Reactive Maintenance

Machine is **used to its limits until it breaks.** Replaced only after machine failure.

- Expensive
- Inefficient
- Safety concerns

We rely on a wide range of machines that must be maintained if we do not want them to break down.

Preventive Maintenace

Prevent failure by performing regular checks.

- **Uncertain** optimal moment for maintenance
- Early maintenance **wastes machine life** that is still usable
- Adds to **costs**

Predictive Maintenance

If you can **monitor** the performance and condition of equipment during normal operation and establish a series of parameters, it is possible to predict when failures are likely to occur. And thus, maintenance can be scheduled at the optimal point.

- Estimate time to failure
- Pinpoint problems in the machinery system
- Identify what parts need to be fixed
- Minimize downtime
- Maximize equipment lifespan

PROBLEM for iIoT massive deployment in the industry 4.0

Wired networks

- High **CAPEX** and lots of hardware required

- Not flexible in upgrading and maintaining

VS.

Wireless sensor networks (IoT)

- **Rapid deployment and flexibility**

- **Low wireless coverage** due to energy limit

- **Need complex and costly** infrastructure

- **Hard to maintain** (frequent battery replacement, process stop, personnel costs)

- **Not sustainable** → Battery env. impact

- **Not suitable for explosive environments** and **heat-intensity facilities** (iron & steel & aluminum & copper, cement, paper, ceramics, etc)

The **Massive Costs** of Lithium-Ion Batteries

Batteries get drained and need to be replaced periodically (in particular in heat-intense environments), which means a high recurrent cost for the companies and a huge maintenance problem.

Lithium-ion batteries are increasingly being preferred for energy storage solutions as we move from fossil fuels to more sustainable, yet unreliable, alternative sources of energy.

They have become an indispensable commodity of our modern lifes. However, they have big environmental, unethical, health and long-run implications for businesses and the society.

The Future of IoT Cannot be Powered by Batteries

South America's "Lithium Triangle"

Takes about 65% of the region's
Huge negative impact on local farmers and communities
Invasive process that destroys the
landscape and destroys and
pollutes the earth
Release of toxic gases when
overheated. Risk of explosion, e.g.
Samsung

Toxic Lithium Leaks
2016 Tagong, China

Toxic and Hazardous Materials

Cobalt and Nikel extracted by child-miners
Expensive minerals (high demand) yet DRC
Is one of the

Cobalt Crisis in Congo

Linked to Heart Problems, Impaired
hearing, Eye Disturbances
Hard-Metal Disease
DNA damage
In a trillion-sensor world, we will need to
make about 913,242,009 battery
replacements every day, assuming a
conservative battery life estimate of 5 years.

Associated to Permanent DNA Damage

High replacement Costs

Explosive Environments,
difficult-access locations...

In Many Cases, it is NOT an Option

Introduction to the energy harvesting space technology principle

Heat conversion to energy

Indu-eye Battery-less Wireless Heat Powered IoT

Link to animation

AEInnova's Technology

- Vibrations & temperature monitoring for predictive maintenance

- Working from 50ºC heat

- Batteryless

- Easy to install & free of maintenance

- Suitable for explosive environments (ATEX) and heat intensive facilities (aluminum & iron & steel & copper)

- Long-range coverage (NB-IOT & LoRa)

- Edge-computing capabilities

- Low data latency

- Tested in big industrial players in the EU

IND-UEYE

Battery-less sensor

The wireless iIoT device:
- IP67
- CE Mark
- Wireless long range:
  - LoRaWAN (up to 14Km)
  - NB-IOT / LTE-M (up to 22km)
- No battery, no maintenance
- Digital sensor bus interface
- Edge computing (FFT, Filters...)
- *ATEX (ongoing)*

The thermoelectric generator:
- IP67
- CE Mark
- Working from 50ºC - 150ºC (at least 25ºC Delta T between hot surface and ambient temperature)
- No battery, no maintenance
- *ATEX (ongoing)*

The sensor:
- 3 Axis vibration (TDK electronics)
  - Up to 4G / 0.01G sensibility
- Temperature (up to 1000ºC)
- *Any industrial 4/20mA / Modbus sensor (in Q2-2022)*

Demonstration at ADIPEC 2021

Link to demonstration

Demonstration at MWC 2021

Link to demonstration

USE CASES

HEAT POWERED

PREDICTIVE MAINTENANCE & CONDITION MONITORING (Vibration / temperature)

- Pumps & Compressors

- Steam Traps

- Cranes

- Chimneys & Filters

- Motors & Engines

Vibration monitor

VIBRATION ON A DRYER IN A **PAPER PLANT**

MAIN FEATURES

- Low infrastructure: INDU-EYE → LoRaWAN Gateway → DAEVIS
- Long range coverage: 40 m
- Parameters:
  - One vibration device for :
    - Monitor: 3-axis vibration
    - Precision: 0.008g
    - Max vibration: ±4g
- Heat source: 90ºC .

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Alternative
Energy Innovations

Vibration monitor

MAIN FEATURES

- Low infrastructure: INDU-EYE → LoRaWAN Gateway → DAEVIS
- Long range coverage: 900m
- Parameters:
    - Monitor: 3-axis vibration
    - Precision: 0.01g
    - Max vibration: ±4g
- Heat source: 60ºC

Vibration monitor

PUMP MONITORING TO PREVENT FAILURES IN AN **OIL REFINERY**

MAIN FEATURES

- Low infrastructure: INDU-EYE → NB-IOT Network → DAEVIS
- Long range coverage: Unlimited
- Parameters:
  - Monitor: 3-axis vibration
  - Precision: 0.01g
  - Max vibration: ±4g
- Heat source: 98ºC
- Edge computing:
  - FFT spectral analysis (1,000 frequencies per every axis).

1. Thermal Battery
2. 3 Axis accelerometer
3. Wireless node

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Alternative
Energy Innovations

Vibration & Temperature

VIBRATION AND TEMPERATURE IN A **BIOGAS PLANT**

MAIN FEATURES

- Low infrastructure: INDU-EYE → LoRaWAN Gateway → DAEVIS
- Long range coverage: 400m
- Parameters:
  - Two vibration devices for motors and pumps:
    - Monitor: 3-axis vibration
    - Precision: 0.008g
    - Max vibration: ±4g
- Heat source: 60ºC – 120ºC

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Energy Innovations

Vibration monitor

MAIN FEATURES

o Low infrastructure: INDU-EYE → LoRaWAN protocol → DAEVIS

o Long range coverage: Up to 2Km

o Heat source: 90ºC

o Parameters: Vibrations

   o Monitor: 3-axis vibration

   o Precision: 0.01g

   o Max vibration: ±4g

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Vibration monitor

MAIN FEATURES

- Low infrastructure: INDU-EYE → NB-IOT protocol → DAEVIS

- Long range coverage: Up to 22 Km

- Heat source: 70ºC

- Parameters: Vibrations

  - Monitor: 3-axis vibration

  - Precision: 0.01g

  - Max vibration: ±4g

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Alternative
Energy Innovations

Vibration Monitor

VIBRATION MONITORING ON RECIRCULATION TURBINE IN A **CHEMICAL FACILITY**

MAIN FEATURES

- Low infrastructure: INDU-EYE → LoRaWAN Gateway → DAEVIS

- Long range coverage: 30m

- Parameters:
  - One vibration device for :
    - Monitor: 3-axis vibration
    - Precision: 0.008g
    - Max vibration: ±4g

- Heat source: 120ºc.

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Alternative
Energy Innovations

Vibration monitor

VIBRATION & TEMP MONITORING ON RASPERS IN A **WHEEL RECYCLING PLANT**

MAIN FEATURES

- Low infrastructure: INDU-EYE → LoRaWAN Gateway → DAEVIS
- Long range coverage: 120-160 m
- Parameters:
  - One vibration device for :
    - Monitor: 3-axis vibration
    - Precision: 0.008g
    - Max vibration: ±4g
  - One temperature device:
    - Temperature (up to 650ºC)
- Heat source: 90ºC -140ºC (Furnace wall).

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Ash clogging detection in collector

① Thermal Battery
② Thermal sensor
③ Wireless node

TEMPERATURE MONITORING ON ELECTROSTATIC FILTERS IN A **THERMAL PLANT**

MAIN FEATURES

- **Low infrastructure:** INDU-EYE → LoRaWAN→Siemens PLC
- Long range coverage: 0.9Km
- Heat source: 70ºC
- Parameters:

  Temperature (up to 650ºC)

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USE CASE

HEAT POWERED

STEAM LEAKS DETECTION in STEAM TRAPS

Stream trap monitor

MAIN FEATURES

- Low infrastructure: INDU-EYE → LoRaWAN→ DAEVIS
- Long range coverage: Up to 2Km
- Parameters:
    - Delta T (2 temperature sensors)
    - *Ultrasound (Q1-2022)*
- Heat source: 90ºC

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Vibration monitor

VIBRATION ON A SLUDGE DRYER IN A **WASTEWATER TREATMENT PLANT**

MAIN FEATURES

- Low infrastructure: INDU-EYE → LoRaWAN Gateway → DAEVIS
- Long range coverage: 90 m
- Parameters:
  - One vibration device for :
    - Monitor: 3-axis vibration
    - Precision: 0.008g
    - Max vibration: ±4g
- Powered by electric grid (220VAC 50Hz).

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Steam trap, & vibration detection

STEAM LEAKS DETECTION IN STEAM TRAPS AND VIBRATIONS ON A AUTOCLAVE IN A **TEXTILE PLANT**

- Low infrastructure: INDU-EYE 2.0 → LoRaWAN Gateway → DAEVIS
- Long range coverage: 490m
- Parameters:
  - Two vibration devices for :
    - Monitor: 3-axis vibration
    - Precision: 0.008g
    - Max vibration: ±4g
  - Two steam leaks devices:
    - Delta T detection.
    - Ultrasound detection (Q2-2022).

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Steam trap, & vibration detection

STEAM LEAKS DETECTION IN STEAM TRAP TREES AND VIBRATIONS ON A COMPRESSOR IN A **OIL REFINERY PLANT**

- Low infrastructure: INDU-EYE 2.0 → LoRaWAN Gateway → DAEVIS
- Long range coverage: 1420m
- Parameters:
  - Two vibration devices for :
    - Monitor: 3-axis vibration
    - Precision: 0.008g
    - Max vibration: ±4g
  - Two steam leaks devices:
    - Delta T detection in steam trap trees.
    - Ultrasound detection (Q2-2022).

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New projects using micro wind turbines

CLOUD

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Vibration monitor in railways, highways & mining ventilators

VIBRATION MONITOR IN VENTILATION FANS FOR TUNNELS TO AVOID ACCIDENTS & BAD QUALITY AIR

MAIN FEATURES

o Low infrastructure: INDU-EYE → LoRaWAN Gateway → DAEVIS

o Long range coverage: 750m in this project

o Parameters:

  o Monitor: 3-axis vibration

  o Precision: 0.01g

  o Max vibration: ±4g

o Wind source from 10Km/h

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New projects using solar power

Use case for silos
Cement / Sand / Grain - cereals

VOLUME MEASUREMENT FOR ROUTE PLANNING IN A CEMENT PLANT

MAIN FEATURES

- Low infrastructure: INDU-EYE → NB-IOT → DAEVIS
- Long range coverage: > 20Km
- Parameters:
  - Monitor: Distance / Lidar
- Fully powered by solar

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INDU-EYE Main economic savings

Data compared to battery-powered IoT devices from (Emerson, ABB, Yokogawa...)

Savings in purchase:

- 50% lower.

Savings in wireless infrastructure:

- LoRaWAN > 80% compared to **wireless solutions** WirelessHart or ISA100
- NB-IOT / LTE-M >95% compared to previous wireless solutions.

Savings per device, in maintenance:

- > 200€ / yearly in battery replacement + personnel costs + process stop

Savings for the environment:

- > 96% reduction in Carbon Emissions, Water usage, Heat and Energy consumption.

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DAEVIS – The cloud Platform
DYNAMIC AEINNOVA VISUALIZER

SaaS PLATFORM FOR INDUSTRIAL SENSORS

DYNAMIC REPORTING and ENVIRONMENTAL IMPACT GRAPH.

CUSTOMIZABLE ALARMS VIA SMS, EMAIL, POP-UP, TELEGRAM, etc.

PREDICTIVE MAINTENANCE

INTEGRATION POSSIBILITIES WITH SCADA OR OTHER PLATFORMS

COST REDUCTION UP TO 60% COMPARED TO OTHER SIMILAR CLOUD PLATFORMS

Our customers

Shareholders & 8 European Union R&D Grants

29 INTERNATIONAL AWARDS

Membership

Press

Link to AEInnova's COP26 Speech

Certification & Patents

US, CANADA and EU Patent accepted.

3 ongoing.

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