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Anomaly Trend Detection Tool

EARLY PREDICTION OF EQUIPMENT FAILURE

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Reduction of unscheduled shutdowns

- Estimated that unscheduled shutdowns cost 5% of total production annually.
- Expected that 80% could have been avoided, which worldwide is equivalent to 16 billon dollar each year.

500 priv ate jets

1 Aircraft carrier

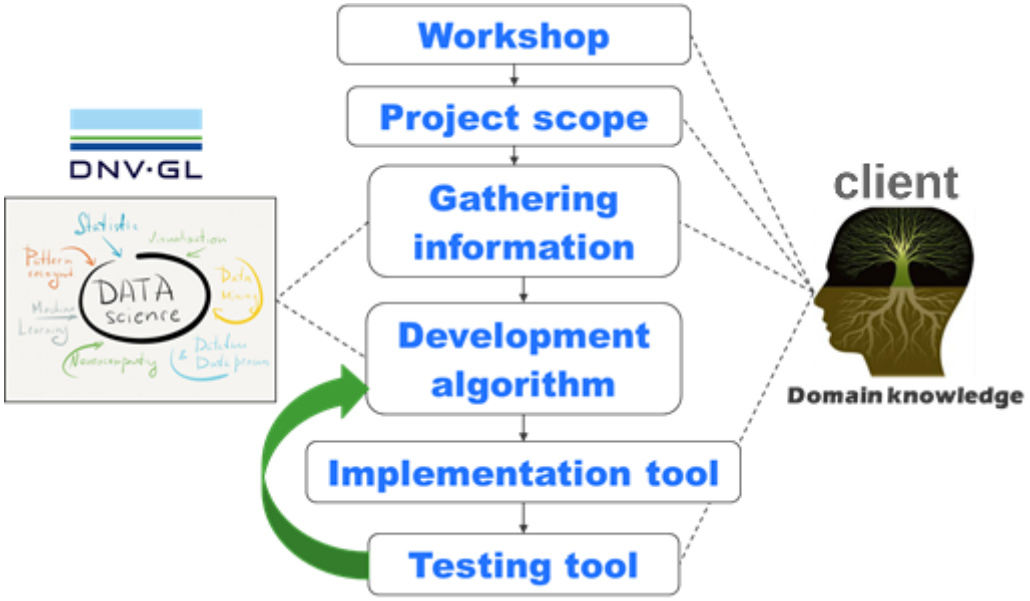
Total GDP Senegal

Machine Learning

- Who can quickly analyze the high amounts of data collected by operators to gain insight in their assets?

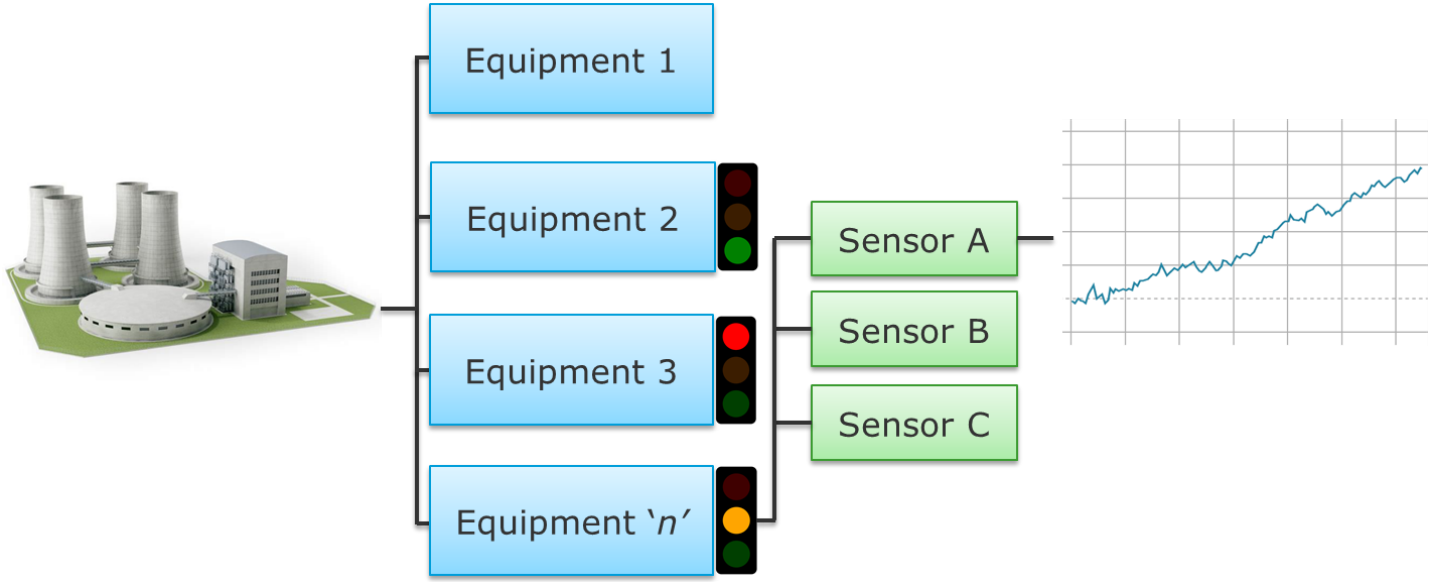
Setting up ‘Big Data’ projects

- Translate this issue to a clear project scope. What is the problem and what output will assist the client.
- Domain knowledge of the system (plant) is critical for understanding the problem and selecting appropriate models and algorithms.



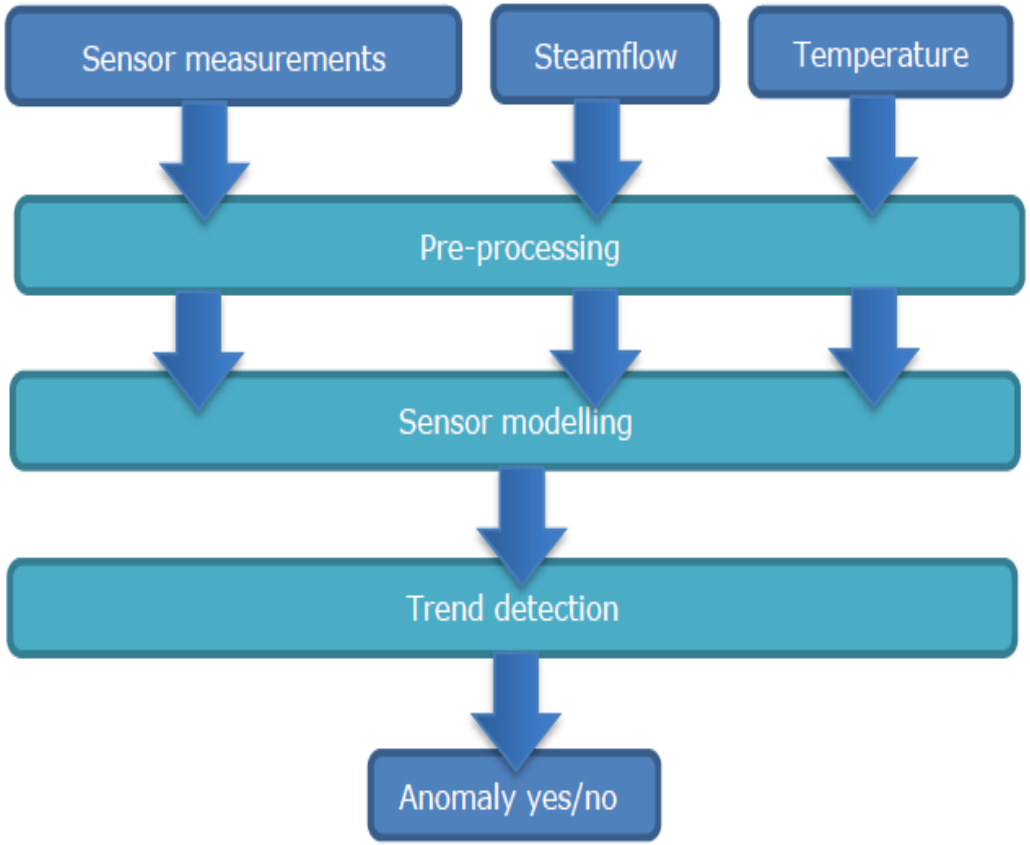
Scope of Anomaly Detection Tool

- Scope: Can we detect degradation and potential failure of components in an early stage, by identifying change in sensor behavior over time?



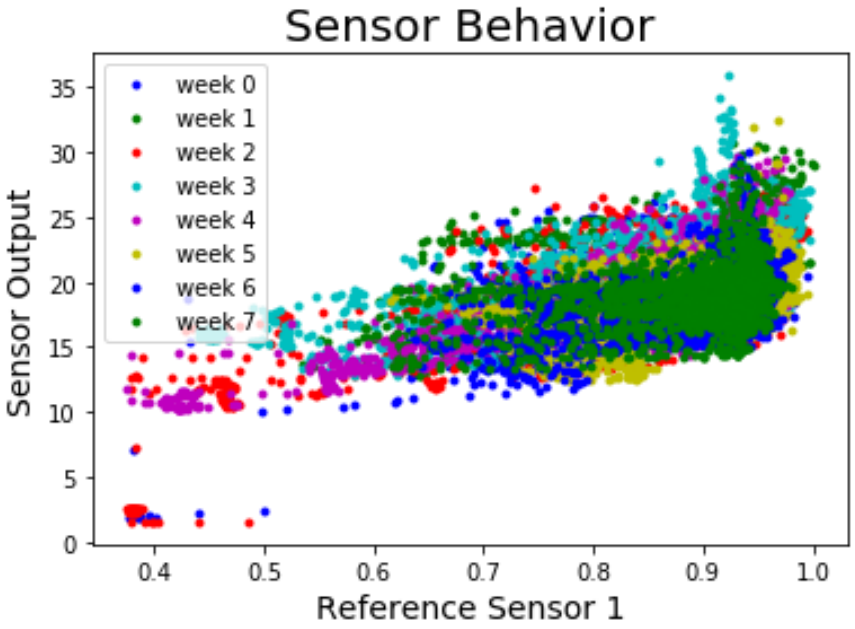
General model overview

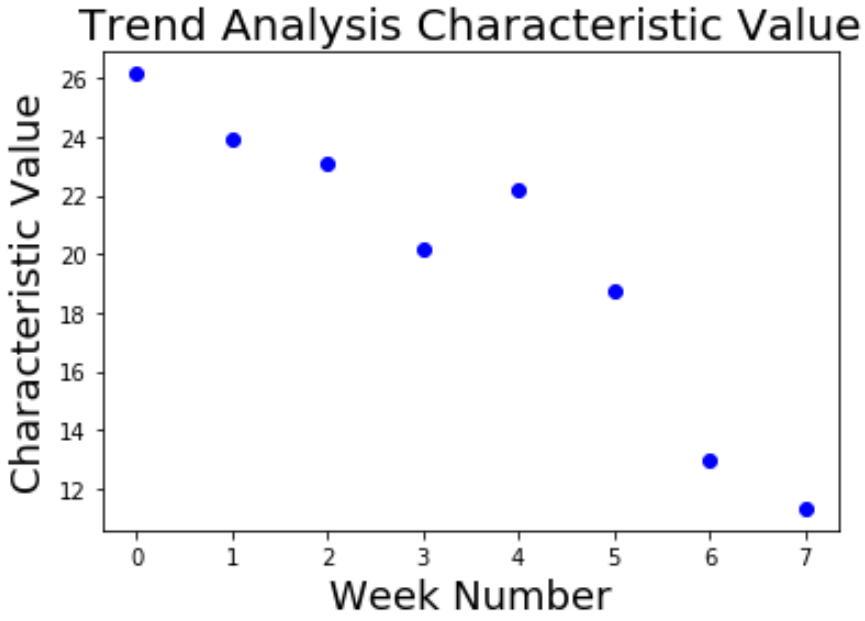
- An unsupervised model is developed which is independent of sensor type.
- The approach is useful for all kinds of plants.
- The performance of the plant is captured by specific sensors labelled as reference sensors.



Modelling of sensor behavior

- For each week the behavior is defined by a set of characteristic values, based on a linear trend analysis.



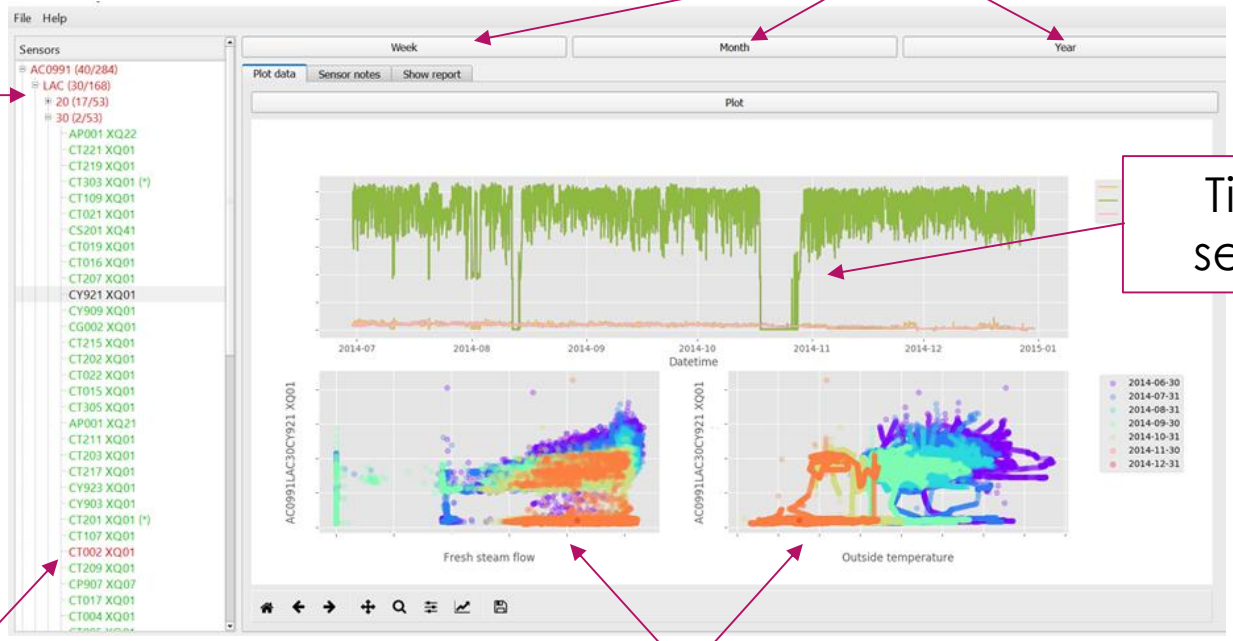


- Each characteristic value is then analyzed if a significant increase or decrease is present.

Interface of the Tool

Drop down menu: Equipment and sensors

Week – month – year analysis



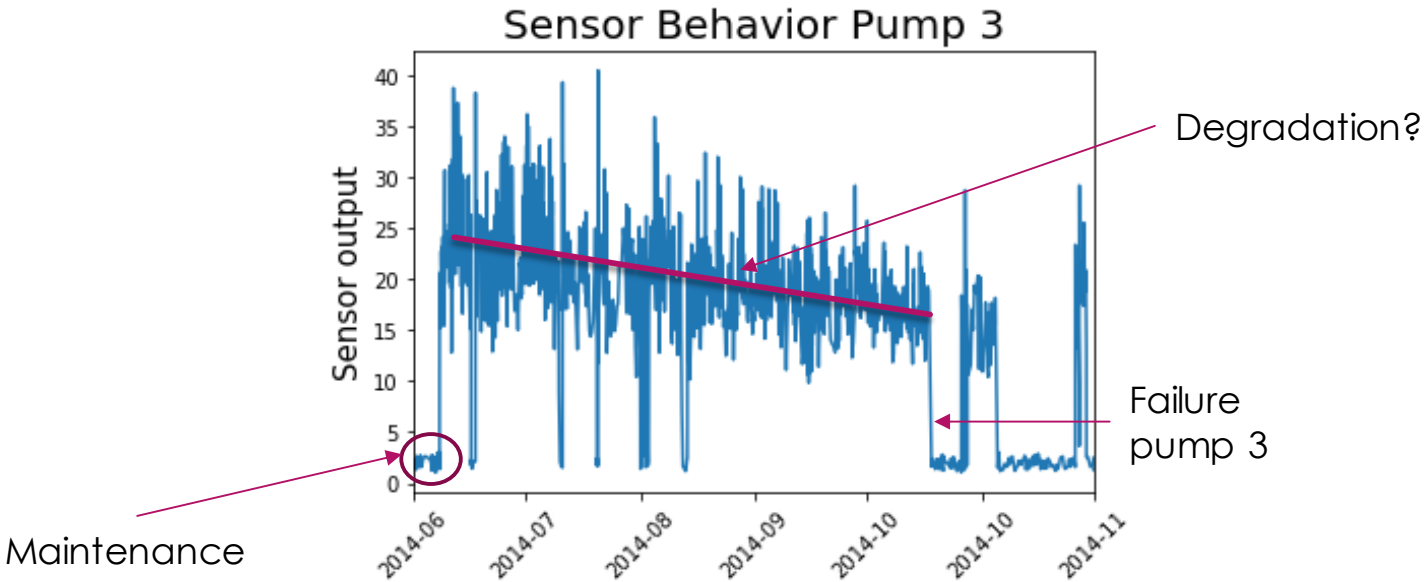
Time series sensor data

Red flag = anomaly detected

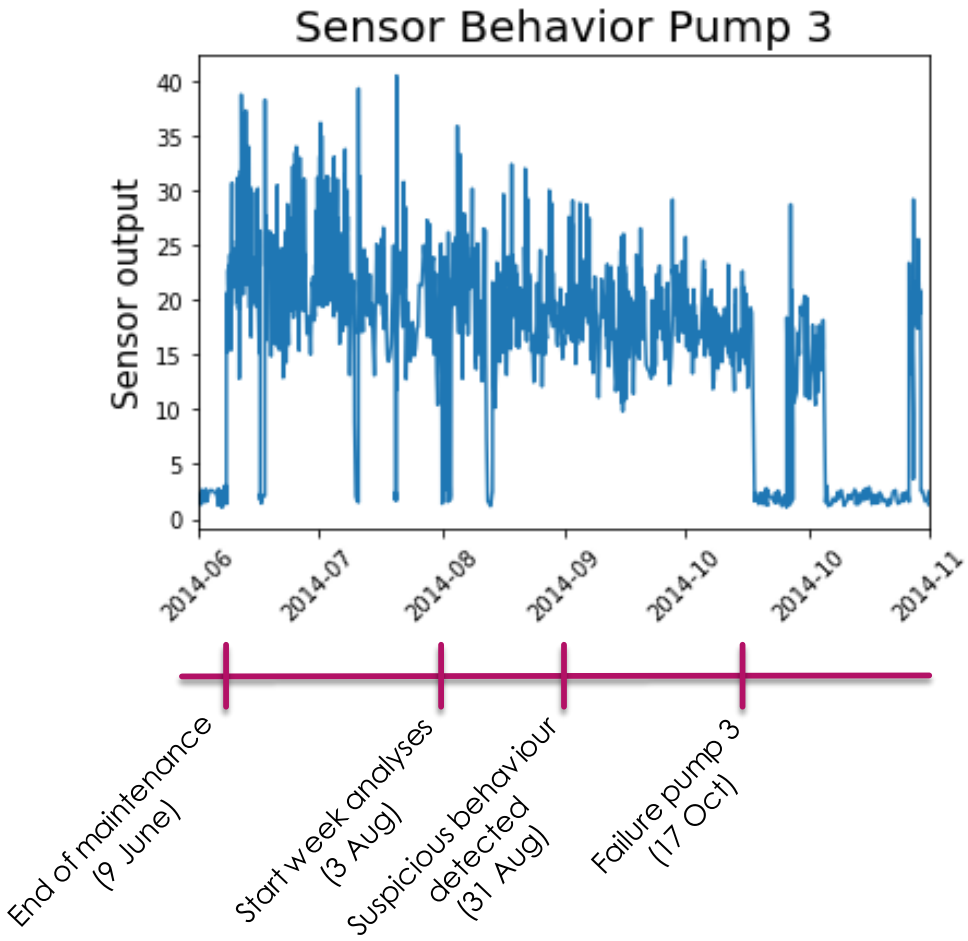
Sensor data vs reference sensors

Case study: Detection of pump failure

- On the 17th of October 2014 a failure occurred in pump 3
- Could we have predicted the failure?



Case study : Week analysis



- On the 31th August a change in sensor behavior is detected. The suspicious behavior is also detected in the analysis of subsequent weeks.

Benefits of the Anomaly Detection Tool

- A high amount of sensor data can be analyzed systematically. To do this manually would be almost impossible.
- The uniform approach can be implement for any type of plant and complement existing scientific models and alarming.
- Gives new opportunities to prevent unscheduled shutdown

Conclusions

- Annually unscheduled shutdowns contribute to a 16 billion dollar loss. Machine Learning can potentially reduce the number of shutdowns.
- Development of a smart algorithm requires Domain Knowledge.
- The algorithm make use of an uniform approach to identify Anomalies. This makes the tool useful for any type of sensor in any type of plant.
- The tool allows running analysis on a weekly, monthly, yearly basis. This enables differentiation between slow and fast degrading equipment.

Thank you

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