



# FROM CYCLICAL TO PREDICTIVE MAINTENANCE IN RAILWAY INFRASTRUCTURES



Porto, 5 November 2021

# The FS Italiane Group



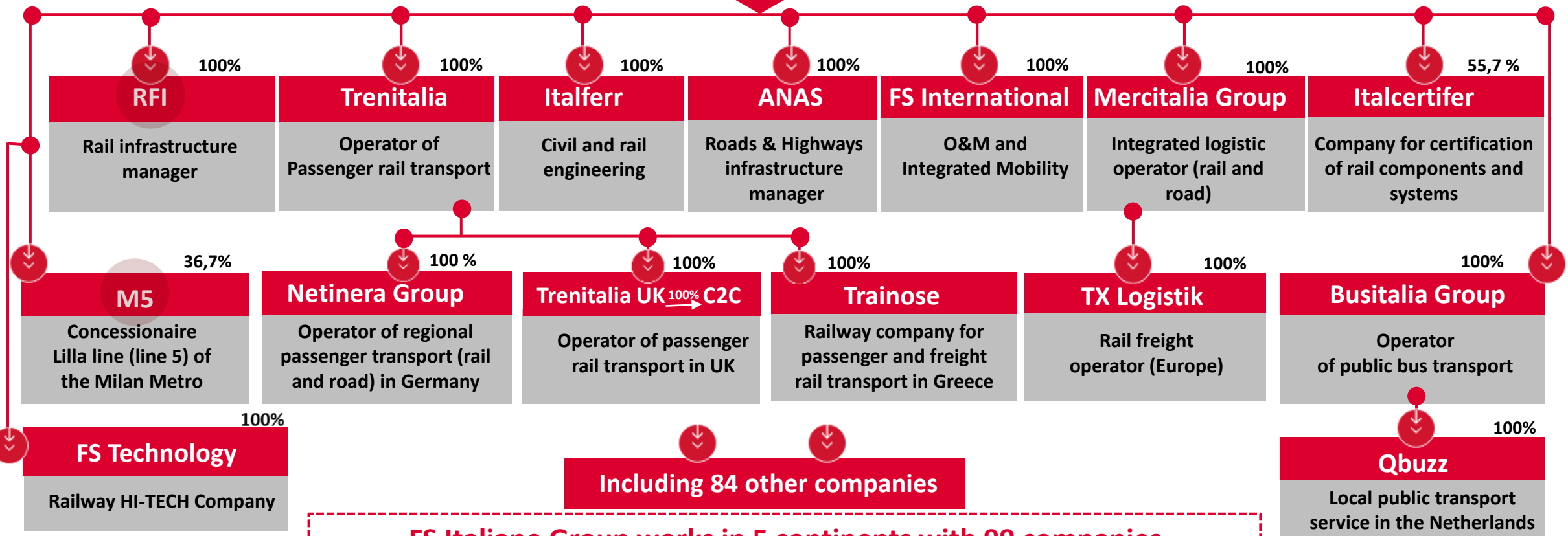
# FS Italiane: one of the largest industrial groups in Italy

Ministry of Economy and Finance

Ministry of sustainable infrastructures and mobility

100%

**Ferrovie dello Stato Italiane**



**FS Italiane Group works in 5 continents with 99 companies**



## RFI – Rete Ferroviaria Italiana S.p.A.

RFI is the company of the **FS Italiane Group** with the public role of Infrastructure Manager.

As the body responsible for the lines, stations and systems, it **guarantees access to the italian network** to the various railway undertakings, **performs the maintenance** and ensures the **safe circulation** across the entire infrastructure, **manages the investments** for the upgrading and improvement of railway lines and installations and **develops the technology** of systems and materials.

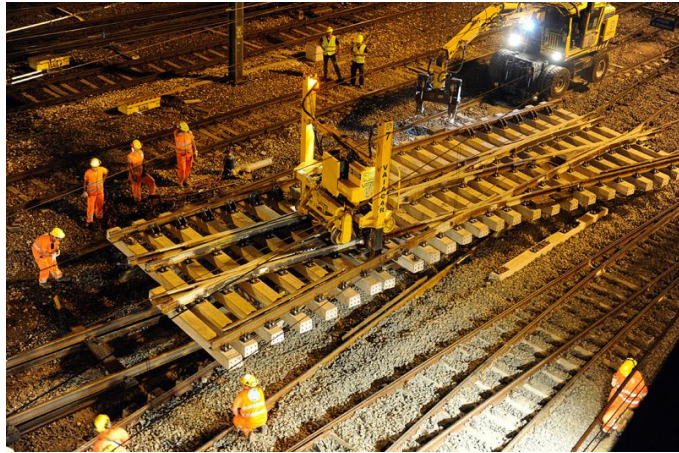


# The scenario



# The scenario

Maintenance or traffic?

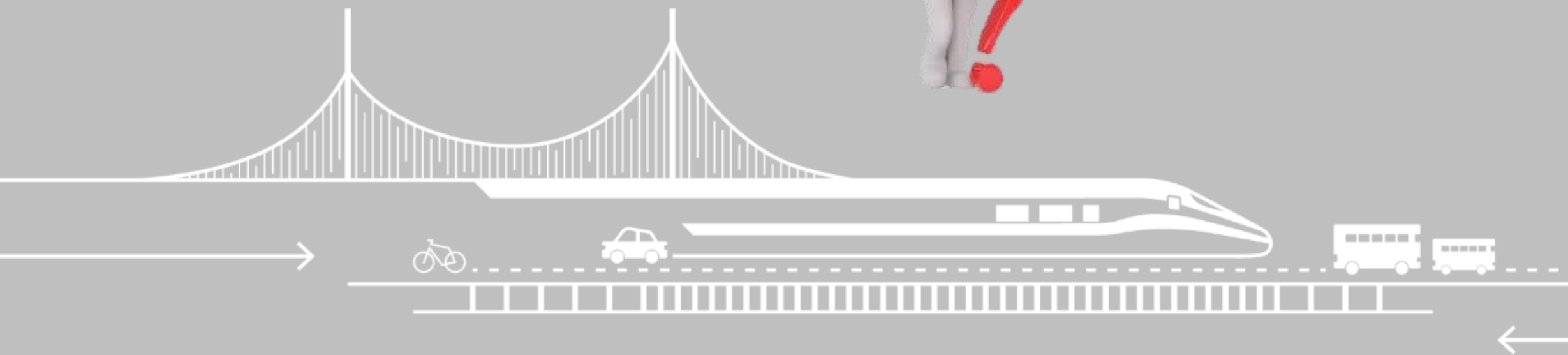


## How to face the scenario at best?



- 1. Reducing infrastructure ordinary maintenance needs**
- 2. Reducing maintenance interventions length**
- 3. Optimizing maintenance scheduling**

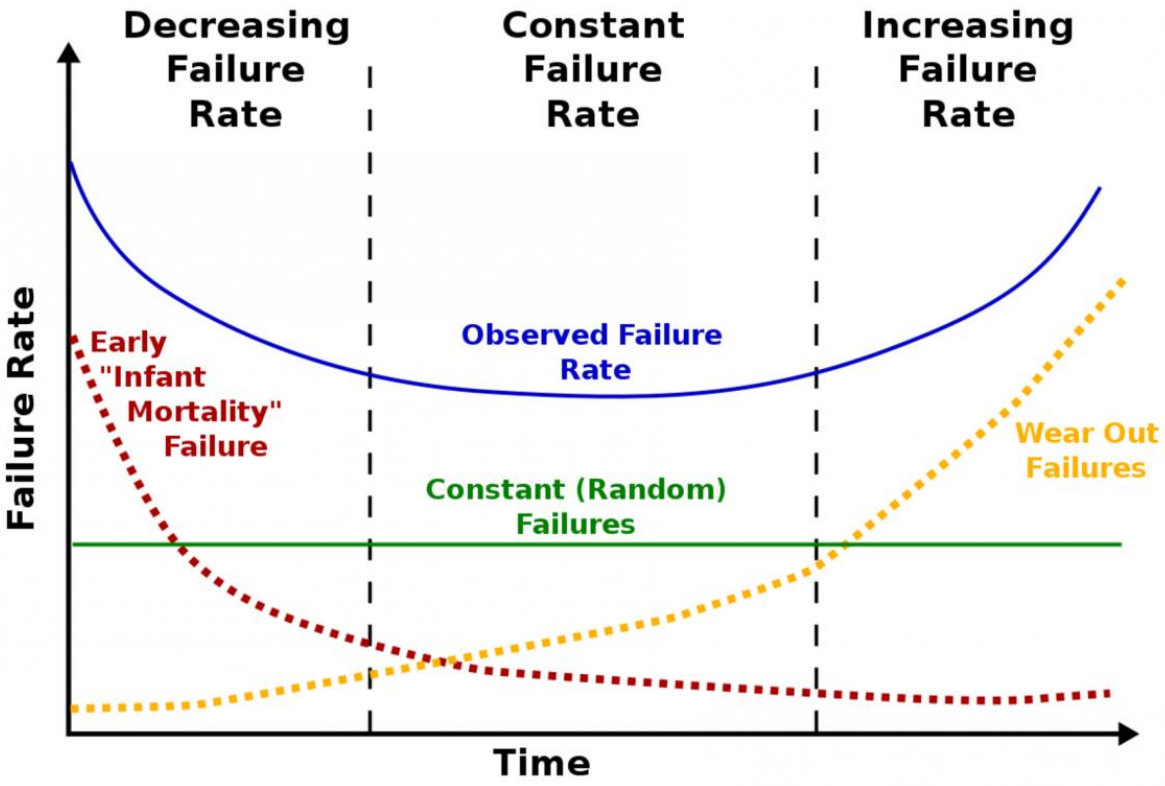
**How to reduce ordinary  
maintenance needs?**





# How to reduce infrastructure ordinary maintenance needs? (1/3)

By renewing infrastructure (extraordinary maintenance)



# How to reduce infrastructure ordinary maintenance needs? (2/3)

By up-grading infrastructure (improvement maintenance)



High strength and friction ballast



Prestressed concrete sleepers



R260 Hard rails



Under Sleeper Pads



Flash weldings



Computer-based interlocking



LED signals



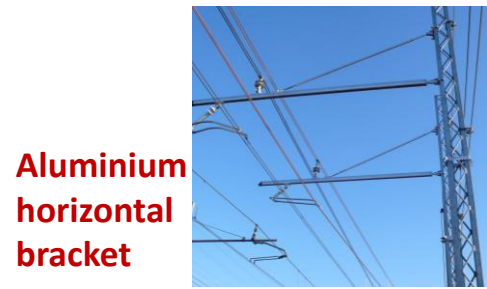
Electronic Relay



Armoured Cable



Cu-Ag and Cu-Mg contact wire



Aluminium horizontal bracket



New pulley tensioning device



Flexible cable dropper (Pendiflex)

# How to reduce infrastructure ordinary maintenance needs? (3/3)

## By improving maintenance procedures

### Preventive grinding

By rectifying rail profiles, the contact geometry wheel-rail is improved. This reduces the contact stresses, i.e. the ordinary maintenance needs.

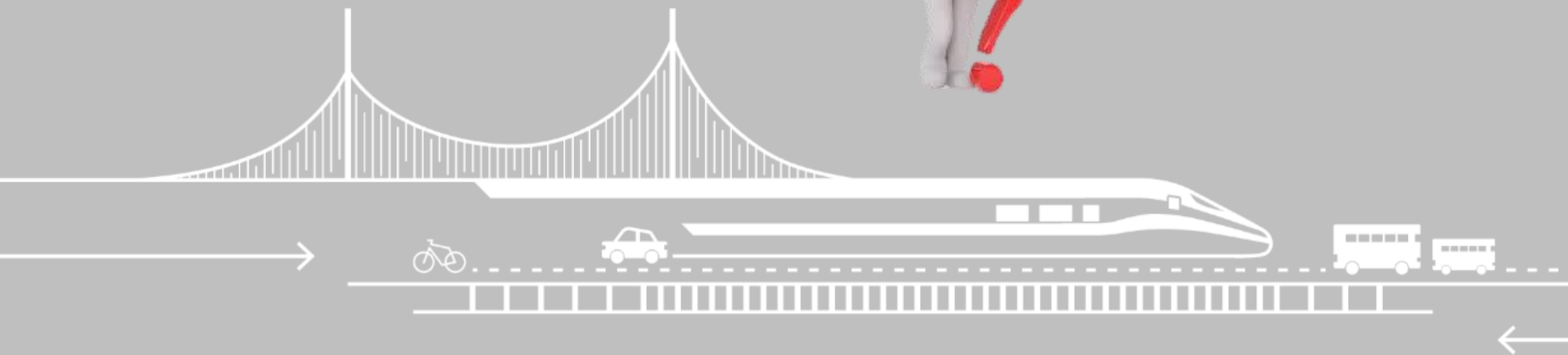


### Absolute track geometry

Tamping with reference to the design position of the track instead of the relative geometry reduces the dynamic loads, i.e. the ordinary maintenance needs.



**How to reduce maintenance interventions length?**

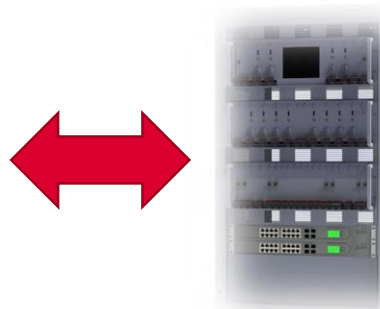


# How to reduce maintenance interventions length? (1/2)

By improving the effectiveness of track possession procedures



Traffic control room



Interlocking



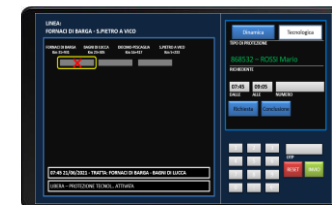
4G/LTE/5G



Railway infrastructure



Tablet



Maintainers

- The system allows maintainers to select via tablet the track circuits/sections to be possessed;
- The system allows maintainers to obtain track possession in real time;
- No printed forms are required;
- The overall system is SIL4.

# How to reduce maintenance interventions length? (2/2)

By adopting high performance maintenance equipment



## Rail road loaders

Able to lift up to 11 tons



## Rail road vehicles

For bridge inspection



## Multipurpose vehicles

Able to move in traffic at 140 km/h

## Multipurpose tamping machines

For track and turnouts tamping, ballast profiling and TG recording, able to move in traffic at 100 km/h.

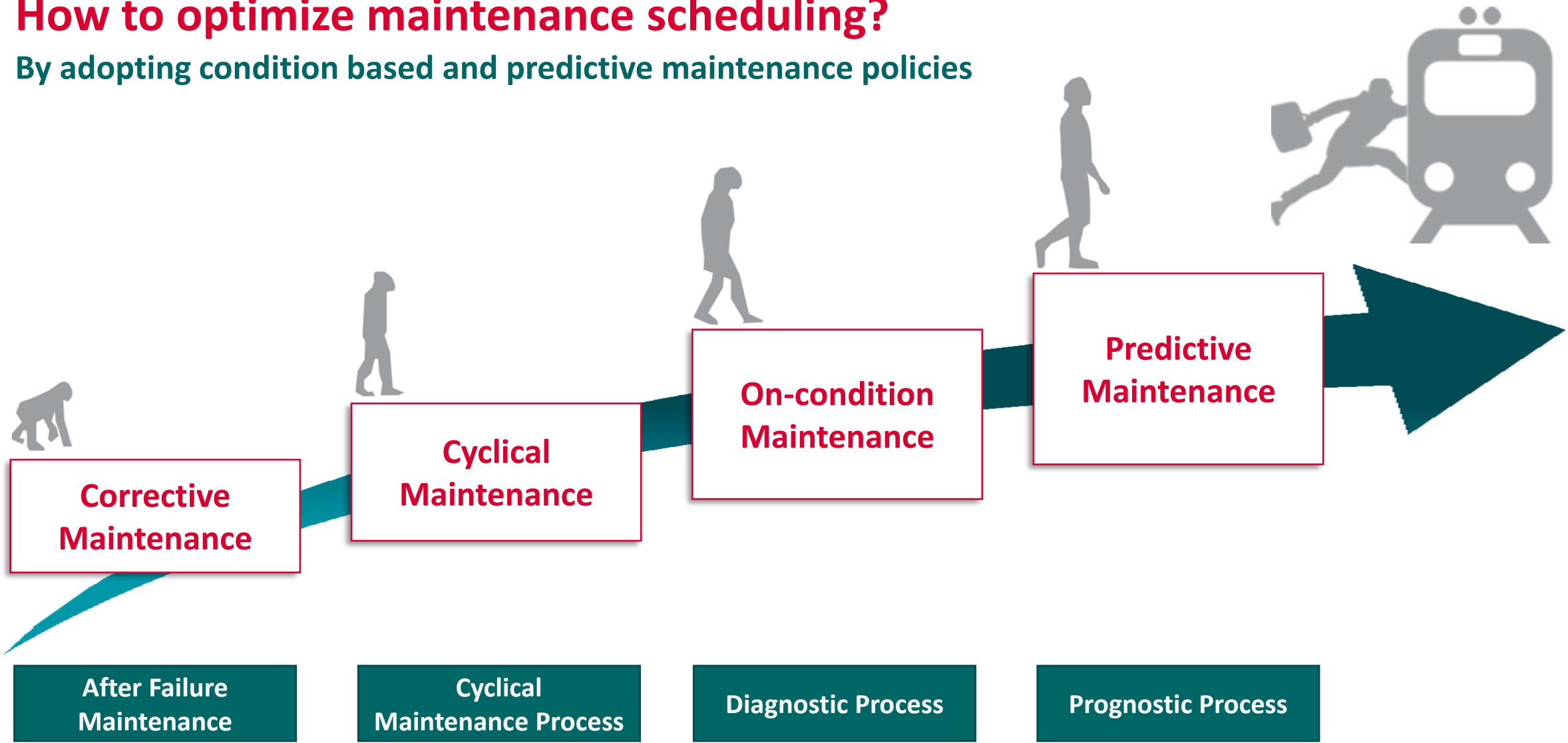


**How to optimize maintenance scheduling?**



# How to optimize maintenance scheduling?

By adopting condition based and predictive maintenance policies





# Which benefits may be achieved by adopting infrastructure diagnostics?



Visual inspections  
Manual measurements



Diagnostics

DIAGNOSTICS

PERMANENT  
DIAGNOSTICS

MOBILE  
DIAGNOSTICS



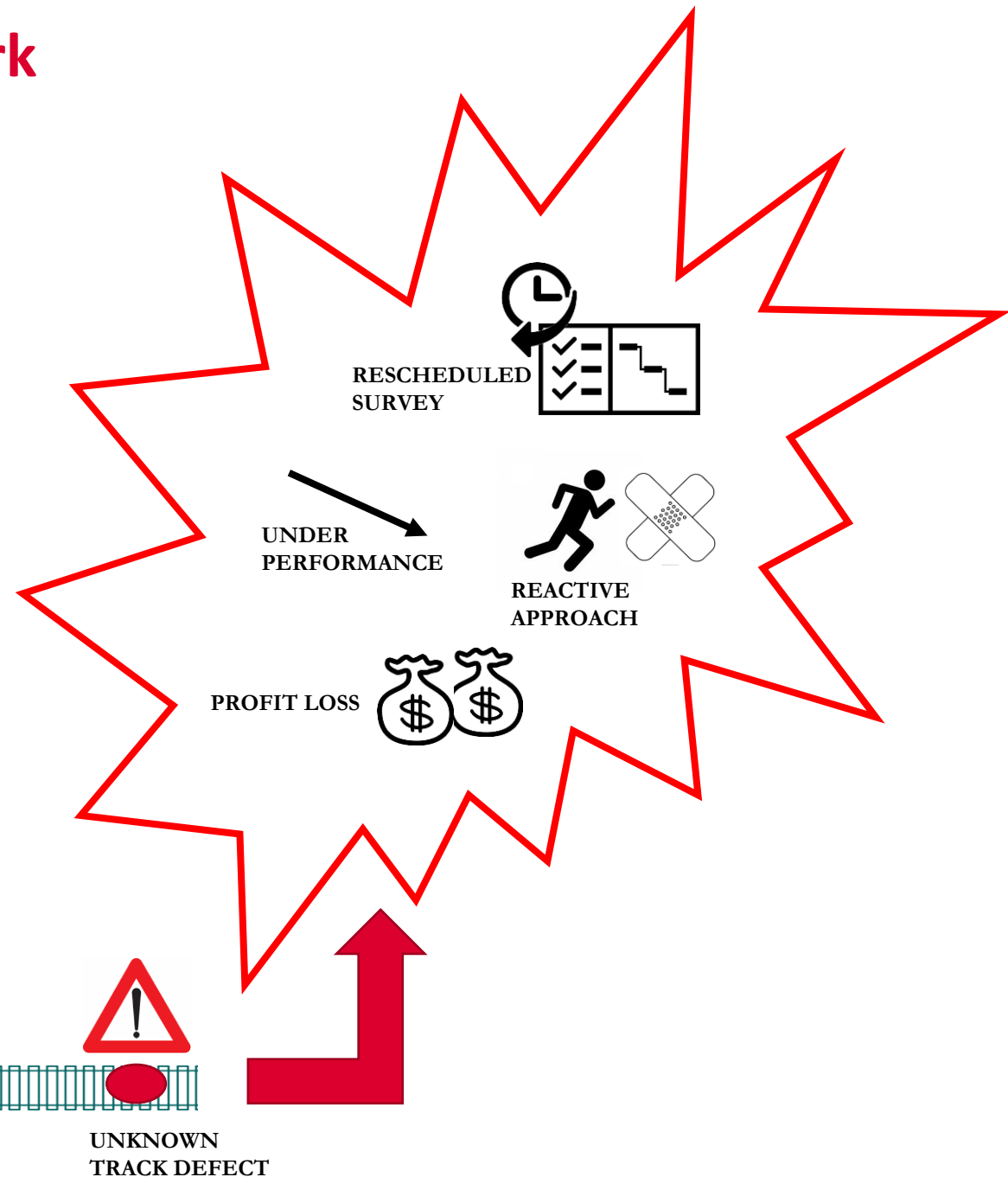
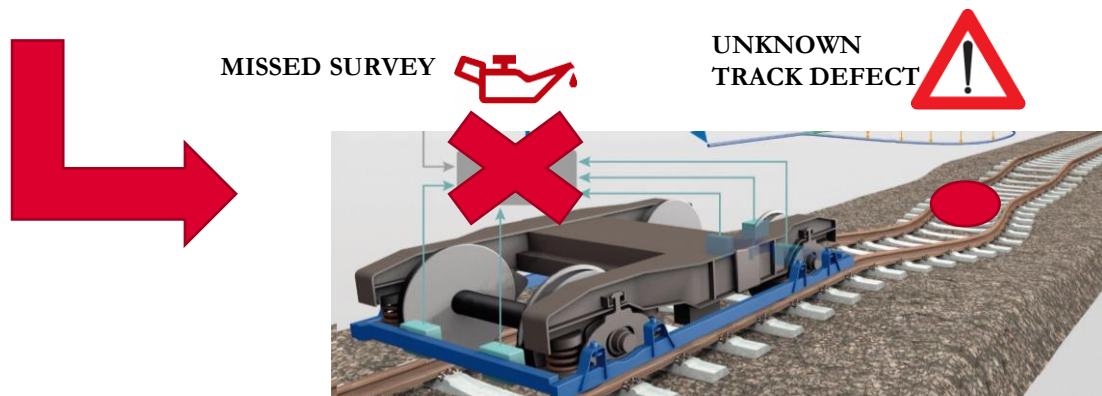
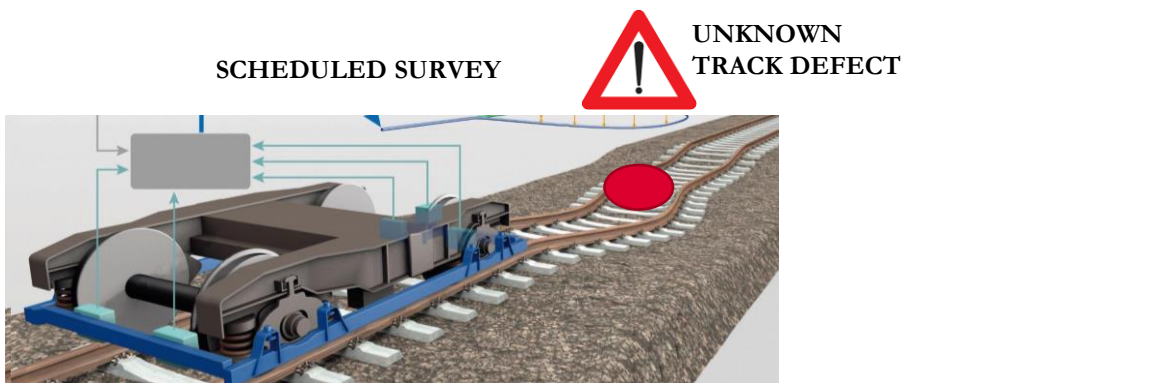
## Benefits:

- ✓ Improved safety;
- ✓ Improved ergonomoy;
- ✓ Improved objectivity;
- ✓ Improved traceability;
- ✓ Improved accountability;
- ✓ Improved effectiveness;
- ✓ Data driven maintenance policies.

- Interlocking
- Rail temperature monitoring
- Hot Axle Box detectors
- Multifunctional monitoring gates
- Vertical loads detectors

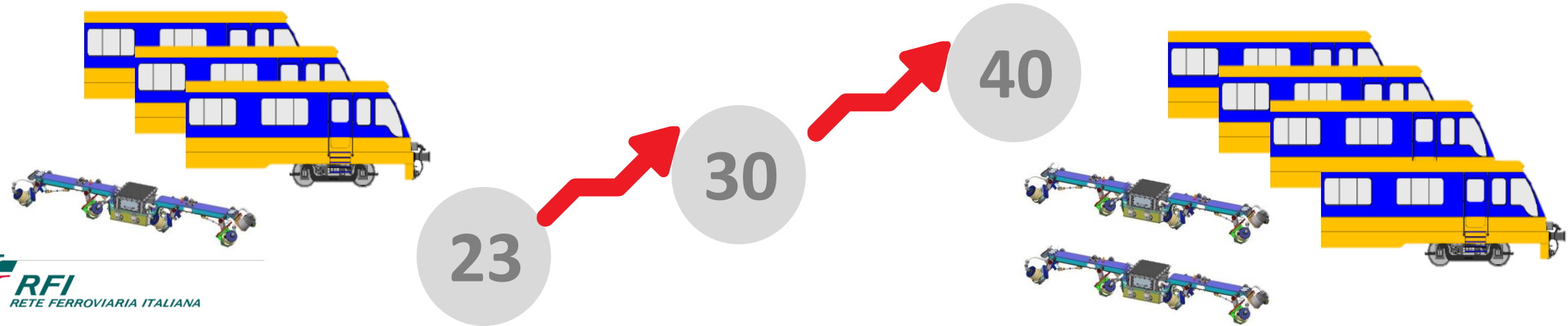
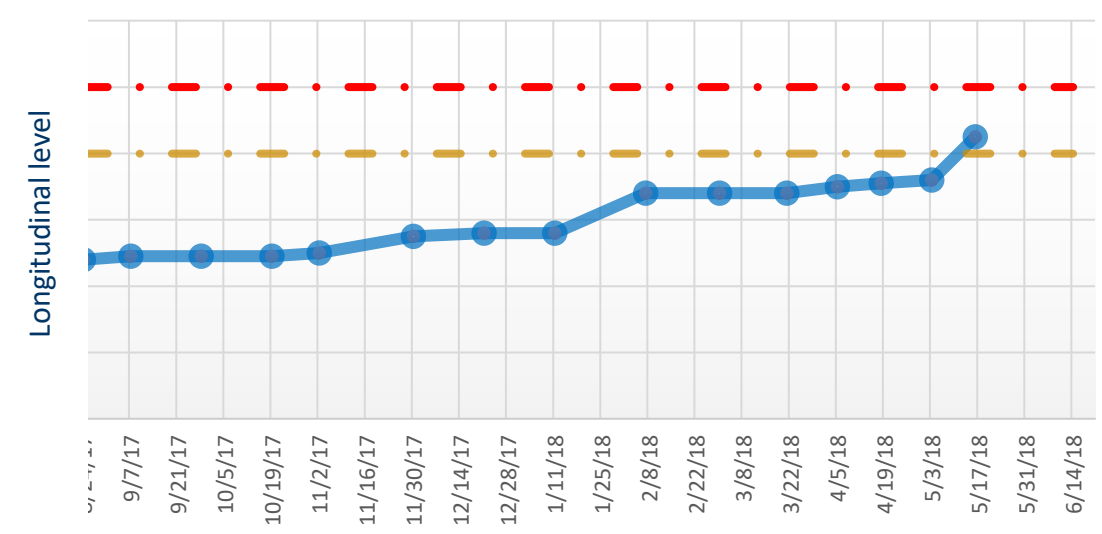
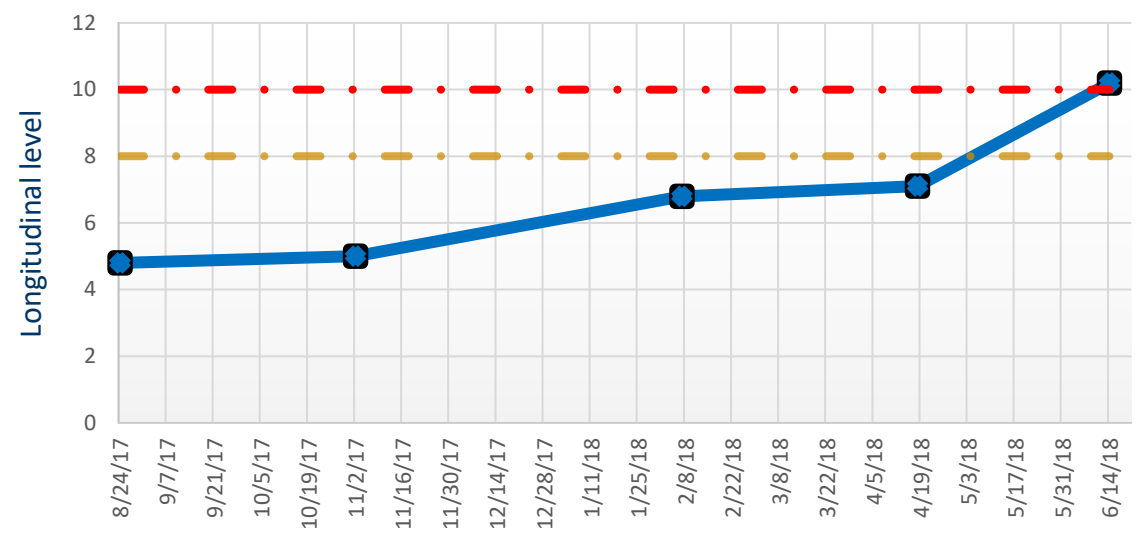
- National fleet
- Regional fleets

# Vulnerability of the «as is» framework



# How to reduce missed surveys?

Fleet enhancement and redundancy of on board measuring systems



# The «to be» diagnostic fleet



## TRACK – OCS – SIG - TLC

- 1<sup>st</sup> Class lines** (2-weeks)
- 2<sup>nd</sup> Class lines** (2-Months)
- 3<sup>rd</sup>/4<sup>th</sup> Class lines** (4/6-Months)
- Nodes, yards and junctions** (4/6-Months)

## UT – MUIF – SIG

**Entire Network**  
(6/12/24 Months)

**TYPE 3**

2

**TYPE 1**

5

**TYPE 4**

15

**Aldebaran 2.0**

1

**Sirter**

1

**Falco1 / Falco2**

2

**K12**

3

**Galileo 2.0**

1

**TYPE 2**

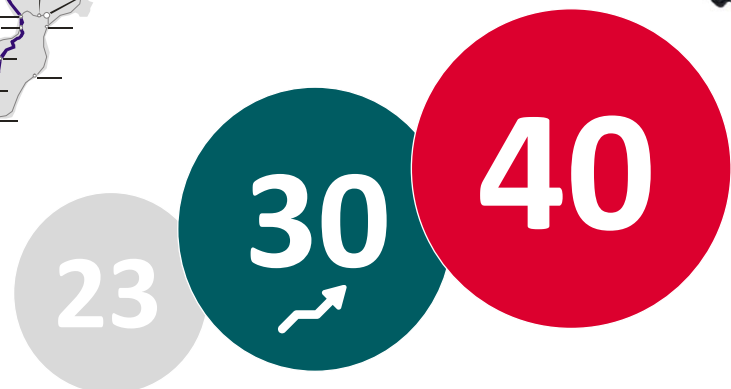
7

**MUIF**

2

**Caronte 2.0**

1



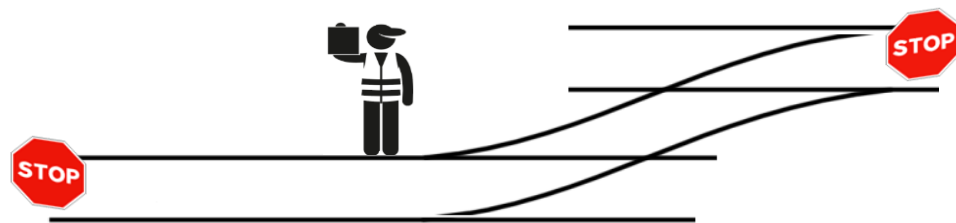
# Work in progress

From unloaded to loaded measurement of switch parameters



The benefits:

- ✓ Loaded measurements
- ✓ Increased productivity
- ✓ Increased ergonomomy
- ✓ No track possession required
- ✓ Automatic data recording and transmission
- ✓ Centralised process
- ✓ Improved traceability





# Work in progress

## ISO EN 17025 certification



Certification to be issued by Accredia in compliance with the ISO EN 17025 standard, concerning the competence of testing and calibration laboratories.

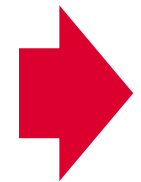


**First step:**

**Track Geometry and rail wear mobile diagnostics**

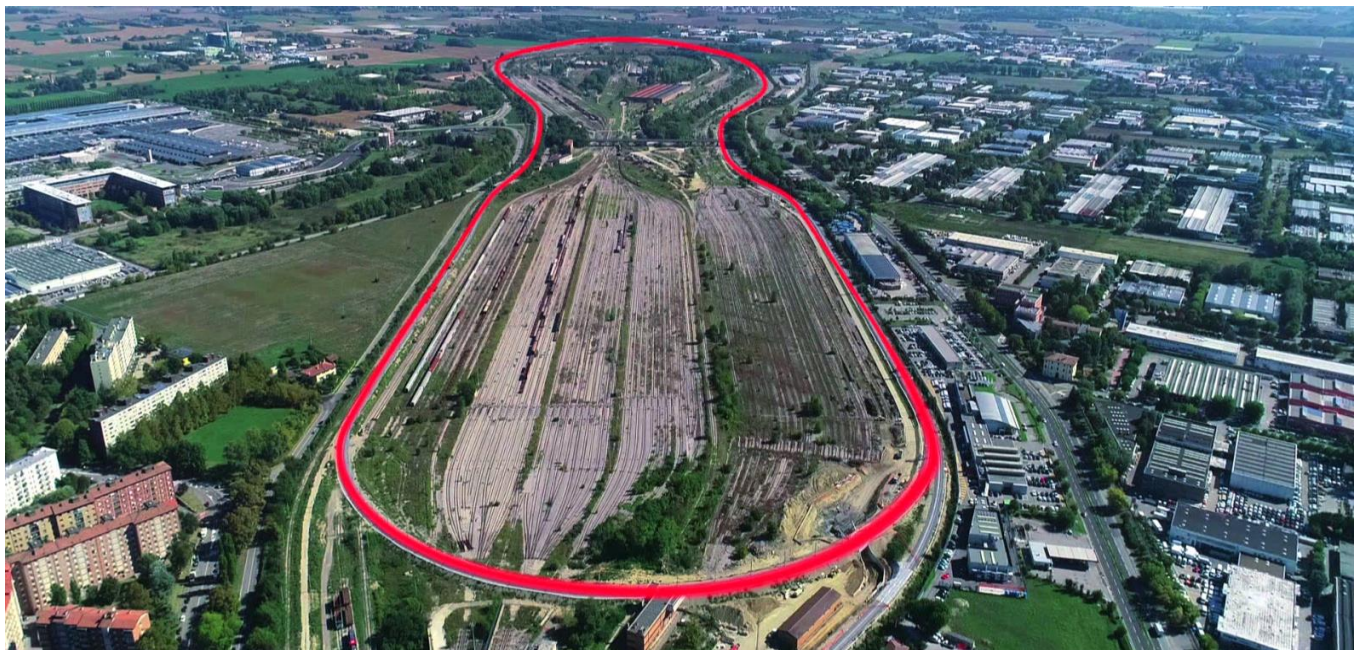
**REGULATOR**  
rely on

**NATIONAL ACCREDITATION BODIES**  
which verify the competence of

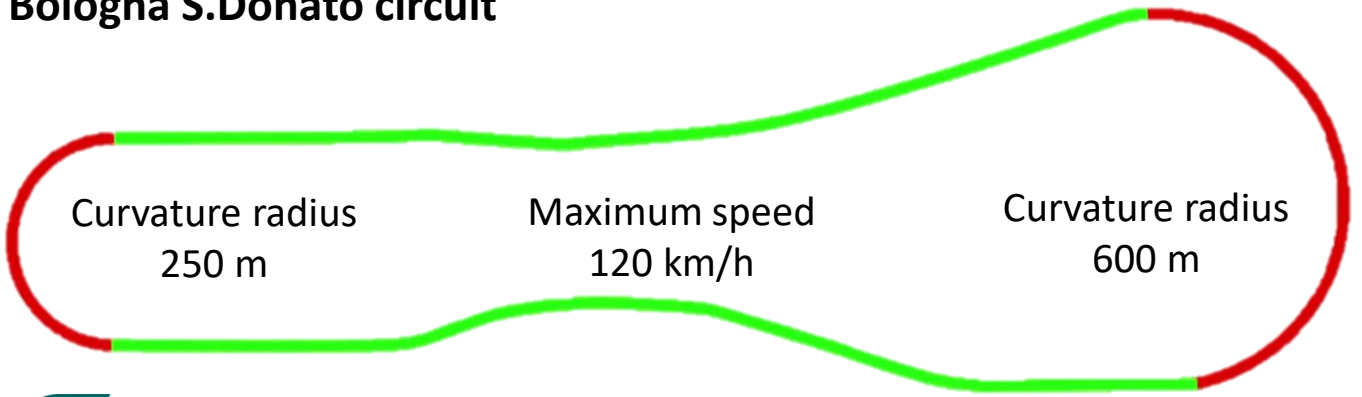


# Work in progress

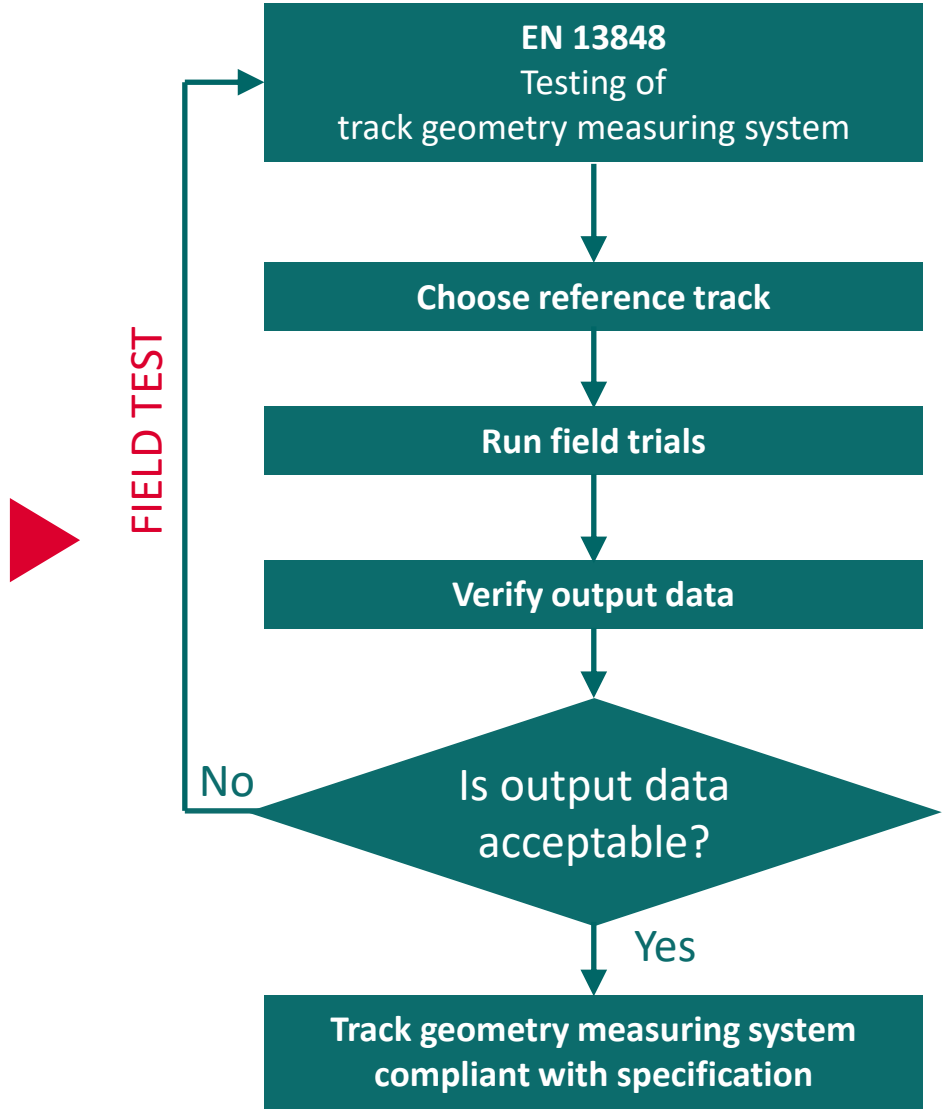
## Ongoing studies to build a FATT: Freely Adjustable Test Track for TGRV calibration



Bologna S. Donato circuit



Total length: 6000m





# The “as is” data analysis and validation process

## Redundancy in validation process

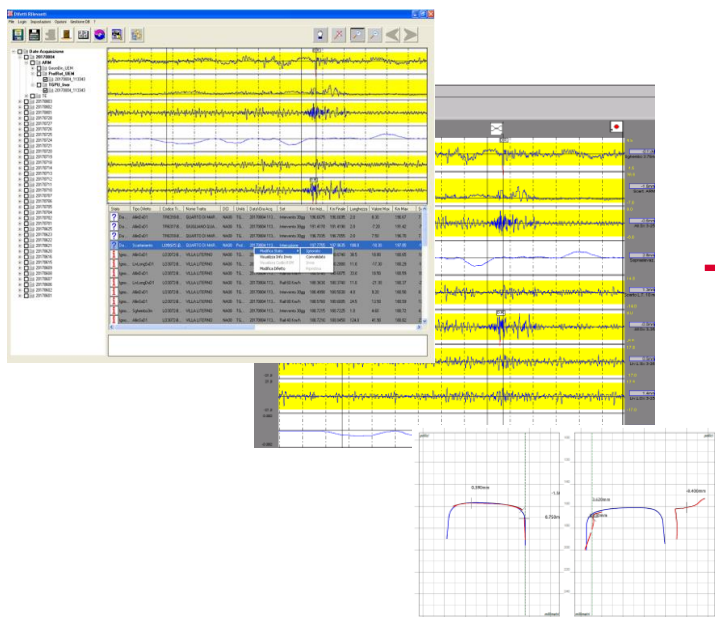
DATA COLLECTION



DATA ANALYSIS



MAINTENANCE



Defects list

ACT

PLAN

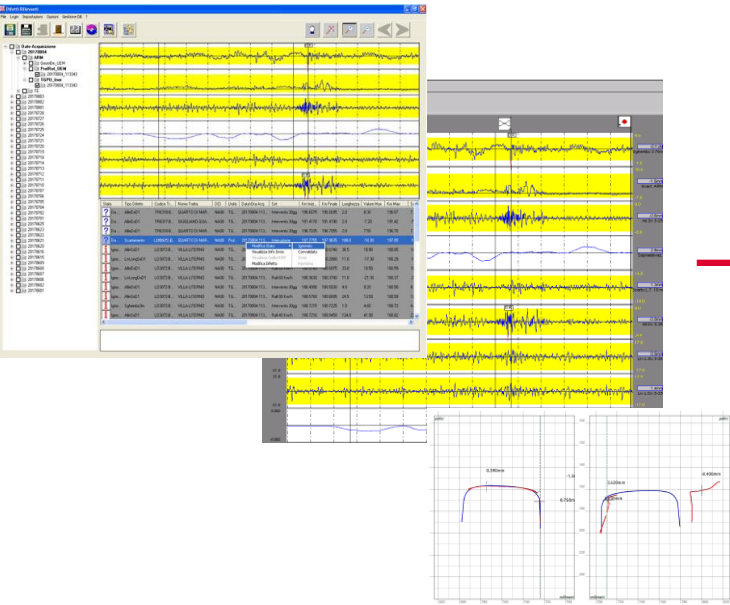
MONITOR

NO MAINTENANCE

# Work in progress

## Introducing AI for data validation

DATA COLLECTION



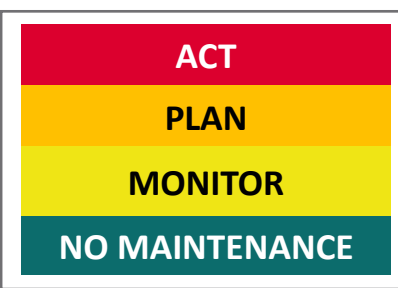
DATA ANALYSIS



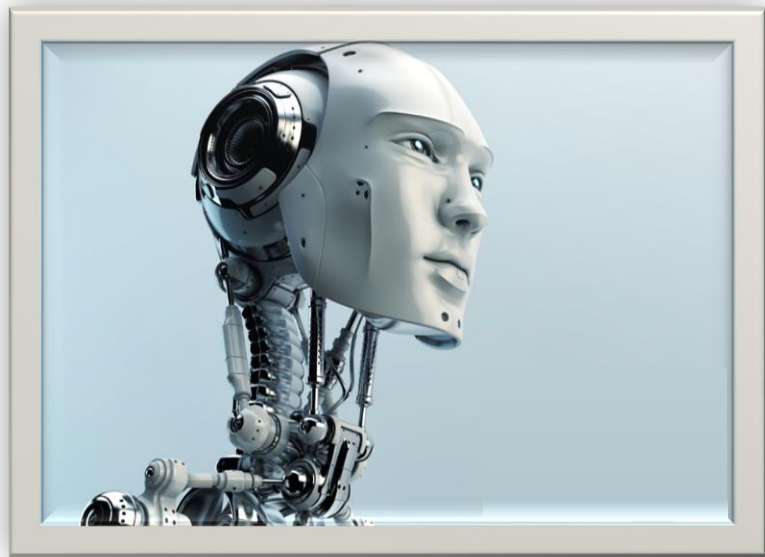
MAINTENANCE



Defects list



## Final thoughts



Artificial Intelligence can help to better identify and classify infrastructure defects...  
 ...Artificial Intelligence can also help to predict defects...

**...but don't forget to keep human knowledge continuously trained, you still may need it!**





# Thank you!

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