Connected Horizons: Transforming Manufacturing with IIoT

Productie Proces Automatisering

25 januari 2024 | Van der Valk Hotel, Vianen

How to IIoT (verb) properly

1

Productie Proces Automatisering

25 januari 2024 | Van der Valk Hotel, Vianen

Begin with the End in Mind

- Steven R Covey

74% of companies considered their IoT projects to be unsuccessful in 2022.

State of Industrial IoT in July 2023

IOT ANALYTICS
MARKET INSIGHTS FOR THE INTERNET OF THINGS

Industrial IoT (IIoT) in 2023 is on the way to becoming mainstream:

66%

66% of industrial organizations reported they are executing an IoT strategy.

14%

IoT projects have a 14% higher success rate than five years ago.

50%

Common challenges have diminished by approximately 50%.

Build, buy, or buy and integrate?

1 Custom-build approach

Share of initiatives using this approach 47%

Advantages	Disadvantages
+ **Provides freedom to customize entire solution** + **Does not generate lock-in with any vendor** + Provides the opportunity to develop a unique solution that may provide a competitive advantage	- **Requires major in-house (IT) capabilities or a reliable partner** - **Typically leads to unpredictable costs** - Typically has the longest project timeline (from start to large-scale roll-out)

Bold = key considerations

ROI Time?

Share of initiatives exceeding expectations ★★★ 40%

2 Buy-and-integrate approach

Share of initiatives using this approach 38%

Advantages	Disadvantages
+ **Allows to combine proven technology with freedom to customize majority of the solution** + Is faster to set up (compared to custom- build) + Allows for shorter time-to-market (compared to custom-build) + Provides the ability to receive external support/maintenance for part of the solution	- **Requires management of multiple stakeholders (internal and external)** - Leads to increased solution complexity (compared to custom-build)

Share of initiatives exceeding expectations ★★★ 40%

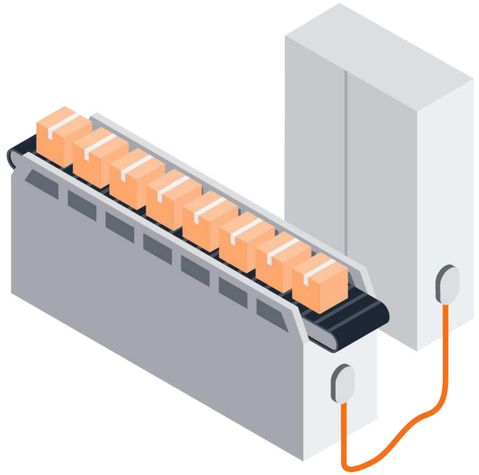
3 Buy approach*

Share of initiatives using this approach 14%

Advantages	Disadvantages
+ **Allows the usage of tested and proven technology** + **Provides the ability to receive external support/ maintenance for the entire solution** + Leads to predictable outcomes	- **Makes it difficult to integrate specific security requirements** - Has limited customization options - Does not provide ability to differentiate to gain a competitive advantage - Is difficult to integrate into own IT/OT architecture

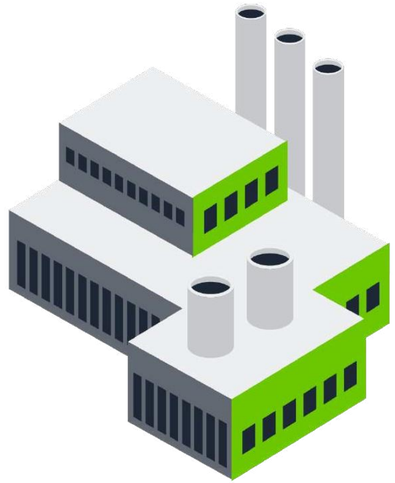
Share of initiatives exceeding expectations ★☆☆ 13%

Two Models for IIoT in Manufacturing



OEM: Create Value Added Services

- Predictive Maintenance as a Service
- Remote Machine Monitoring and Diagnostics
- Data Analytics and Machine Optimization Services
- Pay-per-Use Business Model



Manufacturer: Improve Efficiency

- Predictive Maintenance to reduce downtime
- Energy Optimization (WAGES)
- Quality Control and Real-time Analytics (Camera)

Predictive Maintenance Application

2

Evolution of Maintenance Applications

Reactive

Wait until it breaks

Preventative

Maintain it on regular intervals

Predictive

Threshold Alarms

Statistical Analysis

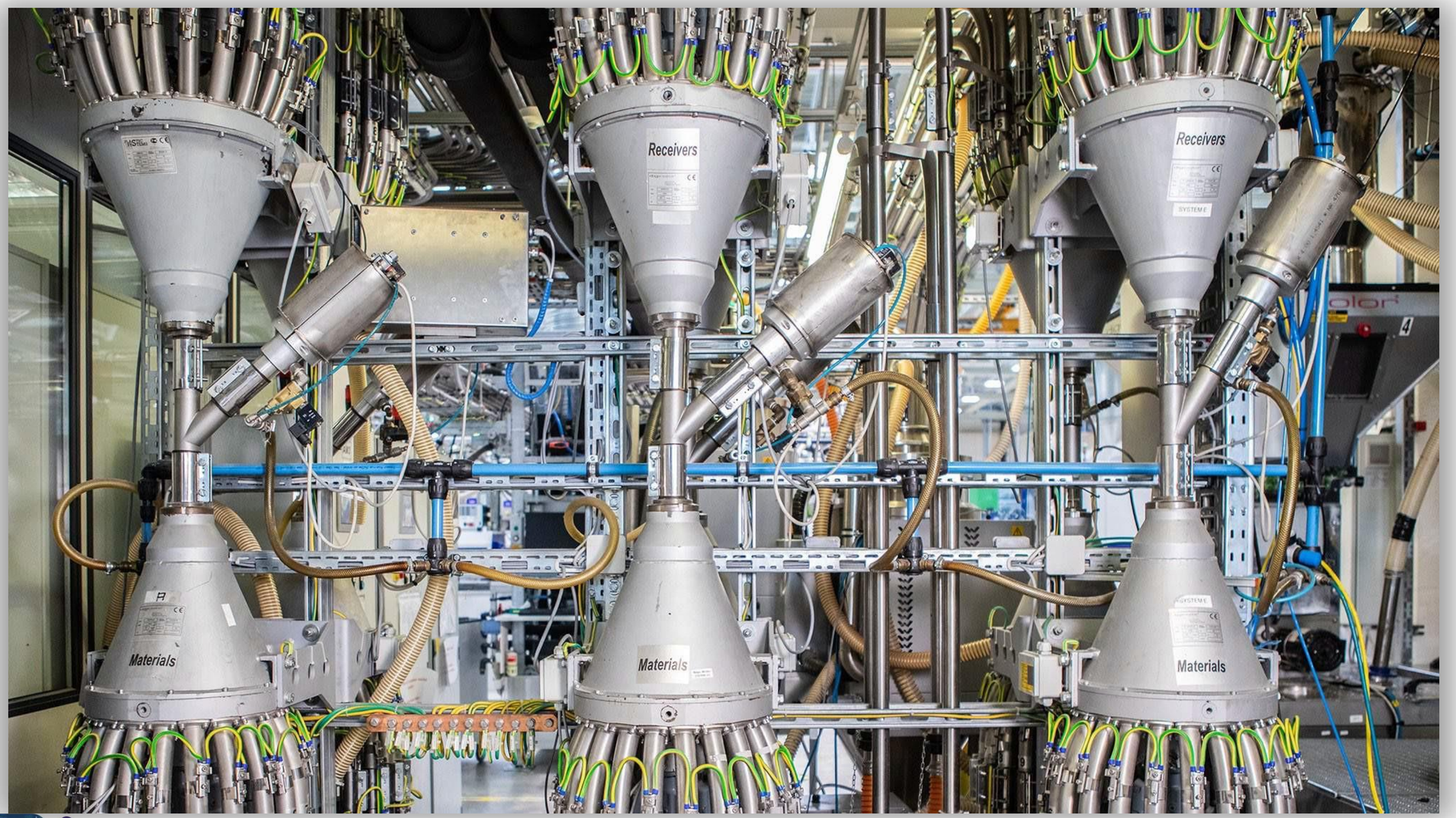
Machine Learning

Physics Based

Prescriptive

Automatically determine how to plan/prepare for failures

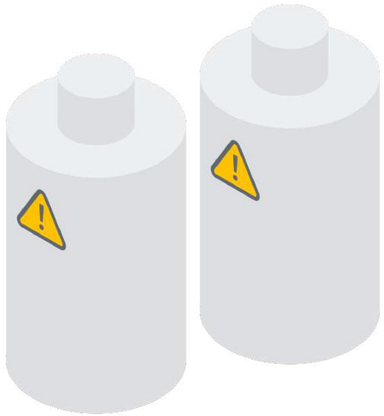
What is this?



Application: Predictive Filter Maintenance

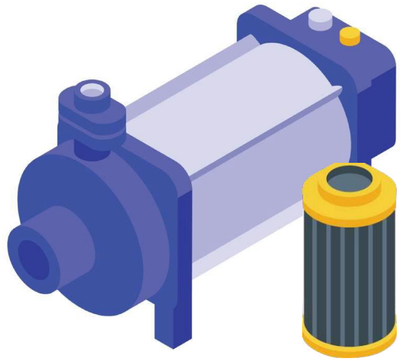
Plastic Transport System for Injection Molding:

1



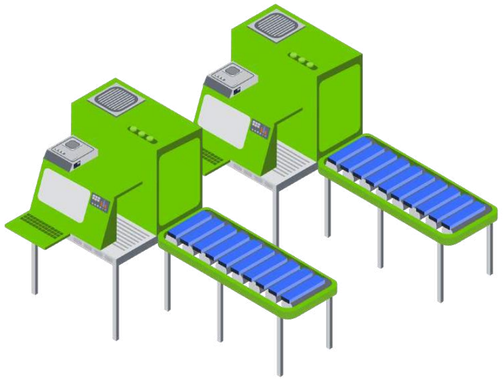
Plastic Bins

2



Vacuum Pump

3



Injection Molding Machines

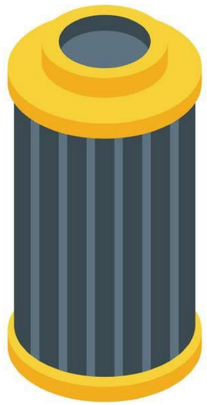
The Problem:

The vacuum pump filters must be cleaned regularly, but it is labor and time intensive.

If cleaned too soon, it is a waste of resources. If cleaned too late, production is affected.

Key Required Outcomes

1



Determine if and when pump filters should be cleaned to reduce cost and maximize uptime.

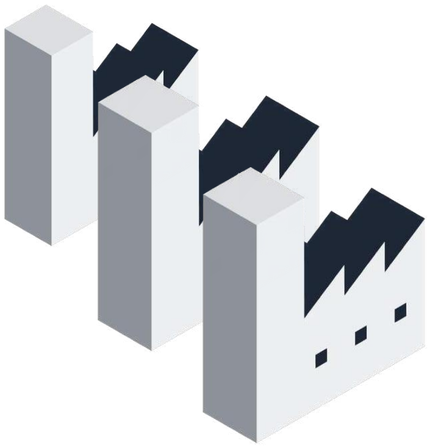
2

Provide visualization for local operators to see status.

3

Output an MQTT message from the system to trigger a work order in the ERP system.

4



The application must scale to multiple production sites.

Outcomes analytics project

Predicts filter performance, triggering a maintenance Work Order for optimum cleaning times, reducing costs, and increasing reliability.

=

Cost reductions and automation.

Detects faults in the material distribution system, reducing troubleshooting time by over 50%.

=

50%

Reduced troubleshooting time.

A dashboard displays the data and provides an instant overview of the process quality, system utilization, and capacity.

=

Increased visibility for production staff.

Niet beveiligd | 192.168.178.213:9000/#!/2/docker/containers

1. WAGO | 2. Demonstration | 3. Studie | 4. Trends | 5. Thuis | 6. Radio | TV

portainer.io COMMUNITY EDITION

Home

local

Dashboard
App Templates
Stacks
Containers
Images
Networks
Volumes
Events
Host

Settings

Users
Environments
Registries
Authentication logs
Notifications
Settings

New version available 2.16.2
Dismiss See what's new

portainer.io Community Edition 2.16.1 Upgrade

Containers

Container list

admin

Containers

Search... | Start | Stop | Kill | Restart | Pause | Resume | Remove | + Add container

Name	State	Filter	Quick Actions	Stack	Image	Created	IP Address	GPUs	Published Ports	Ownership
container-manager	running			data	container-manager:latest	2022-02-16 11:55:15	172.20.0.3	none	-	administrators
mqtt_broker	running			data	eclipse-mosquitto:1.6.13	2022-02-16 11:55:14	172.20.0.2	none	1883:1883 9001:9001	administrators
ntp	healthy			data	wagoanalytics/ntp:latest	2022-02-16 11:55:14	172.21.0.2	none	123:123	administrators
portainer	running			-	portainer/portainer:latest	2022-11-19 22:04:16	172.17.0.3	none	8000:8000 9000:9000	administrators
wago_PLC_PRG.oAnomalyDetectio...	running			-	wagoanalytics/onnx_classifier:latest	2022-07-26 12:17:46	172.17.0.4	none	3306:3306 33060:33060	administrators
wago_PLC_PRG.oGrafana.oGeneri...	running			-	wagoanalytics/grafana:latest	2022-07-26 12:17:13	172.17.0.2	none	5000:3000	administrators

Items per page 10

Productie Proces Automatisering

25 januari 2024 | Van der Valk Hotel, Vianen

Predictive maintenance roadmap

2.1

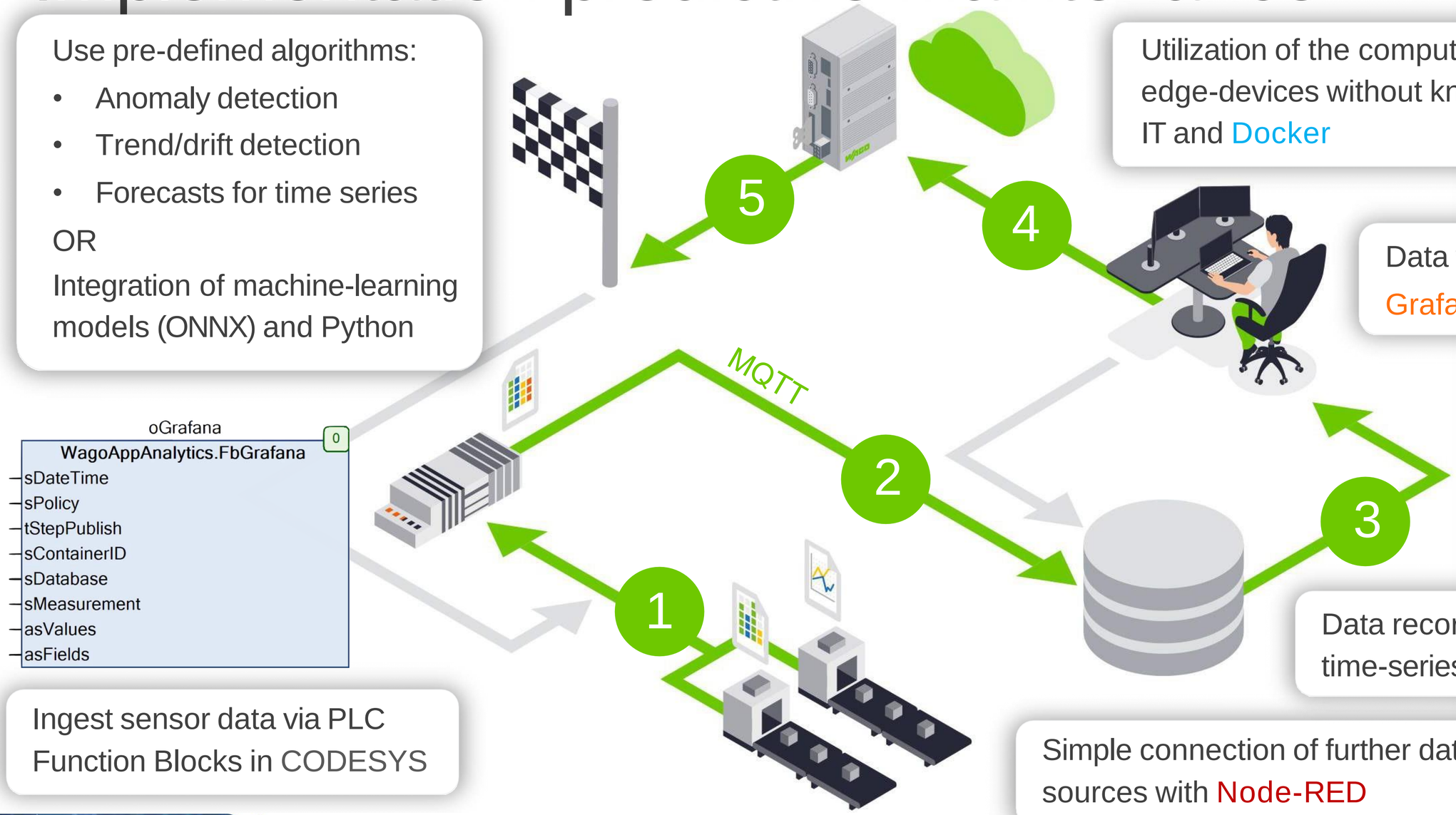
Implementation predictive maintenance

Use pre-defined algorithms:

- Anomaly detection
- Trend/drift detection
- Forecasts for time series

OR

Integration of machine-learning models (ONNX) and Python



Utilization of the computing power of edge-devices without knowledge about IT and Docker

Data visualization with Grafana dashboards

Data recording with **InfluxDB** time-series database

Ingest sensor data via PLC Function Blocks in CODESYS

Simple connection of further data sources with Node-RED

IoT key technology and trends from multiple industries

Edge computing: Processing data closer to the source, rather than in a centralized cloud.

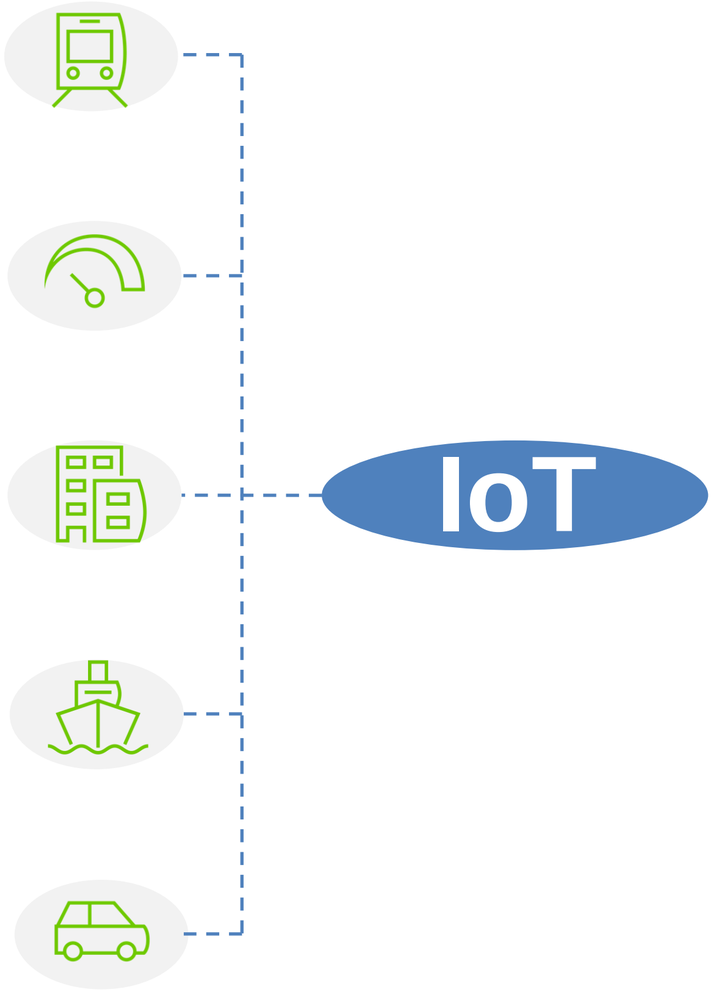
Artificial Intelligence (AI) and Machine Learning (ML): Improving data analysis and decision-making in IoT applications. Examples include AI-based Quality Control in production lines (machine vision) and predictive maintenance and diagnostics for various types of production facilities and process industries.

Security: Ensuring the security of IoT devices and data, as they increasingly become targets for cyber attacks.

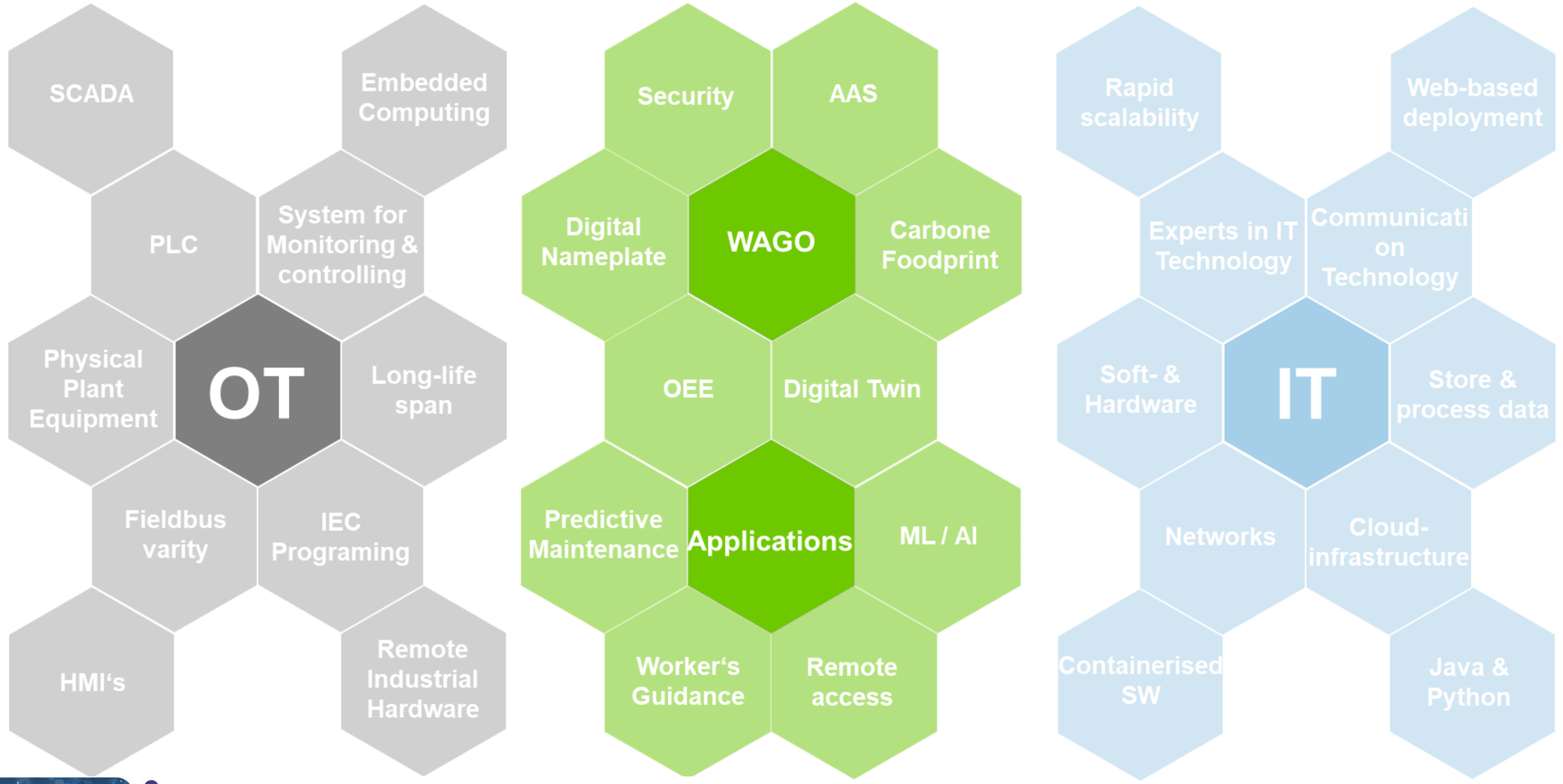
Interoperability: Allowing devices from different manufacturers to communicate with each other seamlessly.

Building Automation: Automating various tasks in homes and buildings for increased convenience and energy efficiency.

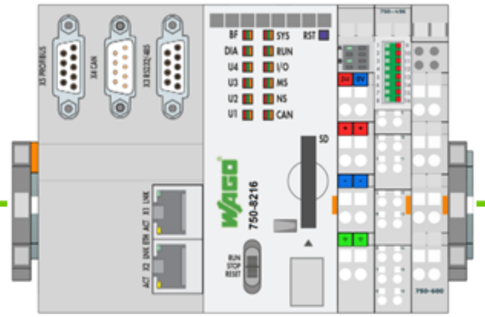
Low-Power Wireless Sensors: LoRaWAN (Long Range Wide Area Network), Bluetooth LE (Low Energy), and others for smart building and smart city applications.



A Bridge between OT and IT



A Bridge between OT and IT



CODESYS

python

BINS

LIBS

DATA

docker

HOST OPERATING SYSTEM

INFRASTRUCTURE

Output Data to Other Platforms with Docker

Programming

Node-RED

CODESYS

C C++ python

Operating Systems

Ubuntu

debian

Red Hat

Databases

influxdb

MySQL

Web Interface

React

ANGULAR

Cloud Services

aws

Azure

Local Visualization

Grafana

CODESYS

Node-RED

Edge Management

docker

kubernetes

portainer.io

Device Management

Prescient

JFrog

Cloud SCADA/Dashboard

ubidots

Ignition! by inductive automation

Distributed Code

Prescient

aws

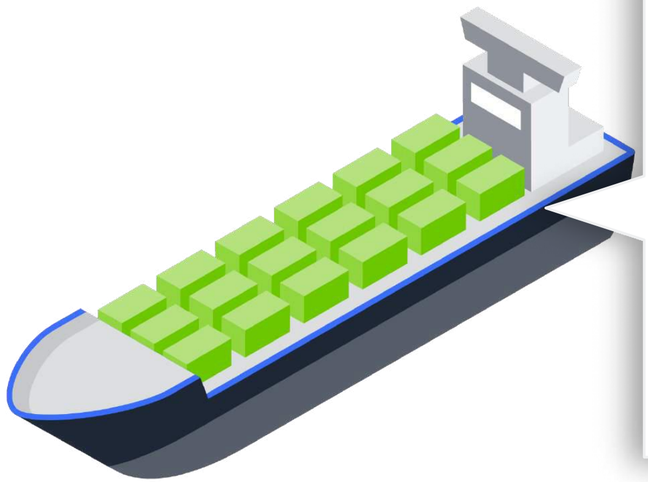
Version Control

git

Co-Creation

WAGO | IoT Partner

Other Applications with predictive maintenance

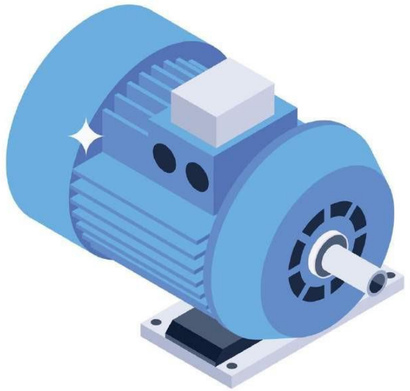


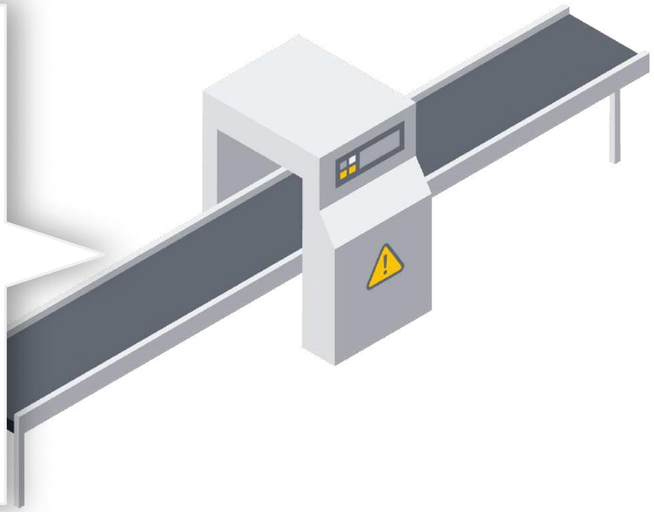
Marine Vessel: Engine Predictive Maintenance

- Vibration, RPM, Temperature
- Anomaly detection, drift detection

Food Processing: Motor Predictive Maintenance

- Vibration, temperature, current
- Anomaly detection, drift detection





On-prem vs. Cloud

2.2

AWS Lookout for Equipment: Higher Accuracy

	WAGO Analytics	Lookout for Equipment
Deployment Model	On-Prem training and deployment.	Cloud training and deployment.
Features	Data preprocessing, anomaly detection, trend/drift detection, forecasts for time series.	Data preprocessing, model training, real-time anomaly detection, and integration with other AWS services.
Industrial Integration	WAGO PLC offers many options for industrial fieldbus communications like Ethernet/IP, Modbus TCP, Profinet, EtherCat, IO-Link.	Data can be sent from a PLC to SQL or InfluxDB then connected to AWS S3 Bucket. Can use a WAGO PLC or Edge Computer.
Machine Learning Algorithm	Incremental Machine Learning leveraging nearest neighbors, decision trees, naïve Bayes.	LSTM (Long Short-Term Memory) networks for time-series data analysis. Neural network-based, higher accuracy.
Cost	Support: Free. License: $600 per device, one-time. Starter Kit: License, PLC, and CPU for $2000.	Support: Various paid plans. Data ingestion, model training, and inference usage fees. AWS offers a pricing tool online.
Time to Start	Depends on what you are monitoring. Can be from a few minutes to a day.	Can take up to a few months.

Diederick Nab
diederick.nab@wago.com
https://nl.linkedin.com/in/diedericknab