AI & Analytics for Chemical Engineers

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AI & Analytics can provide much needed EBIDTA growth in Chemical Engineering

**Problem:**
Performance improvement in chemical manufacturing relied on traditional process knowledge and followed by capital investment.

**Solution:**
Data analytics (AI/Deep learning/ML/Big data) offers a less costly alternative by analyzing the vast amount of data they routinely collect and, to identify improvement opportunities.

In doing so, they gain a better understanding of today’s evolving technologies and the value they deliver.
## Analytics for Chemical Engineers: Key categories

### Data Management
- Data Management, capture, ETL
- Data Governance
- Data integration across multiple systems
- Cleansing, and merging of data across files

### Reporting & Visualization
- Insights led business reporting, visualization
- Process automation, automated reports, 360 customer views and journeys
- Visualization tools like POWERBI, Tableau dashboards, D3Js, Bokeh (python)

### Analytics & ML
- Manufacturing analytics
- Marketing & Revenue analytics – Personalization, choice models, marketing mix, media, trade, pricing & promotions
- FP&A Analytics; Forecasting, planning, expenses, vendor analytics
- Web Analytics; Digital media, sentiment analytics
- Risk & collections analytics; Risk scoring, fraud detection, scorecards

### Deep Learning
- Video, image data capture and storage with annotation for pattern discovery
- Video, NLP and other data sources for integration
- Data labeling for training
- Object detection and classification using various models
- Plant failure prediction with millions of inputs

### Descriptive Analytics

### Predictive Analytics

### Prescriptive Analytics

### Optimization
- Optimization to build a decision support system
- Multi factor – Multi level manufacturing optimization
Typical Analytical Project Map

**Input**
- Historical Data/ ERP Data
- Campaigns Datasets
- Macroeconomic Data
- Internet Based Rate & Demand Datasets
- Social Media/IRI/ Nielsen

**Analytical Engine**
- Exploratory Data Analysis
- Marketing Analytics
- Web Analytics
- Text mining
- Customer analytics
- Forecasting
- Materials analytics
- Optimization Modeling
- Vendor Analytics
- Neural Networks
- Contracts Analysis
- Process mining
- Pricing Modelling
- Segmentation
- Process Analytics
- Cost Analytics

**Output**
- Insights & Recommendation
- Score Cards/ Dashboards
- Model Outputs

**Visibility & Insights**
- Yield Management
- Scheduling
- Composition
- Optimization
- Revenue Assurance
- Strategic Sourcing
- Contract Management
- Vendor Management
- Inventory Management

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Analytics for Chemical Engineer: Typical project plan

1. Diagnostic Assessment
   - 1 Week

2. Exploratory Data Analysis
   - 3 Weeks

3. Demonstration of EDA insights
   - 4 Weeks

4. Validation, detailing & extension of EDA
   - 8 Weeks

5. Solutioning & Implementation
   - 12 - 18 Weeks

6. Benefit Realization

6-24 Months
Analytics is applied across the supply chain to improve performance

**Today’s Focus**

- **P2P analytics, control tower, price forecasting, vendor forecasting, risks**
- **Yield, energy and throughput improvements, maintenance and failure planning, integrated offering**
- **Network planning, estimating delivery times, route optimization,**
- **Demand forecasting, consumer analytics, retail analytics, AI, NLP for revenue growth, assortment**

**Sourcing**
- Supplier

**Manufacturing**
- Manufacturing

**Distribution**
- Wholesaler

**Point of Sale**
- Retailer
- Consumer
SoftSensor is a specific term used in the manufacturing industry for probabilistic model-based variables.

**Wide Usage**
- Widely used in manufacturing processes for quality and safety

**Historic Data**
- Modeling can be done with historic data without detailed subject knowledge.

**Development**
- Dependent variable is plant output with inputs from sensors and other data

**AI & ML**
- Multiple methods can be adopted with dependent variable and techniques

**Performance**
- Model performance needs to be maintained and monitored over time

**Economic Value**
- Models need to be calibrated and continually improved for business value generation

SoftSensor are probabilistic derived variables from multivariable and multisensory data using supervised or semi-supervised AI methods.
Problems faced by the Manufacturing Sector

- Unplanned machine downtime with equipment failure
- Difficult to measure variables in output quality can lead to losses
- Leakages
- Raw materials variability
- Ambient environment variability
- Demand variability
- Hazards, safety issues and rare events
- Operator variability in running plants, visibility of data to operators

Benefits of Soft Sensors

- Real Time Data Prediction
- Backup to hardware sensors
- Reduce operator variance
- Catch lab & measurement error
- Output Quality Management
- Optimization
- Insurance & Legal benefits

Improvement Themes

- Productivity Increase: 3-5%
- Machine Downtime Reduction: ~20%
- Inventory Holding Costs Reduction: ~10-20%
- Forecasting Accuracy Improved: Significant
- Maintenance Cost Reduction: 10-20%
- Quality Improvement: Significant
Example Cases

› A large manufacturer of aluminum improved its operating performance by reducing energy costs with use of SoftSensor for predicting key KPIs in the smelting process

› A furnace operator improved the performance of the furnace using smart furnace SoftSensors to predict key intermediate variables

› A chemical manufacturer improved its manufacturing performance of chemicals by predicting critical and difficult to measure output variables. The outcome improved the yield performance by 3-5%.
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