

# Enhanced points condition monitoring on Network Rail infrastructure

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# NR's intelligent asset management strategy

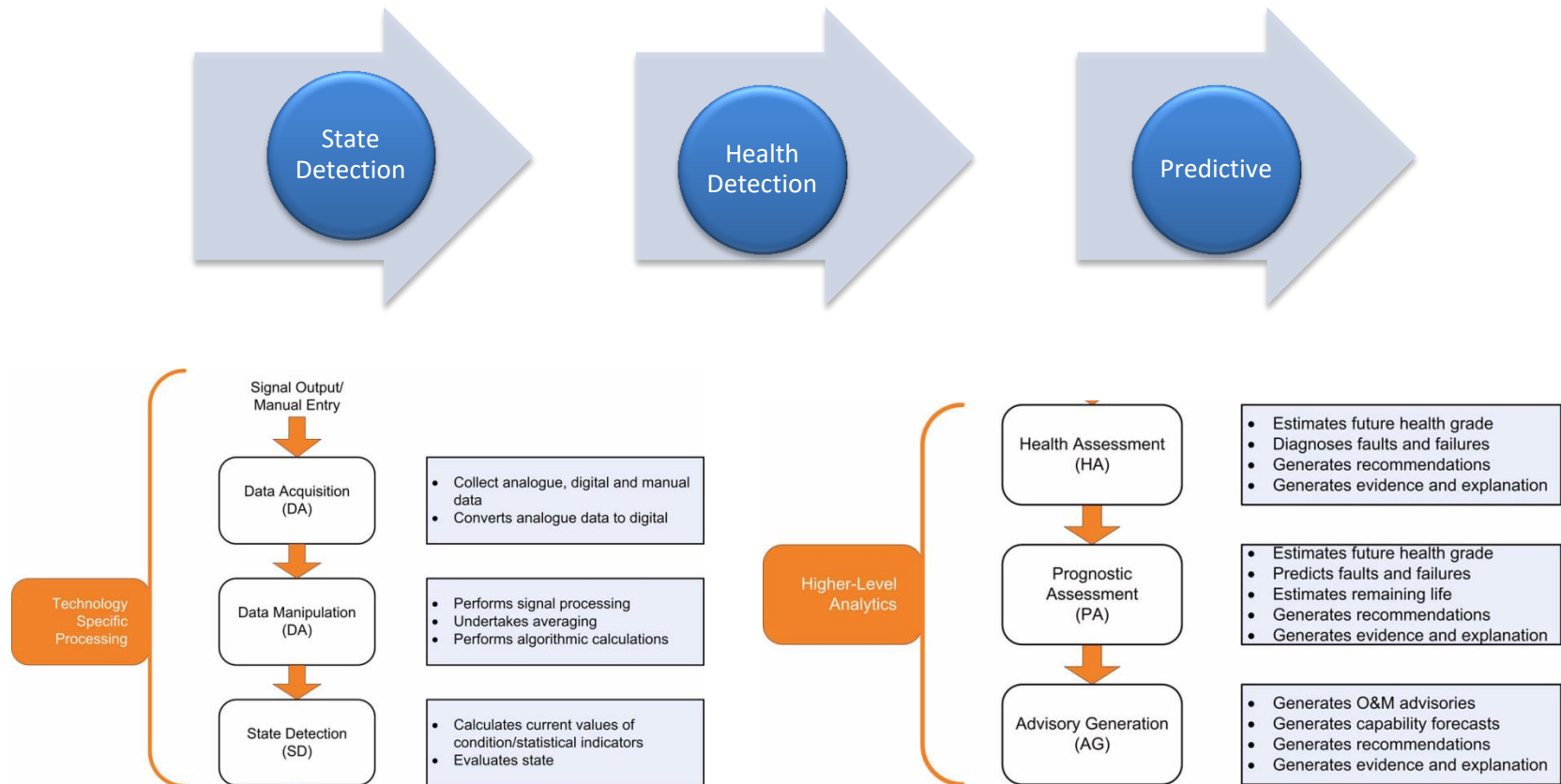
- Network Rail is moving towards an intelligent asset management strategy.
- A key part of this strategy is the intelligent infrastructure programme which uses strategic remote condition monitoring (RCM) of assets to make a major contribution towards improving overall network performance in terms of reliability, safety and efficiency.
- RCM innovation is driving maintenance of fixed infrastructure assets towards a 'predict and prevent' strategy by detecting early deterioration in asset condition thereby reducing the potential for service affecting failures.
- The University of Birmingham is working alongside Network Rail to help achieve this vision.

# Intelligent infrastructure

- The key objective of intelligent infrastructure is to have a system that is capable of using the data that Network Rail collects to generate advisory information for maintenance teams that will improve performance and safety.
- Intelligent Infrastructure currently monitors over 42,000 critical assets including points, track circuits, points heaters, rail temperature and power supplies.
- To further exploit the RCM technology that has been successfully deployed, Network Rail intends to enhance the analytics on existing assets and to introduce new asset types, selected according to criteria and business cases which align with Network Rail's and the broader UK Rail Industry's strategic objectives.
  - Busbars
  - Earthworks
  - Level Crossings
  - Track circuits (enhanced analytics)
  - **Points (enhanced analytics – this project)**
  - Train mounted infrastructure monitoring



# Achieving the ISO 13374 model

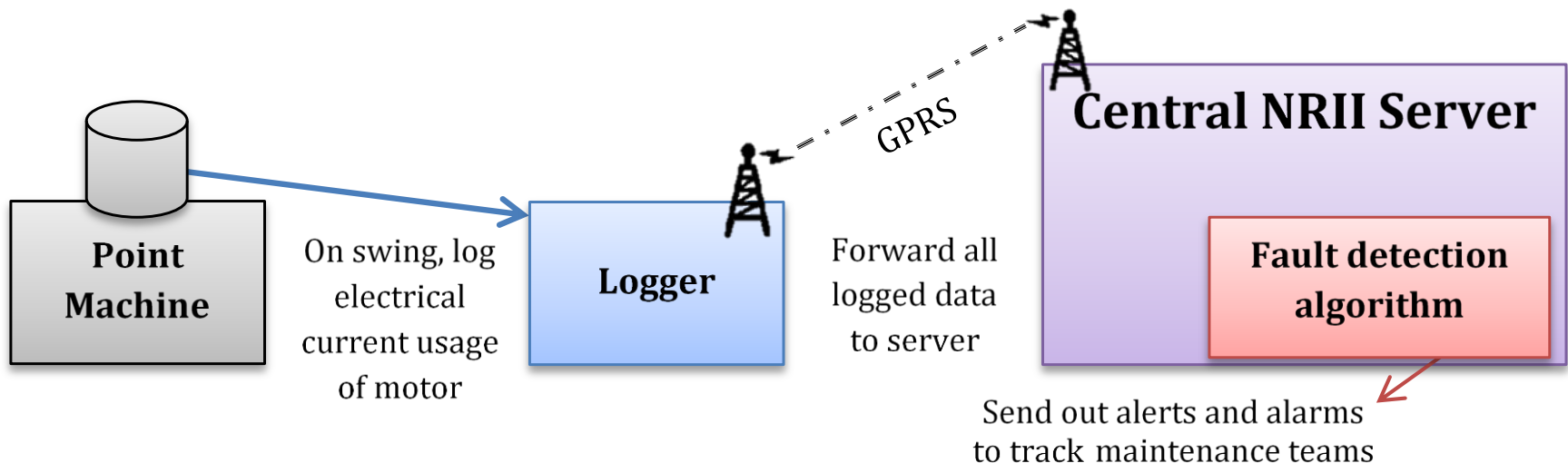


# Points Condition Monitoring (PCM)

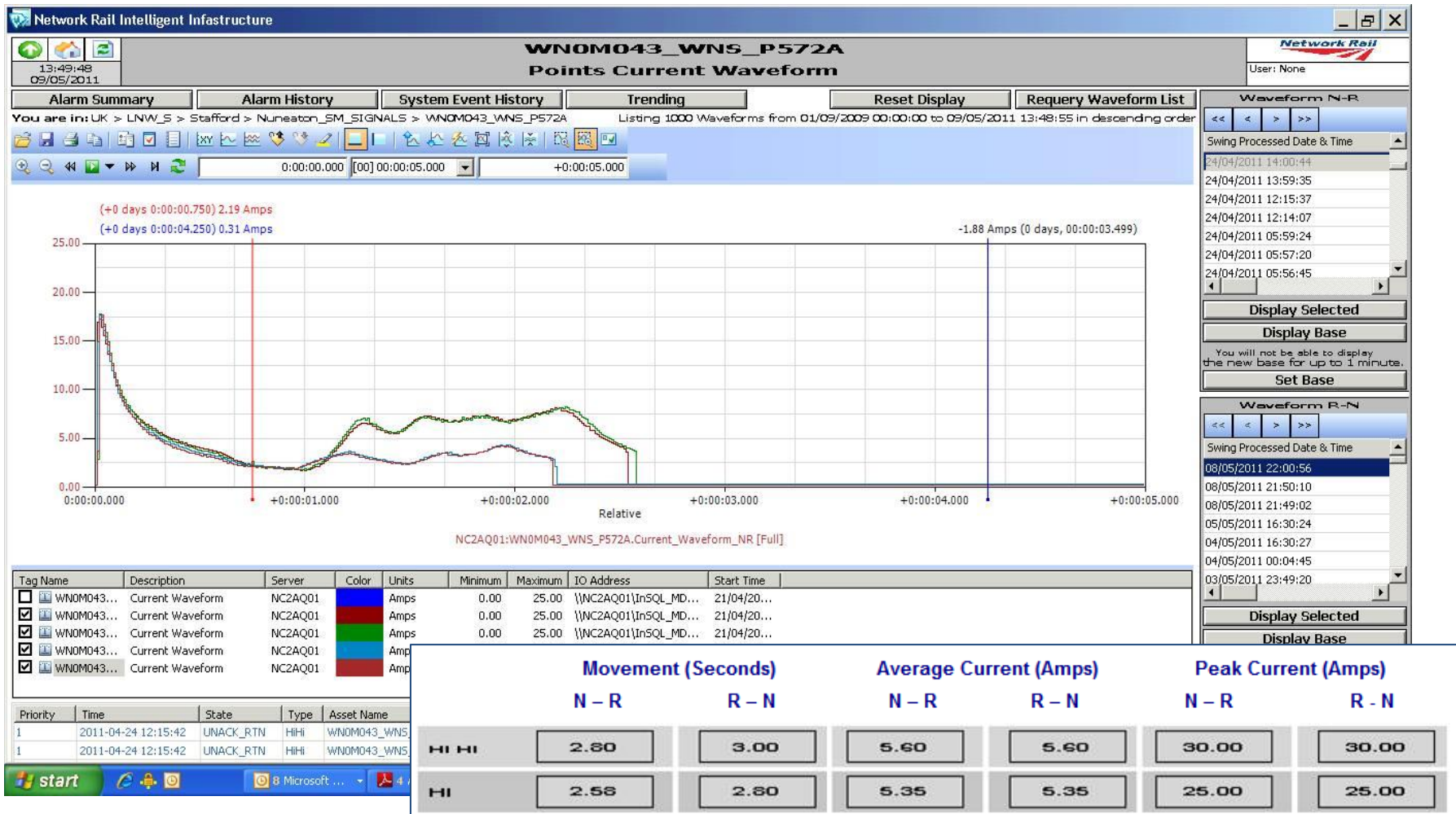
- One of the most common causes of delay minutes attributed to Network Rail are points failures.
- PCM system has already been implemented which triggers an alert or alarm if one of the following monitored values exceeds a predetermined threshold:
  - Swing time
  - Average current
  - Peak current

# UK PCM infrastructure

- Points condition monitoring infrastructure exists in the UK on thousands of points
- Monitors point machine current at 100 samples per second and transmits via GPRS link to central server
- Basic thresholds trigger alarms

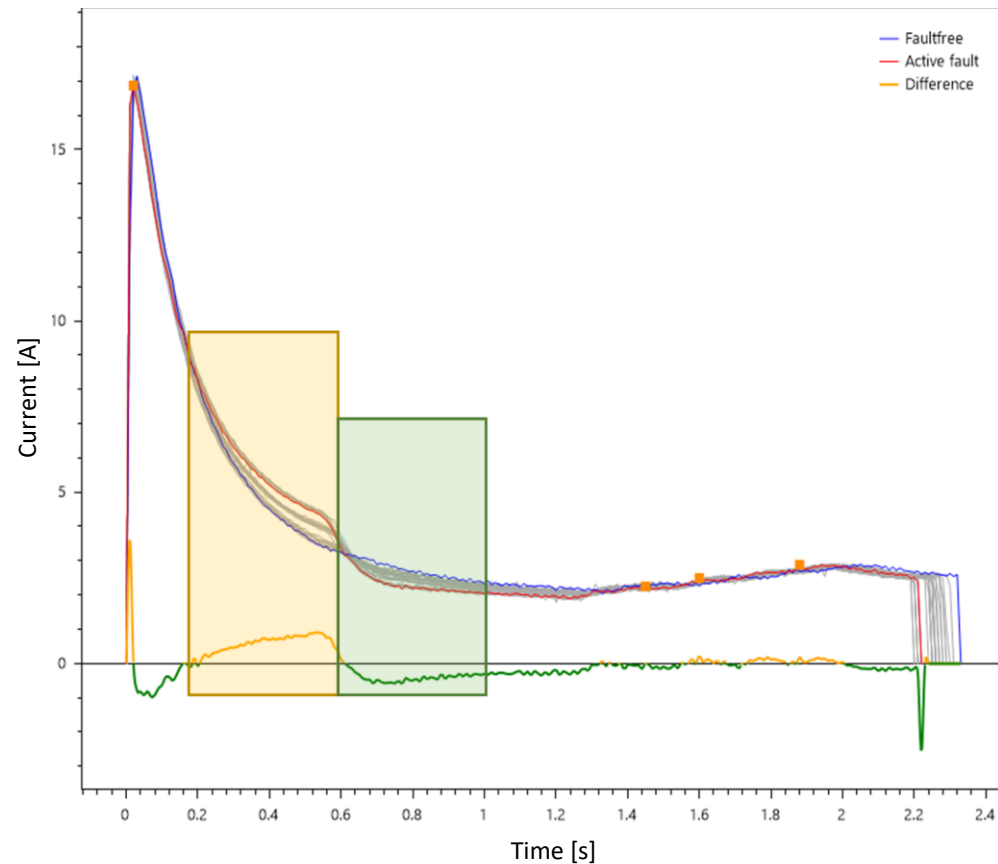


# Existing PCM implementation



# Enhanced PCM (ePCM)

- Fault detection
  - Detect presence of fault
  - Completed
- Fault diagnosis
  - Identification of fault
  - Demonstrator
- Fault prognosis
  - Time to failure
  - More data required





# The requirements of ePCM

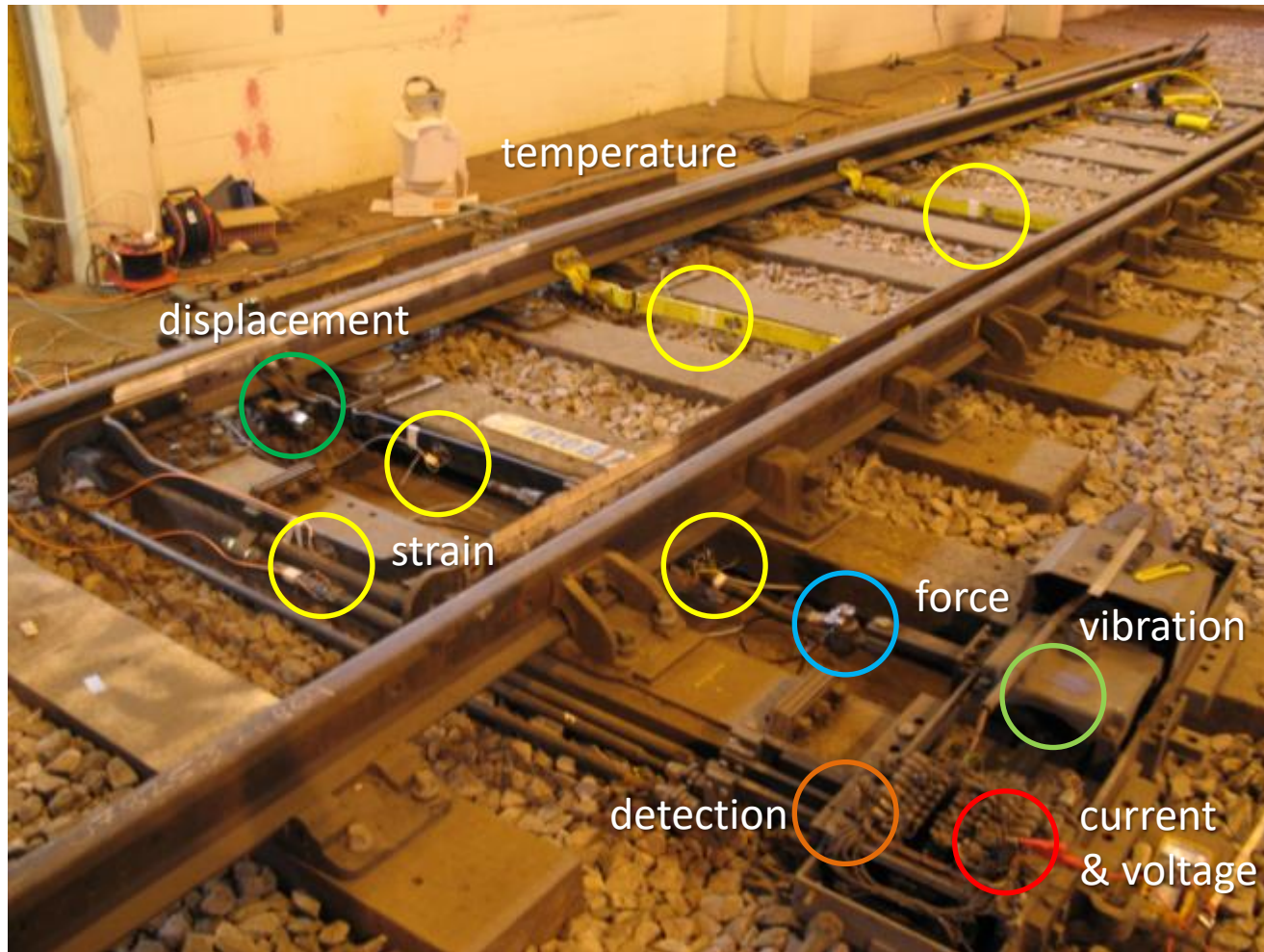
- A system or collection of systems that can detect the majority of point machine faults
- The system must work with the majority of machines of a particular type without having to be customised to each individual machine
- The system must perform its processing in a way that is understandable to engineers with low amounts of false alarms to build confidence

# Current scope of ePCM

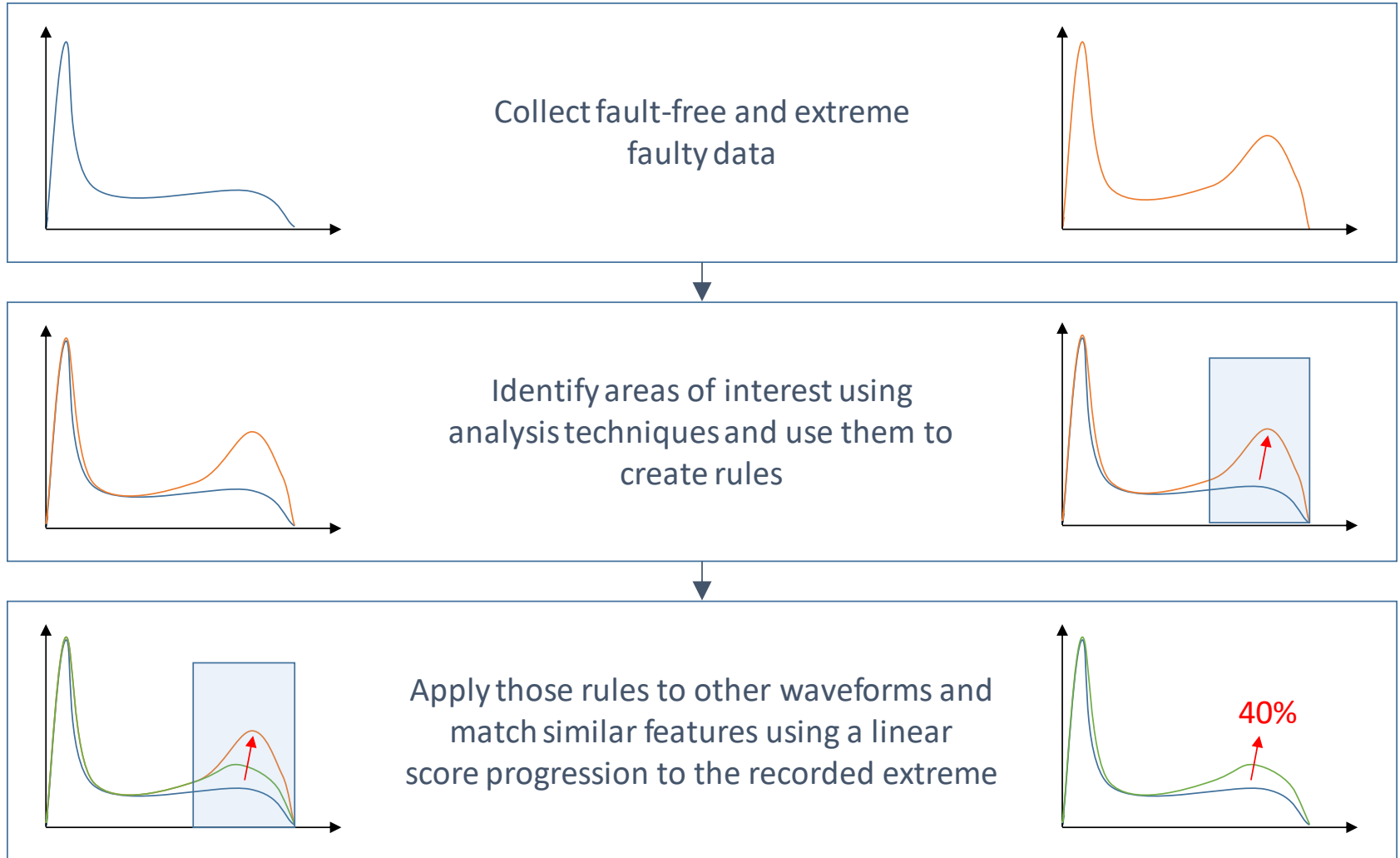
- Existing machines
  - HW
  - M63
  - Clamplock
- Future machines
  - HPSS
  - Hydrive
- Sensors
  - Electric current
  - Displacement (future)
  - Pressure (future)



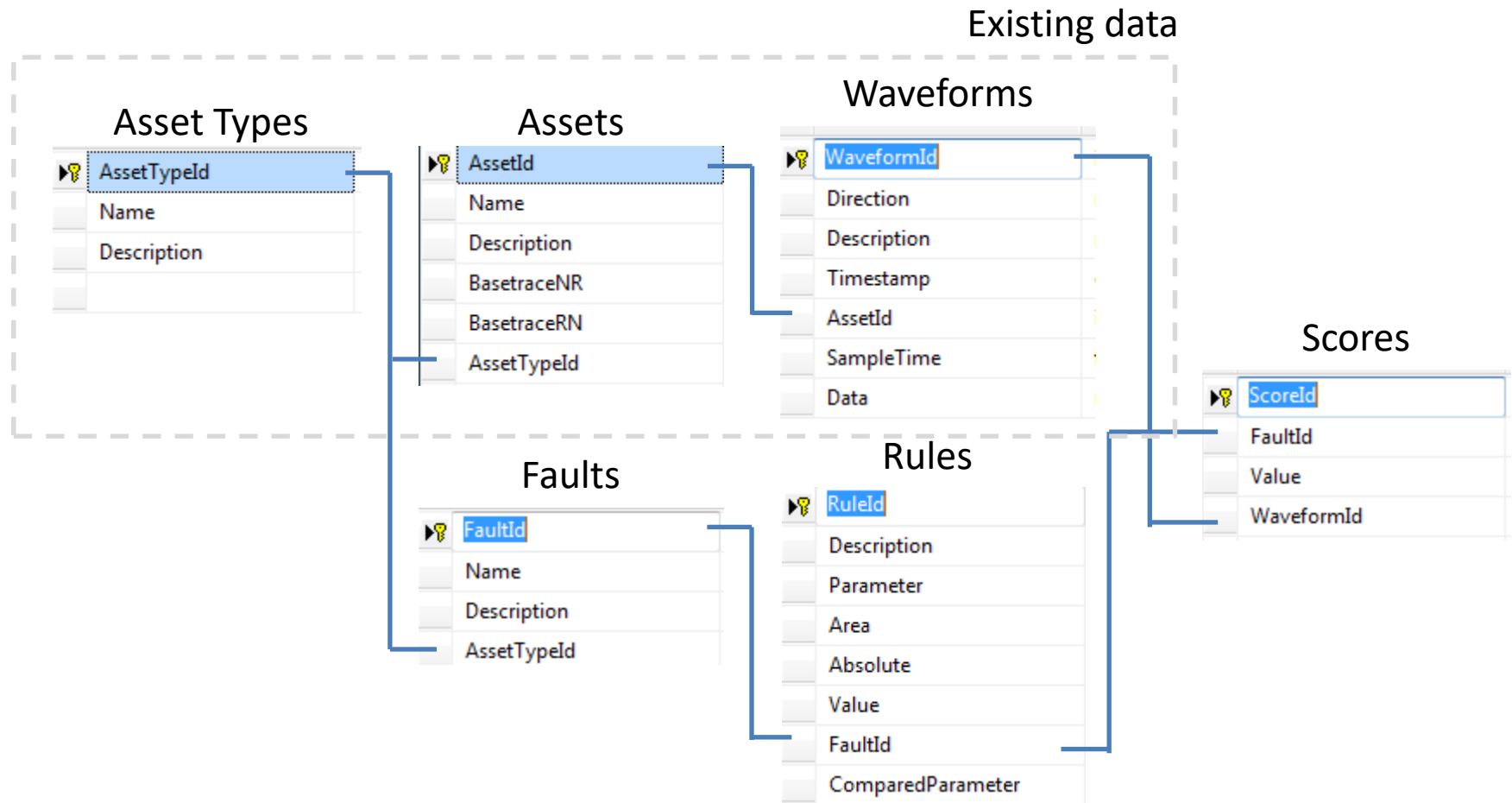
# Potential sensors for PCM



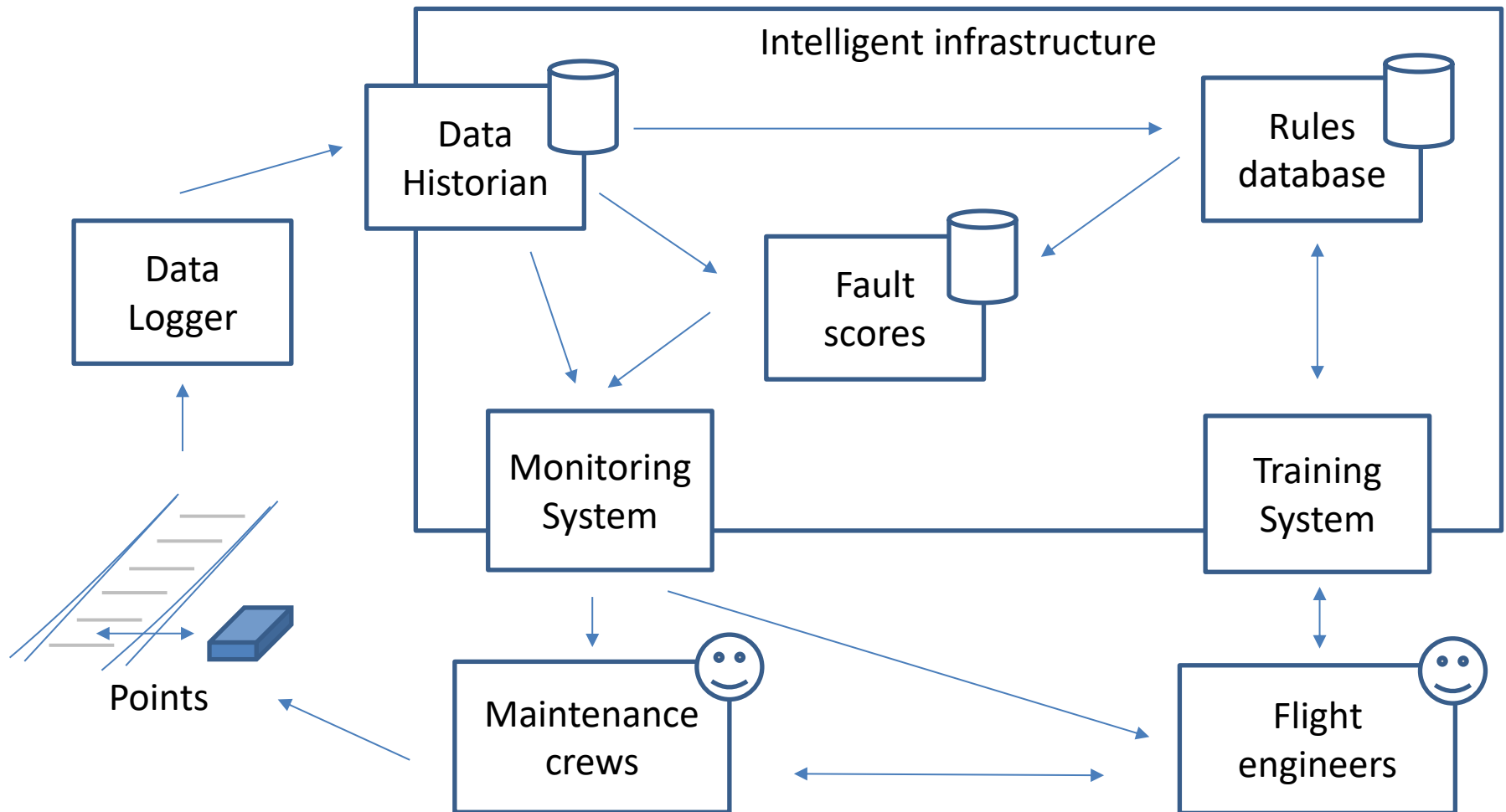
# PCM expert system



# Expert system: linking with existing data



# ePCM expert system





# Expert system considerations

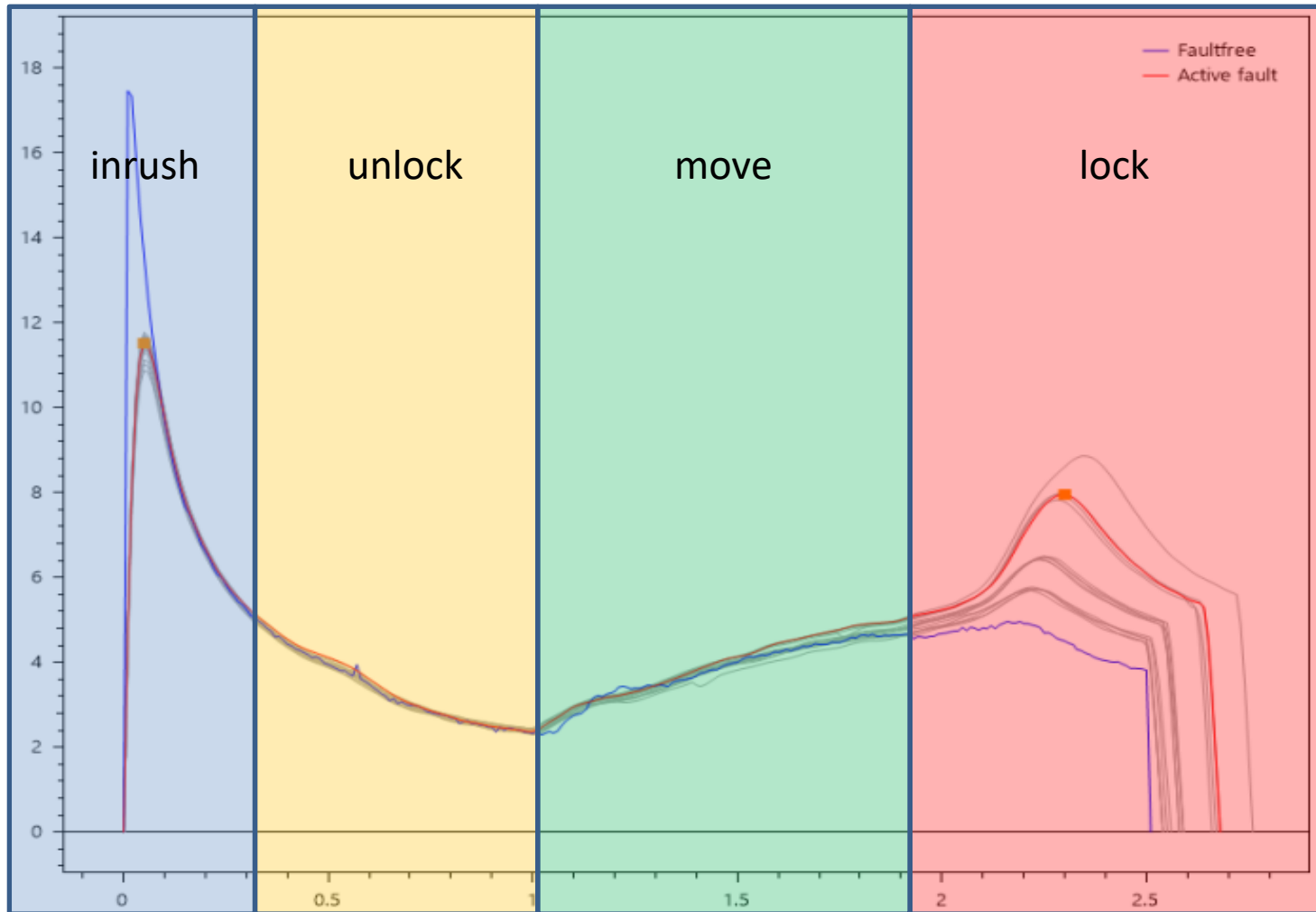
- Area under the curve in a section
- Difference between maintained base trace and current waveform
- Number of peaks or dips in an area
- The variance of the waveform
- Gradient in a section of interest
- Swing duration
- Difference in swing duration between NR and RN throws
- More techniques can be used with additional sensors and higher sampling rates

# Benefits of the expert system

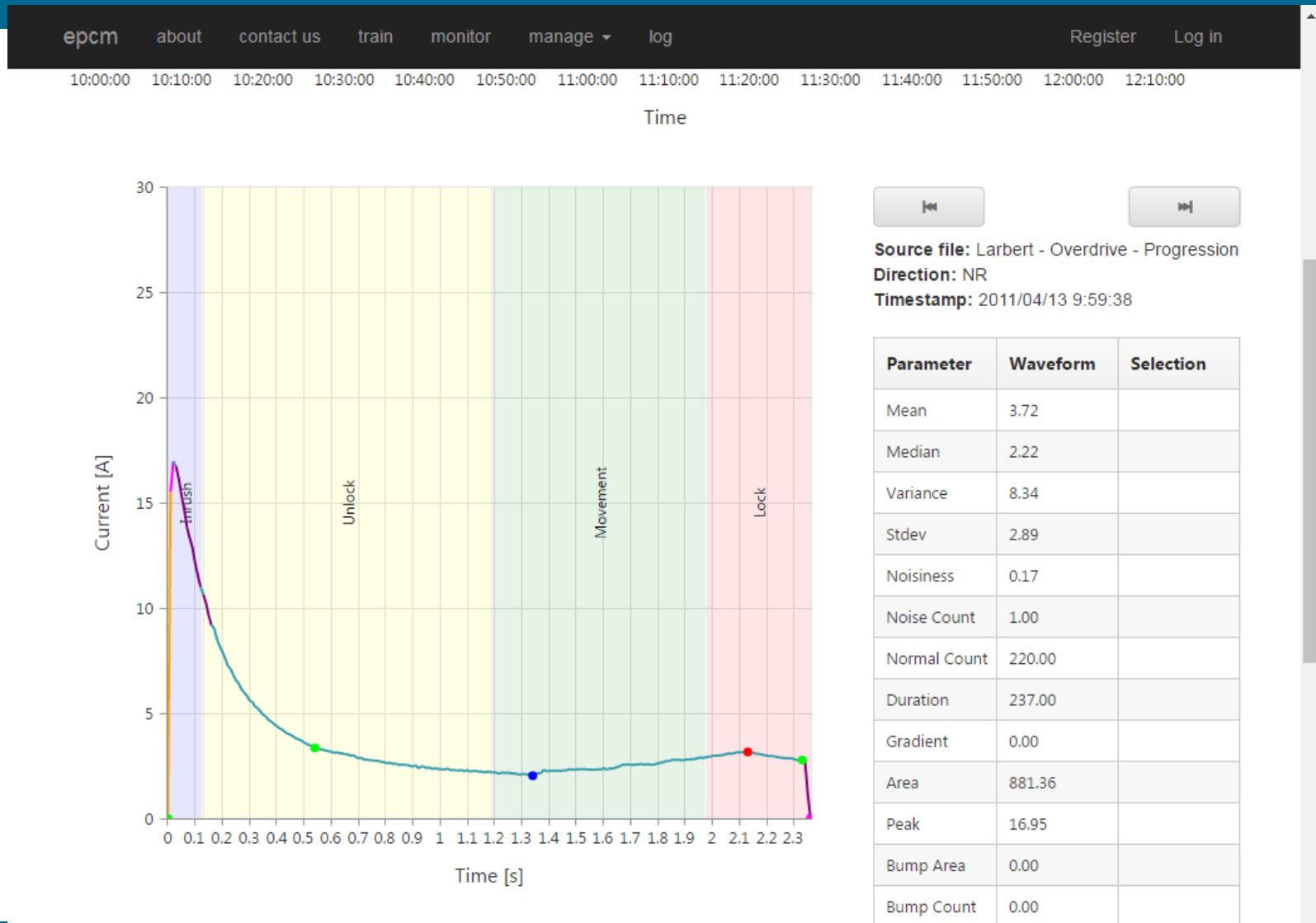
- Retains expert knowledge
- Simple but powerful rules are easy to understand and develop
- Less false alarms due to structured continuous improvement of alarm management
- Allows engineers to have a more extensive but also more detailed view of the health of point machines



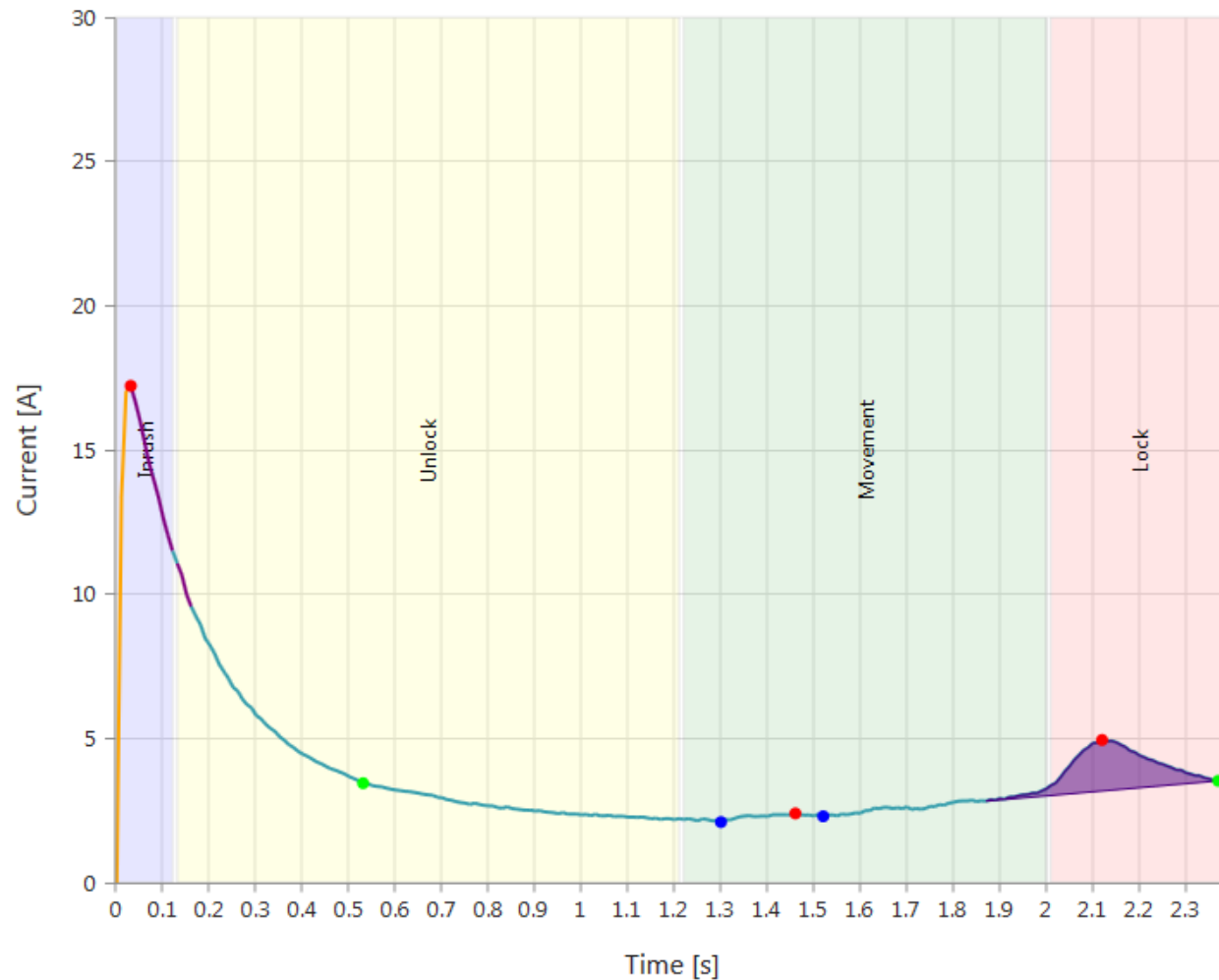
# Areas of interest during points movement



# Prototype web interface



# Overdrive detection



# Overdrive rules

## Add new rule

Fault:

Overdrive

Description:

Parameter:

Select a parameter

Area:

Select an area

Absolute or Relative to basetrace?

Relative

Value for max score

0.00

Compared Parameter:

*Note: select 'none' to just use the max score value,  
otherwise this parameter will be multiplied by the max  
score value*

Select a parameter to compare

Add rule

## Fault scores:

Overdrive: 48.03 %

Tightlock: 0.00 %

Contaminated slide chairs: 0.00 %

Schvihag rollers OOA: 0.00 %

Worn motor brushes: 0.00 %

Snubbing: 0.00 %

## Existing Rules:

One bump in the lock phase

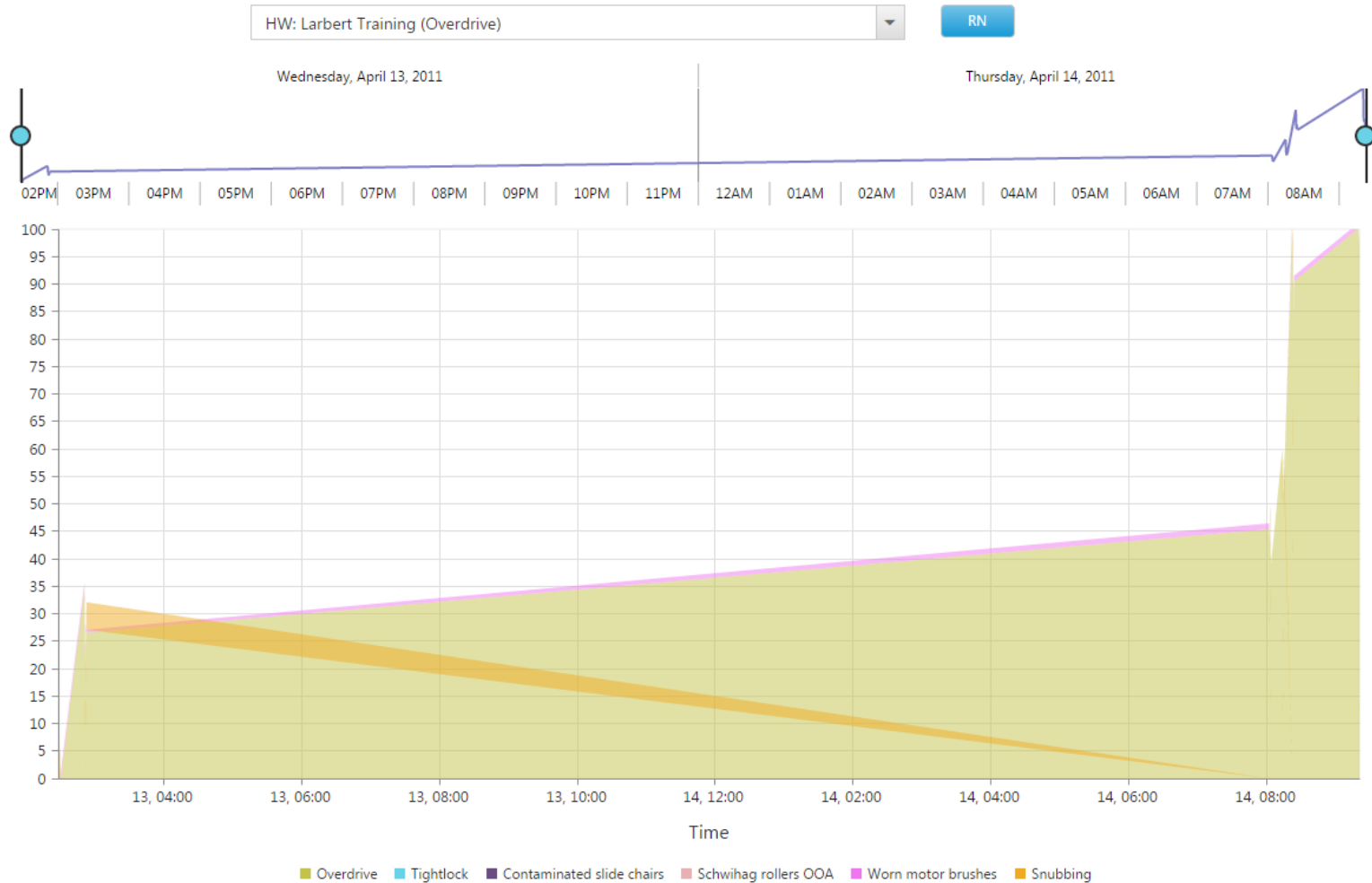
Looking for Bump Count of value 1 in lock (Absolute)

Bump mean @ 1/2 wf stdev

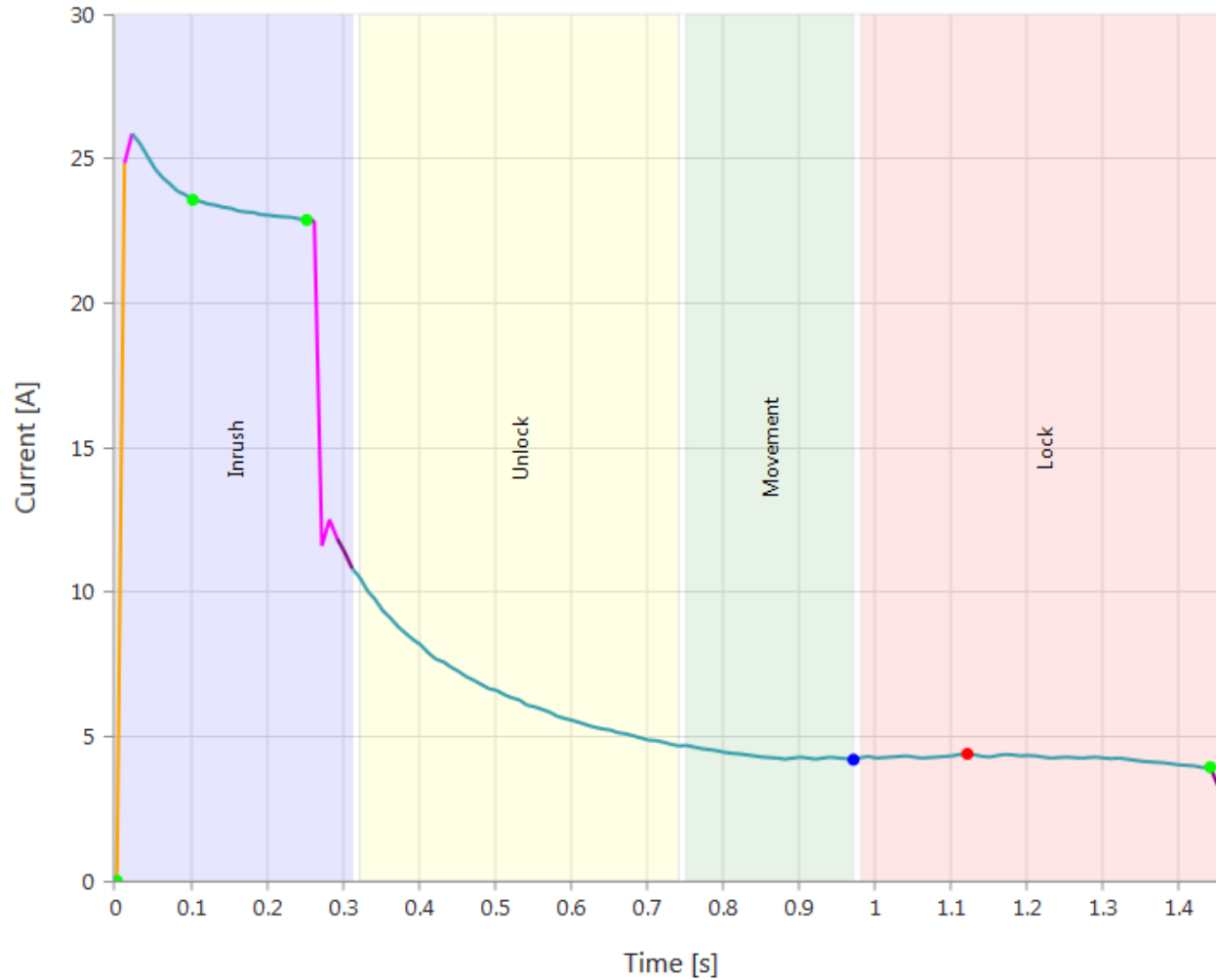
Looking for Bump Mean of value 0.5\*Stdev of waveform in lock (Absolute)

# Overdrive progression

## Monitoring

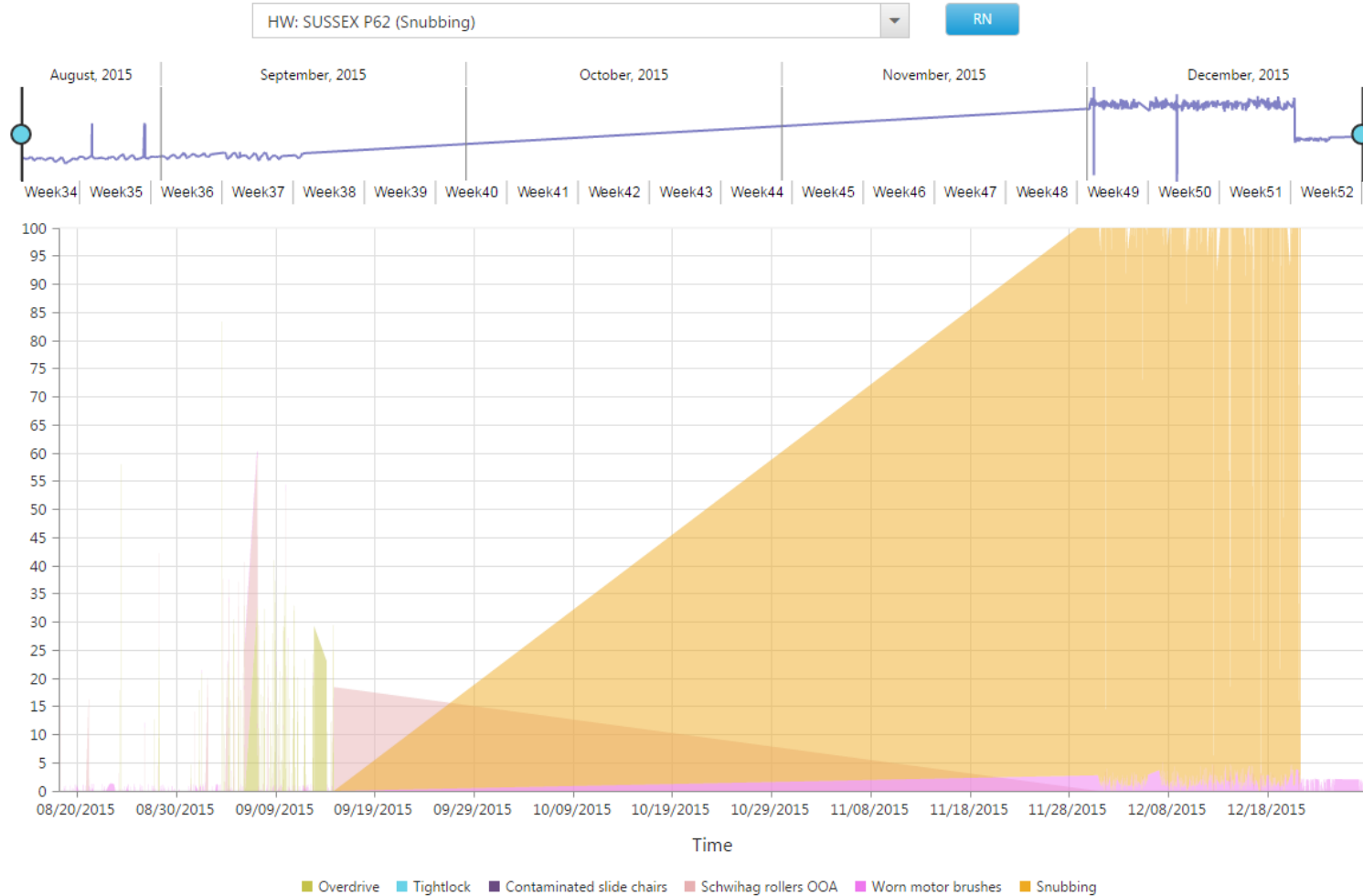


# Detection of snubbing in HW's



# Detection of snubbing in HW's

## Monitoring



# Current algorithm progress

- Confident in detecting faults with obvious characteristics without using a basetrace
- Can detect more subtle faults by comparing to the basetrace
- Diagnostics mainly use electrical current but we have done some research on improving reliability by incorporating additional data streams
- Awaiting data to incorporate fault prognosis into our current diagnostic techniques



# ePCM pilot

- Prototype system shown in this presentation has been demonstrated to Network Rail
- Currently working on implementing a pilot on a single route prior to a national rollout to incorporate feedback from flight engineers that are trialling the system
- This pilot will allow NR to understand the business change impact and define the added value over and above the current 30% of failures detected

# Thank you for listening

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