Harnessing the power of advanced analytics in T&D asset management

Utility Week Energy Summit 2018 | 21 June
Imagine a world where you leverage data and knowledge of all the industry to take a new leap forward in the UK power grids industry

<table>
<thead>
<tr>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited data usage</td>
<td>Internal and external data used at scale</td>
</tr>
<tr>
<td>Annual review</td>
<td>Agile methodology</td>
</tr>
<tr>
<td>Historical performance data</td>
<td>Prediction of the future</td>
</tr>
</tbody>
</table>
However, it’s easier said than done

- **No central risk-criticality approach**
- **Data quality and IT architecture**
  - Data fragmented across systems
- **Advanced Analytics**
  - Lack of advanced analytics expertise
- **Technical knowledge and capabilities**
  - Decentralized knowledge
Using an advanced criticality/health matrix enables you to allocate resources to the assets that need it the most.

- **Transformer**
- **Breakers**
- **Conductors**
- **Towers**

**Optimize maintenance opex**

**Optimize capex**

**Improve reliability**

**Advanced Criticality index**

**Predictive Health index**

(internal & external data)

SOURCE: McKinsey & Company
Key questions that may be in your minds

What results can we expect?  
10 to 25%

Do we need to spend money installing sensors across our network?  
No

Do we actually need big data?  
No

Can we get a plug-and-play solution?  
No

Can we do it gradually?  
Yes
How do we get started?

**Step 1**
Capture and clean up your data

**Step 2**
Quantify your health and criticality levels

**Step 3**
Tailor your asset management strategy

**Step 4**
Bring it all together
Step 1 | Capture and clean up your data

Data digitalization and quality control
- Data validation algorithms help correct non-expected data quality issues
- Ad hoc heuristic algorithms developed to bridge the gap of data holes
- Digitalization of hand-writing through optical character recognition techniques

Network reconstruction for fault allocation
- Algorithm to reconstruct the real network topology at any time period leveraging SCADA
- Physical assets grouped into logical elements in a network, nodes and branches
- The network reconstruction enables accurate allocation of faults

Natural Language Processing classifiers
- “Free-text” data classified using natural language processing algorithms to gain deeper insights from the work performed
- Data can then be translated into variables as indicators of asset condition

Meteorological data integration
- Meteorological information is integrated and allocated to each area of the network
- Typical data includes rain, snow, wind to distance to sea or lightnings
### Health index calculation (failure prediction) – HV overhead cables

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Accuracy, Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Insulator anomaly</td>
<td>Predicting the severity of the anomaly in the isolator / time until it is replaced</td>
<td>68</td>
</tr>
<tr>
<td>2 Vegetation in the foundation</td>
<td>Predicting the severity of the anomaly due to having vegetation in the foundation</td>
<td>82</td>
</tr>
<tr>
<td>3 Structural corrosion</td>
<td>Predicting the severity of anomaly due to corrosion</td>
<td>72</td>
</tr>
<tr>
<td>4 Foundation ground fault</td>
<td>Prediction the severity of the anomaly due to land on which the cement foundation is built</td>
<td>53</td>
</tr>
<tr>
<td>5 Breakage in support or structural element</td>
<td>Prediction of anomaly severity due to breakage or deterioration of a support element</td>
<td>69</td>
</tr>
<tr>
<td>6 Breakage in earthing</td>
<td>Prediction of anomaly severity due to breakage or deterioration of the earthing system</td>
<td>60</td>
</tr>
<tr>
<td>7 Inadequate distance of vegetation</td>
<td>Prediction of the severity of anomaly due to an inadequate distance to vegetation</td>
<td>80</td>
</tr>
<tr>
<td>8 Earth cable oxidation</td>
<td>Prediction of the severity of anomaly due to oxidation appearing in the earth cable</td>
<td>91</td>
</tr>
<tr>
<td>9 Earth cable breakage</td>
<td>Predicting the severity of anomaly due to breakage or damage to earth cable</td>
<td>81</td>
</tr>
<tr>
<td>10 Conductor breakage</td>
<td>Prediction of the severity of anomaly because of breakage or damage to conductor</td>
<td>77</td>
</tr>
<tr>
<td>11 Need to raise conductor</td>
<td>Prediction of the severity of anomaly because the conductor must be raised</td>
<td>72</td>
</tr>
</tbody>
</table>
Step 2 | ... and criticality

Calculation methodology for criticality index of substations

One high value out of three is enough to classify a park\(^1\) as critical.

Impact index:
- Nuclear generation
- Generation power\(^2\)
- Distribution power\(^3\)
- Affected population
- Critical consumers
- International connection
- Market sensitivity
- Transport power\(^3\)
- Critical time
- Lost power if failure
- Substation topology
- Age of installed equipment
- Anomalies per position\(^2\)

Risk index:
- High risk if we have both low safety and high impact

Substation park\(^1\):
- Generation
- Distribution
- Transmission

Safety index:
Step 3 | Tailor and optimized maintenance strategy

- Criticality:
  - Good
  - Low

- Health:
  - High
  - Poor

- Reallocation strategy:
  - Reallocate opex and capex of low risk assets to high risk assets

- Actions:
  - Increase follow up
  - Reduce maintenance frequency

- Trigger for further analysis:
  - Replacement
  - Retrofit
  - Increase maintenance

- Replacement at end of life
Step 4 | Bring it all together through an end-to-end system

- Secure data environment
  - McKinsey’s cloud platform orchestrates project workflows in a secure environment
  - McKinsey encryption approved

- Holistic view of data
  - Proprietary models for data collection, cleaning, categorization and integration
  - Data lake leverages internal client data and external sources
  - Automatically synchronized with the solution

- Purpose-built for electric power
  - Founded in rigorous electrical engineering and technical models
  - Advanced analytics modules for asset management include:
    - Machine learning models
    - Fuzzy logic models
    - Expert system
    - NLP classifiers

- Seamless system integration
  - Easy-to-use visualization tool to prioritize and implement new maintenance activities
  - Geospatial representation of model outputs, analysis of results and client customization
  - Integrates seamlessly into existing workflows
But predictive maintenance is only the start leveraging Advanced Analytics in grids

**Asset management**
- Predictive maintenance
- Identification of defective meters

**Grid operations, loss and fraud detection**
- Theft detection
- Improvement of efficiency / line loss
- Network voltage analysis/load balancing
- Fault detection/outage alarms, network monitoring
- Improve automated planning and dispatch functions

**Grid development and capex**
- Network planning, optimization of distribution facility locations

**Data monetization**
- Multiple use cases leveraging customer data

SOURCE: McKinsey & Company
Recipe for success

1. Ensure leadership from the top
2. Base maintenance strategy entirely on asset health and criticality
3. Build stakeholder (and especially regulatory) management skills
4. Align strategy with analytics and IT to address opportunities with agility
5. Ensure clear understanding of data & IT systems, interactions, weak points and data gaps
6. Fine-tune organizational structures and processes