



Global Leader in Engineering and R&D Services

A Use case of intelligent maintenance

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3 expertise domains to engineer tomorrow

Our Global Service Lines help the world's largest innovators engineer the products and services of tomorrow by leveraging our experts, labs, tools and frameworks around the globe.

Intelligent Maintenance is at the intersection of:

Product & Systems Engineering

40%
of
engineers



- Product Design & Development
- Systems Engineering
- Mechanical Engineering
- Silicon, Electronics & Embedded Systems
- Testing & Compliance

Digital & Software

35%
of
engineers



- Digital Experience Design
- Software Product Engineering & Cybersecurity
- IT & OT Systems Integration
- Advanced Network Technology & IoT
- Data Analytics & AI

Industrial Operations

25%
of
engineers



- Manufacturing Engineering & Technology
- Supply Chain & Quality Management
- Operations & Asset Management
- Network Operations & Transformation
- Product Support & Sustenance

We work with global innovation leaders across industries.



Automotive



Aeronautics



Space,
Defense
& Naval



Rail, Infrastructure
& Transport



Energy



Industrial &
Consumer



Life Sciences



Communications



Semiconductor
& Electronics



Software &
Internet



Finance &
Public Sector



Let's put a focus on our client Orano



Automotive



Aeronautics

AIRBUS

SAFRAN



Space,
Defense
& Naval

DASSAULT
AVIATION

THALES



Rail, Infrastructure
& Transport

A

BO



Energy



Life Sciences



Communications



NOKIA

Telefonica



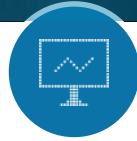
Semiconductor
& Electronics

Qualcomm

ThermoFisher
SCIENTIFIC



Software &
Internet



Finance &
Public Sector



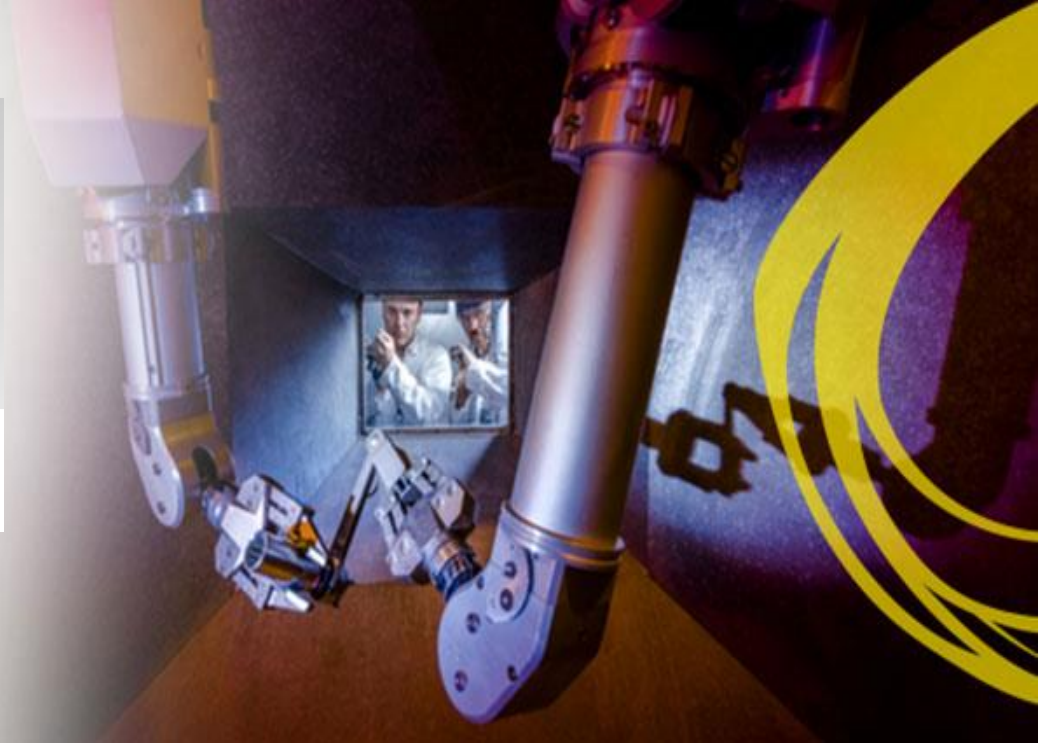
NATIXIS



PREVENT AUTOMATED ARM OUTAGE

EQUIPMENT INSTALLED IN A CRITICAL
ENVIRONMENT

TELESCOPIC MECHANICAL ARMS



USE CASE:

COLLECTING DATA FROM AN
AUTOMATED ARM TO REDUCE
BREAKDOWNS OCCURRENCES ON
LEGACY SYSTEMS

NOT ONLY ABOUT IT, PEOPLE MATTER

REAL TIME ASSET MEASUREMENT

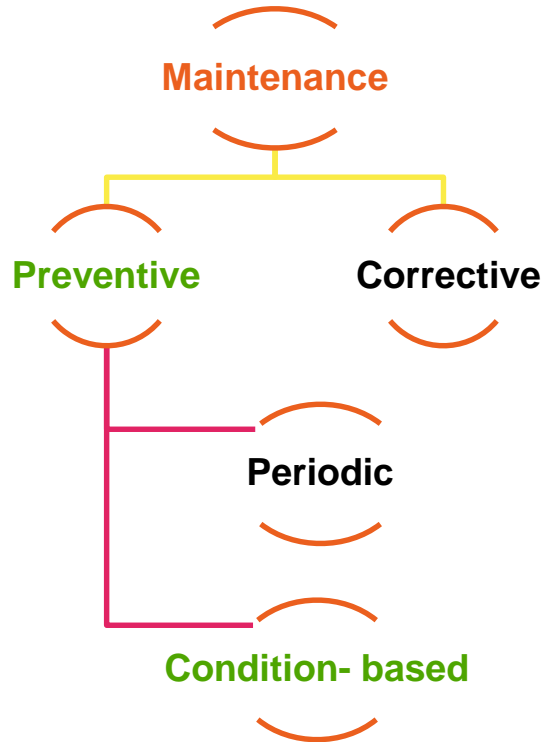
ROTATIONS, SPEED, MECHANICAL
CONSTRAINTS

DEPLOYED TRAINING

INTELLIGENT MAINTENANCE
PREDICT FAILURES



Connected maintenance with IoT on legacy systems



ISO 55000 family standards
ISO 13374 series of standards

Connected maintenance adding data to legacy systems with IoT solutions makes sense:

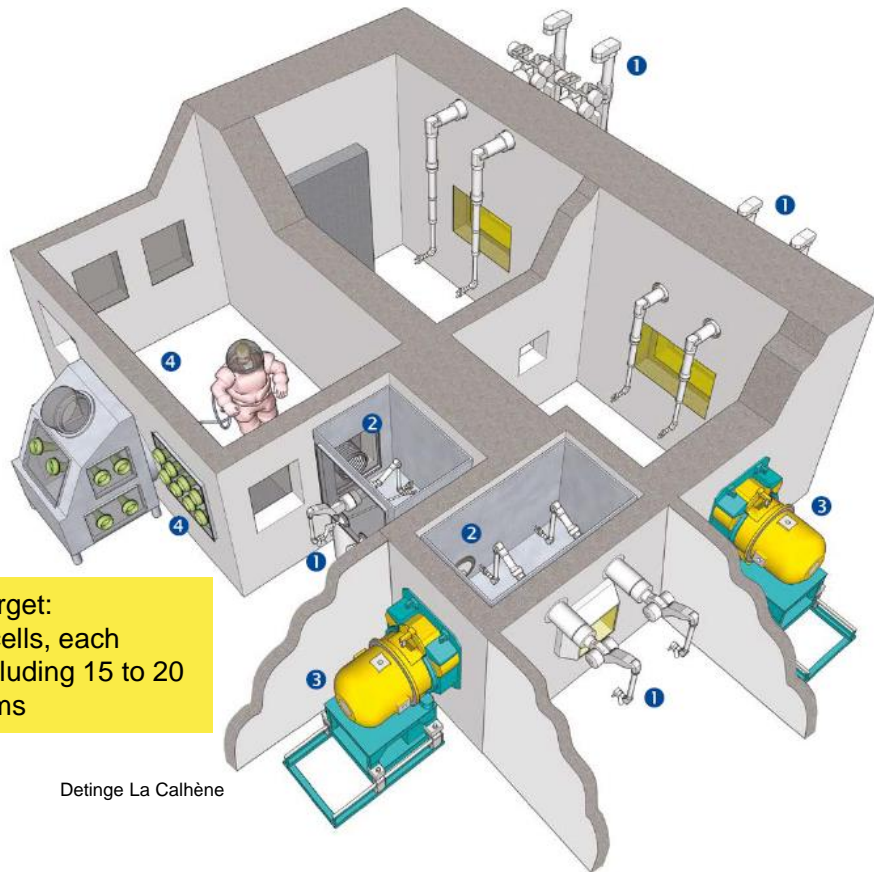
- Equipment area not easily accessible
- From corrective (fail and fix) to conditional maintenance
- Adding diagnostic and monitoring for:
 - Preventing/predicting
 - Learning, self-learning
 - Training

Cost efficiency of adding IoT rather than changing the machine fleet (up to 1000 machines)

Cost of failures are currently (up to 1000 machines) : ????? Per year? Per failure?

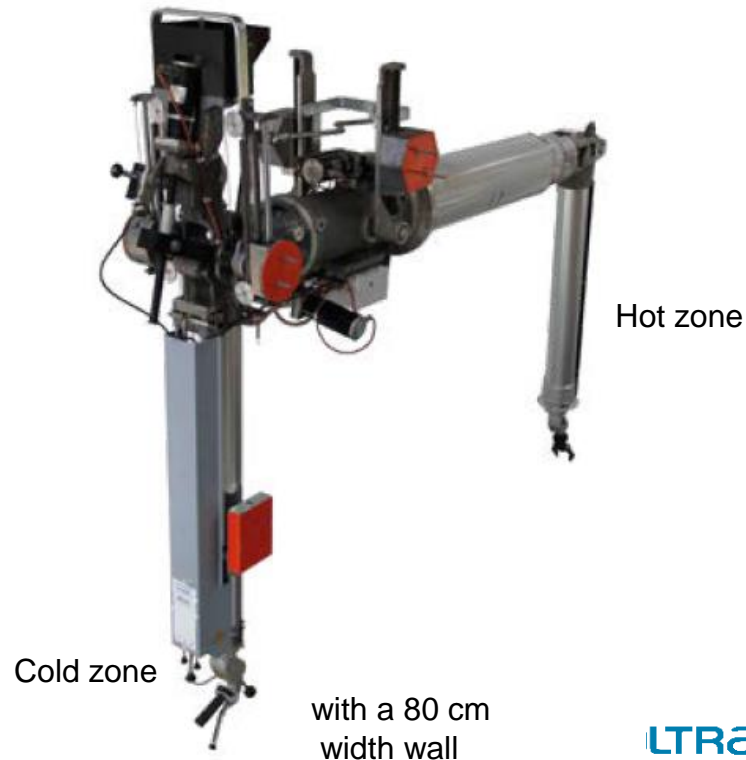
AUTOMATED ARMS in the NUCLEAR INDUSTRY

MT 200, master slave telescopic mechanical arm, suitable for high capacity and heavy remote manipulations (20 daN).



Target:
8 cells, each
including 15 to 20
arms

Detinge La Calhène

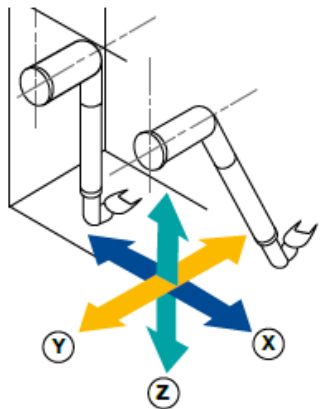


AUTOMATED ARMS in the NUCLEAR INDUSTRY: 1st challenge

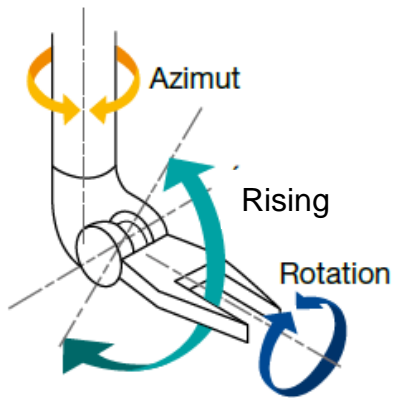
Large movements

/

Small movements



Detinge La Calhène



First challenge: Modelling and choice of the sensors:

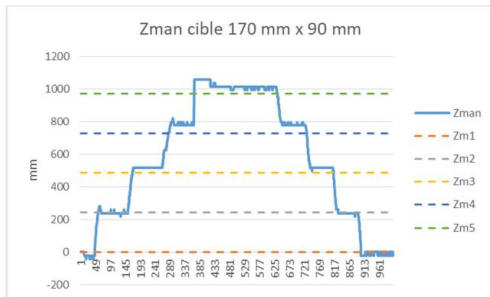
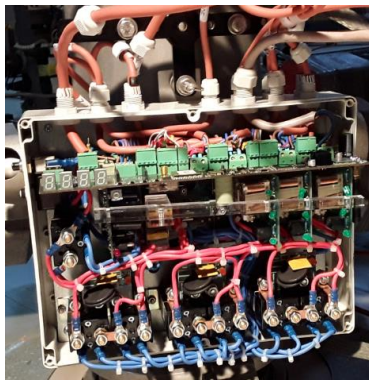
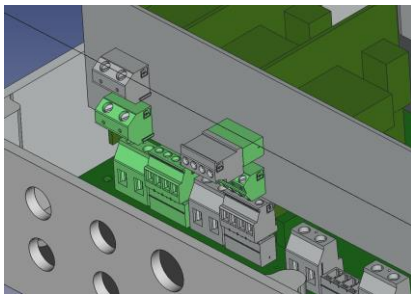
1. and 2. inertial sensors (X, Y)
3. Counterweight Distance measurements (ZMAN/ZE) (Z): IR sensor + Button
4. Constraint: putting the sensors on the « cold » zone requires calculating the real » movements on the « hot » zone and not measuring directly
5. Modelling requires defining critical parameters and assessing relevant thresholds

Designing and adding a set of sensors and data collectors:

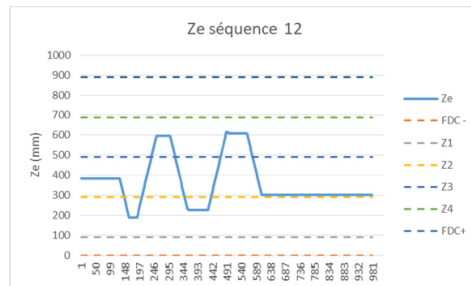
- To measure the subsystems movement
- To collect and transmit the data via a wireless infrastructure
- To expose the results: MMI offering a visualization of angles X/Y, Z, ZMAN/ZE, the thresholds detection, the utilization rates

AUTOMATED ARMS in the NUCLEAR INDUSTRIAL: 2nd challenge

Adding the IoT without interferences, disturbance or reduction of the MTBF



Conclusion : le Zman est reconstitué correctement à +/- 20 mm près avec une cible réduite à 170 mm x 90 mm.



Conclusion : le Ze est reconstitué correctement à +/-100mm.

Second challenge: designing and bringing connectivity

- First trial: using LoRa2.4 GHz (sensors + GTW)
- Second trial: moving to LoRa 868 MHz technology for the alerts + WiFi for the connectivity + using wired sensors => OK and complying to the standards
- Interfacing to the command of the MT200 without compromising security features => synchronize the supervision card with NTP
- Modelling for the integration feasibility
- Powering the sensor set-up without having interferences between both systems
- Compliance to the standards

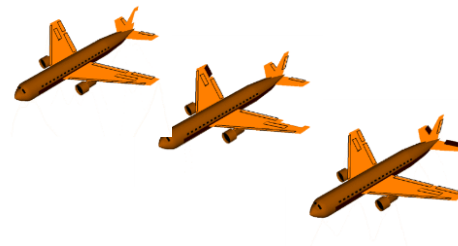
Real time constraints: LoRa Alerts, WiFi (not done yet), kinetics calculations are not done on the edge (data collected every 100ms)

AUTOMATED ARMS in the NUCLEAR INDUSTRY: 3rd challenge

Collecting the data, checking the relevancy, creating value

Third challenge: collecting the data to create value:

- Checking the data and algorithms relevance: Euler angles (Tait Bryan with pitch/roll/yaw like evaluation) was sufficient, no need to use quaternions.
- Analysis of failure causes: quantifying critical parameters and thresholds (Orano)
- Anticipation of failures (combining utilization rates and large movements detection above thresholds)
- Training the collaborators: the client will combine training sessions of collaborators with data signatures and references collected by the IoT system.



Cost efficiency:

- Replacing 1000 arms vs equipping them with the IoT system: cost of the “arm” .vs. 1600 to 2000 Euros for the IoT solution.
- Average failure cost is huge compared to setting this IoT solution (not disclosed by Orano)
- Mutualization of the maintenance operations brings a huge benefit (not disclosed by Orano)

