Substation Asset Performance Using MinMax SMART

Presented by

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Today’s Utility Asset Condition and Maintenance Management

1. The challenge of an aging utility infrastructure
2. Expectations of higher reliability and lower operating costs
3. Increasing pressure to control asset procurement, operating costs
4. Environmentally-conscious regulators, stockholders, consumers
5. Increased pressure to extend the life of existing utility assets
What Keeps the Operations Managers On Edge?

- Poor coordination across processes, resources, and technologies
- Lack of accurate and consistent data for assets
- High corrective maintenance to preventive maintenance ratio
- Excessive equipment downtime and work completion times
- Inconsistent/non-auditable risk management processes
- Above average equipment lifecycle costs
- Lack of rigorous capital expenditure planning & prioritization
What is the Prescription?

1. Build a comprehensive asset information database that:
   - Includes asset ID, location, characteristics, condition, failure risk, depreciation, and replacement
   - Will apply across systems and processes
   - Will interface or support legacy data

2. Develop and promote a set of processes that:
   - Will identify and standardize processes
   - Are intuitive, repeatable, manageable, measurable, and continuously optimizable
   - Will document strategies for managing risks, disaster, and repair vs replace

3. Apply Latest Information Technology that:
   - Will enhance user productivity
   - Will promote integration across different geographies, operations, organizations, and applications
   - Are easily deployable, adaptable, scalable, and affordable
Build a Comprehensive Asset Information Database

- Standardize the Asset data collection and database
- Know the condition of every asset
- Know the risk before it becomes a problem
Where are older lines and equipment located? In what condition?

What is the average age of your distribution system?

How can you evaluate their reliability, safety, and sustainability?

What do you operate, maintain, or replace? And when?

What are your near-term and long-term plans in view of costs, ROI, and environmental & societal impact?

Ask Questions
Develop and Promote a Set of Meaningful Processes

- Simplify using templates and processes from proven practices from the utility and other industries
- Create best practices that will help with:
  - Improving employee satisfaction and productivity
  - Meeting regulatory compliance
  - Aligning the asset management strategy and approach with the overall business strategy
  - Improving the integration between asset management and financial management processes
  - Maximizing return on assets, and asset uptime
  - Fostering an organizational culture focused on quality, safety, and continuous improvement
- Continue to improve upon your best practices
(1) Application look & feel capabilities must meet or exceed field user needs

(2) Application must improve data quality from the field user perspective

(3) Allow for data exchange across applications

(4) Cybersecure and compliance with regulatory requirements

(5) Use internal IT standards wherever possible

(6) Use external data standards and models where appropriate

(7) Keep It Simple
Utility Substation Maintenance Needs

1. An organized record of all substation asset (equipment) data
   ✓ Asset ID
   ✓ Nameplate data (including transformer or voltage regulator tap connection details, trip settings, etc.)
   ✓ Equipment relocation

2. Inspection/Repairs History
   ✓ Inspection checklist
   ✓ Scheduled (time- or condition-based) inspection records
   ✓ Unscheduled repairs and labor data
   ✓ Work orders history and costs

3. Tests
   ✓ Frequency of tests performed
   ✓ Reports of test results
   ✓ Incorporate external test data sources (i.e. lab data)
   ✓ Association with inspection/repairs history

4. Document Management
   ✓ Equipment manuals – existence and locations
   ✓ Latest drawings (one line diagrams, pictures, etc.)
   ✓ Record of comments and communications

5. Reporting
   ✓ Management reporting of exceptions
   ✓ Preparation for NERC audit
   ✓ Other regulatory compliance reporting
   ✓ Export/Import to Excel or PDF
   ✓ Data Trending and Useful Analytics
General Characteristics of SMART
(Substation Maintenance & Asset Reliability Tracking)

1. A browser-based software tool that:
   ✓ Operates in cloud or in-house environment
   ✓ Functions on-line or offline using Google and esri maps
   ✓ Is intuitive and maintains a consistent look-&-feel across multiple devices (laptops, iPads, and smart phones)

2. Enables quick setup with its rich library of data and becomes operational with minimum utility customization

3. Enables users to design custom forms for any number of inspection and equipment types, tests, and maintenance procedures

4. Helps with the audit trail of inspection data to fulfill NERC and other regulatory compliance

5. Provides extensive document management capabilities (pdf, Word, Excel, Drawings, Pics)

6. Enables field users to instantly document assets and their condition by capturing quick pictures

7. Provides bulk export/import of data and interface capabilities with the 3rd party software
## Key Functional Features of SMART for Users

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>User-configurable equip. types, data fields, inspection questions, test data grids, and pre-defined reports</td>
</tr>
<tr>
<td>(2)</td>
<td>Off-line capability to perform inspections using esri GIS maps</td>
</tr>
<tr>
<td>(3)</td>
<td>Customizable forms, User roles, e-mail alerts for abnormal inspections</td>
</tr>
<tr>
<td>(4)</td>
<td>Use of internet-based ambient temperature for each substation</td>
</tr>
<tr>
<td>(5)</td>
<td>PRC, FAC and other NERC compliance reporting</td>
</tr>
<tr>
<td>(6)</td>
<td>Easy Export/Import of data and interface capabilities with 3rd party systems</td>
</tr>
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</table>
Configurable Inspection and Test Data Forms
## Review Inspections and Test Data Instantly

**Activity History**

<table>
<thead>
<tr>
<th>Inspection /WO</th>
<th>Inspection Type</th>
<th>Sub (Site)</th>
<th>Dist (Area)</th>
<th>Equip ID [Name]</th>
<th>Equip Type</th>
<th>Action</th>
<th>Question</th>
<th>Result Recorded</th>
<th>Normal Range</th>
<th>Result Status</th>
<th>Comments</th>
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</thead>
<tbody>
<tr>
<td>Monthly-XFRMR-06</td>
<td>Detailed</td>
<td>CWP-T-Sub01</td>
<td>Distribution</td>
<td>CWP-Trans-01 [Power Transformer]</td>
<td>XFRMR-POWER</td>
<td>Inspected</td>
<td>Condition of paint or gasketing?</td>
<td>Corrosion</td>
<td>Abnormal</td>
<td>Andre Vormbrock</td>
<td></td>
</tr>
<tr>
<td>Monthly-XFRMR-06</td>
<td>Detailed</td>
<td>Sub-01</td>
<td>Substations</td>
<td>RPU-Demo-XFRMR-T1 [RPU Demo Transformer]</td>
<td>XFRMR-POWER</td>
<td>Inspected</td>
<td>Are there any oil leaks?</td>
<td>No</td>
<td>Normal</td>
<td>Andre Vormbrock</td>
<td></td>
</tr>
<tr>
<td>Monthly-XFRMR-06</td>
<td>Detailed</td>
<td>Sub-01</td>
<td>Substations</td>
<td>RPU-Demo-XFRMR-T1 [RPU Demo Transformer]</td>
<td>XFRMR-POWER</td>
<td>Inspected</td>
<td>Overall condition of the transformer</td>
<td>Good</td>
<td>Normal</td>
<td>Andre Vormbrock</td>
<td></td>
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<tr>
<td>Monthly-XFRMR-06</td>
<td>Detailed</td>
<td>Sub-01</td>
<td>Substations</td>
<td>RPU-Demo-XFRMR-T1 [RPU Demo Transformer]</td>
<td>XFRMR-POWER</td>
<td>Inspected</td>
<td>Bushing oil level (Josh)?</td>
<td>Low</td>
<td>Abnormal</td>
<td>Andre Vormbrock</td>
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<tr>
<td>Monthly-XFRMR-06</td>
<td>Detailed</td>
<td>Sub-01</td>
<td>Substations</td>
<td>RPU-Demo-XFRMR-T1 [RPU Demo Transformer]</td>
<td>XFRMR-POWER</td>
<td>Inspected</td>
<td>Make sure you are wearing cotton stuff?</td>
<td>See Comments</td>
<td>Abnormal</td>
<td>Andre Vormbrock</td>
<td></td>
</tr>
</tbody>
</table>

**Review Inspections and Test Data Instantly**
Manage WO’s & Resources using an Interactive Gantt Chart
Distribution Poles Displayed on Google GIS
Distribution Poles Displayed on esri maps
Instant History and Trends
### Sample SMART Reports
#### Inspector Activity Report

**Company Name:** MinMax Technologies  
**Report Name:** Inspector Activity Report

**Date Printed:**  
2014/02/21 11:48

<table>
<thead>
<tr>
<th>Records Selected: 134</th>
<th>No.</th>
<th>Schedule</th>
<th>Substation</th>
<th>Inspector</th>
<th>Equip ID</th>
<th>Equip Name</th>
<th>Question</th>
<th>Action</th>
<th>Result</th>
<th>Remarks</th>
<th>Comments</th>
<th>Activity Date</th>
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</thead>
<tbody>
<tr>
<td>1 WC-Feb-1 Sub 04</td>
<td>Nand Singh</td>
<td>Trans-x</td>
<td>Oil Transformer</td>
<td>Are there any leaks?</td>
<td>Inspected</td>
<td>Fixed</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>2 WC-Feb-1 Sub 04</td>
<td>Nand Singh</td>
<td>Trans-x</td>
<td>Oil Transformer</td>
<td>Condition of above-grade ground connections at equipment, structures, and fences</td>
<td>Needs Work</td>
<td>See Comments</td>
<td>Repair it</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>3 WC-Feb-1 Sub 04</td>
<td>Nand Singh</td>
<td>Trans-x</td>
<td>Oil Transformer</td>
<td>Winding Temp. (Present)</td>
<td>Inspected</td>
<td>Repaired</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>4 WC-Feb-1 Sub 04</td>
<td>Nand Singh</td>
<td>Trans-x</td>
<td>Oil Transformer</td>
<td>Protective Relays - Annunciator panel alarm indications</td>
<td>Inspected</td>
<td>Good</td>
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<td></td>
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<tr>
<td>5 WC-Feb-1 Sub 04</td>
<td>Nand Singh</td>
<td>Trans-x</td>
<td>Oil Transformer</td>
<td>Clear the bird nest</td>
<td>Repaired</td>
<td></td>
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<tr>
<td>6 WC-Feb-1 Sub 04</td>
<td>Nand Singh</td>
<td>Trans-x</td>
<td>Oil Transformer</td>
<td>Bushing all levels</td>
<td>Inspected</td>
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<td>7 WC-Feb-1 Sub 04</td>
<td>Nand Singh</td>
<td>Trans-x</td>
<td>Oil Transformer</td>
<td>Inspected</td>
<td>No</td>
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<td>8 WC-Feb-1 Sub 04</td>
<td>Nand Singh</td>
<td>Trans-x</td>
<td>Oil Transformer</td>
<td>Inspected</td>
<td>Good</td>
<td></td>
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<tr>
<td>9 WC-Feb-1 Sub 04</td>
<td>Nand Singh</td>
<td>Trans-x</td>
<td>Oil Transformer</td>
<td>Inspected</td>
<td>No</td>
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<td>10 WC-Feb-1 Sub 04</td>
<td>Nand Singh</td>
<td>Trans-x</td>
<td>Oil Transformer</td>
<td>Inspected</td>
<td>No</td>
<td></td>
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<tr>
<td>11 WC-Feb-1 Sub 04</td>
<td>Nand Singh</td>
<td>Trans-x</td>
<td>Oil Transformer</td>
<td>Inspected</td>
<td>Good</td>
<td></td>
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<tr>
<td>12 WC-Feb-1 Sub 04</td>
<td>Nand Singh</td>
<td>Trans-x</td>
<td>Oil Transformer</td>
<td>Inspected</td>
<td>No</td>
<td></td>
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<tr>
<td>13 WC-Feb-1 Sub 04</td>
<td>Nand Singh</td>
<td>Trans-x</td>
<td>Oil Transformer</td>
<td>Inspected</td>
<td>No</td>
<td></td>
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<tr>
<td>14 WC-Feb-1 Sub 04</td>
<td>Nand Singh</td>
<td>Trans-x</td>
<td>Oil Transformer</td>
<td>Inspected</td>
<td>Good</td>
<td></td>
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<tr>
<td>15 WC-Feb-1 Sub 04</td>
<td>Nand Singh</td>
<td>Trans-x</td>
<td>Oil Transformer</td>
<td>Inspected</td>
<td>No</td>
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<tr>
<td>16 WC-Feb-1 Sub 04</td>
<td>Nand Singh</td>
<td>Trans-x</td>
<td>Oil Transformer</td>
<td>Inspected</td>
<td>No</td>
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<tr>
<td>17 WC-Feb-1 Sub 04</td>
<td>Nand Singh</td>
<td>Trans-x</td>
<td>Oil Transformer</td>
<td>Inspected</td>
<td>No</td>
<td></td>
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<tr>
<td>18 WC-Feb-1 Sub 04</td>
<td>Nand Singh</td>
<td>Trans-x</td>
<td>Oil Transformer</td>
<td>Inspected</td>
<td>No</td>
<td></td>
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<tr>
<td>19 WC-Feb-1 Sub 04</td>
<td>Nand Singh</td>
<td>Trans-x</td>
<td>Oil Transformer</td>
<td>Inspected</td>
<td>No</td>
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</tbody>
</table>

**Report Name:** Inspector Activity Report
1. A small municipal utility with 10 substations
2. Adopted SMART in 2014
3. One full time inspector and a supervisor
4. Savings of 3 hours per week
5. Helped them move from a focus on reactive repairs to a proactive maintenance model
6. Further cost and labor savings due to:
   ✓ Replacing parts under warranty, rather than waiting for equipment to fail.
   ✓ Improved reliability
   ✓ Avoided costly emergency repairs
7. Supervisor was able to show exactly how he and the inspector were using their office time and was able to create and justify the need for an additional position
# Direct and Intangible Benefits of Asset Management Systems

<table>
<thead>
<tr>
<th>Direct Savings Due to:</th>
<th>Intangible Benefits Due to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Cost avoidance due to improved equipment reliability and prolonged equipment life</td>
<td>- Reduced audit preparation and support time</td>
</tr>
<tr>
<td>- Increased employee productivity, inspection accuracy, and consistency</td>
<td>- Increased employee satisfaction</td>
</tr>
<tr>
<td>- Cost avoidance due to reduced contractor cost</td>
<td>- Improved inspection and safety training</td>
</tr>
<tr>
<td>- Avoidance of regulatory fines</td>
<td>- Greater customer satisfaction</td>
</tr>
<tr>
<td>- Take advantage of manufacturer warranty</td>
<td>- Favorable societal / PR effects</td>
</tr>
</tbody>
</table>