HKUST predictive maintenance contest
May 8, 2018

nexperia

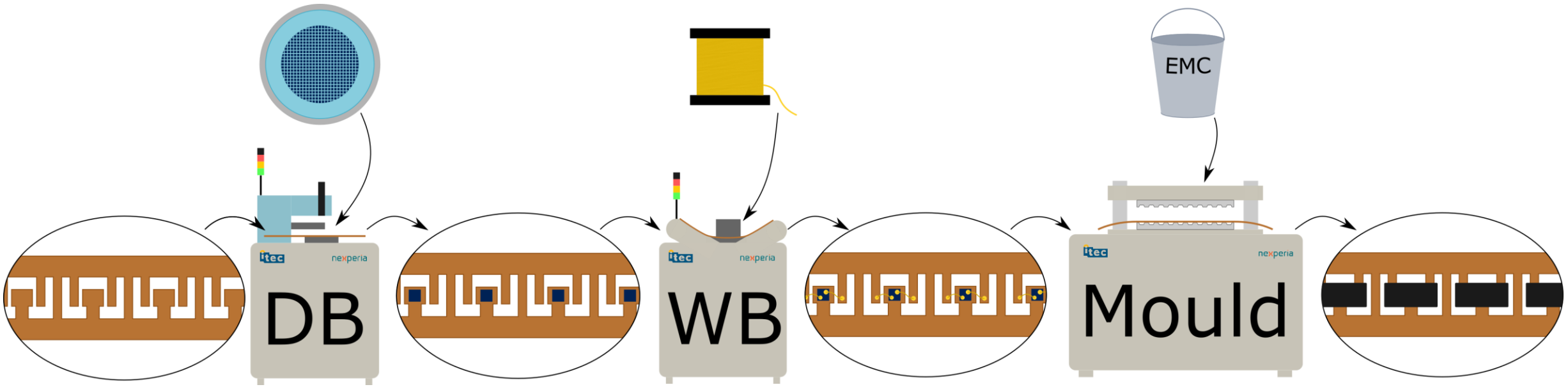
Predictive maintenance

Predicting failures using machine learning

Introducing

Nexperia is a dedicated global leader in Discretes, Logic and MOSFET devices. We became independent at the beginning of 2017.

Semiconductor packaging



Predictive Maintenance

Machine time-to-failure estimation

What is it?

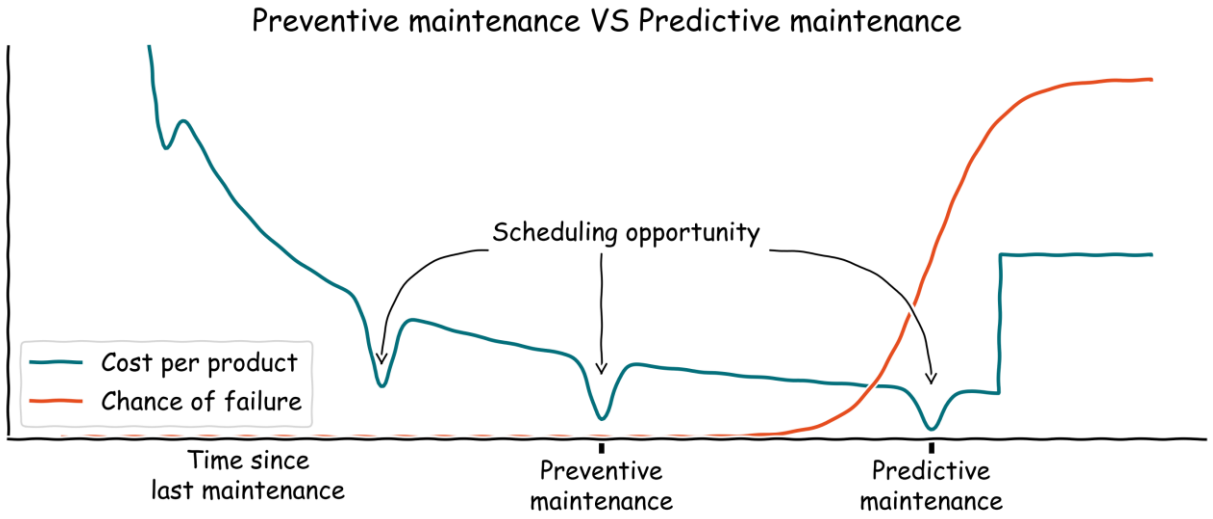
A maintenance strategy based on a time-to-failure estimate acquired from machine-, process- and test-data.

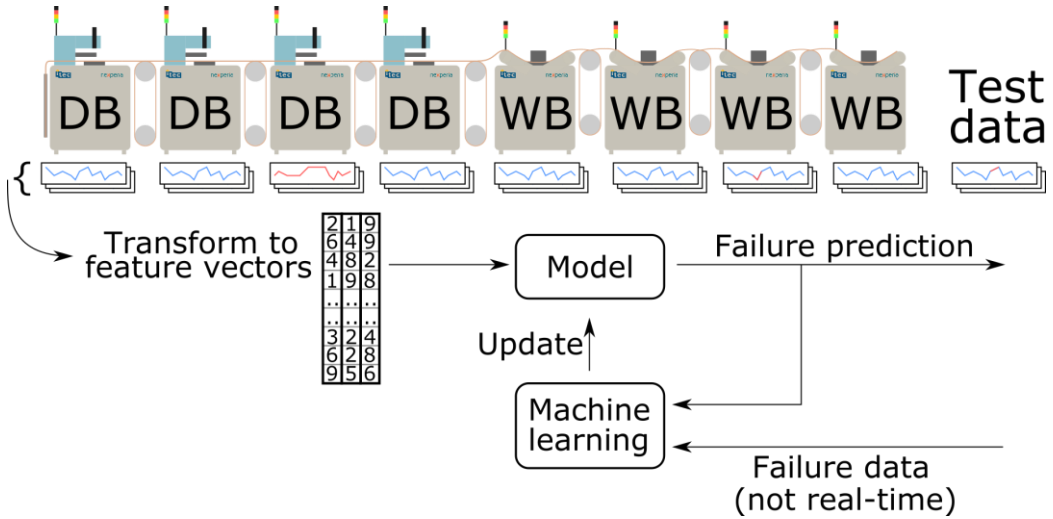
How does it work?

By analysing data from many different machines and production lines, a statistical correlation between the data and common failures can be made. This process can be aided by several tools from the Data Mining and Machine learning fields.

What is the benefit?

The maintenance can be scheduled more efficiently. By only scheduling maintenance when it is convenient and necessary, the costs of downtime can be reduced.



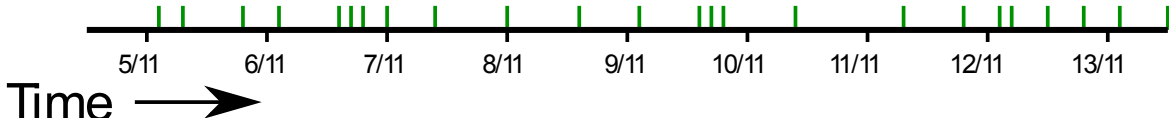


Machine learning contest

Event analysis

Available data

- Error events (Time-stamp + Error ID)



Machine learning contest

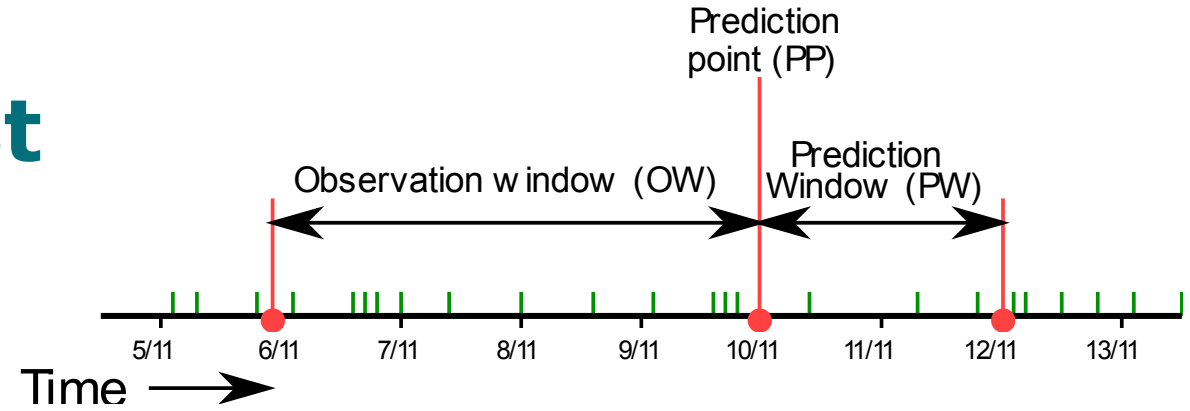
Event analysis

Available data

- Error events (Time-stamp + Error ID)

Data preparation (already done)

- Define the Prediction point, Observation window and Prediction window



Machine learning contest

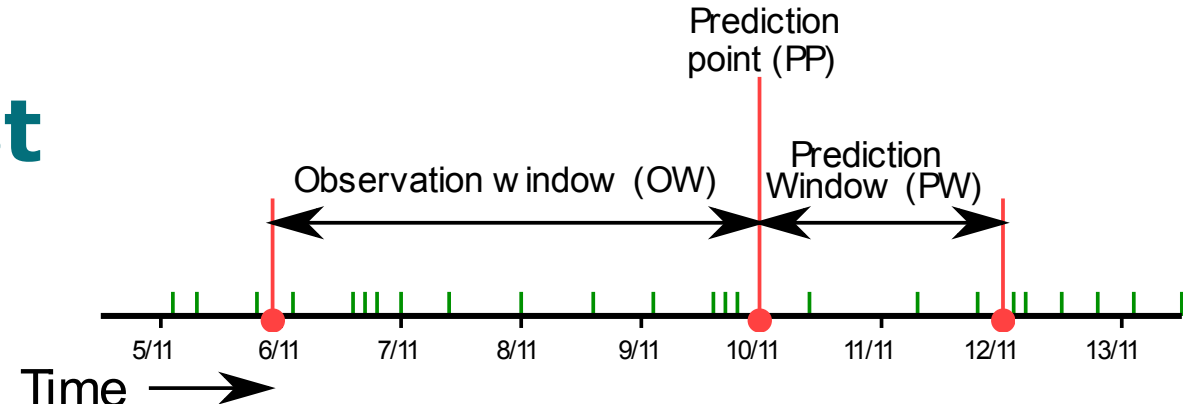
Event analysis

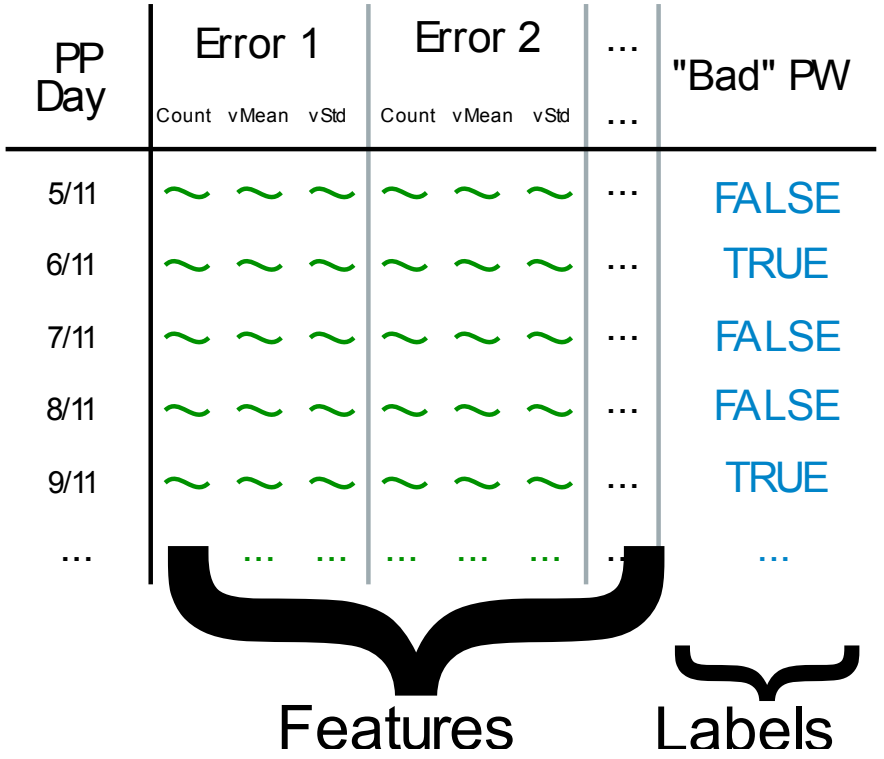
Available data

- Error events (Time-stamp + Error ID)

Data preparation (already done)

- Define the Prediction point, Observation window and Prediction window
- Label each prediction point using the machine performance in the Prediction window
- Generate features using the Error events in the Observation Window. For each error type:
  - The amount of errors
  - The mean interval of the errors (vMean)
  - The standard deviation of the interval of the errors (vStd)





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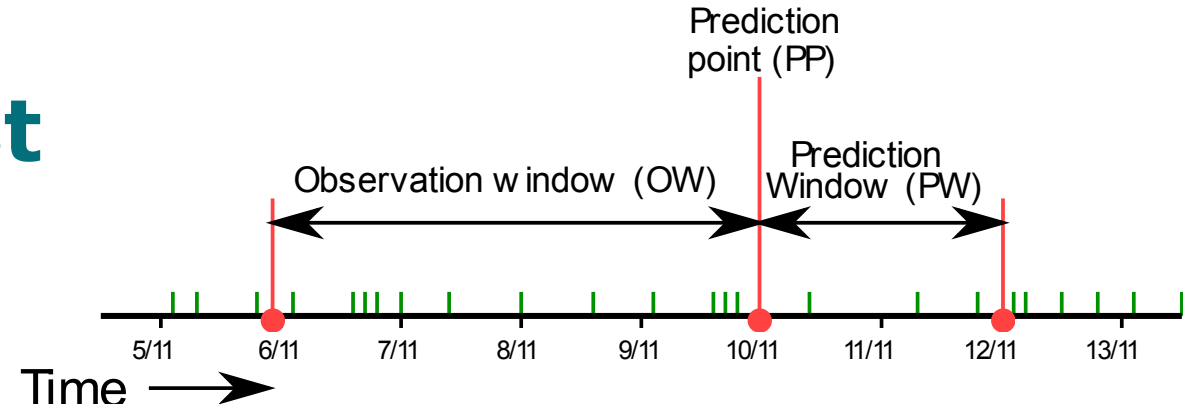
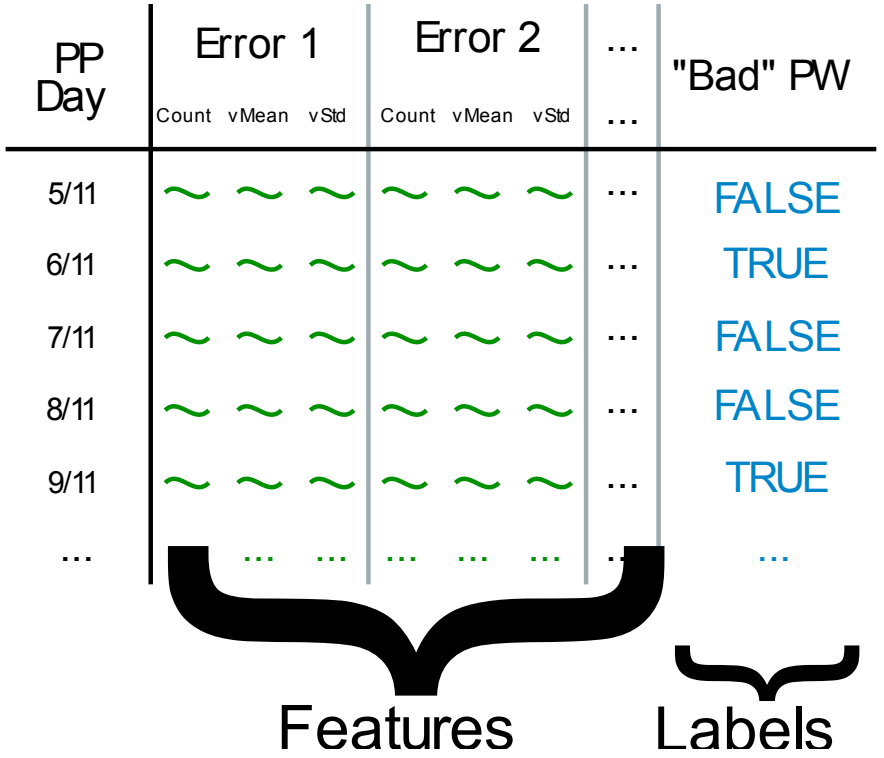
NOTE: THIS IS DIFFERENT THAN BEFORE





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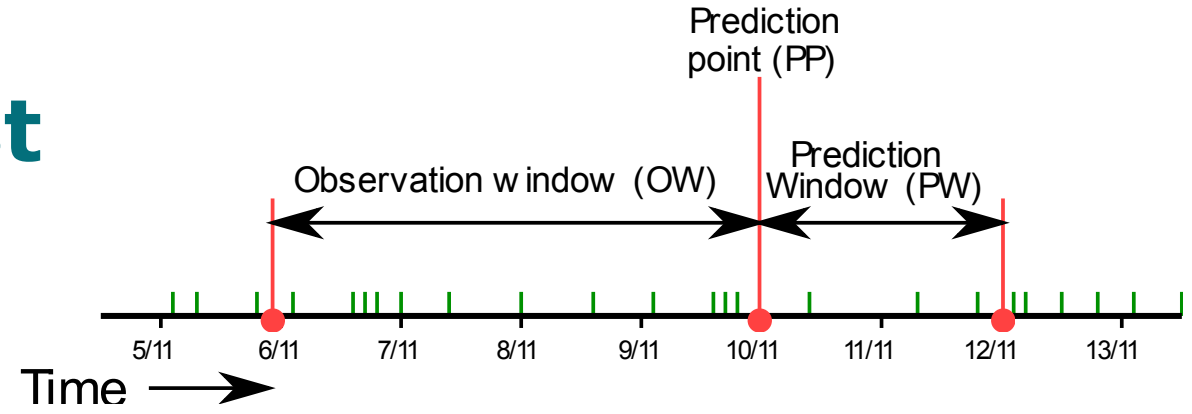
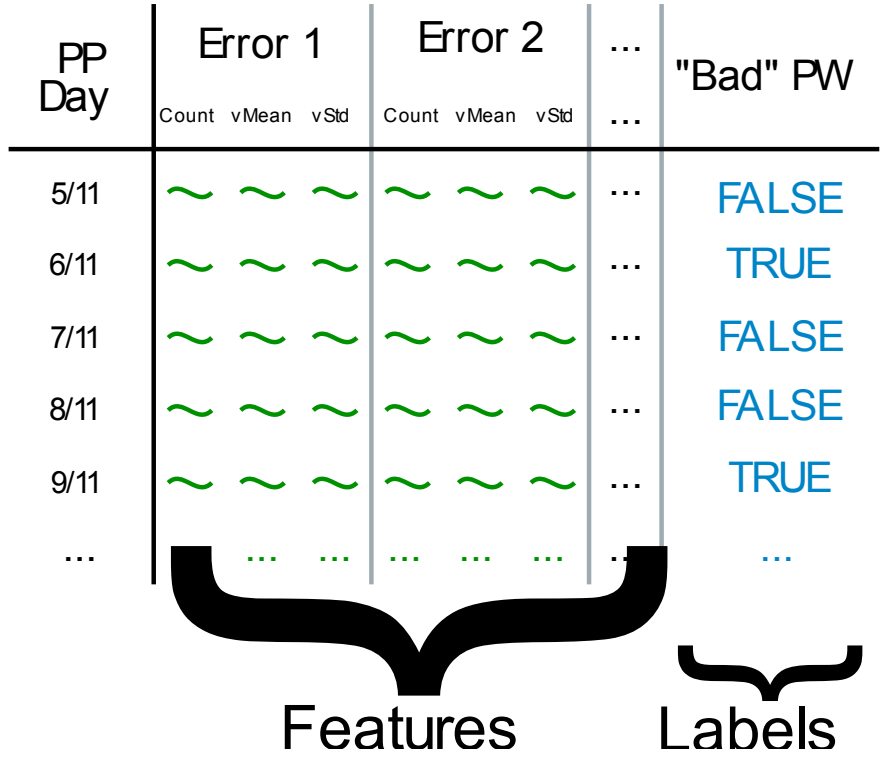
Notes

- For this contest, the data is already provided in the standard feature-label tabular form.
- Different data-sets with different Observation- and Prediction-Window sizes are provided:
  - OW: [1,2,4,8,16] days
  - PW: [1,2] days
- 26 frequent errors have been selected to be relevant, these errors are represented by their Error ID.
- All other (infrequent) relevant errors are grouped as rare errors. They are grouped under Error ID 1.
- The training sets consists of 12 machines
- The verification sets consists of 4 machines
- **NO shifting of columns is required, the labels directly correspond to the features on the same row.**
- Data is provided in tabular form, in both Comma-separated-Value and Pickle format. Python (Pandas) command for reading the Pickled files:

```
pd.read_pickle(fileName)
```





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Assignment summary

Goal

- Predict “Bad Prediction Windows” by using event-analysis of log-data obtained in the field

Assignment

- Use the OW=2, PW=1 training dataset to:
  - Perform exploratory data analysis on the test-data to identify important features
  - Start by training some models with a low amount of features (the ones identified as the most important), evaluate the models using the verification dataset.
  - Experiment with adding more features
- Experiment with the different datasets for OW=[1,2,4,8,16] and PW=[1,2]

Performance evaluation

- The best AUC-score for any of the datasets

Machine learning contest

Reference

The event analysis method is based on a paper from IBM:

Authors:	J. Wang, C. Li, S. Han, S. Sarkar and X. Zhou
Title:	Predictive maintenance based on event-log analysis: A case study
Journal:	*IBM Journal of Research and Development,* vol. 61, no. 1, pp. 11:121 - 11:132
Year:	2017