



UNIVERSITÄT
LEIPZIG

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IMPROVING THE MONITORING OF OFFSHORE WIND POWER PLANTS BY INTEGRATING CONTEXTUAL INFORMATION FROM LIFECYCLE RECORDS

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AGENDA

- Motivation

- Data Analysis Approaches
 1. SCADA Client
 2. Intelligent Data Monitor
 3. Integrated Digital Life Cycle Record

- Conclusion

MOTIVATION

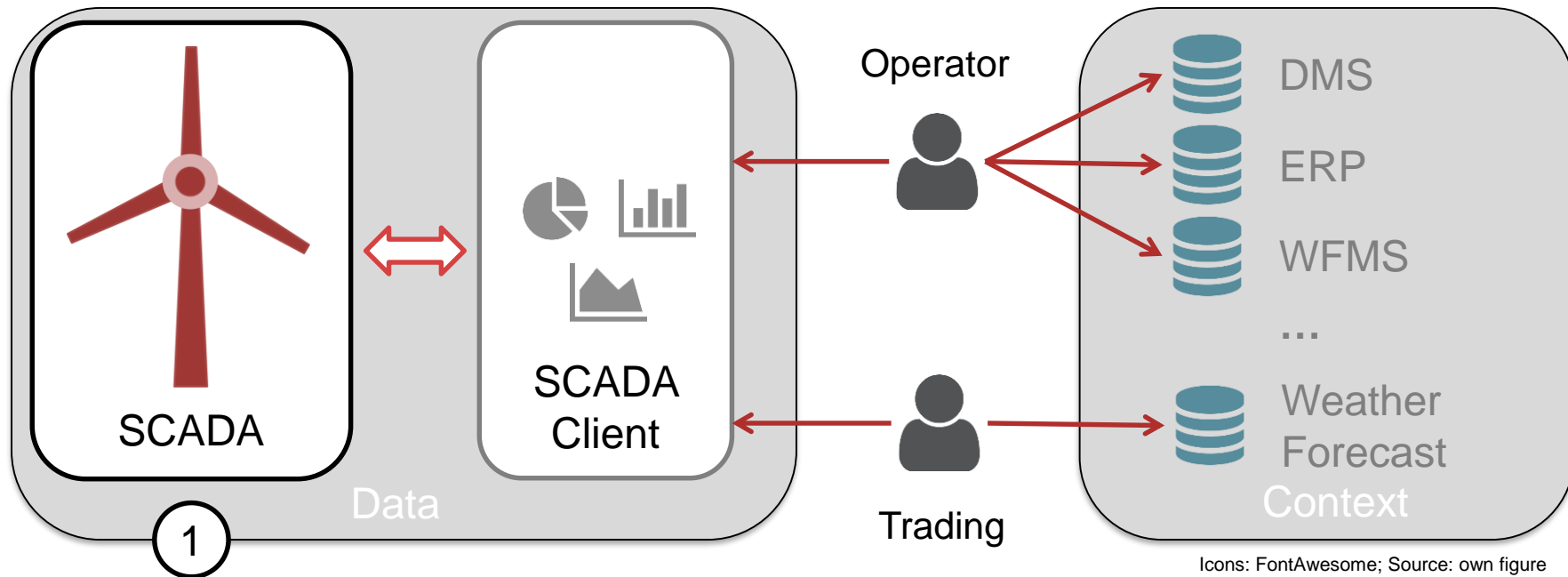
- **Machine learning** in the wind industry with promising results
- Mostly **focussing on SCADA** data (**exclusively**)
- Open challenges in practice
 - **High quality annotated data** sets needed
 - **False alarm** rates
 - **Distributed context information** leading to high **efforts** for operators

QUESTION OF INTEREST

- **How can we increase the practical impact of machine learning algorithms for plant monitoring and operation in practice?**
- Working packages
 - Providing knowledge **context** to **algorithms**
 - Providing knowledge **context** to **users**
 - User **experience**

DATA ANALYSIS APPROACHES

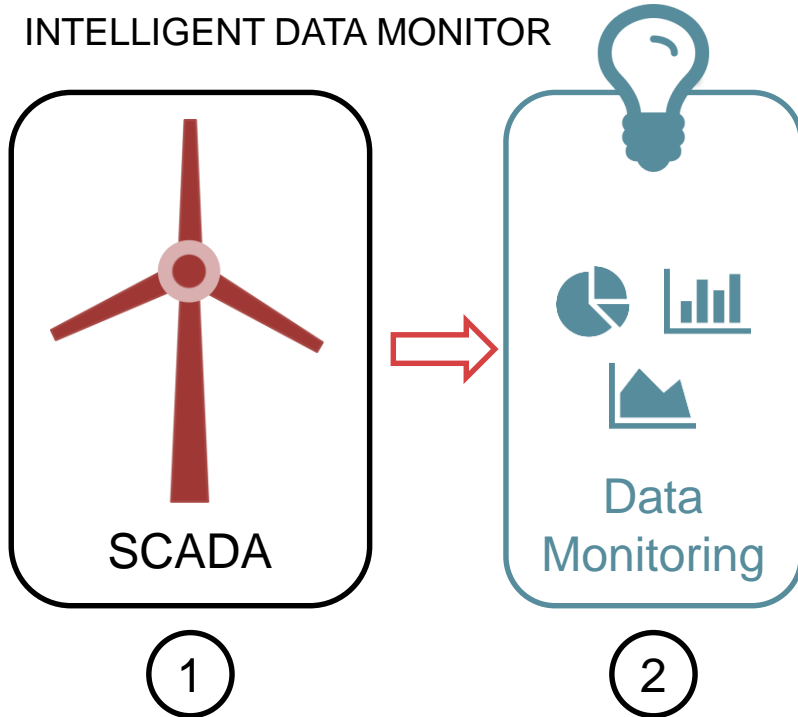
SCADA CLIENT



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DATA ANALYSIS APPROACHES

INTELLIGENT DATA MONITOR



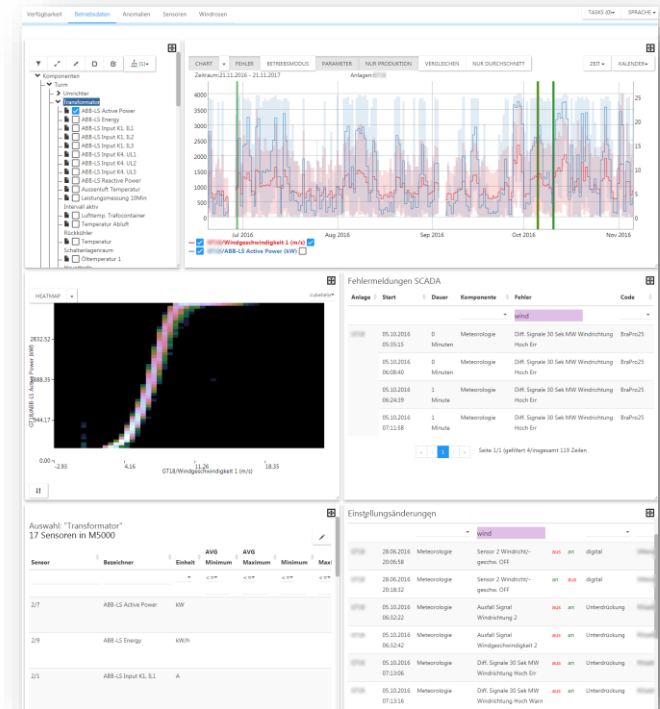
Icons: FontAwesome; Source: own figure

DATA INTELLIGENT DATA MONITOR

FEATURES

- **High-performant and intelligent data analysis and prediction**
- **Interactive dashboards**
- Notifications **linked** to anomaly data
- **Real-time data support**

Source: own figure



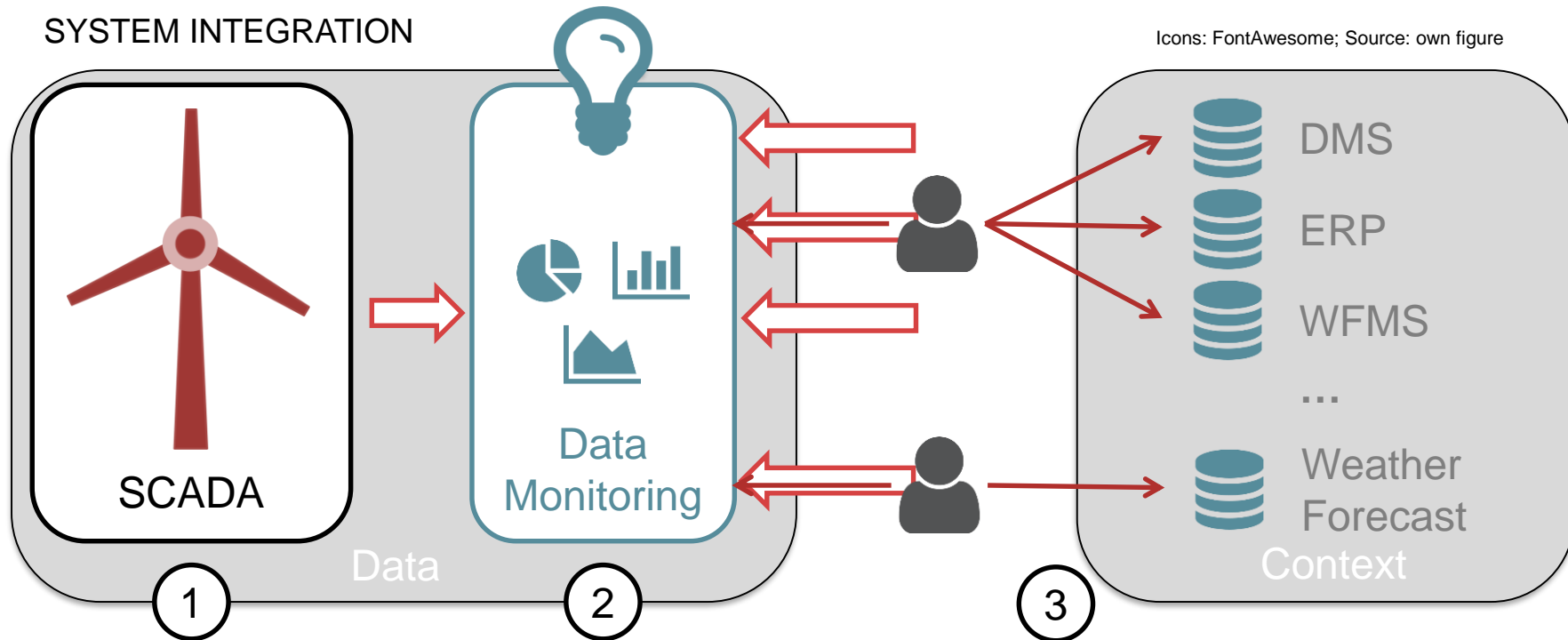
INTELLIGENT DATA MONITOR

CHALLENGES

- Not every **change** is caused by a defect
 - Hardware (sensor) upgrades lead to different measurements
 - Previously unseen or seasonal behaviour
 - Firmware or parameter updates lead to different turbine behaviour
- Notify only, if “**not yet known**”, ignore subsequent and in progress defects
- Prioritize the impact on **current** and **future power production**

DATA ANALYSIS APPROACHES

SYSTEM INTEGRATION



SYSTEM INTEGRATION

- **System integration enables**
 - Automatic creation of monitoring rules
 - Improvements on SCADA messages and sensor anomaly interpretation
 - Predictions based on plant history for predictive maintenance

SYSTEM INTEGRATION

AUTOMATIC CREATION OF MONITORING RULES

- Component **structure** from ERP
 - Parameterise physical models
- **Component semantics of RDS-PP®** : e.g. different types of “container”
 - = MDK30 CM011 “hydraulic oil tank” / can run empty
 - = MDK30 CL011 “hydraulic oil drip pan” / can spill over
- **Component master data and specification**
 - eCl@ss 36-03-01-04 “tank (closed)”:
 - Property: 0173-1#02-BAA138#005 (nominal volume)
 - Format: float (number);
 - Unit: litre

SYSTEM INTEGRATION

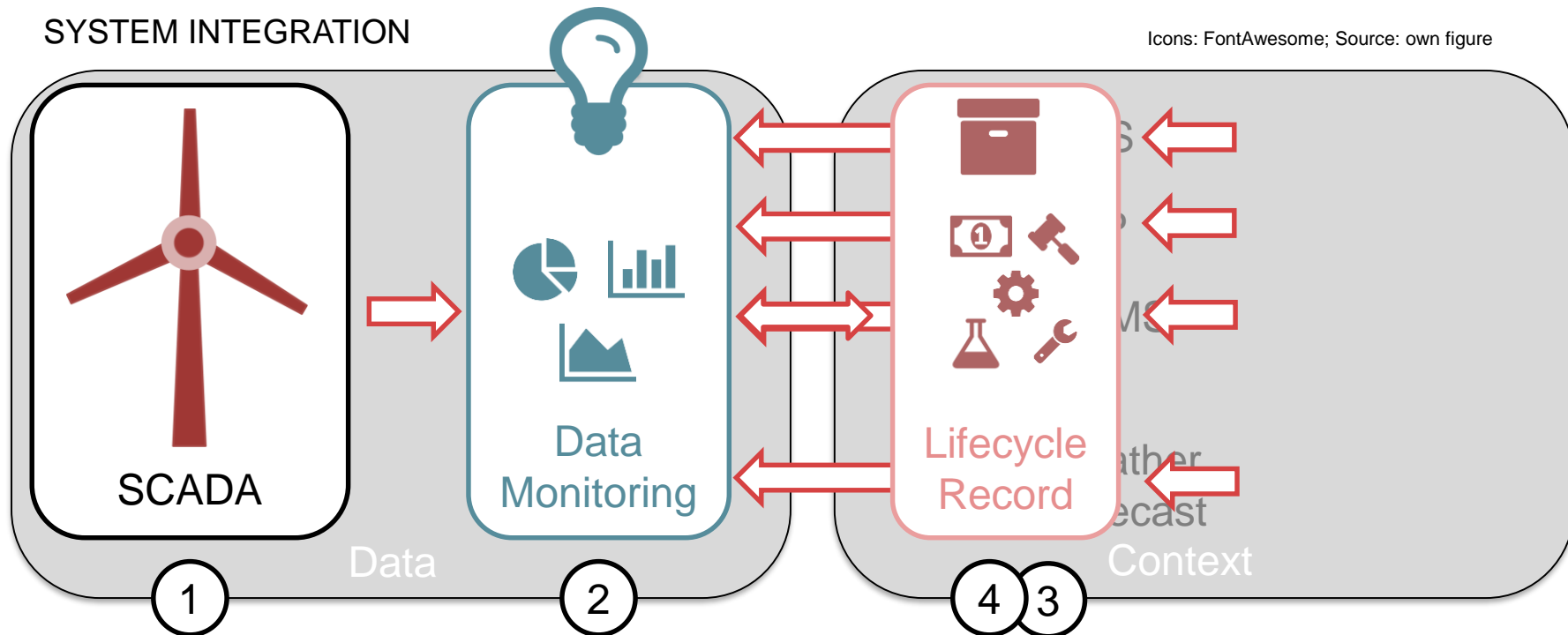
CONTEXT INFORMATION FOR SCADA MESSAGES AND SENSOR ANOMALY INTERPRETATION

- Integrate WFMS or DMS
- Use **wiring diagrams** to reason about dependant sensors
 - Enable anomaly classification
 - Improve user experience
- Use maintenance or incident **reports**
 - Detect **component exchange** or **software updates**
 - List of “**known incidents**” to suppress notifications

DATA ANALYSIS APPROACHES

SYSTEM INTEGRATION

Icons: FontAwesome; Source: own figure



LIFECYCLE RECORD

ACCORDING TO GERMAN STANDARD DIN 77005-1

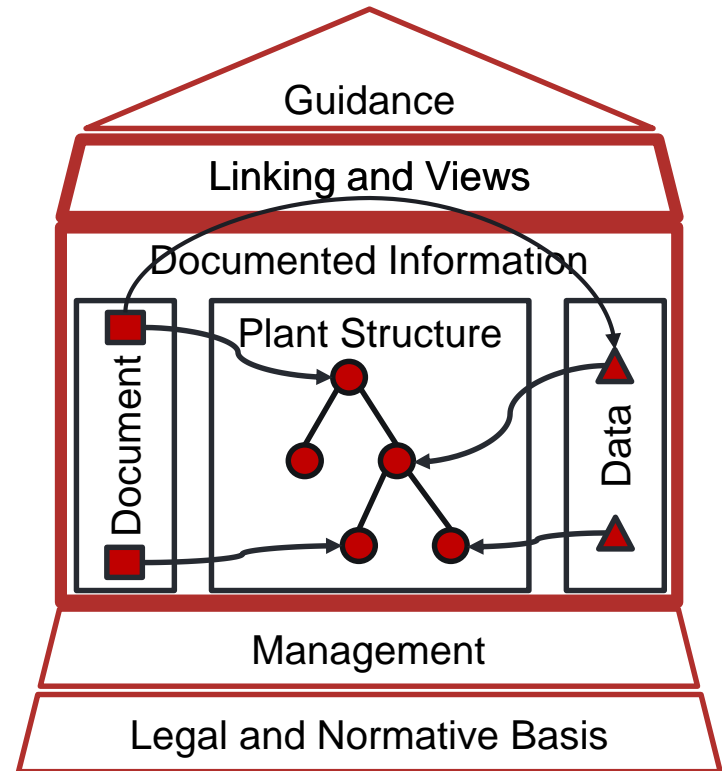
- Contains for each object **every related documented information** throughout the **whole lifecycle** in chronological order
- Broad normative (international) basis
- **Key properties**
 - Different **types of information** including **relationships**
 - Strict **reference to the object**
 - Recording **lifecycle** and **lifetime**
 - **Contextual extensions through views**

Source: DIN 77005-1:2018-09

LIFECYCLE RECORD

REFERENCE FRAMEWORK

- Normative specifications (and more)
 - information **model**
 - **adoption and extension** according to individual needs



Source: own figure, see also DIN 77005-1:2018-09

LIFECYCLE RECORD AND DATA MONITORING

BENEFITS AND POTENTIALS

- **Single point of integration** providing inter-connected information
 - Complete incident work logs and changes including **related information**
- Enables
 - **Triggering** data monitor after structural changes to **update models**
 - Extraction and **learning** of **incident patterns** for prediction
 - **Similarity search** in plant histories (e.g. other turbines in the park)
 - Knowledge linkage for anomaly **classification**

CONCLUSION

- Different **maturity levels** of Data Analysis Approaches
- **Importance of contextual information** to
 - Automatically create and maintain monitoring rules
 - Interpret SCADA messages and sensor anomalies
 - Enable history based predictions
- Lifecycle record provides **common information model**

**High quality lifecycle record as annotated dataset
(e.g. for supervised learning) to empower machine learning
in practice.**

PROJECT GRANTS

MINDSET: MACHINE LEARNING FOR ANOMALY DETECTION IN STREAM DATA

- Sächsische Aufbaubank (SAB)
- Funding program: InnoTeam
- Project: Grant number: 100341518

Der Europäische Sozialfonds in Sachsen 2014 bis 2020

 www.strukturfonds.sachsen.de



PROJECT GRANTS

SCADS DRESDEN/LEIPZIG

- Competence Center for Scalable Data Services and Solutions
Dresden/Leipzig

Specialists from computer & domain sciences

Focal point for new research activities

Collaborative big data research



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THANK YOU

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