Agenda

- Issues with Aging Aircraft (Wiring and Structural Systems)
- Aging Starts at Delivery
- The Enablers for Life Cycle VHM
- The Benefits
Economic Drivers for Predictive and Automated Inspection Technologies

- Aging Wiring is a concern:
  - High priority at FAA
  - High priority at DoD JCAA
- TWA 800 and SR 111 investigation reports by NTSB strongly suggested actions by FAA
- FAA created a working group (ATSRAC) in 1999
- NPRM due April 03
- AC/SFARs... due 2005
- ATA created sub chapter 97 to log wiring defects
- More than 1,000 smoke in cabin incidents reported in 2000
- Wiring related costs estimated to be 10% of airframe maintenance

- Structural testing is a growing concern with new and aging fleet:
  - High priority at US Navy (Corrosion)
  - High priority at USAF (Composite)
  - Concern at FAA (Composite)
- DoD/FAA created the Joint Council on Aging Aircraft to combine efforts on R&D toward automation, prediction...
- Drive to:
  - Reduce human factor of inspections
  - Reduce inspection requirements
  - Enhance composite detection capabilities
- Inspection costs estimated to be 20% of airframe maintenance
Not Just an “Aging” Issue

Aircraft life-cycle requirements

New aircraft production
• Initial installation
• Function check
• Pre-flight
• Fault identification & correction

Aircraft trading
• Complete aircraft insp.
• Improved residual value

Retrofits/refurbishments
• Mods & upgrades
• Interiors
• Entertainment systems
• Safety products

Aircraft completion
• Upgrade options
• Interiors
• Entertainment systems
• Safety products

Aircraft acceptance of buyers & leasees
• Shake down flight
• Aircraft acceptance

Warranty coverage
• No fault found removal savings
• Precise & faster issue resolution
• Improved customer satisfaction

Line maintenance
• Responsive & precise fault location
• Service by the hour

Heavy maintenance visits
• Required system inspections
• Aircraft opened Up
• Service by the hour or event

Major maintenance
• Deferred maintenance issues
• Service by the hour or event

Aircraft are aging the day they enter service – Technology based tools can be implemented to monitor their health, predict failure modes, and plan for maintenance more effectively

Nova & SAM Overview - October 2002
Nova **Wire Integrity Program™**

**The Problem:** Aging takes a toll on aircraft **wiring systems**, causing aircraft down-time, no-fault-found component removals, and safety hazards.

**The Solution:**
- Prognostics & diagnostics software
- Portable testers that can plug into one end of the cable and diagnose faults location with high accuracy.
- Saves on direct maintenance costs & Improves safety

**In Production** - Awarded a program with USAF/FAA started 5/1/02

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SAM™ **- Structural Anomaly Mapping**

**The Problem:** Aging takes a toll on **airframes**, causing aircraft down-time, not easily discerned structural defects in metal & composites, and safety hazards.

**The Solution:**
- Integrated suite of prognostics & diagnostics software
- Robot driven technology
- Replaces labor-intensive, outdated NDT techniques
- Repeatable, High Accuracy
- Saves on direct maintenance costs & Improves safety

**In Development Stage** – Working Prototype located in DC area

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**Available technologies using open architecture designs and COTS components**

Nova & SAM Overview - October 2002
Synopsis of the Nova Wire integrity Program™

Product Customization
- Wiring Digitization
- Criticality Analysis
- Prognostics / Risk Assessment

Integration
- Customer’s Maintenance Schedule & Legacy Systems
- Maintenance Optimization Module
- Trend Analysis & Reporting

Hardware
- Hand Testers Fault Location Devices
- Circuit Analyzers
- Airborne Sensors*

Assessment
- Test Results
- Repair Data

• Initial one time loading of parameters and attributes
• Tests take only minutes
• Fully automated
• Enables Enhanced Zonal Analysis

*: planned

Real-time criticality assessment and maintenance optimization through prognostics

Enables Entire Life Cycle Wire Integrity Management
Synopsis of the SAM™ System Architecture

**Existing Maintenance Data**
- Maintenance manuals
- Maintenance schedules

**SAM™ Database**
- Location of measurement
- Comparison to expected and previous measurements on same and other aircraft in fleet
- Knowledge Management / Sharing with Supply Chain Management System

**Vehicle Health Monitoring**
- In-flight sensor data
- Use/abuse data

**SAM™ Sensor Delivery Vehicle**
- Operates autonomously based on SAM™ database model
- Operates sensors required by maintenance optimization module
- Acoustic, Eddy Current, etc.

**Maintenance Optimization Module (Shared with WIP)**
- Analysis of trends
- Prognostics / Risk assessment
- Based on existing system approved by NASA, FAA, and DoD

Enables Entire Life Cycle Structural Integrity Management
Key benefits of Advanced Diagnostics and Prognostics Technologies such as Nova Wire Integrity Program™ and SAM™

1. Progressive & proactive maintenance concept
   - Determines probability of defects
   - Enables preventive maintenance versus on-condition failures or delays

2. Enables accurate forecasting for inspections
   - A predictable inspection process
   - Minimizes the unknown element of inspection time

3. Quickly performs multiple tests
   - Across multiple aircraft zones, multiple systems
   - Performs highly technical tests not currently performed!

4. Offers In-depth Prognostics
   - Advises of probability failures
   - Archives data
   - Generates fault reports
   - Allows Trend Analysis

5. Fault location and state-of-the-art technology
   - Identifies the location of defects accurately

6. Up to 20% direct maintenance cost reductions
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