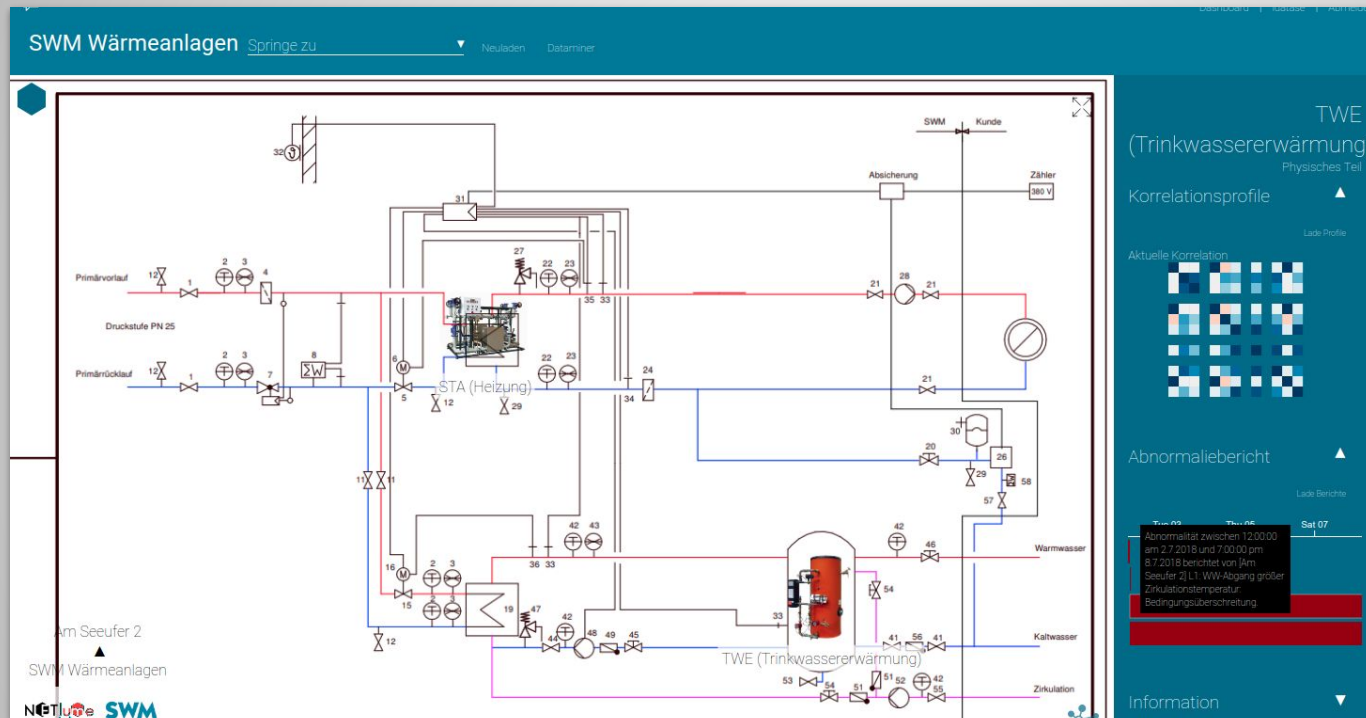# Unsupervised Predictive Maintenance System



NetLume operates an AI monitoring system for district heating stations for a german state capital utility. Over 1500 district heating stations are being monitored 24/7 and checked for sanity.

Different KPIs and features are derived running as "Softsensors" in parallel to common sensor readings of temperatures, pressures, energy consumption and output, etc. in order to infer health states of components.

Anomalies are processed, gathered and presented or notified to operators at anytime.

- **Savings in 6 digits** (Maintenance and Operations - 800 stations)
- **Expected savings in Millions** (Maintenance and Operations - 1500 stations)
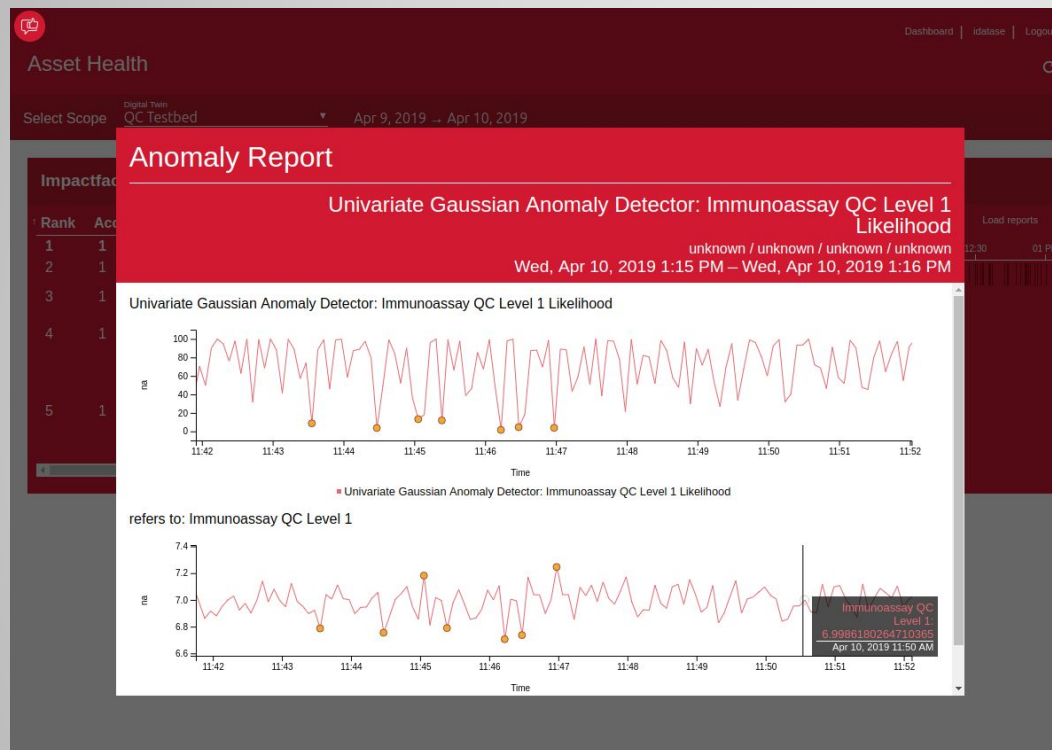
# Unsupervised Predictive Maintenance

# Use Case: Predictive Maintenance - Asset Health
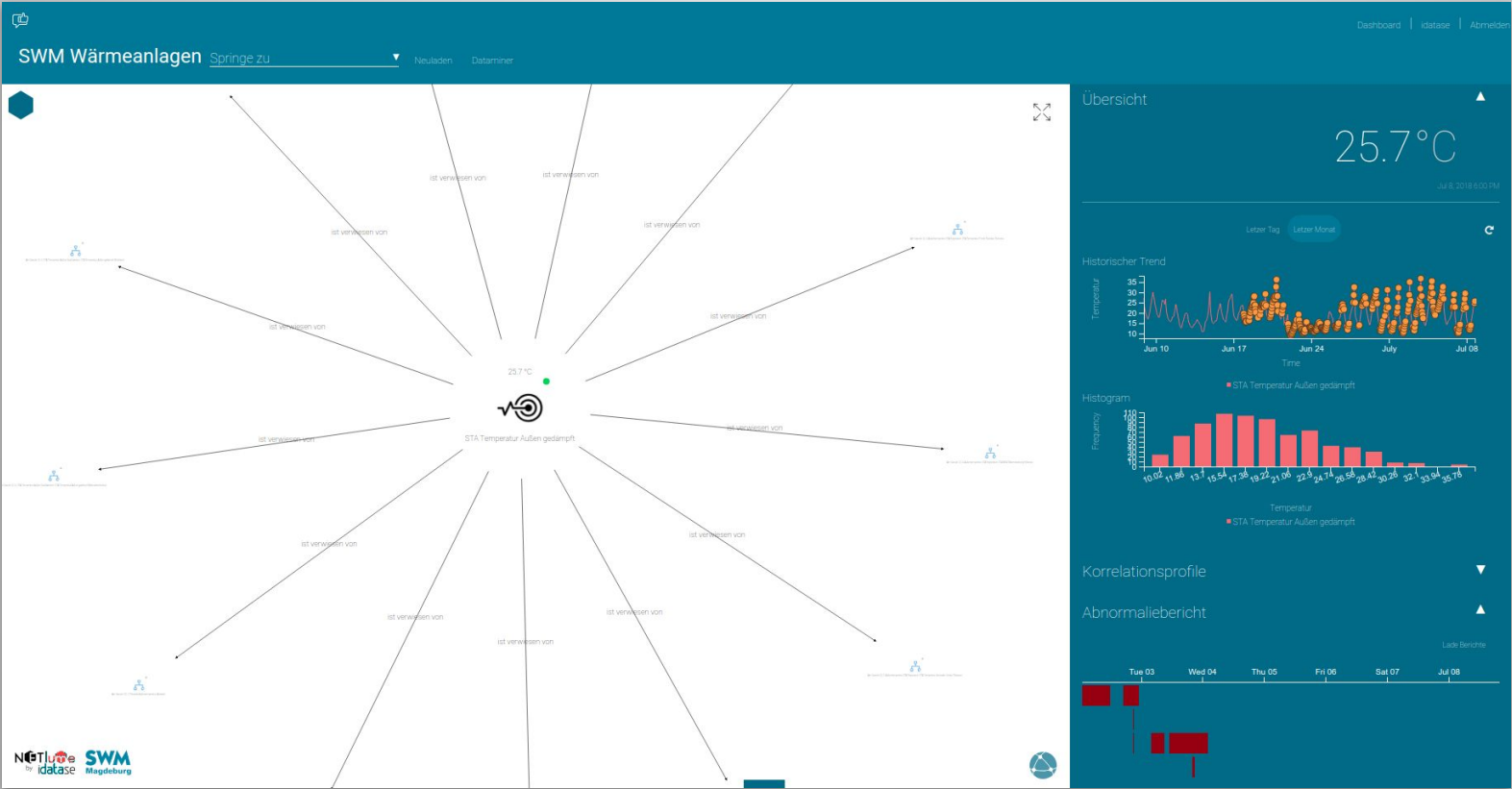
# **Use Case:** Predictive Maintenance - Lifetime Expectancy

# Event Prediction & Anomaly classification
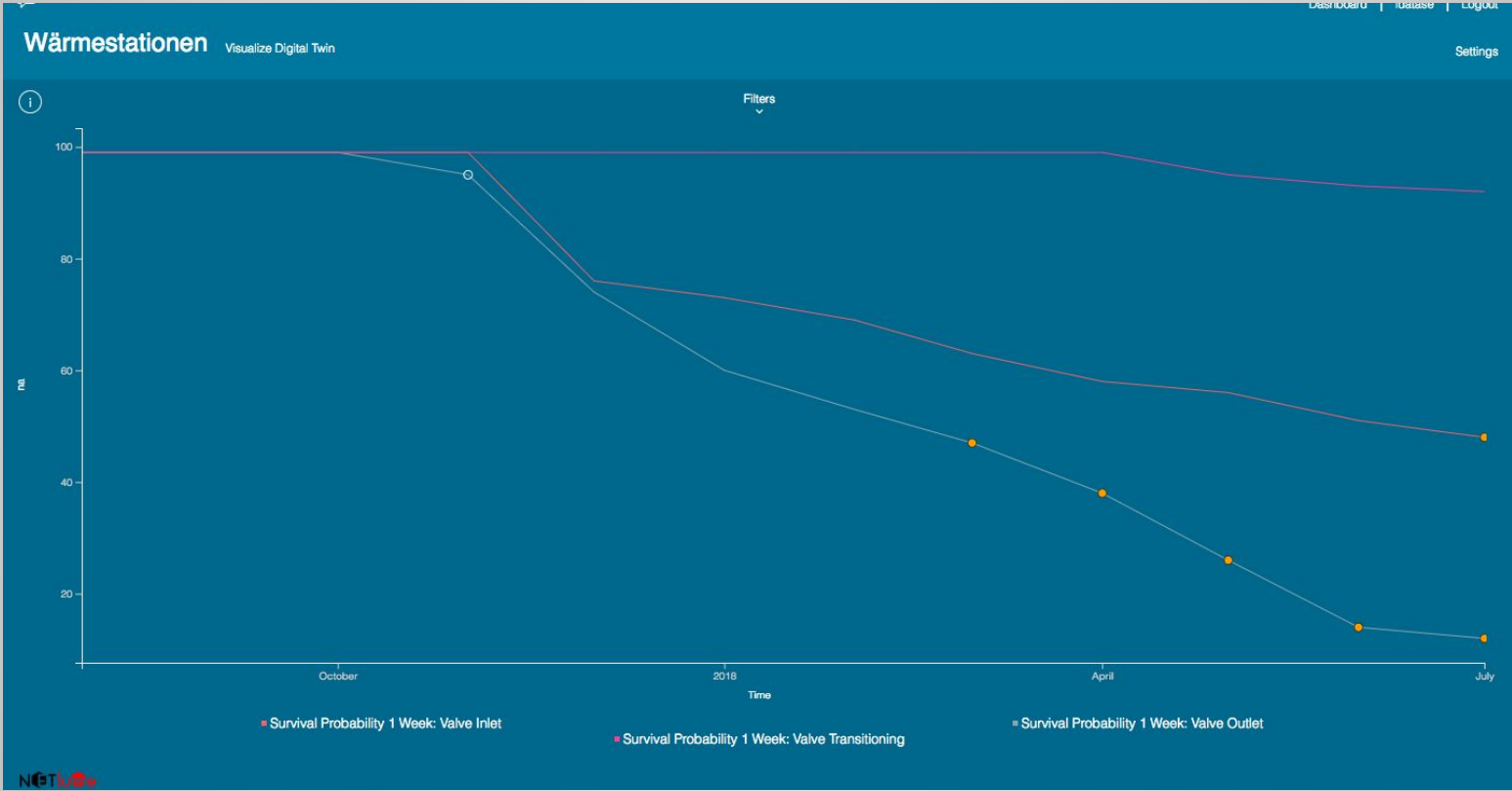


The pilot between idatase and Roche aims at digital business enablement across a laboratory landscape. A foundation by collecting and unifying data from laboratory the landscape will be created, based on which analytic services from laboratory data can be developed tested, evaluated and deployed.

- Easy vehicle to deploy service over distributed labs
- Landscape Unification across laboratories
- Testbed for data analytics
- Life cycle management for analytics

# Data Driven Services
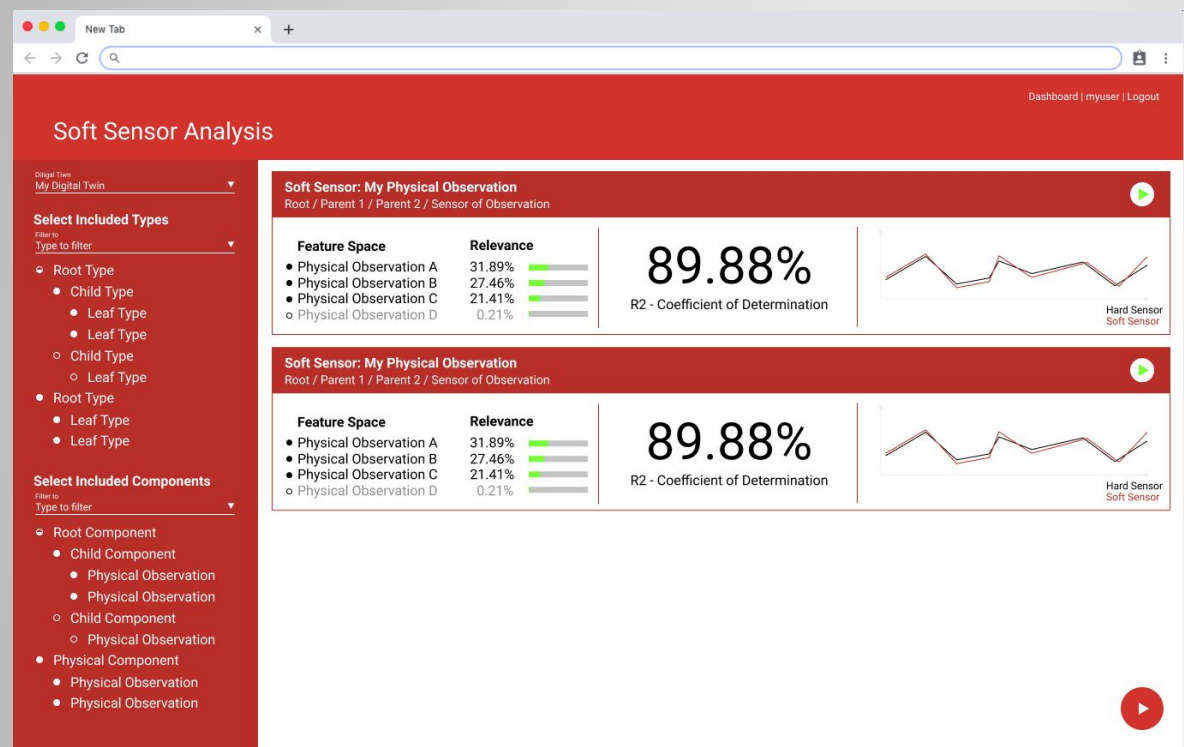


An air filter manufacturer is using NetLume as an innovation tool to create new digital service to offer to their client with their air filters. They just don't want to be only a manufacturer but also take a step towards IoT and digitalization and be a service provider. NetLume acts as a digital business enabler.

- **Soft Sensor Service  (Analytics that replaces hard sensors)**
- **Predictive Maintenance**
- **New Services to offer with their air filters.**
- **Life Cycle management of analytics**

# Public Transport Prioritization
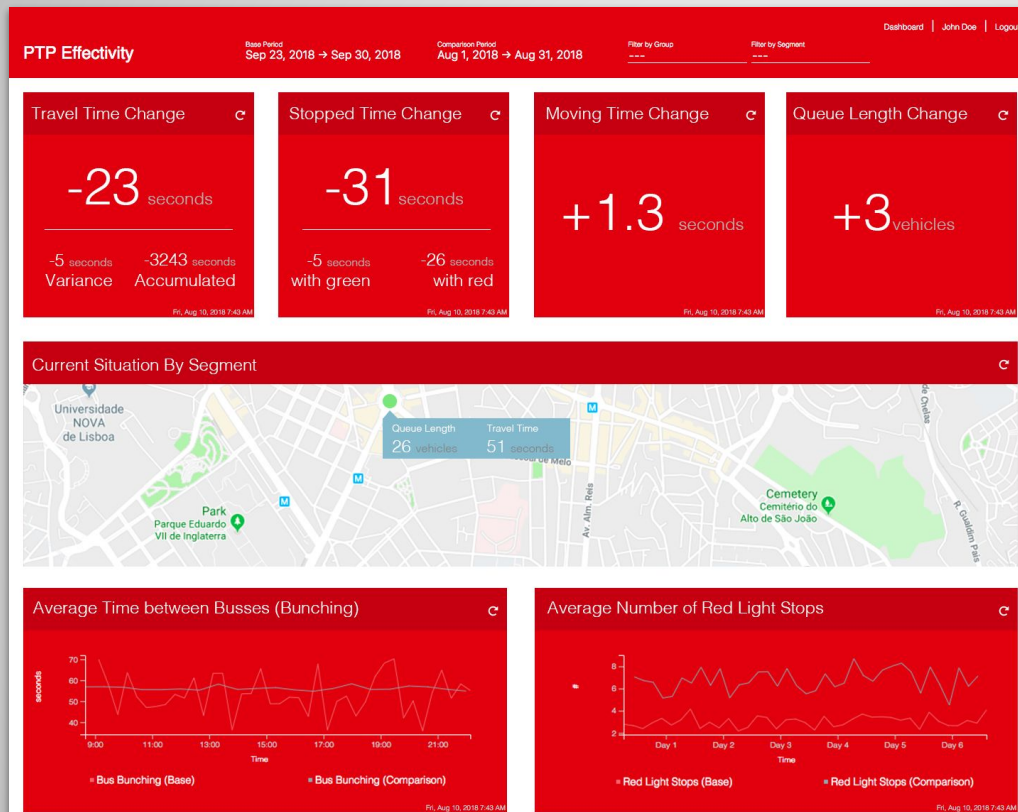


Reliability and effectivity of road-bound public transportation has always been under pressure by the general traffic situation in cities. Prioritization systems aim at keeping the streets clear for transit to keep their schedules and passengers to value their service.

NetLume is providing the tools to monitor and assess in real-time the effectivity of prioritization systems, as well as a suite of visualizations to present the information in an intuitive manner.

**- Savings: 5 Million Euros** (Transportation Operation costs)

# E-Mobility Services

Municipality can contribute to the reduction of local noise and air pollution caused by commercial vehicles used in urban areas by optimizing existing vehicles and adding new EVs. The plan is to outline the complete metrics including, but not limited to operational efficiency, usage efficiency (gardening trips and for waste disposal etc...), logistic network optimization and gathering technical data in order to understand:

- Usage of the EVs and existing vehicles
- Operational impact based on the usage (Expert Diagnosis, Battery Life-cycle, Charging Life-Cycle)
- Information regarding routes, schedules and fixed points, such as charging or parking stations.

Mentioned below are the specific areas of focus:

- **Battery efficiency** in terms of improved range prediction and determination of influence factors, such as acceleration, braking, battery temperature, up-/downhill;
- **Battery lifetime insights**, looking at proxies to the following negative usage patterns; like fully charged but sitting idle for hours, or 60% charge is enough for the task at hands etc...
- **Congestion analytics**
- **Optimised scheduling and routing for vehicles**
- **EV Solutions**
   a. Management system that allows EV station owners to comfortably control their installations, no matter where they may stay and eventually be able to easily add BI and advanced analytics.
   b. Proactive network planning for next EV Charging stations set-up in Lisbon area through data-driven decision & analytics.

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# EV - Mobility services: Daimler
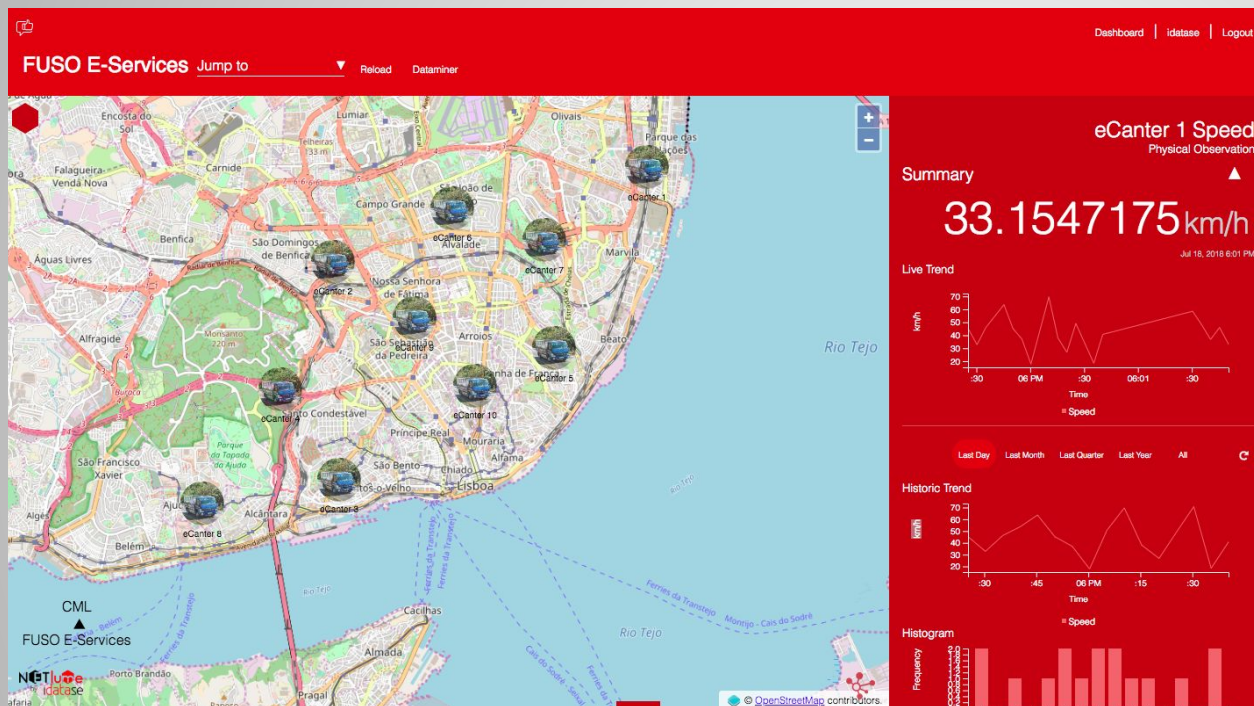


NetLume is involved in a project with Daimler where the value generation of the mobility solution will demonstrate the distinct benefits of the NetLume approach to data driven service creation and the adaptability of the resulting eServices App based as well as its benefits for Daimler and Daimler clients.

NetLume will create the prototype system that will demonstrate how to track and evaluate the effects of Daimler E-trucks and defined services by covering the complete vehicle journey from usage and operations while as well taking logistic network information into account. The two services that will we created are:

- **Predicting Battery and Charging lifecycle**
- **Dynamic Route Optimization**
- **Reducing Noise and Air Pollution**

# Monitoring System

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**Monitoring System:**
- Monitor effectivity of charges, how well are the trucks used?;
- Keep an eye on route delays and trace back to the key issue - are those due to missing charge?;
- Always be up to speed with where your trucks are;
- Gain insight on the Battery cycles to fuel the ever-changing operation strategy; and
- Use one-look gauges to emissions, usage and problems to create confidence in your fleet
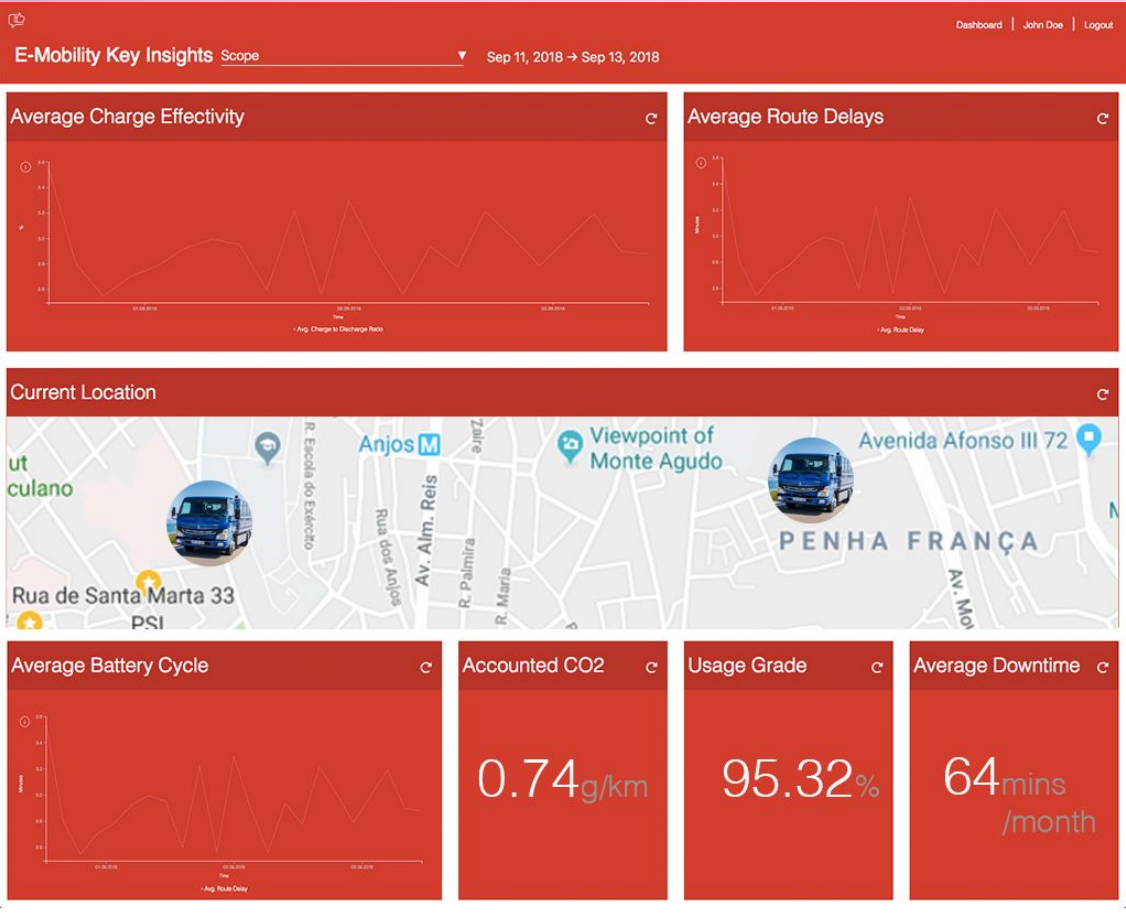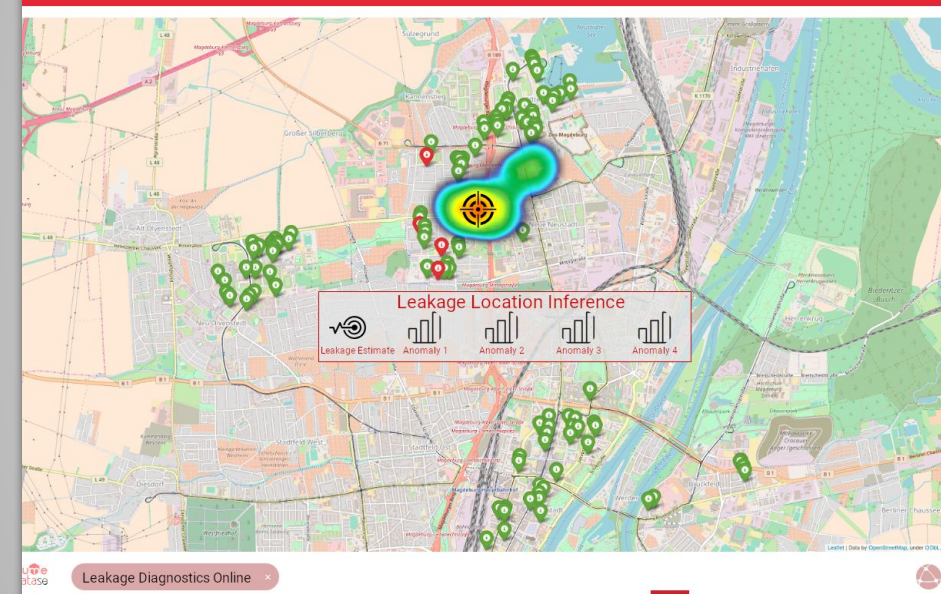
# Leak Detection in Pipe Networks
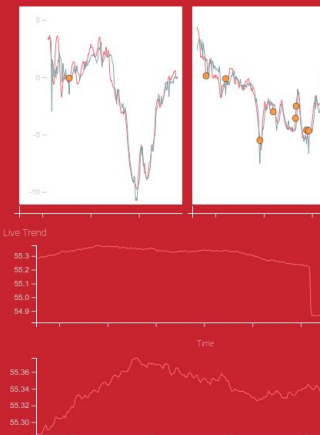


The majority of leaks in pipe networks often go unnoticed as the effects accumulate over long time and cause significant losses. Detecting and localizing leaks is therefore a major challenge in research as well as in industry.

NetLume is used by one of our partners to semantically model water distribution networks and structure their knowledge/information base. They were able to combine different physical leakage detection models with localization algorithms to increase detection and localization accuracy mostly independent of the kind of measuring sensors.

- **Reduction in lost water due to quick response times**
- **Reduction in maintenance cost due to reduced field trips**

# Load and Power Generation
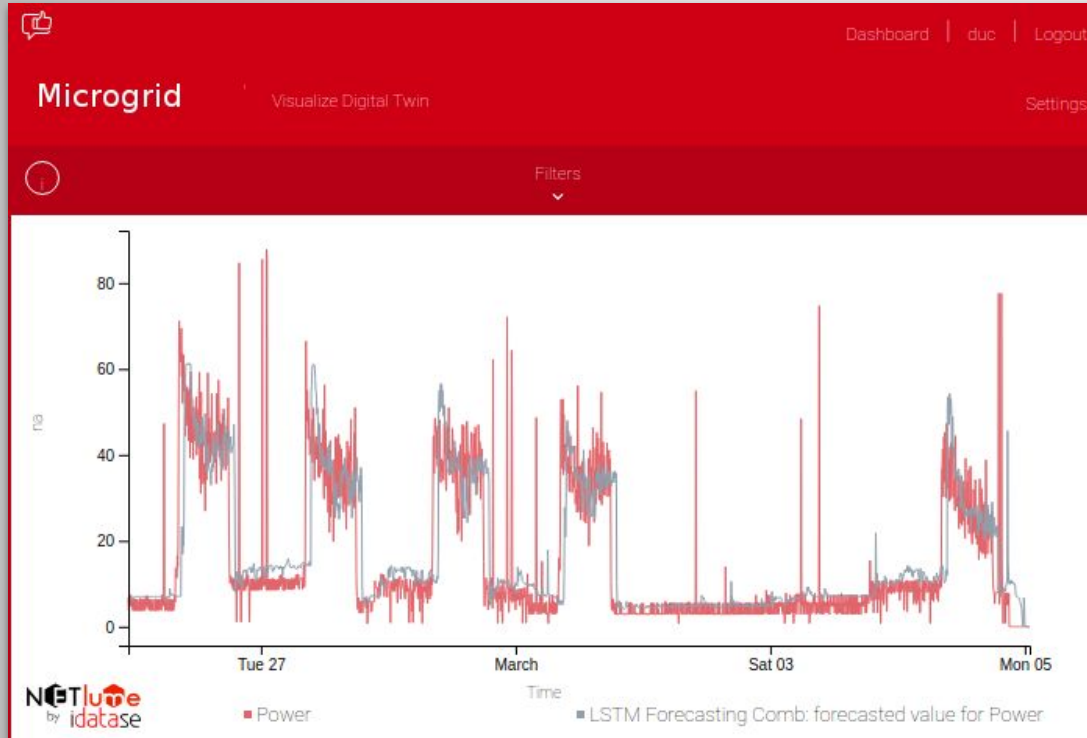


Instead of using external forecasting data, the microgrid itself also provides state indications for load and power generation patterns observed in historic data. A smart microgrid system is able to use the grid sensors to forecast load and generation.

Load and generation patterns can be broken down to groups and individual components of the grid (e.g. group of PV stations, a single PV station at a specific location, groups or individual buildings). The learning algorithms will be able to forecast patterns for some components well, while worse for others and offer an insight into consistent or unstable components in the process.

- **Operators receive a regular report on the next day and month forecasting highlighting critical load and generation patterns to prepare for them.**
- **The smart system itself can use the forecasts to automatically pre-adjust controls (e.g. improve load balancing) of and imminent warnings for the microgrid.**

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# Real-Time Anomaly Detection System
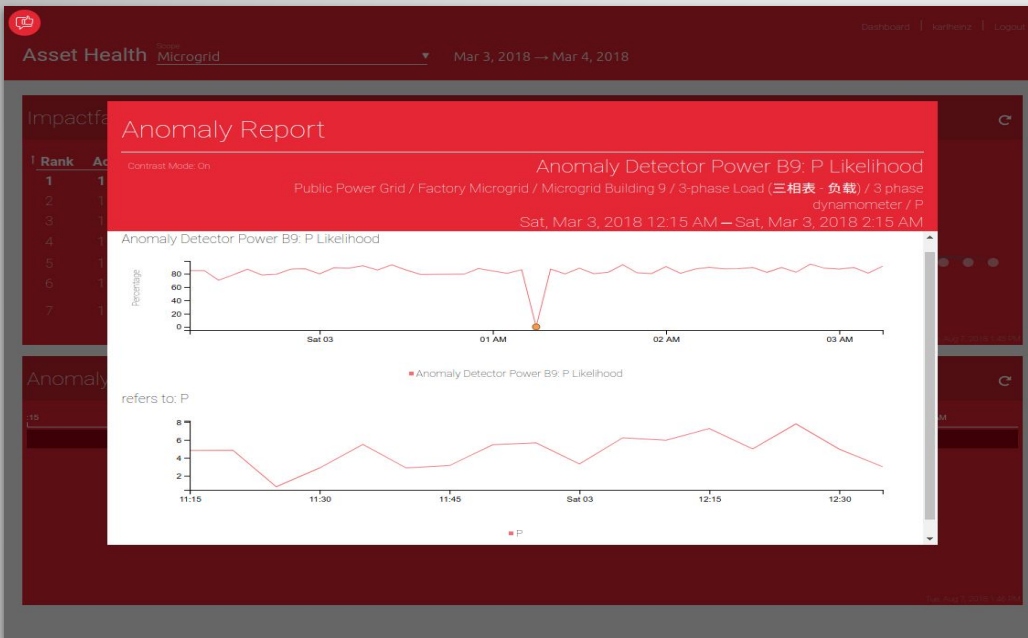


Using a multitude of analytic anomaly detection algorithms, a smart system is able to automatically identify and report unusual behavior.

Unusual behavior can be either defined through domain experts (e.g. simple thresholds, constraints between sensors) or trained automatically by learning from recent sensor history (e.g. complex neural networks and probabilistic models).

The system is able to monitor for complex patterns in the data 24/7 and taking tenth or hundreds of sensor constellation into account.

- **Reports and forecast summaries (daily, monthly and yearly) with all kind of anomalies.**
- **The feedback is automatically incorporates into the smart system to improve.**
- **Regular anomaly patterns detected by the system are often significant entry points for grid optimization.**

14

# Load Prediction in Microgrid Systems



Grids, and especially microgrids, have different and highly distributed units to produce and consume energy. Knowing the short- as well as the long-term demand beforehand is the main driver for unit optimization and scheduling.

NetLume is engaged in a PoC to augment the digital ecosystem of a microgrid with different combinations of short- and long-term load and power forecasts.

- **Understanding of the future consumption or load demand.**
- **Maximum utilization of power generating plants. The forecasting avoids under generation or over generation**.

# Grid Anomaly Detection & Localization
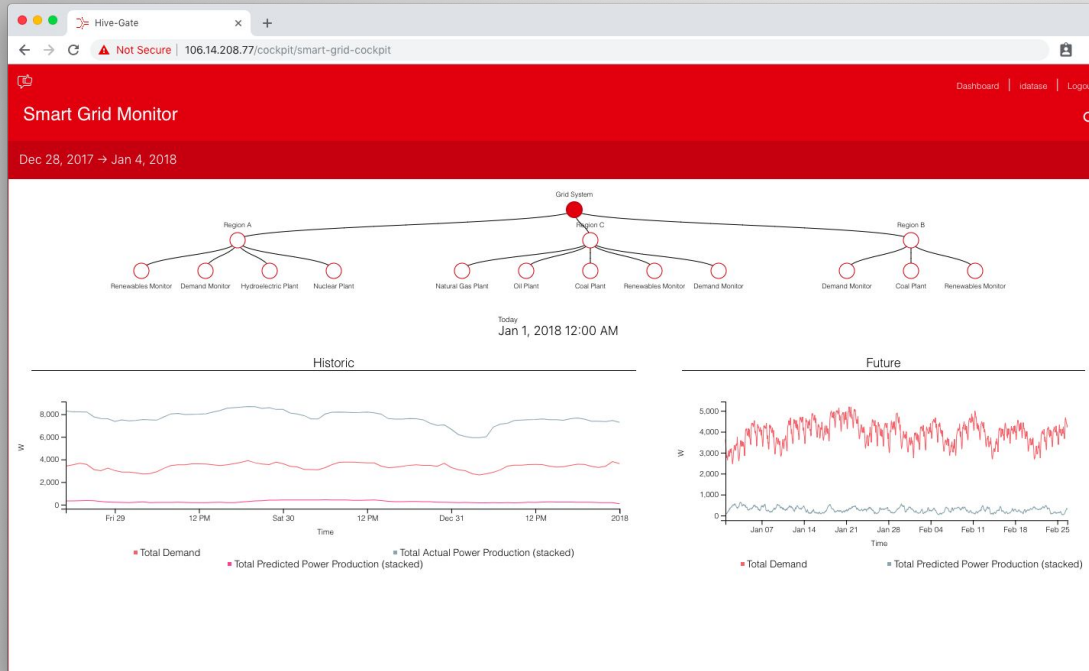


Power grids are used by a various different customers and stakeholders and prone to be exploited by public intruders, damaged by environmental events or simply misused by consuming entities in the grid.

NetLume is engaging in a first project for automatic anomaly detection in energy consumption and production patterns. In a combination of human domain expertise ("how should the pattern look like") and data-driven models ("how did patterns looked so far"), the goal is

- **Self-learning AI System that works hand-in-hand with grid operators to detect unusual behavior in the whole grid system.**

# Early Gearbox Failure Detection
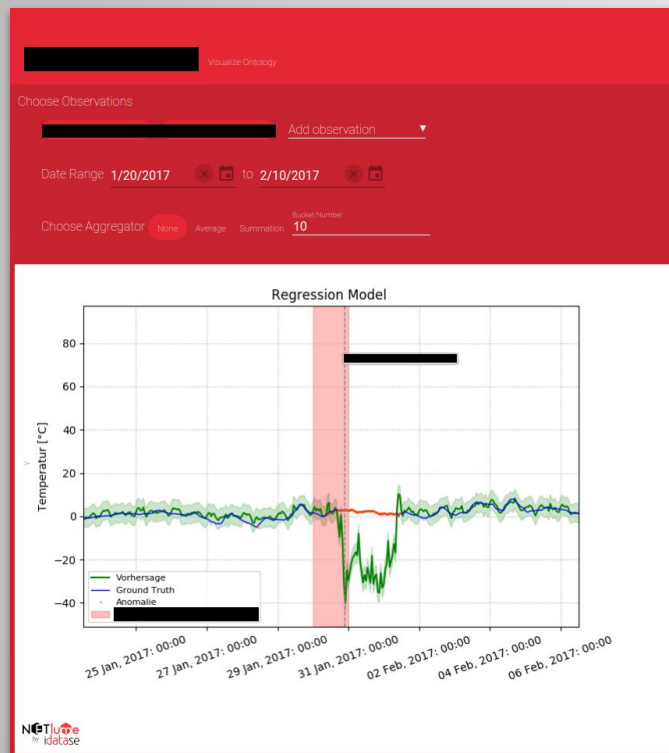


Gearbox failures are in many systems the cause of complete machinery breakdowns. Once a gearbox breaks, repair of the machinery and lost performance take a toll with costs.

- **KPIs to detect gearbox breakdowns in Wind Turbines days or even weeks before they actually happen.**

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