Aircraft Health Monitoring & Maintenance Costs

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### AGENDA

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Aircraft Health Monitoring (AHM) – The Basics

- Modern aircraft are data-rich and designed with significant advancements in digital technologies

- Data transmitted from these modern-talking aircraft can be harnessed to enhance the aircraft health monitoring and prognostic maintenance capabilities

- Data streams into the AHM system can also be applied to optimise aircraft maintenance programs; and consequently a reduction in related maintenance costs
VAA AHM SYSTEM: AHEAD PRO

- VAA utilises the functionality of AHEAD PRO - a system developed by Embraer to continuously monitor the status of aircraft in real time.

- A computational web-based platform developed to support Health Monitoring processes within the airline operation, from data acquisition to time-to-failure prognosis.

Source: Customer AHEAD Pro Presentation by Embraer (2014)
AHEAD PRO System Architecture

Source: Customer AHEAD Pro Presentation by Embraer (2014)
AHM Application to Scheduled Maintenance

- AHEAD PRO is integral to VAA aircraft health management processes with functionalities integrated as active features:
  - ACARS enabled aircraft receives Real-Time information while aircraft is still in flight – CAS & CMC messages
  - Display Aircraft fault messages in a real-time user-friendly Interface
  - System Trend monitoring via QAR data

- VAA utilized the functionality of the AHM system to analyse & implement an escalation of a candidate scheduled maintenance program task interval based on:
  - the accuracy of the AHM transmitted data
  - the real time availability
  - continuous assessment of system fault conditions
Maintenance Task Escalation using AHM

The following MPD task was selected and analysed for interval escalation using the real time health monitoring offered by the AHM system.

Task Description:

**MPD 72-00-00-001: Visual Check of the Master Chip Detector Indication on the MFD (Multi-Functional Display)**

Current MPD Interval: 120 FH
VAA Approved Task Interval: 250 FH*
* Optimised to align with a scheduled maintenance opportunity
Task Escalation: Analysis

Task interval escalation subjected to a comprehensive analytical review process.

Engineering – Technical analysis

- Verified all previous messages were reported
- Verified all reported events originated with 72-00-00-001 and simultaneously visible through VA AHM system
- Verified the effectiveness of the AHM system

AHM - Framework Analysis

- Confirmed chip detection metric is captured by AHM system
- Confirmed relevant ‘Alerts’ set up to advise if chip detected
- Work instruction set up for maintenance action when fault message is received

Engineering - Reliability Analysis

- Compliance, Yield and findings were analysed
- Reviewed unscheduled findings related to task
Task Escalation: Cost Benefit

Existing functionality within the AHM resulted in a reduction in maintenance cost

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Interval</th>
<th>MH/Task</th>
<th>Annual Util (18x Aircraft)</th>
<th># Compliances (Util/Interval)</th>
<th># Tasks (Savings)</th>
<th>MH (Savings)</th>
</tr>
</thead>
<tbody>
<tr>
<td>72-00-00-001</td>
<td>Visual Check of the Master Chip Detector Indication on the MFD (Multi-Functional Display)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>195</td>
<td>97.5</td>
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Cost Benefit:
- **Fleet of 18x aircraft**
  - Savings of 195x scheduled maintenance events
  - Overall (annual) savings of 97.5 MH
Task Escalation: Justification

Escalating the task MPD 72-00-00-001 was therefore substantiated and regulatory approved by the following key elements:

1. Analysis process confirmed that the AHM system was designed to reliably detect faults and communicate the alerts in real time.
2. Cost benefit analysis indicated a savings in MH requirements with no risk to ongoing continuing airworthiness.
3. Introduction of a new process to address the fault condition into bench level work instructions, including maintenance actions to be initiated on identification of the Chip Detector Alert.
**Task Selections: Further Escalation Candidates**

VAA proved the internal concept with the candidate task—*Maintenance inspections and associated costs can be effectively reduced by the accuracy of AHM functionality when set up to generate real time fault alerts.*

The next set of candidate tasks have been identified to analyse for potential escalation of task intervals based AHM functionality:

<table>
<thead>
<tr>
<th>MPD Task #</th>
<th>Task Description</th>
<th>Task Interval (MPD)</th>
<th>Task Man Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-51-01-001</td>
<td>RST - PACK FLOW CONTROL VALVE FILTER</td>
<td>7500 FH</td>
<td>0.9</td>
</tr>
<tr>
<td>21-51-10-001</td>
<td>RST - PACK BYPASS VALVE FILTER</td>
<td>3000 FH – P/N 820914-5, 7500 FH – P/N -6 AND ABOVE</td>
<td>2.8</td>
</tr>
<tr>
<td>21-62-05-001</td>
<td>RST - TRIM AIR MODULATING VALVE FILTER</td>
<td>7500 FH</td>
<td>0.9</td>
</tr>
<tr>
<td>30-11-01-001</td>
<td>RST - WING ANTI-ICE VALVE</td>
<td>6000 FH</td>
<td>2.04</td>
</tr>
<tr>
<td>30-31-01-001</td>
<td>OPC - AIR DATA SMART PROBE (ADSP) HEATING</td>
<td>16,087 FH</td>
<td>2.08</td>
</tr>
<tr>
<td>49-00-00-001</td>
<td>VCK - APU SYSTEM FAULT CODES</td>
<td>750 FH</td>
<td>0.5</td>
</tr>
<tr>
<td>71-00-00-002</td>
<td>VCK - ENGINE FAULT MESSAGES</td>
<td>750 FH</td>
<td>0.5</td>
</tr>
<tr>
<td>36-10-01-001</td>
<td>RST - CROSS BLEED VALVE SUPPLY FILTER -</td>
<td>7500 FH</td>
<td>1.2</td>
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<tr>
<td>36-11-01-001</td>
<td>RST - HIGH STAGE BLEED VALVE FILTER -</td>
<td>7500 FH</td>
<td>0.64</td>
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<tr>
<td>36-11-06-001</td>
<td>RST - TORQUE MOTOR CONTROLLER FILTER</td>
<td>12,000 FH</td>
<td>3.00</td>
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<tr>
<td>36-11-09-001</td>
<td>RST - FAN AIR VALVE FILTER</td>
<td>7500 FH</td>
<td>0.82</td>
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AHM as a Method to reduce Maintenance Costs!

- AHM technology deliver succinct technological advantages that provide effective and real-time aircraft health monitoring functionality.

- When these digital data streams are combined with reliable infrastructure set-ups, airlines can extract well defined credits for scheduled maintenance tasks as well as efficient prognostic defect management of aircraft systems and components.
What’s Next?

With clear operational and costs benefits for airlines, the industry stakeholders must:

- Consider tapping on the significant volumes of reliable aircraft digital data
- Develop policies, techniques and maintenance solutions
- Create AHM Data based maintenance program concepts
- Initiate an ISC stakeholder process to update the existing MSG-3 framework to include AHM capabilities
Thank you!