Using Operational Data for the Future Maintenance of the French Rail Infrastructure

Presented by

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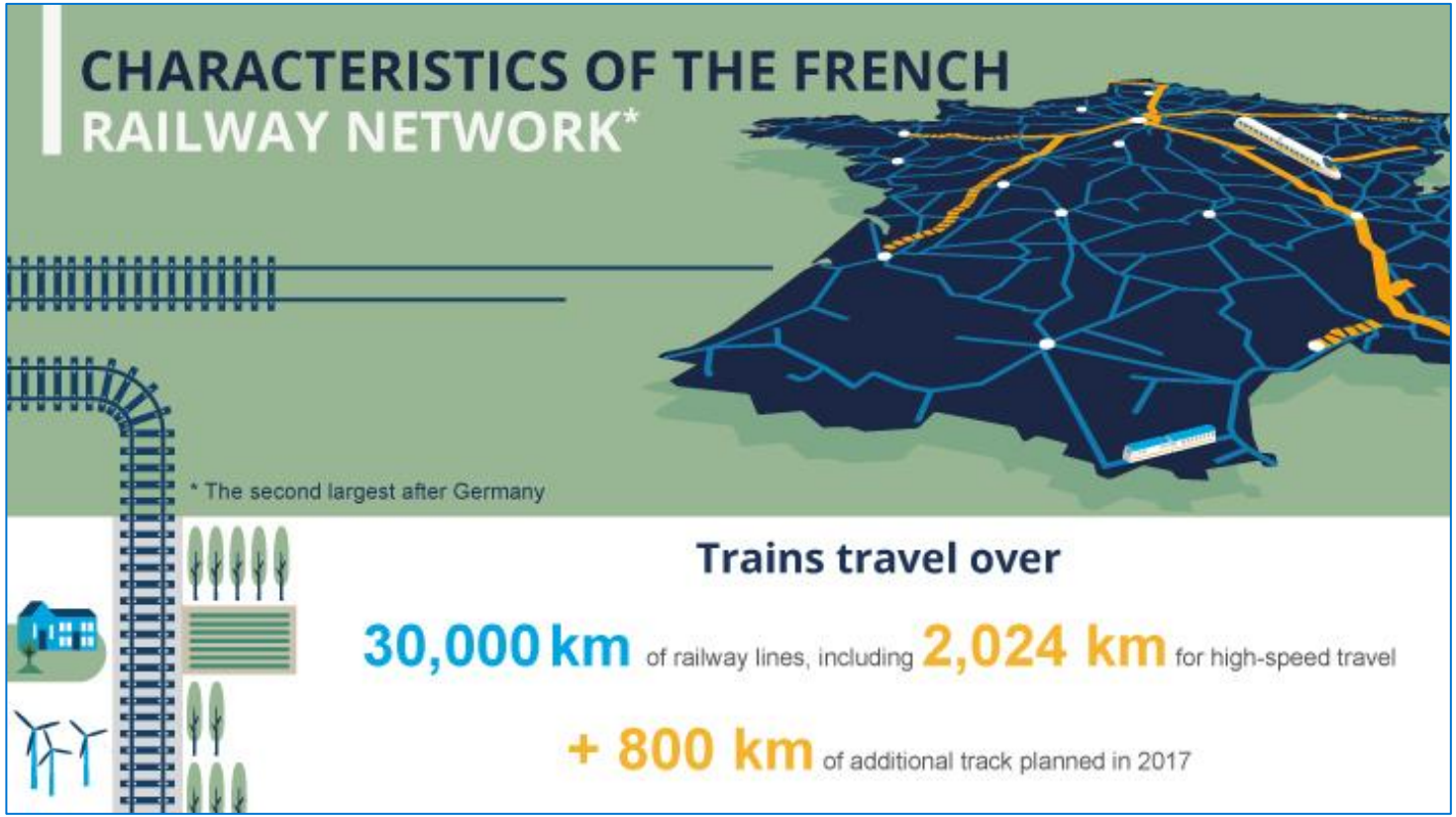
SNCF RÉSEAU

DATAPRED

Agenda

- SNCF Réseau
- The stakes for Maintenance
- Why the PI System for SNCF Réseau ?
- Use Cases

SNCF Réseau : key figures (1/2)



SNCF Réseau : key figures (2/2)

SNCF Réseau : businesses

Engineering & Projects

Guaranteeing access to the network

Maintenance & Works

Traffic Management

SNCF Réseau Maintenance Transformation

TRANSFORMATION — LEVERS

IMPROVE SURVEILLANCE

- **REMOTE MONITORING DEPLOYMENT**
- **NEW TECHNOLOGIES**
  (sensors, wireless, connected objects,…)
- **EQUIPMENT SURVEILLANCE**
  (static & onboard measurements)

LIMIT IMPACTS ON TRAFFIC

ANTICIPATE INCIDENTS

EVOLUTION OF MAINTENANCE POLICIES

- **REINFORCE NETWORK SUPERVISION**
  - *Regional Remote Monitoring Centers*
- **ASSET MANAGEMENT**
  - *Define and adjust degradation curves*
  - *Capitalize on asset knowledge to define new maintenance policies*

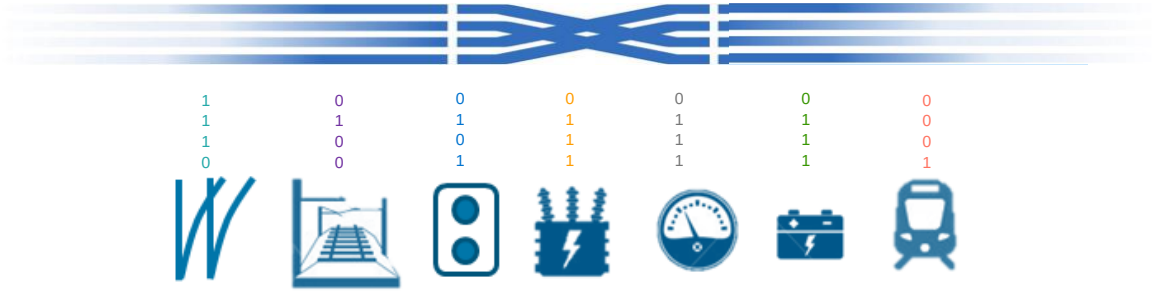
Why the PI System ? 1/2

SNCF RÉSEAU

+

OSIsoft.

- **Rediscover our assets** by leveraging 10+ years collected field data
- **Deploy new analyses** and tools, designed and implemented by and for the maintenance personel
- **Open perspective** to (smart) asset management
- **One single place** to easily access field data



Why the PI System ? 2/2

Users & Applications

PI Tools

Web Portal

Advanced Analytics

Scheduled

CMMS

GIS

Field Data Infrastructure

PI Server

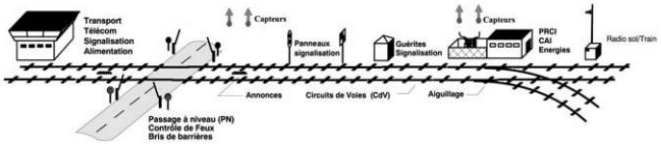
Field Data Sources

PI Interfaces

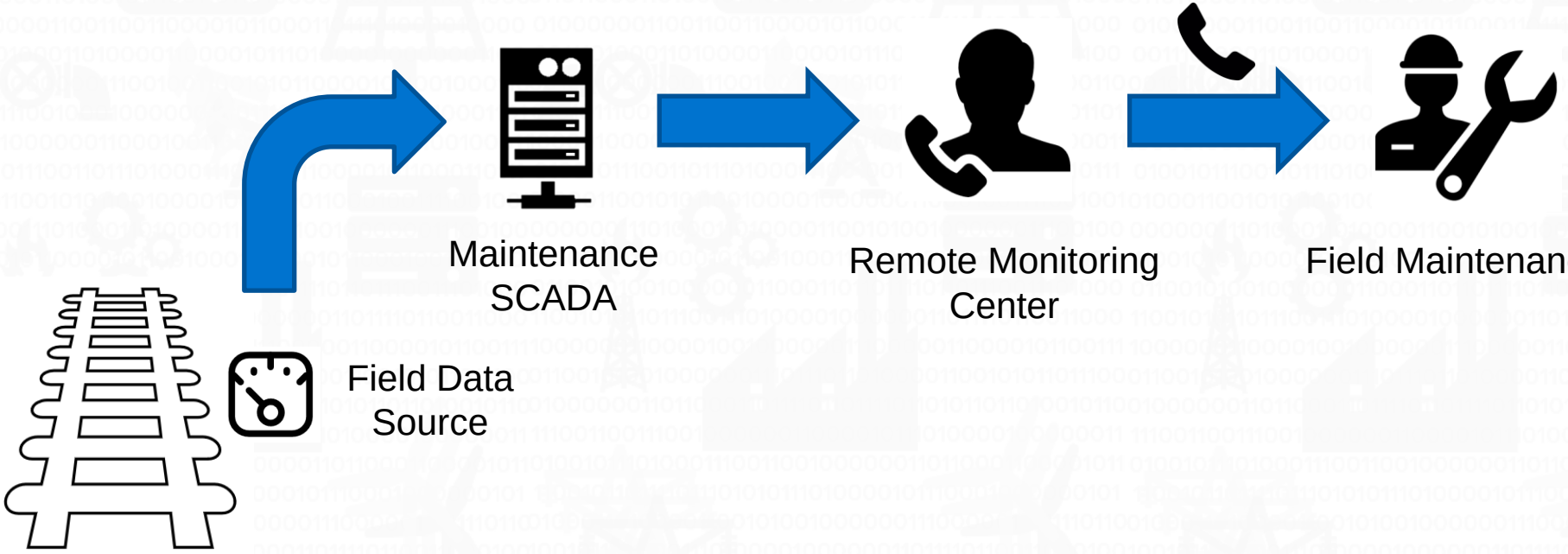
Remote Monitoring Data Concentrators

Weather Stations

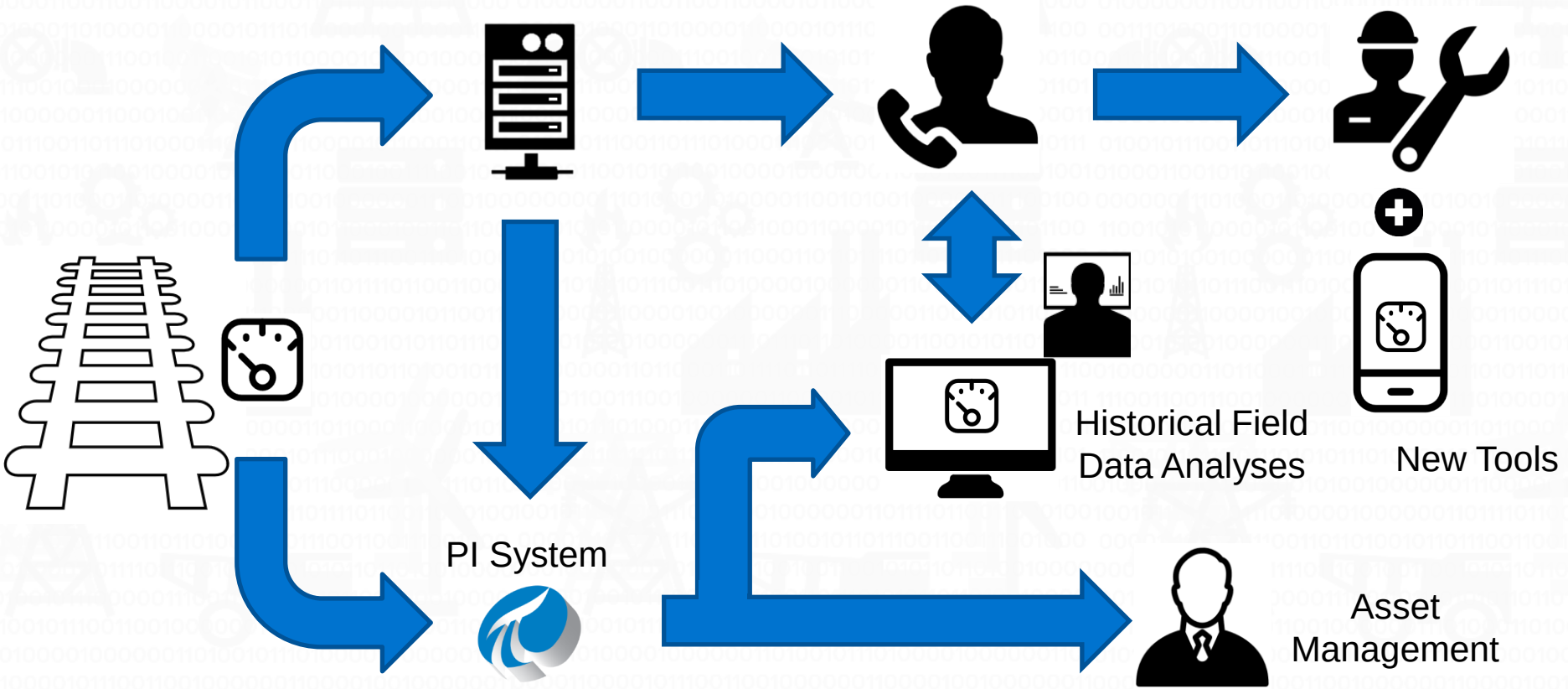
IoT Platform IBM Watson



Using Field Data for Maintenance: Before PI System

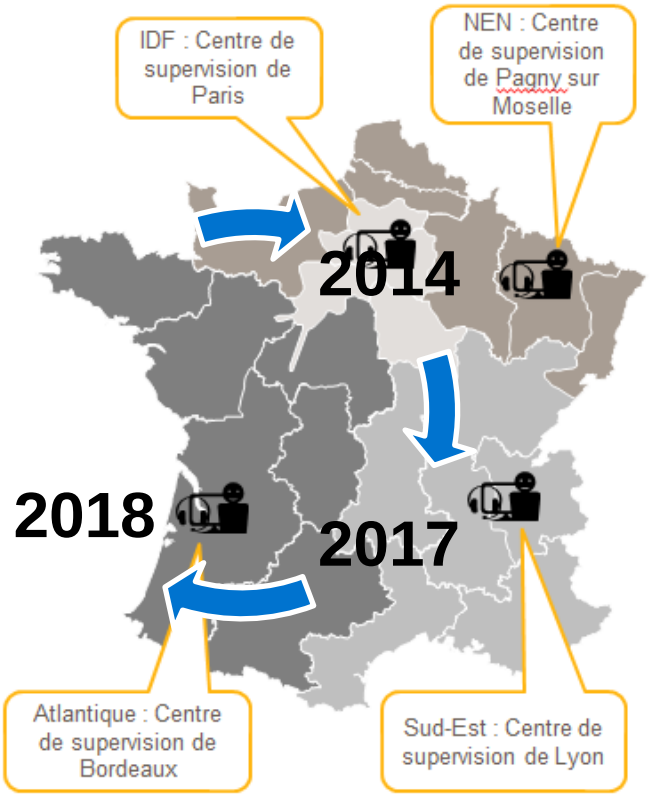


Using Field Data for Maintenance: With PI System



National Deployment to our 4 Regional Divisions

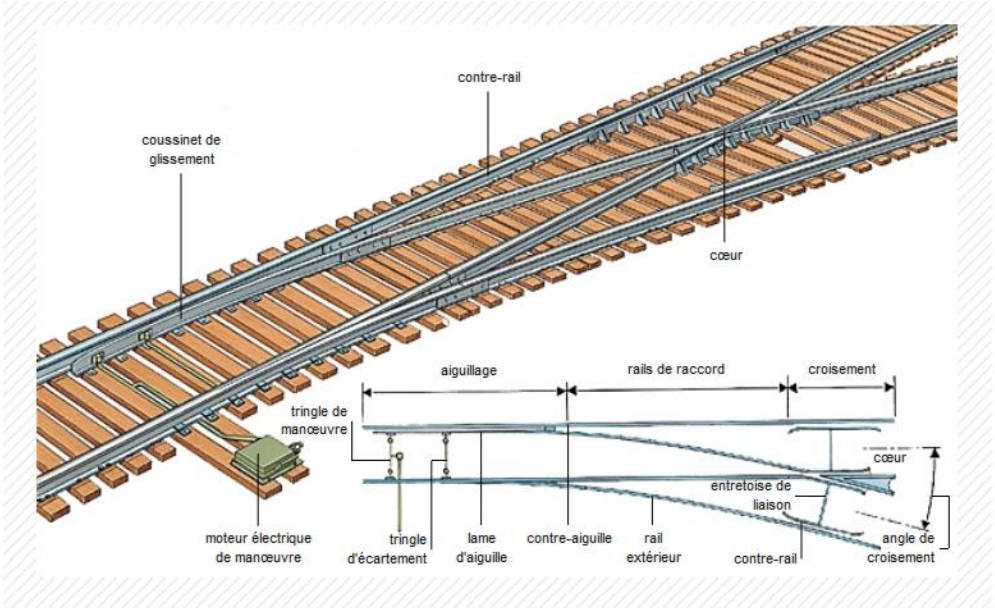
SNCF RÉSEAU + OSIsoft



Railway Infrastructure Terminology 1/3

Railroad Equipment

Two-tracks railroad switch, actuated by an electric motor, from a signal box



Branchement à deux voies

Branchement à deux voies, système d'aiguillage permettant à une voie de se dédoubler.

Railway Infrastructure Terminology 2/3

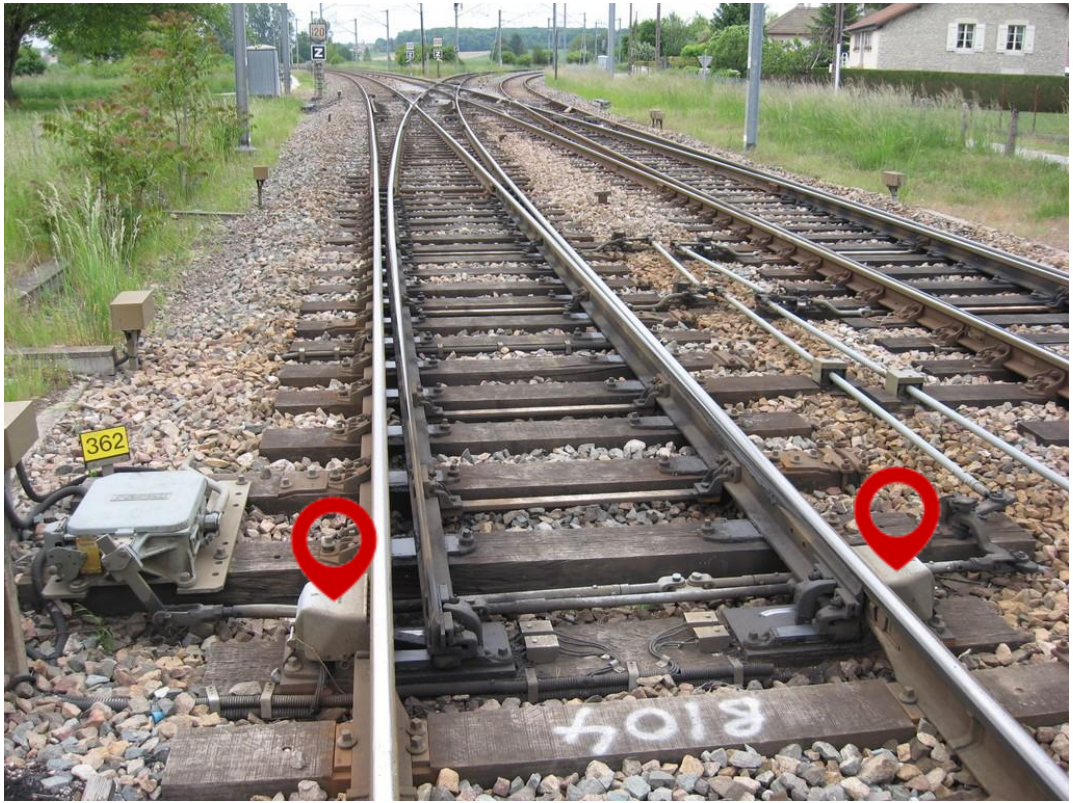
Railroad Equipment

- Electric switch motor with power sensors (SCAG)

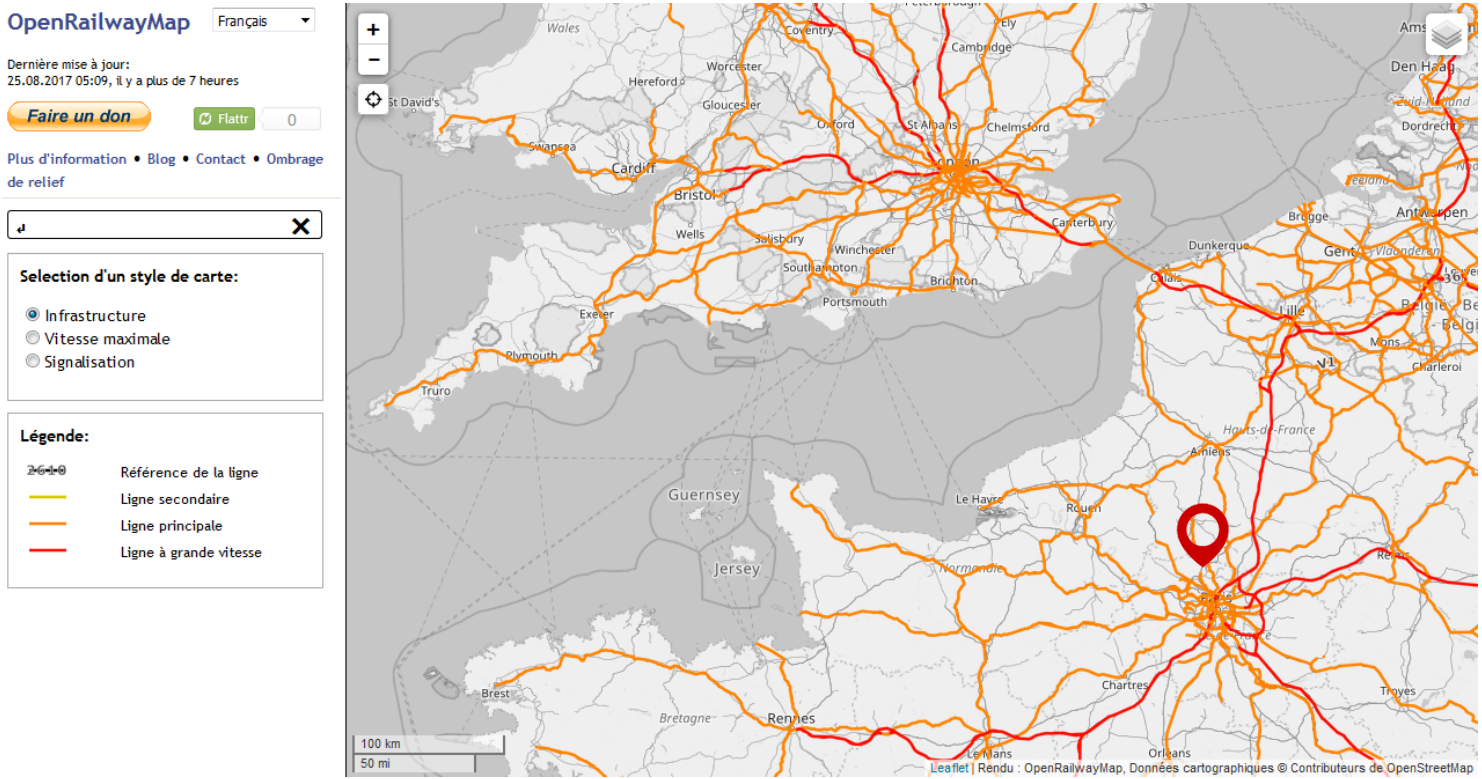
Railway Infrastructure Terminology 3/3

Railroad Equipment

- Electric switch motor with power sensors (SCAG)
- Point blades with half-open sensor (SKAG)

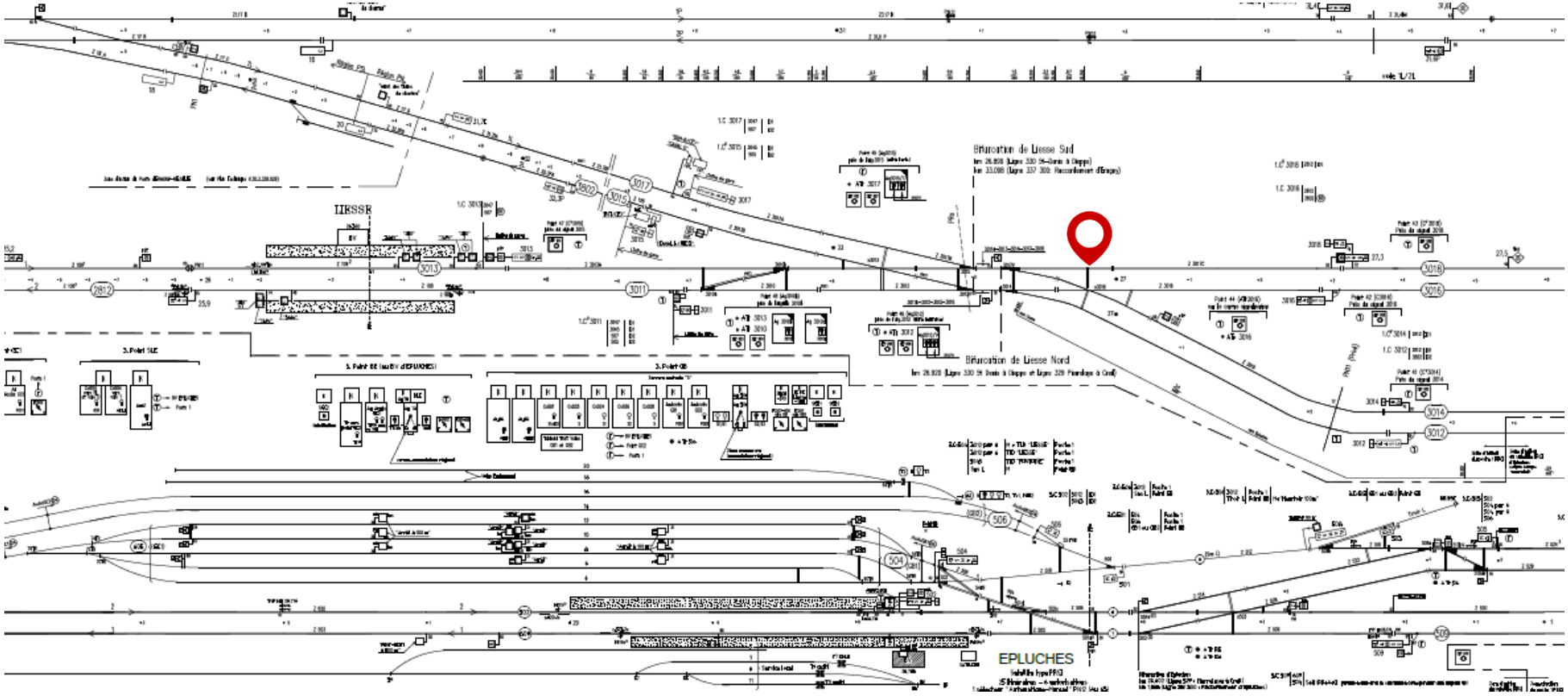


Railroad Switch #3017

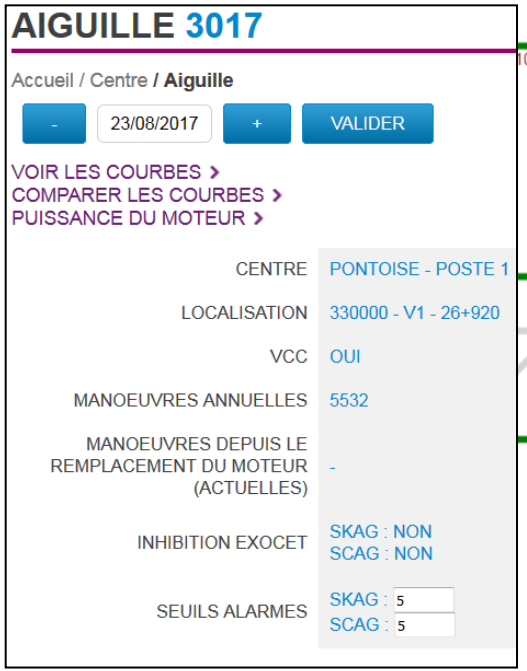


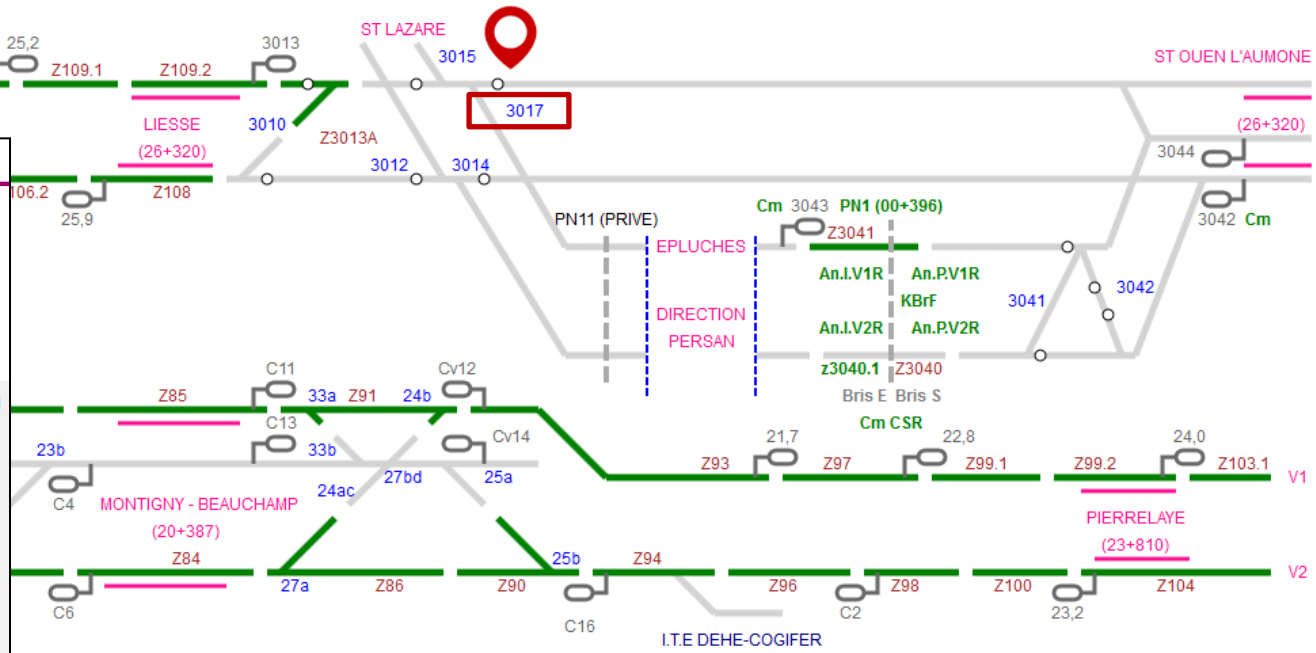
Railroad Switch #3017

Railroad Switch #3017



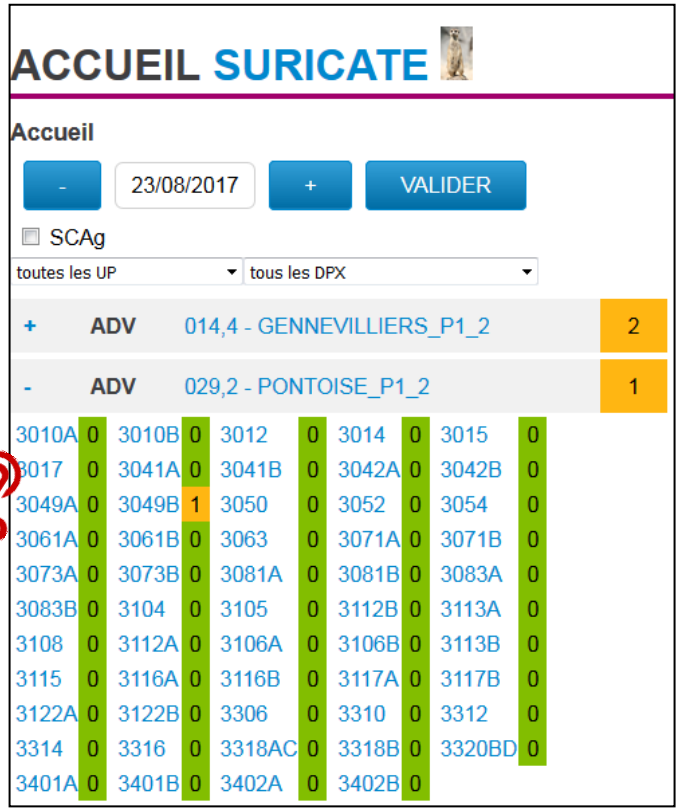
Dynamic View of Railroad Switch #3017 in Context

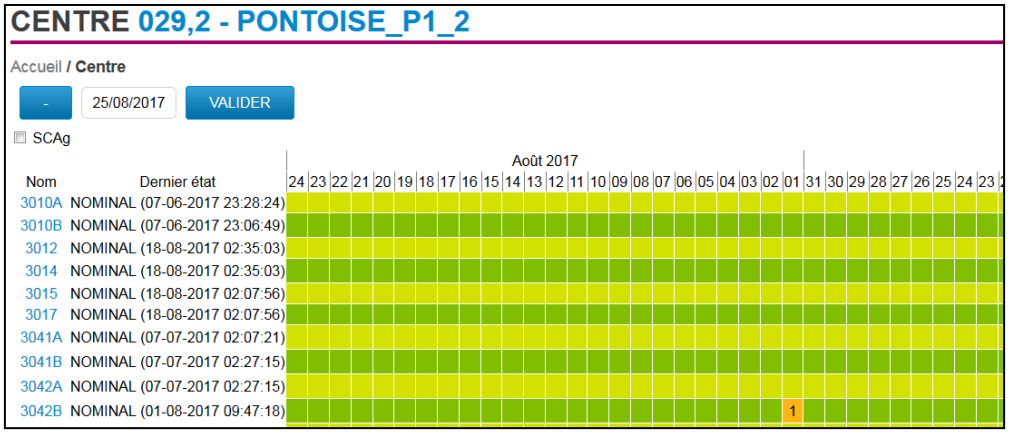




Asset Key Information

Maintenance Dashboard : Assets Condition KPIs at a Glance





Historical Drill-Down

Post-Incident Manual Entry : On-Site Feedback into PI Server

RETOUR D'EXPÉRIENCE

REX

LISTE DES REX

REX-20160712-PV2
REX-20161130-3014
REX-20170105-1501b
REX-20170112-1501a

DÉTAILS

CENTRE	014,9 - VILLIERS LE BEL _PRCI
OBJET	ADV / 1501A
DATE	12/01/2017
DÉRANGEMENT ÉVITÉ	OUI / NON
DESCRIPTION	Manque de graissage dur mécanique lors de la translation.Vu avec les déclenchements d'alarmes SCAG et analyse des courbes.
IMAGE	

List of incident feedback

Location

Asset

Date

Was traffic impacted ?

Reason

Picture

Self-Service Access to Switch Motor Curves

LISTE DES COURBES 3017

Accueil / Centre / Aiguille / **Liste des courbes**

Du 15/08/2017 au 23/08/2017 VALIDER

☐ Afficher uniquement les courbes en défaut

Date	SKAg
23-08-2017 20:31:05,6	NOMINAL
23-08-2017 20:28:13,6	NOMINAL
23-08-2017 19:42:21,6	NOMINAL
23-08-2017 19:37:39,6	NOMINAL
23-08-2017 18:09:32,6	NOMINAL
23-08-2017 18:03:51,6	NOMINAL
23-08-2017 15:53:23,6	NOMINAL
23-08-2017 15:48:47,6	NOMINAL
23-08-2017 11:09:43,6	NOMINAL
23-08-2017 11:03:55,6	NOMINAL
23-08-2017 09:45:32,6	NOMINAL
23-08-2017 09:42:49,6	NOMINAL
23-08-2017 06:38:39,6	NOMINAL
23-08-2017 06:27:47,6	NOMINAL
23-08-2017 06:23:48,6	NOMINAL
23-08-2017 06:19:25,6	NOMINAL
22-08-2017 20:46:51,6	NOMINAL
22-08-2017 20:42:15,6	NOMINAL
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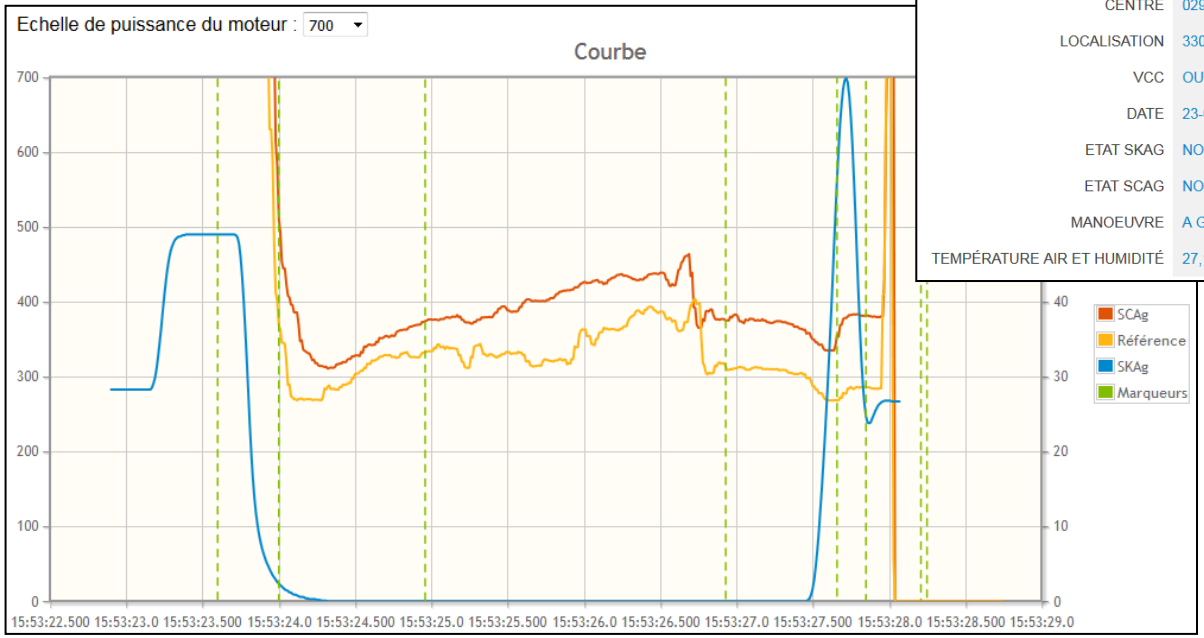
22-08-2017 19:49:22,6	NOMINAL
22-08-2017 19:45:33,6	NOMINAL



COURBE AIGUILLE 3017

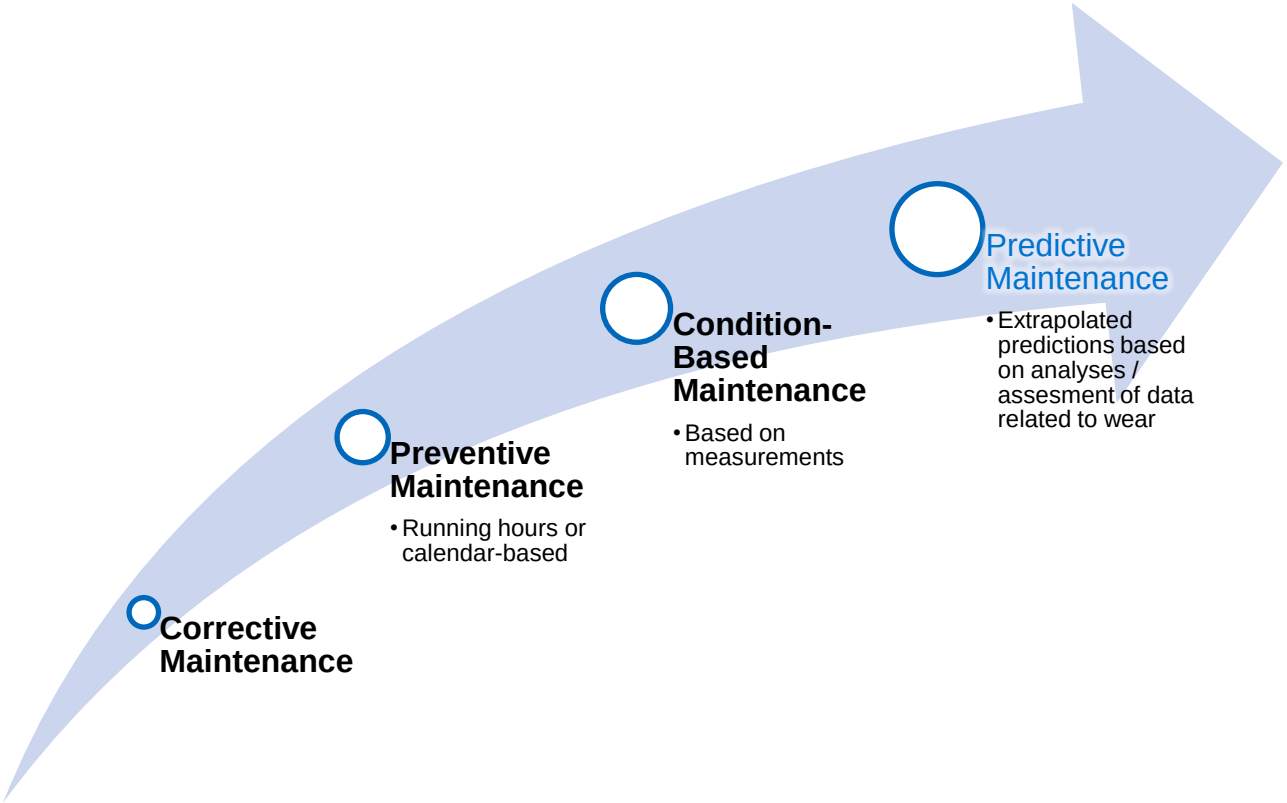
Accueil / Centre / Aiguille / Liste des courbes / **Courbe**

CENTRE	029,2 - PONTOISE_P1_2
LOCALISATION	330000 - V1 - 26+920
VCC	OUI
DATE	23-08-2017 15:53:23,6
ETAT SKAG	NOMINAL
ETAT SCAG	NOMINAL
MANOEUVRE	A GAUCHE
TEMPÉRATURE AIR ET HUMIDITÉ	27,1 °C – 53%

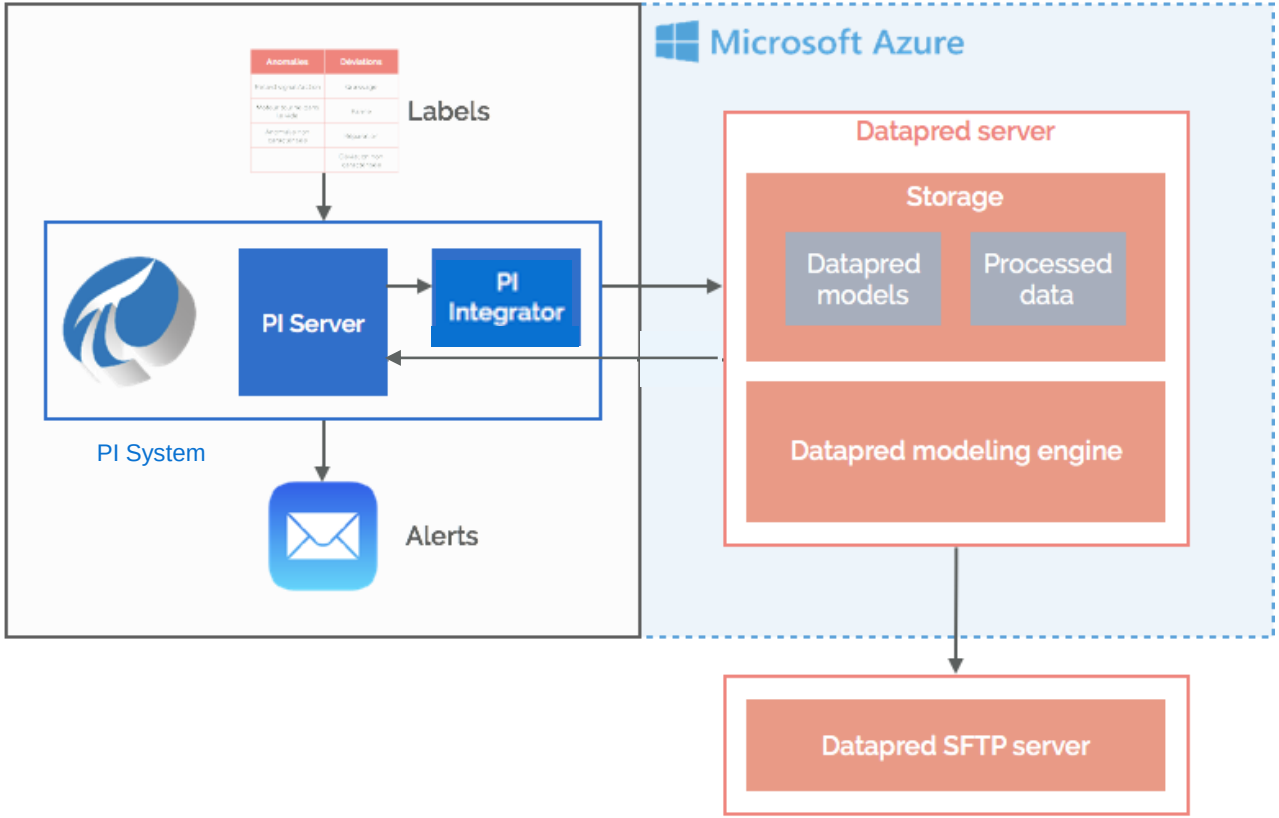
Reference & Actual Power Curves - Temperature & Moist - Time to actuate

Startup Generation: Predictive Analytics & Machine Learning

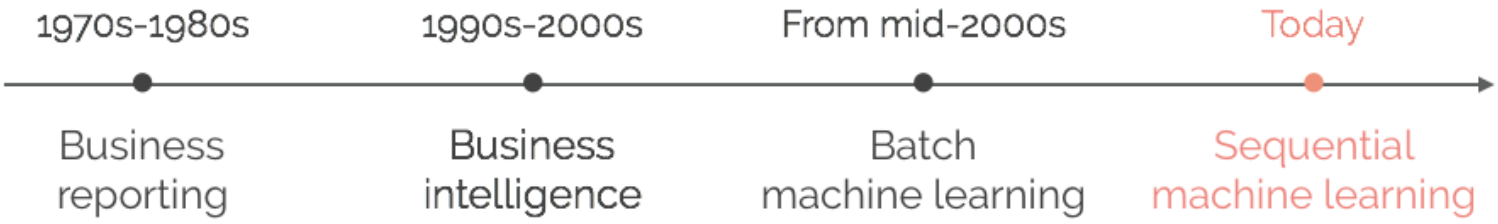
SNCF RÉSEAU + OSIsoft + DATAPRED



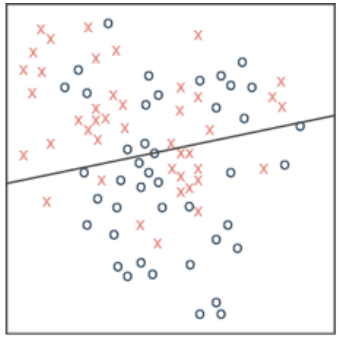
Predictive Maintenance Architecture



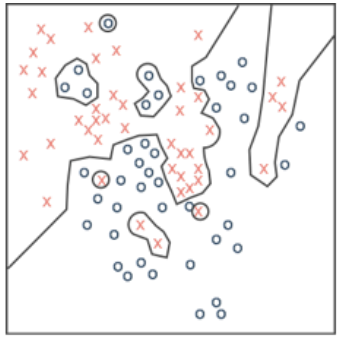
Datapred is a Machine Learning Suite Dedicated to Time Series



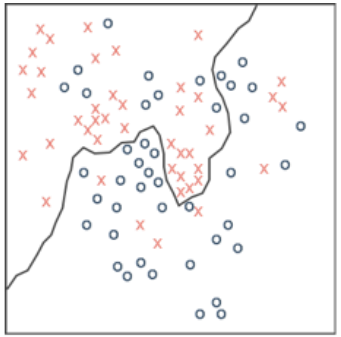
Quick Refresher on Machine Learning



1. Select an algorithm that can identify patterns in large and diverse data sets

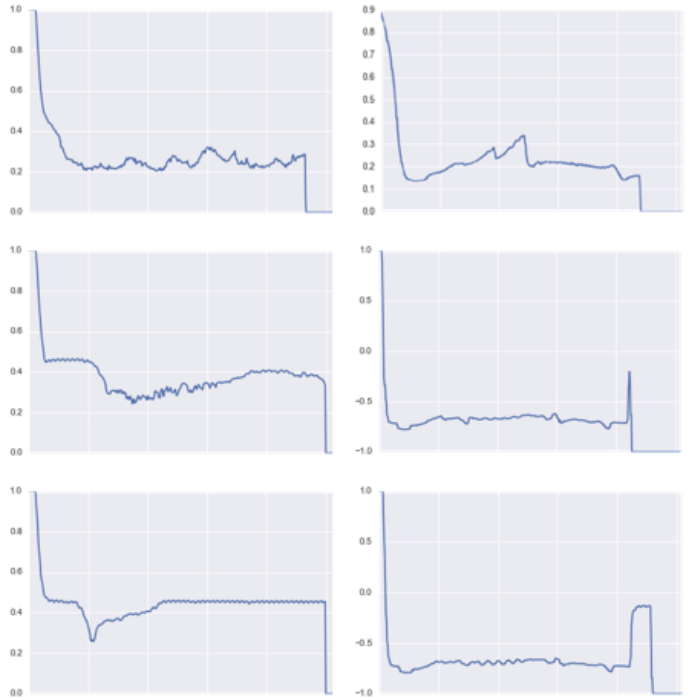


2. Launch the algorithm on your data and let it learn



3. Choose the right balance between accuracy and adaptability

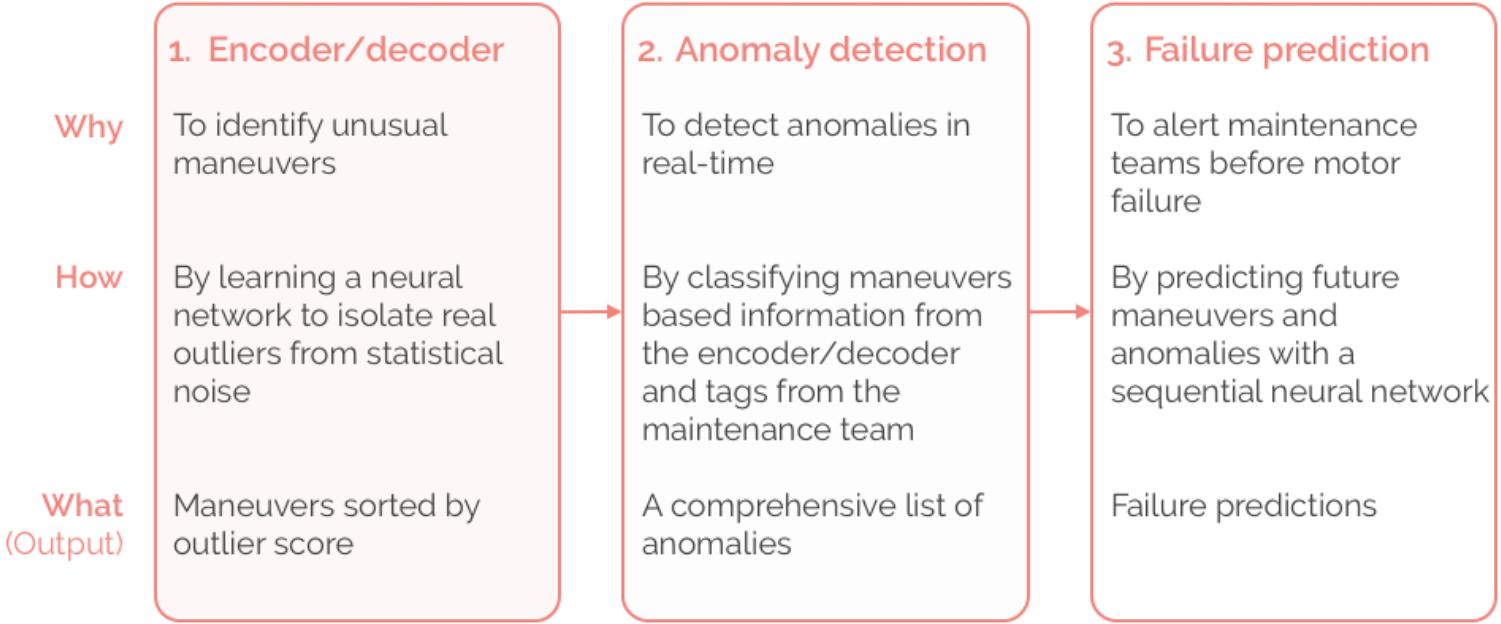
Advanced Analytics Challenge – Curves as Time Series



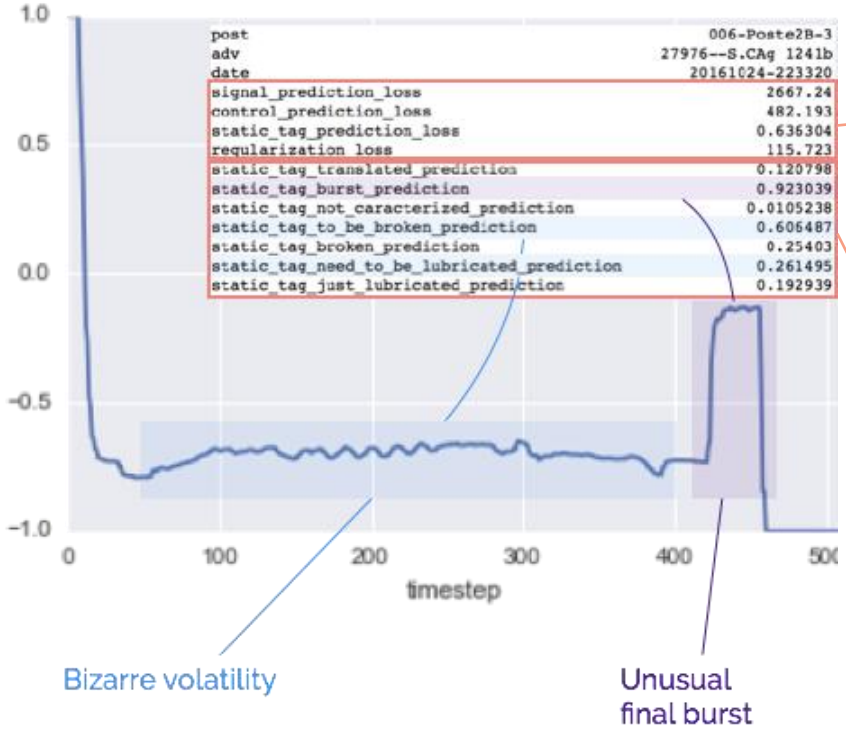
Which of these curves is abnormal? 🤔

- Curves are archetypal time series
  - Perfect cases of continuous information
  - A series of curves is also a time series
- Supervised and unsupervised learning
  - 1st challenge ➔ detect anomalies and predict failures based on a library of labels
  - 2nd challenge ➔ use advances in deep learning to unearth « unknown unknowns »
  - The integration of unsupervised learning increases the solution's durability
- Complementary information
  - Machine learning can process raw curves with any kind of complementary data

Datapred's Solution: Learning Motor Power Curves in Real-Time



Anomaly Detection in Practice (1/2) – Monitoring



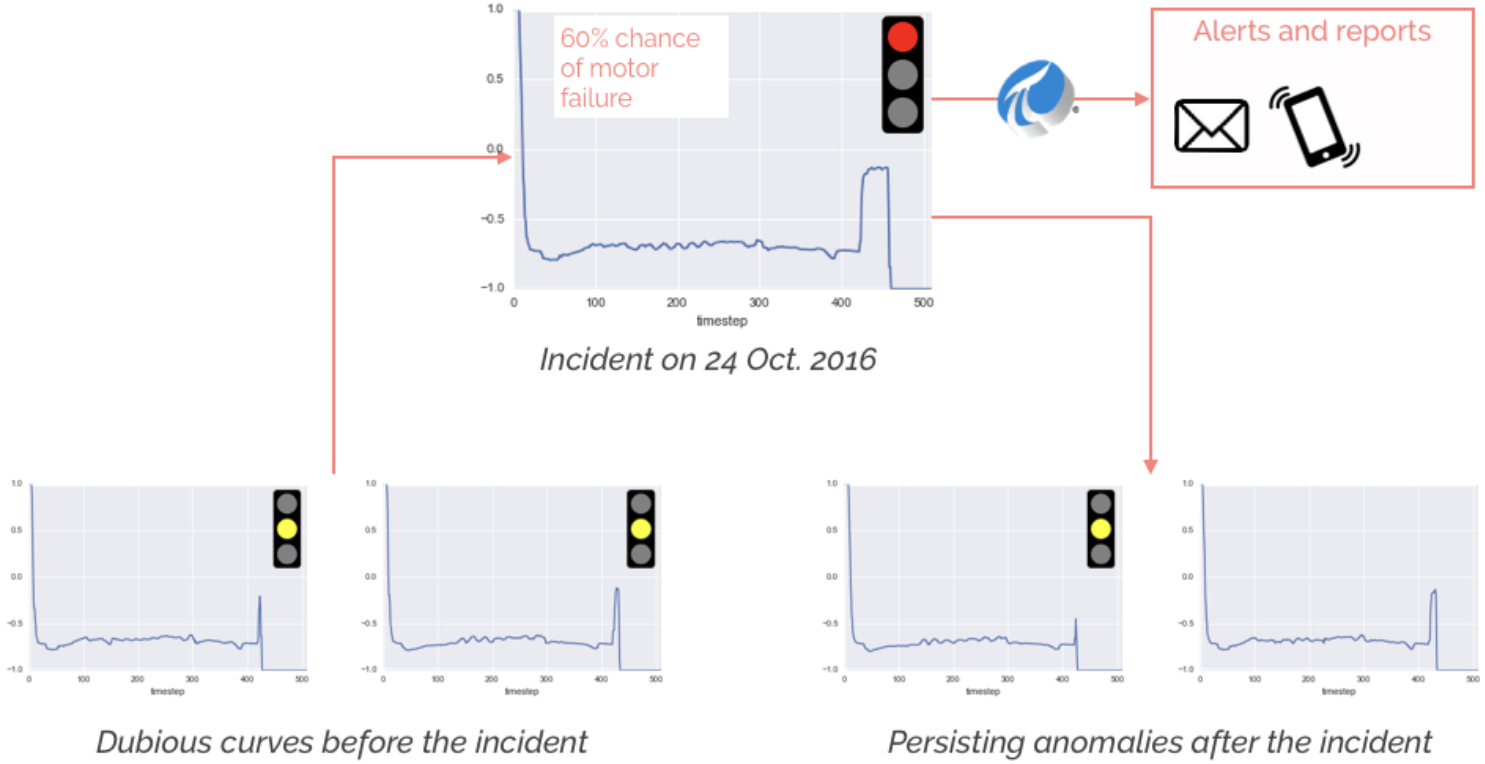
Encoder/decoder performance

- The 4 « losses » correspond to differences between the denoised and raw curves that can't be explained by statistical noise
- Together, these 4 losses make up the outlier score

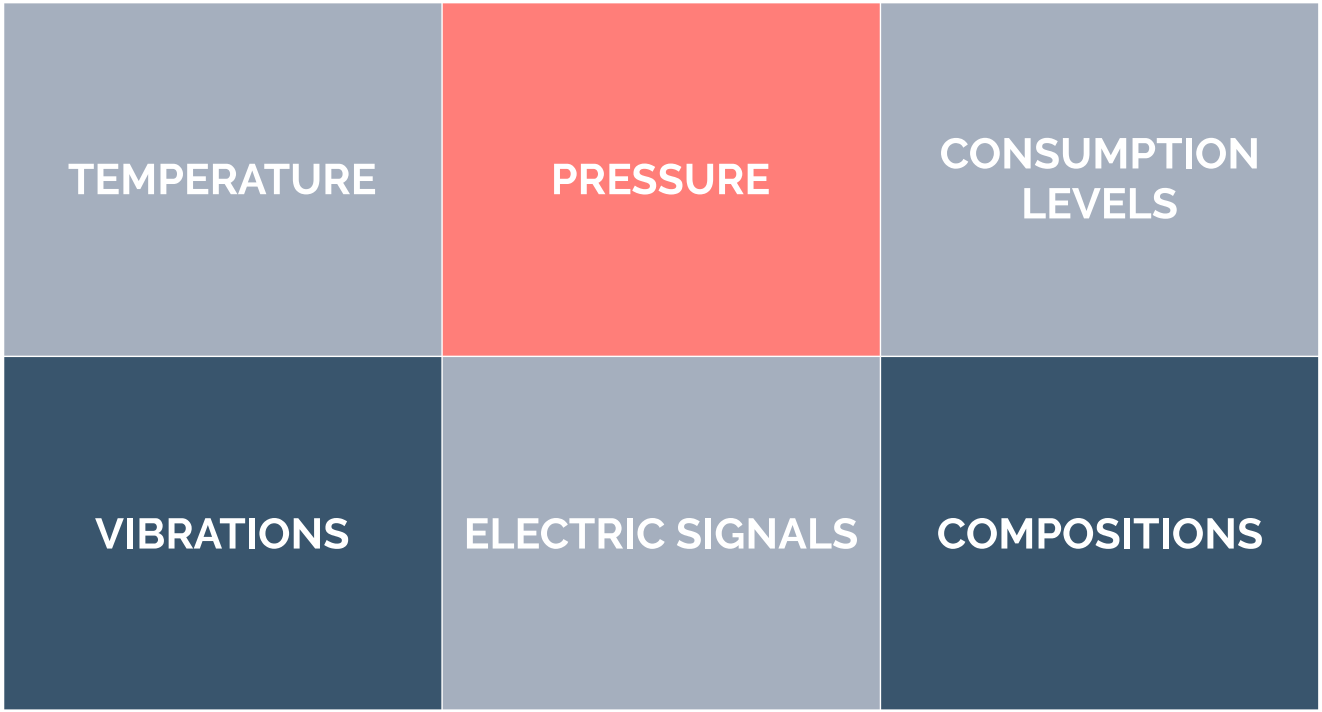
Detected anomalies

- Each anomaly in the maintenance team's library receives a score
- The highest scores correspond to the bizarre volatility of the curve during the maneuver (failure risk + lubrication problem) and the unusual final burst

Anomaly Detection in Practice (2/2) – Alerting



Potential Extensions of Datapred Machine Learning Suite



Digital Transformation of Maintenance, for the Benefit of Customers

COMPANY and GOAL

Each day, SNCF RÉSEAU enables **15.000 trains** and **5 millions+ passengers** to use the **#2 EU railway system.**

CHALLENGE

Limit impact of maintenance activities on rail traffic

- Further improve assets surveillance
- Anticipate and prevent incidents
- Maintenance policies evolutions

SOLUTION

Invest in monitoring and analysis of field data !

- Increase deployment of remote monitoring, innovations (IoT, wireless…)
- PI System lays the foundation for more field data analysis
- New innovative tools

RESULTS

Improve visibility on real asset conditions and anticipation (predictive)

- Improve asset knowledge
- Accelerate DATA projects
- Maintenance Teams = Driving Force for Change !

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Co-Founder
Datapred

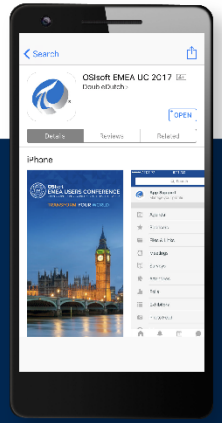
Questions

Please wait for the **microphone** before asking your questions

State your **name & company**

Please remember to…

Complete the Online Survey for this session



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Danke

谢谢

Merci

Gracias

Thank You

ありがとう

Спасибо

Obrigado