Introduction to Predictive Maintenance with RapidMiner
Anticipate Equipment Failures and Optimize Maintenance

The Need for a Smarter Maintenance Approach

In product manufacturing, sudden malfunctions of the manufacturing equipment can stop a business on a dime, resulting in unmet delivery expectations, potential contract penalties, and lost revenue – not to mention the costs for fixing the equipment. But it is not only manufacturing companies that suffer from unexpected failures of their equipment. Every business whose operations rely on technical equipment constantly faces the threat of having the business infected by technical issues.

Maintenance measures are regularly employed in preventing these unplanned disasters. Typically, such maintenance activities are however scheduled without any prioritization on urgency nor do they acknowledge whether there has been need for executing maintenance activities at all. The one extreme of facing unplanned production or operation downtimes and high recovery costs is simply traded in for the other extreme of overcautious failure insurance which comes at high regular maintenance costs. Such so-called preventive maintenance may be reasonably reducing failure risk but in a not cost-effective way due to non-optimal allocation of maintenance staff and too-high a consumption of spare-parts.

Predictive maintenance can overcome these problems of traditional maintenance approaches: Applying predictive maintenance means using available data about manufacturing or operations and leveraging predictive analytics methodology for smarter planning and optimizing maintenance activities in order to prevent unplanned malfunctions and avoid costs for failure recovery, but to minimize maintenance costs at the same time.
The Concept of Predictive Maintenance

Predictive maintenance approaches utilize data that describe the production or operation processes of the equipment to be maintained. Whether coming from post-process quality assurance or being directly captured from sensors or machines within the respective processes, these data encompass information about equipment usage, wear and other conditions. Historical data describing states of equipment are mashed up with the information whether maintenance had been needed within these states. Usually, this is captured by the fact that the equipment exhibited a failure at some point after the state had been recorded.

Upon such historical data, predictive analytics techniques can be used to train analytical models that capture the dependency between equipment states and maintenance needs. Being trained and given some data describing the current state of the equipment, these analytical models can be used to accurately predict future failure occurrence for that equipment and maintenance can be planned and executed accordingly.

RapidMiner – Best-in-Class Technology for Predictive Maintenance

RapidMiner is a most comprehensive tool suite bringing predictive analytics to business users understanding their need for easy-to-use interfaces while being compliant to every requirement that may be added by company IT departments.

For business users being responsible for equipment operation and maintenance planning, RapidMiner comes with a Predictive Maintenance application wizard which provides means to learn what causes equipment failures and also to detect potential future failures of the equipment before they actually occur. With a simple three-step configuration, data that contains equipment state descriptions and maintenance need information for at least some of the equipment instances can be loaded into RapidMiner and analyzed to provide meaningful insight on failure aspects. Most important, equipment being at risk of exhibiting failures is identified. The relevance of factors that allow for detecting failures or even of those critical factors that drive failures is quantified and presented to the users. Through descriptive visualizations, overall risk of the surveyed equipment assets is as clearly revealed as is the accurateness of the predictive approach itself which might vary due to the varying expressiveness of the users’ data. Should the need arise to generate a more tailored insight into these data, RapidMiner is prepared through its wide variety of analytical functions that range from simple data transformations to in-depth technical analysis steps originating from signal processing, data mining and predictive analytics fields.

Being designed for more than ad-hoc analyses of predictive maintenance data, RapidMiner also is a best fit for scenarios in which predictive maintenance should be directly tied to manufacturing or operations processes and embedded into the corresponding IT infrastructure. Common challenges for implementing predictive maintenance in a productive setting comprise the seamless integration of information technology from data sourcing to the generation of predictive information and finally addressing it to the intended recipients, may they be human or destination IT systems. Also, predictive maintenance technology embedded into real production scenarios typically
requires high data throughputs and near real-time operation. RapidMiner Server meets all these challenges as it allows for quick and easy integration of predictive analytics workflows into diverse IT system infrastructures through its various data source and API connectors. Leveraging the computing power of today’s server computers, RapidMiner Server can also provide analytical results at a very high speed making it an especially ideal fit for productively deployed analytics in the scope of predictive maintenance applications.

RapidMiner Optimizes Businesses
– A Few Examples

RapidMiner can be, and is been used within various settings and applications including those aiming at optimizing maintenance measures of equipment. Such equipment can be versatile. Consider an ATM that is required to function properly for every banking customer using it. Malfunctions may result in both missed financial revenue and reputation loss. As such, ensuring continuous operation and avoiding malfunctions is a serious business objective of ATM manufacturers who often maintain their ATMs on a service-contractual basis. As an ATM continuously provides various sensor data capturing its state, RapidMiner and predictive maintenance techniques can be used to detect failures in advance and schedule maintenance measures in a timely manner, both having positive effects on relevant KPIs like mean time between failures or mean time to repair.

For manufacturing companies continuous operation of their manufacturing equipment is equally essential which makes them also monitor relevant KPIs: Generally, availability of an equipment asset is expected to be high to receive a maximum return on asset (RoA). The reason for that is obvious. In the example of a cement manufacturer who operates large cement mills, even short downtimes of a few hours can easily result in 6-digit losses of revenue. Even worse, a real crash of some parts in a cement mill can result in a downtime of several weeks. Based on sensor data capturing physical properties like temperature and pressure, RapidMiner thus can not only predict malfunctions of the mills, optimize maintenance activity scheduling and spare-parts purchasing and minimize downtime through its predictive maintenance application capabilities. RapidMiner can also help optimizing equipment operation itself turning predictive into prescriptive.

Beyond these traditional applications, RapidMiner is ready for next-generation scenarios where analytical applications will incorporate emerging and growing technologies like mobile communication and big data. Even today, modern cars and trucks already keep track of various operational aspects through built-in sensors and computers. Even today, these data are partially sent to central data warehouses of manufacturers or logistics companies already. It won’t be long until these data will be used for predicting threatening failures and maintenance needs on a large-scale to improve customer experiences and business operations. Being one step ahead in embracing new technology, RapidMiner will be prepared to take predictive maintenance to the next level.