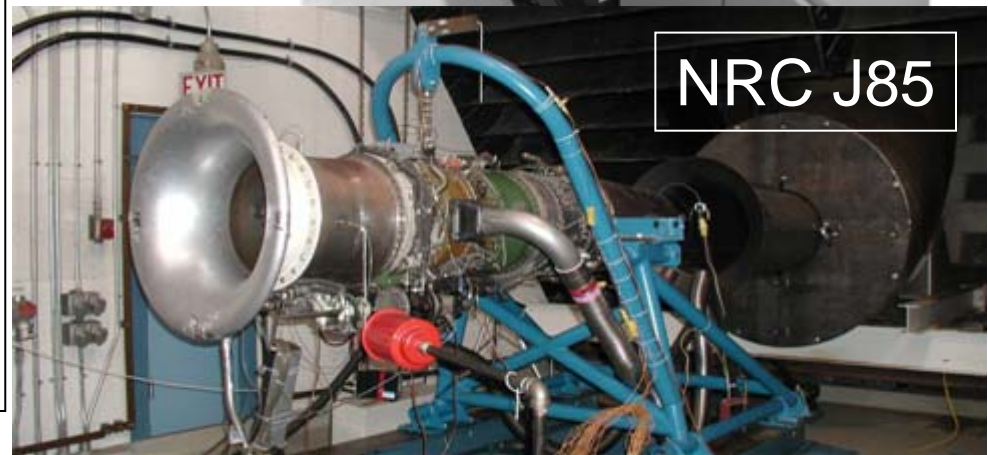
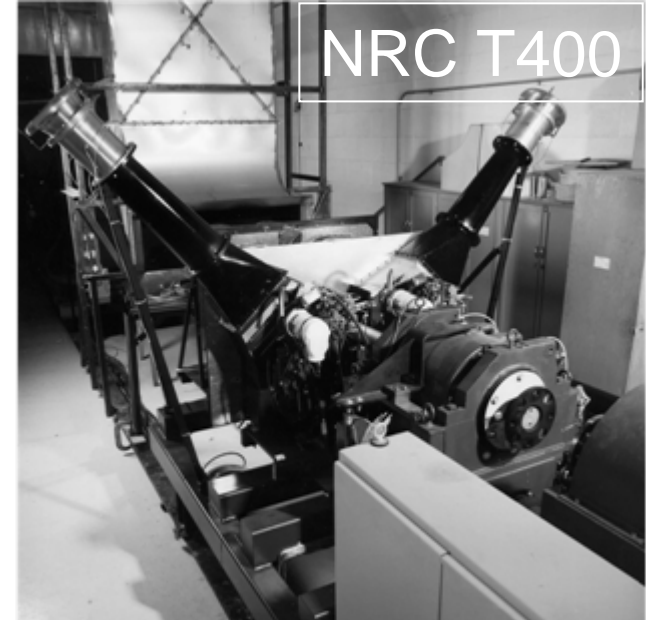


Health Management Challenge

- Modeling and sensor system developments need to contribute to operations and maintenance decision support
- GT technology demonstration engines (J85, T400, microturbine) for developers and evaluators: turbojet, turboshaft, gearbox
- How do we gather field experience data for validation and evaluation?
- How can you get involved and benefit?
 - Needs identification
 - Monitoring sites and test opportunities
 - Endurance tests, overhaul/pass off data
 - Demonstration projects
 - DPHM Working Group
 - IVHM Technology Demonstrator Infrastructure Project



DPHM Canada Working Group

Industry-led, government-supported initiative over 4 years and 4 workshops to:

- Identify development needs in diagnostics, prognostics and health management
- Build collaborative teams of OEMs, technology integrators and technology firms
- Launch projects

PWC, Bombardier, Bell, RR, Honeywell, SAL, GasTOPS, Casebank, DND, NRC, Industry Canada and others

www.dphm-canada.org

Current projects

- 003: FMEA/Field Diagnostic Interoperability
 - 004: Interpretation of Trends and Multivariate Correlations
 - 007: Develop and Demonstrate DPHM Benefits on Legacy Fleet
 - 008: Maintainability Tracking and Rapid Maturing Process
 - 009: Maintenance Intervention Planning
- \$: NSERC, SADI, CRIAQ, Industry*

IVHM Needs

- System level integration in flight
- Technology demonstrators to mature systems for weight and cost
- Impact
 - maintenance operations and life cycle mgt
 - new design processes at the air vehicle level
- “Finish a system that the board room cares about”

IVHM Technology Demonstrator Program Concept

Business Case

- Deliver an infrastructure for technology demonstration & transition of technologies
- Leverage Technology Insertion Road-mapping results to promote DPHM R&D in Canadian companies and stimulate international collaboration
- With Industry Canada, coordinates Canadian activities and provides technology demonstration facilities



Technical Approach

Phase 1: Systems Level Demonstrations

- 1.1 Modified/adapted/new infrastructure: structural, engine, mechanical, aero, flight, landing gear, ...
- 1.2 Mission-relevant demonstrations to transition mid TRL technologies
- 1.3 Clean sheet of paper design for IVHM-enabled vehicle



Phase 2: Vehicle Level Demonstrations

> Flight demonstrations



Session 2: Performance and Condition Monitoring

Field Experience

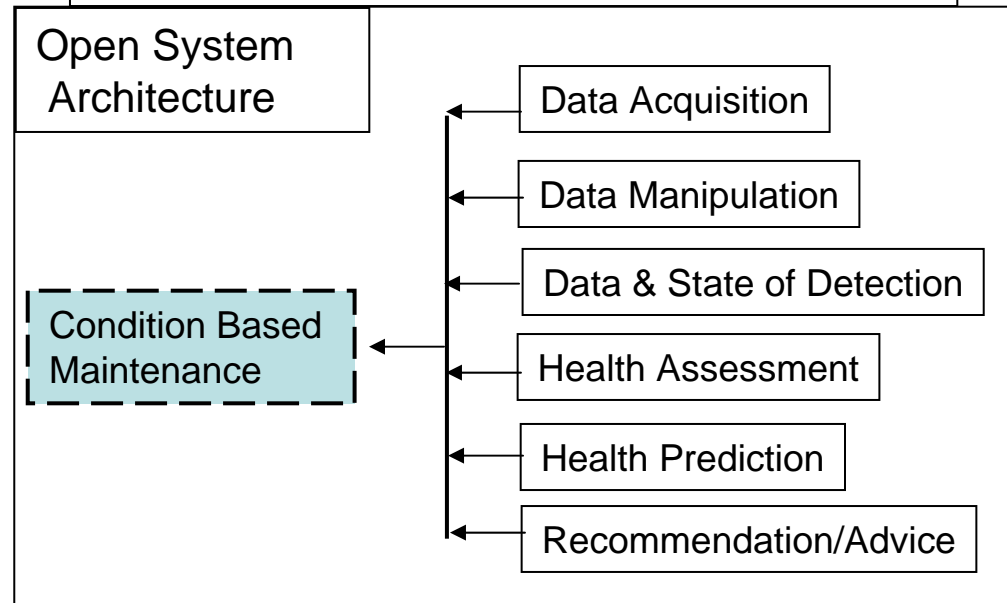
- Fuels nozzles: clogged, streaking, fanning
- Blade damage: tip curling, platform cracking
- Compressor fouling
- Oxidation, erosion, corrosion
- Thermal barrier coating delamination, cracking
- Tip clearance changes, seal rubs glazing
- Oil seal leakage
- Variations in fuel composition, combustion stability
- Hot streaks
- Decreased efficiency

Session 2: Performance and Condition Monitoring

Field Experience

- Fuels nozzles: clogged, streaking, fanning
- Blade damage: tip curling, platform cracking
- Compressor fouling
- Oxidation, erosion, corrosion
- Thermal barrier coating delamination, cracking
- Tip clearance changes, seal rubs glazing
- Oil seal leakage
- Variations in fuel composition, combustion stability
- Hot streaks
- Decreased efficiency

Open System Architecture Condition Based Maintenance Functional View



Session 2: Audience Quiz

1. What gas turbine engine **field support problems** should be added to the technologists' "job jar?"
2. Can we find a way to create more realistic exercises to **test diagnostic tools**, especially gas path analysis (e.g., drawn from real examples)?
3. Does anyone have **results from applying a gas path analysis tool** or new technology in service: qualitative or, better yet, quantitative? Who worked together and how?
4. Technology development/implementation requires an **adequate business case** and strong participation from end-users (operators). Do we have some lessons learned when this worked or didn't? DRIVERS: ensure uptime is maximised or is there a drive to reduced manning, or even unmanned operation?
5. Does the audience allow **direct access** to their machines by the OEM and others to download data? Is there any current, or future, changes which may make this harder to achieve, such as the use of FieldBus and ProfiBus to multilink devices back to a main control system?