



Best practices for the monitoring of railway assets

Gdansk, 18/01/2018



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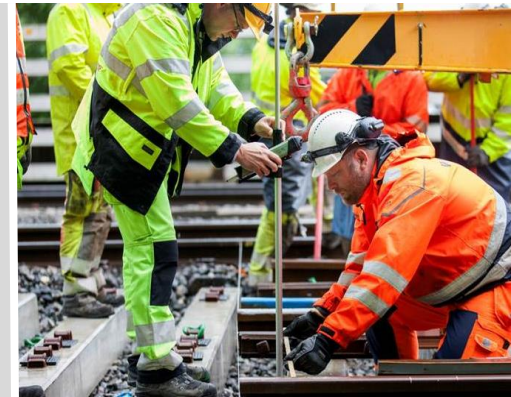
Predictive maintenance

Predictive maintenance

Concept

➤ Definition (NF EN 13306 X 60-319)

a condition-based maintenance, performed according to the forecasts extrapolated from the analysis and the ratings of the relevant parameters of the asset degradation

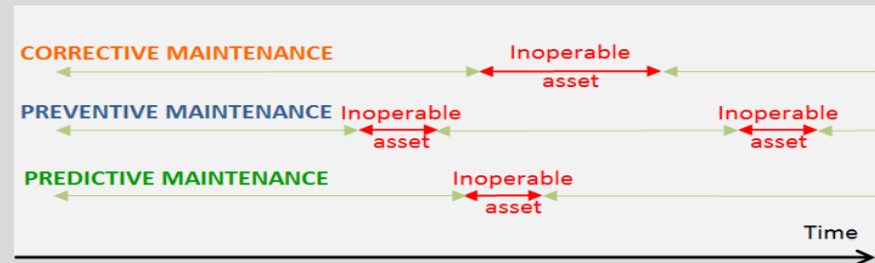
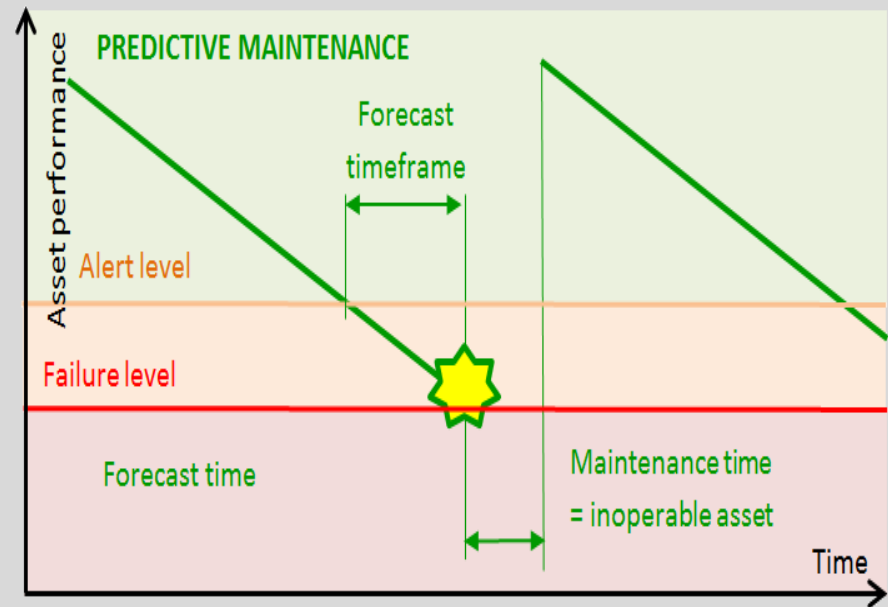
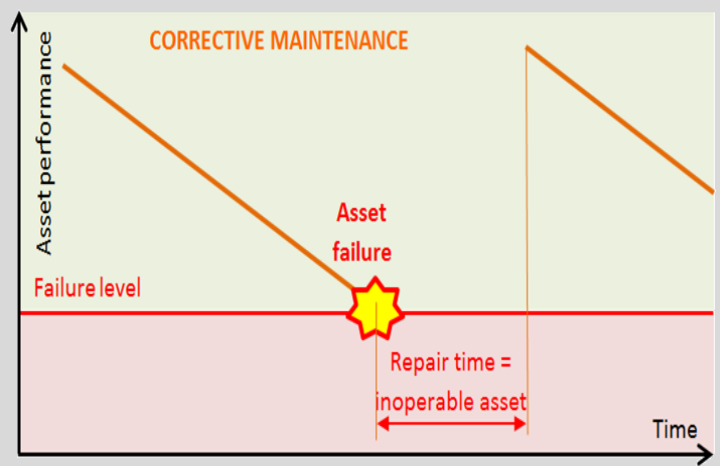
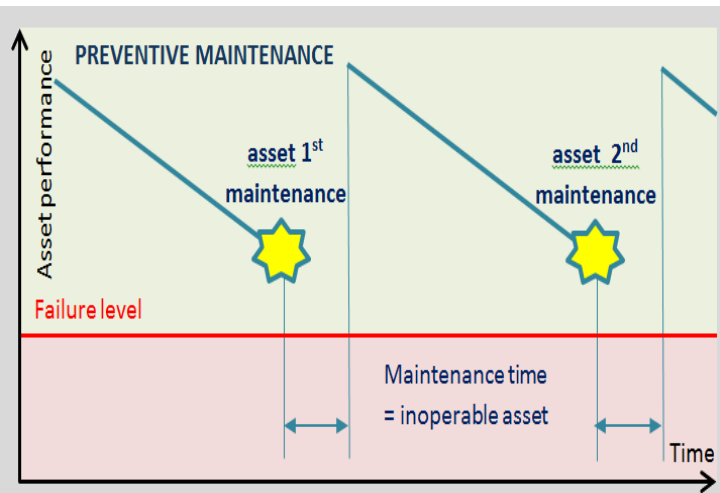


➤ Cost reductions

- maintenance operations are shorter...
- ...and less frequent
 - Assets availabilities are optimized
- Spare components quantities & urgent orders are reduced...

Predictive maintenance

Concept



Predictive maintenance

Remote monitoring

➤ Predictive maintenance requires numerous measures

→ remote monitoring record them without any impact on the train traffic

➤ Remote monitoring improves :

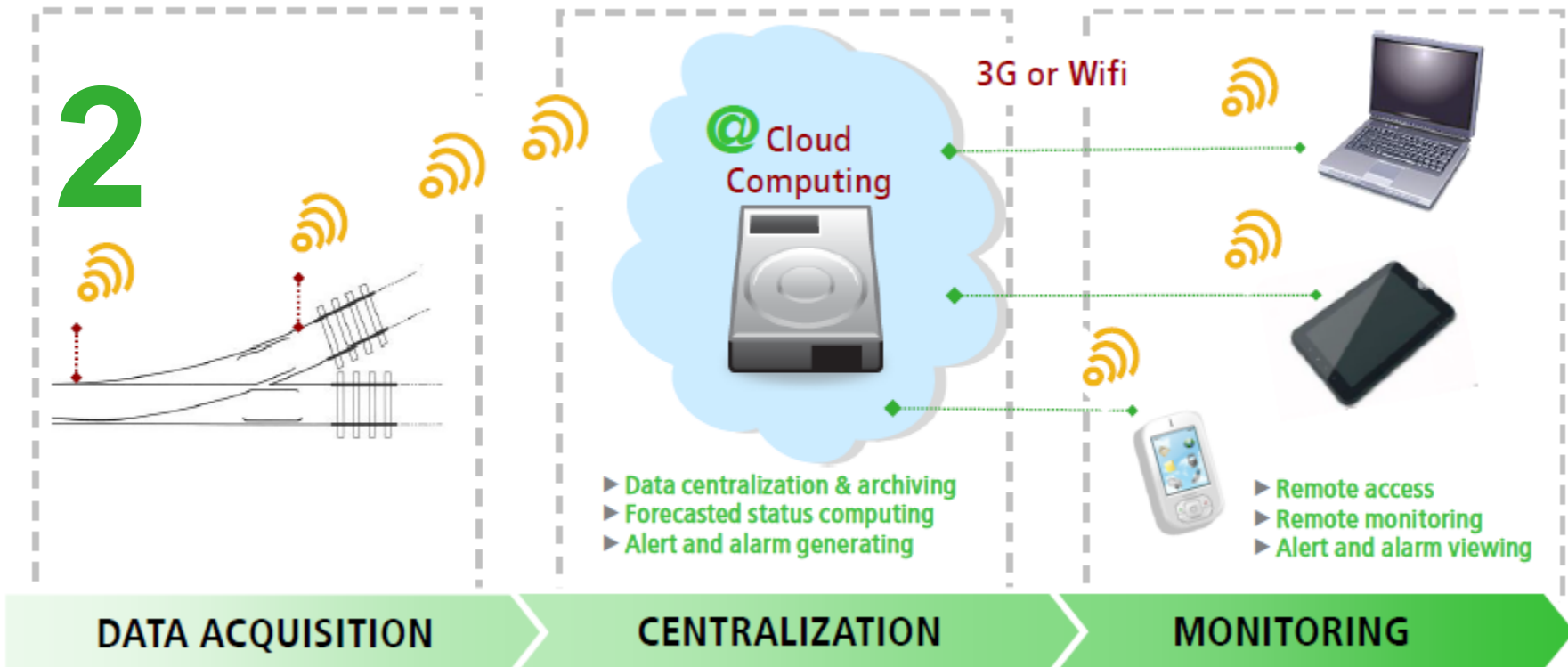
- the failure reporting time
- the time dedicated to identify and analyze the cause of failure
- reliability
- availability
- maintainability
- safety
- maintenance cost



➤ Main detected defects

- inspection detector
- lock adjustment
- friction
- obstacles
- driving rods/guidance

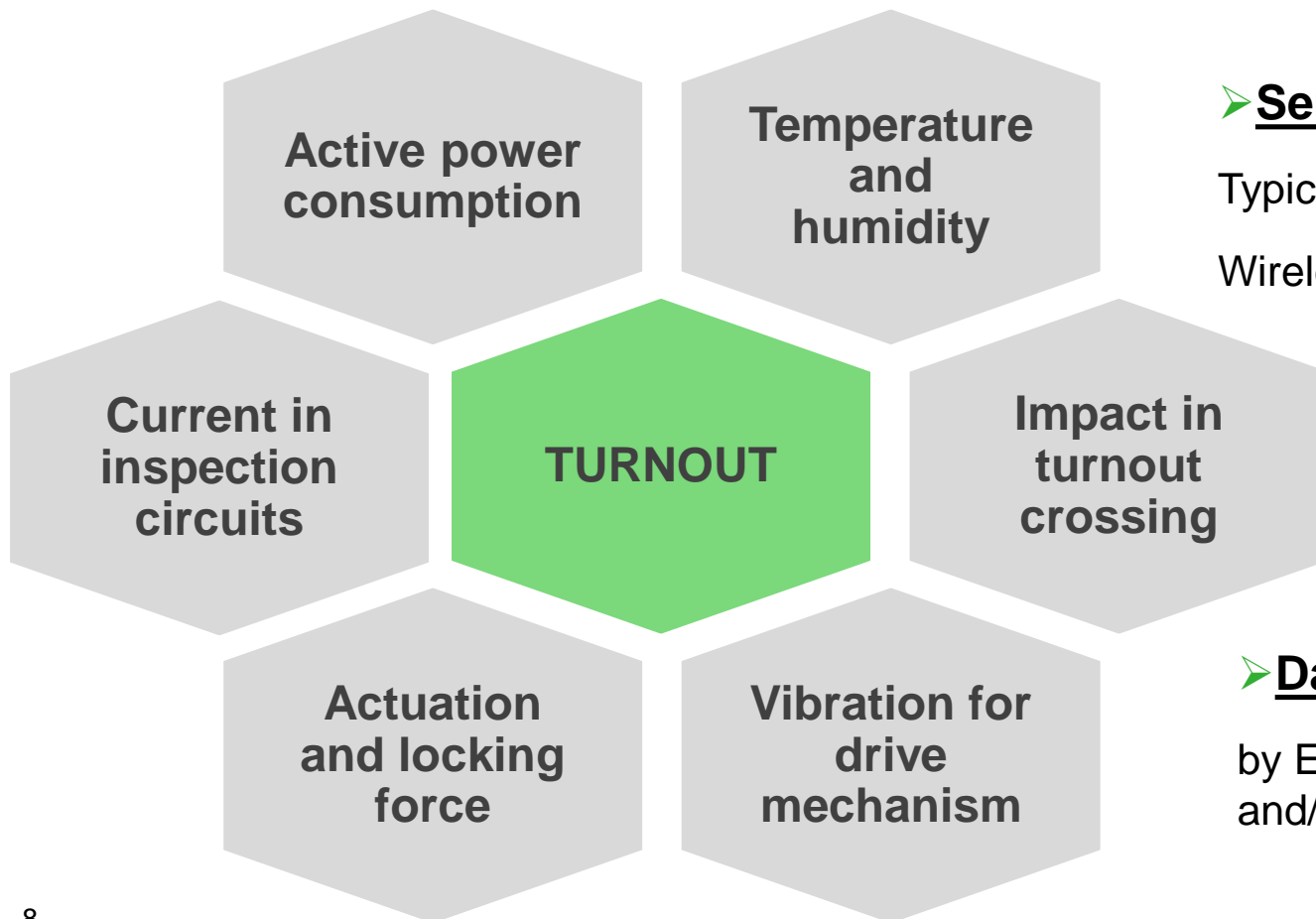
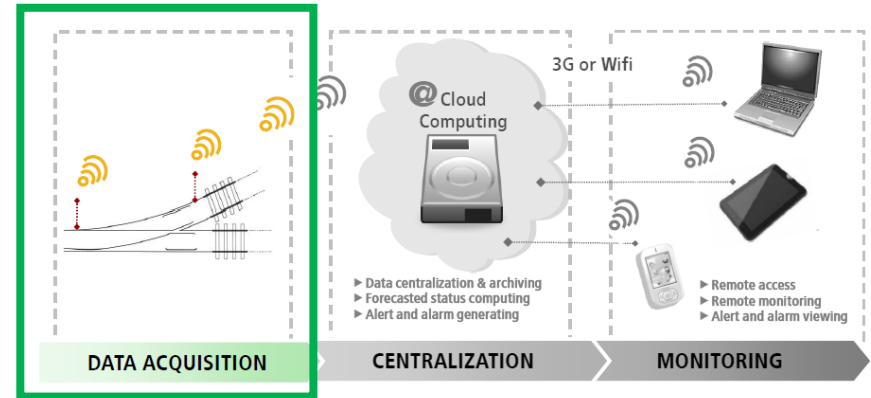
2



Monitoring system

Monitoring system

Data acquisition



➤ Sensors

Typically with 4-20 mA output

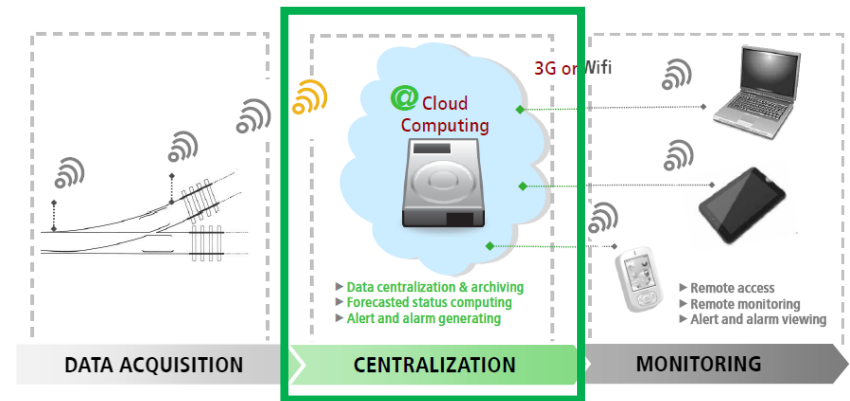
Wireless for next generations

➤ Data transmission

by Ethernet, optical fiber, and/or G.SHDSL

Monitoring system

Centralization



➤ Database

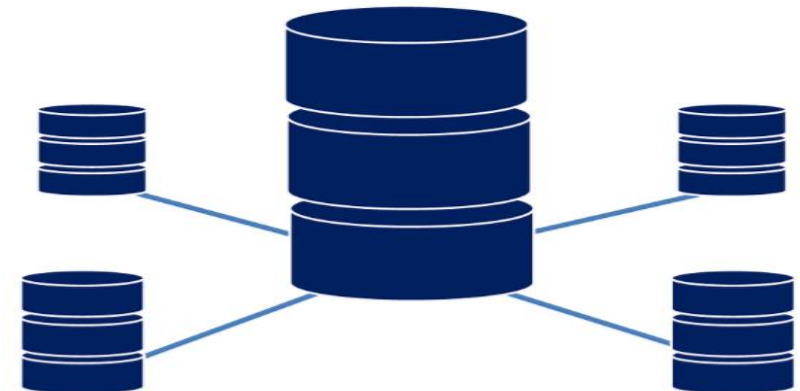
Most of the time, predictive systems require learning period and long-terms analysis. They could thus be considered as “big data” systems.

➤ Indicators

- to ease understanding
- to allow comparisons and operations between various measures of different types.

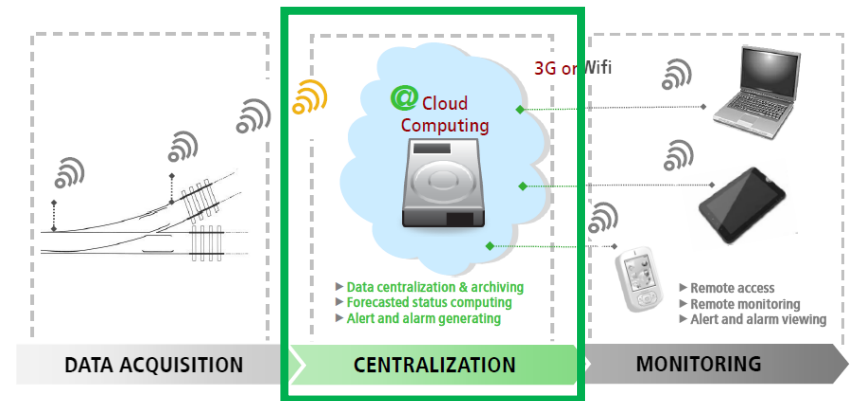
➤ Thresholds

to grade the measured or calculated values and give them a status



Monitoring system

Centralization

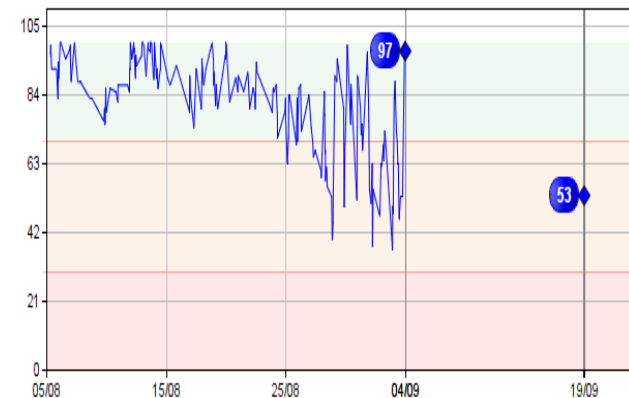
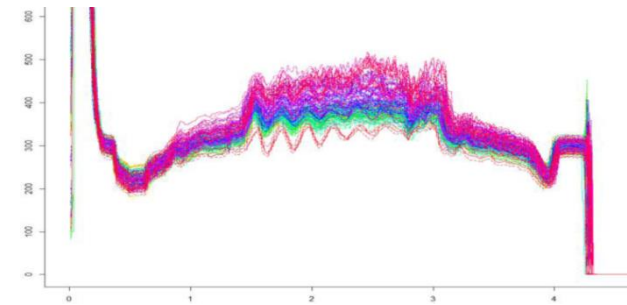
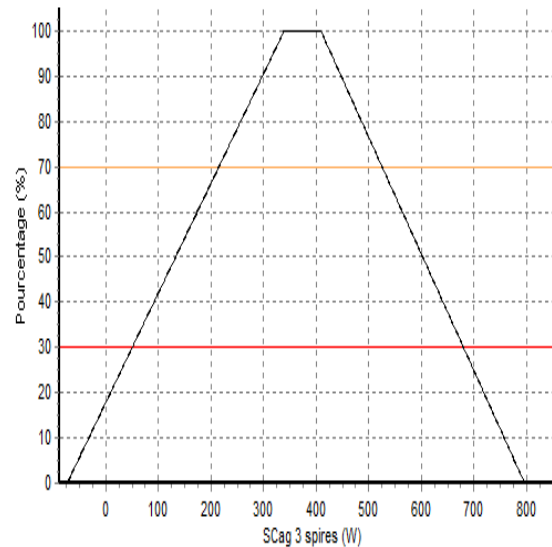
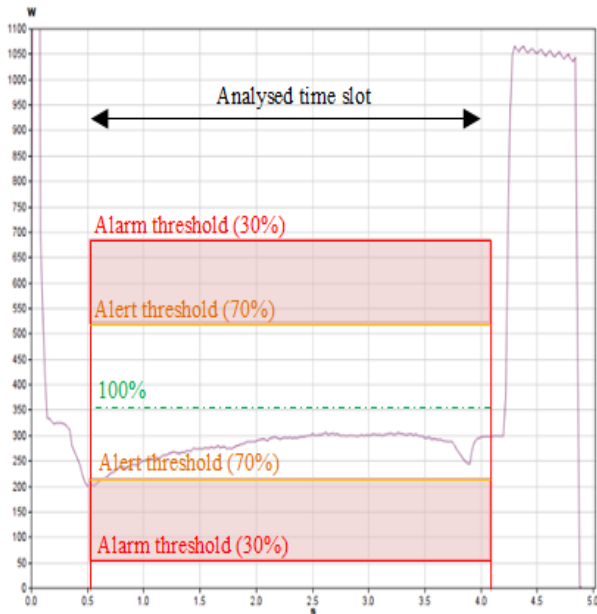


Typical case

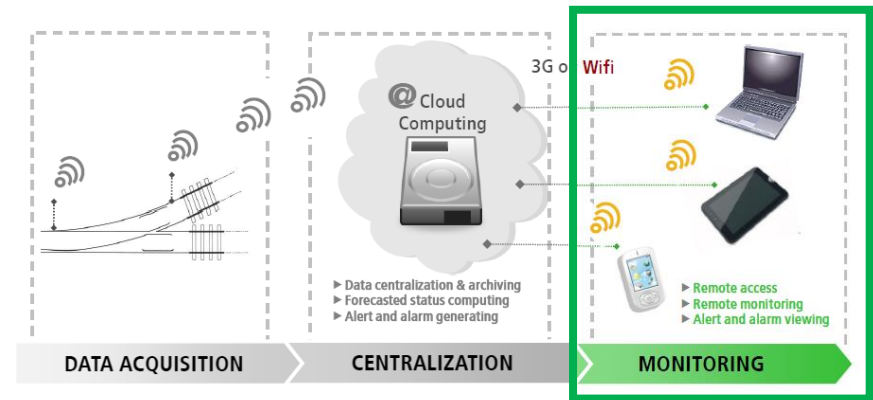
Status definition

Indicators calculation

Turnout calculation



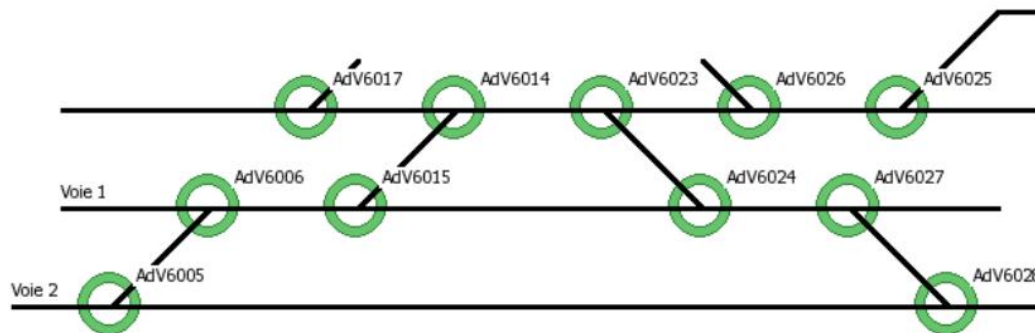
Monitoring system Interfaces



Interface IHM

- has to be synthetic and user friendly to allow maintenance department saving time and focusing on critical assets
- should also be accessible from a standard browser.

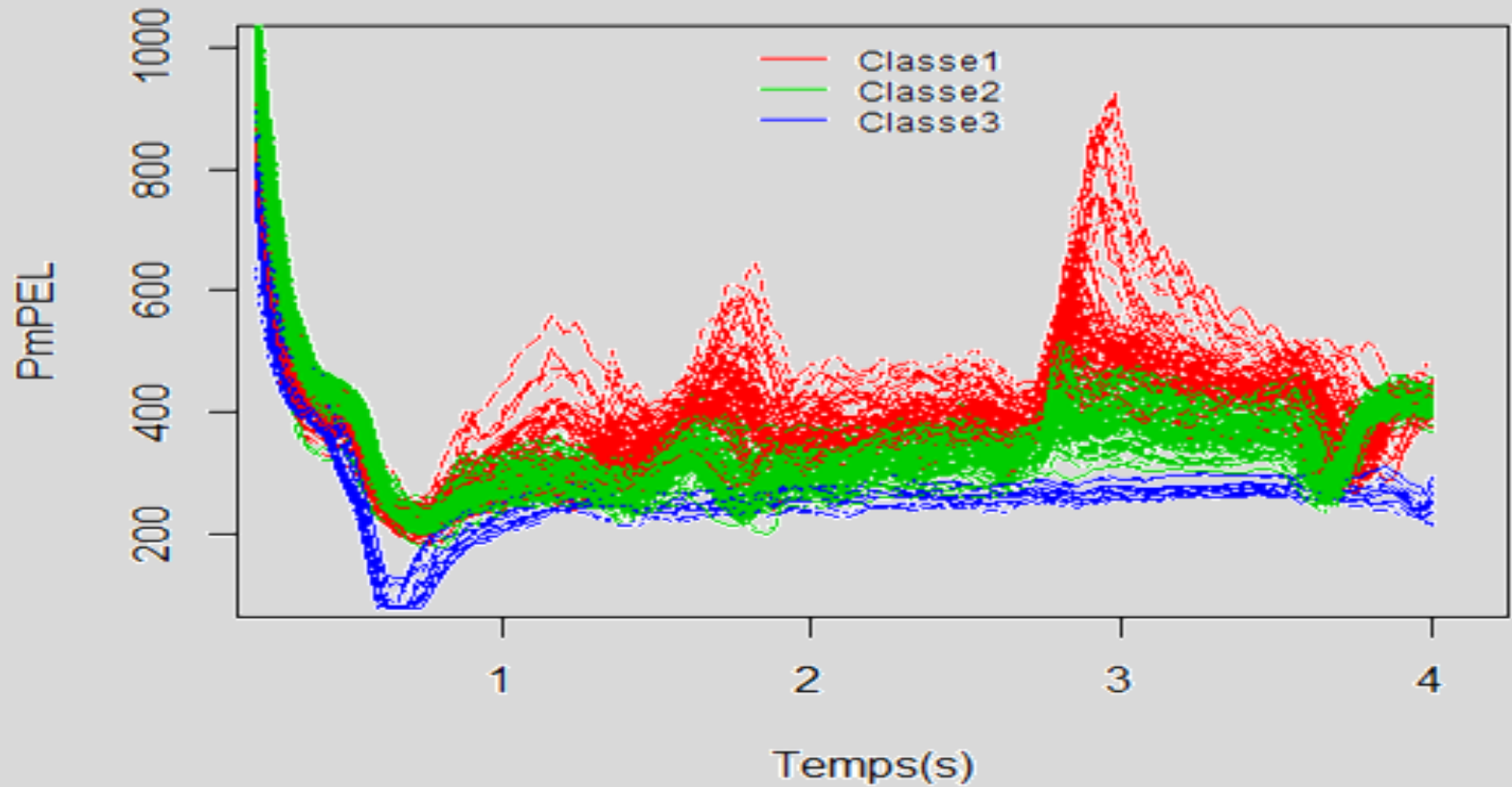
Appareil de voie	Date	Position	Libelle
Aiguille 26 BD	30/04/2008 07:43:25	Vers la gauche	ALARME -> Normal - Valeurs physiques de la dernière manoeuvre : Pver_moy = 263,00 ; Pdev_moy = 241,00 ; Pman_moy = 268,50 ; DureeNonContrôle = 4,19 ; FMax = 109,00 ; Fmaintien = 38,00
Aiguille 26 BD	30/04/2008 07:43:25	Vers la droite	ALARME -> Normal - Valeurs physiques de la dernière manoeuvre : Pver_moy = 263,00 ; Pdev_moy = 241,00 ; Pman_moy = 268,50 ; DureeNonContrôle = 4,19 ; FMax = 109,00 ; Fmaintien = 38,00
Aiguille 26 BD	30/04/2008 07:43:25	Vers la gauche	ALARME -> Normal - Valeurs physiques de la dernière manoeuvre : Pver_moy = 263,00 ; Pdev_moy = 241,00 ; Pman_moy = 268,50 ; DureeNonContrôle = 4,19 ; FMax = 109,00 ; Fmaintien = 38,00
Aiguille 26 BD	06/02/2008 20:41:50	Vers la gauche	ALARME -> Normal - Valeurs physiques de la dernière manoeuvre : Pver_moy = 263,00 ; Pdev_moy = 241,00 ; Pman_moy = 268,50 ; DureeNonContrôle = 4,19 ; FMax = 109,00 ; Fmaintien = 38,00



Compatibility

- With other supervision system (SNMP)

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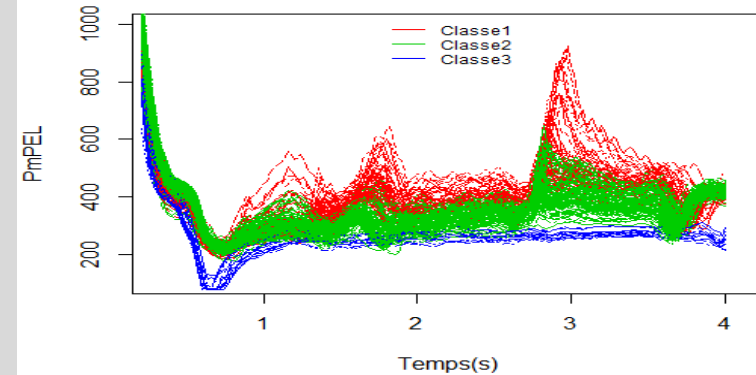
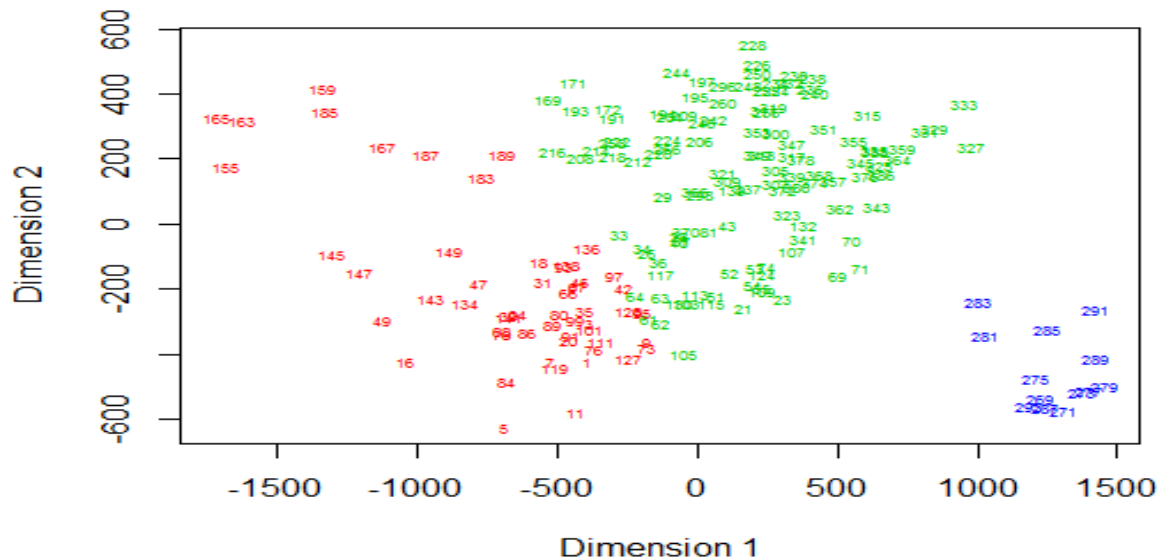


Data mining

Data mining

Ascending Hierarchical Classification (AHC)

The Ascending Hierarchical Classification consists of carrying out progressive grouping of individual values in accordance with their degrees of similarity to obtain a single class that groups them all.



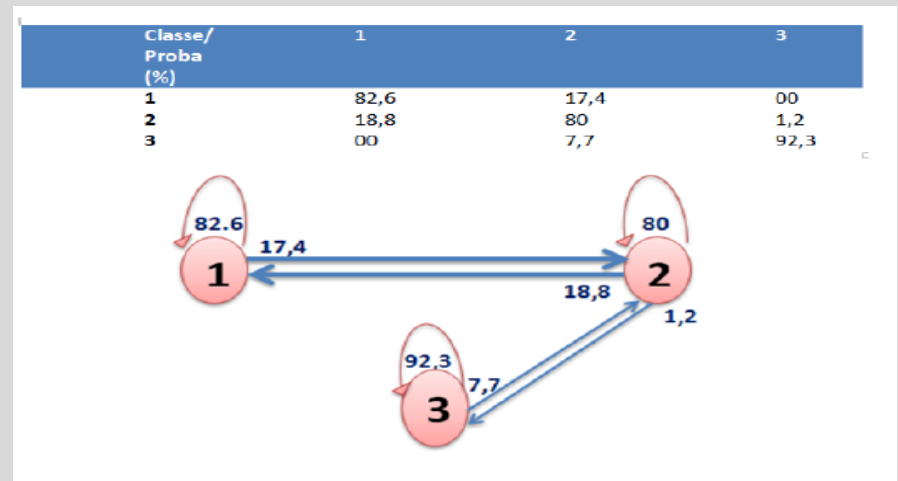
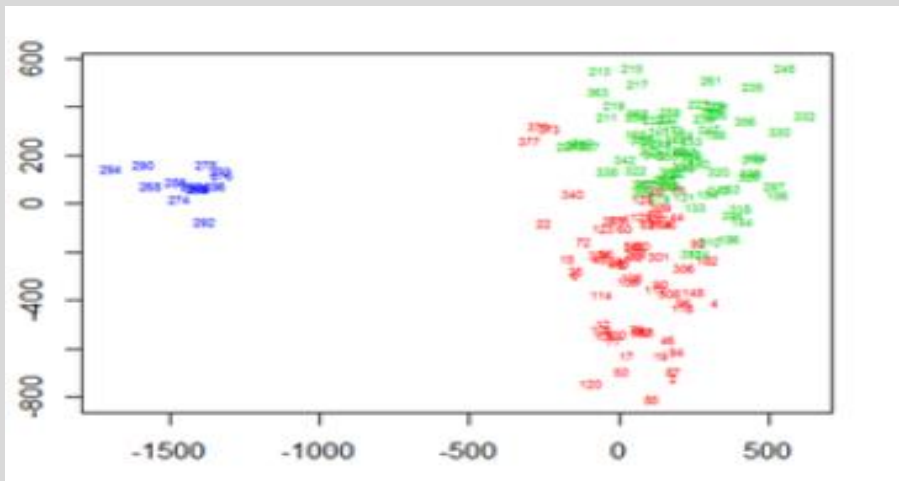
Once this calculation has been made, the individual values are divided up into various classes

Data mining

Partition Around Medoids (PAM)

The PAM algorithm partitions the dataset of n objects into k clusters. This algorithm works with a matrix of dissimilarity, whose goal is to minimize the overall dissimilarity between the representants of each cluster and its members.

This algorithm is intended to find a sequence of objects called medoids that are centrally located in clusters. In other words, a medoid can be defined as the object of a cluster whose average dissimilarity to all the objects in the cluster is minimal.



Data mining

Results

- most of the measures could be split into 3 classes
- each class represented a status (ok / alert / alarm) and included similar measures
- some classification irregularities occurred



- classification can be used for automatic learning...
- ...and for studying predictive algorithms



vossloh