South African Smart Grid Initiative Meeting

The Eskom Distribution perspective on Asset Management

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On behalf of the MCOE Team
17 JUNE 2015
‘to love what you do and feel it matters’
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**What is Asset Management?**

**Asset Management** - ‘Coordinated activities of an organization to realize value from assets.’ *(ISO 55000)*

Asset management aims to achieve the organizational objectives and involves the optimising of costs (opportunities), and risks against the desired performance of assets,

![Risk - Cost - Performance Diagram]

**Asset** *(ISO 55000)*

An asset is an item, thing or entity that has potential or actual value to an organization. The value will vary between different organizations and their stakeholders, and can be tangible or intangible, financial or non-financial.
Drivers for change –
The Current reality of Conflicting Pressures

- Age of Facilities
- Cost/Revenue
- Reliability Demand
- Budget
- Personnel
- Planning Horizon
Distribution’s Asset Management Framework & Strategy
1. **Structure the Maintenance Engineering Landscape first**

   Focus on achieving a well-founded maintenance incremental (year 1 to 4) by:
   
   I. **Alignment of Engineering data (Smallworld) and CMMS (Maximo)**
   II. **Configuring CMMS aligned to plant**
   III. **Identifying establishing criticality of maintainable assets**
   IV. **Ensuring maintainable assets have a maintenance strategy implemented**
   V. **Generating the maintenance plan for year 1 to year 6**
   VI. **Execute maintenance plan**
   VII. **Monitor performance**
   VIII. **Assurance**

2. **Define Refurbishment clearly (year 3 to 5)**

3. **Develop AM Plans (year 4 to 7)**

4. **Integrate with other life cycle stages and introduce other initiatives (year 6 to 9)**
Why Maintenance First?
For quick wins focus on maintenance – immediate benefits?

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For quick wins focus on maintenance – immediate benefits?
## DX Maintainable Asset Base ‘Work In Progress’ - Volumes

<table>
<thead>
<tr>
<th>POWER PLANT ASSETS</th>
<th>Denominator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakers</td>
<td>26 753</td>
</tr>
<tr>
<td>Isolators</td>
<td>31 357</td>
</tr>
<tr>
<td>Overhead Networks (approx 337,000 kms of HV &amp; MV network)</td>
<td>7 917</td>
</tr>
<tr>
<td>NECs</td>
<td>2 321</td>
</tr>
<tr>
<td>Substations</td>
<td>2 935</td>
</tr>
<tr>
<td>Tap Changers</td>
<td>2 909</td>
</tr>
<tr>
<td>Power Transformer and SVCs</td>
<td>4 300</td>
</tr>
<tr>
<td>Capacitor Banks</td>
<td>516</td>
</tr>
<tr>
<td>Reactors</td>
<td>15</td>
</tr>
<tr>
<td>Regulators</td>
<td>639</td>
</tr>
<tr>
<td>MV/LV Transformers (and Approx 400,000 kms of LV network)</td>
<td>322 961</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>402 623</strong></td>
</tr>
</tbody>
</table>
1. Process control manuals (PCMs) – define an activity path thru the organisation detailing responsibilities, accountabilities etc.

2. Small world- Engineering/GIS/ Landscape

3. CMMS – Maximo for Dx and SAP for GX / TX

4. FMS - Fault Management System

5. SCADA- Supervisory Control and Data Acquisition

6. NEPS- Network Electrical performance system
Eskom shall ensure that the Maintenance of its Power Production Plant and Power Delivery Networks are aligned to Eskom’s Management of Assets Policy, supporting the requirements of ISO 55000 and managed in such a manner that it enables Eskom to meet its objectives.

1) Maintenance shall always be conducted in compliance with Eskom’s SHEQ policies to ensure zero harm to employees, contractors, public and the environment; and shall comply with all legislative, regulatory and statutory requirements
2) Maintenance shall maximise performance of our assets over their life, taking into account the trade-off required between cost and risk, and implemented utilising a Computerised Maintenance Management System.
3) Maintenance planning, execution and reporting will be conducted in accordance to the approved Maintenance Process Control Manuals Generic Maintenance Standards will be developed and reviewed in line with the Design Base
4) Asset specific maintenance strategies will be developed based on defined Asset Condition, Criticality (based on consequence of failure) and Operational factors within the parameters of the Generic Maintenance Strategy. An Asset Risk framework will be adopted for the consequence of asset failure
5) Maintenance is conducted by competent personnel. The right mix of competent and motivated people are developed and retained to improve our maintenance capability
6) Legal, regulatory and statutory requirements are identified and categorised on the Maintenance plans and Maintenance Management System and are complied with.
7) Maintenance Metrics will provide a measure of the entire maintenance process to monitor and maximize maintenance planning, completion, efficiency and effectiveness.
8) The health of assets will be determined, reflecting the remaining expected useful life of assets. This will be the base for retirement planning and/or refurbishment
Maintenance Strategy

Maintenance requirements are defined based on the activities identified from the FMECA and taking criteria, associated with the actual functional location, into consideration. This results in several possible maintenance requirement permutations, one of which will be selected by the maintenance function for any item of plant, and from which a consolidated maintenance plan can then be developed.

Maintenance tasks definition

The maintenance categories include the following:

1. **Condition Monitoring:**

   These are routine tasks performed manually or automated to determine deterioration on plant / asset condition and triggers condition based maintenance.

2. **Preventative maintenance based on time:**

   Maintenance carried out at predetermined intervals intended to reduce the probability of failure. Preventative maintenance is based on condition / Duty and carried out based on performance and/or parameter monitoring.

3. **Corrective maintenance:**

   Maintenance carried out after fault recognition (including out of specifications) and intended to put an item into a state in which it can perform a required function.
Purpose of Maintenance is ‘ensuring that physical assets perform as per design’

(John Moubray 1997)
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Figure 1.1 - The Bathtub Curve
**Maintenance Engineering** is the discipline and profession of applying Engineering concepts to the optimisation of equipment, procedures and funding (Maintenance Landscape) to achieve better reliability, availability, maintainability and sustainability (RAMS) of equipment.
An Implementation approach
Well Founded Incremental in Maintenance as a catalyst for Asset Management

**Phase 1**
- Anticipated Maintenance improvement
  - X % by year 3
  - Y % by year 5

**Phase 2**
- Other initiatives-implemented.
  - Manage the improvement initiatives introduced.
  - Focus on Governance
  - Take AM awareness to the next level.
  - Embed AM Plans.
  - Introduce new investment philosophy eg. LC costing

First 4 years focus is on Learning, Improvability, Redefining beliefs and embedding new behaviours. AM awareness. In Dx we focused on Maintenance base improvement. Collaboration between OU & MCOE. on Policies, Procedures, Standards, Process, Specifications, Resources, etc. ……purifying The Maintenance landscape. Reducing wastage.

Other initiatives Planned Proactively.

Operational efficiencies

Improvement at a price
Recommended focus for AM framework over 10 yrs.

**YEAR 1 TO 5**

**Maintain and Operate**
- Asset information
- Maintenance register
- Maintenance strategies
- Network & Asset operation
- Planning & Scheduling
- Work execution
- Performance monitoring
- Emergent work
- Spares management
- Quality
- Training

**YEAR 6 to 10**

**Planning**
- Investment planning
- Planning integration
- Asset replacement
- Asset refurbishment

**Design**
- Network design
- Application of Designs & Standards
- Application of new technologies

**Acquire / Construction**
- Contract Management
- Project Management & Execution
- Asset Installation

**Commission**
- Asset Info & Doc Hand Over
- Commissioning tests
- Retire
- Asset Replacement, Retirement, Disposal

Asset Management growth from Innocence to Excellence
Results of above approach reflected in Performance

1. Processes - Maintenance Health Dashboard (MHD)

2. Failure Rates on MV OH Network Components
This KPI measures if the selected Asset Locations have Asset information. The objective is to ensure that these Assets are correctly populated in Maximo. This covers maintainable assets which is about 90% of locations.

Generally there has been improvement on this KPI. This KPI is dependent on the manner in which Small World Configures the Source Data and how the OU’s capture data against these locations eg. McWade Isolators, Ring type CT’s etc. CT’s and VT’s have not been a focus area previously. WCOU is focusing on this KPI by addressing the 4000 exceptions.
This Index measures if the selected Assets/Locations have PM’s created with the relevant Job Plan as per the Strategy. The objective of this Index is to ensure that the maintenance strategies are correctly applied.

This KPI is significant because it ensures that National Strategies are applied to maintainable equipment. The correlation between Strategies and PM Completion should be high in order to provide assurance of the full maintenance plan being completed in the OU. This KPI measures the degree of standardisation of the strategies. Through the EMSOP workgroup, the OU’s have received guidance on this. Some PMs still require National Job Plan to be developed.
Generation of Maintenance Plan

This KPI establishes if the Maintenance Plan for the selected Assets/Locations had been generated for the 2014/15 financial year. The objective of this KPI is to ensure that the Maintenance plan for selected Assets/Locations have been generated as per the strategy. This enables optimal and effective maintenance, outage co-ordination and resource planning.

The Maintenance PCM’s require that the Maintenance Plan be generated by Oct for the following Financial Year.

NB: The generation of the 2015/16 plan was hindered by the 6to9 project. Historically some OU’s generated the maintenance plan in 3 month blocks, and the focus has moved to generating the full years maintenance plan.
Preventative Maintenance Completed

This KPI measures the completion of the Maintenance Programme. The objective of this KPI is to drive the completion of the Maintenance Program.

This KPI has an improving trend. Although DX has met this target, DX's performance has been subsidised by the better performing OUs. In order to maximize the effectiveness of maintenance completed, DX should aim to complete the maintenance program before the onset of the summer months i.e. Oct/Nov.

Weekly reports are available for this KPI. This KPI should be analysed together with the Time Spent on Preventative Maintenance KPI.
Preventative Maintenance Completed – Network Categories

Preventative Maintenance Completed - Substations

Preventative Maintenance Completed - HV Networks

Preventative Maintenance Completed - MV Networks

Preventative Maintenance Completed - LV Networks

Legend:
- DX
- ECOU
- FSOU
- GOU
- KZNOU
- LOU
- MOU
- NCOU
- NWOU
- WCOU
- Jul-13
- Aug-13
- Sep-13
- Oct-13
- Nov-13
- Dec-13
- Jan-14
- Feb-14
- Mar-14
- Apr-14
- May-14
- Jun-14
- Jul-14
- Aug-14
- Sep-14
- Oct-14
- Nov-14
- Dec-14
- Jan-14
- Feb-14
- Mar-14
- Target

Graphical representation showing the completion of preventative maintenance across various network categories with data points from different months.
This KPI measures the percentage of Preventative Maintenance Hours as a ratio of total Hours that were captured in Maximo. The objective of this KPI is to optimise the amount of time spent on preventative maintenance.

Although DX is meeting target, it is being subsidised by the better performing Network Categories.
This Graphs shows the time spent performing Preventative Maintenance Work against the Completion of the Preventative Maintenance Work that was issued. Internationally benchmarked figures are as follows:
S/S : 90%   HV : 95%   MV: 80%   LV: 25%
Current Status of Maintenance Engineering Landscape

- Asset information and condition
- Maintenance Processes
- Maintenance Assurance
- Maintenance Planning
- Asset Maintainability
- Maintenance Scheduling
- Maintenance target setting and reporting
- Spares Management
- Quality
- Equipment modifications, refurbishment / replacement
- Financial Management
- Fault Management
- Maintenance Strategies
- CMMS
- SHE
- HR Management (adequacy + skill)
- Vehicles, Tools and equipment
- Contractor Management
- Maintenance Execution
- Maintenance Policy.

Progress Needs Focus Future
Results of above approach reflected in Performance

2. Failure Rates on MV OH Network Components
Conductor Failure Rates - 6 year trend

International benchmarks - 1.0% (low) and 2% (high)
Insulator Failure Rates - 6 year trend
Isolator Failures Rates - 6 year trend

International Benchmarks – 0.4% to 1.4%
Jumper Failures Rates - 6 year trend
Structure Failure Rates - 6 year trend

International benchmark - < 0.04%
Transformer Failure Rates - 6 year trend

**OU trfr failure rate (2009/10 - 2014/15)**

International Benchmarks – 0.5% to 1%
Transient Failure Rates - 6 year trend
Key Lessons Learnt
AM key success aspects

Introduce a RAMS focus earlier in the life cycle

Manage Information to ensure operational readiness and performance

- Least capital cost
- Least life cycle cost (Total Cost of Ownership)
Key Lessons Learnt

- ISO 55000 - it’s not a ‘noddy guide to AM’
- Challenging old norms and embedding new behaviours eg. Preventative routines vs condition monitoring
- Seamless integration between life cycle stages in a ‘silo’ structured organisation very challenging
- Asset creation resistance to embracing ‘true life cycle costing’ wrt to AM
- Standardisation of asset information, maintenance strategies, maintenance plans, work flow, work management, KPIs, work execution provide great leverage for AM
- Effective Asset management plans are data hungry
- Geographically dispersed environments hinder standardisation efforts
- Senior leadership commitment is imperative.