Increase Data Availability and Reduce Logistical Support Cost through Maintenance Management Information Systems

Daniel Sillivant
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The University of Alabama in Huntsville
Reliability and Failure Analysis Lab
• My Background
• Overview
• Maintenance Management System
• Example
• Results
• Education:
  – BSE Chemical Engineering from UAH
  – MSE Industrial / Reliability Engineering from UAH
  – Pursuing PhD in Industrial / Reliability Engineering
    • Focus on Reliability, Maintenance, and Life-Cycle Cost Analysis
    • Passed my oral exam in the spring
• Notable Publications: Co-Authored a book published by CRC Press
  – Affordable Reliability Engineering: Life-Cycle Cost Analysis for Sustainability and Logistical Support (Released April 2015)
• Experience:
  – Reliability and Failure Analysis Lab
• Hobbies:
  – Running: Qualified to run the Boston Marathon
  – Hiking: Everest Base Camp and Mt. Kilimanjaro
Current Situation

• System is Broken

• Reports
  – Hand Written
  – Electronically Transmitted
  – Requires Human Intervention
    • Update Database

• Result
  – Multiple Errors
• Right Data
  – Configuration Management
  – Bill of Materials, BOM

• Right Format
  – Useable Data
  – Templates

• Error Free
  – UID

<table>
<thead>
<tr>
<th>Equipment Removed:</th>
<th>Date</th>
<th>Type</th>
<th>Model</th>
<th>S/N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>16 - Feb 2014</td>
<td>Digitizer</td>
<td>EUROPA-T</td>
<td>5524</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Equipment Installed:</th>
<th>Date</th>
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</tr>
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<tbody>
<tr>
<td></td>
<td>19 - Feb 2014</td>
<td>Digitizer</td>
<td>EUROPA-T</td>
<td>5837</td>
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</tbody>
</table>

Reason for Removal: Faulty

Comments for removal: The LCD screen did not display the time, date, or the "health" icon.

Comments for install: New digitizer did not come with mounting screws.

Time to Remove: 20 minutes
Time to Replace: 30 minutes
ALDT 72 hours
Comments
• Configuration management at each site
  – Maintained by the operators through normal maintenance actions
**Digitizer Removal**

**People Required:**
- 1 Technician

**Parts:**
- N/A

**Tools Required:**
- Small Philips head screw driver
- Flashlight
- Small rag / wash cloth

**Estimated Time:**
- 20 Minutes
1. Disconnect Power Cable (Fig. 1)
2. Remove GPS Antenna (Fig. 2)
3. Remove Data Cables (Fig. 3-5)
4. Remove Digitizer from mount
5. Model: Europa T
6. S/N: 5524
7. Reason for Removal
   Faulty ▼
8. Removal Comments
   The LCD screen did not display the time, date, or the "health" icon.

Complete
<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>Report Id</strong></td>
<td>1234</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Station/Lab Code</strong></td>
<td>Example Site</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Heading</strong></td>
<td>Digitizer Replacement</td>
<td></td>
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<tr>
<td><strong>Tech Name:</strong></td>
<td>Daniel Sillivant</td>
<td></td>
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<td><strong>Report Submitted</strong></td>
<td>20 - February 2014</td>
<td></td>
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<tr>
<td><strong>Comments for removal:</strong></td>
<td>The LCD screen did not display the time, date, or the &quot;health&quot; icon.</td>
<td></td>
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<td></td>
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<td><strong>Comments for install:</strong></td>
<td>New digitizer did not come with mounting screws.</td>
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<td><strong>ALDT</strong></td>
<td>72 hours</td>
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<td></td>
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<td><strong>Additional Info:</strong></td>
<td></td>
<td></td>
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Minimizing Opportunity for Human Error

**Manually Inputting Data**

- Industry experience
  - 1 error per 30 key strokes
  - Each error requires human intervention to correct
  - 2000 times the cost to fix problem

**Alternative Solution**

- Defined Template
- Drop Down Menus
- Machine Readable Code
  - UID

*Prevents Data entry errors*
“Error Free” Data: UID

- UID an alternative to Manually inputting data.
- Contains all part data
- Eliminates human data entry
- Now an ISO US DoD & NATO standard
What does an MMIS look like?
United States Operated Auxiliary Seismic Sites

- AS 105 (GUMO)
- AS 108 (PFO)
- AS 111 (ANMO)
- AS 114 (QSPA)
- AS 106 (PMSA)
- AS 109 (YBH)
- AS 112 (ATTU)
- AS 115 (NEW)
- AS 107 (TKL)
- AS 110 (KDAK)
- AS 113 (ELK)
- AS 116 (SJG)

Example Site
Example: Fishbone Diagram

Example Site

Sensor Equipment

Central Facility

DC/DC Converter
DC Filtering Box S/N: NA

GDI Equipment

Seismometer
ST5-2 20000 S/N: 56342

Intrusion Switch
Generic S/N: NA

Digitizer
EUROPA-T S/N: 5524

Authentication Card
LUNA2Token S/N: 15169

Repeater
Telesto S/N: 0235

Cable
RS432 S/N: NA

CTBT: SnT 2015 Hofburg Palace

6/25/2015
Example: Remove / Install

Example Site

Digitizer
EUROPA-T
s/n 5524

Remove

Install
Digitizer Removal

People Required:
– 1 Technician

Parts:
– N/A

Tools Required:
– Small Philips head screw driver
– Flashlight
– Small rag / wash cloth

Time:
– 20 Minutes
Example: Digitizer Removal - E-Card

1. Disconnect Power Cable (Fig. 1)
2. Remove GPS Antenna (Fig. 2)
3. Remove Data Cables (Fig. 3-5)
4. Remove Digitizer from mount
5. Model: Europa T
6. S/N: 5524
7. Reason for Removal
   - INOP
8. Troubleshooting
   - Inop
   - Upgrade
   - Faulty
   - Other:

The LCD screen did not display the time, date, or the "health" icon.

Complete

CTBT: SnT 2015 Hofburg Palace
## Removed Equipment

1. Removed by: Daniel Sillivant
2. Equipment: Digitizer
3. Model: Europa T
4. S/N: 5524
5. Removal Time: 20 Min
6. Removal Comments:

   The LCD screen did not display the time, date, or the "health" icon.
Report Id | 1234
---|---
Station/Lab Code | Example Site
Heading | Digitizer Replacement

Tech Name: | Daniel Sillivant
Report Submitted | 20 - February 2014

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Reason for Removal: | Faulty
Comments for removal: | The LCD screen did not display the time, date, or the "health" icon.
Comments for install: | New digitizer did not come with mounting screws.
Time to Remove: | 20 minutes
Time to Replace: | 30 minutes
ALDT | 72 hours
Additional Info:
Example: Fleet View

United States Operated Auxiliary Seismic Sites

- AS 105 (GUMO)
- AS 106 (PMSA)
- AS 107 (TKL)
- AS 108 (PFO)
- AS 109 (YBH)
- AS 110 (KDAK)
- AS 111 (ANMO)
- AS 112 (ATTU)
- AS 113 (ELK)
- AS 114 (QSPA)
- AS 115 (NEW)
- AS 116 (SJG)
- Example Site
Results

- Minimizes Human Intervention
  - Fewer Errors
- Allows for Easy Analysis of Data
  - Useable Data
  - Ability to transfer data
    - Update Maintenance Procedures
- Optimize Site Support Models
  - Supply Chain
  - Failure Models
  - Failure History
  - Availability Models
- Increases System Availability
- Reduces System Life-Cycle Costs
### MTBF - Comparison

**Type:** Digitizer  
**# Samples:** 87  
**Failures:** 6  
**Run Time:** 4,193,192

**MTBF DOTS:** 154,000  
**Calculated MTBF:** 144,284  
**Delta:** -9,716

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<th>Model</th>
<th># Samples</th>
<th>Run Time</th>
<th>Failures</th>
<th>DOTS MTBF</th>
<th>Model Calculated MTBF</th>
<th>Delta</th>
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<tr>
<td>Smart 24D</td>
<td>16</td>
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<td>Smart 24</td>
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<td>140,000</td>
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<td>121,246</td>
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<td>Q330</td>
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<td>EUROPA-T</td>
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<tr>
<td>Digitizer</td>
<td>87</td>
<td>4,193,192</td>
<td>6</td>
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<td>-9,716</td>
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*Tuesday, June 02, 2015*
Results

• Reduce maintenance burden at sites
• Enhanced training
  – Multilingual
  – Aide those not as well Trained
• Visibility of sites world wide and local
  – Look down capability only

Capabilities

• Ability to transfer data
  – Update Maintenance Procedures
• Data collected can help optimize site support
• Transfer of knowledge base across technologies
• Reduces Sustainment Costs