

# FME AI FOR INDUSTRY JAAREVENT



**Predictive Maintenance  
in de praktijk**

**7 december 2023**

## PREDICTIVE MAINTENANCE

# 8 Areas of opportunity for implementing AI in industry





## PREDICTIVE MAINTENANCE

# Agenda

- Mark Peters
  - Intro use case & Ai Roadmap
- Mark Roest
  - Verdieping:
    - Data Analytics & AI
    - Dashboarding & Appreciation
- Ronald Teijken
  - Verdieping:
    - Data Collection
    - Digitization & Computing
    - Cloud & Connectivity
- Mark Peters
  - Ai Roadmap en uw bedrijf?



**Deel 1 Mark Peters**  
**Introduction use case & Ai Roadmap**

# Kort voorstellen



- Al vanaf studie Technische Bedrijfskunde geïnteresseerd in hoe met nieuwe technologie meer waarde te leveren
- Als Innovatieversneller Smart Industry verantwoordelijk voor het initiëren en versnellen van innovaties bij IJssel Technologie



# Tata Van gieten op 1.600 °C naar met 70 km/uur op de rol



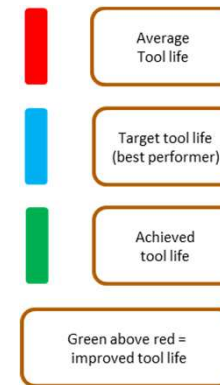
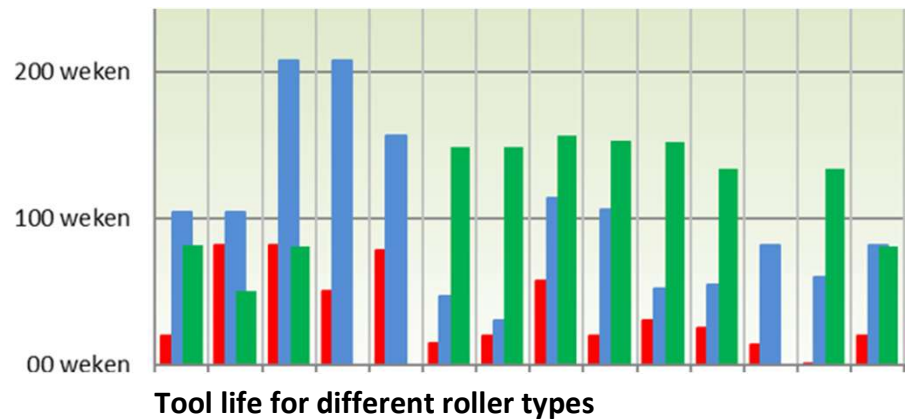


# Standaardiseren rollenonderhoud



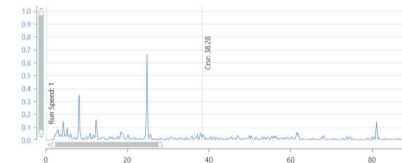
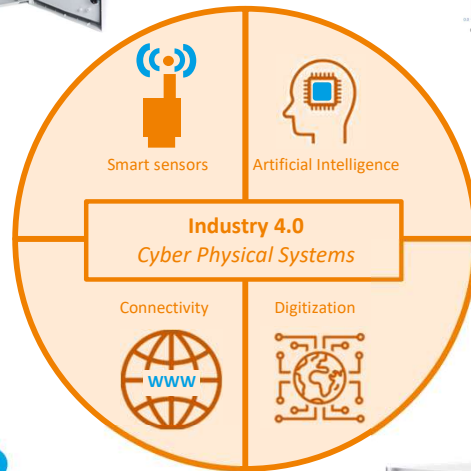
# Optimaliseren rollenonderhoud

## Tool life extension, Improvement projects





# Innoveren rollenonderhoud



## EXAMPLE FOR PREDICTIVE MAINTENANCE

# AI Roadmap



### Inspiration

- What is Ai?
- Smart Maintenance
- New Technologies
- Success stories
- Call for action?

### Ambition

- Dream statement
- Relevant KPIs
- New Business Models

### Scoping

- Critical assets
- Failure modes
- Failure chances
- Failure effects

### Data collection

- Predictive values
- Existing data
- Smart Sensors

### Digitization & computing

- Digitization
- Edge/cloud computing
- Software

### Cloud & Connectivity

- Cloud platform
- 5G/BLE/LoRa
- API & Integration

### Data analytics & Ai

- Monitoring
- Anomalies
- Labeling
- Trends
- Prediction

### Appreciation

- Dashboarding
- Reporting
- Value stating
- Follow-up
- Celebrating Successes

### Elevation

- New areas
- Elevated services
- New Business Models

# Ambition: SMARTMAINTENANCE

*Leading industry towards zero (unplanned) downtime*

## Ambition

- Dream statement
- Relevant KPIs
- New Business Models

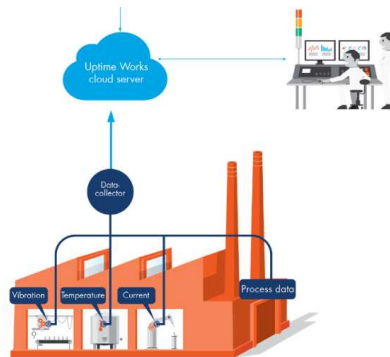
Inspiration  
• What is it?  
• Smart Maintenance  
• New Technologies  
• Success stories  
• Call for action!

Cloud & Connectivity  
• Cloud platform  
• I4.0/IIoT  
• API & Integration

Data analytics & AI  
• Monitoring  
• Anomaly detection  
• Predictive

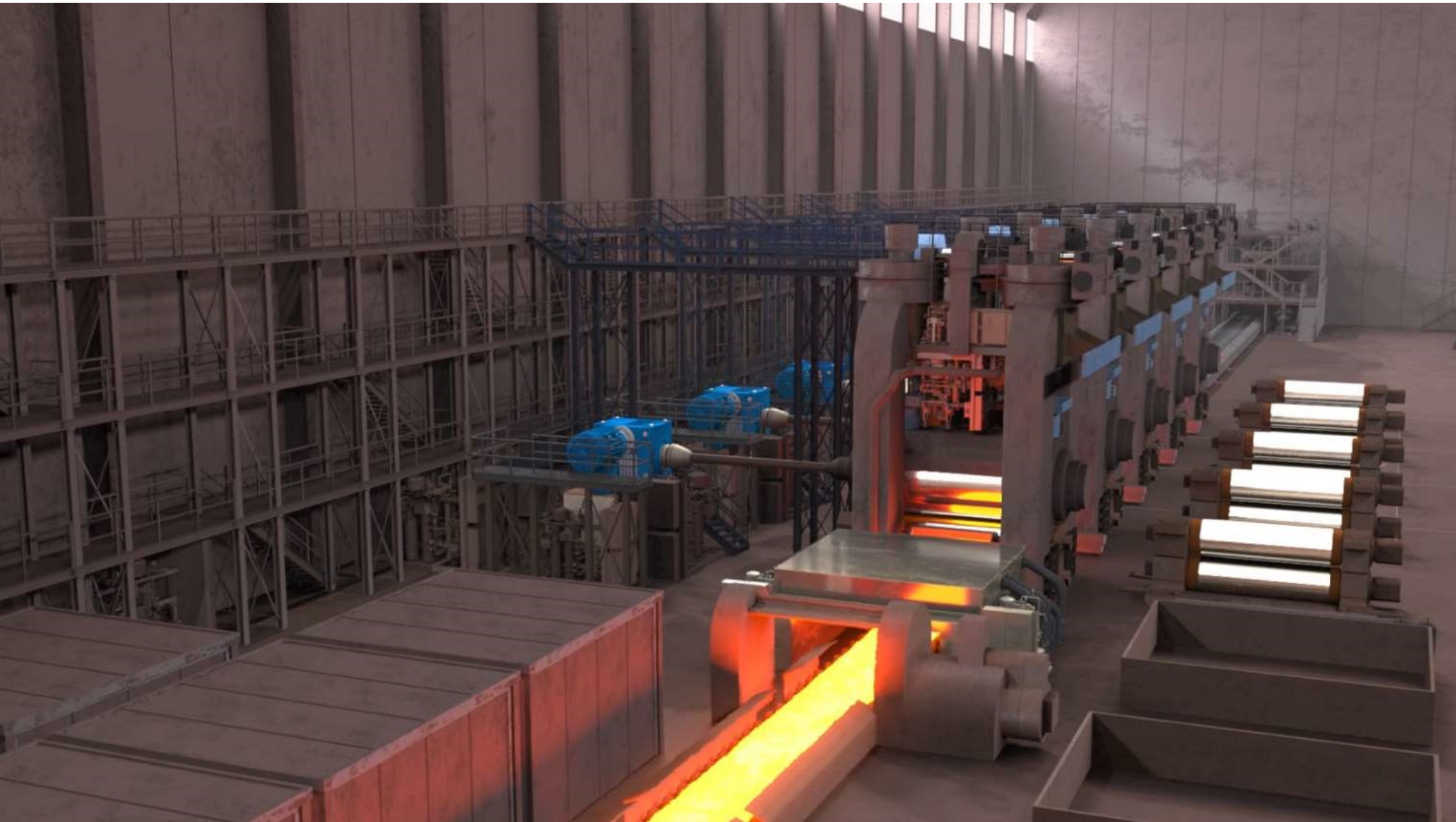
Appreciation  
• Dashboarding  
• Reporting  
• Visualization  
• Training  
• Success stories

Elevation  
• New assets  
• Extended services  
• New Business Models

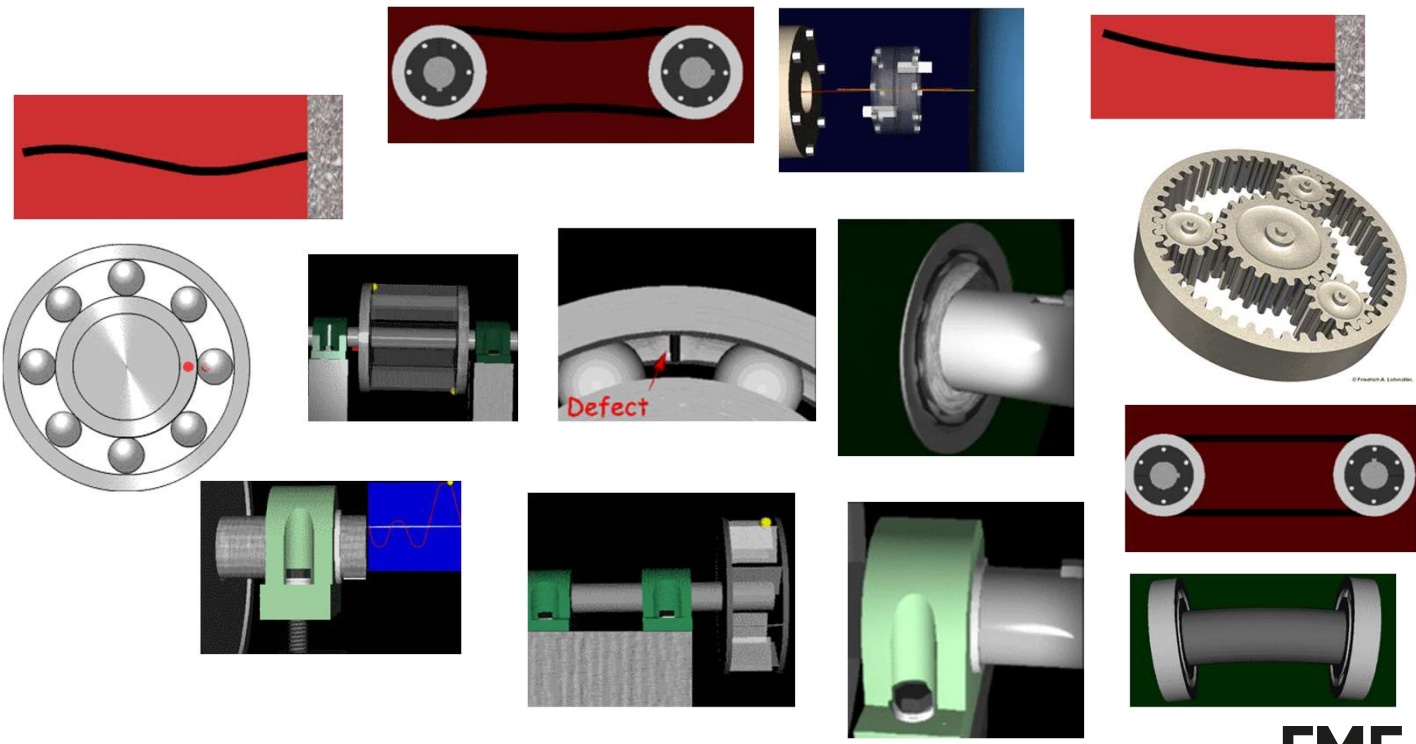
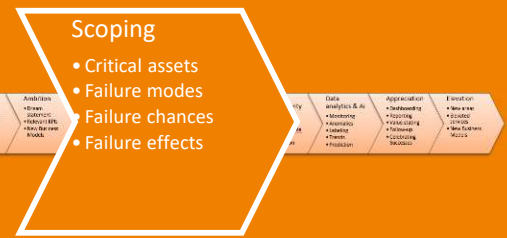






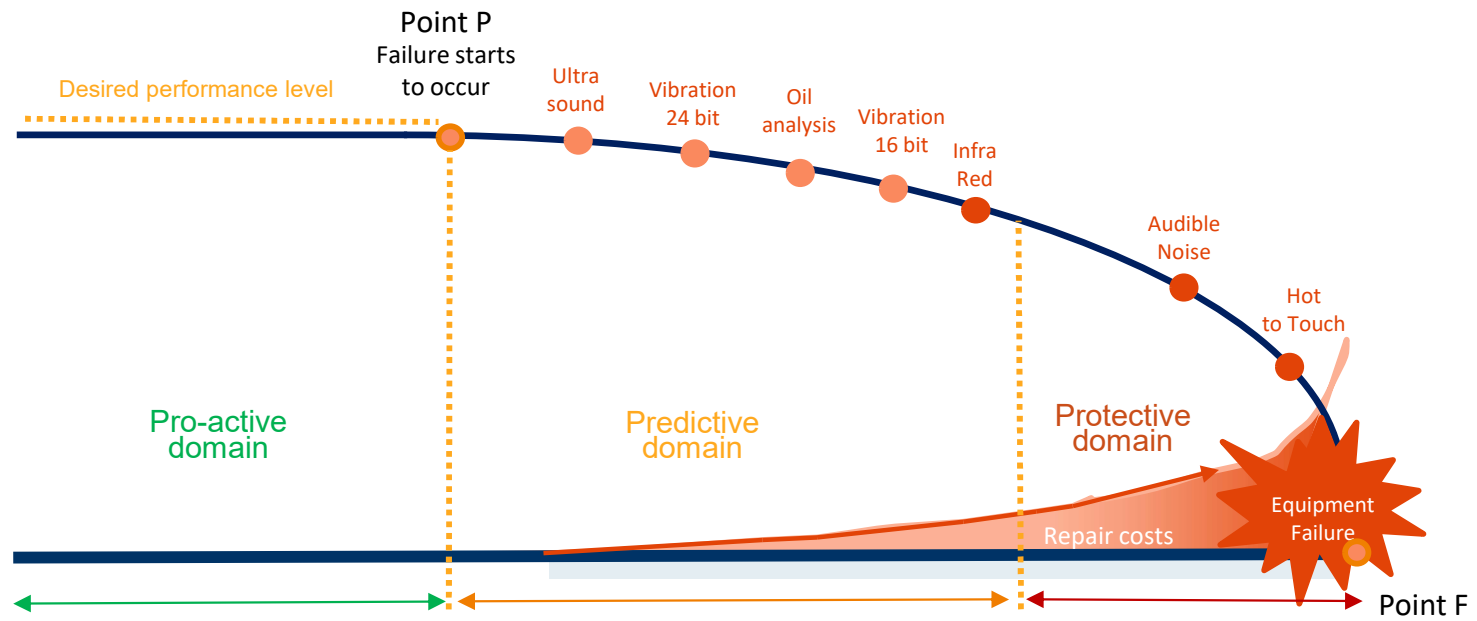
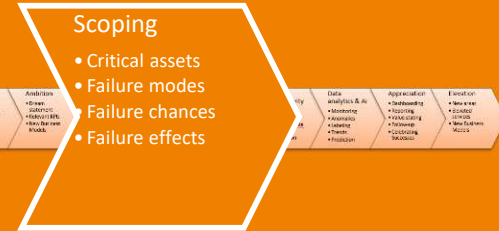


# Scoping: Rotating equipment

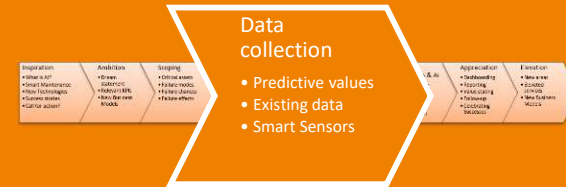




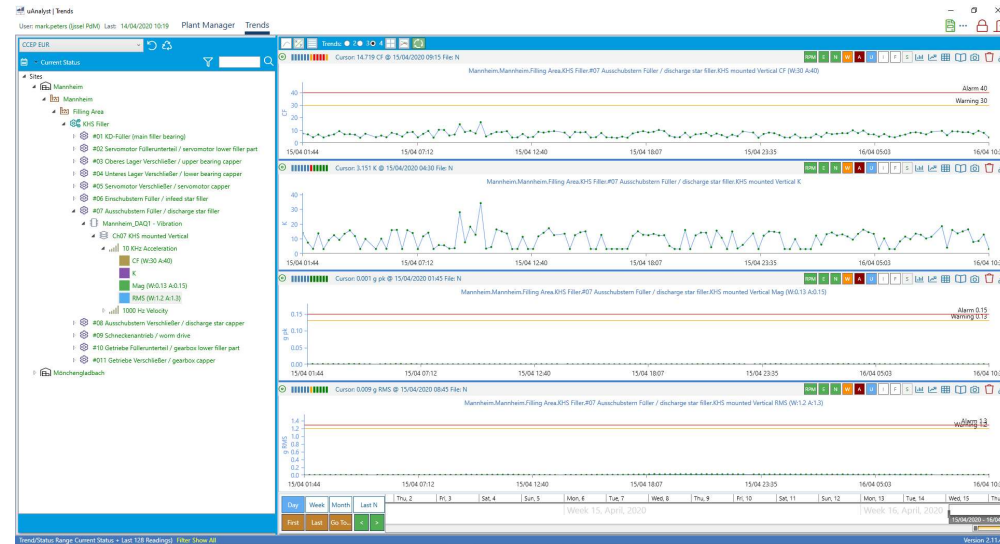
# Point of failure concept (P-F Curve)



# Data collection

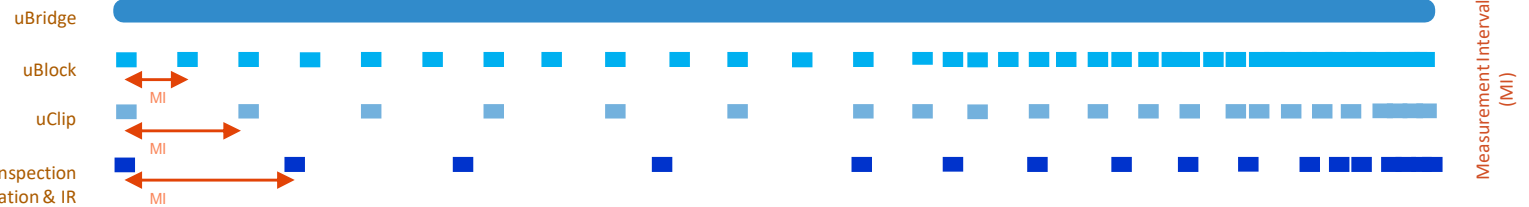
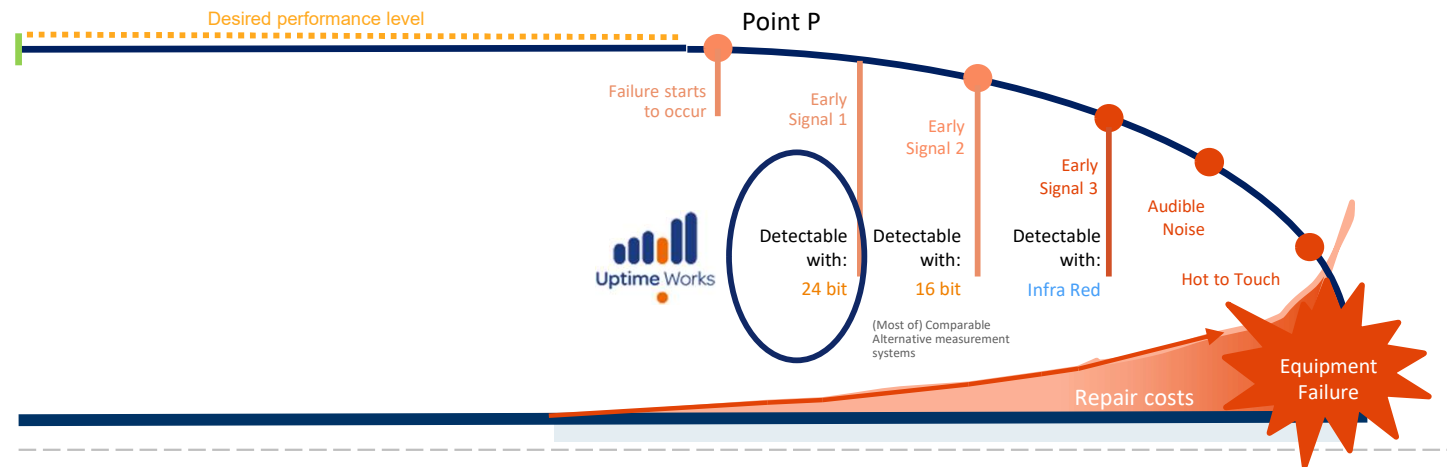
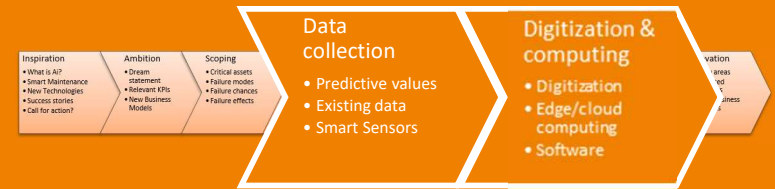


- Standardized vibration measurements:
  1. Acceleration (RMS g)
  2. Velocity (ISO)
  3. Magnitude
  4. Crest factor
  5. Kurtosis
- Standard addable measurements:
  1. RPM
  2. Temperature
  3. Current
  4. Oil quality
  5. Integration with other process data



Prepare for Ai standarized measurements

# Point of failure concept



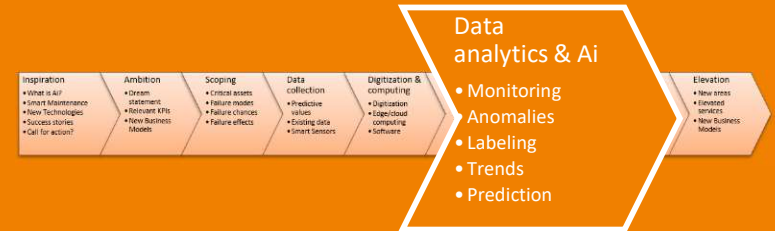




Deel 2 Mark Roest  
**Data analytics & AI**

DATA ANALYTICS & AI

# Kort voorstellen



**Mark Roest**

**VORTECH**

Your development partner for computing and modelling software

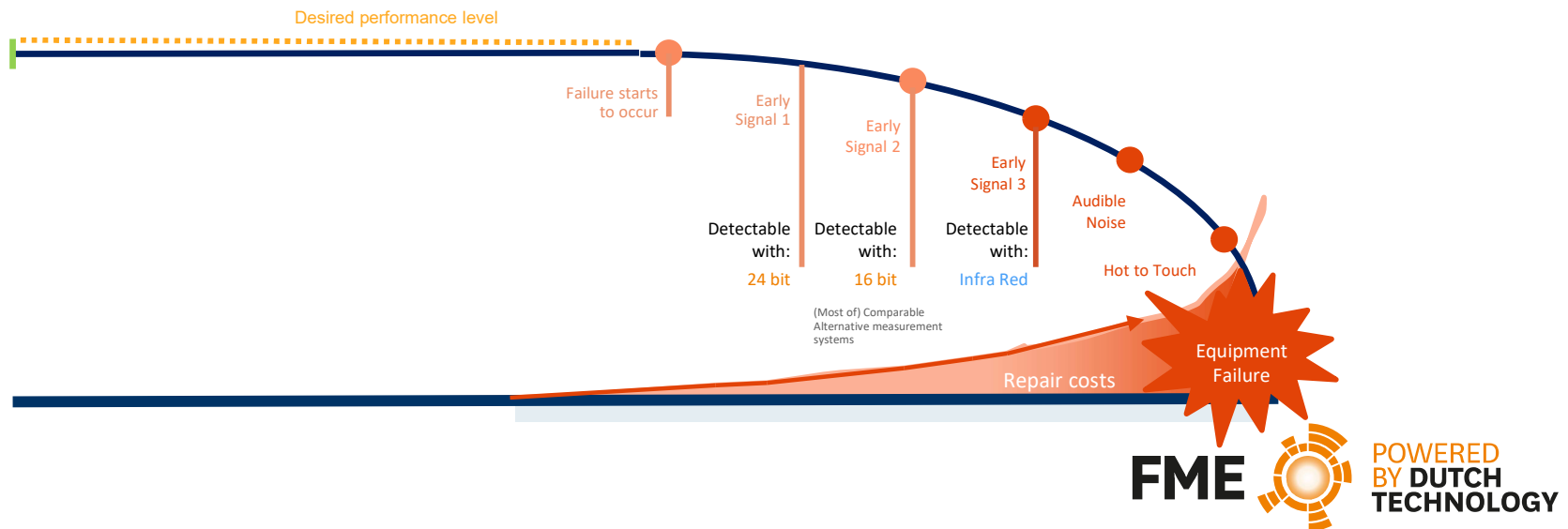


## DATA ANALYTICS & AI

# Doel data analyse & AI



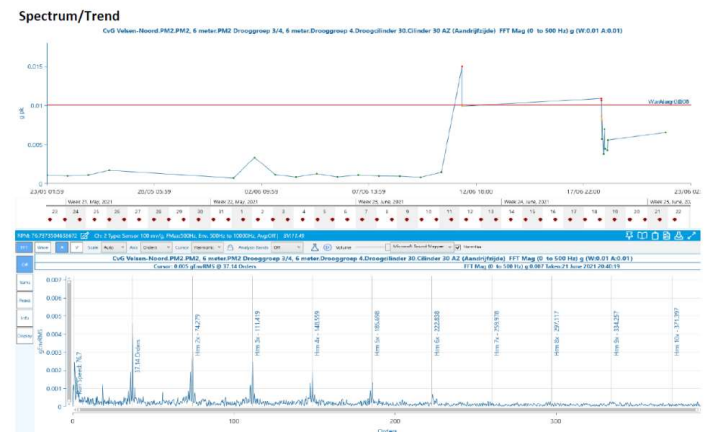
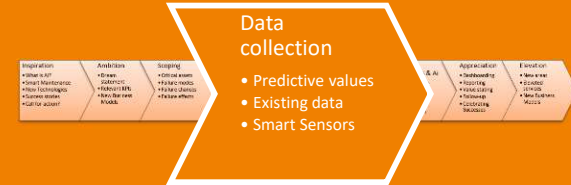
- Detecteren van relevante veranderingen in het functioneren van machines
- Adviseren van gewenste ingrepen





DATA ANALYTICS & AI

# Vibration Analyses

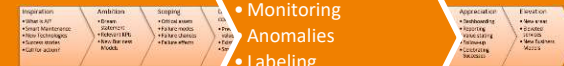


DATA ANALYTICS & AI

# Workflow van meting -> AI

Data analytics & Ai

- Monitoring
- Anomalies
- Labeling
- Trends
- Prediction



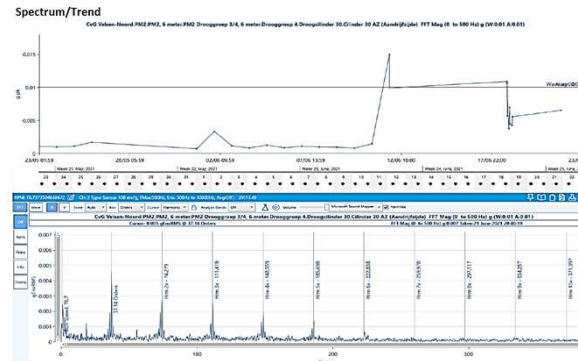
## 1. Collecting Measurements

## 2. Detecting Anomalies/Alarms

## 3. Analyzing the Selection

## 4. Reporting findings

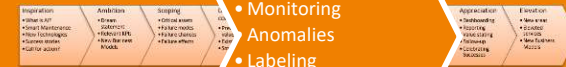
## 5. Improvement process



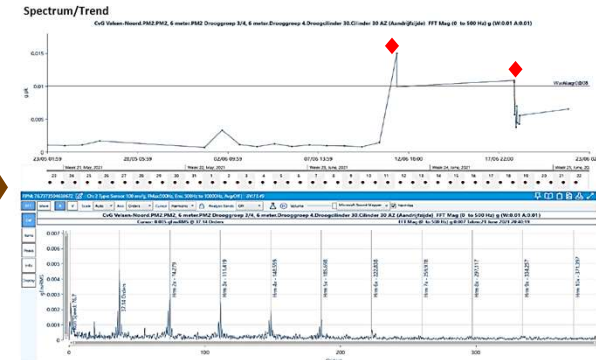
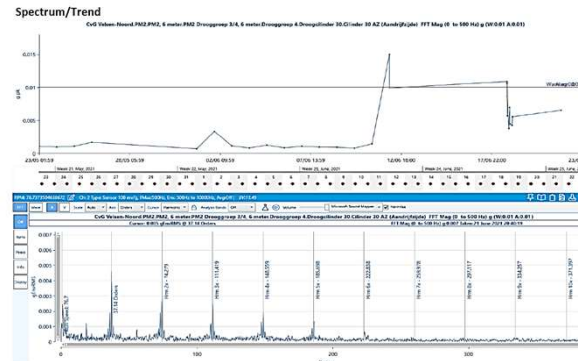
DATA ANALYTICS & AI

# Workflow van meting -> Ai

Data analytics & Ai



1. Collecting Measurements
2. Detecting Anomalies/Alarms
3. Analyzing the Selection
4. Reporting findings
5. Improvement process





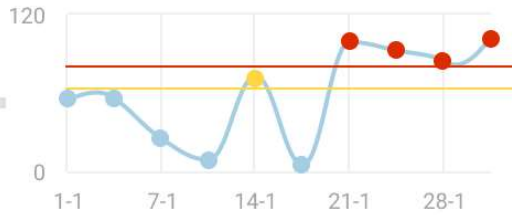
DATA ANALYTICS & AI

# Roadmap anomaly detection

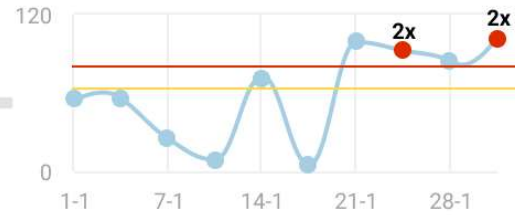
Data analytics & Ai

- Monitoring
- Anomalies
- Labeling
- Trends
- Prediction

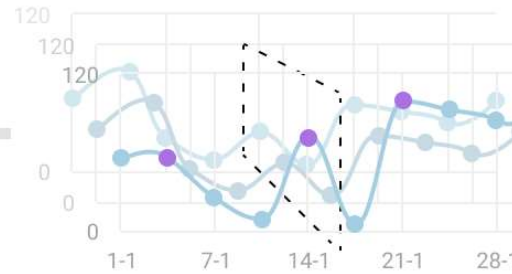
Manual Alarm Limits



Smart Features



Trend-based Anomaly Detection



Complex Anomaly Detection

*From improving efficiency towards seeing more.. earlier*

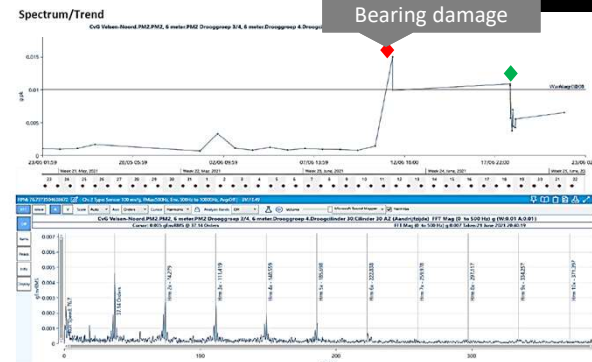
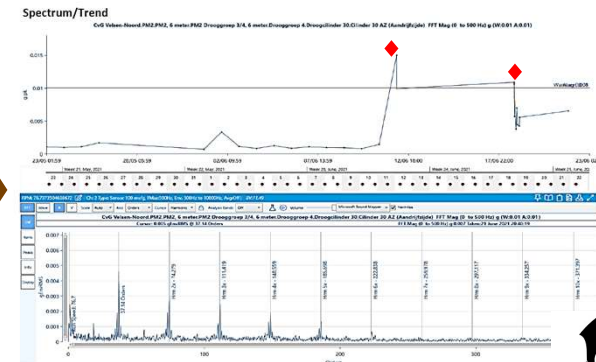
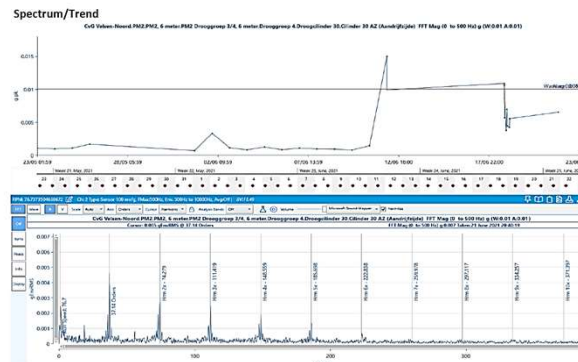
## DATA ANALYTICS & AI

# Roadmap supervised learning

Data analytics & AI

- Monitoring
- Anomalies
- Labeling
- Trends
- Prediction

1. Collecting Measurements
2. Detecting Anomalies/Alarms
3. Analyzing the Selection
4. Reporting findings
5. Improvement process



VERED  
DUTCH  
TECHNOLOGY

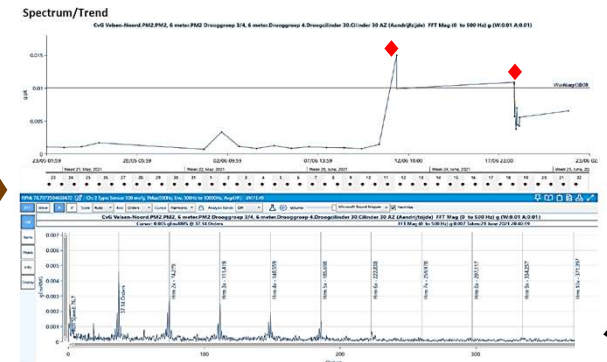
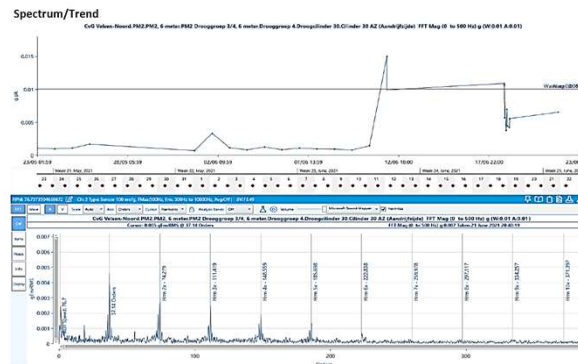
## DATA ANALYTICS & AI

# Roadmap supervised learning

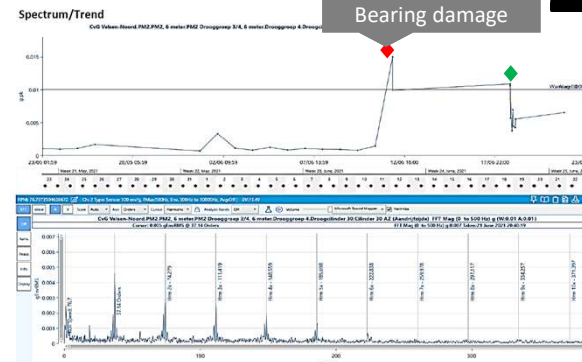
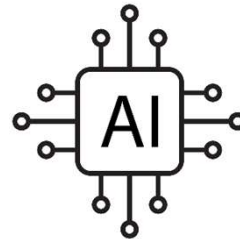
Data analytics & Ai

- Monitoring
- Anomalies
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- Prediction

1. Collecting Measurements
2. Detecting Anomalies/Alarms
3. Analyzing the Selection
4. Reporting findings
5. Improvement process



Wear  
Deformation  
Corrosion  
Leakage  
Bearing damage



VERED  
DUTCH  
TECHNOLOGY



# Types of algorithms/models

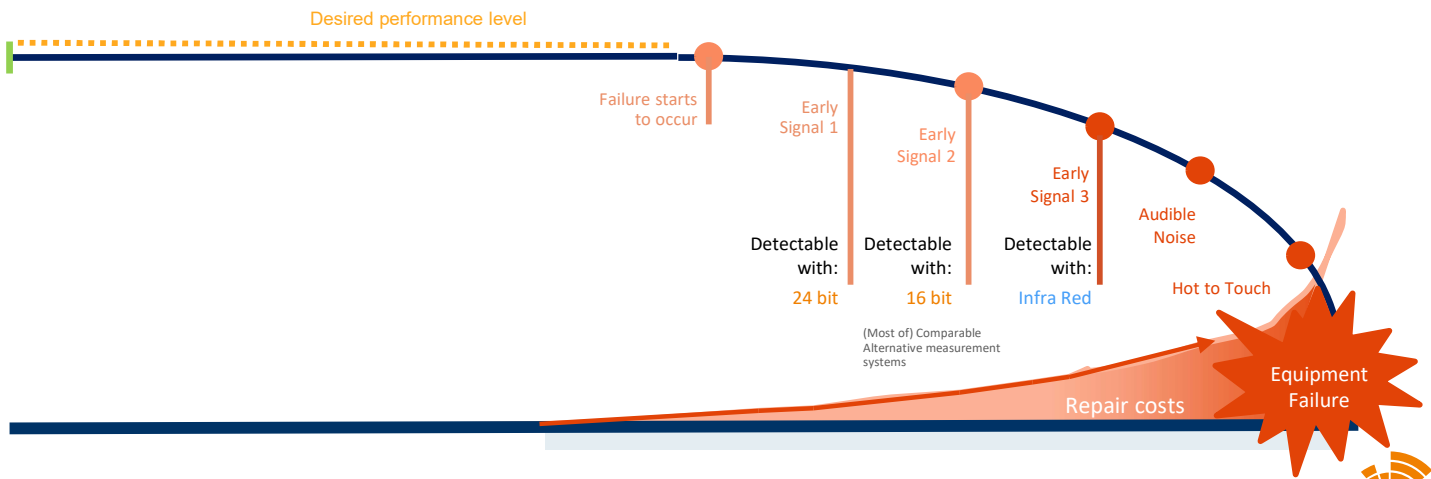
- **Anomaly detection**
  - Which assets show anomalous behavior
- **Factors that contribute to failure**
  - What are the top features that contribute to failure
- **Asset life curve**
  - What is the probability of failure when an asset is n years old
- **Probability of failure**
  - Which assets will fail in the coming n days
- **Predicted failure date**
  - How many days until failure, how to increase/decrease

DATA ANALYTICS & AI

# How to predict

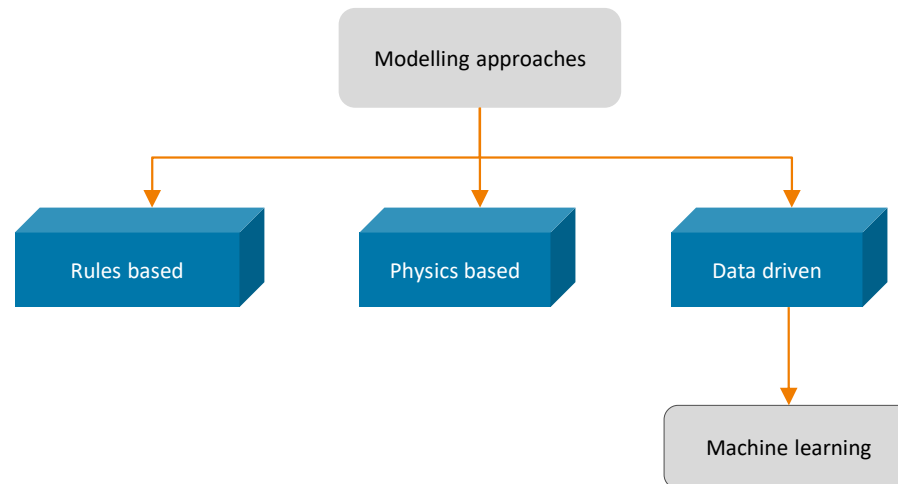
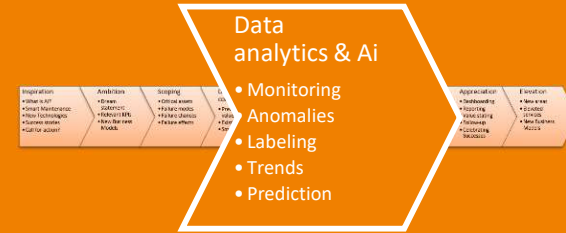


To predict, you need some form of model to describe the failure curve



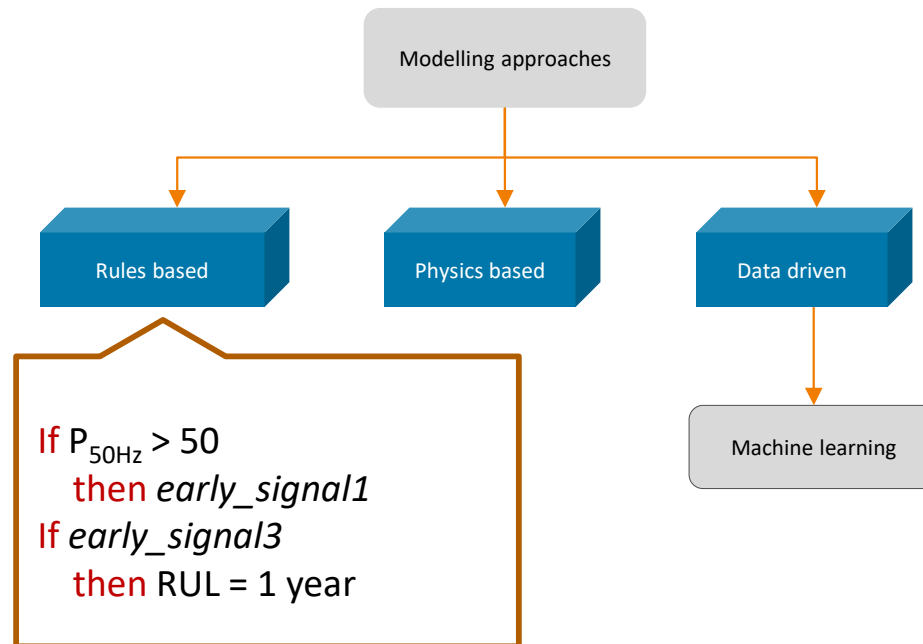
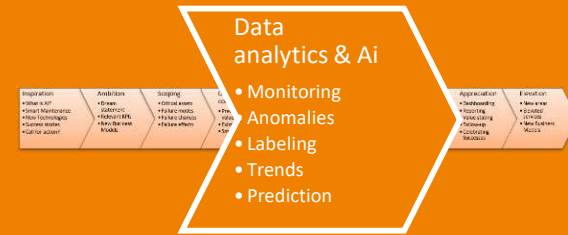
## DATA ANALYTICS & AI

# Approaches to model the failure curve

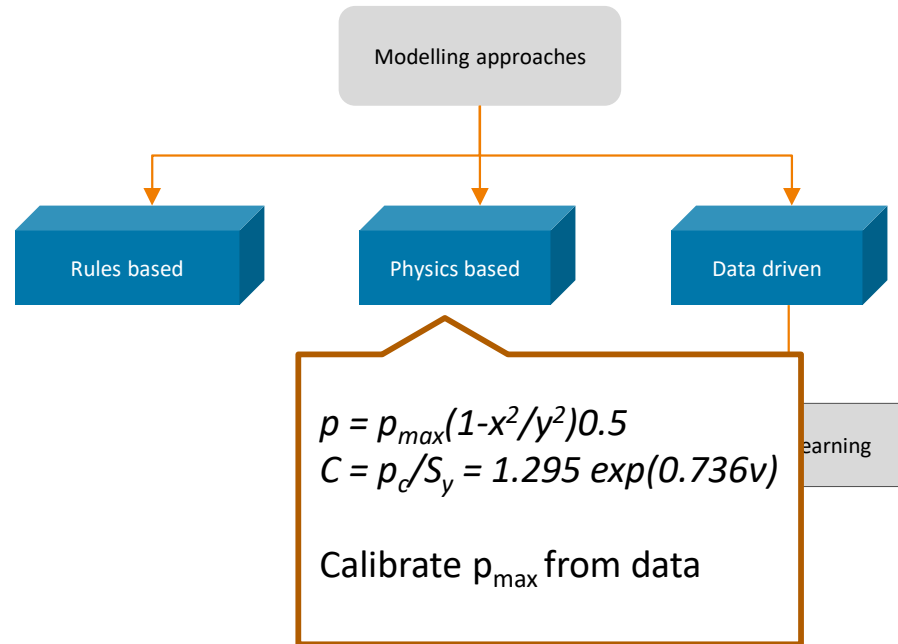
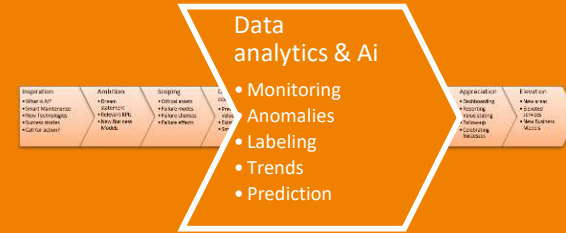




# Approaches to anomaly detection and prognostics

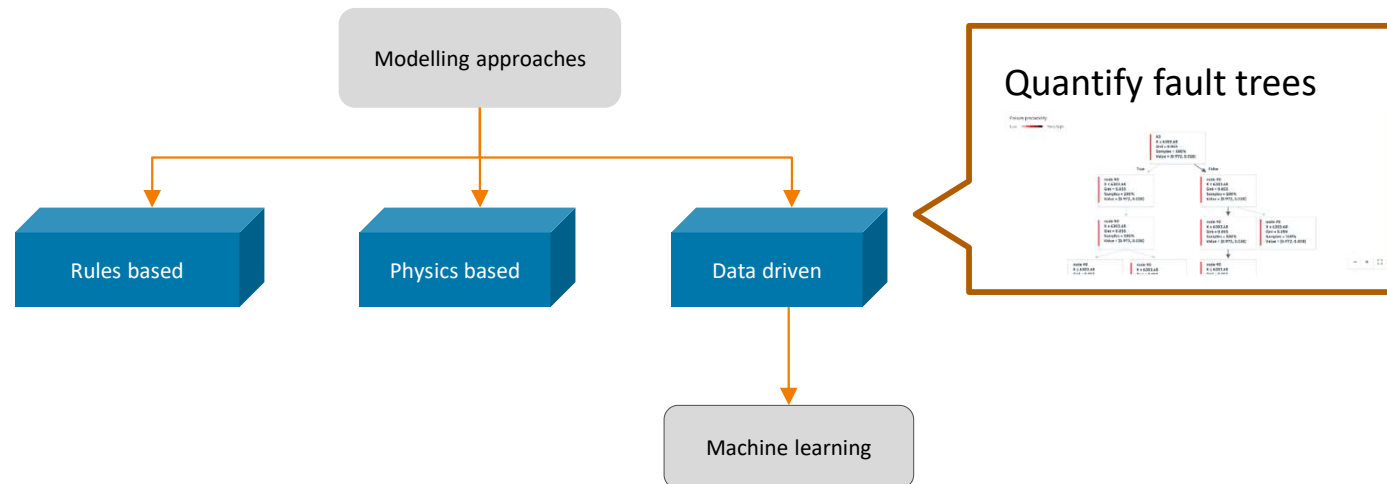
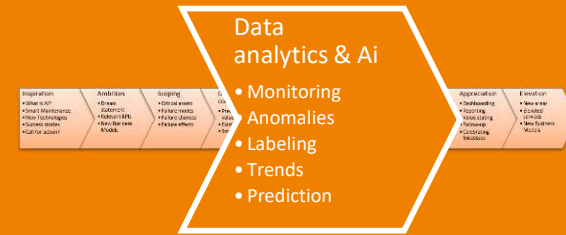


# Approaches to anomaly detection and prognostics



## DATA ANALYTICS & AI

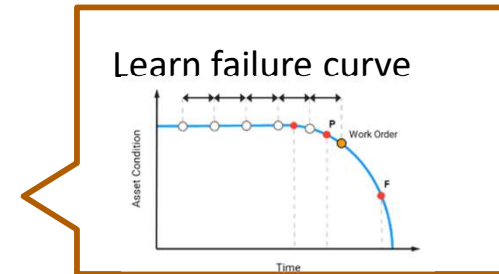
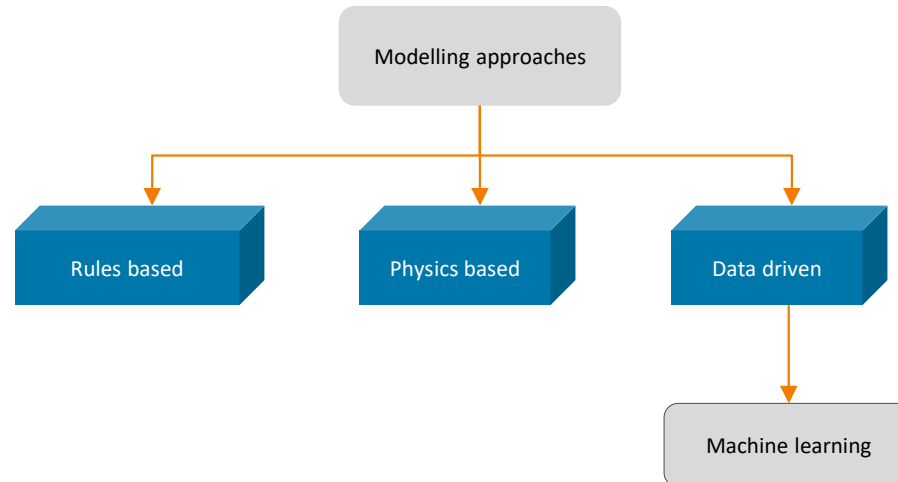
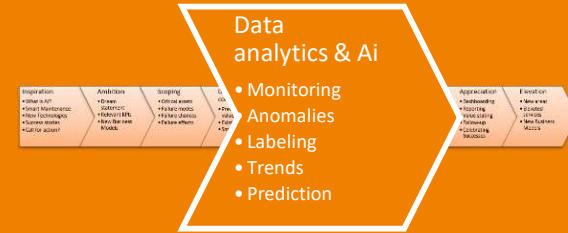
# Approaches to anomaly detection and prognostics





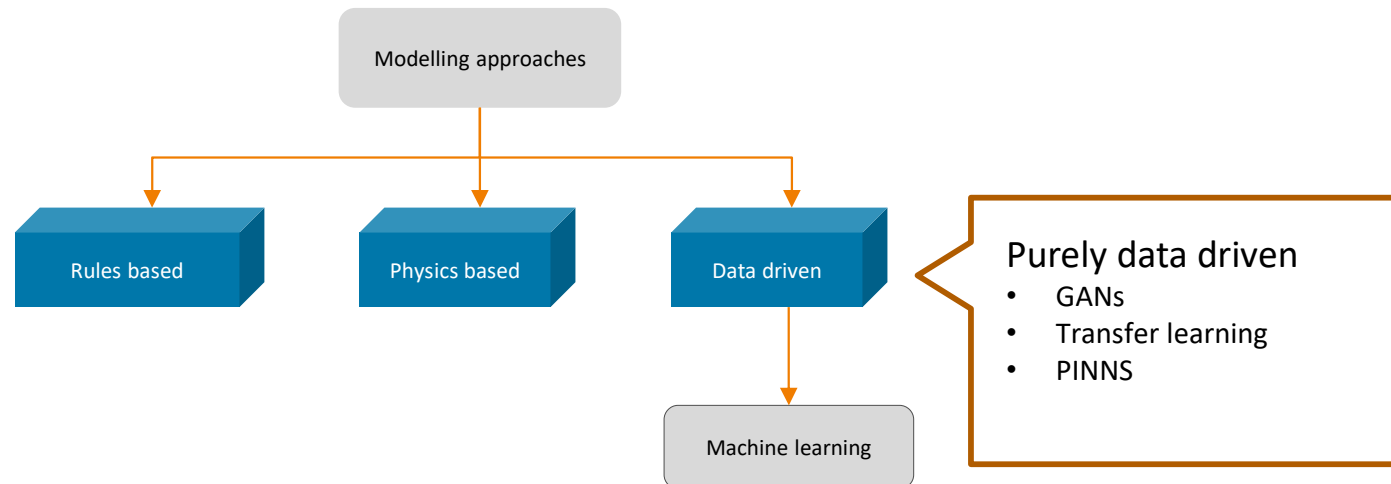
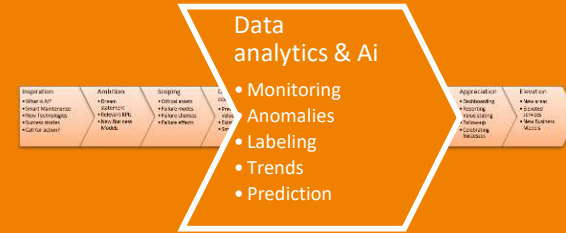
## DATA ANALYTICS & AI

# Approaches to anomaly detection and prognostics



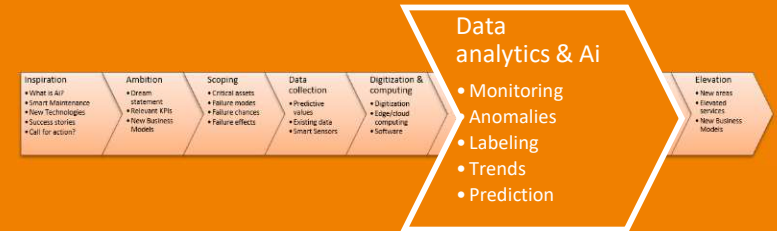
## DATA ANALYTICS & AI

# Approaches to anomaly detection and prognostics



## PREDICTIVE MAINTENANCE

# Praktische uitwerking



- **Standaard tools**

- Voordeel: vaak tools die breed getest zijn op basis van veel data
- Nadeel: kosten aan verbonden, vaak ook in combinatie met consultants
- Cognos, MindSphere, Maximo APM, AVEVA, Fluke, ...

- **Do It Yourself**

- Voordeel: zeer laagdrempelig, geeft gevoel voor materie
- Nadeel: vergt IT-beheersing en kennis van zaken
- PowerBI, Python Notebooks

- **DIY op een platform**

- Voordeel: infrastructuur en security geregeld
- Nadeel: enige kosten
- IBM cloud, Azure, AWS



**Deel 3 Ronald Teijken**  
**Data collection, Digitization, Cloud & Connectivity**

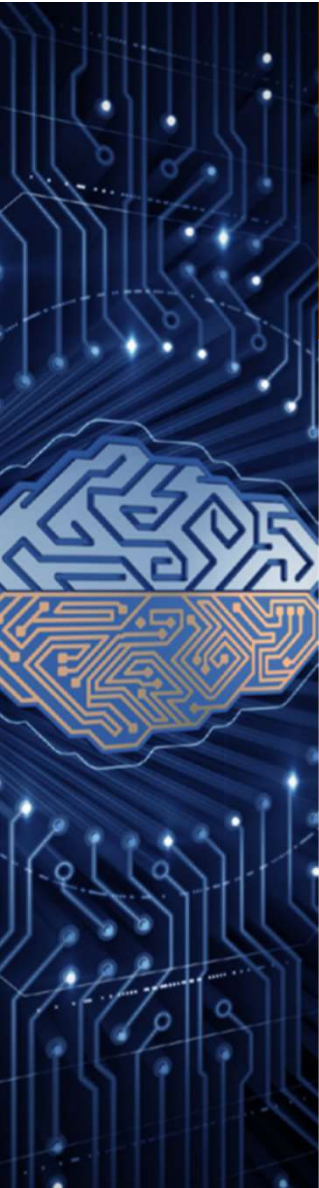


# Kort voorstellen



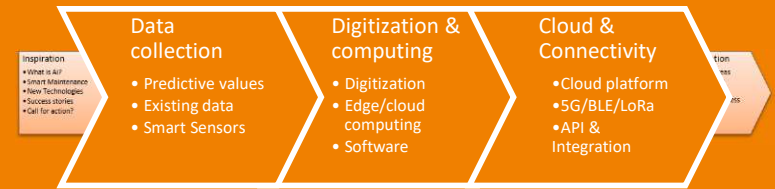
- Channel Manager IBM Sustainability Solution
- IBM oplossingen op het gebied van Sustainability, EAM, IoT, SCM, AI en TWC
- Sales en BD via partners en continue op zoek naar nieuwe (ESA) partners
- Zelf: HBO logistieke opleiding, ervaring in Productie, SCM en SW.





## PREDICTIVE MAINTENANCE

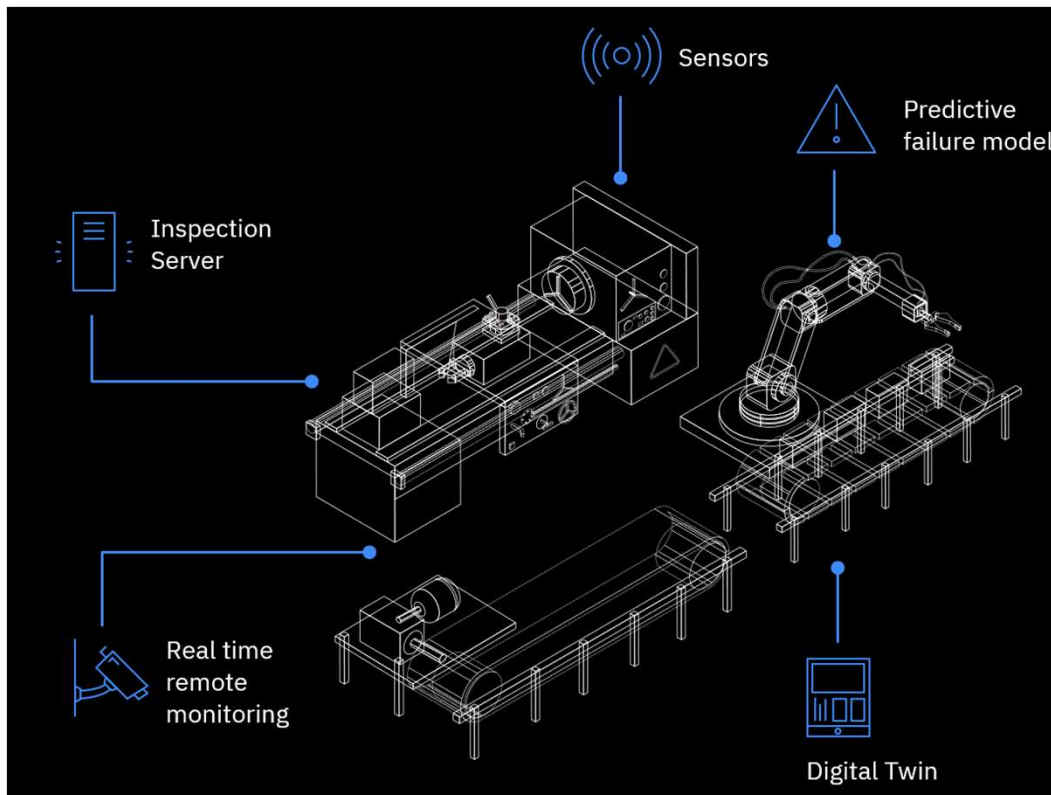
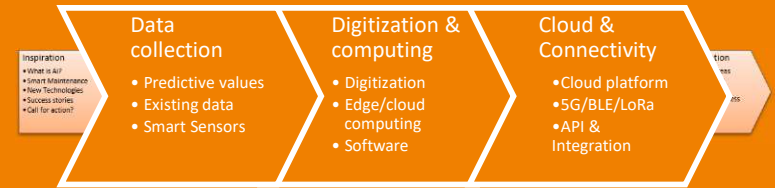
# Era of asset optimization



New technologies yield vast maintenance efficiency potential for industries with distributed fixed assets. Companies that have digitized and automated their maintenance processes now show a significant increase in labor productivity and a 20 to 30 percent reduction in maintenance costs.”\*

## PREDICTIVE MAINTENANCE

# The **technology** and Assets are Changing

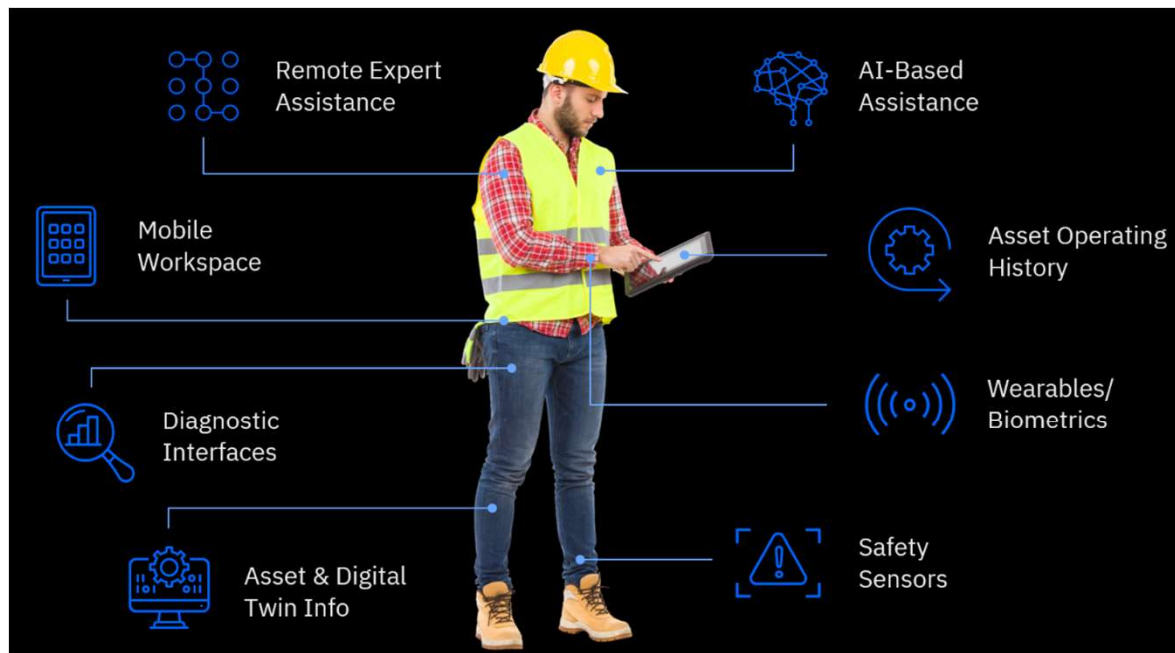
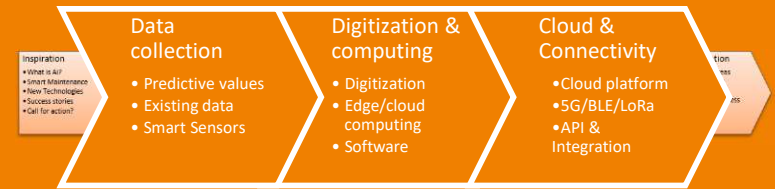


- Most asset failures are random resulting in unplanned downtime and additional costs
- Growing backlog of Preventative Maintenance activities
- Maintenance Costs too high
- Limited capital budget with no insight into how to prioritize based on asset condition



## PREDICTIVE MAINTENANCE

# The **People** and the Role of Technicians are Changing



## Capabilities

New insights from your assets

AI anomaly or alert

Visual inspection

Asset health score

Predicted failure



An aging workforce resulting in loss of knowledge



Tech savvy candidates expect connected workplaces







## PREDICTIVE MAINTENANCE

# APM is designed for decision support

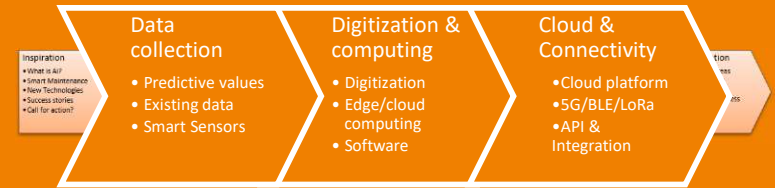
- Optimize maintenance with repair/replacement decisions
- Reduce unplanned downtime
- Shorten planned downtime/outages
- Extend asset life
- Assist with transitioning workforce
- Reduce time investigating false positives
- Increase asset availability
- Reduce time to make strategic replacement decisions
- Reduce overall operational risk by focusing on the right assets





## PREDICTIVE MAINTENANCE

# Real-time Insights across Large Operations



### Connecting the Enterprise

Data integration from multiple sources of data about operating state.



### Operate at Scale

Ability to scale and visualize operations across enterprise through single dashboard.



### AI-Powered Anomaly Detection

Advanced analytics and AI that can quickly detect issues and leverage data from operating history.



### Root Cause Analytics

Alert notifications and drilldown capabilities for resolution teams.



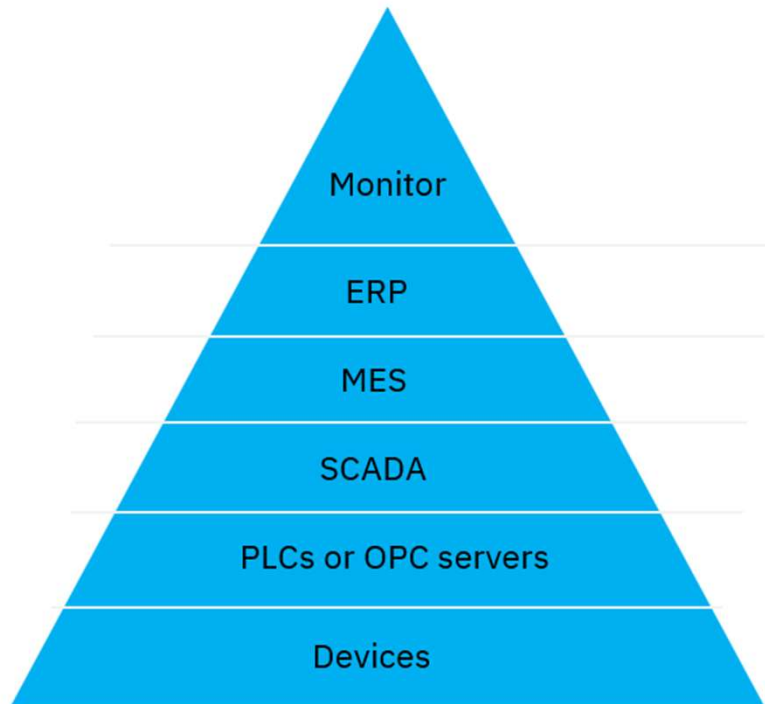
### Journey to Predict

Monitor is the foundation for predictive maintenance and asset health.



## PREDICTIVE MAINTENANCE

# How to collect data in your company

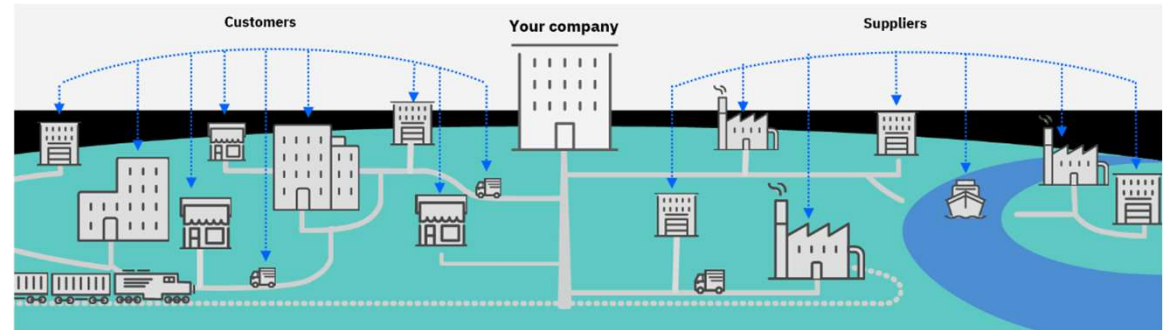
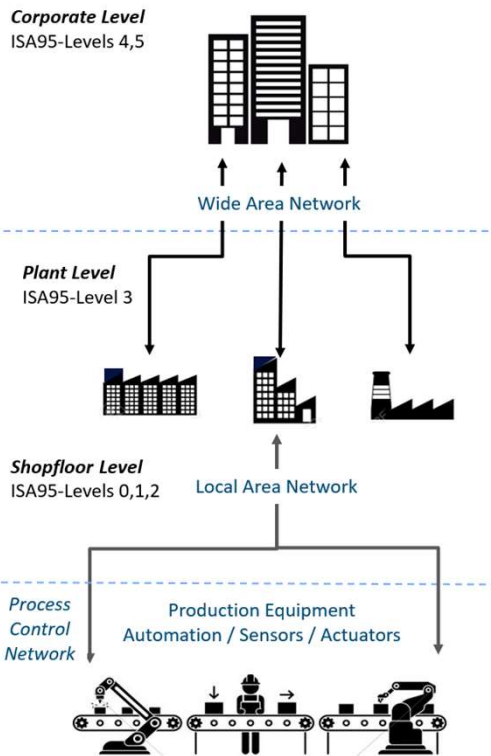


- Connect devices in minutes with pre-configured connectors
- Leverage data unification to use data from different sources in the same application
- OT complexity reduced, benefitting the IT department



## PREDICTIVE MAINTENANCE

# Data travels across your company and supply chain

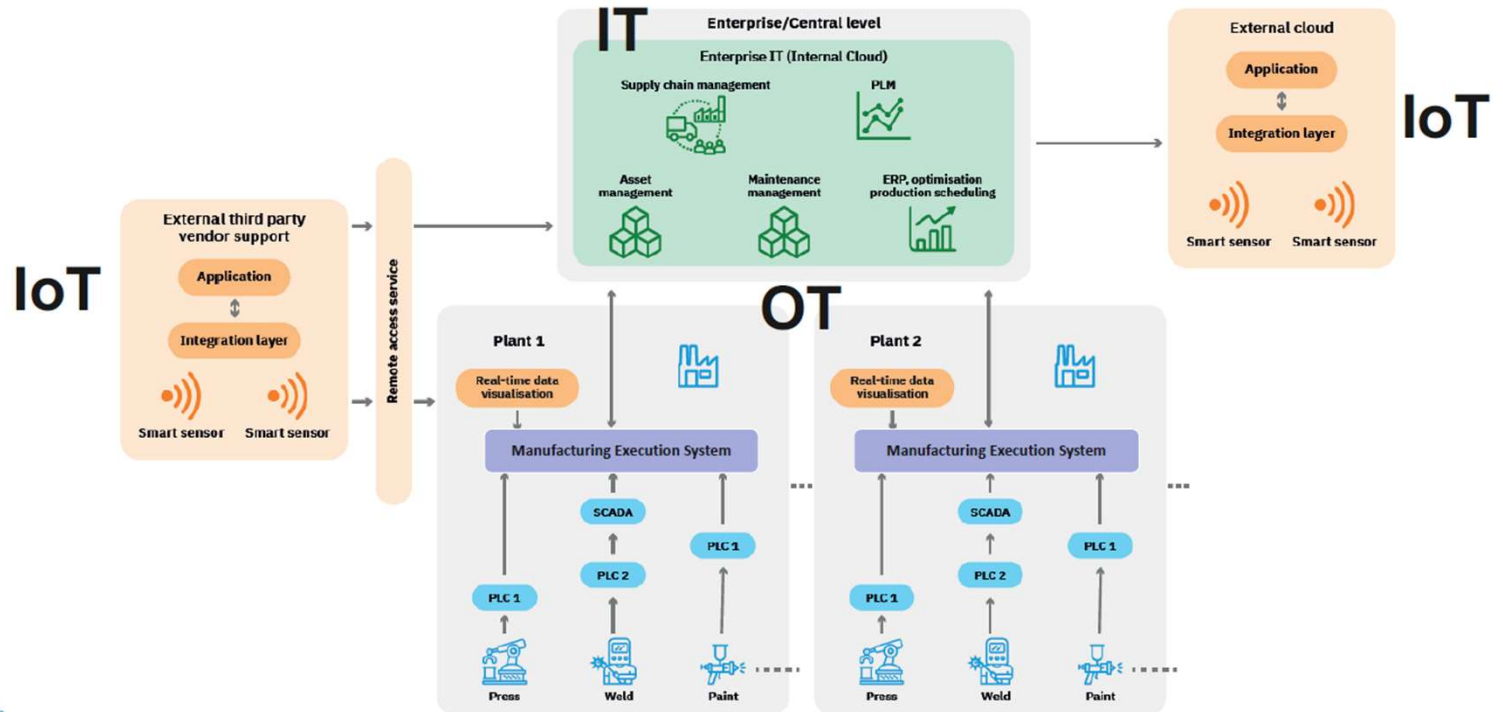
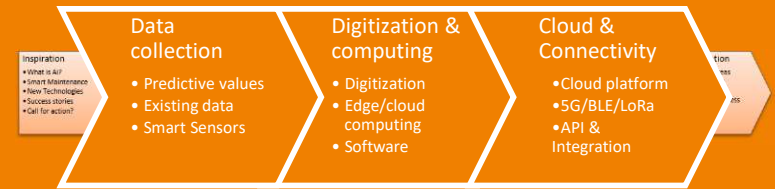


Bundle data together from IoT, middleware, cybersecurity, networking, modern plant applications and edge analytics



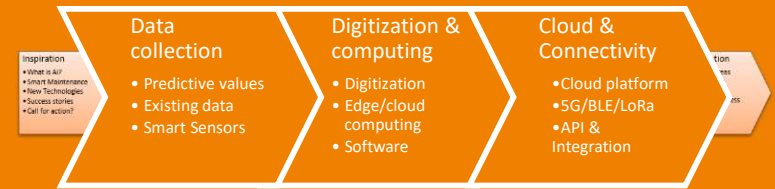
## PREDICTIVE MAINTENANCE

# IT and OT environments Adding IoT



## PREDICTIVE MAINTENANCE

# Digital technologies are redefining manufacturing



### Hybrid Multi Cloud

Allows applications to be built once and deployed anywhere. Delivers cost-effective innovation quickly

### AI & Analytics

Supports staff to make decisions. Identifies business-critical operational improvements

### Software-defined Networks

Ability to control network resources as compute needs scales

### Blockchain

Improves identity management and distribution. Enables transformational business model innovations

### Edge Computing

Enables data to be processed at point of action and data be transferred with minimum latency

### Cybersecurity

Embeds safeguards into systems. Surfaces threats

### Internet of Things

Extracts digital data from physical assets. Optimizes existing operational processes

### Mobile

Connects engineers, technicians and planners with insights where they are. Enables on-going collaboration and decisions

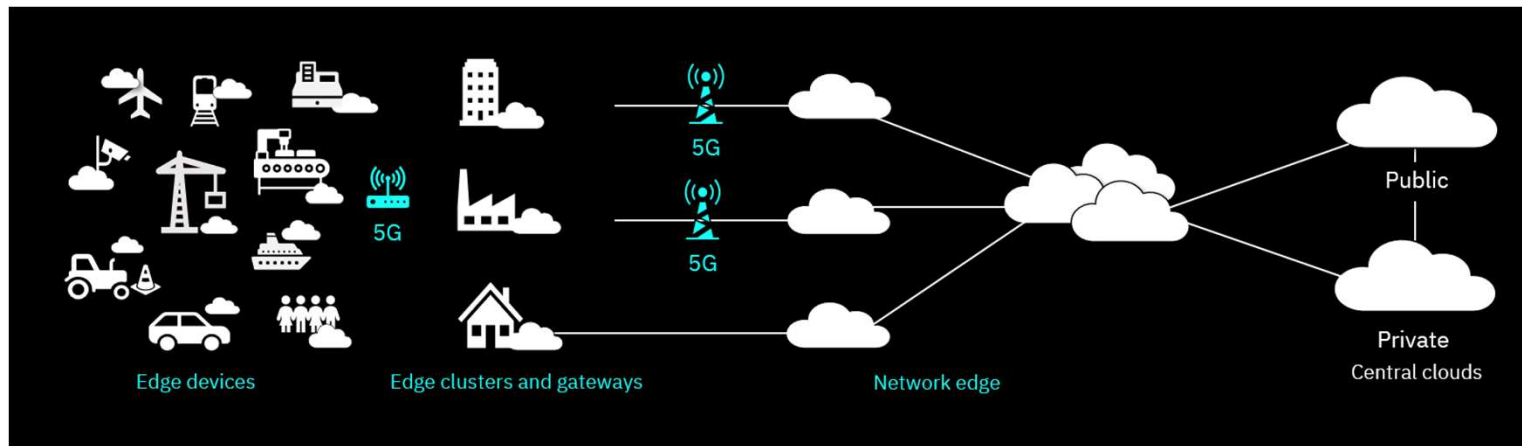
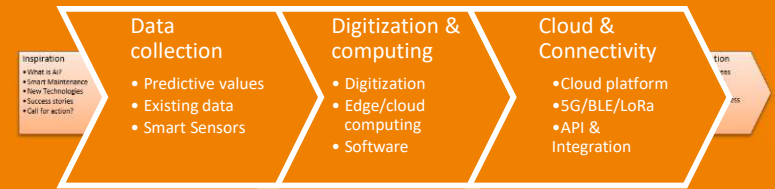
### Robotics & Process Automation

Enhances productivity by working autonomously or in conjunction with staff. Increases worker safety

**POWERED  
BY DUTCH  
TECHNOLOGY**

# PREDICTIVE MAINTENANCE

## Edge computing



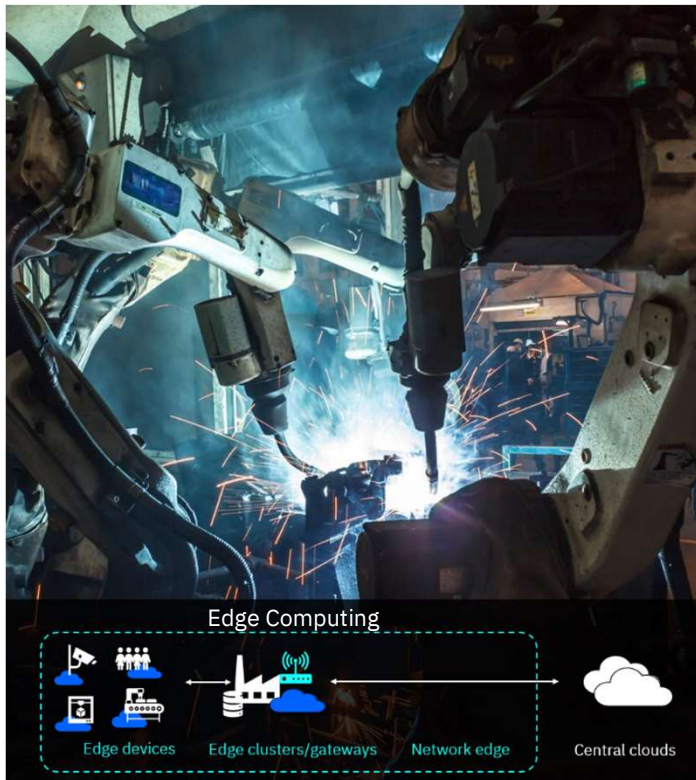
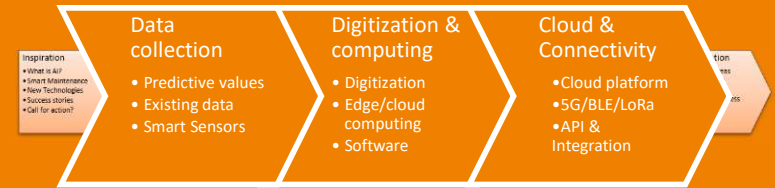
A distributed computing paradigm which brings computation and data storage closer to the location where it is needed, to improve response times and save bandwidth.

– *Wikipedia*



## PREDICTIVE MAINTENANCE

# Edge AI in Manufacturing Operations



Real-time visualization, simulation and analysis of machine and worker data

Automate production line and perform analytics at the edge to improve product quality

Inspect, optimize and “self-heal” production line in real-time

Detect and correct at the point of installation

Improve worker and inventory management





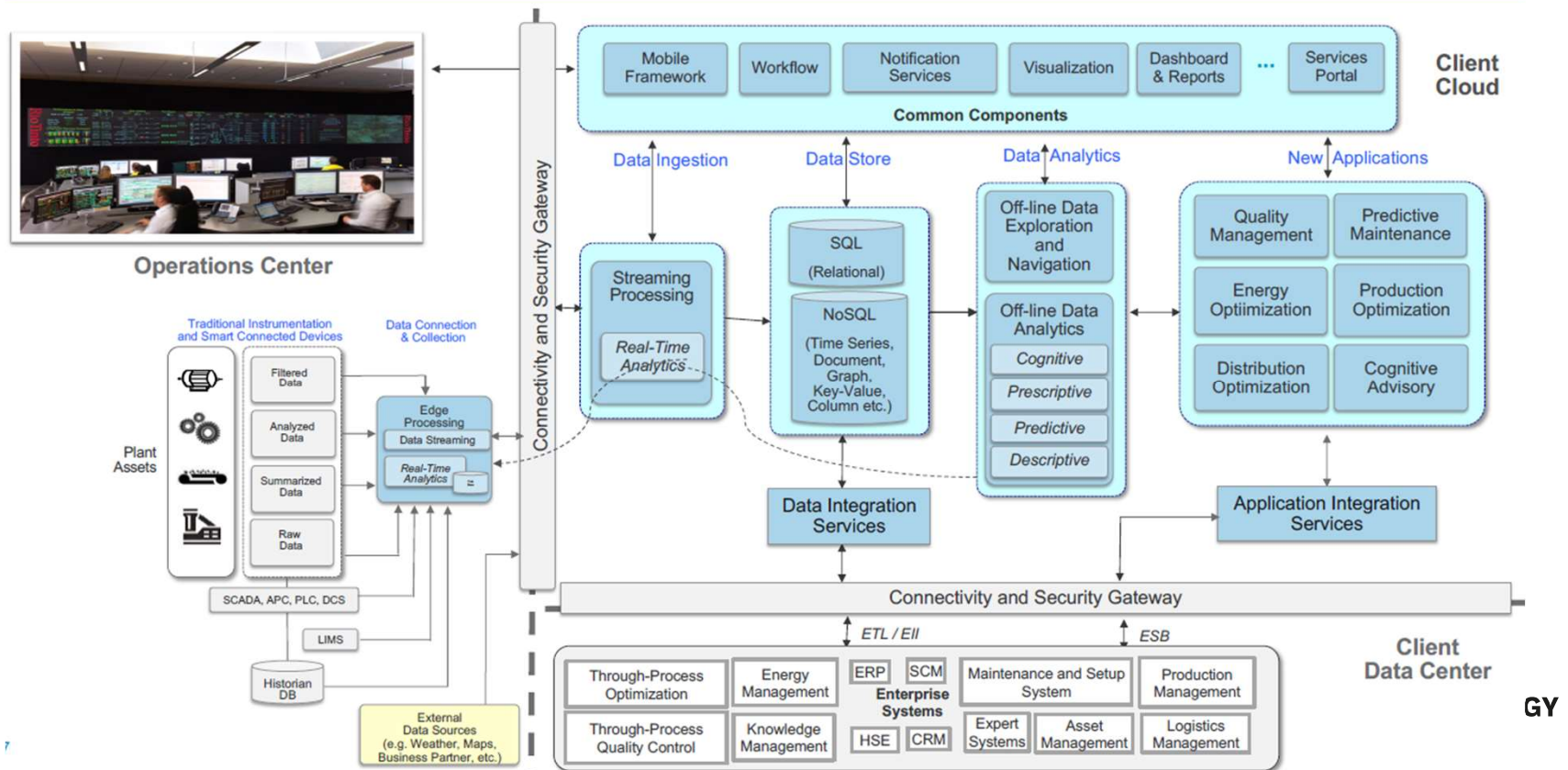
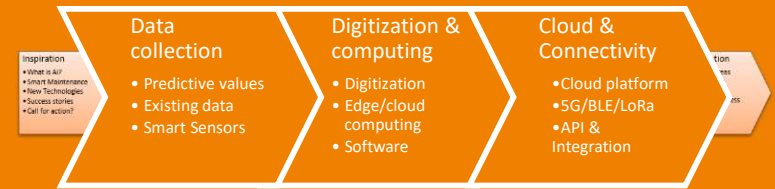
# PREDICTIVE MAINTENANCE

## Visual Insights For Edge



## PREDICTIVE MAINTENANCE

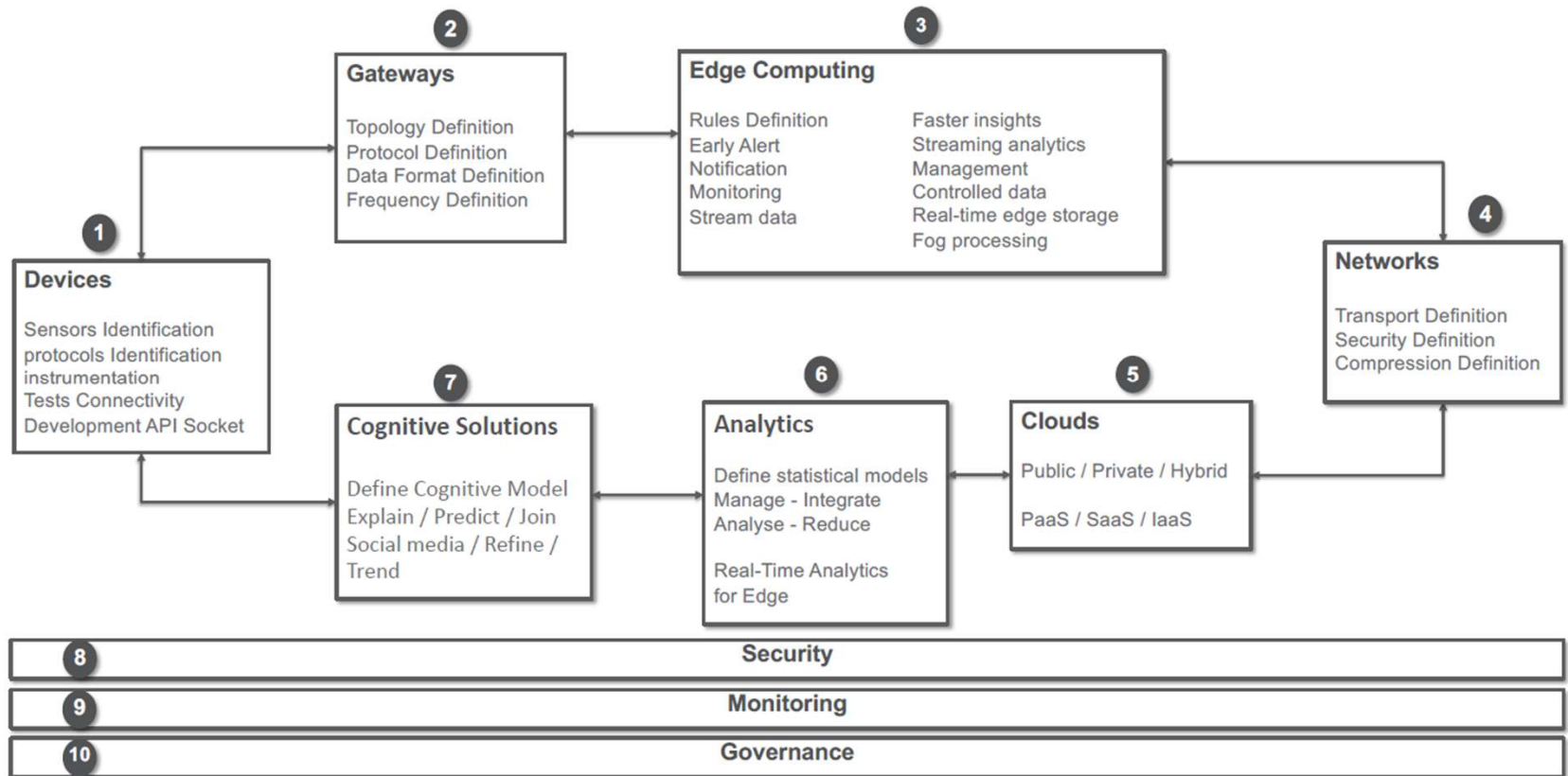
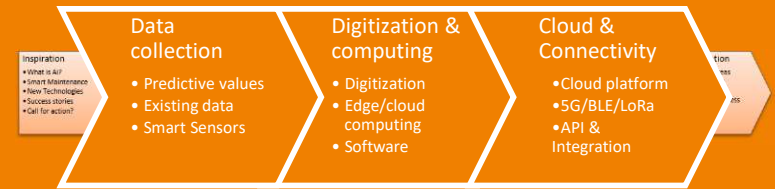
# Industry 4.0 Solution Architecture





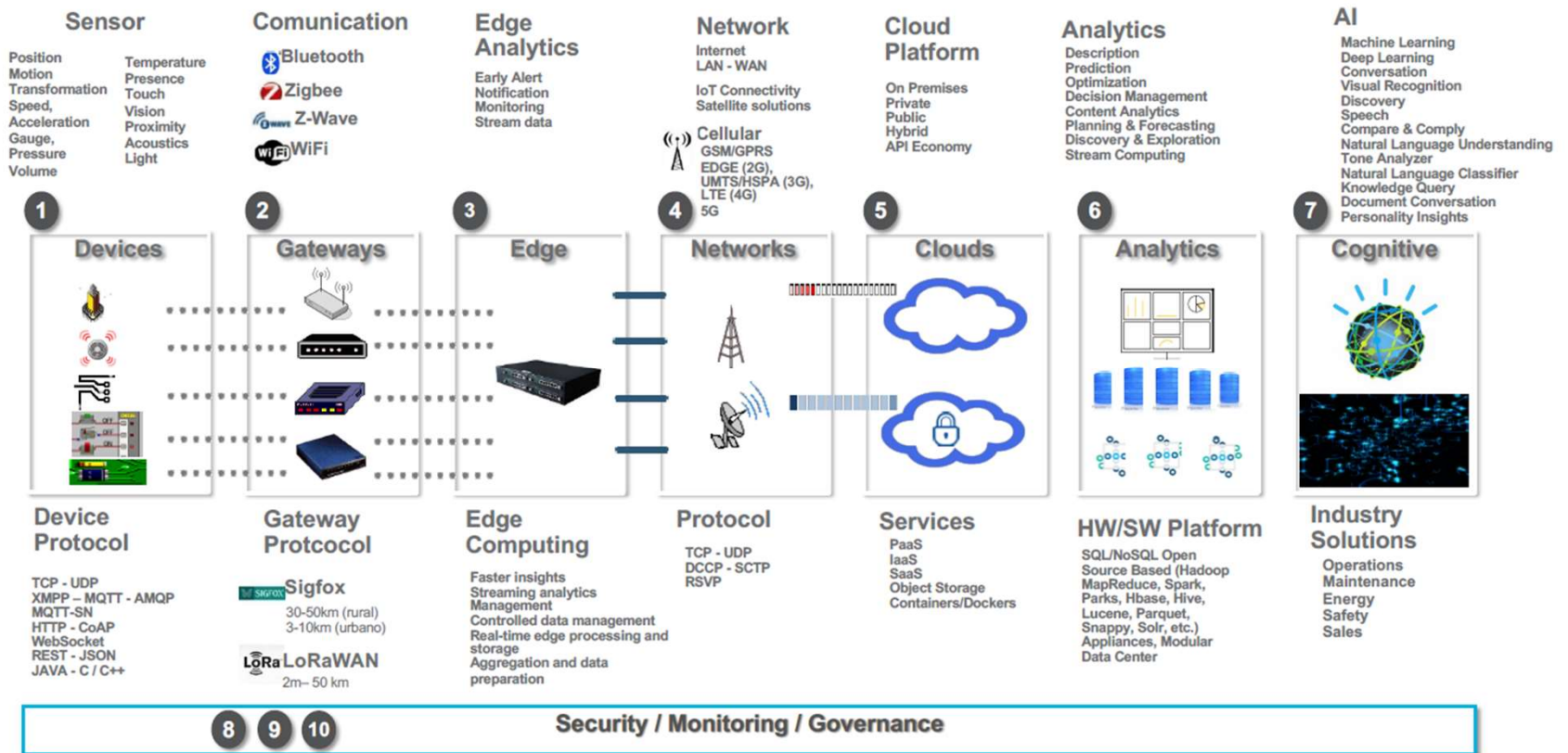
## PREDICTIVE MAINTENANCE

# Technology components to be considered



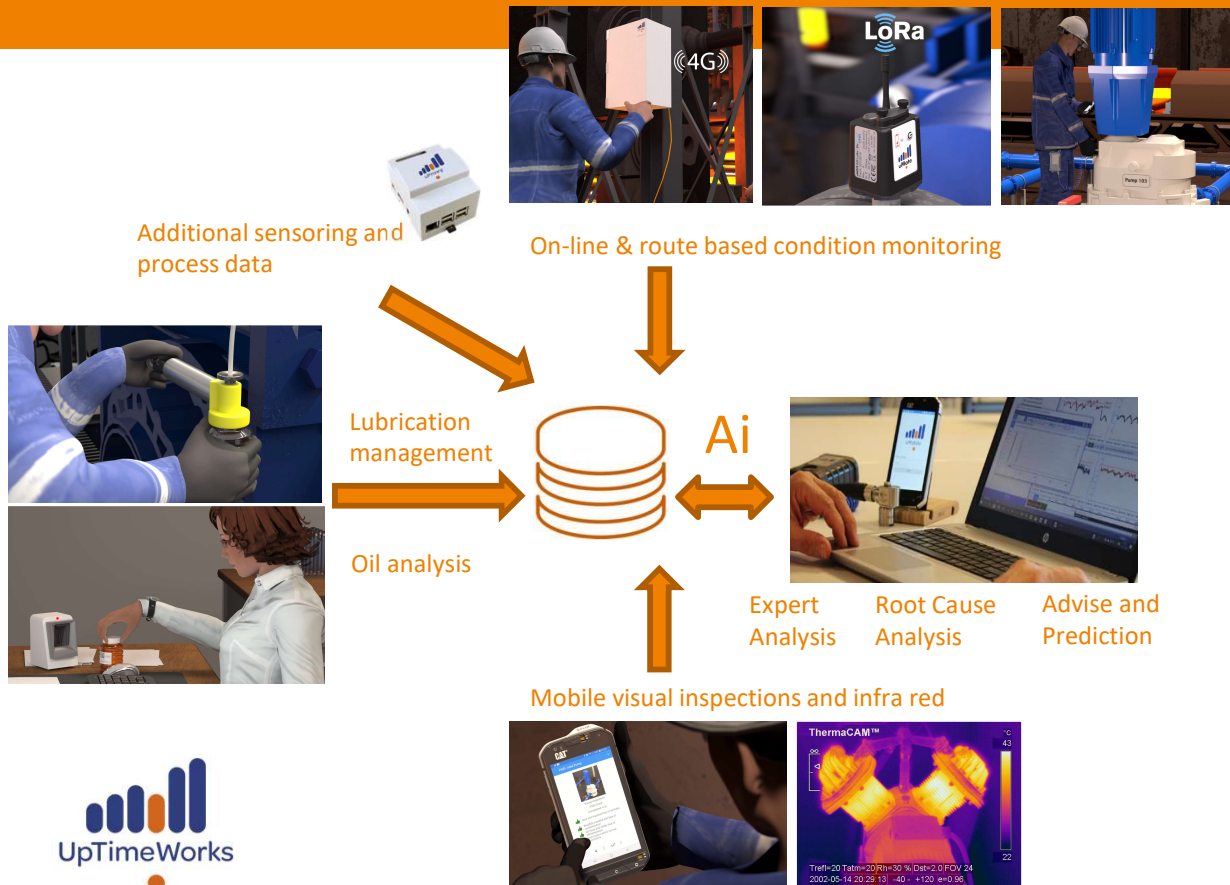
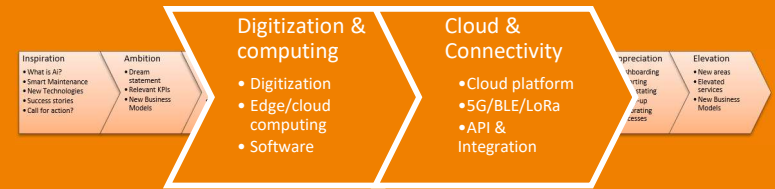
## PREDICTIVE MAINTENANCE

# Technology components to be considered





# Integrated Condition Monitoring



# Integrated Condition Monitoring



Additional sensing and process data

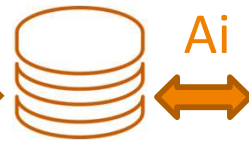


On-line & route based condition monitoring



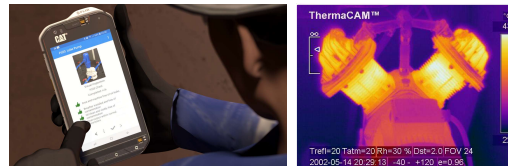
Lubrication management

Oil analysis



Expert Analysis    Root Cause Analysis    Advise and Prediction

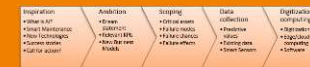
Mobile visual inspections and infra red



- Trend and Alarm reporting
- Expert analysis & advise
  - Repair
  - Modify
  - Maint. Concept
- Dashboarding
- Value reporting



# Waar ligt de waarde voor een Service-bedrijf?



## Elevation

- New Areas
- Elevated services
- New Business Models

## Regiewerk

1: inhuur  
technici  
(uren x tarief)

2: inhuur  
+uitvoering  
(uren x tarief)

## Projecten

3: inhuur  
+planning  
(unitprice-vastbedrag-  
/periode)

## Procesverantwoordelijk

4: Verantwoordelijk  
beschikbaarheid  
(bedrag/output)

5: Verantwoordelijk  
+ output  
(bedrag/output)



# From Uptime to OEE

Inspiration • Better data • More visualization • More technology • More people • Call for action	Ambition • Better • More • More • More • More	Strategy • Create value • Increase • Increase • Increase	Data collection • Increase • Increase • Increase	Digitalization • Increase • Increase • Increase
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## Elevation

- New Areas
- Elevated services
- New Business Models



**TECHPORT**

### KPI's (OEE):

Beschikbaarheid x Snelheid x Kwaliteit  
(Koudband en TSP)

### On-line meting van:

- Conditie: trilling, toerental en temperatuur op rollagering en aandrijving
- Slip: productsnelheid versus rol-snelheid (TSP)
- Gecombineerd met IBA data over procesoutput



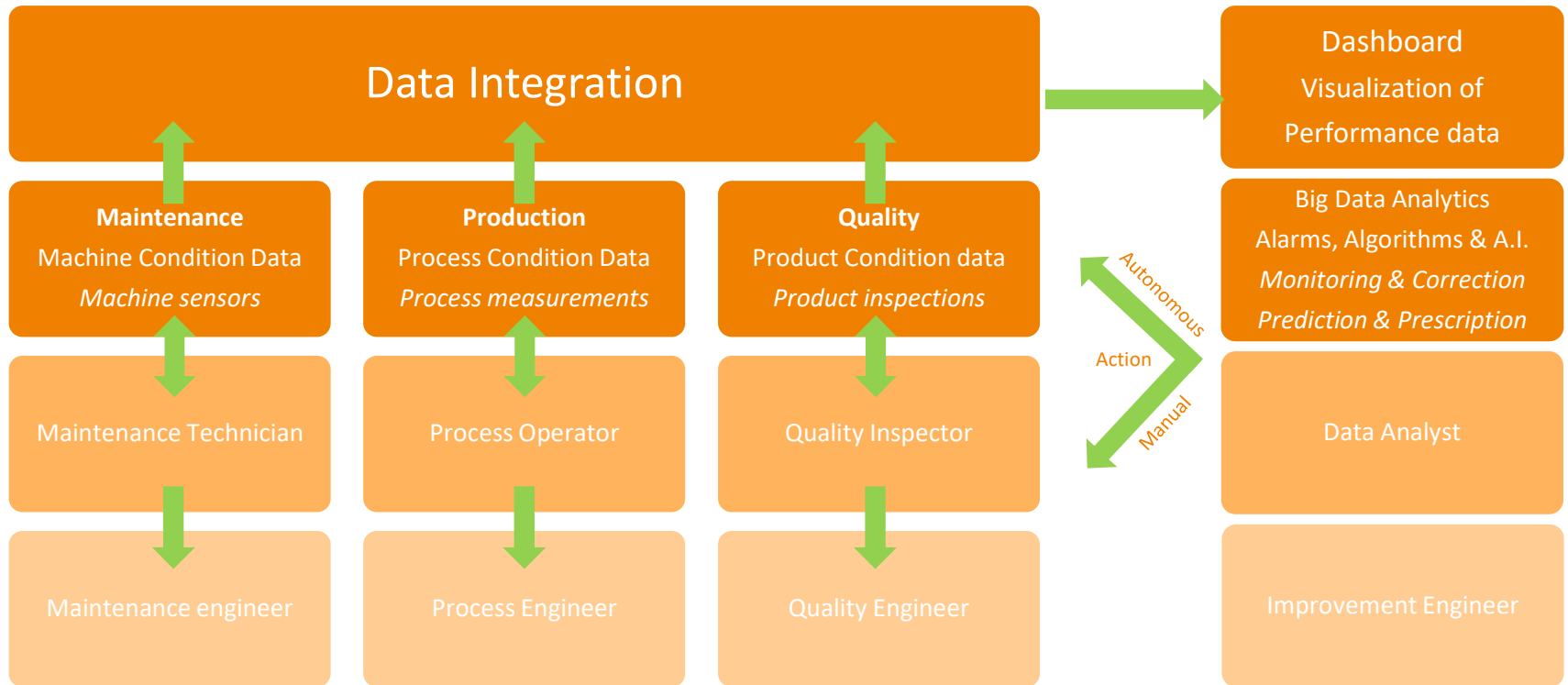


Vragen?



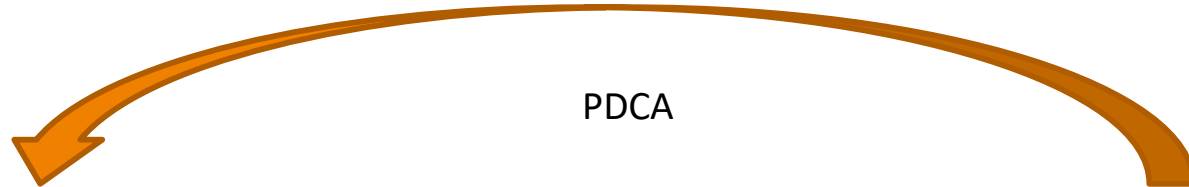
## OVERALL EQUIPMENT EFFECTIVENESS

# Big Data Optimizes OEE



## PREDICTIVE MAINTENANCE

# Ai Roadmap



Bedrijfskunde

Vakmanschap

Data engineering

Data Analytics/  
ML expert

Vakmanschap

Bedrijfskunde

# Vraag 1: Waar staat uw bedrijf?

*In welke stap van de roadmap is uw bedrijf?*





# Vraag 2: Wat heeft u nodig?

*Wat heeft u nodig om de volgende stap te zetten?*



PREDICTIVE MAINTENANCE

# Bedankt voor je aandacht!

Volg van het FME Platform AI for Industry ook een AI Deep Dive sessie over Predictive Maintenance

## Meer informatie:

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# FME AI FOR INDUSTRY JAAREVENT



**Bedankt voor  
je aandacht!**