PROJECT

Predicting HVAC Lockouts

CLIENT

LNER

Overview

Wabtec Faiveley UK have had a Full-Service Maintenance Contract since 2013 for legacy (30-year-old) HVAC systems on a UK fleet of 30x 9 car Intercity Trains.

Since this time, the Field Services (FS) and Technical Service Solutions (TSS) teams have increased Availability from 7% to 98% and Reliability from 10 Months to 28 Months by installing RCM and providing dedicated on-depot support.

Despite this increase in availability and reliability, the module maximum design temperature is 28°C (82.4°F) and therefore modules can still struggle to perform during the peak of Summer. Summer of 2018 saw many HVAC systems 'locking out' and disabling cooling as a mechanism for protecting the compressor in adverse conditions.

In Spring of 2019 in preparation for another hot summer period, the TSS team set out to use the previous summer's dataset intelligently in order to reduce the adverse effect of compressor lockouts. If a lockout could be predicted with enough time to act, a module could be investigated or replaced pre-emptively in order to reduce the impact on cooling performance.
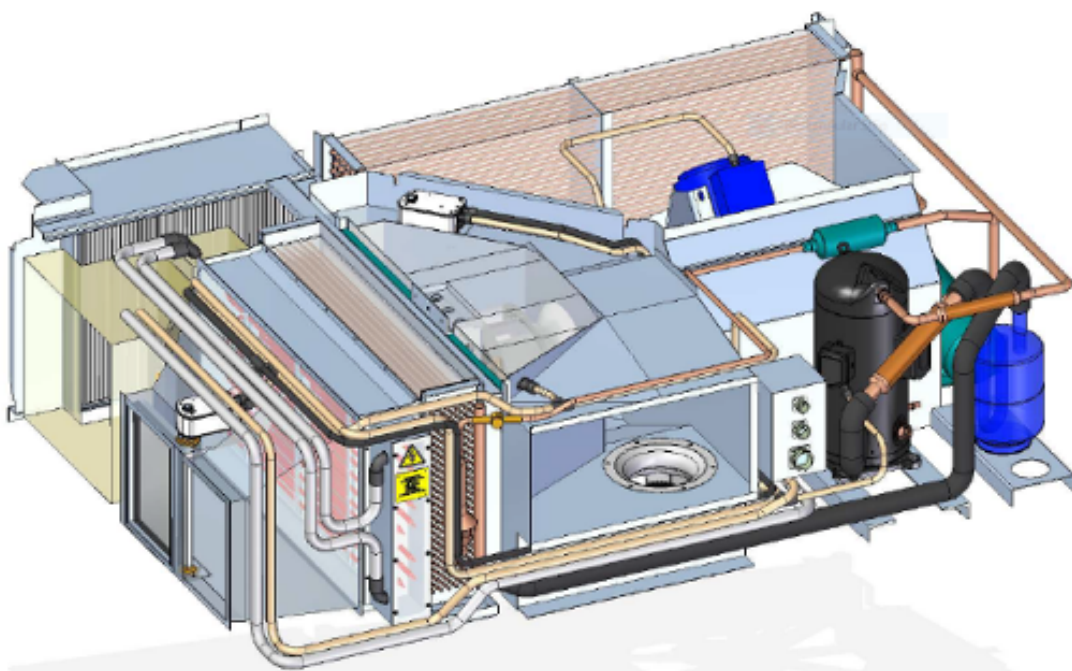
Deliverables

The TSS team worked with the WabtecONE Data Science team in order to build a Machine Learning (ML) model to predict compressor lockouts using the Summer 2018 dataset.

The machine learning model algorithm was integrated in the cluster on the WabtecONE cloud, on the live data set to operate in shadow mode.

Delivering automatic alerts on the visualization tool when a failure prediction is registered.
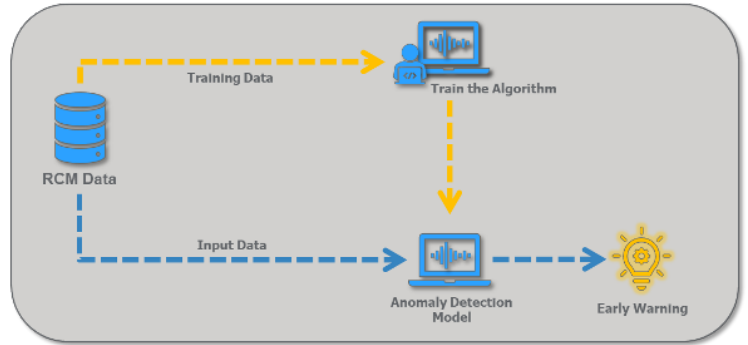

Challenges

The model was then implemented on the non-production version of the RCM dashboard system, making predictions against live data during Summer 2019. Initial results showed that the model was misclassifying some lockouts due to the volatility in weather during the period. The model was built without any knowledge of weather forecasts so assumed that weather conditions were fairly stable between days. This assumption largely held during Summer 2018 but was less realistic in Summer 2019.

Solutions

Leveraging Remote Condition Monitoring (RCM) data, subject matter expertise, and AI techniques, we can deliver a real-time model capable of identifying anomalous HVAC behavior to provide early warning of impending failure.

The model was trained to use various statistics of the temperature and status flags in order to predict whether a compressor would 'lock out' in the next 24 hours.
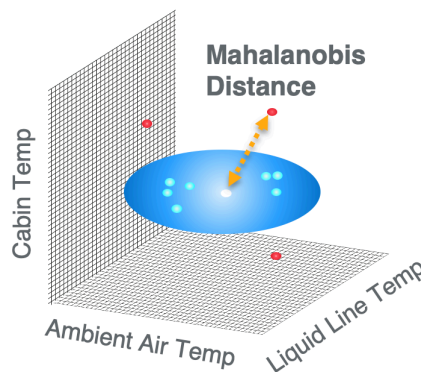
Included within the analysis of the algorithm was a real time external weather API.

The elliptic envelope model is trained on selected features, identify anomalies, measure magnitude, and leverage historical data to generate a time-to-failure prediction.

Benefits

The model performed well on a held-out sample of data, with 98.8% accuracy on 344 data points, only 1 False Positive (predicting a lockout when there was none) and 3 False Negatives (predicting no lockout when there was one).

- Optimized asset strategies.
- Enables reduced life cycle cost of system through right sizing of maintenance schedules based on system performance.
- Unrivaled levels of environmental comfort for passengers.
- Increased system availability and reduced system downtime.
- Operational resilience and diagram flexibility.
- Pre-planning of inventory, resources and shop space.

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