

Advisory Board Meeting – 31st March 2022

WP6 – Integration and Testing



Grant 881805

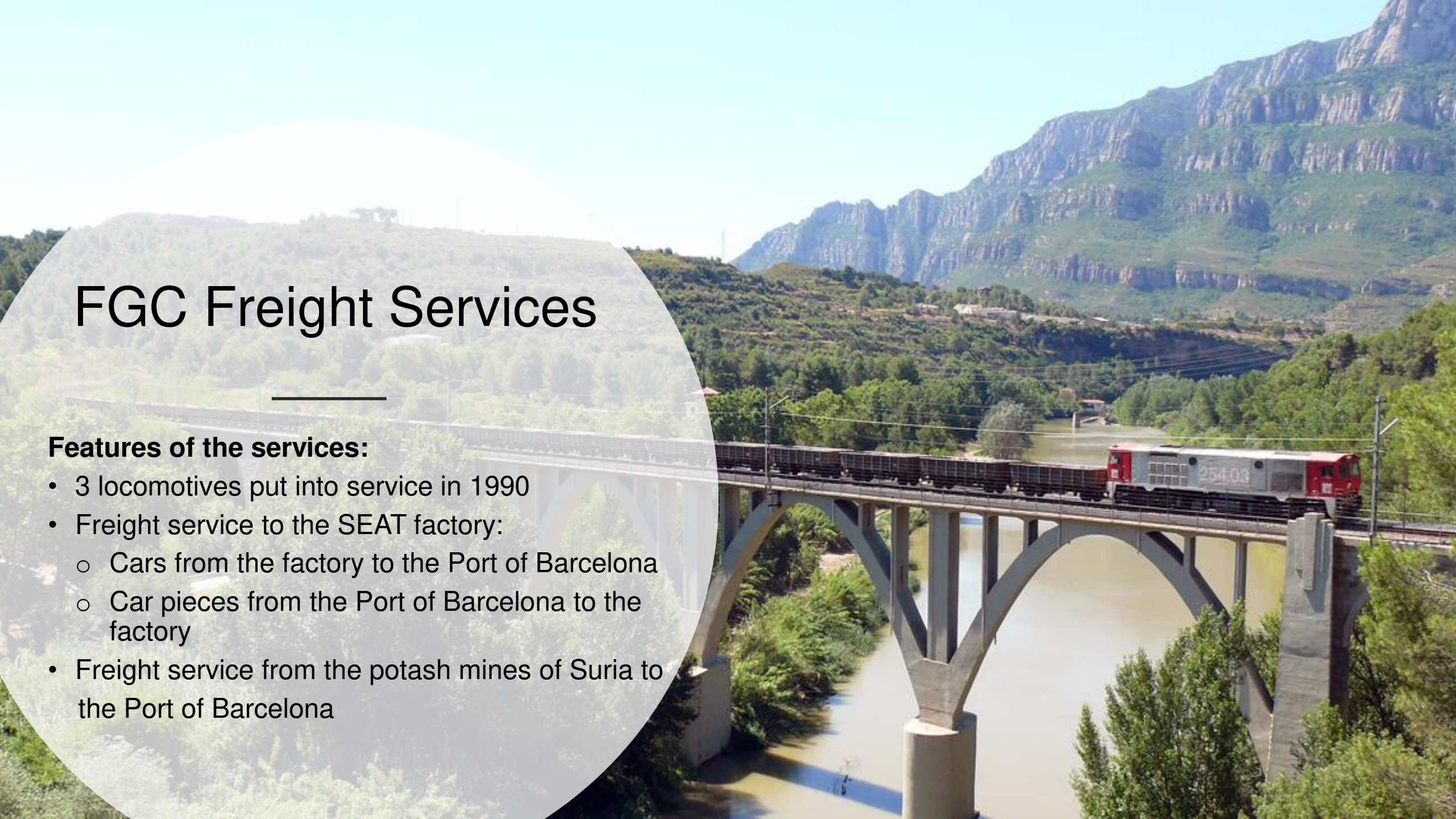
WP6 Aims & objectives

- The main objective of WP6 is the deployment, assessment, and validation of a condition-based maintenance scheme for the locomotive bogie: sensors, data transfer, condition assessment, insights to guide maintenance, and alerts in case of component defect.
- Based on data acquired in operation, the full scheme will be validated in comparison to the original scheduled maintenance plan

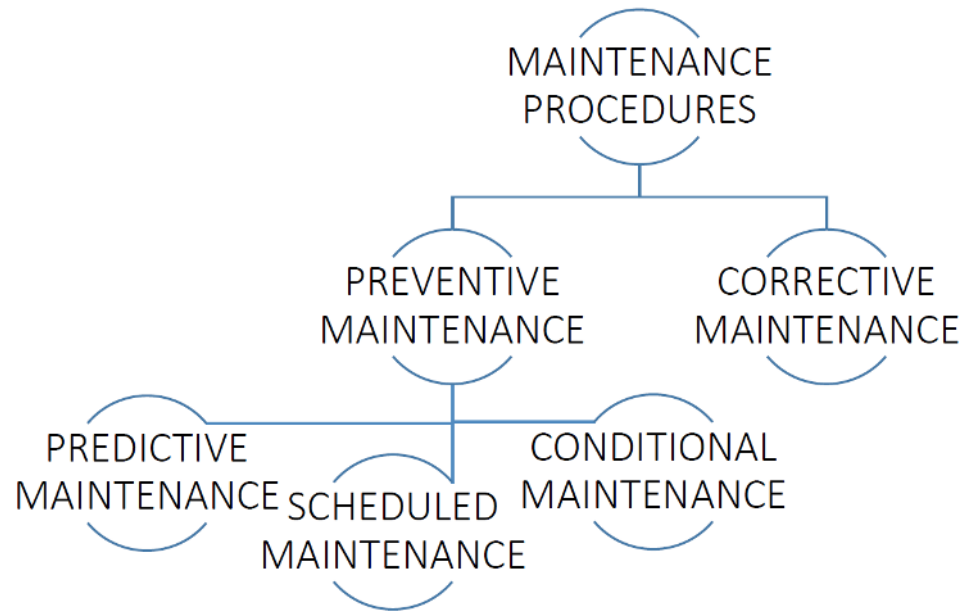
FGC Freight Services

Features of the services:

- 3 locomotives put into service in 1990
- Freight service to the SEAT factory:
 - Cars from the factory to the Port of Barcelona
 - Car pieces from the Port of Barcelona to the factory
- Freight service from the potash mines of Suria to the Port of Barcelona



FGC Maintenance Scheme (I)



FGC Maintenance Scheme (II)

- **Corrective maintenance:** Maintenance actions that are not expected and are detected during operation. When any malfunctioning is detected, its effect is evaluated and, if it impacts the service, it is corrected immediately. If the service is not jeopardised, then a working action is created and the maintenance action will be applied during the scheduled maintenance.
- **Preventive maintenance**
 - Scheduled: Periodically carry out scheduled inspections in which:
 - Visual inspection to check different components. This data is used for predictive and conditional maintenance.
 - Carry out several scheduled maintenance actions (e.g. replacements, in situ repairs, etc.)
 - Conditional: When some measurement is out of an acceptable value range, conditional actions are carried out (e.g. sandbox)
 - Predictive: For some components, the data collected in the schedule maintenance is introduced into a tracking document and some basic predictive analysis is carried out to select the best timing for maintenance action.

Main objectives:

- Ensure high quality of the service through good railway RAMS indicators (esp. Safety and Availability)
- Basic idea is to reduce to zero the corrective actions



LOCATE System Integration

Main objectives from an end-user perspective:

- Facilitate that the developments carried out in LOCATE can be tested in a real operational context
- Carry out the installation of the system without jeopardising the quality of the freight services provided by FGC
- Follow the results of the test and the related developments in order to evaluate the possible optimisations that could be implemented in our maintenance actions

Workflow

Installation report

- VIBRATEC proposed a first installation report (system and sensors)
- Continuous validation with FGC Maintenance and Engineering
- Several iterations of the document until final version, ensuring safety and availability of the service



Installation

- Coordination between VIBRATEC and FGC to install the sensors while carrying out the regular maintenance actions
- Coordination between VIBRATEC, EVO, and FGC to solve the issues found after the start-up



Data Collection

- The locomotive is currently providing regular services
- The LOCATE system collects data from the sensors installed
- The data is sent to



System Validation and Results Evaluation

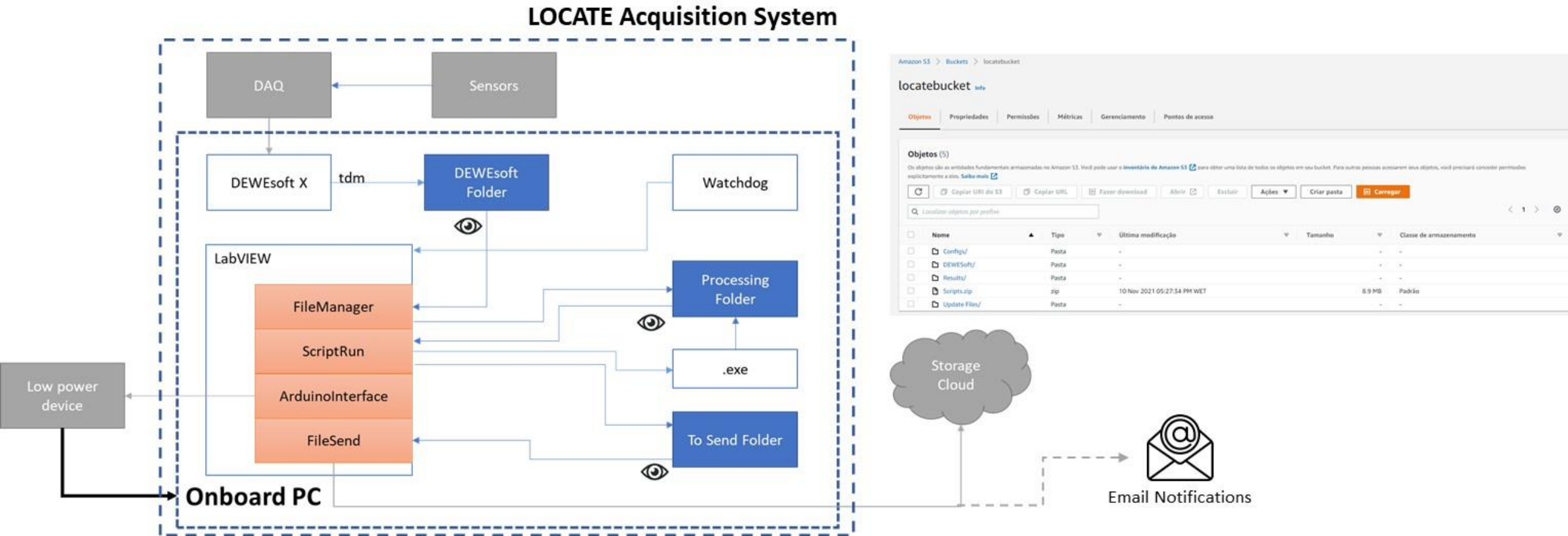
- Work In Progress



Installations

- On-board demonstrator box
- Sensors (accelerometers, extensometers, current clamps, IMU)
- Cabling from sensors to the demonstrator box
- GPS and GSM antennas in the upper grid of the locomotive

Onboard/ cloud SW Architecture



Maintainer's point of view: from Project to Operation 1/4

To define a maintenance scheme for a rolling stock being used in specific conditions of operation we must consider :

- The safety related issues
- The needs of the customer
- The possible price of the service

Therefore a balance between safety and availability of the assets has to be found. LOCATE was organised accordingly.

Maintainer's point of view: from Project to Operation 2/4

The different steps corresponding to the definition of a new maintenance organisation are the following

1. The use cases were defined in D2.1. (bogie and its links to the carbody of the locomotive, wheels, transmission traction engine)
2. An FMECA analysis was performed in D2.3 according to EN 60812 to identify the risk priority number for each defect of each component corresponding to the use cases. FGC's teams participated to this work bringing their experience.
3. The current maintenance scheme applied by FGC teams is described (maintenance levels, steps, limits): these maintenance was compared to the results of the FMECA analysis
4. A list of the defects of the components that can be addressed using the LOCATE methodology has been defined in D3.2

System / subsystem / component	
Bogie	Stability: detection of abnormal behaviour in suspension
Wheelset	Issues related to profile, conicity Wheel tread defects
Axle box	Behaviour of the bearing
Gear box	Behaviour of the box
Brake system	Braking distances

Maintainer's point of view: from Project to Operation 3/4

Currently:

- A measurement system has been implemented on a locomotive
- On line tests have been made
- A digital twin of the systems has been created
- A simulation tool to help the fleet management staff of FGC is provided

Maintainer's point of view: from Project to Operation 4/4

To be done before changing the maintenance scheme of the FGC locomotives

The new maintenance has to be as safe as the current one. It also has to increase the availability of the locomotives.

Therefore, we must apply the LOCATE measurement and calculation system in parallel with the current inspections. Compare the results in order to:

- Demonstrate the accuracy of the method
- Estimate the time between detection and defect and therefore the time given to the fleet management to organise the interventions by minimising the time required for maintenance

Advisory Board Request for Comments:

- Is any of the Advisory Board members implementing (or knows about) a similar solution to LOCATE system? If so, how is it being implemented? How are the maintenance schemes evolving in that sense?