PHM Technology

made

MAINTENANCE AWARE DESIGN

INTRODUCTION TO MADe SOFTWARE

HUMS – Avalon 2009

Background

- PHM Technology is an Australian company focused on advanced engineering applications.

- The ‘Maintenance Aware Design environment’ (‘MADe’) is a software tool that meets the practical engineering requirements for reliability & PHM system design, assessment and management.

- Only private company to secure a JSF Science and Technology Board R&D grant [to develop the ‘Aerospace PHM Software Tool based on MADe]

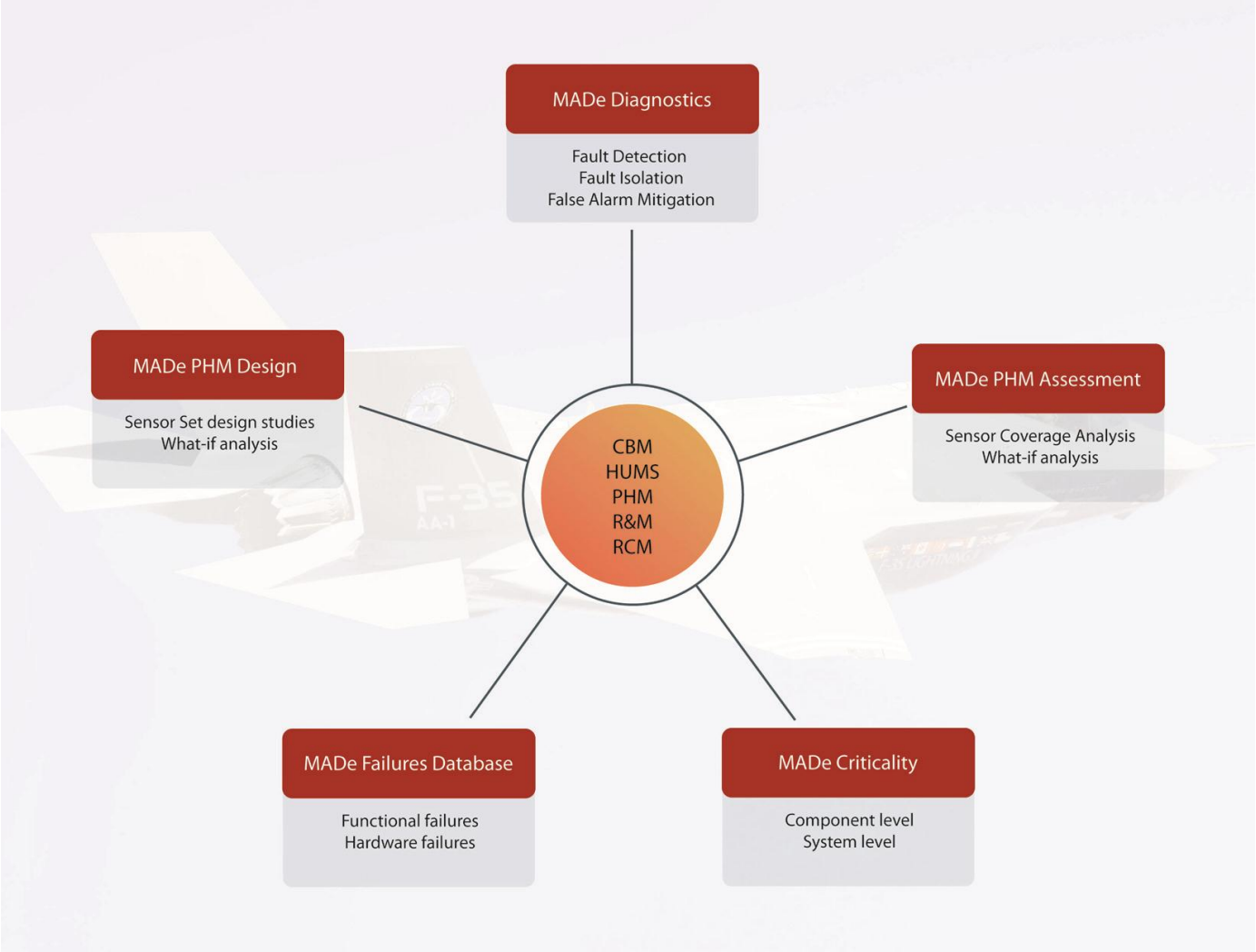
What is MADe?

- The Maintenance Aware Design environment ('MADe') is a software tool that meets the practical engineering requirements for reliability / HUMS / PHM system design and management, including:
  - detailed failures databases for systems based on standardized taxonomies with user configurable outputs
  - dependency modeling: effects of failures are accurately propagated through complex hierarchical systems
  - trade study analysis and assessment of system coverage of sensor set design based on FMECA
  - advanced diagnostic capability, including Fault Detection & Isolation / False Alarm mitigation

MADe Features

- MADe provides:
  - generic and proprietary libraries (re-usable parts and extensible component / system elements)
  - design of HUMS / PHM systems based on FMECA (what-if analysis conducted in real-time based on user defined parameters, eg. cost, weight, reliability, etc.)
  - performance assessment of legacy HM systems (failure mode coverage based on existing sensor sets)
  - design version controls (multiple concurrent system versions to meet internal / customer specific requirements)

MADe Overview



Customer Outcomes

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Implementation of MADe to:

1. optimise system design (reliability)
2. reduce design costs & risks
3. reduce compliance costs (documentation)
4. standardise design process (concurrent)
5. improve condition / health monitoring capability
6. accelerate product development lifecycle
7. Quality Assurance for supply chain
8. reduce Life Cycle Costs

Summary – optimise design, reduce costs & risks

MADe - Business Case

- reduces time taken to create, update and maintain accurate failures database – reduce design cost
- supply chain failures data is often redone, eliminates replication of effort – reduce process cost
- verification and validation of sensor set designs improves health monitoring – increase reliability
- improving system reliability during operations leads to reduction in total operating costs – reduce life cycle costs (LCC)

Module
MADe Failure Database

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Concept stage	Generate a complete list of failure modes and effects
	Assess criticality of failures and faults
	Generate database of faults and failures for other applications (e.g. MBR)
	‘What if?’ analysis (e.g. effects of system modifications)
Post design	Verify failure modes, effects and criticality for existing or legacy systems
	Update list of failure modes and effects for a modified system
	Verify results obtained from Model-Based Reasoners

Features	Automated analysis eliminates errors and omissions
	Speed, ease, efficiency
	Enables concurrent design practices (Maintenance Aware Design)
	Re-useable, scalable system models

Module
MADe Performance Assessment

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Concept stage	Assess predicted performance of a PHM design against specifications
	Conduct ‘what-if?’ analysis for PHM capability vs. design trade-offs for weight, cost etc.
	Identify additional PHM requirements for system design modifications
Post design	Verify the failure coverage of existing sensor set designs
	Test diagnostic capability of other programs, e.g. Model-Based Reasoners
	Verify results obtained from Model-Based Reasoners
Features	On-screen, real-time analysis results facilitates decision making
	Automatically generate validation and support documentation
	Accommodate Built-In-Tests, evaluate virtual sensing capability
	FMECA based approach to failure coverage assessment

Module
MADe Design Optimisation

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Concept stage	Assessment of anticipated PHM requirements for system designs and design variations
	Conceptual design of PHM system in terms of sensor types
Post design	Optimisation of total number and location of sensors
	'What-if' analysis to determine impact of trade-offs (e.g.: weight, cost etc.) on PHM capability
	Ranking of potential sensor set designs in terms of total weight, cost etc.
Features	FMECA - based approach to sensor placement
	On-screen, real-time results for trade studies
	Automatic audit trail and documentation of PHM design iterations

Module
MADe Diagnostic

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Concept stage	Design diagnostic application for a system to detect and localise failures
	Design prognostic application able to predict likelihood of failures
Post design	Validate results from MBR and other diagnostic/prognostic tools
	Provide real-time, on-board FDI capabilities
Features	Ability to rapidly update application based on revised FMECA (system upgrades)
	‘Bottom up’ approach provides efficient software – smaller code and processing requirements