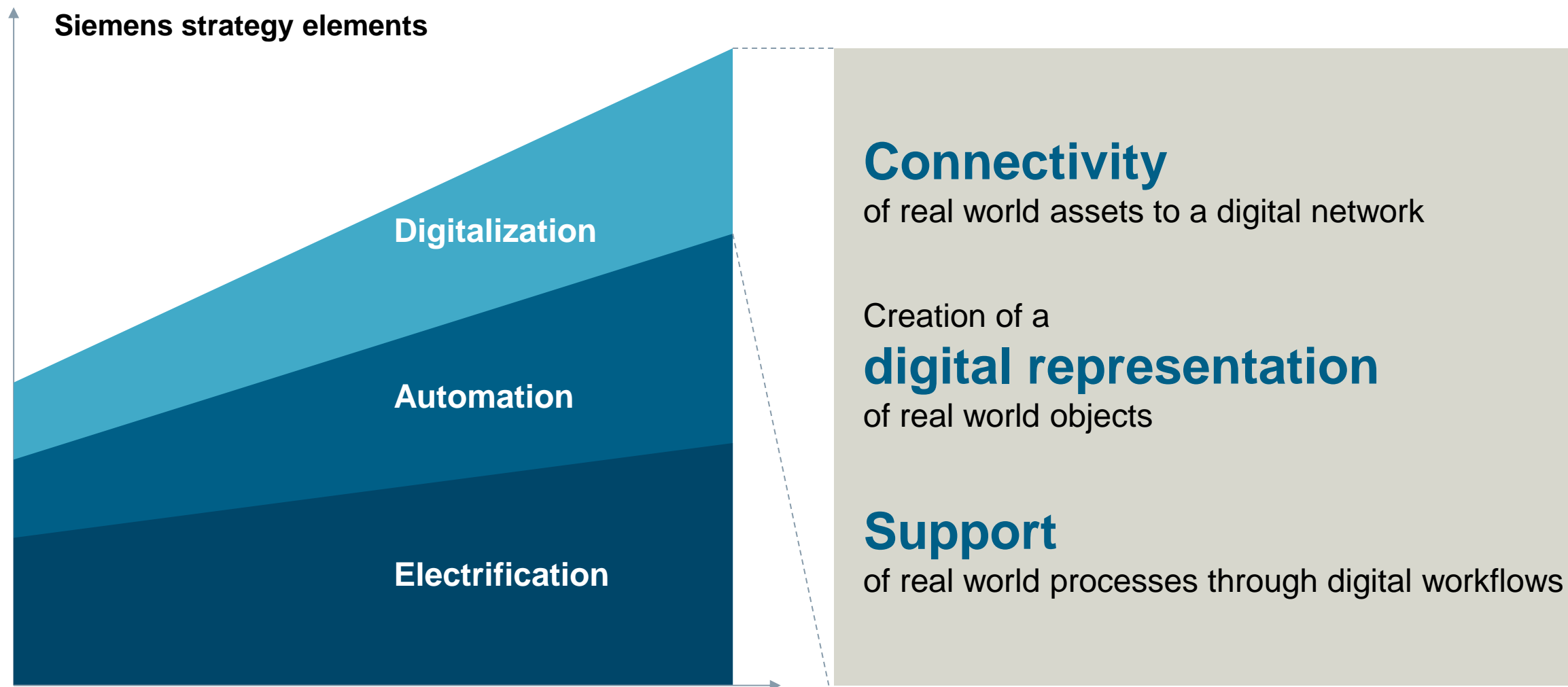


Internet of Trains

Gerhard Kress – Siemens AG

[siemens.com/mobility](https://www.siemens.com/mobility)

Digitalization supports our rail customers in their operations



Imagine: Your rail assets have 100 percent availability for their schedule

The data available

- Rail vehicles today send between 1 and 4 billion data points per year
- Rail infrastructure can send billions of messages per year inside the system
- Additional data:
 - Work orders
 - spare parts data
 - geographical data
 - weather data

The challenge

Turn

data

into

information

and drive appropriate

actions

**Ensure 100%
operational
availability**

In order to implement such digital services, Siemens built a large team of data scientists enabled by the Railigent platform

SIEMENS

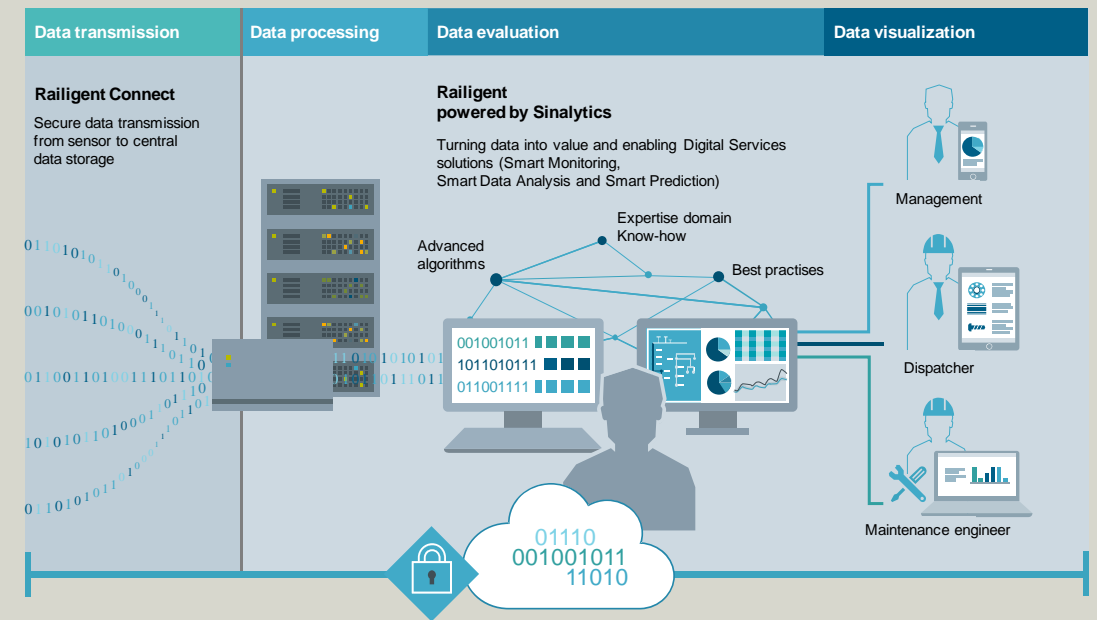
Human Resources

- Data scientists
- Implementation managers
- Technology experts



Data management capabilities

- Open and cloud based architecture
- Scalable data storage
- In-database analytics

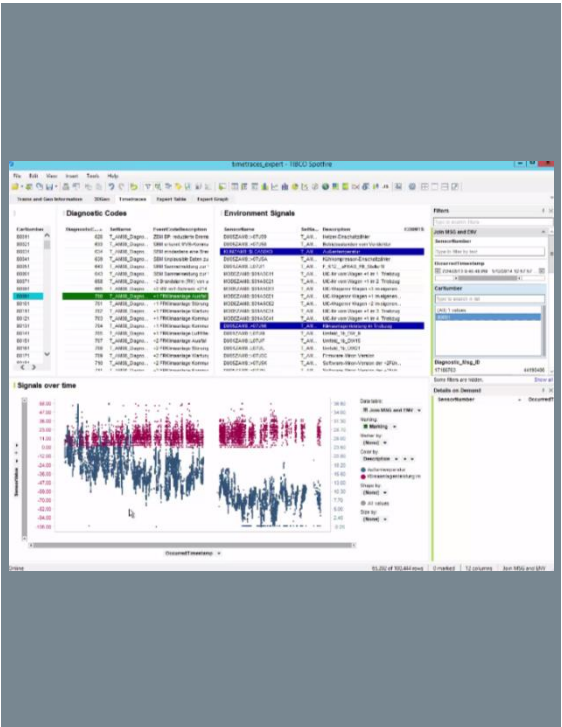


Data from rail assets is analyzed to create insights automatically:

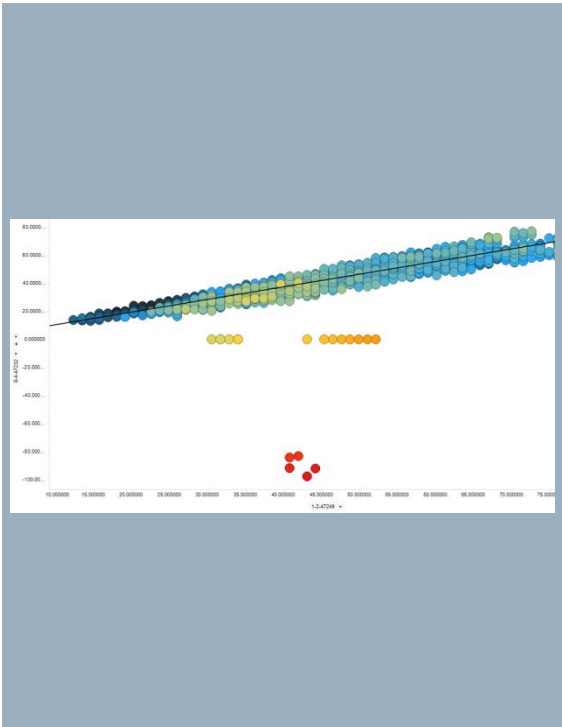
Process example



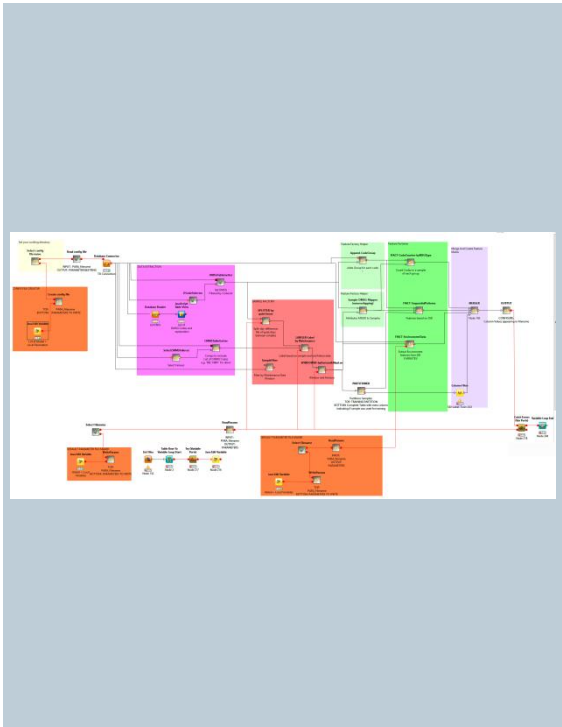
Data access



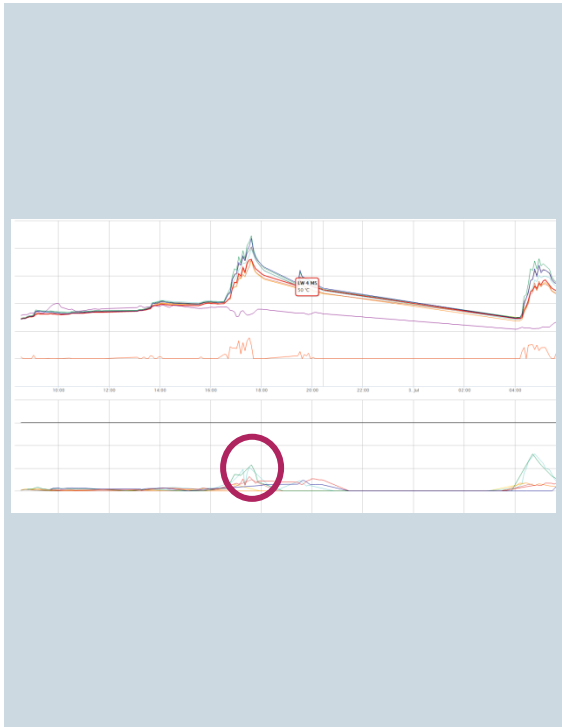
Search for patterns



Machine learning



Automated insight generation



What exactly is the target of high end data analytics? Improve existing processes and create new insights unavailable before!

Improve things we are already doing

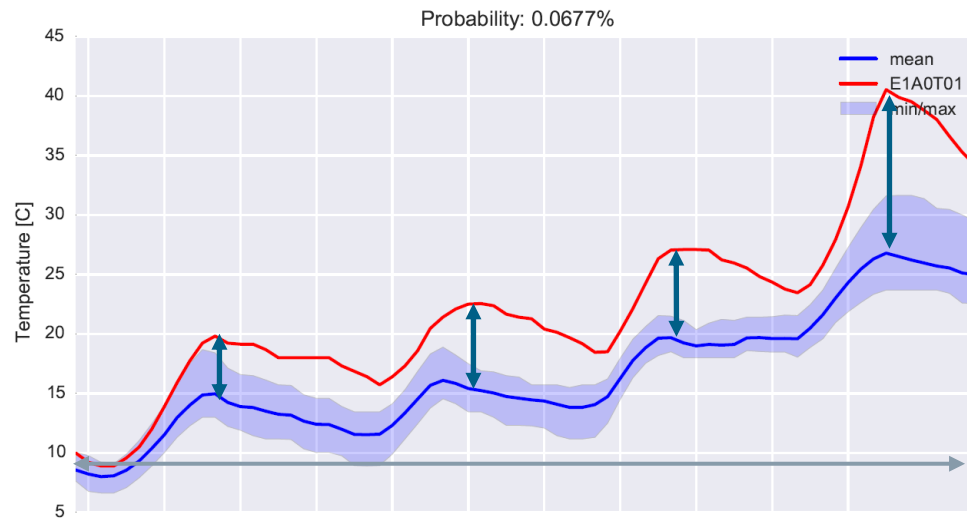
- Improved maintenance
- Root cause analysis of failures

Create new insights we could not have previously

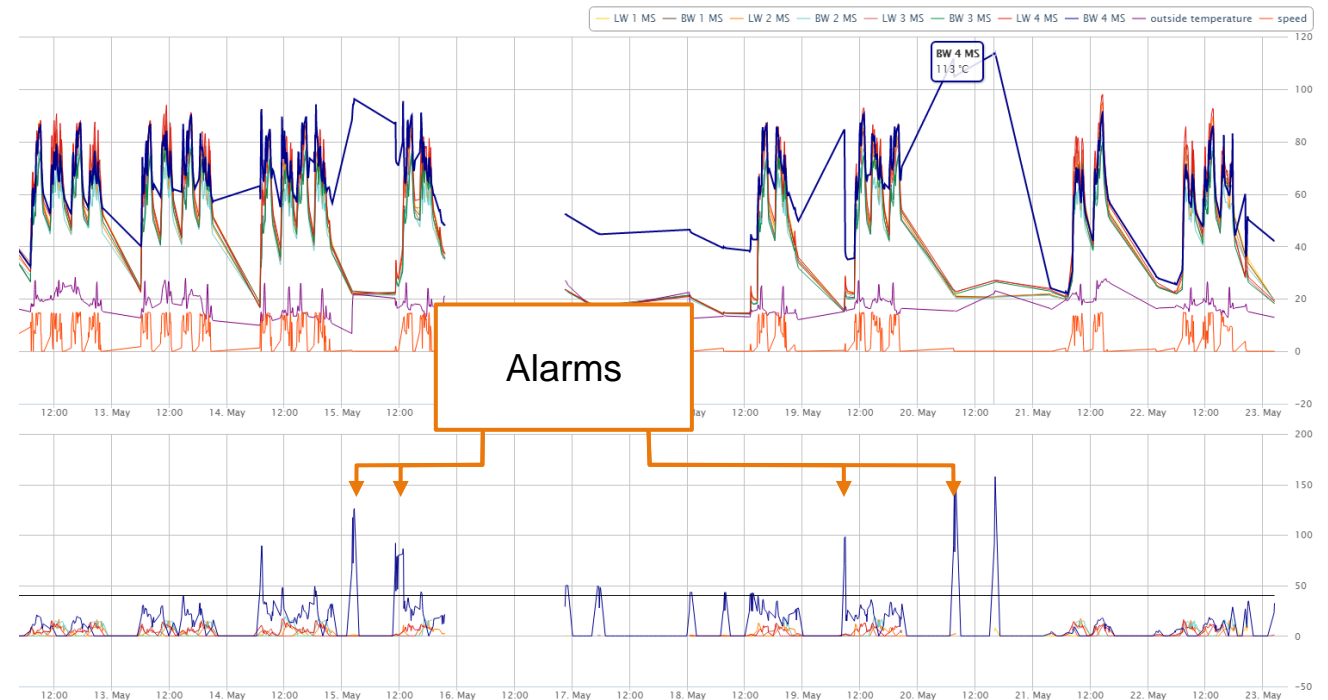
- Component failure prediction to increase availability (“Predictive maintenance”)
- Monitoring of infrastructure elements from vehicle data

Example automated failure prediction: Bearing monitoring on a high speed train

Machine learning model



Operational application



Simplified picture – In reality 8 machine learning models analyse the complete drive train and help identify the exact component and the failure type

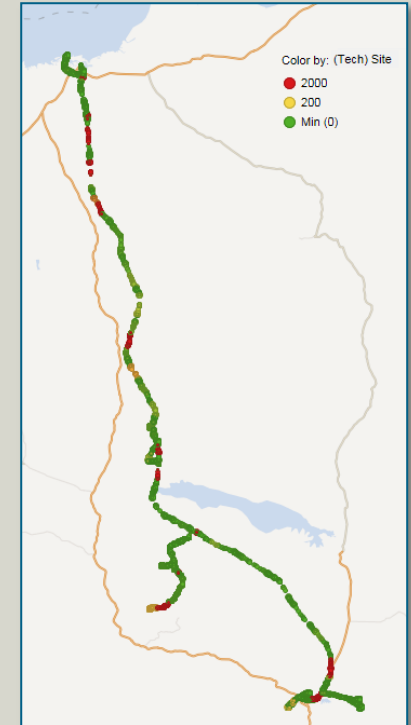
Example rail network optimization: Movement and failure analysis in a mining operations network



Example

- Identification of areas and elements responsible for vehicle delays in the overall system as trains of up to 240 wagons cause extreme loads on infrastructure elements
- Analysis of data from operations control systems, interlockings, point machines, vehicle messages and train movement data gives detailed insights about correlations and root causes

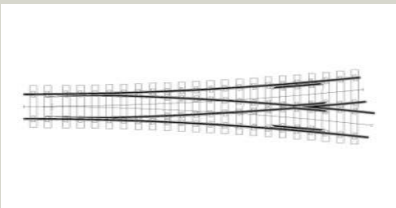
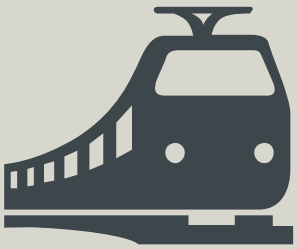
Point machines, interlockings, and substations for power supply deliver important data, supplementing information derived from the vehicles directly



Siemens has a unique differentiator: To ensure customer value creation, insight generation needs to combine data science with domain expertise

SIEMENS

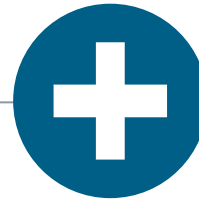
Data



Problem: Prediction of rare events

Data mining/machine learning

- State-of-the-art algorithms
- Innovative analytics approaches
- Siemens' intellectual property



Deep domain expertise

- Engineering knowledge
- System simulation results
- Design expertise

Insights

**Validated action
proposal from
domain experts**

Real examples show that tangible business value can be achieved

Examples

**Velaro
Spain**



**Metro
Bangkok**



**Velaro
Russia**



**Thameslink
Class 700**



Achievements based on data usage

Market share gains against the plane on the route Madrid – Barcelona due to punctuality

Availability: 99.98%

100% vehicle availability in rush hours allows to operate without reserve trains

Availability: 99.96%

Successful service provision on the route Moscow – St. Petersburg without spare capacity

Availability: 99.99%

Component monitoring especially for doors reduces delays and increases availability