Integrating IT/OT systems for the new energy economy

Data Integration and Analytics for Asset Management and Operations

Data Analytics for the Smart Grid
August 28, 2017
We help capture the opportunities of digitalization in the grid

In 2014, Siemens and Accenture launched a joint venture based on the market’s need for a new solution provider

- Engineering and energy technology
- Smart grid applications
- Grid control experience
- Systems integration and services capabilities
- Proven delivery methodologies
- Industry-specific technologies, assets and processes
- Dedicated to utilities
- OT-IT integration specialists
- Integrated smart grid solutions for a digital grid

...dedicated to helping utilities bridge the gap between operations and information technology

...existing as a separate entity to which both Siemens and Accenture could bring their IP and integrate IT and OT more effectively

...with expert practitioners from both companies, working as one team
T&D Asset Analytics Use cases
Analytics Potential from Measurement Data

Example Use Cases from our Clients

**Assets**
- 1.1 PMA – Predictive Maintenance Analytics
- 1.2 CQI – Communication Quality Intelligence
- 1.3 RCAM – Reliability Centered Asset Management
- 1.4 MSPA – Mid-Stream Pipeline Asset Analytics (O& G)

**Market**
- 2.1 TDS – Trading Decision Support
- 2.2 SDSP – Smart Data and Service Platform

**DERs**
- 3.1 RMF – Renewables Meta Forecasting
- 3.2 ISSN – Intelligent Secondary Substation Node

**Customers**
- 4.1 CCA – Campus Consumption Analytics
- 4.2 FRO – FTTH Return Optimization
- 4.3 ACCP – Advanced Commercial Consumption Analytics
- 4.4 CCI – Comprehensive Customer Insight
- 4.5 RAA – Revenue Protection Analysis
- 4.6 WUA – Water Usage Analytics

**Sensors**
- 5.1 ELV – Extended LV Analytics
- 5.2 PAD – Phase Asymmetry Detection
- 5.3 ESA – Enhanced Sensor Analytics

**Operations**
- 6.1 RSS – Rollout Support Services
- 6.2 CSI – Comprehensive SCADA Intelligence
- 6.3 POIS – Planning and Outage Intelligence Service
- 6.4 iMOC – Integrated Meter Operations Center
- 6.5 GTF – Grid Topology Fingerprinting
- 6.6 GVS – Grid Video Surveillance
- 6.7 SMOC – Smart Meter Operations Center

**Advisory**
- 7.1 RPC – Roadmap and Prioritization Consulting

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Projects currently under preparation

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### 1.3 RCAM – Reliability-centered Asset Management

**Health index and risk calculation for strategic asset lifecycle management**

<table>
<thead>
<tr>
<th><strong>WHERE?</strong></th>
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<tbody>
<tr>
<td>‣ Worldwide TSO, DSO operating HV, MV grids</td>
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<td>‣ Large industrial facilities electrical grids</td>
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<td>‣ Rail electrification grids</td>
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<table>
<thead>
<tr>
<th><strong>WHAT?</strong></th>
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<tbody>
<tr>
<td>‣ Calculating tactical and operational asset management functions by calculating (predicting) an asset’s current and future health and associated risk based on the probability of failure.</td>
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<tr>
<td>‣ Online data retrieval and constantly recalculating asset states ensures a high level of accuracy of the presented data.</td>
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<table>
<thead>
<tr>
<th><strong>HOW?</strong></th>
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<tbody>
<tr>
<td>‣ A data platform collects online, offline asset related data to calculate health index and risk using rule based models per asset type</td>
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<table>
<thead>
<tr>
<th><strong>WHY?</strong></th>
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<tr>
<td>‣ Mid and long term Asset Investment Planning</td>
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<tr>
<td>‣ CAPEX/OPEX optimization</td>
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<td>‣ Asset infrastructure risk mitigation,</td>
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<td>‣ Regulatory reporting</td>
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<td>‣ PAS 55 / ISO 55000 compliant</td>
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Low level Grid Monitoring: Fault, Outage Detection & Location

WHERE?
- Several DSOs performing Pilot projects

WHAT?
- Sensors deployed along MV / LV lines to take high-frequency measurements
- Line sensors and PMU are sensor devices that collect high-frequency data
- Measures many types of measurement
  - Phase ID, High Z, Disturbance, Load Direction, Fault, Synchrophasor
- Data collected at high-frequency, locally aggregated and available at a granular level compared to telemetry data available to SCADA systems
- Real-time analytics performed on streaming data and on correlated data with traditional operational systems such as SCADA, OMS, AMI, MDM, etc

WHY?
- Decrease outage & maintenance costs
- Monitor load direction for deployed DERs
- Asset infrastructure risk mitigation,
- Decrease SAIFI & SAIDI
- Increase safety
  - High Impedance
  - Vegetation Management

HOW?
- Sensors rely on the AMI mesh network or 3G cellular networks to communicate with a centralized data concentrator
- Analytics performed on raw data, real-time analytics performed to detect ongoing fault events, correlated with traditional operational data and aggregated sensor data integrated with operational applications
Detection and prediction of failure trends in measurement transformers to perform predictive maintenance

WHERE?
- European TSO

WHAT?
- Focus on measurement transformers: data from oil measurements is used to identify the health status of the assets
- Our approach: analyze data independent from the given assessment method
- Our aim: Secure insight into data
  - Identify influencing factors of the asset’s health status
  - Predict how individual transformers behave in future

HOW?
- Data enrichment: weather data + external information
- Principle Component Analysis on oil and on gas measurements
- Event sequence analysis for error detection
- Decision tree classification and modeling

WHY?
- Insights into measurement transformers’ disturbances
- Influencing factors for performance
- List of transformers that should be observed carefully due to their higher statistical risk profile
Outage risk assessment and prediction for smart maintenance and grid control planning

**WHERE?**
- European DSO

**WHAT?**
- Focus on outages in the grid: Which assets are involved in outages and what factors are most influential?
- Client’s aim:
  - Combine all relevant internal & external data
  - Build a reliable statistical outage assessment model
  - Develop a fully-automated prediction model indicating the risk-status of assets and sections of the grid

**HOW?**
- Data integration: Multidimensional data enrichment (assets, maintenance, weather, GIS, elevation, SCADA, customer, etc.)
- Hadoop environment for large-scale data processing
- 2-stage logistic regression model for outage risk prediction

**WHY?**
- Help to reduce outages without increasing maintenance budget by focusing on highest-risk assets and grid sections
- Extensive data integration for in-depth analysis
- Reliable model with >80% prediction accuracy
- List of critical assets for maintenance prioritization
### 3.1 RMF – Renewables Meta Forecasting

Improved accuracy in forecasting data with a smarter combination of data sources

#### WHAT?
- Adaptive combination of multiple forecasts
  - Combines forecasts based on statistical facts
  - Gives confidence intervals for better decision making
- Improvement of present forecasts by adding additional data
  - Forecasts often only based on production data
  - Improvement by additional wind and weather data from turbines and weather stations

#### WHERE?
- European Utility
- European TSO

#### HOW?
- Time series analysis
- Sequence and pattern mining
- Classification-based transfer function

#### WHY?
- Wind power plant operator:
  - Reduce penalty costs by reducing forecasting errors
  - Optimize trading strategy based on forecast confidence
  - Align maintenance schedule with production forecast
- Transmission system operator (TSO) and Distribution system operator (DSO):
  - Prevent critical situations in the grid
  - Keeping the network balanced
  - Congestion management
  - Reserve monitoring
Integrating diverse energy systems into the main grid challenge operations and solutions build for grid stability and reliability.
The Process

- Network Model Planning and Analysis kicks off end-to-end process
- Devices typically connected to the Control Center via protocols such as DNP3
- Real-time operations would eventually activate devices at a planned time
- Asset Owners interact with this process manually and have no visibility of progress

Highlights

- Process is simplified, controlled and cyclical
- Perfected over decades of iterations
- Not flexible enough for new Utility business models (Microgrids, CCA, DR, DER)
- Operations/OT centric and supported by traditional platforms such as SCADA

The Challenge

- Consumers are becoming prosumers, having their own generation & demanding data
- Going from integrating Renewables to Demand Response to Distributed Energy Resources
- Requirements are complex to integrate systems that need to talk to each other
- Traditional OT systems don’t cut it
- Processes are complex, non-cyclical, data intensive, collaborative

What's out there

- International Electrotechnical Commission (IEC) Common Information Model
- Green Button, IEEE Smart Energy Profile 2030.5, OpenADR, OpenFMB
- IT to the rescue (?)
- Non-codified expert knowledge within Utilities
- Industry Organizations
Integration strategy

- Implement a consistent integration strategy
- Build upon industry standards
- Unified data model foundation
- Add additional enterprise capability
- **Build business value and save costs**

Enterprise Service Bus

- Analytics
- Market Management
- T/D Network Apps
- SCADA
- Legacy
- Settlements
- DEMS/DERMS
- CIS
- Outage Management
- MDM
- Visualization
- AMI
- WFM

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## Data Integration Methodology

**Translating Standards and Best Practices to Implementation**

<table>
<thead>
<tr>
<th>Phase Description</th>
<th>Business Process</th>
<th>Service Definition</th>
<th>Map to CIM</th>
<th>Message Definition</th>
<th>Implement/Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>Define &amp; Refine business processes</td>
<td>Modularize Business Functions</td>
<td>Describe Services via Standards (CIM)</td>
<td>XSDs &amp; WSDLs</td>
<td>Enterprise Service Bus</td>
</tr>
<tr>
<td>Core</td>
<td>Analyze Input/Output Interfaces for each system</td>
<td>Group interfaces, Pub/Sub, Req/Rep, etc</td>
<td>Map &amp; model interface attributes to the CIM</td>
<td>Produce CIM compliant CIM messages from the Data Model</td>
<td>Implement the underlying ESB technology &amp; services</td>
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**Orchestration, BPM, CEP, Security, Monitoring**
OMNETRIC Group is dedicated to helping energy providers reap the benefits of the digital energy system by integrating their energy operations with IT to support their business goals. Our global team of engineering, IT, security and data experts brings extensive industry experience to help customers discover and exploit data intelligence to capitalize on industry change, and realize new business models.

Helping customers since 2014, we are an inventive technology services company and a joint venture between Siemens AG and Accenture. For more, visit www.omnetricgroup.com.

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Appendix
### Algorithmic Techniques

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<thead>
<tr>
<th>Classification</th>
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<tbody>
<tr>
<td>Predict one or more discrete values based on the values in the data set (e.g. Random Forest / Decision Trees for non-technical loss case identification, root cause analysis etc.)</td>
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<table>
<thead>
<tr>
<th>Regression and Logistic Regression</th>
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<tr>
<td>Predict one or more continuous values based on values in data set (e.g. generation or load forecast based on historical data sets). Logistic regression for predicting discrete values</td>
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<table>
<thead>
<tr>
<th>Segmentation and Clustering</th>
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<tr>
<td>Grouping of data into clusters, sometimes based on common or pre-defined patterns</td>
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<th>Association</th>
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<tr>
<td>Look for co-relations between different sets of data inputs (what is common thread), e.g. correlation analysis of multiple streams of time series data</td>
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<th>Sequence Analysis</th>
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<td>Summarize frequent sequences or episodes in data (e.g. time sequence analysis of SCADA alarms to identify trigger and root cause)</td>
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<tr>
<th>Ensemble</th>
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<tr>
<td>Combination of different analytical approaches and algorithms</td>
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Some fundamental techniques underlying to most data analysis algorithms