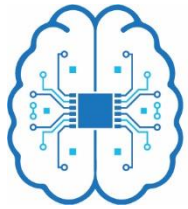

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AI & Analytics for Chemical Engineers

by **Gopal Salvady** & Dr **Vivek Gupta PhD**

Aug 2020

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

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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.

5-10%
EBIDTA

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Analytics for Chemical Engineers: Key categories

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Descriptive Analytics

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)

Predictive Analytics

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

Prescriptive Analytics

Optimization

- Optimization to build a decision support system
- Multi factor – Multi level manufacturing optimization

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Typical Analytical Project Map

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Input

- Level 4 (SAP) — Historical Data/ ERP Data
- Level 3 Systems (Historian) — Campaigns Datasets
- Level 2 Systems (DCS) — Macroeconomic Data
- Level 1 Systems (PLC) — Internet Based Rate & Demand Datasets
- Level 0 Systems (Sensors) — Social Media/IRI/ Nielsen

Data Files Prepared

Analytical Engine

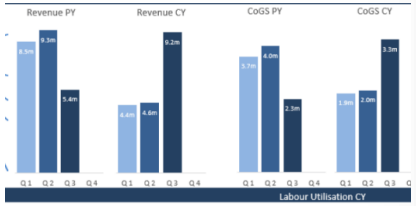
- Exploratory Data Analysis
- Text mining
- Forecasting
- Optimization Modeling
- Neural Networks
- Process mining
- Segmentation
- Marketing Analytics
- Web Analytics
- Customer analytics
- Materials analytics
- Vendor Analytics
- Contracts Analysis
- Pricing Modelling
- Process Analytics
- Cost Analytics

Visualization

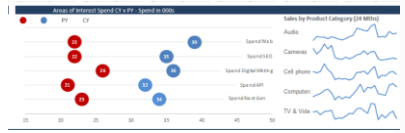
Output

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

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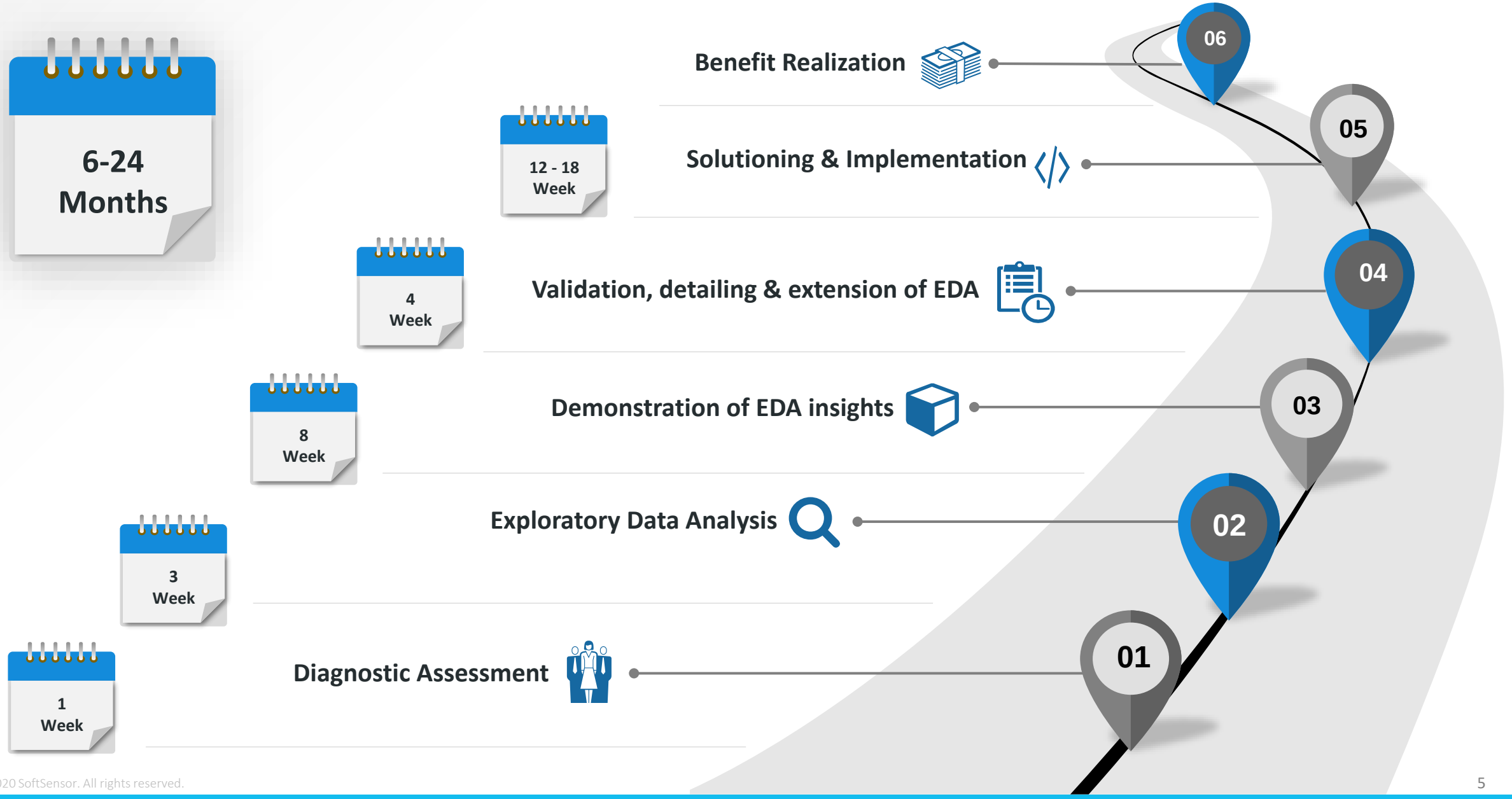

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Analytics is applied across the supply chain to improve performance

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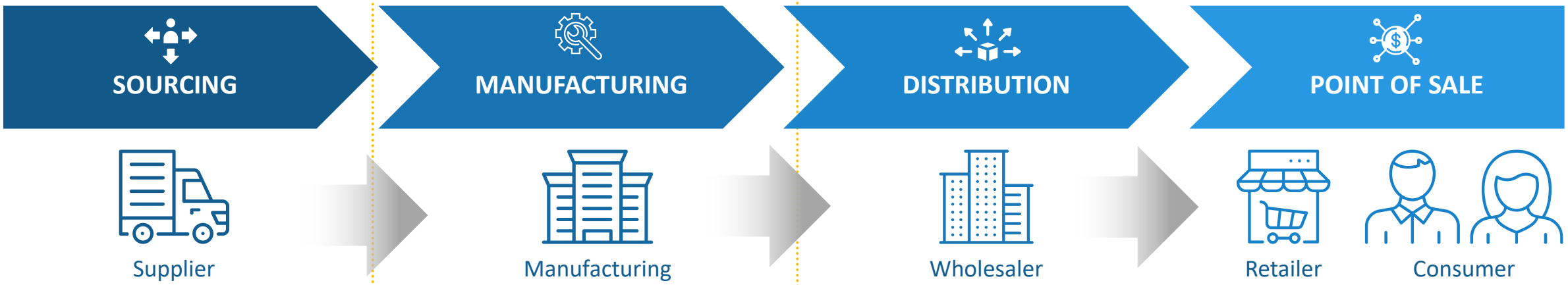
Today's Focus

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



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SoftSensor is specific term used in manufacturing industry for probabilistic model-based variables

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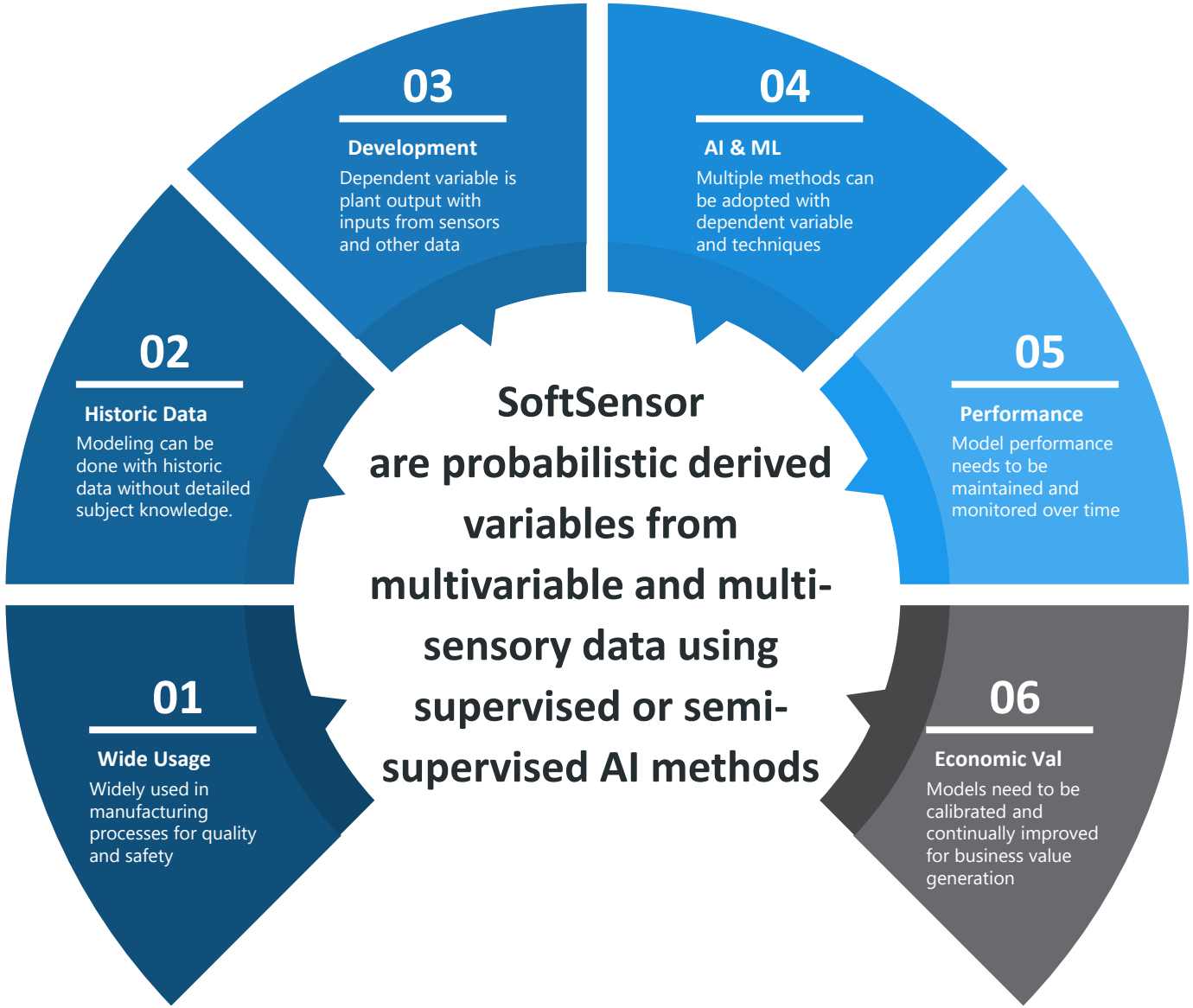

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Soft Sensors In Action

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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

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Example Cases

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- 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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