

Potential Applications of PWST

Nezih Mrad, Ph.D.
Defence R&D Canada (DRDC)
Air Vehicles Research Section (AVRS)

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Defence Research and
Development Canada

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Canada

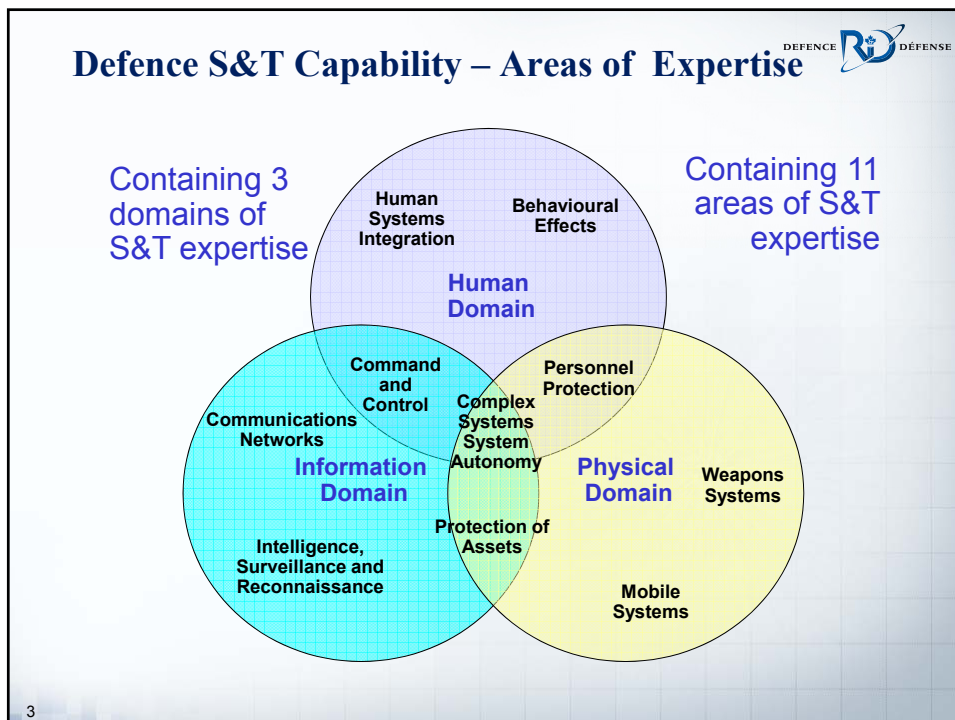
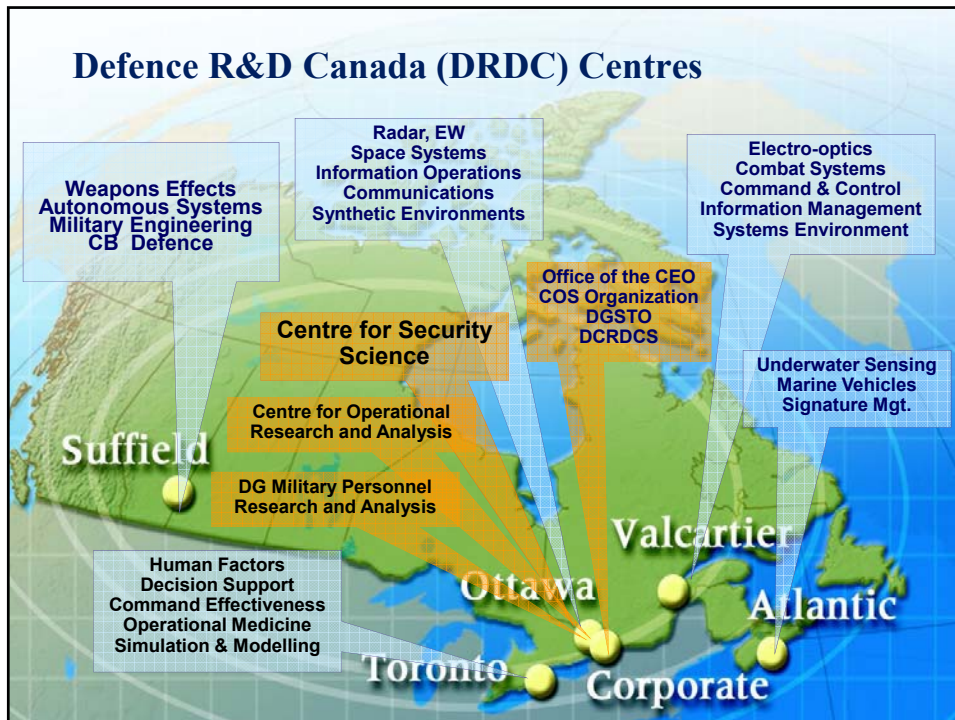


Defence R&D Canada - Mission

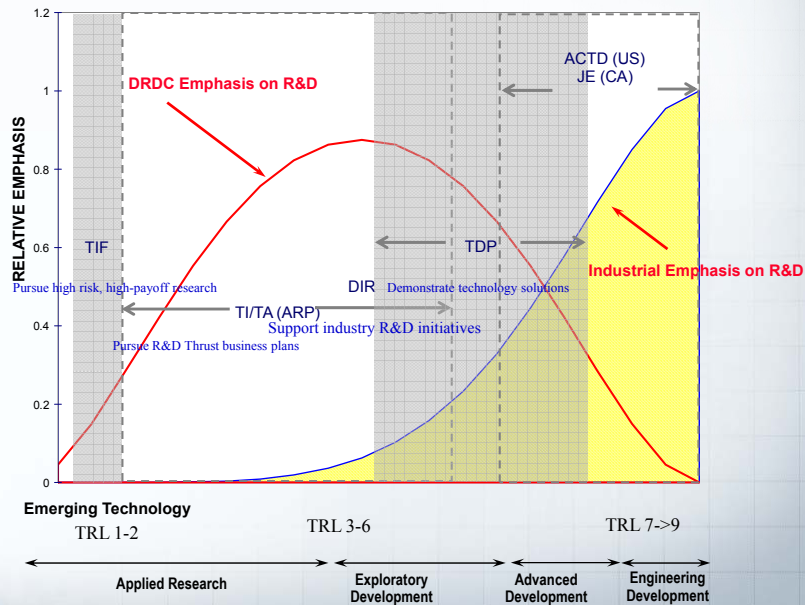
To ensure the Canadian
Forces are technologically
prepared and operationally
relevant.

- ◆ Advise on Science & Technology
- ◆ Conduct Defence research, development and analysis
- ◆ Assess technology trends, threats, and opportunities
- ◆ Engage industrial, academic and international partners in the commercialization of technology
- ◆ Conduct S&T projects for non-DND clients





Defence R&D Canada - Funding



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Sample of Platforms of Interest for PWST

CC-130 Hercules transport aircraft



Coyote LAV-1 Wheeled armoured reconnaissance vehicle



CH149 Cormorant SAR helicopter

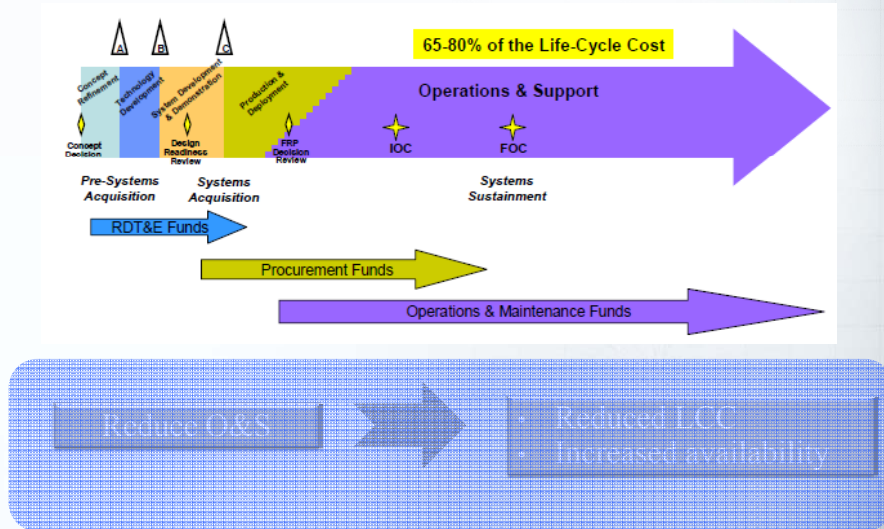


Cold weather testing centre for icing research in gas turbines

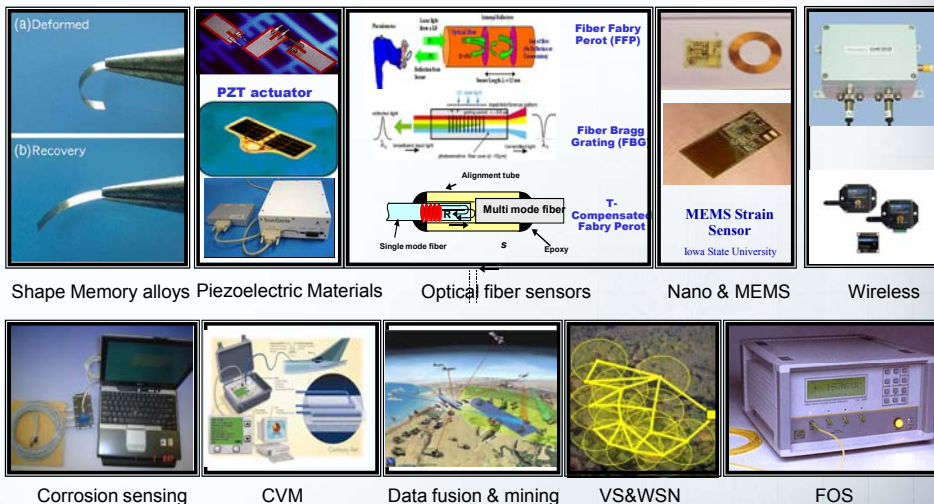


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Cost of O&S – The Need for PWST

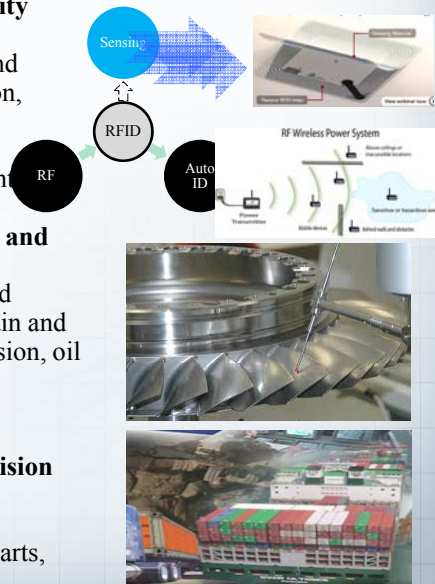


PWST Alternatives



Current Air Related Activities

- **Advanced Health Monitoring Capability Development and Demonstration**
 - Sensors development, evaluation and demonstration (strain, load, corrosion, chemical, damage, cracking, etc.)
 - Modeling, simulation and analysis
 - Experimental capability development
- **Engine PHM Capability Development and Demonstration**
 - Sensors development, evaluation and demonstration (H/L Temp blade strain and temperature, blade damage and erosion, oil quality/debris monitoring and leak)
 - Data fusion and mining, etc.
- **Asset monitoring and tracking for decision making and command and control**
 - Materials visibility and condition assessment (e.g. ration, fuel, spare parts, etc.)



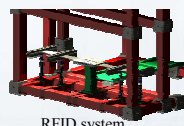
Advanced Health Monitoring Capability Development and Demonstration

- Nano sensors (crack, humidity, impact damage, etc.)
- MEMS sensors (acceleration, strain)
- Wireless SHM/PHM sensors (vibration, load, strain, etc.)
- Piezo based sensors and sensory systems
- Fiber optic sensor systems (multi-parameter, highly multiplexed, high frequency (>100khz), small size and weight)
- RFID chemical and corrosion sensors
- Energy harvesting (RF, vibration, thermal)
- Full scale demonstration facility

Integrated UT for embedded crack detection



Fiber optic interrogation system



RFID system

Nano crack sensor



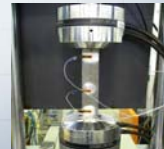
MEMS humidity sensor



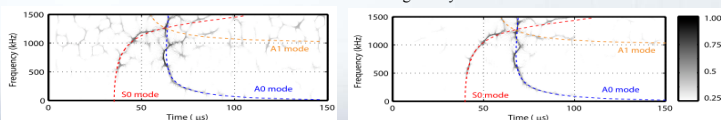
Wireless SHM sensor



PZT sensor evaluation sensor



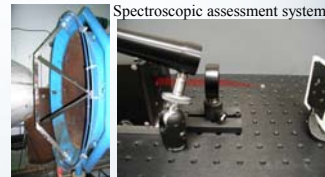
SHM PZT based damage analysis software



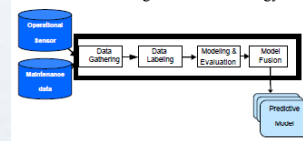
Engine PHM Capability Development and Demonstration

- Electrostatic condition assessment
- Spectroscopic fault assessment
- Data mining based prognostics
- Eddy current blade condition monitoring
- Strain and temperature sensor deposition and blade condition monitoring
- Engine oil quality/debris and leak condition monitoring
- Bearing condition monitoring
- MEMS wireless sensor for engine monitoring
- Virtual sensors development and demo
- Full scale engine PHM capability development and demonstration.

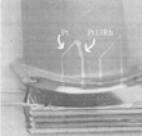
Hoop sensor on F404 engine



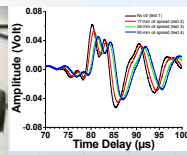
Data mining based methodology



HT Strain and Temp deposited on Turbine blade



Engine oil condition, oil leak and fuel leak monitoring



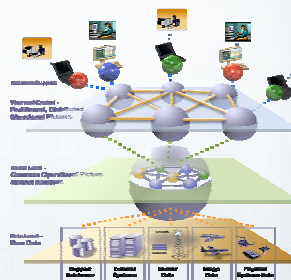
Blade condition monitoring



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Asset monitoring and tracking for decision making and command and control

- Supply chain and life cycle management
- Asset movement planning and execution
- Asset visibility (Active and passive RFID, UID)
- Sensor technology (UID, visibility and tracking, DPS, RFID, iButtons, chemical fingerprint, UID, temperature, event tagging and chronology, shelf life monitoring, corrosion detection, stress and wear & tear, vibration & shock, intrusion, wireless)
- Software Agents
- Sense and Respond Logistics (S&RL)
- Autonomic logistics



Maintenance forecasting report (Source: LOGTOOL)

PRFID, ARFID and wireless



Container security



SAVI ST-674 Active RFID Tag



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Does Wireless Technology Meet the challenge?



Example for operational Load Monitoring using strain gauges

Wired system

20 meters per channel
Installation and materials cost = \$40 per meter
250 Strain sensors
Sensors & cabling instrumentation = \$200,000
Computer cost \$ = 5,000
Amplifier and signal conditioner cost = \$100 per channel
Total cost for strain survey using 250 Gauges = \$230,000

Much of the cost is installation of the wiring looms if these were to be attached to the airframe components **additional cost is required to clear any engineering modifications to the airframe**

Wireless system

Cost per 1 channel = \$150 (3 channel device)
Installation cost = \$100 per device (3 channels)
250 Strain sensors
Sensors and instrumentation cost = 46,000
Data storage cost = \$100 per device (\$8,300)
Computer cost \$ = 5,000
Total cost for strain survey using 250 Gauges = \$60,000

Wired system cost = \$230K (4x)

Wireless system cost = \$60K

Challenge Power, Size, Weight

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PWST Capability Implementation Challenges



- **Economic – Return on Investment (business Case),**
- **Technology – Technology maturity (TRL)**
 - Physical : Size, weight, weight distribution, redundancy.
 - Cost: Systems cost, instrumentation, maintenance and operation (data acquisition and interpretation).
 - Power: power management and reliability.
- **Certification - (modification of procedures and manuals)**
- **Benefit Credits:**
 - Maintenance credit,
 - Operational credits, and
 - Future platform design and analysis credits

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Nezih Mrad, Ph.D., Defence Scientist
Phone: 613-993-6443, **Cell:** 613-769-8036
E-mail: Nezih.Mrad@drdc-rddc.gc.ca



Air Vehicles Research Section (AVRS), Defence R&D Canada – Atlantic (DRDC)
Department of National Defence (DND), National Defence Headquarters
1200 Montreal Road, Bldg. M-14, Ottawa, ON, K1A 0R6