Master di I livello

INDUSTRY 4.0 DESIGN

Enterprise Digitalization and 4.0 Technologies

INDUSTRIAL IOT


FACTORY ON INTERNET
LINE 0374
STATUS OFF
HOURS TO NEXT MAINTENANCE 96 h
STATUS ON
HOURS TO NEXT MAINTENANCE 327 h
LINE 0374
STATUS UNDER MAINTENANCE
HOURS TO NEXT MAINTENANCE NOW
LINE 0376
ENERGY CONSUMPTION 45 kwh
VIBRATION LEVEL MEDIUM
OIL LEVEL OK
WORKING HOURS 10 h
LINE 0377
STATUS ON
HOURS TO NEXT MAINTENANCE 238 h
ENERGY CONSUMPTION 41 kwh
VIBRATION LEVEL LOW
OIL LEVEL OK
WORKING HOURS 6 h
LINE 0378
STATUS ON
HOURS TO NEXT MAINTENANCE 112 h
DASHBOARD
LINE 0377
ON
SETTINGS
STATISTICS
STATUS ON
HOURS TO NEXT MAINTENANCE 238 h
VIBRATION LEVEL MEDIUM
OIL LEVEL OK
ENERGY CONSUMPTION 45 kwh
WORKING HOURS 10 h
DA IOT A INDUSTRIAL IOT – MASTER 4.0 20-21 - DANIELE MAZZEI - ALL RIGHTS RESERVED
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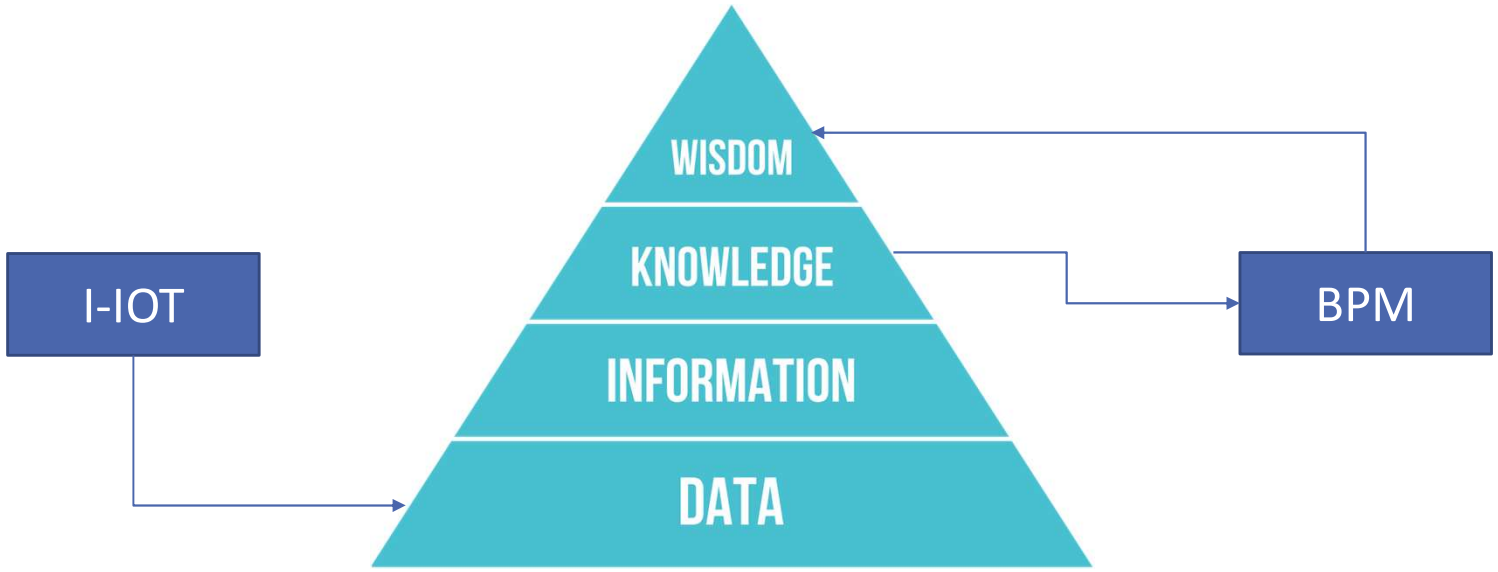
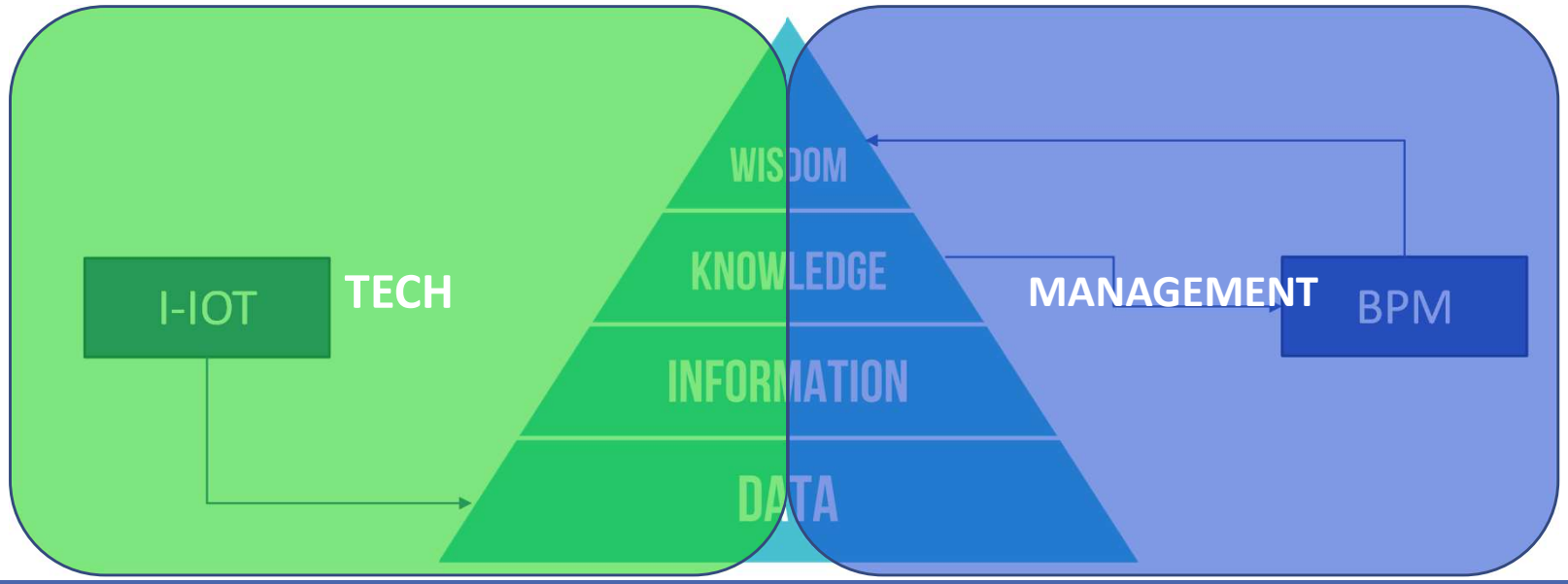
INDUSTRIAL IOT

IOT in FACTORY (I-IOT)



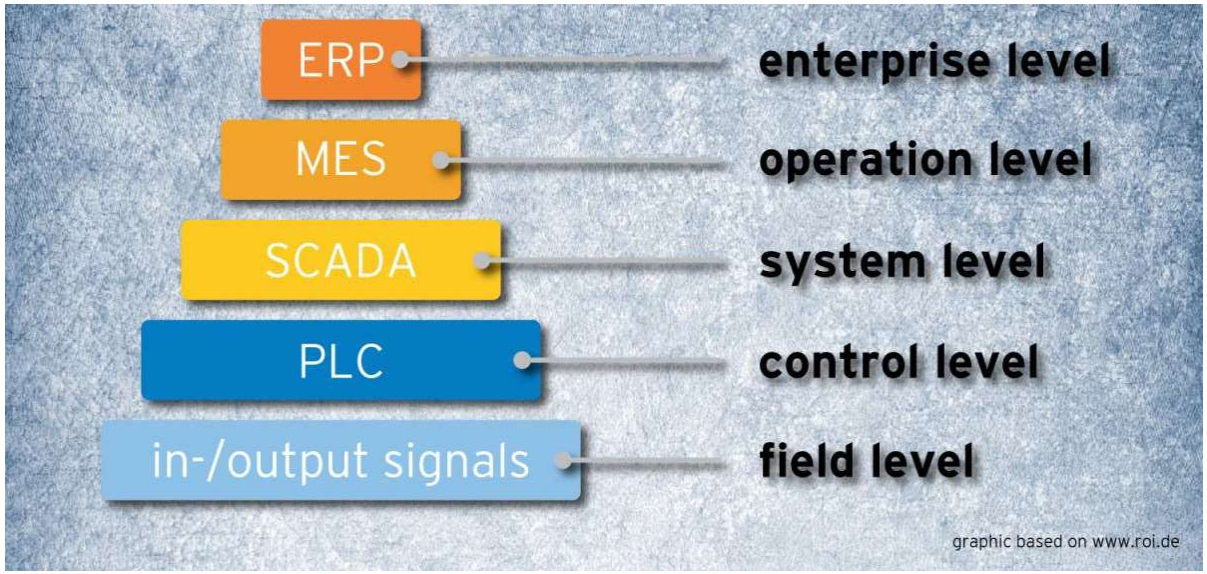
IOT in Business Process Management

TECH and MANAGEMENT departments must bridge their visions and identify common needs



INDUSTRIAL INTERNET OF THINGS FOR 4.0

THE TYPICAL AUTOMATION ARCHITECTURE



THE TYPICAL AUTOMATION ARCHITECTURE

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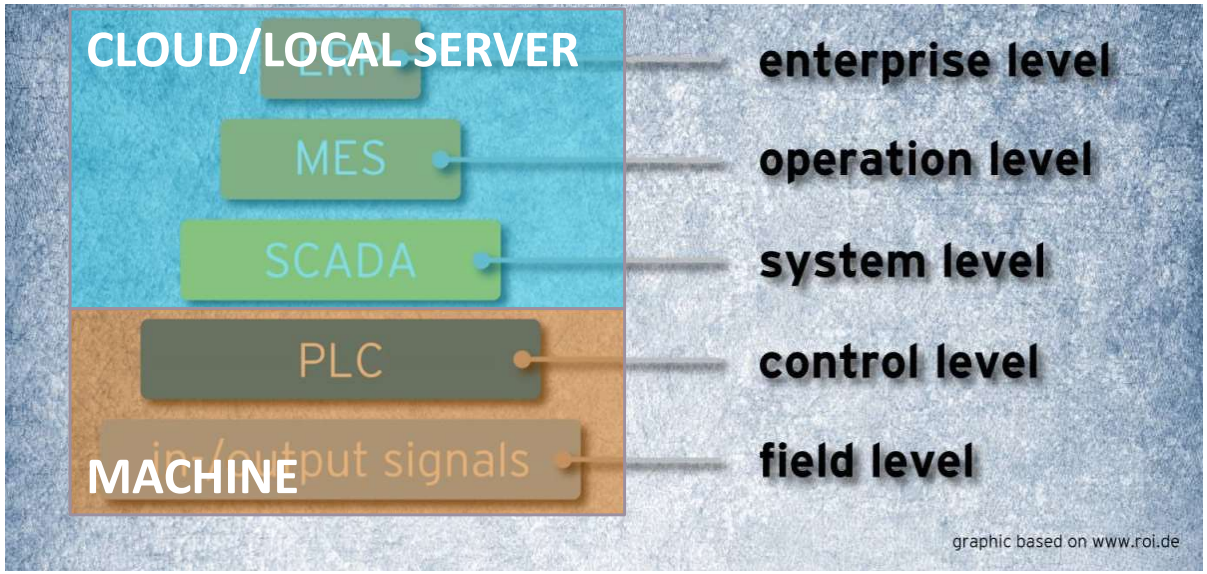

THE TYPICAL AUTOMATION ARCHITECTURE

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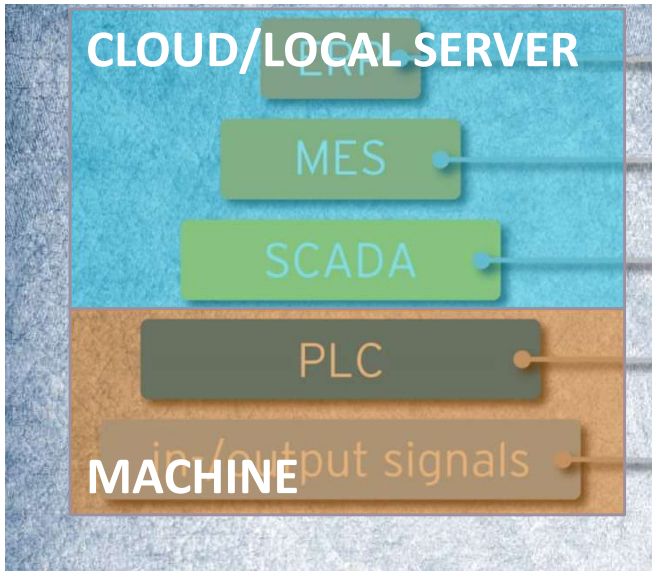
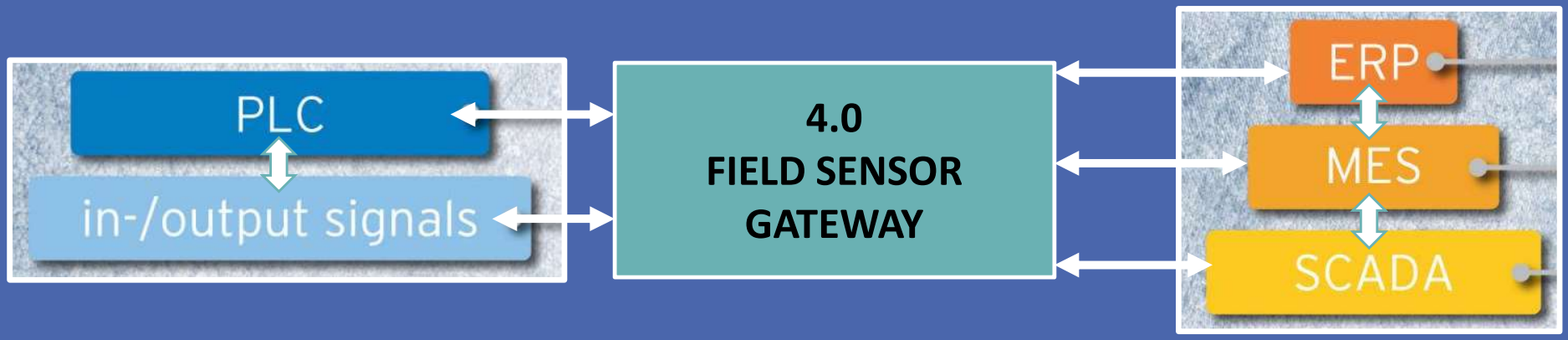


Limitations:

- Every system only exchanges data with the adjacent levels
- PLC not connected to the Internet;
- PLC firmware are typically not available/maintained by the company;
- Different world regions different PLC vendors for the same machine;
- Different PLC different interfaces;
- Custom PLC data gathering solutions do not scale;

THE 4.0 PARADIGM

IN THIS MODERN APPROACH EACH SYSTEM IS DECOPLUED FROM THE ADJACENT LEVELS



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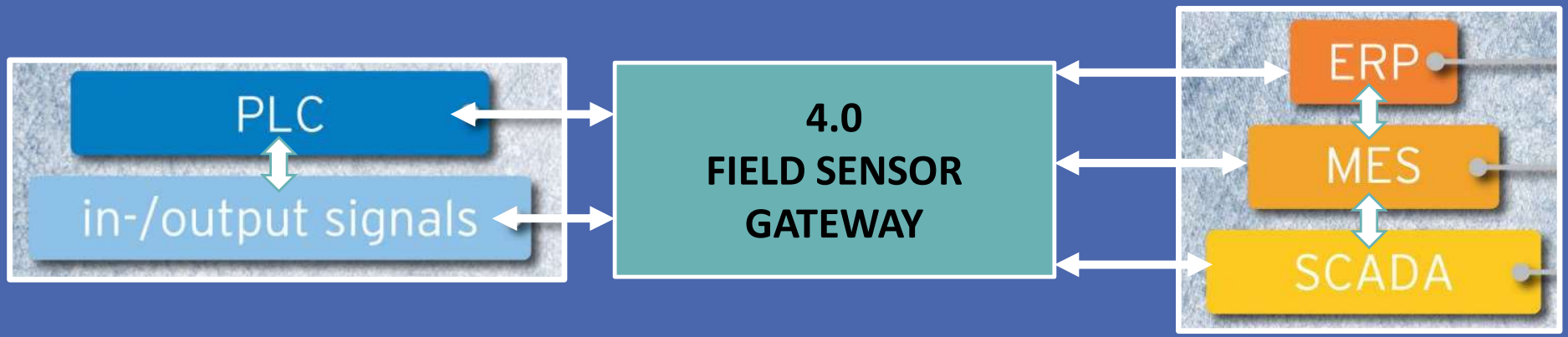


OT – OPERATION TECHNOLOGY

IT – INFORMATION TECHNOLOGY

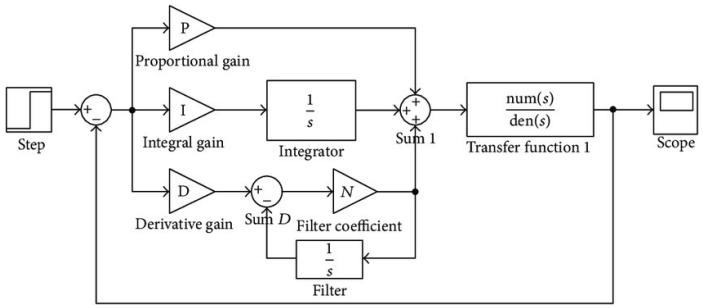
OT Operation Technology

Le reti industriali M2M sono nate per gestire il “controllo” di apparati. Sono quindi progettate per avere basse latenze, ricezione garantita di pacchetti e comportamento certo ed affidabile. Il perché di questa struttura è intrinseco nella funzione a cui le reti M2M devono assolvere: controllare una macchina vuol dire agire sul mondo fisico attraverso segnali digitali. Se qualcosa va storto, non è possibile cliccare su “*undo*”!

Questa tipologia di rete è nota nel mondo industriale come **OT**. In OT il digitale funge solo da mezzo di trasferimento veloce e immateriale di informazioni fisiche.

Un tornio a controllo numerico invierà sulla rete la velocità di rotazione del proprio mandrino perché fisicamente ha un mandrino. Un tornio non manderà mai sulla rete OT la stima delle ore di moto previste per il mese successivo.

OT Operation Technology



Nell'OT viene digitalizzato solo ciò che esiste e lo si fa in maniera lineare, così da consentire un'immediata associazione fra variabile digitale e suo corrispondente fisico. I **PLC** (Programmable Logic Controller) utilizzati per il controllo delle macchine industriali, mappano, tramite componenti hardware dedicate, i segnali acquisiti dai sensori in variabili scritte nel database. I PLC sono dei digitalizzatori della realtà fisica.

Il programmatore di PLC si limita a scrivere un algoritmo di controllo che a ogni passo, letti i segnali fisici provenienti dai sensori, modifica lo stato degli attuatori e quindi il mondo fisico in cui la macchina opera.

Il programma di un PLC lega ingressi e uscite attraverso un modello che è dato dalla natura fisica della macchina e che potrebbe essere replicato anche grazie a complessi circuiti elettrici analogici. Molte macchine industriali potrebbero infatti essere controllate, come si faceva negli anni 70-80, con soli cavi e componenti elettroniche discrete e analogiche.

In sintesi, il PLC è un digitalizzatore di modelli di controllo fisici.

PLC

A programmable logic controller (PLC), is an industrial digital computer which has been ruggedized and adapted for the control of manufacturing processes, such as assembly lines, or robotic devices, or any activity that requires high reliability control and ease of programming and process fault diagnosis.

IT Information Technology

La rete IT è ben diversa da quella OT. Nel mondo di Internet, la maggior parte dei dati non hanno un corrispondente fisico. Le variabili rappresentano idee presenti nella mente dei programmatori che poi vengono dotate di significato grazie alla creazione di un modello concettuale anch'esso definito dal programmatore.

Il modello concettuale è la descrizione estremamente semplificata di un sistema. Per esempio, i file organizzati in cartelle del nostro computer sono solamente un'illusione che i programmatori hanno deciso di dare agli utenti per rappresentare le informazioni digitali in maniera simile a come è organizzato un archivio cartaceo o una libreria. Lo hanno fatto per consentirci di utilizzare una tecnologia molto complessa in maniera semplice ed intuitiva.

IT Information Technology

Questa dicotomia fra presenza di modello fisico o di modello concettuale porta a ciò che nella comunità informatica è noto come “symbol grounding problem”. Nell’OT i dati rappresentano sempre una realtà fisica, nell’IT è spesso vero il contrario. Questa differenza di vedute e modelli è all’origine della difficile convivenza fra OT e IT.

Nelle reti OT i simboli presenti nei programmi (variabili) hanno una rappresentazione fisica chiara e diretta perché legate a sensori fisici realmente presenti nella macchina industriale. Nel mondo IT non c’è invece corrispondenza fra variabili del programma e realtà fisica. Le variabili rappresentano solamente degli elementi di appoggio per la gestione dei dati che hanno significato solo nella mente del programmatore e servono solamente all’implementazione dell’algoritmo nella forma in cui il programmatore lo ha pensato.

Ogni programmatore può scrivere un software diverso per implementare lo stesso algoritmo e possono esistere diversi algoritmi per modellare lo stesso fenomeno o gestire lo stesso processo.

OT vs IT

La tecnologia IT non è adatta al controllo industriale, non è stata progettata per questo e non è necessario sforzarsi per adattarla.

Non è possibile controllare una taglierina industriale a cui lavorano degli operatori tramite un modello software completamente slegato dalla realtà fisica. Diventa complesso garantire la sicurezza degli operatori e avere garanzie sul comportamento degli apparati. Una taglierina deve avere un sistema di sicurezza che è gestito a hardware dal controllo macchina ed è quindi immune da errori di programmazione e hackeraggi.

OT vs IT

Pensiamo per un attimo a un frullatore. L'unico modo per garantire la sicurezza dell'operatore è rendere impossibile l'accensione del motore se il tappo non è inserito. Per fare questo esiste un solo modo sicuro e garantito: inserire un interruttore che scollega il motore se il coperchio non è inserito. La presenza fisica del coperchio va quindi a perturbare lo stato dell'interruttore interrompendo la connessione con il motore, non c'è nessun algoritmo da inventare. Qualsiasi altra soluzione software non potrà mai garantire lo stesso livello di sicurezza.

INTEGRAZIONE

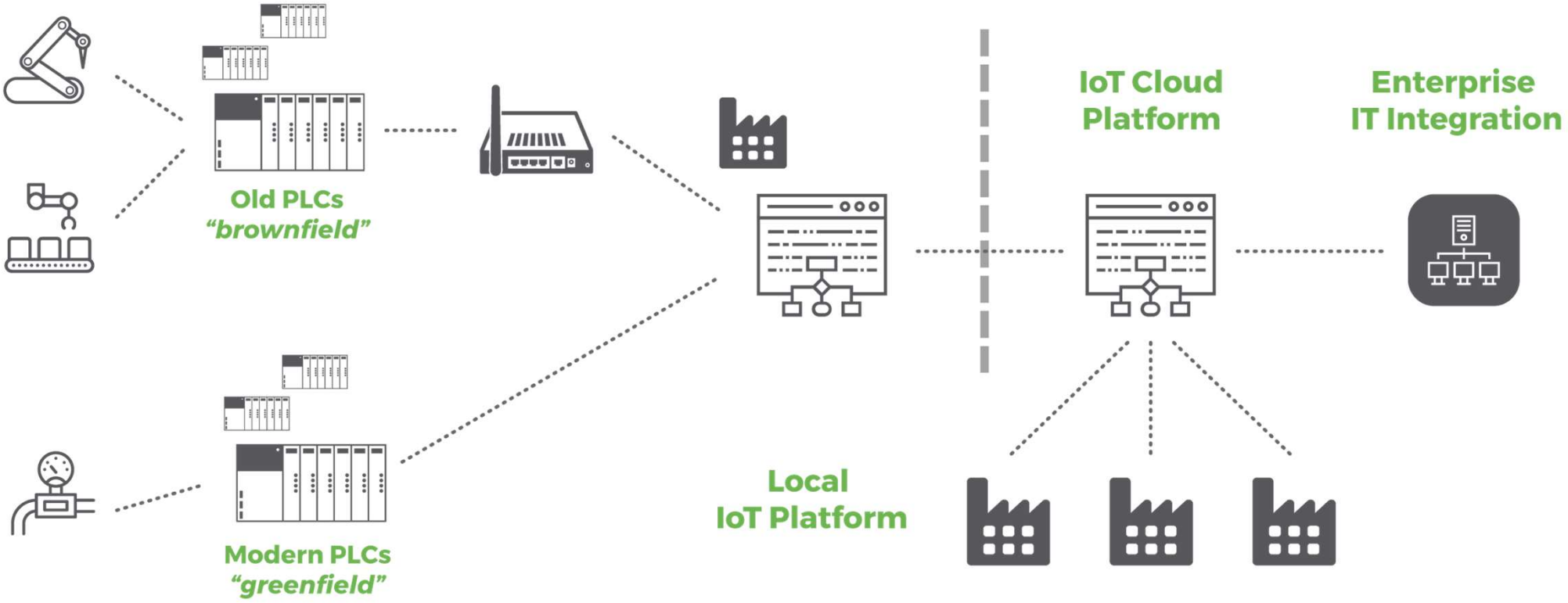
Il 4.0 si fa con l'integrazione fra IT e OT

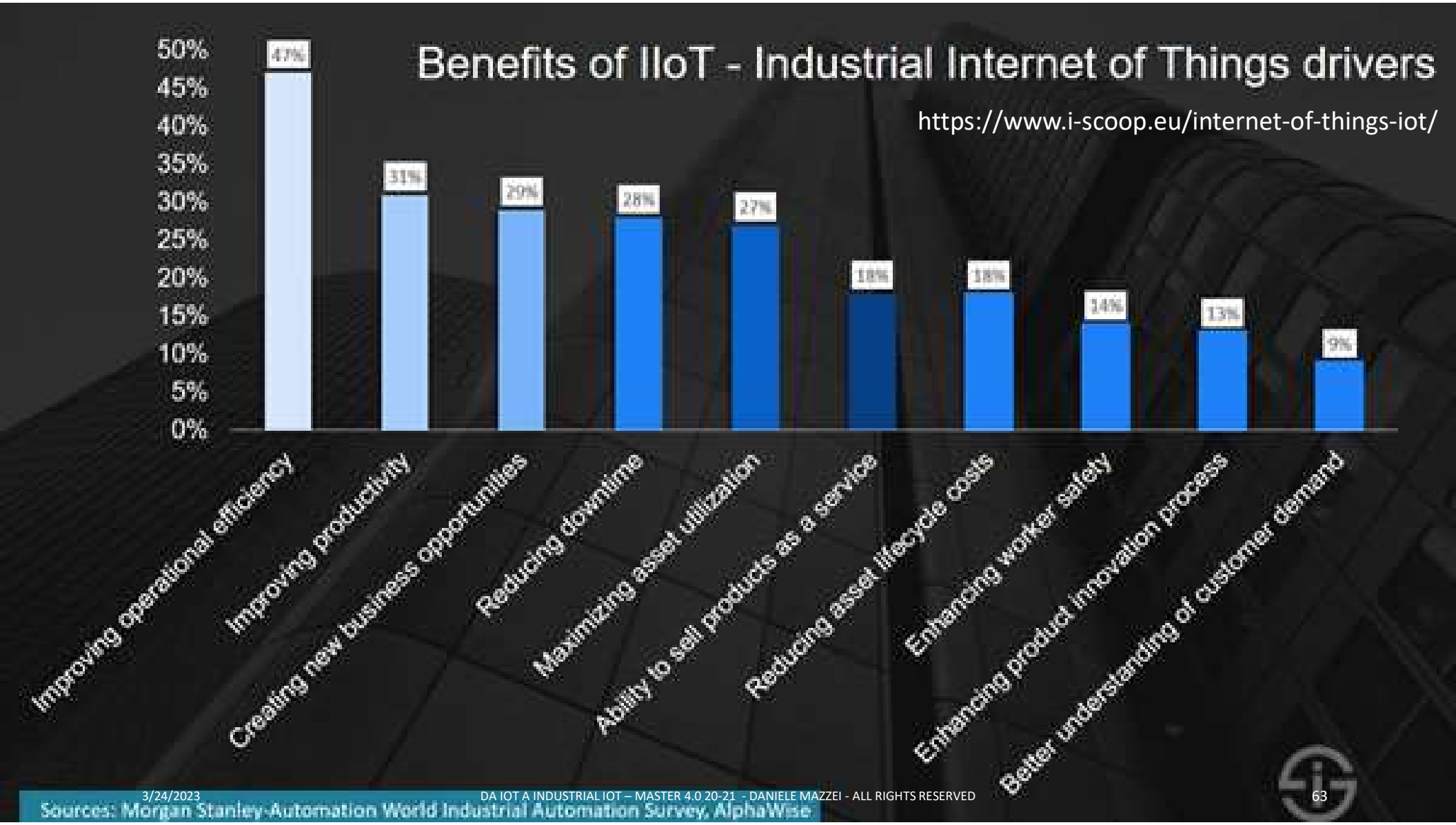
Le imprese 4.0 integreranno tecnologia IT con quella OT andando a creare reti multilivello in cui ogni strato è gestito con la tecnologia più opportuna. In questo scenario, la tecnologia IT verrà utilizzata soprattutto per uniformare la comunicazione fra i livelli e fra le varie reti OT, aventi strutture e protocolli diversi.

L'integrazione di tecnologie IT, come l'Internet delle cose, nel mondo industriale non è quindi un processo puramente tecnologico, **il fatto che oggi ci sia molta tecnologia IT di tipo consumer, pronta all'uso, non rende automatico il processo di evoluzione delle reti industriali verso un modello ibrido.**

IOT industrial gateway

I gateway IOT industriali servono a questo. Sono dei nodi di interfacciamento fra OT e IT. Un gateway IOT parla da un lato la lingua dell'OT, traduce questi segnali continui e legati al fisico in segnali adatti all'IT e quindi legati al modello concettuale con il quale si sta astraendo la fabbrica e poi li invia nella rete IT. L'internet of things industriale porterà quindi le potenzialità del mondo IT in industria, traghettando l'azienda oltre il paradigma del fisico e introducendo così il famoso "digital twin".


IoT Cloud Platform
Enterprise IT Integration
Old PLCs
"brownfield"
Local IoT Platform
Modern PLCs
"greenfield"


Benefits of IIoT - Industrial Internet of Things drivers
https://www.i-scoop.eu/internet-of-things-iot/
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
47%
31%
29%
28%
27%
18%
18%
14%
13%
9%
Improving operational efficiency
Improving productivity
Creating new business opportunities
Reducing downtime
Maximizing asset utilization
Ability to sell products as a service
Reducing asset lifecycle costs
Enhancing worker safety
Enhancing product innovation process
Better understanding of customer demand
Sources: Morgan Stanley-Automation World Industrial Automation Survey, AlphaWise

USE CASES

By Zerynth

Zerynth

Armal

Industrial IoT for production monitoring

Armal chose Zerynth to implement a **remote monitoring IoT system** for energy production and consumption.

The Challenges

- Optimize the energy consumption of the entire production line.
- Automatically calculate the quantity of products manufactured per machine.
- Reduce defective components, downtime, and maintenance costs.

The Solution

- Industrial machine digitization in a minimally-invasive retrofit mode with no machine replacement.
- Real-time machinery consumption monitoring for the production cycle and power system.
- Custom dashboards to constantly monitor the status of production.

Find more use cases on https://www.zerynth.com/customers/case-studies/

Zerynth

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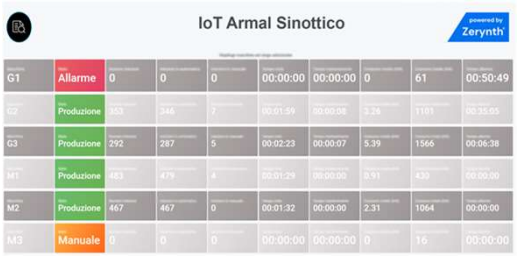

Results

20 YEARS — Average machine age to digitize

40% — Reduction in energy consumption

4 MONTHS — Return on Investment

Find more use cases on https://www.zerynth.com/customers/case-studies/

Zerynth

vitesco TECHNOLOGIES

Industrial IoT for automotive components

Vitesco **reduced machines' downtime** with Zerynth's Industrial IoT platform, and they are now able to **predict malfunctions** of pneumatic valves within 24 hours.

The Challenges

- Reduce downtime of the final test module in an automotive fuel injector assembly line.
- Remotely monitor the state of each assembly line's test module.
- Minimize false-negative results of module damage.
- Decrease manual diagnostics and intervention.

The Solution

- On-premise IIoT system for real-time monitoring and predictive maintenance.
- 24 hours advance prediction of valve / sealing element failure.
- Custom dashboard.
- Maintenance database and email server for real-time push notifications.

Find more use cases on https://www.zerynth.com/customers/case-studies/

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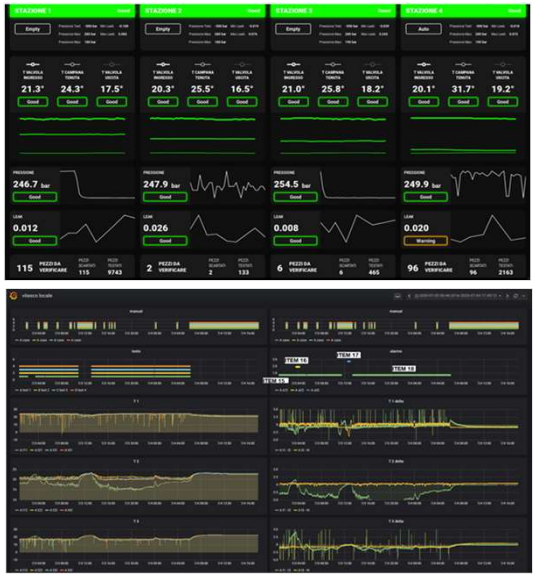

The Results

<6 MONTHS	Implementation time
24 h	Malfunctions prediction
€€€	Savings from false-negative scrap detection

Find more use cases on https://www.zerynth.com/customers/case-studies/

Zerynth

ROBOTSYSTEM automation

IoT Machine transformation

RSA **bundled their machines** with **Zerynth** IoT technology and saw **business soar**.

The Challenges

- Implement a remote monitoring system for mask production machines.
- Obtain the incentives from the Italian tax program.
- Measure and control energy consumption.
- Estimate operation speeds in a cost-effective manner.

The Solution

- IoT system developed to monitor the machinery parameters.
- Machinery compliant with the "Industry 4.0" Italian tax incentives.
- Monitor heterogeneous data sources such as generic industrial sensors, dedicated output devices, etc.
- Exchanging data with the end-customer's software.

Find more use cases on https://www.zerynth.com/customers/case-studies/

ROBOTSYSTEM
automation

IoT Machine transformation

RSA **bundled their machines** with **Zerynth** IoT technology and saw **business soar**.

The Results

<2 MONTHS	Implementation time
1	New business line
15%	Revenue Increase

Find more use cases on https://www.zerynth.com/customers/case-studies/

Zerynth

SCAPIGLIATO

IoT for the Waste Industry

Scapigliato is now able to **monitor leachate wells** and their biogas energy production plants.

The Challenges

- Improve the management of leachate wells with remote and real-time monitoring.
- Monitor the biogas production process.
- Report data collected from the plant.

The Solution

- IoT system to monitor 32 leachate wells and the biogas production process in real time.
- Data processing on-the-edge for GSM-enabled devices.
- Data visualization and analytics through an easy to use dashboard.

Find more use cases on https://www.zerynth.com/customers/case-studies/

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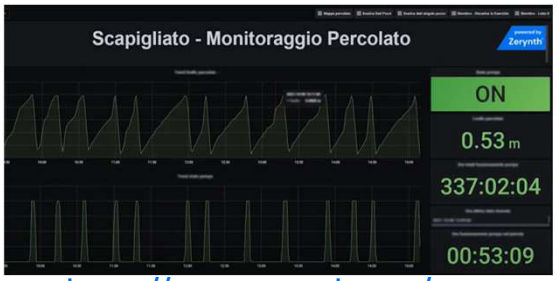

The Results

32	Wells monitored in real time
12%	Reduction in operating costs
<2 MONTHS	Implementation time

Find more use cases on https://www.zerynth.com/customers/case-studies/

Zerynth

Smart Warehousing

Zerynth empowered a warehouse company with a **non-invasive IoT solution** for smart warehousing systems

The Challenges

- Product sorting, optimization, and breakdown prediction.
- Energy consumption control.
- Real-time monitoring.
- Non-invasive mode of technology's integration.
- Visibility and efficiency improvement.

The Solution

- IoT monitoring system in a retrofitted mode.
- Real-time detection of conveyor belt overload.
- Detection of wear on barcode labels and scanners.
- Predictive maintenance and real-time alerts.
- Data visualization and analytics.

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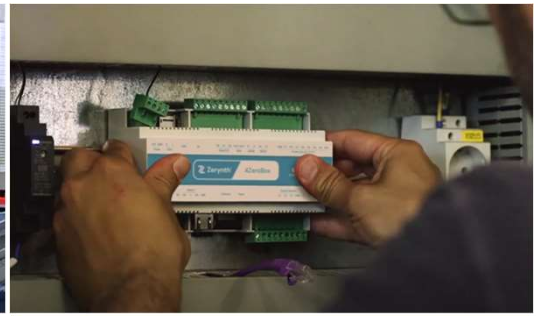

The Results

- **30%** Decrease in energy consumption
- **24/7** Real-time monitoring of conveyor belt overload
- **100%** Malfunction prediction

Find more use cases on https://www.zerynth.com/customers/case-studies/

Zerynth

IoT Production Monitoring in the factory of the future LEF

Remote monitoring of legacy and new generation industrial machinery, asset management not covered by the internet, optimization, and production maintenance.

The challenges

- Digitize both the old and new generation machines with a non-invasive solution.
- Reduce defective components and anomalies with a minimum installation period.
- Disengage from machinery manufacturer vendor lock-in.

The solution

- Complete digitalization of machinery with a homogeneous view between brownfield and greenfield setups.
- 100% anomaly detection with less than 30 minute downtime for single machines.
- Real-time energy consumption monitoring and visualization of all active machines on custom dashboards.

Find more use cases on https://www.zerynth.com/customers/case-studies/

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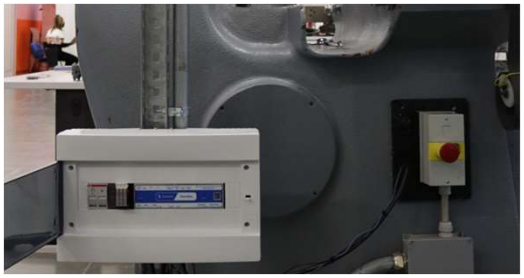

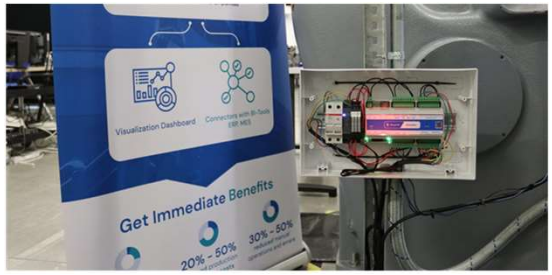

LEF buildings

Asset	Actual Status	Last Cycle Time	Cycles	Total consumption
Legacy Cutter	Standby	00:20:43	20	67.2 kWh
Legacy CNC	Working	00:15:30	88	176.9 Wh
Modern Cutter	Standby	00:07:30	45	56.34 kWh
Modern CNC	Working	00:12:33	120	201.7 Wh

Results

100% Brownfield and greenfield coverage

3h Connection of 4 machines at 2 different sites

24/7 Remote and real time monitoring

Find more use cases on https://www.zerynth.com/customers/case-studies/

Seares

Innovative IoT Mooring System

Zerynth enabled Seares to release on the market an innovative IoT mooring system ensuring a fast development time and affordable costs

The Challenges

- Monitor mechanical deterioration.
- Lack of onboard battery charging.
- Remotely monitor the system on the boat.
- Noisiness and oscillation in mooring systems.

The Solution

- Producing energy from waves induced motion and provides real-time information via GSM.
- Complete remote management with high security standards.
- Continually monitoring the selected values.
- Automatic report generation.

Find more use cases on https://www.zerynth.com/customers/case-studies/

Zerynth

Seares

Innovative IoT Mooring System

Zerynth enabled Seares to release on the market an innovative IoT mooring system ensuring a fast development time and affordable costs

The Results

+12%	Increased Revenue
24/7	Real-time monitoring of parameters
-10%	Development time

Find more use cases on https://www.zerynth.com/customers/case-studies/

Zerynth

BAGLIONI CONDIZIONAMENTO REFRIGERAZIONE

Digitalized Industrial Refrigeration

Baglioni cut costs, improved efficiency and digitalized their refrigeration system with Zerynth

The Challenges

- Reduce maintenance costs.
- Control Energy consumption.
- Improve efficiency of systems.
- Remote monitoring.
- Meet compliance regulations.

The Solution

- Expanded business offer to the customers.
- Real-time monitoring of the refrigeration components.
- Predictive maintenance, real-time alerts.
- Custom reporting.

Find more use cases on https://www.zerynth.com/customers/case-studies/

Zerynth

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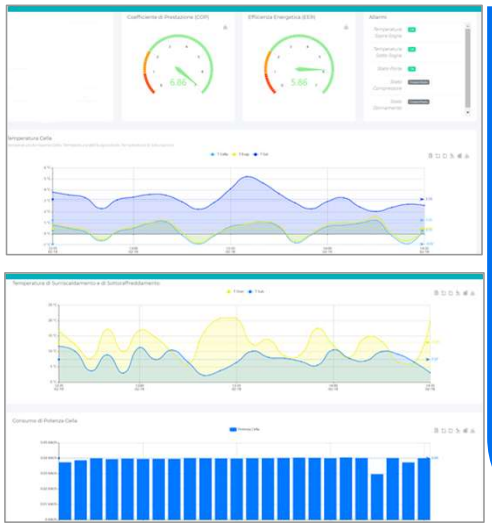

The Results

<6	Months implementation
+60%	IoT-Enabled Machines
-20%	System Downtime

Find more use cases on https://www.zerynth.com/customers/case-studies/

Pierucci agricoltura

Smart Agriculture

Zerynth empowered Pierucci with the IoT technology to optimize plant production efficiency, monitor cultivation health parameters, and cut consumption costs.

The Challenges

- Increase productivity by optimizing fertilizer use.
- Decrease manual operations to reduce cultivation costs.
- Reduce water and energy consumption.

The Solution

- IoT platform for real-time monitoring of cultivation health (salinity, humidity, substrate temperature and watering time).
- Continuous monitoring of consumption and system functionality (water and power consumption, fertilizer level).
- Data visualization and analytics through an easy-to-use dashboard accessible from any device.

Find more use cases on https://www.zerynth.com/customers/case-studies/

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Smart Agriculture

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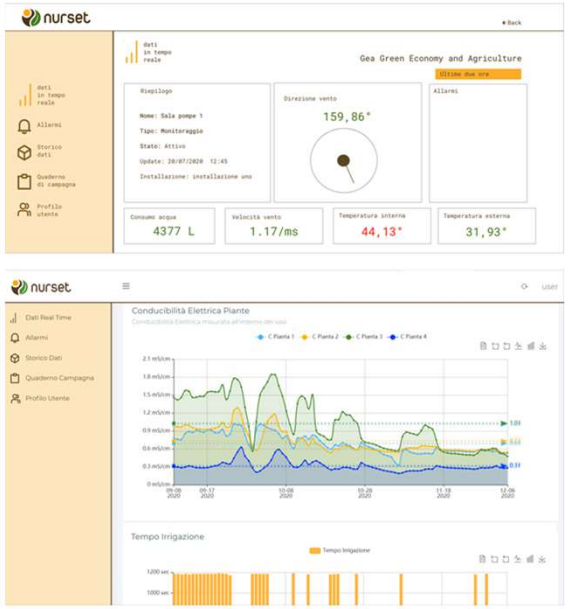

The Results

2 x Cultivation growth optimization

20% Water and power consumption savings

30% Savings from on-site visits

Find more use cases on https://www.zerynth.com/customers/case-studies/

MEGA DIAMANT

IoT technology for workplace safety

Zerynth supported Mega Diamant in ensuring safety in marble quarries thanks to IoT technology.

The Challenges

- Track the parameters of machines that are located in remote places.
- Create an IoT solution with non-invasive implementation into machines.
- Replace Arduino products with cost-effective technology to analyse the energy efficiency in real-time.
- Eliminate the unplanned response equipment malfunction and failure.

The Solution

- A complete IoT solution to monitor machine energy consumption parameters.
- 24/7 real-time notification for taking better data decisions using custom dashboards.
- Cost savings from optimizing data footprint collection.
- An innovative IoT device for worldwide residential and industrial applications.

Find more use cases on https://www.zerynth.com/customers/case-studies/

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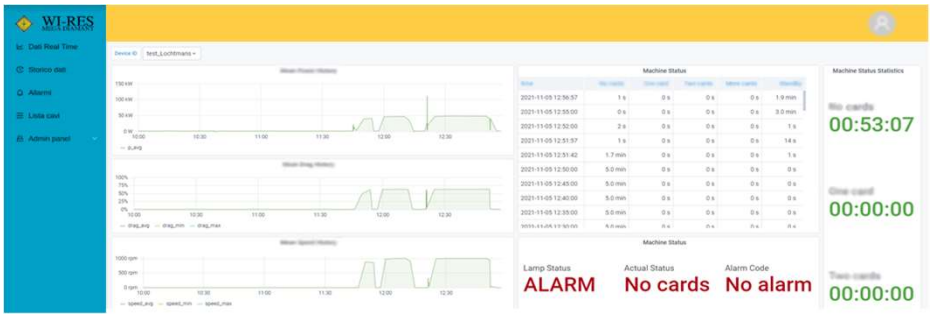
IoT technology for workplace safety

Zerynth supported Mega Diamant in ensuring safety in marble quarries thanks to IoT technology.



The Results

30% Machine damage risk reduction

24h Real-time diamond wire performance monitoring

30% Assistance and revision time saved

Zerynth

Plant monitoring and energy consumption

IoT technology enables **environmental sustainability** by monitoring ventilation systems and energy consumption.

The Challenges

- Monitor energy consumption.
- Limit bad smells inside the systems.
- Purify and treat the air coming from the sheds.
- Monitor the level of liquid waste tanks.
- Monitor the environmental parameters of the plants.

The Solution

- Current sensors for monitoring electrical panels.
- Alarm notifications for controlling the opening of doors to the sheds in order to contain the dispersion of odors.
- Continuous monitoring of consumption and correct operation of the systems.
- Remote control of the waste storage process to make emptying logistics more efficient.

Find more use cases on https://www.zerynth.com/customers/case-studies/

Zerynth

Esa Spa
ELBANA SERVIZI AMBIENTALI

Plant monitoring and energy consumption

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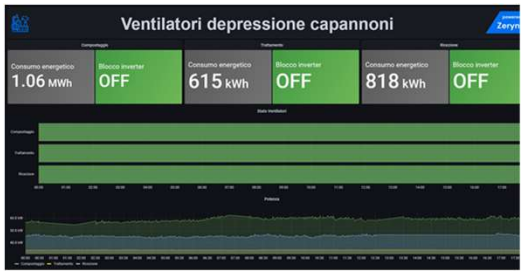

The Results

24/7	Monitoring of odor emissions from plants
9	Systems monitored and interconnected
100%	Compliant with the sustainability report

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Zerynth

Monitoring of production, set-up times and machinery downtime

Interconnection and monitoring of energy consumption of all machinery in the industrial plant of an engineering company.

The Challenges

- Monitor set-up times and machinery downtimes
- Monitor the progress of production
- Ensure greater usability of the data
- Improve integration between machine data and the management software already present at the company

The Solution

- Installation of the Zerynth IoT Platform for monitoring both brownfield and greenfield machinery.
- Visualization via dashboard of machine status, set up times and machinery downtimes.
- Use of the Industrial IoT APP for asset monitoring.
- Direct interaction with the management system and remote configuration of machine parameters.

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Zerynth

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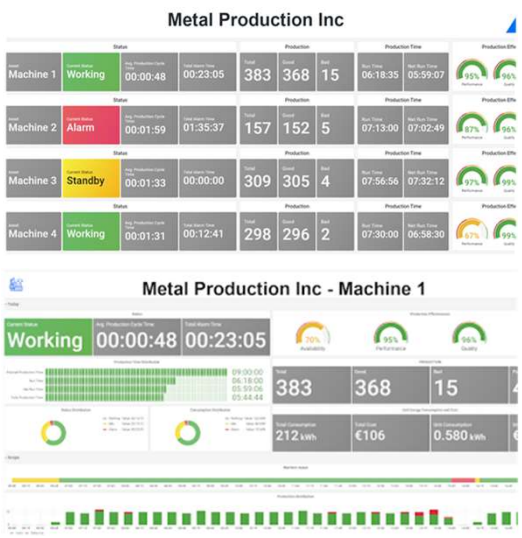

The Results

35	Machines connected at two plants
10%	Reduction in set-up times
15%	Reduction of downtimes

Find more use cases on https://www.zerynth.com/customers/case-studies/

Zerynth

Visibility and tracking of production processes for the fashion industry

Utilizing IoT technology to streamline production processes by offering complete visibility into orders, product quality, and machinery maintenance, resulting in increased efficiency.

The Challenges

- Monitor legacy machinery of different types with custom production for each customer
- Track orders in the production chain in real time
- Estimate the quality of the pieces produced
- Reduce waste and downtime
- Gain visibility across the entire production line
- Gain visibility into energy consumption and costs
- Support maintenance management

The Solution

- Interconnection of legacy machinery in different plants
- Use of barcode readers for real-time tracking of orders and management of machinery maintenance
- IoT solution for monitoring energy consumption and costs

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Zerynth

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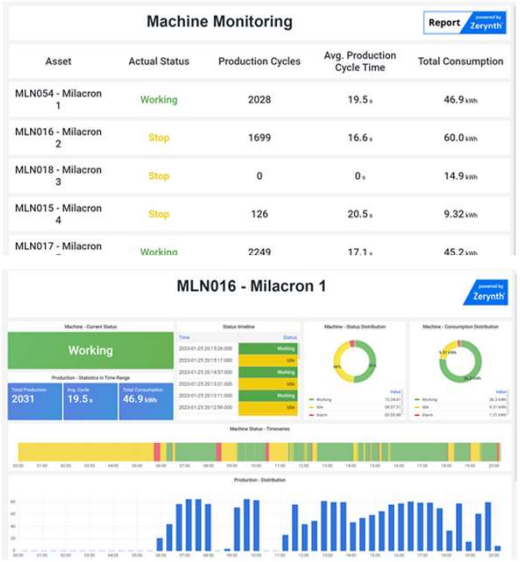

The Results

- Complete production visibility and OEE calculation per machine
- Visibility on the quality of the pieces produced
- Maintenance management support

Find more use cases on https://www.zerynth.com/customers/case-studies/