

Naples, December 19th

SYPLA[®] AEROSPACE: from Health Monitoring to Predictive Maintenance innovation

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SYPLA®

SYENMAINT® PLATFORM

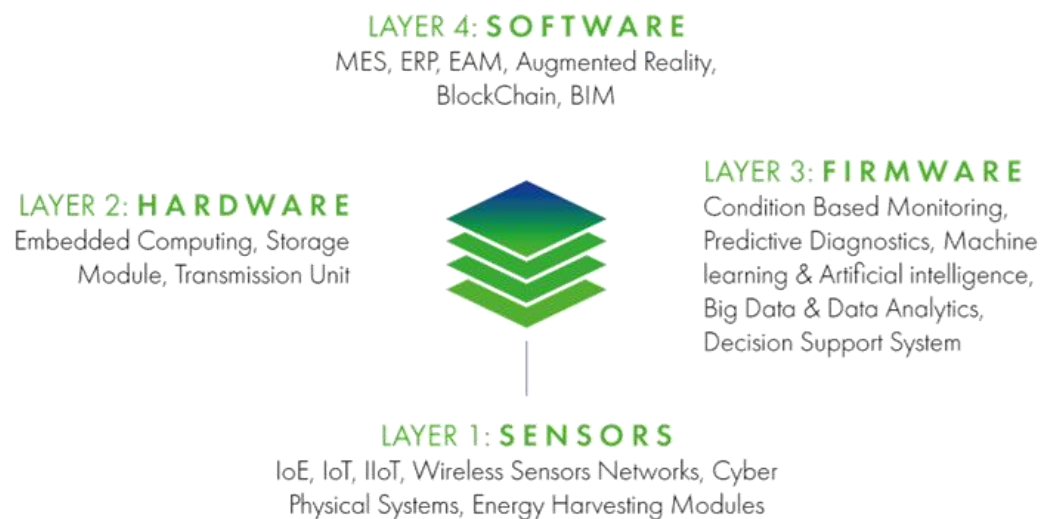
SYPLA® SYENMAINT® PLATFORM

TECHNOLOGY FRAMEWORK FOR THE PREDICTIVE MAINTENANCE

Dynamic management of the maintenance time plans
Life-cycle management optimization

- stocks & costs reduction, reliability improvement,
- safety mitigations, service quality enhancement

Multilayer technology platform for industrial sectors



BUILDING

ENERGY

INDUSTRY 4.0

HEALTH

RAIL

AEROSPACE

SYPLA Intelligent Predictive Decision Support System: where does it work...?

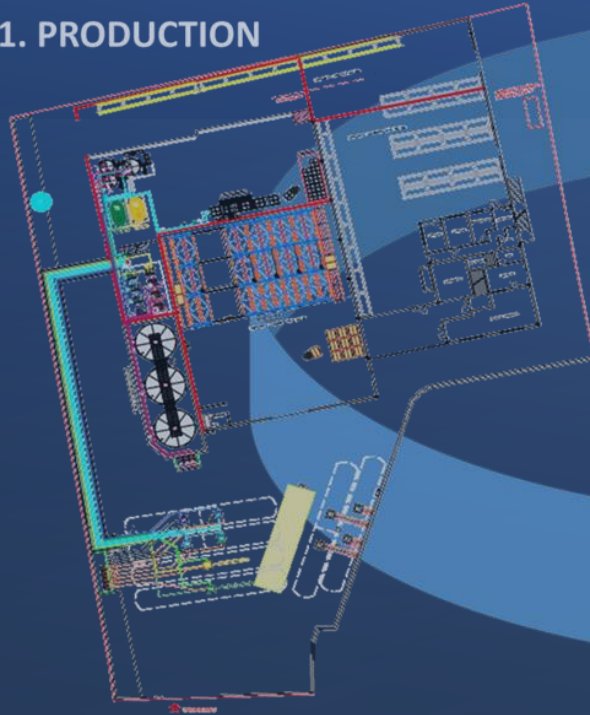




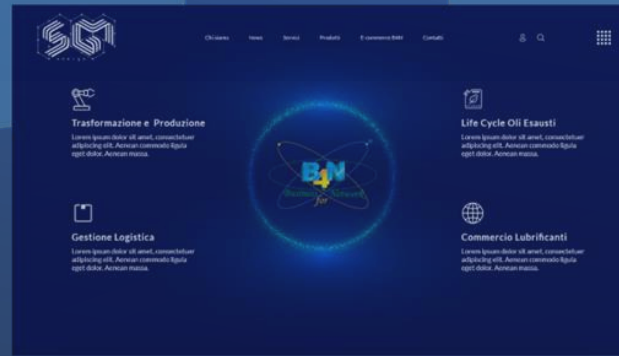
SYPLA
INDUSTRY 4.0



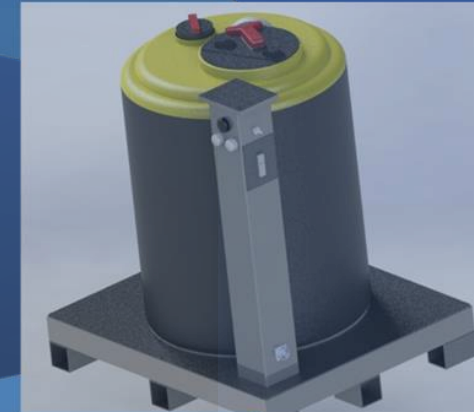
1. PRODUCTION



2. SALE



3. RECOVERY



4. RICYCLE



Base Oils

AUTOMATED PRODUCTION AND RECYCLING OF LUBRICATING OILS 4.0
Energy self-consumption maximization





GALLARATE CATHEDRAL

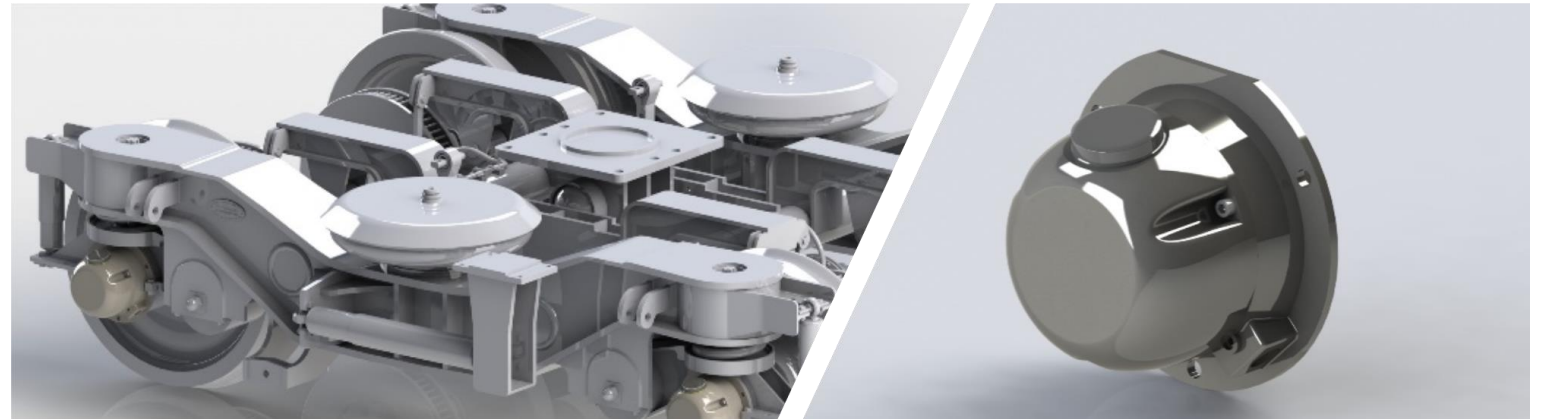
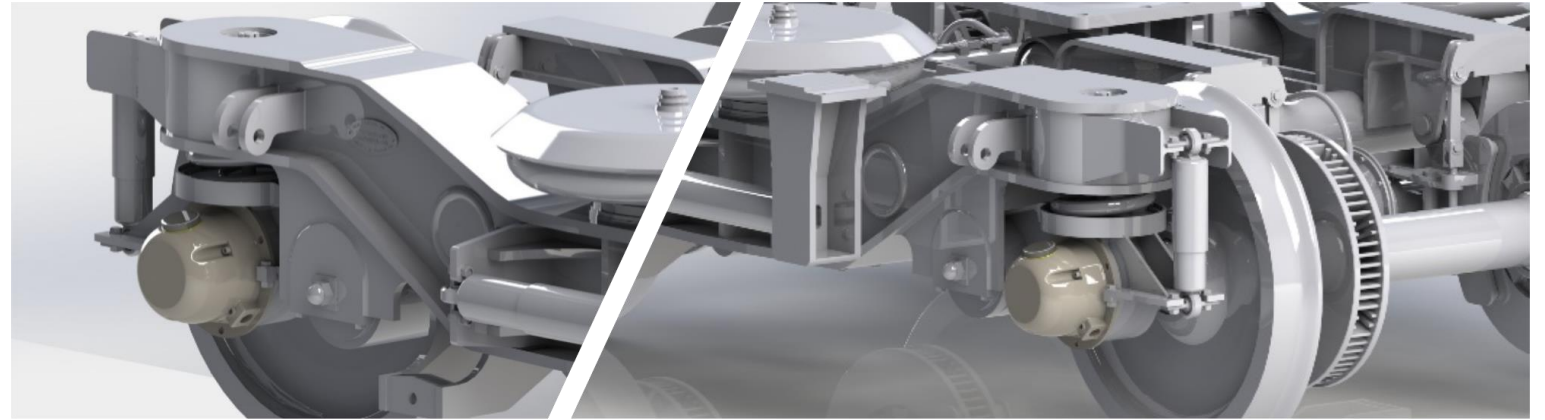
Structural Health Monitoring

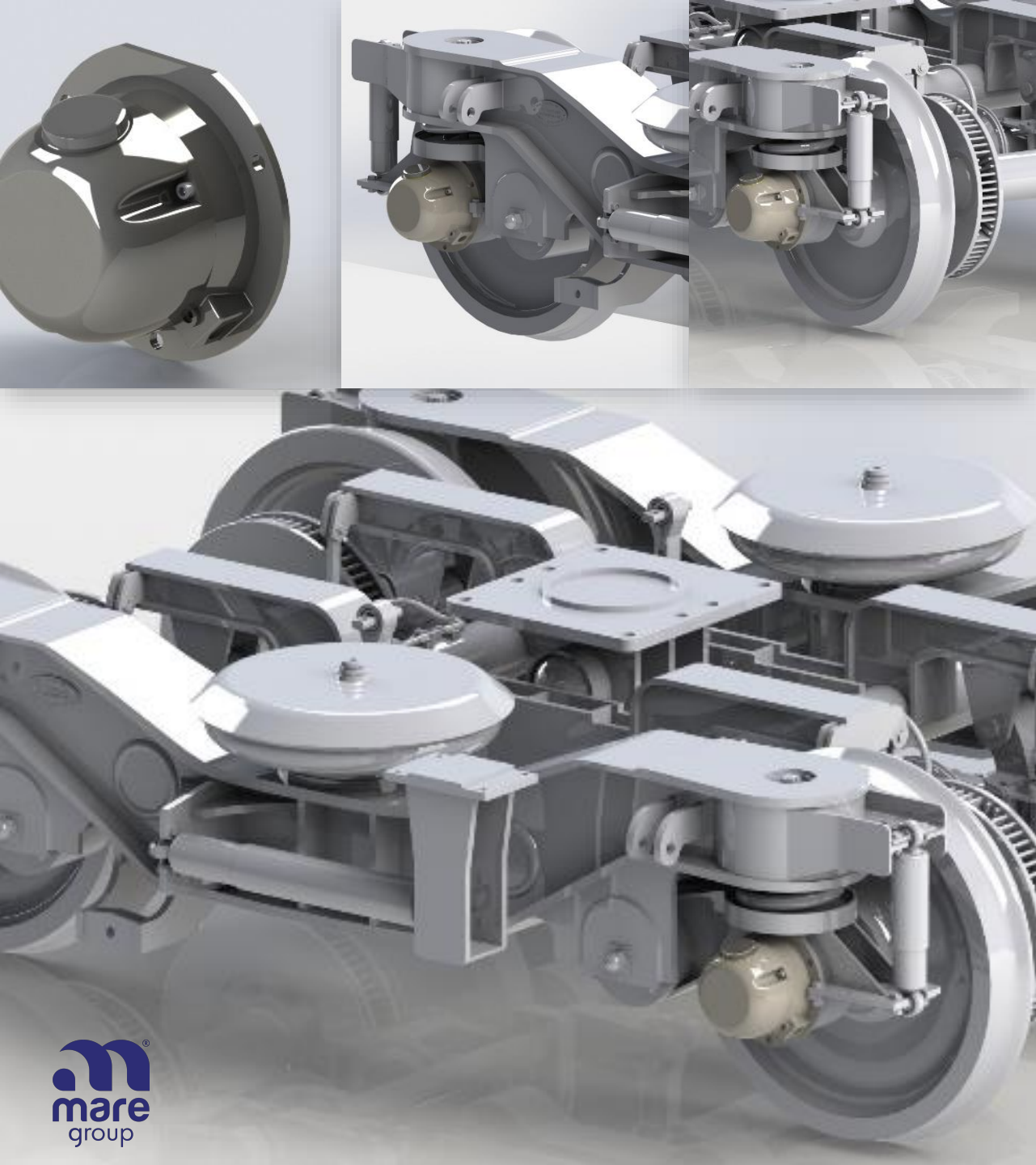


PREDICTIVE MAINTENANCE MANAGEMENT OF ROLLING STOCKS AND RAILWAY INFRASTRUCTURES WITH SAX

What is SAX...? SYPLA SMART AXLE BOX

Vehicle Dynamics Monitoring
System for Rolling Stocks and
Railway Infrastructures
Predictive Diagnostics

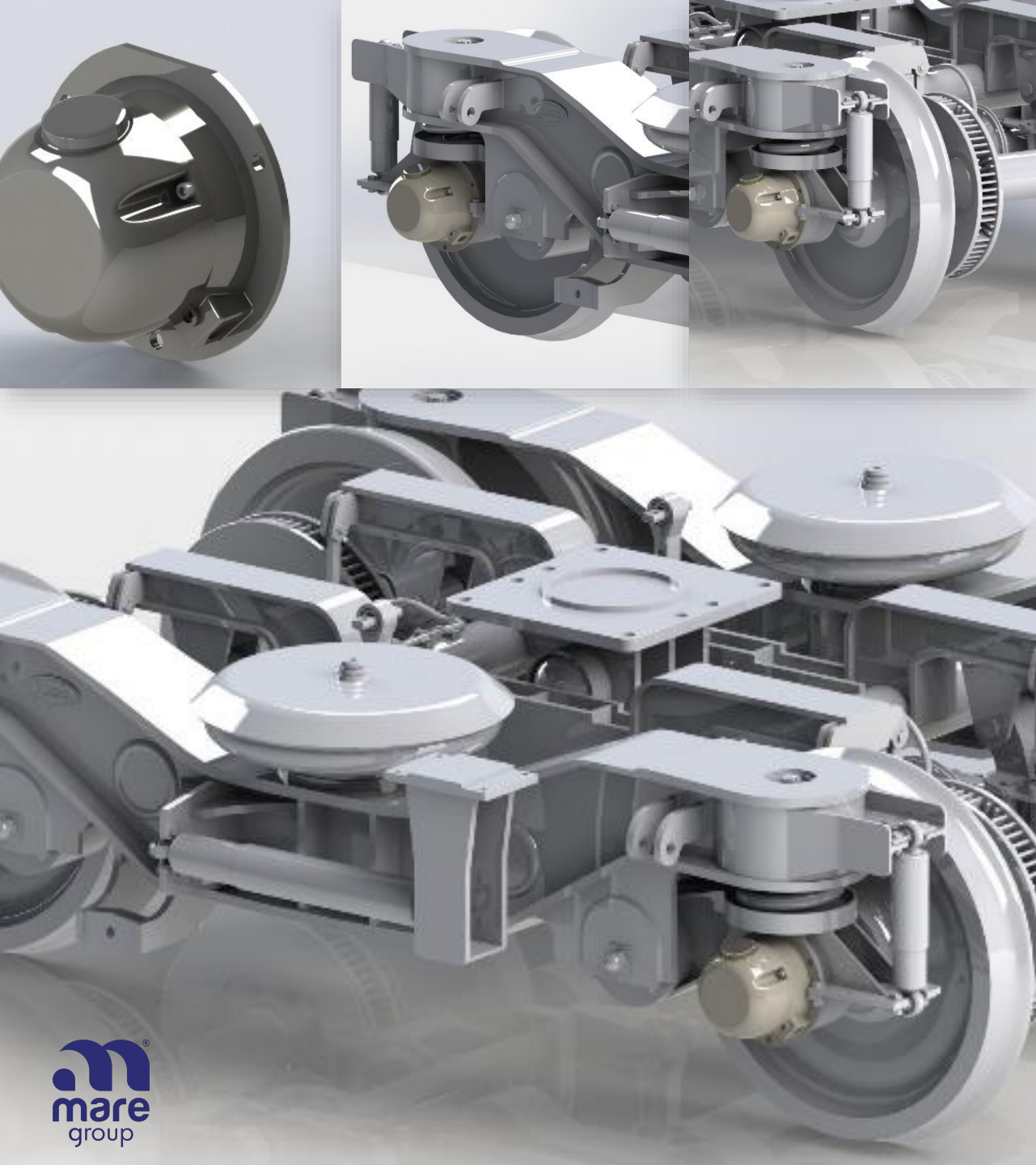




SAX: System Functionalities

Product Innovation: Predictive Diagnostics

- Self-powered system, unwired
- Measurements of acceleration, vibration, gyroscopy, inclinometry, attitude, temperature, acoustic
- GPS Positioning – Covered distance – Current speed
- Web server Data communications: GSM-LTE 5G - WiFi
- Real-time data processing & Data Storage



SAX: System Functionalities

Process Innovation: Integrated Maintenance Management

- Rolling stock anomalies detection
- Identification of track degradation patterns
- Automatic Definition of the Detected Anomaly
- Maintenance Work Order Prescription
- Maintenance People & Reporting Management
- Maintenance execution supported by AR application

BOGIE DETECTED ANOMALIES

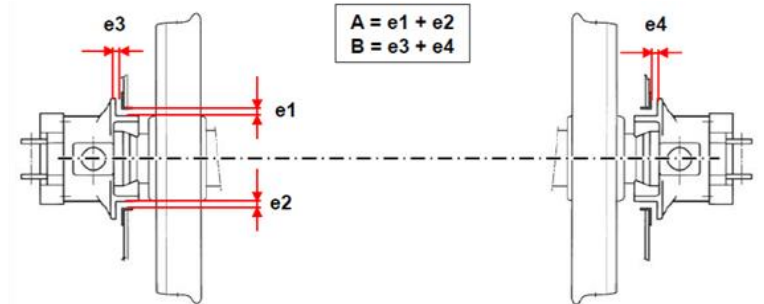
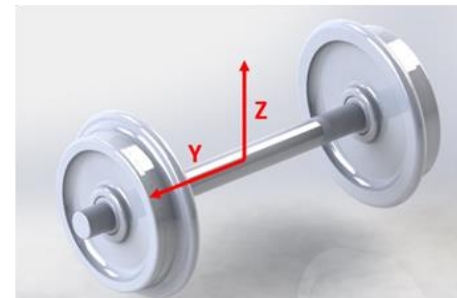
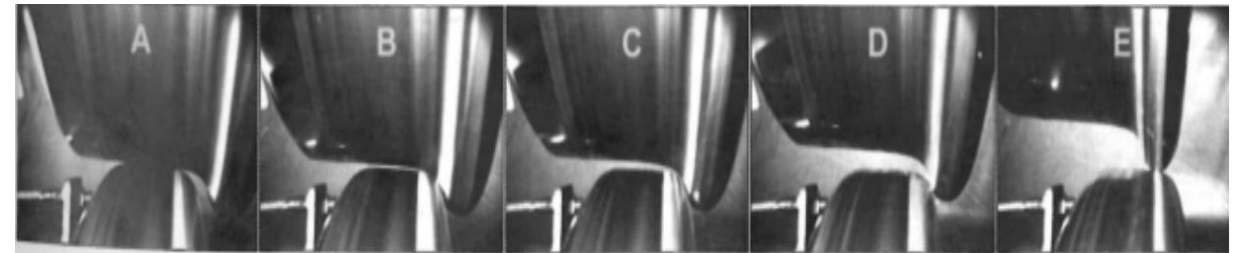
Bearing thermal and acoustic detection

Primary and secondary shock absorbers

Anti-wave bogie dampers, vertical & horizontal dampers

Wheel defects (profiling, taper, ovality, faceting)

Y and Z displacement
Wheel-Rail Interaction



RAILWAY INFRASTRUCTURE DETECTED ANOMALIES

Rail surface defects

Thermal expansion
joints

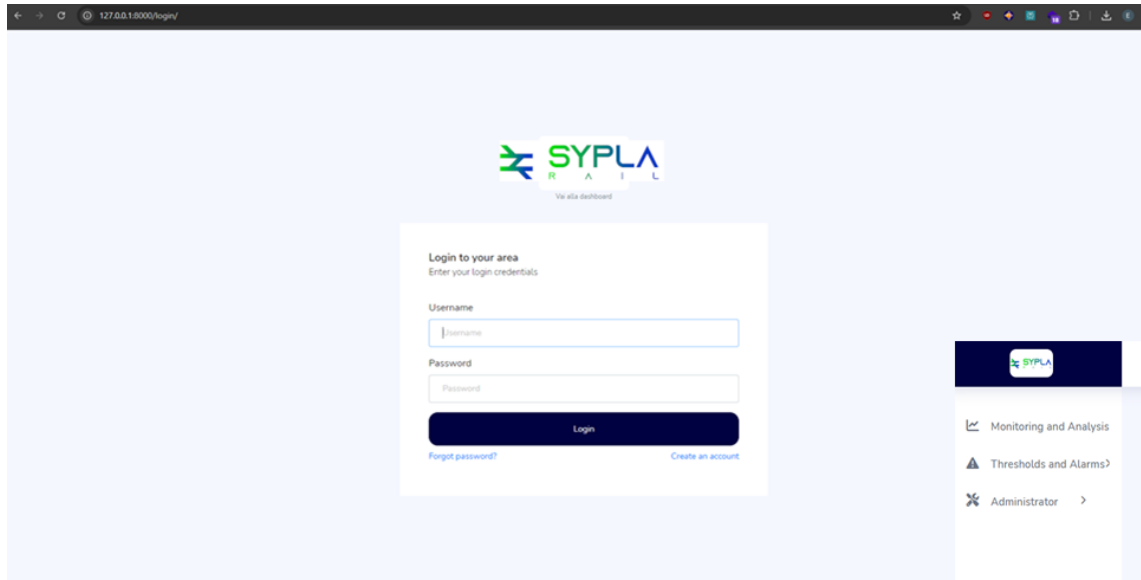
Track Geometry based
on Inertial
measurements



SAX Validation in Campania Region

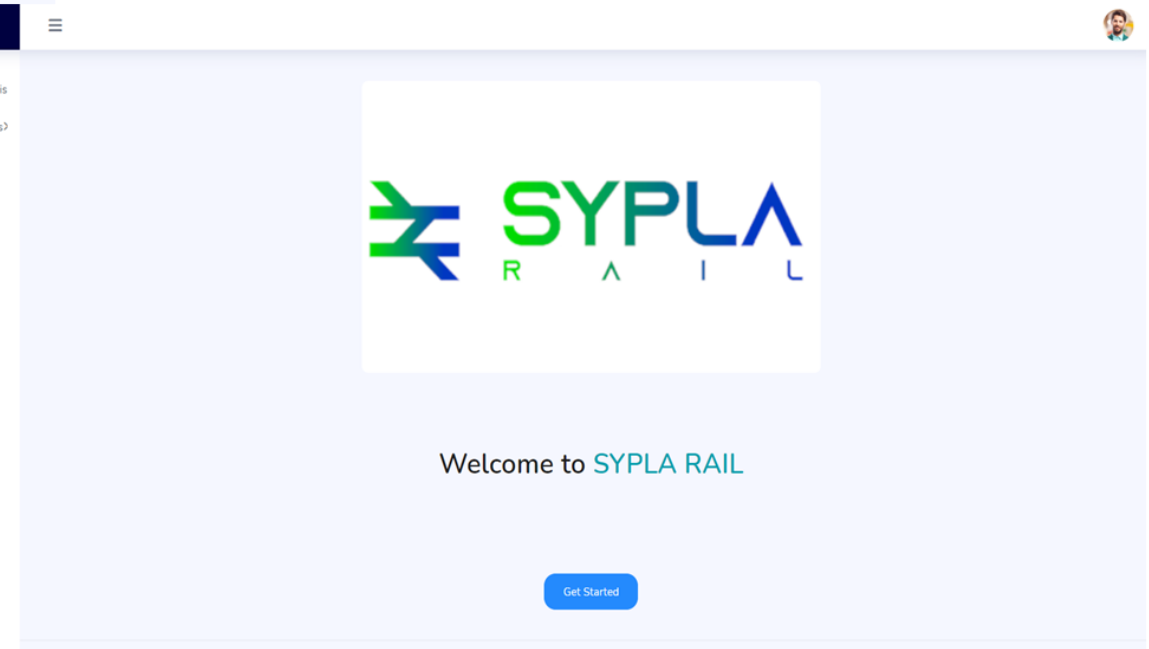


What is SYPLA RAIL...?



<https://syplarail.maregroup.it/>

- In the time domain, we perform **Monitoring**
- In the space domain, we perform **Data Analysis**



SYPLA RAIL Validation



User Interface Thresholds, Alarms, Warnings & Maintenance Work-order

Legend

- Warning (red icon): Indicates that the sensor value has exceeded the predefined upper threshold.
- Alert (yellow icon): Indicates that the sensor value has exceeded the predefined lower threshold.
- Validation status (icon lit): Indicates that the alarm is active.
- Validation status (icon off): Indicates that the alarm is not active.
- Active alarms not in maintenance (red line): Positioned at the top of the table for quick identification.
- Monitored alarms (yellow line): Located in the central section to distinguish them.
- Inactive and unmonitored alarms (white line): Listed at the bottom without any specific color.

| ID | Type | Validation Status | Activation | Measure | Details |
|------|---------|-------------------------|---------------------|-------------|---------|
| 9302 | Alert | Validation status (off) | 07/30/2024 3:38 pm | vel | Details |
| 9 | Alert | Validation status (off) | 06/05/2023 4:55 pm | temperature | Details |
| 5 | Alert | Validation status (off) | 06/03/2023 2:05 pm | temperature | Details |
| 1 | Warning | Validation status (off) | 06/01/2023 10:15 am | temperature | Details |

Alarm Details

| | | | |
|---------------------------|---|--|--|
| Alarm ID: 1 | Alarm Status: Active | Exceeding measure: temperature | Threshold reference value: 80.0 |
| Type: Warning | Activation date: June 1, 2023, 10:15 am | Threshold Exceedance L3: 85.2 | Reference threshold type: high threshold |
| SAX: 11 | Deactivation date: --- | L3 threshold exceeded date: June 1, 2023, 10:30 am | |
| Monitoring Status: Active | | | |

Description
Temperature alarm

Put in maintenance | Turn off alarm | Enable/Disable Tracking

Maintenance Interventions:

| Activation Date | Deactivation Date | Intervention Start Date | Interv End Date | ID | Details |
|--------------------|-------------------|-------------------------|--------------------|----|---------|
| 09/23/2024 2:55 pm | — | — | 09/23/2024 2:59 pm | 17 | Details |



SYPLA
AEROSPACE

HERFUSE



FROM HEALTH MONITORING TO PREDICTIVE MAINTENANCE



SYPLA AEROSPACE PoC Phases



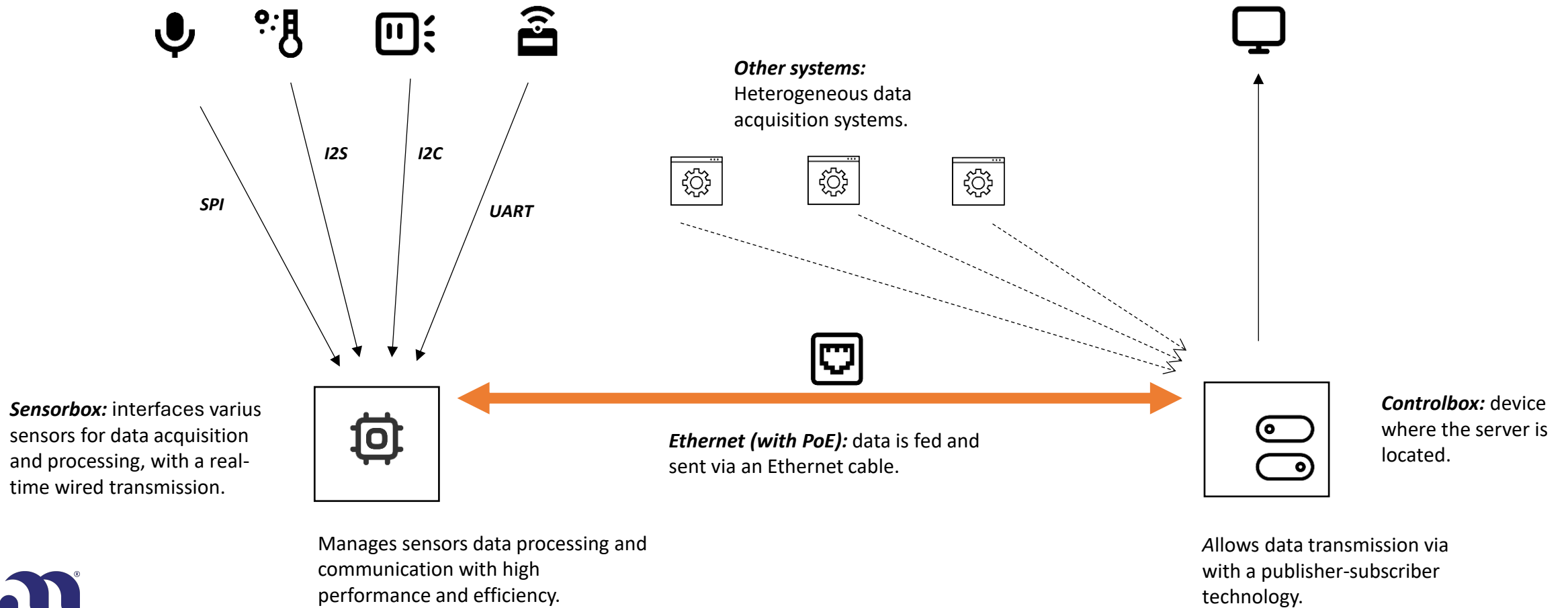
1. Context Analysis
2. Definition of
 - a. Signals
 - b. Sensors
 - c. Hw
3. Definition of the Architecture
4. System Integration
5. Monitoring Implementation
6. User interface Development

SYPLA AEROSPACE Architecture

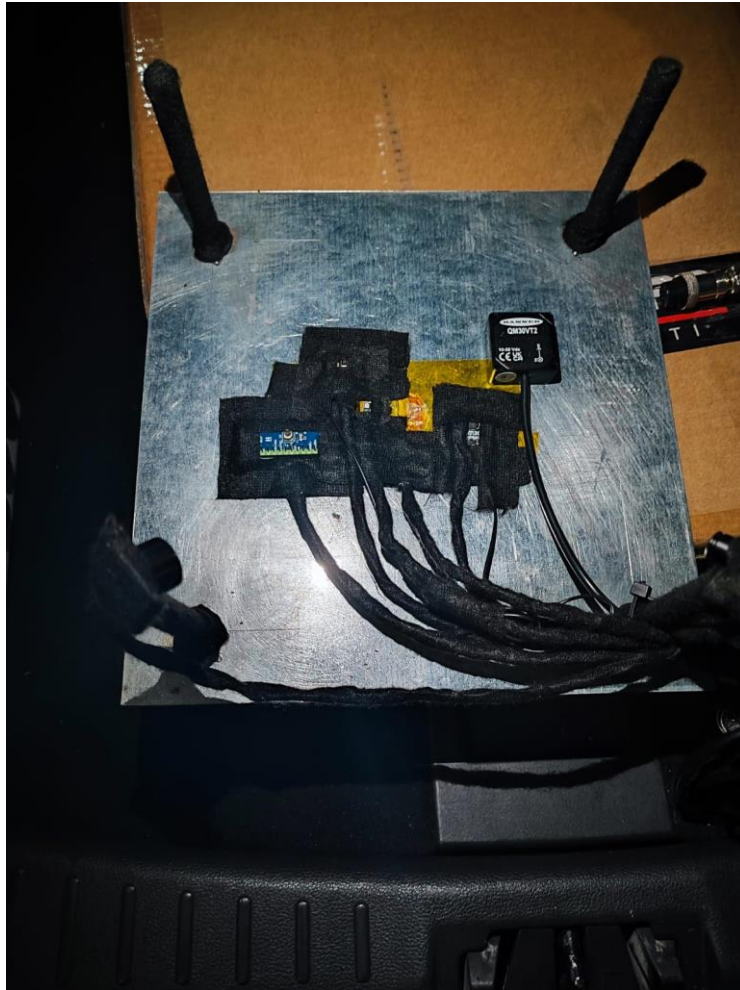


Sensors: tools for acquiring and sending the relevant quantities.

Dashboard: system for historicizing and visualizing data.



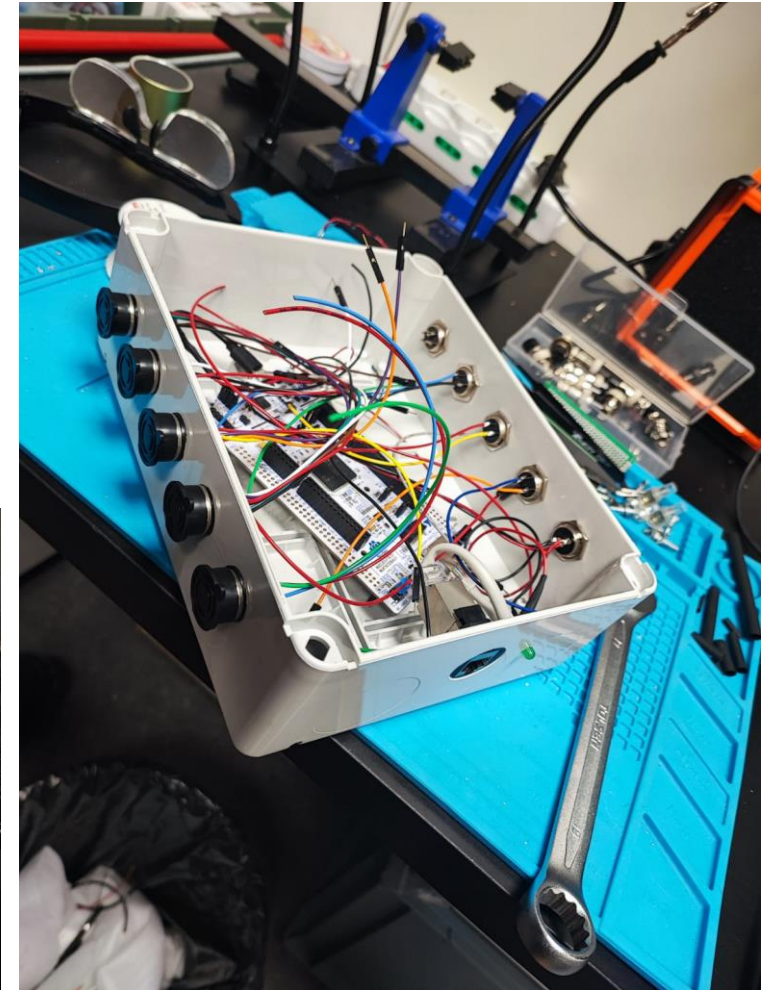
Sensors



Control Box



Sensor Box



Sensor Box

SYPLA AEROSPACE User interface



The screenshot displays the SYPLA AEROSPACE user interface, which is organized into three main vertical panels. Each panel features a 'Time Interval' section with 'Start' and 'End' time pickers. The first panel shows a start time of 18/12/2024 16:50 and an end time of 20/12/2024 00:00. Below this is a 'View' button and a tip: 'Remember that you can zoom in on Cartesian graphs by selecting the area of interest with your mouse. Right-clicking on the graph will open a menu with additional options.' The main graph in this panel is 'Deformation' (Def [u]_1_1), showing a line graph of displacement in micrometers (µm) over time. The second panel has the same time interval and tip, but its main graph is 'Loudness' (Loud [dBFS]_10_1), showing a line graph of sound pressure level in dBFS. The third panel is divided into two columns. The left column contains three stacked line graphs: 'Acceleration X' (Acc X [m/s^2]_2_1), 'Acceleration Y' (Acc Y [m/s^2]_2_1), and 'Acceleration Z' (Acc Z [m/s^2]_2_1), all showing acceleration in m/s^2. The right column contains two stacked bar charts: 'Vibration X' (Mag X [uT]_11_1) and 'Vibration Z' (Mag Z [uT]_11_1), both showing magnetic field magnitude in uT. A tooltip is visible over the Vibration Z chart, displaying the time '18/12/2024 16:58:19' and the value 'Mag Y [uT]_11_1: 2.9533101504632864'. Each panel includes a 'View' button and a copyright notice at the bottom: '© SYPLA RAIL Layer 5 2024 | Powered by Mare Group'.



A real-time data slider displaying dynamic graphs for sensor readings. The graphs update live, offering instant visual feedback on sensor performance and changes, enabling users to track trends over time.

Conclusions: from Health Monitoring to Predictive Maintenance innovation “how to”



The system is designed to be expandable, with *the possibility of connecting additional sensors for advanced monitoring of etherogenous components*. The data acquired will be presented and analysed via an interactive dashboard, allowing clear visualisation and efficient processing of information.

1. **Integration** of different airplane components for additional functionalities
2. **Optimization** of the dashboard for post processing big data analytics
3. **Implementation** of advanced algorithms for predictive maintenance from SYPLA RAIL
4. **Integrated** Maintenance Management Platform development
5. **Validation** of the system in real operating scenarios.

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