
DIGITALISIERUNGSWORKFLOW ZUR STRUKTURIERUNG UND STANDARDISIERUNG VON INSTANDHALTUNGSINFORMATIONEN VON WINDENERGIEANLAGEN

- KÜNSTLICHE INTELLIGENZ IN DER UMWELTINFORMATIK -

01.10.2021 | Fraunhofer IEE | Marc-Alexander Lutz



Gefördert durch:



aufgrund eines Beschlusses
des Deutschen Bundestages

DIGITALIZATION WORKFLOW FOR STRUCTURING AND STANDARDIZING WIND TURBINE MAINTENANCE INFORMATION

DIGITALISIERUNGSWORKFLOW ZUR STRUKTURIERUNG UND STANDARDISIERUNG VON INSTANDHALTUNGSINFORMATIONEN VON WINDENERGIEANLAGEN -KÜNSTLICHE INTELLIGENZ IN DER UMWELTINFORMATIK -

- Introduction
- Maintenance processes
- Existing standards and guidelines
- Digitalization of not yet usable data
- Summary

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FRAUNHOFER INSTITUTE FOR ENERGY ECONOMICS AND ENERGY SYSTEM TECHNOLOGY



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Making the most of Maintenance Information

- Introduction -

- Asset and operational management systems are used to document maintenance actions on wind turbines
 - Service reports, O&M records are issued to operators
 - Maintenance logs and invoices are created
- Lot of data available, mostly this information is only used for documentation

Why not use it for calculation of KPIs?

Failure Rates

Maintenance Optimization

Spare Part Recommendation

Identification of frequent faults

Making the most of Maintenance Information - Introduction-

- Operators can not make use of all available maintenance information
- Service-reports, Invoices and Maintenance logs are available but not yet usable
 - Information available in PDFs or other data sinks.
 - Company specific form of documentation
 - Not standardised and therefore little interoperability given
 - No KPIs can be calculated, nor strategic decisions be made
- Asset value harder to understand

Making the most of Maintenance Information

- Maintenance processes: Operator 1 -

- Operation management software is used to document every visit at the turbine
 - E.g. Inspections, Repairs
 - This information is documented but is only partly used further



24.01 Inspection of foundation
25.01 Pitch battery replaced
27.01 Gearbox oil refill

- Operator wants to assess frequent failures / component failure rate

Making the most of Maintenance Information

- Maintenance processes: Operator 2 -

- After a service measure is performed at the turbine a service report is issued
 - Material consumption is listed in report
 - So far this information is partly used further



Wind industry is very heterogeneous

Different grades of maturity in digitalization is seen

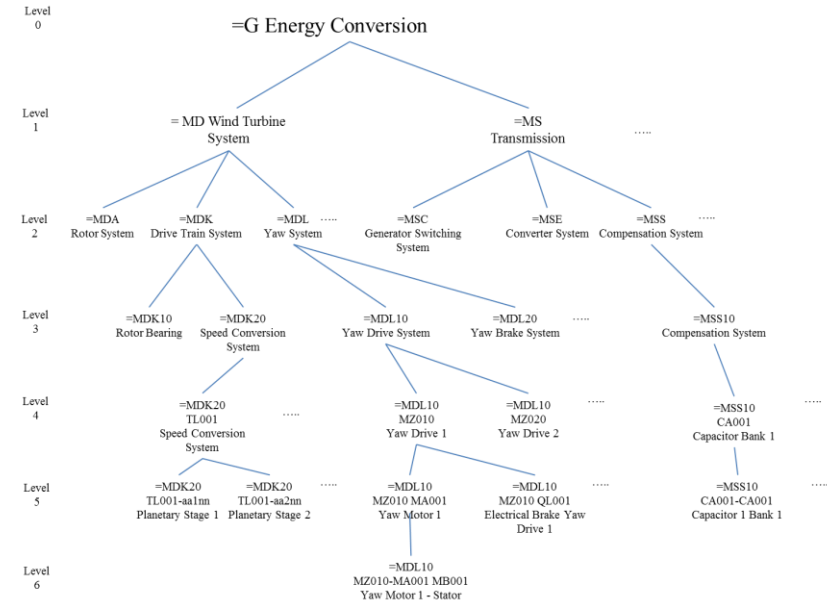
- Operator wants to assess materials used and to plan spare parts

Making the most of Maintenance Information

- Existing standards and guidelines -

■ Automated classification of service reports into domain standards using text classification methods

- RDS-PP®
- Unique label of components
- Clear hierarchy of systems and subsystems
- Same schema can be applied to different wind turbines

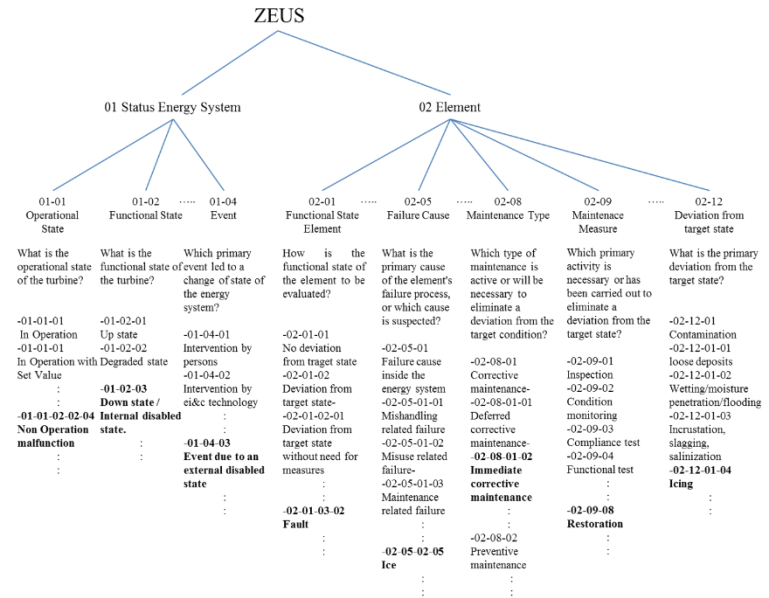


Making the most of Maintenance Information

- Existing standards and guidelines -

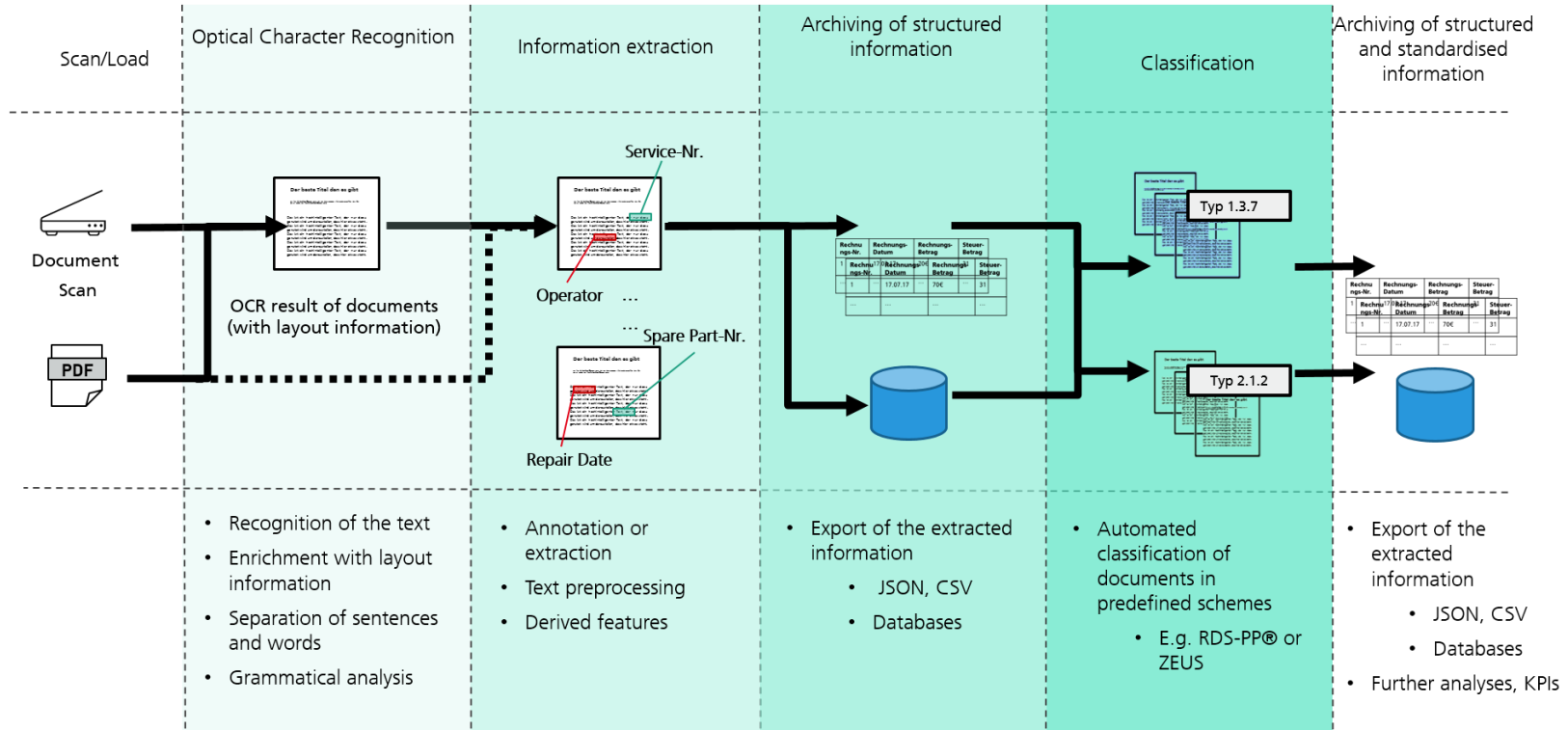
■ Automated classification of service reports into domain standards using text classification methods

- ZEUS (state event cause key)
- Questions for state
- Answers will give ID
- Describes state of wind turbines
- Unique set of IDs



Making the most of Maintenance Information

- Digitalization -



Making the most of Maintenance Information - Digitalization -

■ Aim: Link Maintenance Descriptions to Standards

Rust wind direction tracking

Surface damage yaw

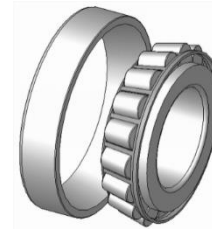
Corrosion azimuth

Problem with the generator bearing,
needed to add some lubricant



RDS-PP: Azimut System (MDL)

ZEUS: 01-01-02-02-01, 01-02-01,
01-04-01-01, 02-01-02-01, 02-05-
XX, 02-08-XX, 02-09-XX, 02-12-01-
03



RDS-PP: MKA11 GA001

ZEUS: 01-01-02-02-04, 01-02-03, ...

Making the most of Maintenance Information - Digitalization -

Text classification
How can it be done?

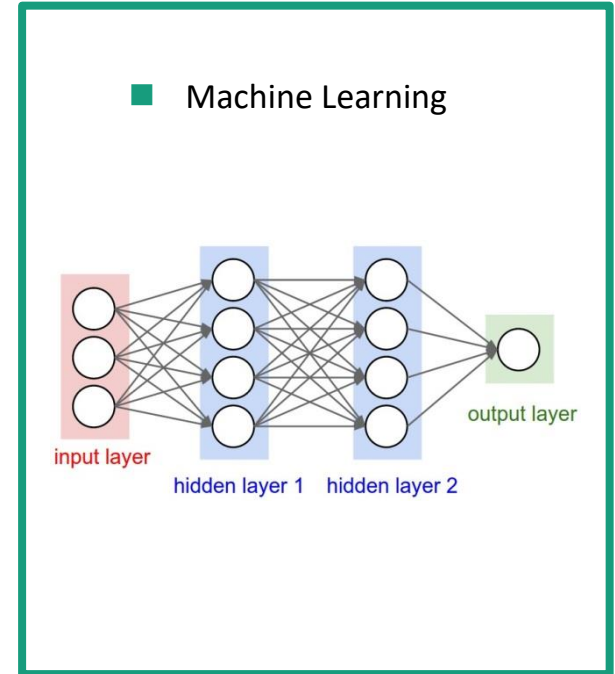
■ Manual Labour



■ Key word mining

Keywords
Keywords are the words
Particular words or phr
context of search eng
describes the conte
describes or define
the conte

■ Machine Learning



Making the most of Maintenance Information - Digitalization -

Text classification
How can it be done?

- Manual Labour is tedious
 - Necessary as an initial step (> 1000 records)
- Key word mining only partly accurate
- Different methods of text classification for RDS-PP implemented
 - Support Vector Machines, Linear Regression, Naive Bayes
 - SVM shows good Micro F1 score on RDS-PP Level 1 (~ 93%) and Level 2 (~ 83%)
- Further to be implemented
 - Artificial Neuronal Networks (ANN), Convolutional Neuronal Networks (CNN)

Making the most of Maintenance Information

- Conclusion -

- Use standards
- Data from the past can be made usable
- Intermediate solutions to speed up use of standards exist
 - Failure statistics can be made
 - Material consumption can be assessed
 - Spare parts can be recommended

DIGITALISIERUNG VON INSTANDHALTUNGSINFORMATIONEN

- DIGMA -



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