EMBRAER Perspective on SHM Introduction into Commercial Aviation Programs

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Service & Support Development
Agenda

Introduction
- EMBRAER
- SHM applications on maintenance programs

Maintenance Program Development

Status of SHM on the MSG-3 Methodology

SHM Introduction into Scheduled Maintenance Programs
- MRB process / MSG-3 Methodology Familiarization
- Scheduled SHM (S-SHM) applications
- S-SHM Ground Support Equipment
- S-SHM as provisions for initial Automated SHM applications
Embraer – Business Areas

Defense Systems

Executive Aviation Market

Commercial Aviation Market
**Introduction - Embraer Defense Systems**

**Super Tucano**

**AMX/A-1M**

**KC-390**

**EMB 145 Multi Intel Airborne Ground Surveillance and Strategic Intelligence**

**EMB 145 MP Maritime Patrol**

**EMB 145 AEW&C Airborne Early Warning & Control**
Introduction - Embraer Commercial Aircraft

ERJ 145 Family
(37 to 50 Pax)

E-Jets Family
(70 to 122 Pax)
Introduction - Embraer

E-Jets Program Status: 60 Airlines from 40 Countries
Introduction - Embraer

Brazil
São José dos Campos
Eugênio de Melo
Botucatu
Gavião Peixoto
Taubaté
ELEB

USA
Nashville
Fort Lauderdale
Melbourne
Mesa

FRANCE
Villepinte
Le Bourget

PORTUGAL
Alverca
Évora

CHINA
Beijing
Harbin

SINGAPORE

Commercial Aviation Backlog

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2009 FAA & EASA accepted SHM into Commercial Aviation Maintenance Programs

2011
WHAT DO WE NEED?

Technical Feasibility
Consistent Business Case
Approved in a Certification Process
Compatible with Continued Airworthiness Requirements
Acceptability by Operators

SUCCESSFUL SHM SOLUTION

Status of SHM on the MSG-3 Methodology

A-SHM approval on PPH

MSG-3 2009.1 Approval

ATA SHM Working Group Meeting
Sep 12th to 13th, 2007
Stanford - USA
Initial MSG-3 Revision Proposal for S-SHM

Maintenance Programs Industry Group (MPIG) Meeting
Nov 3rd to 5th, 2009
Bordeaux, France
Present A-SHM and System MSG-3 Revision Proposals

International MRB Policy Board Meeting
April 2010
Singapore
Final review and acceptance of A-SHM and System MSG-3 Proposals

International MRB Policy Board Meeting
Mar 31st to Apr 3rd, 2009
São José dos Campos, Brazil
Review and final acceptance S-SHM Proposal

Maintenance Programs Industry Group (MPIG)
Nov 18th to 20th, 2008
Washington, USA
Conclusion of S-SHM Methodology Proposal

ATA SHM Working Group Meeting
Sep 29th to Oct 1st, 2009
Toronto, Canada
Detail P/C-SHM Methodology Proposal

Maintenance Programs Industry Group (MPIG) Meeting
Jan 8th to 10th, 2008
Memphis – USA
Defined Industry accepted Methodology

International MRB Policy Board Meeting
Apr 22nd to 25th, 2008
Cologne – Germany
Requested further review of MSG-3 structure procedure steps

ATA SHM Working Group Meeting
Sep 16th to 18th, 2008
Hamburg, Germany
Detailing of S-SHM proposal and Introduction of P/C-SHM general concepts

International MRB Policy Board Meeting
Apr 2010
Singapore
Final review and acceptance of A-SHM and System MSG-3 Proposals

A-SHM approval on PPH
Status of SHM on the MSG-3 Methodology

MSG-3 Methodology Revision 2009.1 (current)
- Scheduled SHM (S-SHM) - “the act to use/run/read out a SHM device at an interval set at a fixed schedule”.
- S-SHM as new maintenance task category: alternative for current inspections

International MRB Police Board Issue Paper 105
- Automated SHM (A-SHM) - any SHM technology, which does not have a pre-determined interval at which maintenance action much takes place, but instead relies on the system to inform maintenance personnel that action must take place.

- SHM technology types
  i. Damage Monitoring System – It uses sensors to directly monitor the structure for deterioration conditions.
  ii. Operation Monitoring System - It uses sensors, which do not directly check the structure for damage, but instead correlate various measurements (e.g. environment conditions, loads) to make an inference to the probability or likelihood of damage.

- Once a SHM system design is demonstrated to be applicable and effective, it may be used to ensure inherent airworthiness of the item being monitored and traditional inspection task selection may not be appropriate.

- When an A-SHM system is used to monitor structure which has maintenance/inspection requirements, appropriate transfer policies should be used to show that the intent of the damage detection (ED/AD/FD) requirement is being satisfied by the monitoring system. This process takes place after the development of the Structures Requirements described previously in this section.
Status of SHM on the MSG-3 Methodology

Diagram:

D12: CAN TASK REQUIREMENT BE AUGMENTED BY SHM SYSTEM?
- NO: P26
  - REDESIGN MAY BE REQUIRED
- YES: D13
  - CAN TASK REQUIREMENT BE IMPROVED?
    - NO: IDENTIFY TASKS MODIFIED / AFFECTED BY SHM
    - YES: P23
      - NO TASK
      - P24
        - LIST TASK REQUIREMENTS

D11: REQUIREMENTS MET BY SHM DETECTION CAPABILITIES?
- NO: D14
  - CAN INSPECTION REQUIREMENTS BE IMPROVED?
    - NO: LIST TASK REQUIREMENTS
    - YES: P22
      - IDENTIFY TASKS MODIFIED / AFFECTED BY SHM
      - P25

## Introduction of SHM on Scheduled Maintenance

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<tr>
<th>MRBR Task Number</th>
<th>Zones</th>
<th>Type Category</th>
<th>Title Description Note Access Panels</th>
<th>Applicability</th>
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Internal Visual Inspections of rear passenger and service doors cutout structures

What is the issue with current maintenance requirements for this region?
Galley, Lavatory and linings removal

**Current Mtx Requirement**

To inspect every 5000 FC for fatigue damage (threshold of 20000 FC) & every 12000 FC for corrosion

**With SHM (fatigue)**

To inspect every 12000 FC for corrosion

**BENEFITS**

Reduction of 120 Man-hours (MH) every 12000 FC
If SHM also covers corrosion, MH reduction every 12000 FC would be >250 hours
Elimination of maintenance induced problems
Higher aircraft availability (lower downtime means more revenue flights)
FAMILIARIZE YOURSELF WITH MSG-3 MRB MAINTENANCE RULES
SHM Introduction into Scheduled Maintenance Programs

Scheduled SHM (S-SHM) applications

START WITH SIMPLE S-SHM SOLUTIONS
SHM Introduction into Scheduled Maintenance Programs

AFFORDABLE LIGHT RESISTENT SIMPLE GSE

FRAGILE
SHM Introduction into Scheduled Maintenance Programs

S-SHM

AS PROVISIONS FOR INITIAL
A-SHM

6,000 FC
12,000 FC
18,000 FC
24,000 FC
30,000 FC
36,000 FC
42,000 FC

GVI
Thank You