Predictive Maintenance
Customer Stories
Multinational glass manufacturer: Predictive maintenance for manufacturing equipment

CHALLENGES

- Experiencing equipment failures unexpected costs in production process
- High machine downtime and low production availability
- Managers are challenged to see through all the rapidly growing machine data volumes captured throughout the process

SOLUTIONS

- Using Azure Machine Learning, Neal Analytics identified key variables that influence the failure of equipment such as pressure, current, and duty cycle
- Used a classification model to predict future failures in equipment based on known failure events
- Used an anomaly detection to identify outliers in sensor data that could lead to failures throughout the production process

RESULTS

- Reduce total maintenance costs through better planning of predictive maintenance programs
- Able to identify potential breakdowns with 85% Precision up to two days before breakdown.
- Reduce production downtime and asset utilization
- Improve spare part supply chain planning
Automotive part manufacturer: Quality prediction and driver analysis for aluminum castings

**CHALLENGES**
Manufacturer has a population of parts which pass a final inspection but are actually defective
The defective parts are used to build cars, which results in costly repairs or recalls
Manufacturer desires to understand how to better control process manufacturing in order to better detect defective parts in the factory

**SOLUTIONS**
Integrated external data sources that were hypothesized to have an effect on manufacturing quality (ex. weather data where plant is located)
Analyzed manufacturing data to uncover relationships between key manufacturing variables and final product quality
Developed machine learning models to predict the probability that a part is defective

**RESULTS**
Used machine learning to identify key drivers of part failures which can be adjusted to improve product quality
Provided model-driven strategies to improve defect detection
Found that parts tend to fail in sequence, i.e. a part produced right before or after a bad part is more likely to fail
Improving process control at a leading craft brewery

**SOLUTIONS**

Neal Analytics developed parametric models to inform performance of key processing stages in brewing process.

Neal Analytics developed a methodology for automatically identifying abnormal beer batches, improving opportunities for early intervention.

Models were integrated into existing BI dashboards and Power BI to allow for improved insights and decision making on factory floor.

**CHALLENGES**

Brewery management wanted to leverage analytics to improve control of brewing process.

Brewing stages proved difficult to time, leading to inefficiencies in brewing changeovers.

Identifying abnormalities in brewing process were difficult to automate.

**RESULTS**

Improved visualization into core brewing stages enabled improved feedback and control of brewing process.

Improved early identification of abnormal beer batches.

Beer brewing is a complex process made up of multiple stages including mashing, boiling, fermenting, condition and filtering. Careful control of each stage is needed to produce a specific brand of beer.
Aerospace supplier: Designing an analytics data pipeline

**CHALLENGES**
- Variations in manufacturing process lead to quality issues in final product
- Lack of traceability of products across factory processes inhibited ability to analyze variation in product quality
- No infrastructure in place to connect disparate systems across manufacturing facilities

**SOLUTIONS**
- Automated movement of data from 10+ on premises systems across 5 manufacturing facilities to Azure Data Lake Store using Data Factory
- Developed USQL scripts to load data to Azure Data Lake Analytics tables and perform data transformations which eliminate gaps in traceability of products across factory process stages
- Loaded transformed data into Azure SQL Data Warehouse tables using PolyBase for downstream activities (ex. visualization, machine learning, etc.)

**RESULTS**
- Identified gaps in traceability of products across factory process steps
- Connected fragmented systems to provide a 360° view of the manufacturing process
- Created an automated data pipeline for continuous analysis of quality in factory
Quality prediction and driver analysis for a high-tech aerospace manufacturer

**CHALLENGES**

- Variations in manufacturing process lead to quality issues in final product
- Influence of manufacturing settings on material properties not completely understood
- Risk of bad product quality represents large financial risk for customer

**SOLUTIONS**

- Built Power BI dashboard and user interface which allows users to compare quality metrics across multiple batches and lines
- Identified relationships between mechanical properties of carbon fiber products and manufacturing processes/inputs
- Developed machine learning models that predicts target mechanical properties based on key input variables

**RESULTS**

- Identified gaps in traceability of products across factory process steps
- Created reusable data pipeline for continuous analysis of quality in factory
- Identified important levers to in manufacturing process that can be used to improve quality
Unplanned shutdown prevention at major natural gas producer

**CHALLENGES**

- Gas well failure events result in significant lost natural gas production
- Limited visibility into potential causes of wellsite shutdowns
- Maintenance planning lacks complete view of asset health

**SOLUTIONS**

- Leveraged sensor signals to classify condition of well, gas lift compressors, saltwater disposal pumps, heater treaters, and other well pad devices
- Created data features that capture recent device behavior
- Identified “Normal” and “Pre-Shutdown status for well pads
- Key data inputs:
  - Facility pad configuration
  - Unscheduled Maintenance records
  - Operational Data
  - PAD/DHCP level data

**RESULTS**

- Detected potential shutdowns within a 12 to 72-hour window to allow preventative maintenance
- Developed approach to increase well production through unscheduled downtime prediction
- Created ROI methodology for retrofitting sensors on legacy well pads
Multi-national oil & gas company: Pump jack predictive maintenance

**CHALLENGES**
Large oil producer interested in understanding the ongoing effectiveness of their downhole pumps to lift fluid to the surface

Pump jack failures proved difficult to detect using rule-based diagnostic methods and often led to expensive field failures and lost production

**SOLUTIONS**
Created a unified view for wells over time by combining dynamometer, operational, well maintenance, downtime and performance failure data

Using Azure Machine Learning, Neal Analytics classified failure types to identify patterns of failure occurrences and allow for remote diagnostics of pre-failure conditions

**RESULTS**
Reduced cost of nonproductive time and operations
Increased Return on Assets by avoiding severe pump jack failures
Optimized maintenance schedules based on risk probabilities
Multi-national oil & gas company: Pump jack predictive maintenance (details)

Data Visualization

Analysis Process & Diagnosis

ADF consumes aggregates
returns ML results

DocumentDB

Consumed
Produced

Machine Learning
Predictions

Data

Data to Card Shapes
+ Area per shape

Quantify shape, match to problem shapes

Daily notifications generated

Notifications sent to dispatch system
Solutions

- Leveraged advanced solvers to improve fit of virtual metering models
- Created data pipeline in Azure and scripts to automate process of model tuning
- Validated results against multiple well layouts and configurations

Results

- Automated tuning of virtual meter algorithms
- Improved tuning accuracy of production model

Challenges

- Virtual Gas/Oil production flow assignments utilize complex models, which must be periodically tuned to maintain accurate readings
- Errors in models accumulate over time and can lead to incorrect allocation of large dollar values of production to producers
- Customer interested in improving tuning accuracy and automating the tuning process
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TRANSFORMING YOUR BUSINESS WITH DATA

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