Test System Avengers: Managing System Level Risks Through Design for Maintainability

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Diversity of Customers & Applications

- More than 25,000 Customers in over 80 countries
- No industry greater than 15% of our revenue
• High Mix, Low Volume
  – Diverse Applications
  – Challenging Customer Test Solution Problems
• Customizations
Components to Modules to Systems
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## Field Data & Predictions

<table>
<thead>
<tr>
<th>Information</th>
<th>PRR Data Point Estimate</th>
<th>PRR Data 60% CL</th>
<th>PRR Data 90% CL</th>
<th>Prediction (uses 90% CL component failure rates)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quantity</strong></td>
<td><strong>MTBF (hour) from Return Data</strong></td>
<td><strong>Failure Rate Contribution</strong></td>
<td><strong>PRR</strong></td>
<td><strong>MTBF (hour) from Return Data</strong></td>
</tr>
<tr>
<td>12</td>
<td>956,251</td>
<td>1.25E-05</td>
<td>0.37%</td>
<td>956,251</td>
</tr>
<tr>
<td>4</td>
<td>618,812</td>
<td>6.46E-06</td>
<td>0.57%</td>
<td>618,812</td>
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<tr>
<td>1</td>
<td>58,830</td>
<td>1.70E-05</td>
<td>3.96%</td>
<td>58,830</td>
</tr>
<tr>
<td>1</td>
<td>1,244,030</td>
<td>8.04E-07</td>
<td>0.28%</td>
<td>1,110,754</td>
</tr>
<tr>
<td>4</td>
<td>189,215</td>
<td>2.87E-05</td>
<td>2.52%</td>
<td>130,830</td>
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<tr>
<td>1</td>
<td>692,822</td>
<td>1.59E-05</td>
<td>0.55%</td>
<td>579,526</td>
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<tr>
<td>1</td>
<td>151,324</td>
<td>6.13E-06</td>
<td>2.83%</td>
<td>144,484</td>
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<tr>
<td>1</td>
<td>340,416</td>
<td>2.94E-05</td>
<td>1.03%</td>
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<tr>
<td>1</td>
<td>453,856</td>
<td>2.02E-06</td>
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<tr>
<td>0</td>
<td>1,354,440</td>
<td>0.00E-00</td>
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<tr>
<td>1</td>
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<td>3.38E-05</td>
<td>2.85%</td>
<td>148,883</td>
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<tr>
<td>1</td>
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<td>1.58E-05</td>
<td>1.19%</td>
<td>249,922</td>
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<tr>
<td>4</td>
<td>51,883</td>
<td>9.55E-05</td>
<td>8.37%</td>
<td>40,705</td>
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<tr>
<td>2</td>
<td>156,045</td>
<td>1.28E-05</td>
<td>2.24%</td>
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<td>1</td>
<td>1,971,564</td>
<td>5.07E-07</td>
<td>0.18%</td>
<td>1,205,787</td>
</tr>
</tbody>
</table>

**Notes:**
- MTBF = Mean Time Between Failures
- PRR = Probability of Return
- Confidence Levels: 60% and 90%

*Field Data & Predictions for MTBF Analysis*

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**Additional Images:**
- Field equipment images
- Conference logo

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*Reliability Maintenance and Managing Risk Conference 2019*
Actual vs Predicted

MTBF (Hours/Failures) with Weighted Avg Baseline

Q3, 2016 to Q3, 2019

RMMR 2019, Oct. 15 - 16, San Antonio, TX
Design & Process FMEA – System Maintainability Reviews

- Assembly and Disassembly
- Shipping, Handling, and Storage
- Customer Usage and Handling
- On-Site Support and Maintenance
- Environmental
- Service Entitlements
  - Onsite Bring-up
  - Sparing
  - Upgrades
- Depot Support and Maintenance
- Service Entitlements
  - Sparing
  - Calibration
Quality Approach - Products & Systems
System Reliability Improvement Approach

Current Condition
(Challenges and Inefficiencies)

Ideal State
(Efficient and Effective)