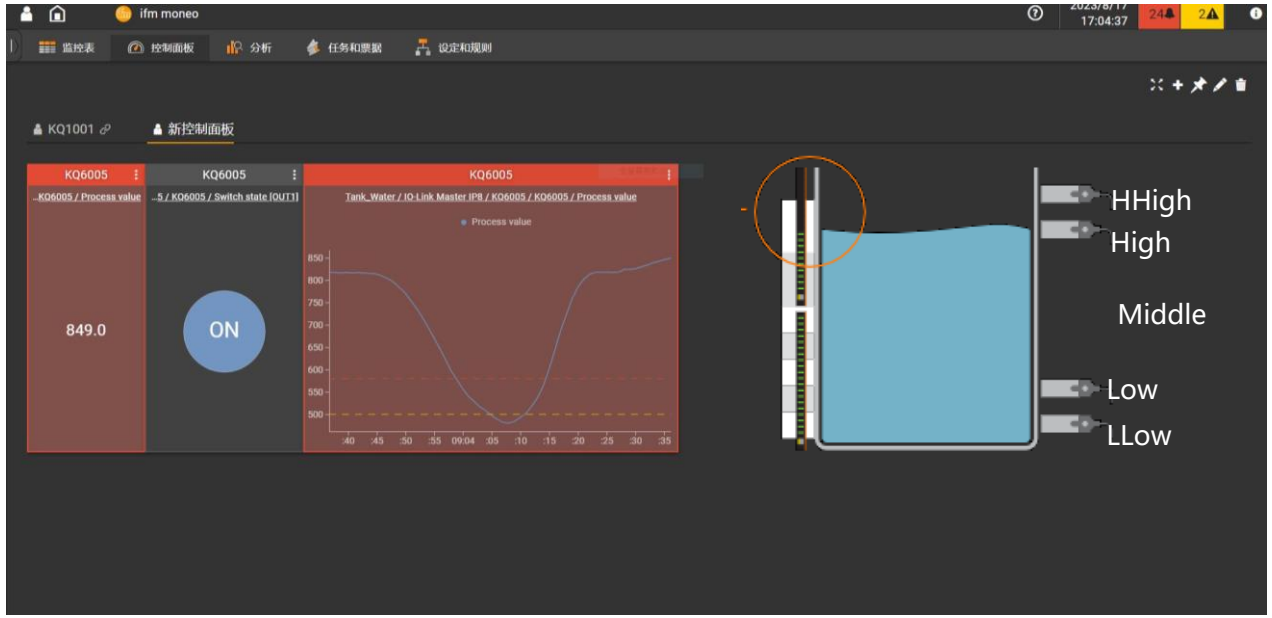
CDS study case

Challenge:
- After a period of use, the sensor does not switch when level is reached.

Possible caused
- Adhesion on the tank/piping cause sensor to stay switch on
- Poorly configured sensor cause abnormal switching behavior

Solution:
Saves commissioning and maintenance time
Avoidance of unscheduled downtime due to sensors failure.

Intelligent CDS Systems through Pipeline Preventive Maintenance



Back to solutions
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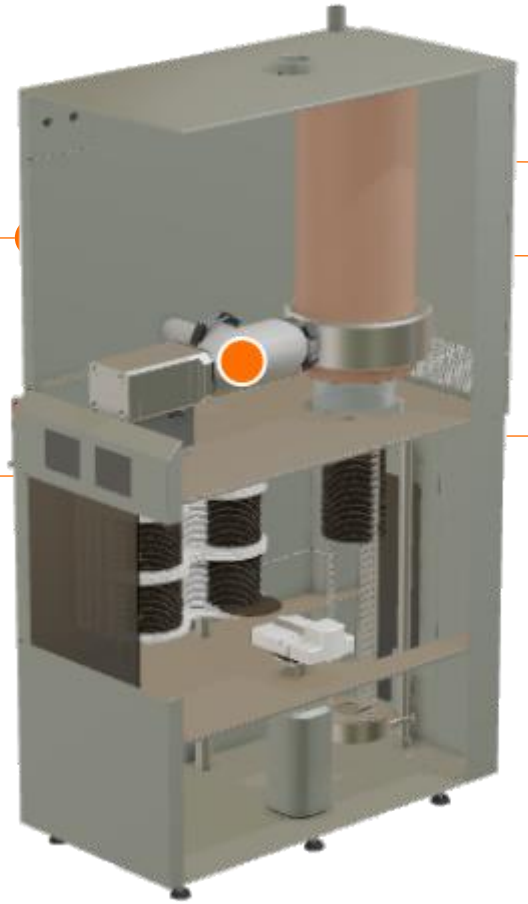
Furnace

Condition based monitoring

Nitrogen purging

SDx6xx



Simpfy connection and reduce wiring and commissioning time

Cooling flow

Condition based monitoring (pump temperature)

Back to solutions
Back to applications

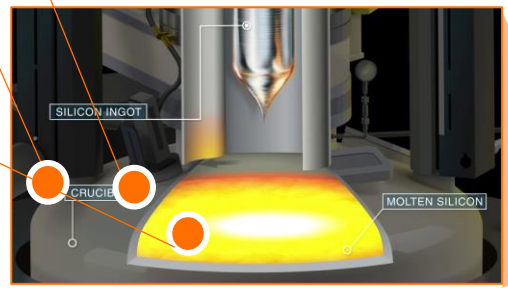
Ingot growing

Argon gas monitoring (Cublic)

Monitoring of chamber cooling

Monitoring of melt temperature

TW



Simpfy connection and reduce wiring and commissioning time

Base leveling to ensure product quality

Condition based monitoring

Back to solutions
Back to applications

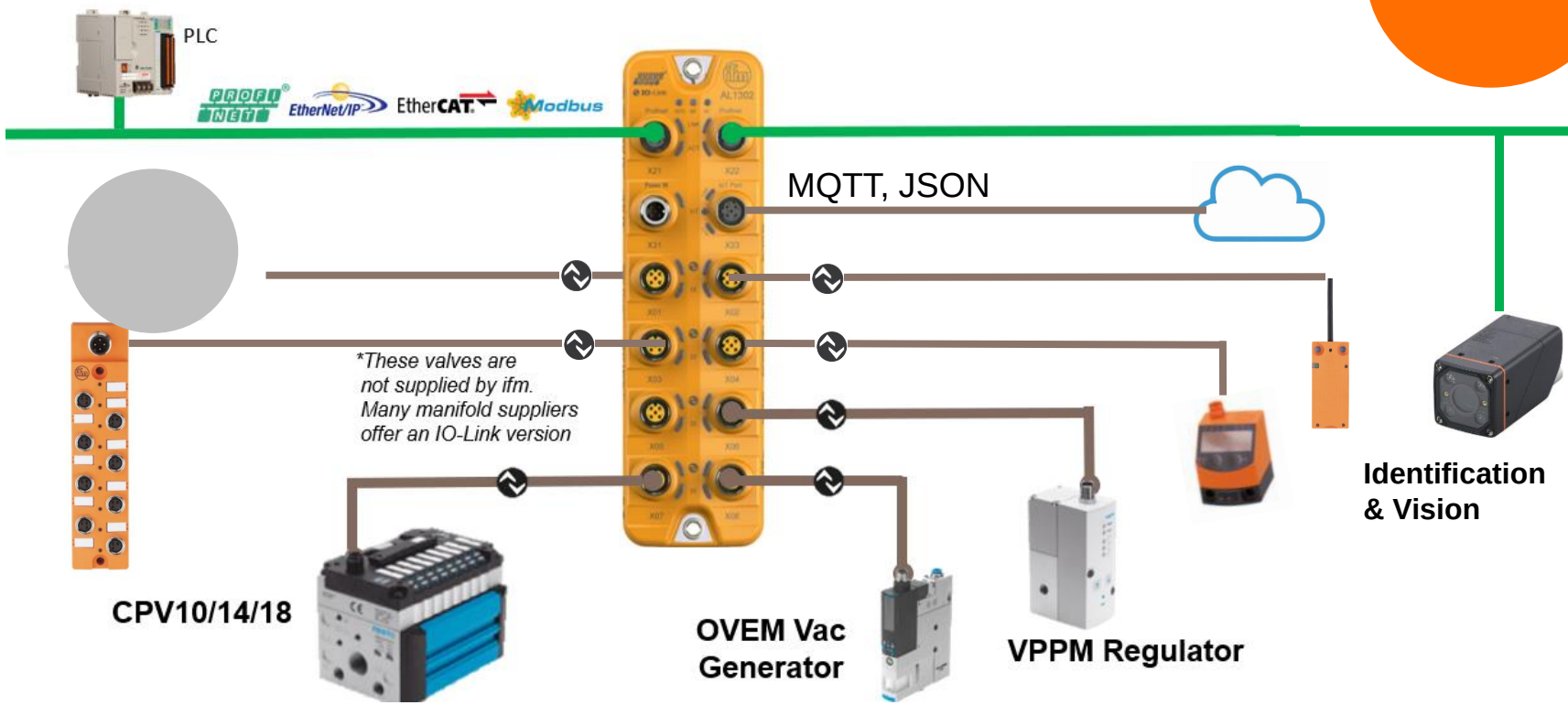
Smart Assembly and Test Equipment

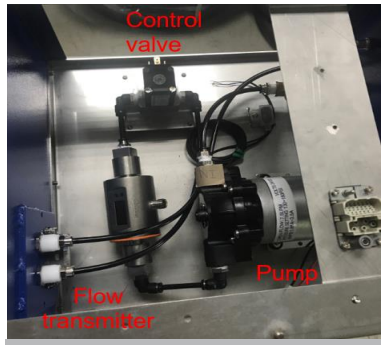
Diagnostic + sensor “heartbeat”

OEE

Traceability and Verification

Sensor parameter according to receipe





OMH550
30-80mm detection
10um resolution

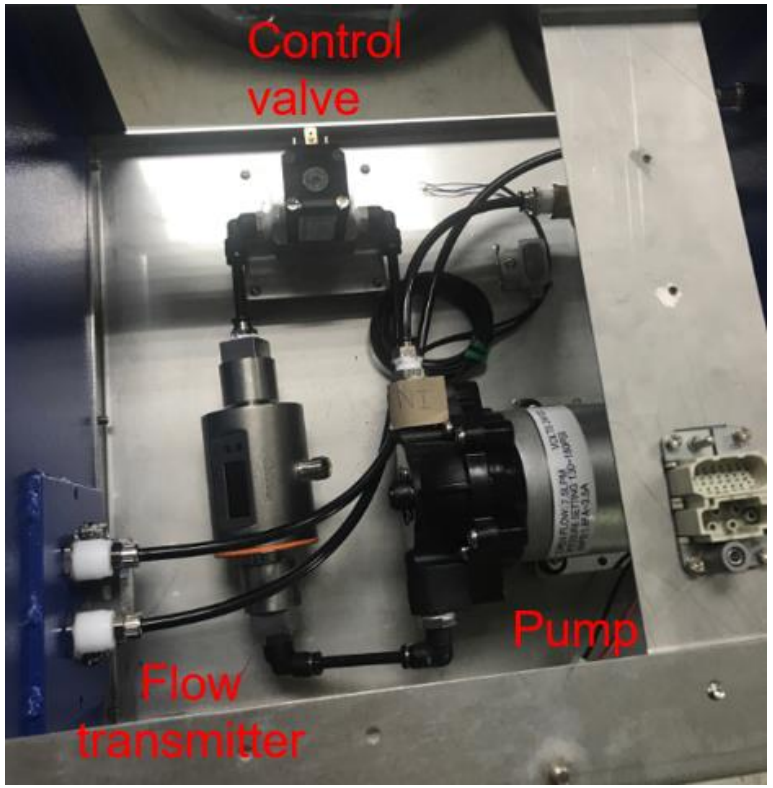
+IO link solution for wafer position

Cooling solution for Test handlers

Back to solutions
Back to applications

Chips testing environment

- Precise temperature control that mimic ambient temperature for comprehensive test conditions.
- Reliable for high volume, continuous testing equipment
- Parallel connectivity to control (PLC or IPC) and IIOT systems



Back to solutions
Back to applications

Smart automation for efficient water recovery


Pressure sensors / Vacuum sensors


Flow sensors / flow meters


Temperature sensors


Level sensors

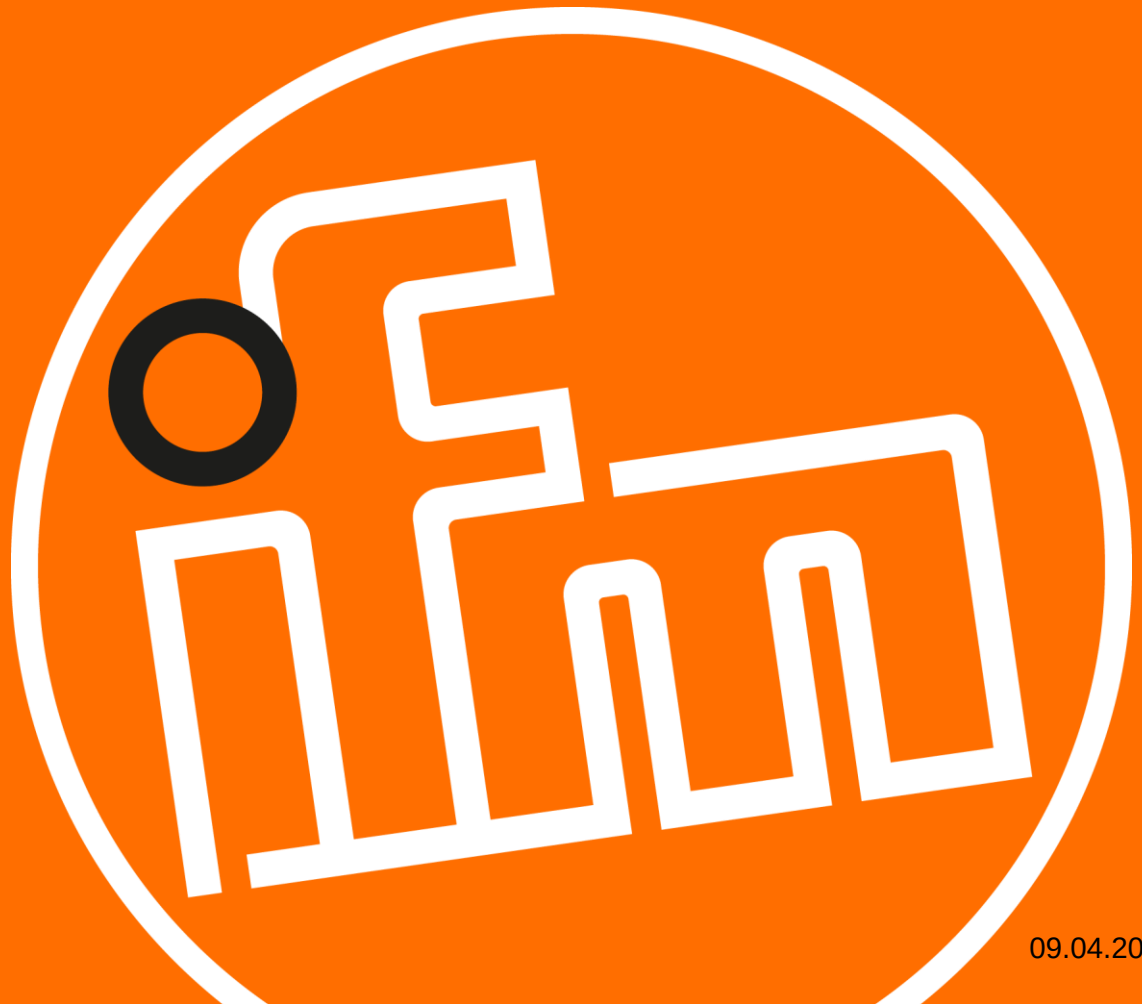

Conductivity sensors


Signalling lights


IO-Link - Masters for field applications in factory automation

ifm Technology

Products and solutions



Purge gases - Air flow consumption monitoring

THE REVOLUTIONARY ALL-IN-ONE-INNOVATION: 4 VALUES IN ONE UNIT!

- CDA
- Argon
- Carbon Dioxide
- Nitrogen N2
- Helium

Totaliser

Flow

Temperature

Pressure

Back to solutions

Back to applications

Conductivity sensors

Water quality monitoring

LDL101

- Purity of the water is critical to the processes
- UPW resistivity is 18.2MΩ or approximately 0,055uS/cm at 25ºC

$$Resistivity = \frac{1}{Conductivity}$$

- Color on remote display unit DX2043 indicate water quality.

Back to solutions
Back to applications

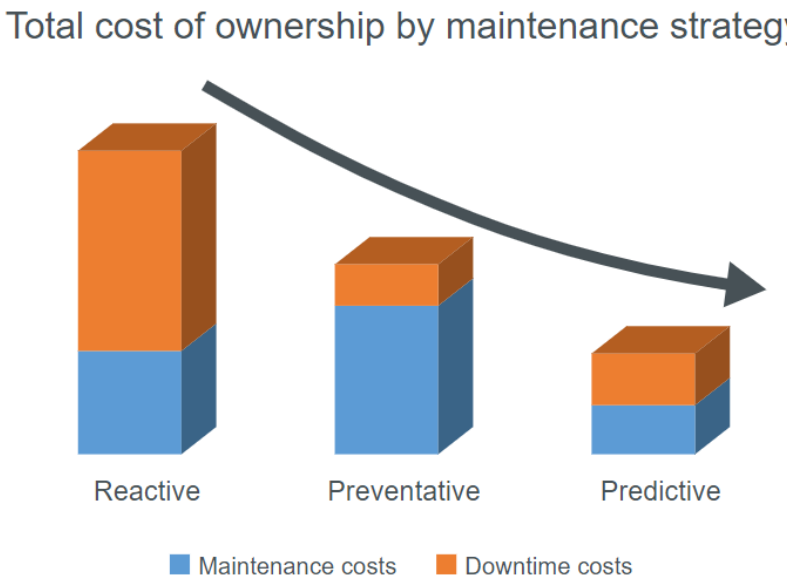
We make vibrations visible

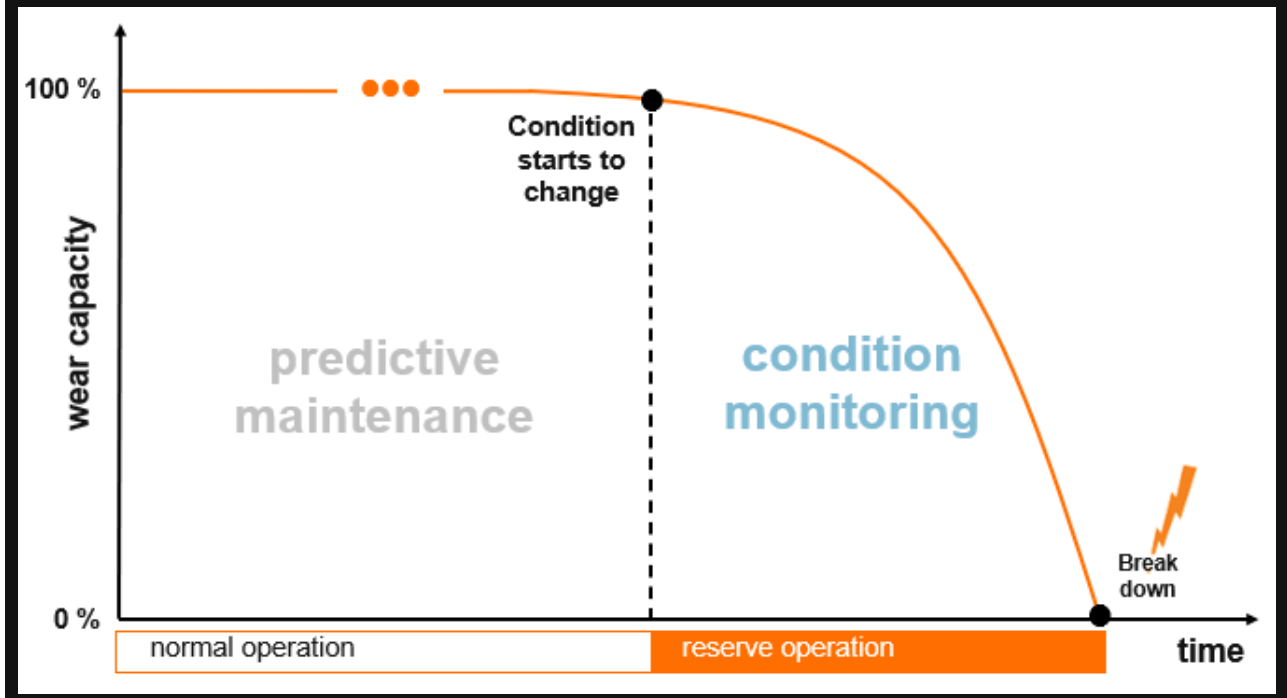
Real time Condition based maintenance

Back to solutions
Back to applications

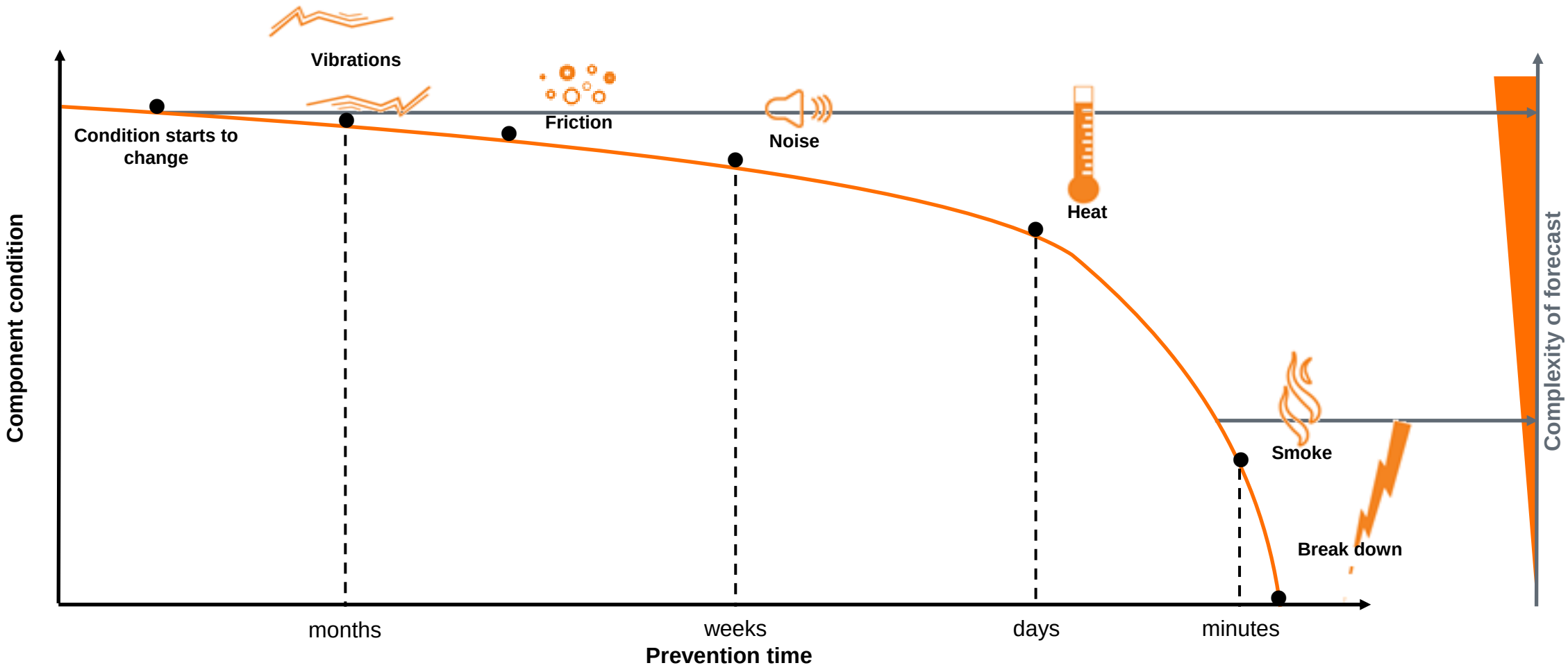
What if your equipment could provide alarms **before** it fails?

- Eliminate unplanned downtime due to equipment failures.





Why vibration for equipment health diagnostic?



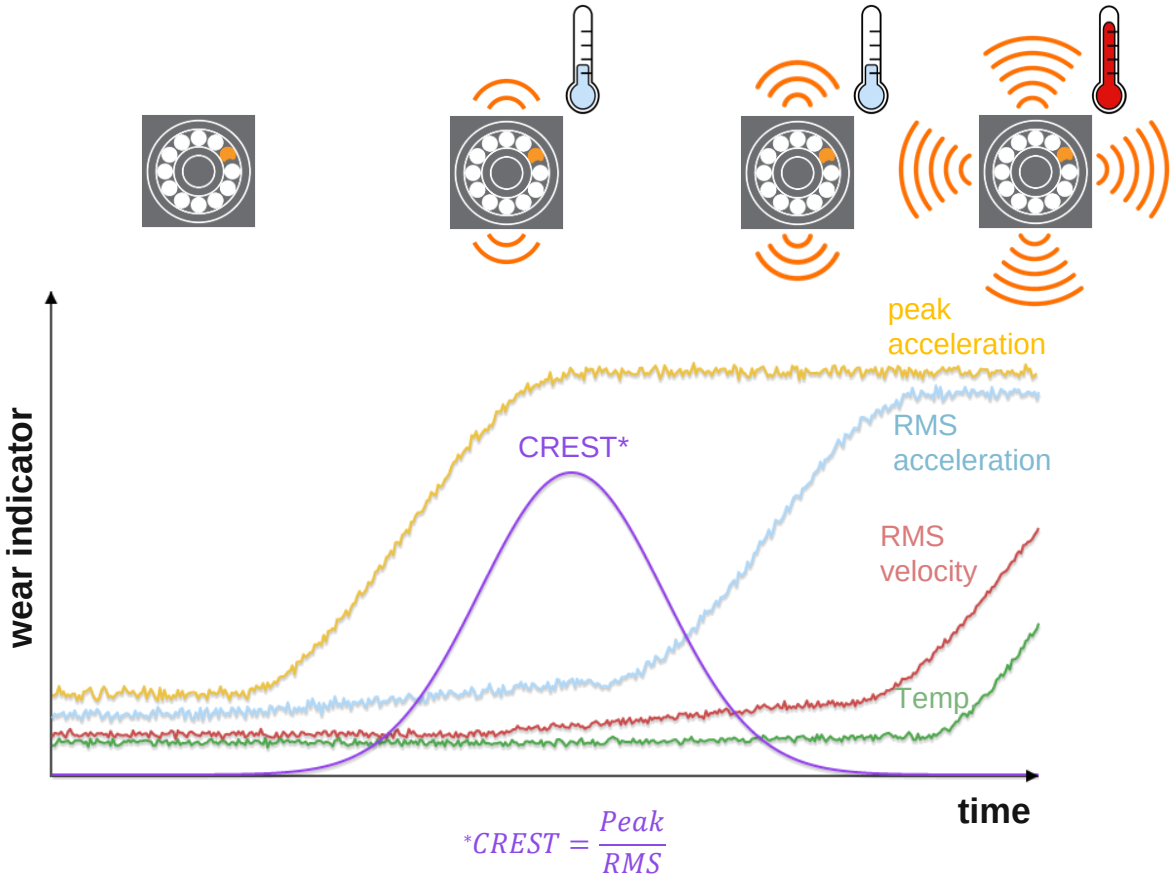
The Generic Monitoring Approach

Real time Condition Monitoring

Monitoring indicator methods:

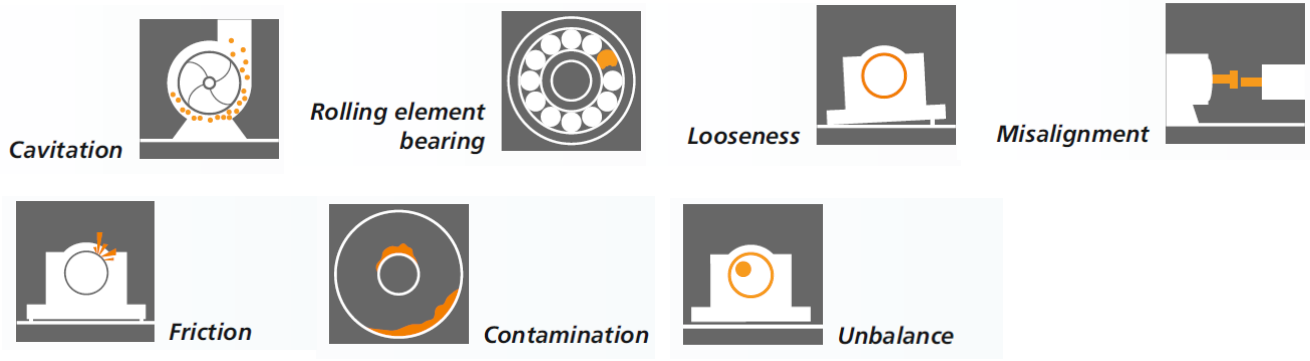
- Component fatigue (v-RMS)
  - Proven ISO10816 method of 2/10 Hz…1 kHz velocity
- Mechanical friction (a-RMS)
  - Widely used broad band acceleration monitor of friction
- Mechanical impact (a-Peak)
  - Full dynamic range (10 kHz) crash detection
- Vibration severity (Crest Factor)
  - Widely used severity indicator (CF = a-Peak / a-RMS)
- Temperature
  - Second complementary sensing principle for friction

Example: developing bearing damage



Pump system

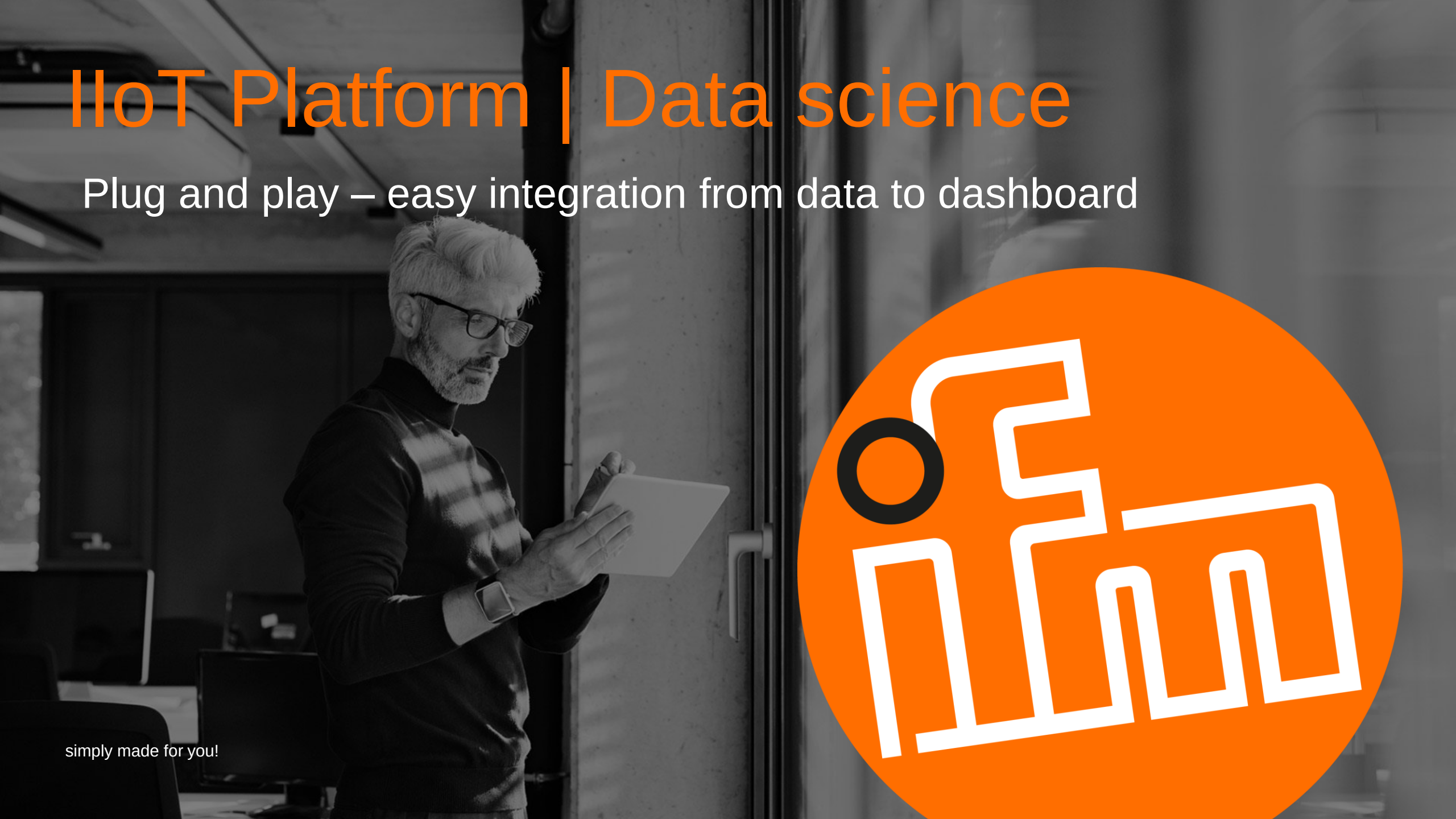
Points of monitoring



Sensor Type	Points to consider
	• Simple setup based on ISO10816 generic vibration monitoring • Additional temperature and bearing (CREST Factor) • Raw data in BLOC • Limited to ISO10816
	• Configurable to monitor different key assets/equipment parameter • Y-path to Data Management systems and Fieldbus • Scalable and easy of upscaling • Some expertise on condition monitoring needed

IIoT Platform | Data science

Plug and play – easy integration from data to dashboard



simply made for you!

Your advantages

Why IIOT is important for you

Open technology platform simplifies integration

- moneo is an industry-independent, manufacturer-independent IIoT platform.

Increase the efficiency of your plants!

- moneo converts, evaluates and transmits sensor data to IT world as a reliable basis and fast for decision making.

Early detection of damage, avoidance of unplanned downtimes

- moneo analyses sensor data, detects deviation and indicates changes in the process that could lead to a failure.

Customizable system solutions

- The modular approach of moneo offers convenient use with low investment and high flexibility to your requirement IIoT projects.

Scalable as your requirement

- Moneo continue grows with your requirements and at the industrial evolution pace.

Well-proven in many use cases

Use case with many other possibilities

Smart Metering

- Compressed air energy management
- Industrial gases (Argon, N2, CO2)
- Water / Oil consumption
- LR Agent connectivity (Modbus TCP, OPC UA etc.)
- DP2302 pulse / S0 interface

Smart Counter

- Work piece counting
- Batch counter
- Sorting parts counter
- Central monitoring
- Continuous data logging
- Production floor transparency

Vibration Monitoring

- Vacuum pumps
- Blower fans
- Process pumps
- Chiller
- Compressor
- Motors
- Machining tools
- Machine learning (SLW)

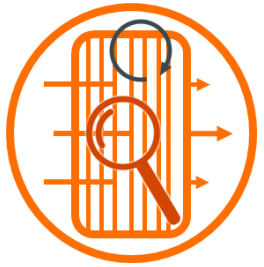
Overall Equipment Effectiveness

- Primary metrics to determine production floor’s equipment effectiveness
- Customizable calculation via calculated value
- Performance analysis
- Notification

CIP Process Monitor

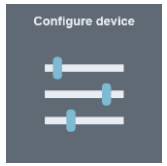
- Temperature differential
- Timing analysis
- Flow rate analysis
- Conductivity monitoring
- Cycle analysis

Condition-based Monitoring

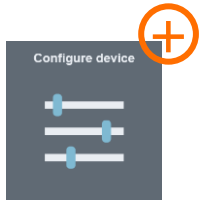


- Filter condition monitoring (oil / air / water etc.)
- Cycle count maintenance
- Time-based maintenance
- Notification
- Before & after maintenance condition analysis

Modules & features



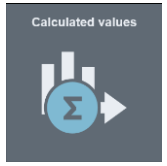
Connected device
•Find all devices connected to the network
•Configure IP addresses of IO-Link masters
•Adjust parameters of IO-Link sensors
•Quickly view real time process values from sensors



Configure PLC Tools
•Offer a simple GSDML parameter setting tool as the first feature of this toolbox
•The GSDML files of ifm master AL14xx series can be configures & integrated into the control environment in few steps
•Add important device parameters to GSDML files, export and implement in TIA portal

IODD management
•View local and online IODD catalog
•Install updates
•Import IODD files

Device management
•View all devices and calculated values
•Select desired infopoints from each sensor or calculated value
•Manually add new devices by IP address



Calculated values
•Simple drag and drop interface for logic/math functions
•Preconfigured templates available or create your own
•Produces additional infopoints from sensor values

Dashboard
•Drag and drop interface to quickly create custom dashboards for a machine or process
•Images and drawings of equipment or processes can be uploaded
•Selectable visualizations – thermometer, gauge, traffic light, chart, etc.

Analysis
•Provides tools to view historical data from the system as graphical trends
•Simply drag in process values and select the time range
•Export data for further analysis

Settings & rules
•Define thresholds for warning and alarm conditions
•Establish rules for actions when threshold values are reached including raw data recording & e-mail/text notification

Tasks & tickets
•Review warning/alarm history and check current status
•Acknowledge and clear open warnings and alarms

Monitoring table
•Displays all process values with time/date stamp from devices currently on the network
•Provides verification that devices have been properly added

Data science modules & features

Vibration Raw data recording
•Set rules for triggering of raw vibration sensor data recording
•Recording can be triggered by a warning/alarm or time-based

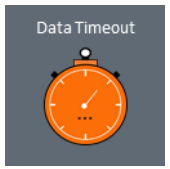
Vibration threshold setting wizard
•Aid of vibration threshold setting according to DIN ISO 10816-3
•Motor, fan and pump with different speed and mounting

Data Science Toolbox – Smart Limit Watcher
•Intelligent process monitoring
•Dynamic process
•ETL in December 2021

Data Science Toolbox – Pattern Monitoring
• Automated pattern monitoring
•ETL by end of 2022

Data Science Toolbox – Lifetime estimator
• Prediction for smart maintenance
•ETL in 2023

Data Science Toolbox – Value Predictor
• Time series forecasting
•ETL in 2023



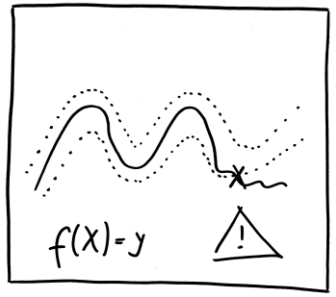
Data Timeout
•Ensure data transmission on-time.
•Data timeout notification with pre-configured timing.

EdgeConnect
•Provie necessary connectivity to forward the process data from moneo to third-party system via MQTT
•With connected MQTT Broker, selected data can be sent under “Data Management”

DataScience modules

SmartLimitWatcher

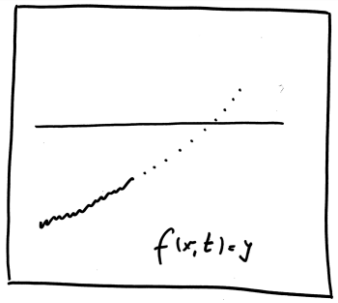
Intelligent process monitoring



LifetimeEstimator

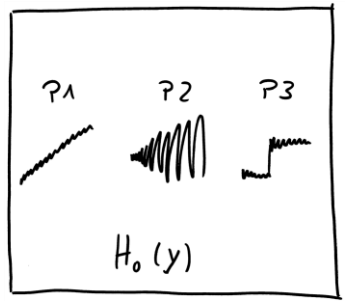
Predictions for smart maintenance

*ETL End 2024



PatternMonitor

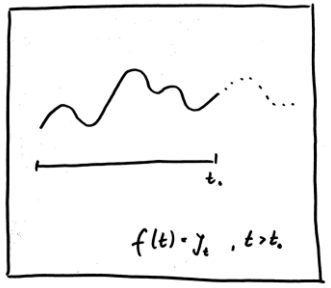
Automated pattern detection



ValuePredictor

Timeseries forecasting

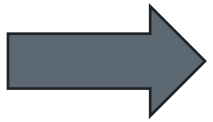
*ETL End 2024

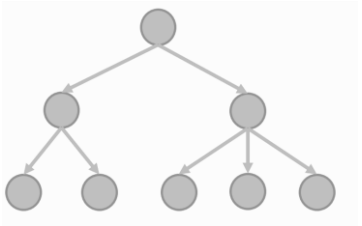


... More features / apps in the pipeline

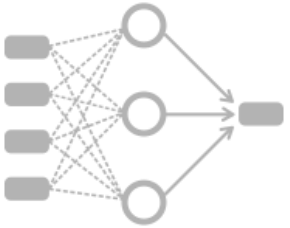
Basic of predictive Modelling

	Value 1	Value 2	Value 3	Value 4	Value 5
Train	5,599	28,7	7,869	101,4	0,0184
	5,199	28,5	7,699	99,2	0,0002
	4,612	28,6	4,079	86,5	0,0001
	4,352	29,3	4,079	92,7	0,0002
Test	4,802	29,1	7,769	91,3	0,0001
	4,472	28,8	7,719	98,4	0,0196
	Input (“Support Variables”)				Target

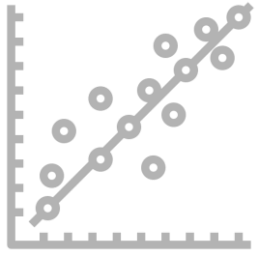




Decision Tree



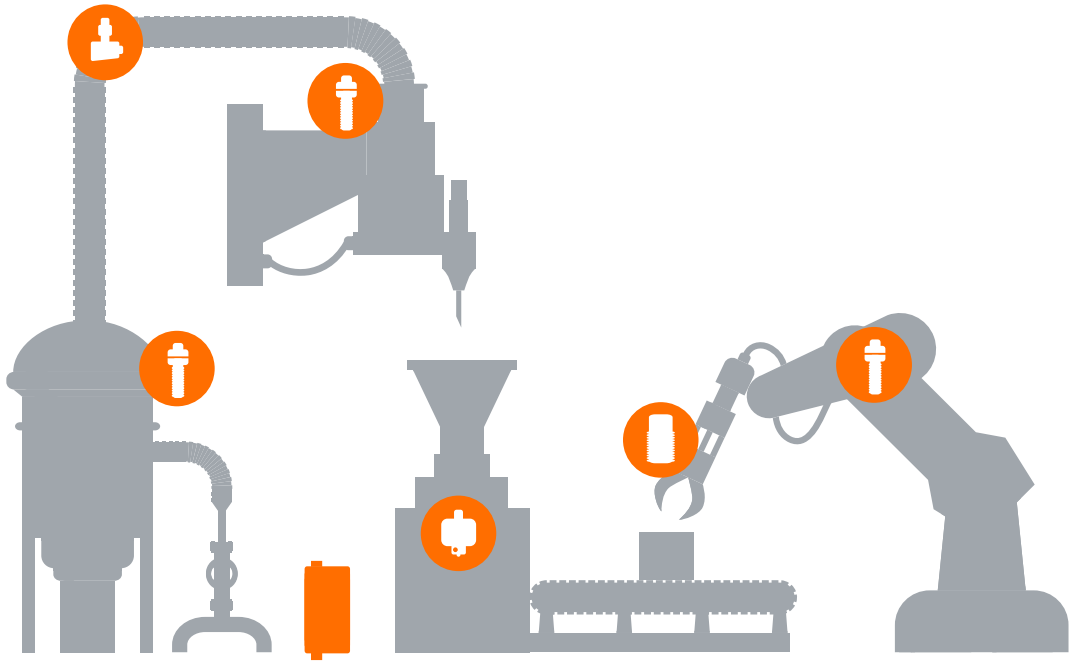
Neural Net



Linear Regression

Smart Limit Watcher in action

Working principle



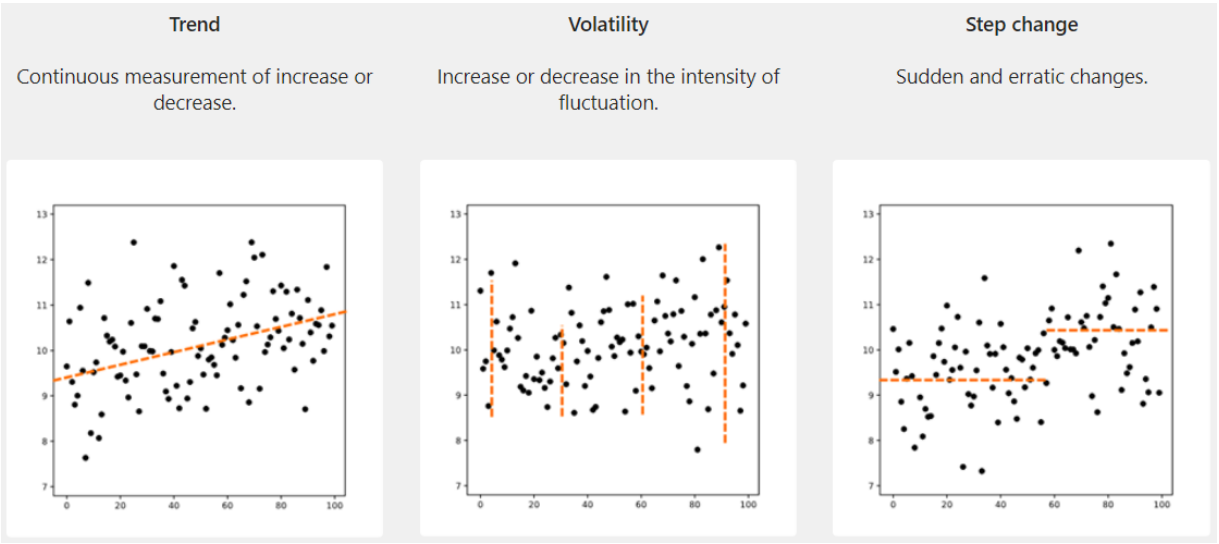
Machinery and equipment
with different sensors

Intelligent and preventive monitoring
with the SmartLimitWatcher

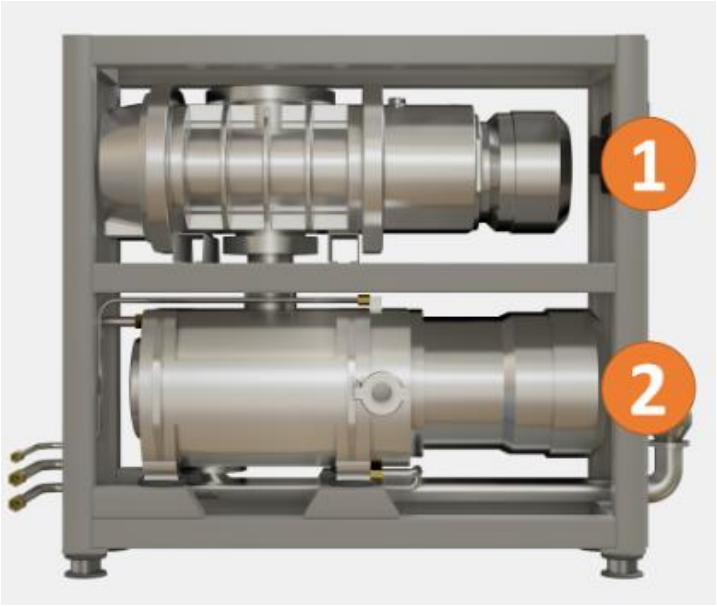
Pattern Monitoring

Working principle – Structural change

Trend	Volatility	Step change
Continuous measurement of increase or decrease.	Increase or decrease in the intensity of fluctuation.	Sudden and erratic changes.



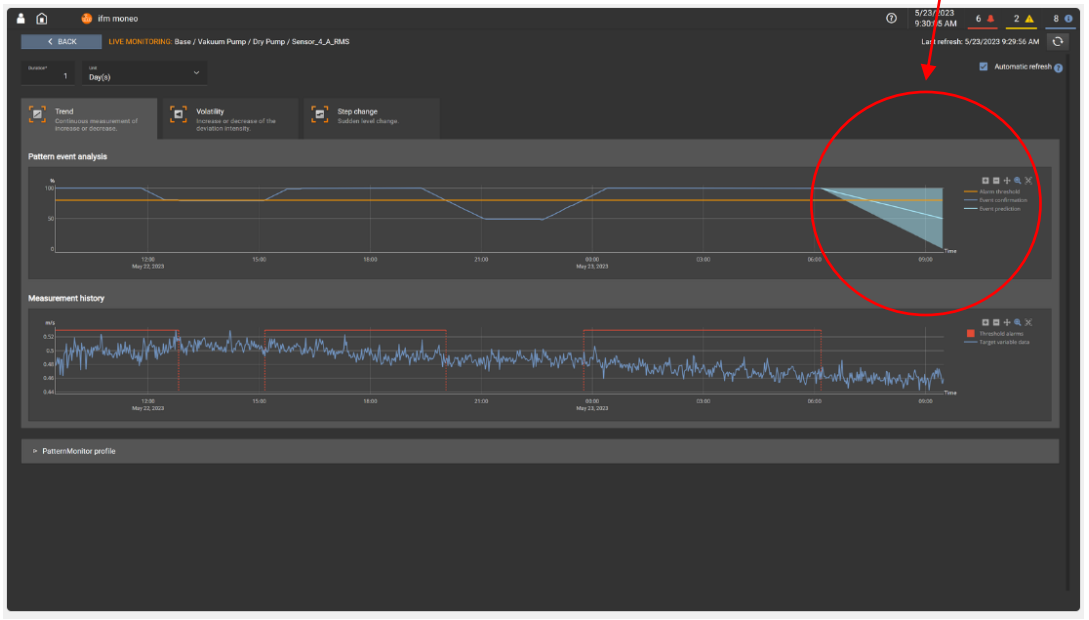
Early detection for anomalies



1 Booster pump
2 Dry pump

Vibration as single critical target variable

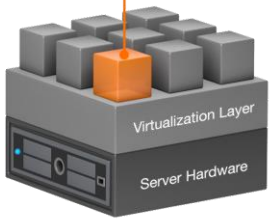
Prediction

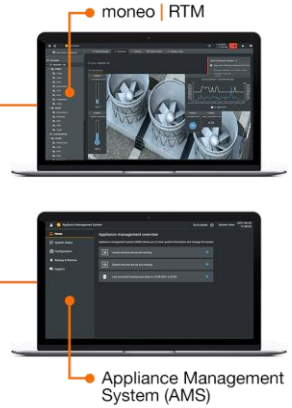


System Architecture Overview

AMS (appliance management system)

moneo | IIoT Software





Windows 10

Network (LAN)

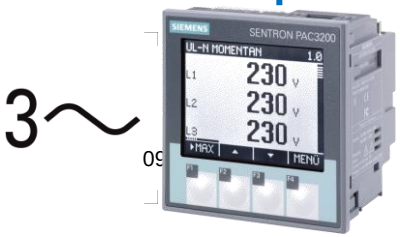
TCP/IP

JSON
MQTT
HTTP(S)

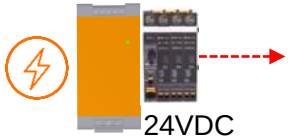
Industrial Fieldbus

Industrial Fieldbus

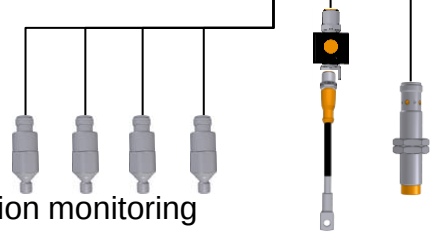
Switching & analog signals



Electrical power monitoring



24VDC Electronic Breaker



Advanced Vibration monitoring

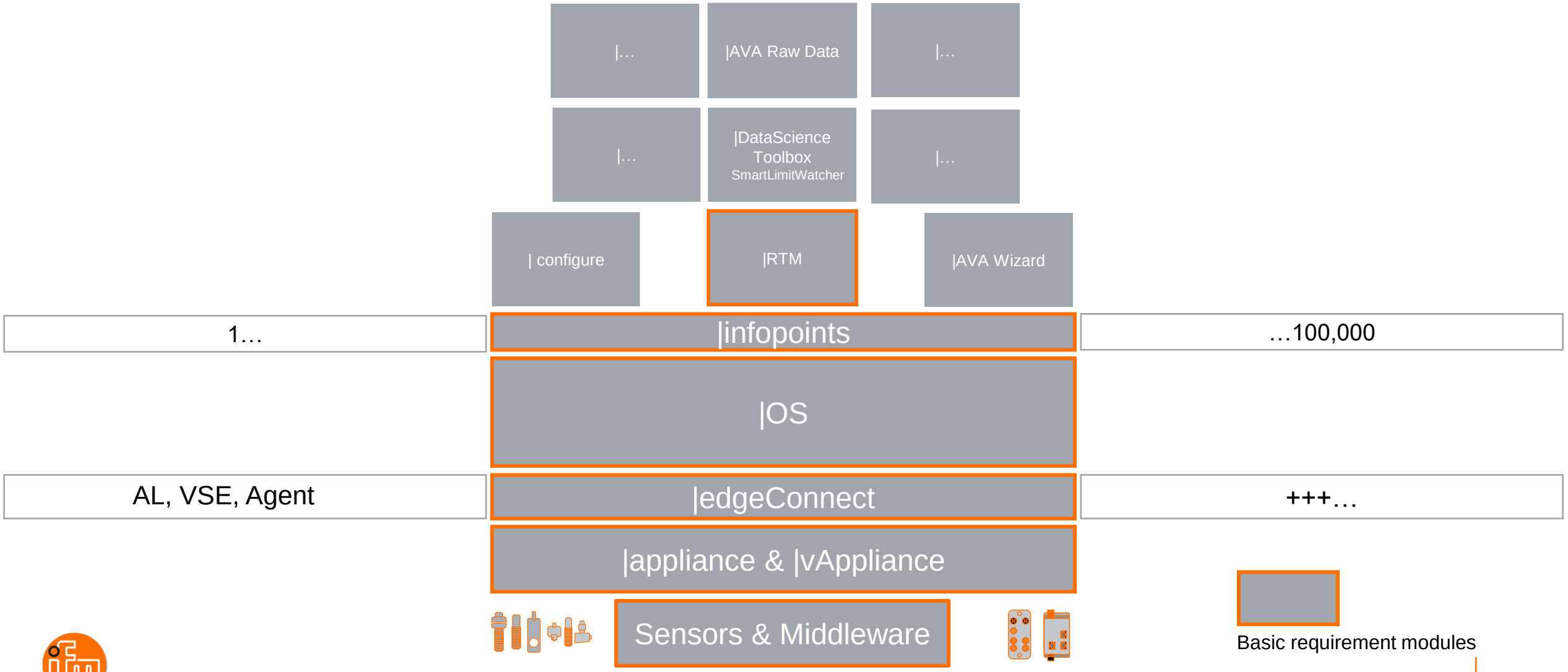
Compressed Air monitoring

Humidity monitoring

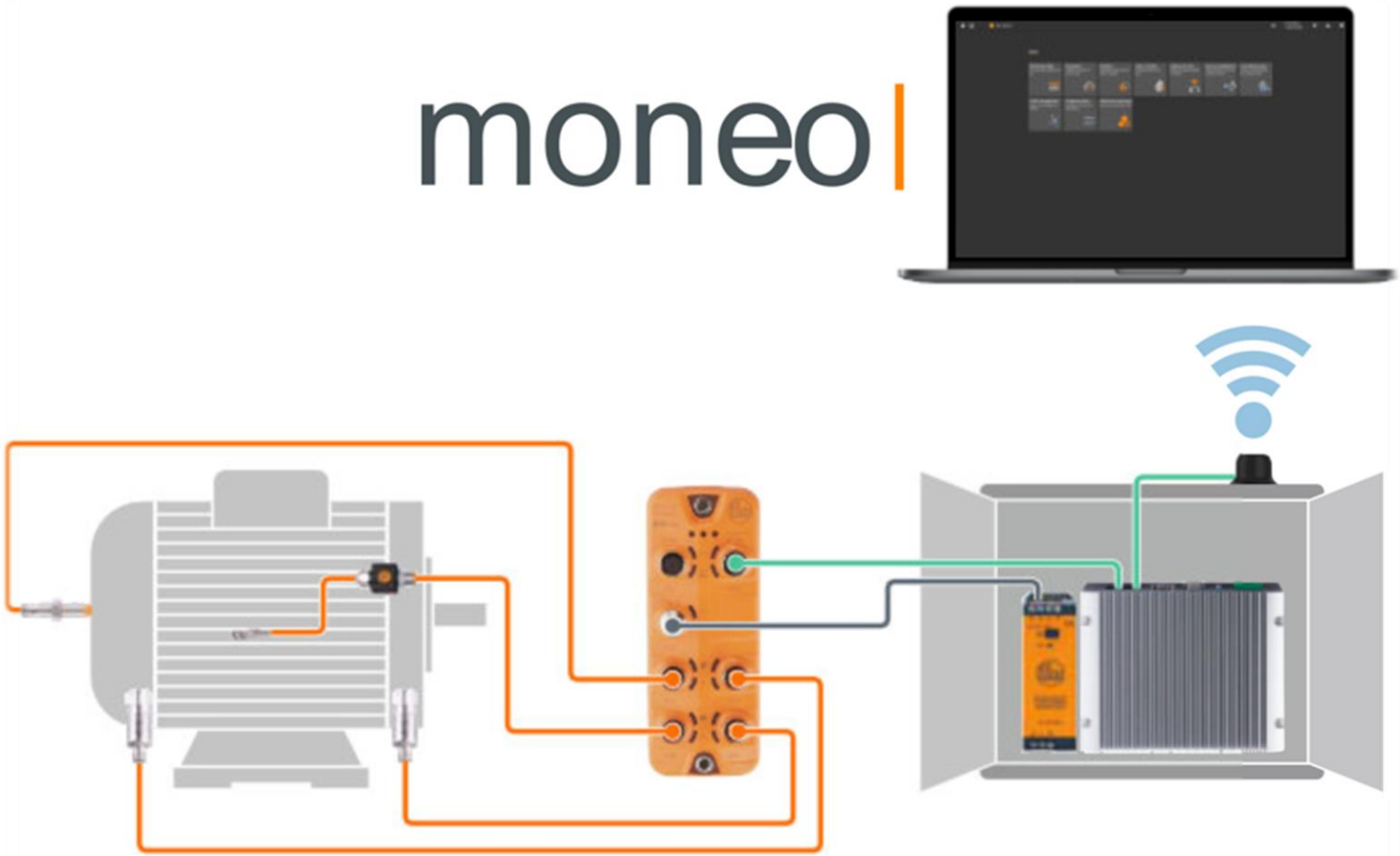
Speed monitoring

Vibration sensor

moneo | Structure



moneo | Starterkit



The moneo | starter kit is a complete stand-alone package with all the hardware and software required to monitor the health and condition of motors, fans, pumps and many other machines. It is intended to provide a simple and fast proof-of-concept of the moneo IIoT platform. With the single hardware part number QZ9100 + software package QM9101 , you receive:

- Two vibration sensors (VVB001)
- One temperature transmitter (TP3231)
- One surface mount bolt-on RTD (TS2229)
- One speed monitor (DI5028)
- One 4-port IO-Link master (AL1350)
- One moneo | appliance IPC (QHA200)
- One WLAN wireless bolt
- Power supply and all required cord sets
- 25 infopoints
- Configuration module
- Rea-time Monitoring
- ifm IO-Link edgeConnect

Thank you