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HUMS Certification for Military Aircraft

Safety First, Capability Always

Directorate General Technical Airworthiness
Australian Defence Force

Air Commodore Terry Saunder

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Scope

- Certification
- The importance of Validation and Verification
- The Challenge of Complexity
- Exploitation of HUMS Data
- HUMS Infrastructure
- Case Studies

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Certification

- Lack of robust international standards for HUMS
- Defence has its own requirements of HUMS certification
  - Usage Monitoring
  - Health Monitoring

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Certification (2)

- May require indigenous V&V
  - Support from DSTO and industry
- iRPA
  - Early stipulation of data requirements

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The Importance of Validation and Verification

- Replacement of legacy maintenance
- Need rigorous demonstration of validity
- Invalid usage can result in catastrophic failures

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The Challenge of Complexity

- Modern HUMS much more complex than legacy
- Strain gauges, sensors and complex mathematical algorithms
- Increased complexity / reduced conservatism
  - Cost savings and improved failure prediction

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The Challenge of Complexity (2)

- Increased complexity = increased V&V effort
  - Must balance complexity with development / verification cost
  - Must match complexity with underlying design methodologies
    - "Don't measure grains of sand if your lives are in mountains."

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The Challenge of Complexity (3)

- More frequent inspections might ease requirements for HUMS fidelity
  - Reduced V&V effort / time
  - Reduced system cost and complexity
- Example (KC-30A)
  - Complex system presents challenges
  - Cumulative error from multiple discrete processes
  - Neural Network requires significant data to train

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Exploitation of HUMS Data

- Must understand how the HUMS / HUMS data will fit into System of Maintenance
- Elements may be included to satisfy specification requirements only
  - Not incorporated into System of Maintenance
  - Data collected but never used

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Exploitation of HUMS Data (2)

- Appropriate limits should be set
- Data mining to identify uses for raw data
  - Trends / peaks leading up to actual in service failure
  - Update processes to monitor for those trends

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HUMS Infrastructure

- Integrated HUMS ground systems must be robust
  - Modern aircraft have their own unique systems / software
  - Difficulties integrating with Defence IT
  - Support and management must be appropriate
  - Need to understand scope of use
- Requirements for Certification / V&V must be appropriately specified to supplier early in the project

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Case Studies

- MRH90 Taipan
- E-7A Wedgetail

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MRH90 Taipan

- HUMSVP
  - Difficulty getting access to necessary data
  - IP limitations
  - Different aircraft baselines with different functionalities
    - Complicates / fragments V&V activity

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MRH90 Taipan (2)

- GLIMS (Ground Logistics Information Management System)
  - Support and implementation issues

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MRH90 Taipan (3)

- Certain key functions independently validated and authorised by DGTA-ADF
  - UM for engine critical parts
- Majority of HUMS still not validated
- Issue will require ongoing management


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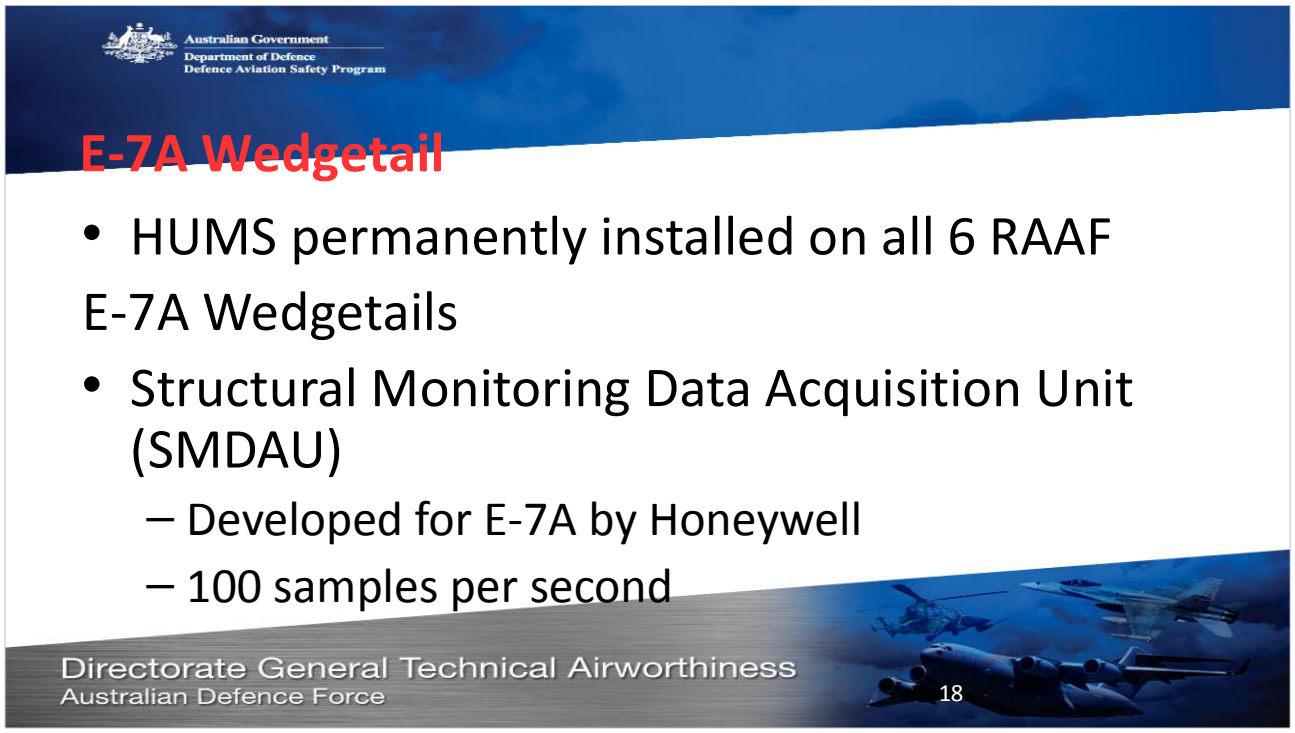
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E-7A Wedgetail
• HUMS permanently installed on all 6 RAAF
E-7A Wedgetails
• Structural Monitoring Data Acquisition Unit (SMDAU)
– Developed for E-7A by Honeywell
– 100 samples per second
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E-7A Wedgetail (2)

- Analog recording capability
  - Measures
    - Acceleration
    - Angular rate data
  - FDR
  - Operational Loads Monitoring System
- SMDAU gathers flight performance data via ARINC-429

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E-7A Wedgetail (3)

- Aircraft Structural Integrity Ground Station (ASIGS)
  - COTS Windows Server Platform
  - Post-processes HUMS data to calculate usage statistics and fatigue damage
  - Uses parametric approach to calculate fatigue damage

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E-7A Wedgetail (4)

- ASIGS generates:
  - Individual and fleetwide usage
  - Service life data analysis
  - Routine Usage Status Reports
  - Usage Analysis Reports
  - Annual Fatigue Assessment Reports

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E-7A Wedgetail (5)

- ASIGS Certification
  - CoA conducted certification testing
  - HUMSVP
  - Multi-faceted approach (compliance auditing, software testing, system functional testing)
- Certified in August 2012

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Conclusions

- HUMS are important, but must assure robust
  - Certification
  - Validation and Verification
- If correctly implemented
  - Improved maintenance forecasting
  - Reduced cost of ownership
  - Data collection for aircraft and engine usage analysis

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Conclusions (2)

- If incorrectly implemented
  - Infrastructure issues
  - Cumbersome / difficult to support
- If not correctly validated
  - Limited use
  - Airworthiness risk / incorrect usage accrual

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Conclusions (3)

- Most recent aircraft acquisitions have learning opportunities
- Treatment: planning and certification ensure HUMS performs its functions (including airworthiness) effective and efficiently

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QUESTIONS?