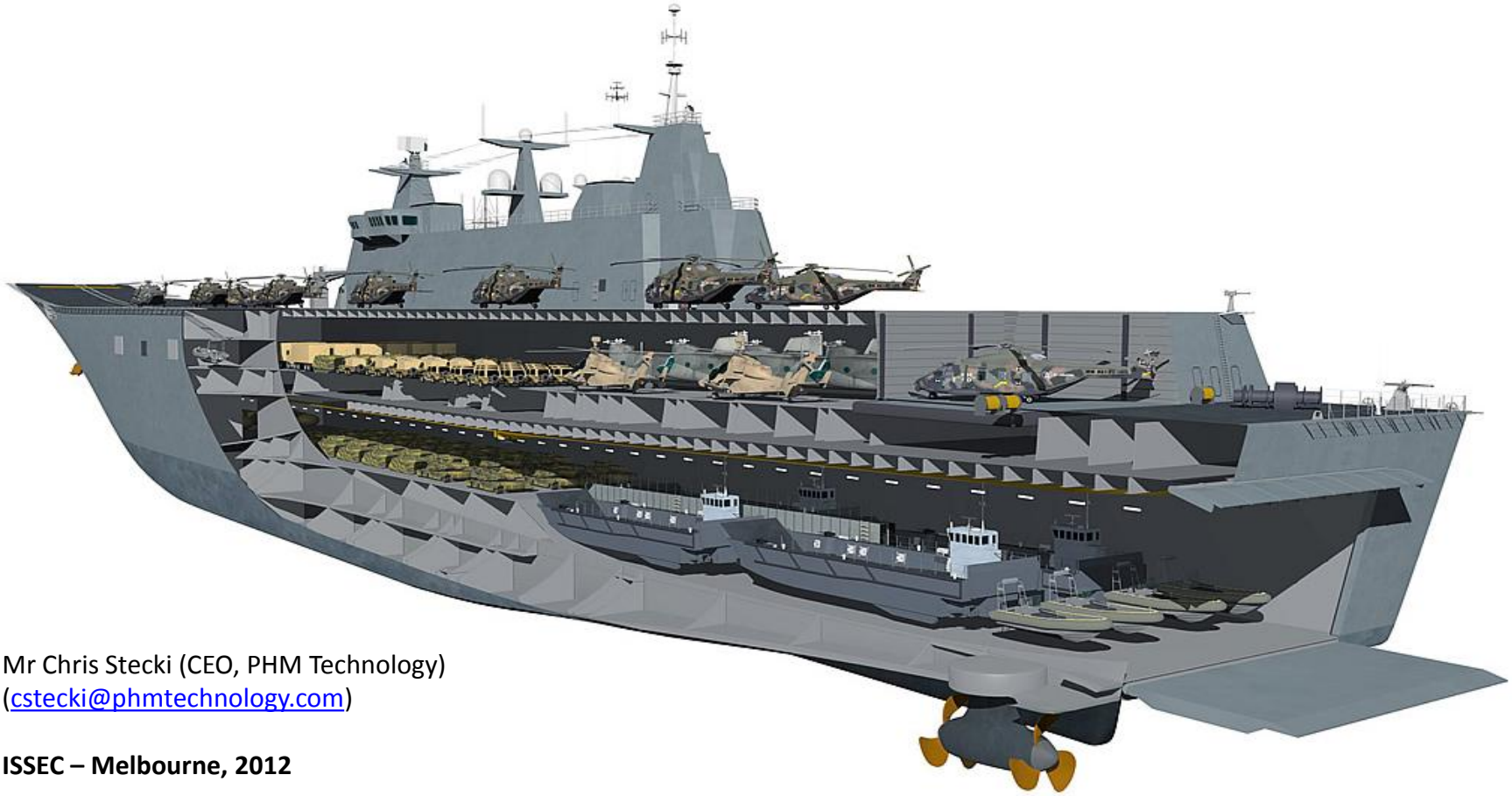
“Design for Support”

A model based architecture to analyse and optimise supportability concurrently from the system engineering process to operations



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What is ‘Design for Support’?

- ‘Design for Support ‘is a methodology using a model based architecture to optimise the engineering of a system design and its maintenance requirements / approach ***concurrently.***

- Design for Support requires ***compounding analysis*** to identify and validate the key engineering decisions that are critical to system performance – the models used to understand system behavior must be extensible and evolutionary.

- Design for Support offers demonstrable cost benefit by reducing Through-Life support’ costs (‘supportability’) based on configuration management of the analysis and ***improved knowledge of the system*** for both the customer and the OEM.

- The Design for Support methodology can be equally applied to new systems or legacy platforms – ‘but a stich in time saves nine’.

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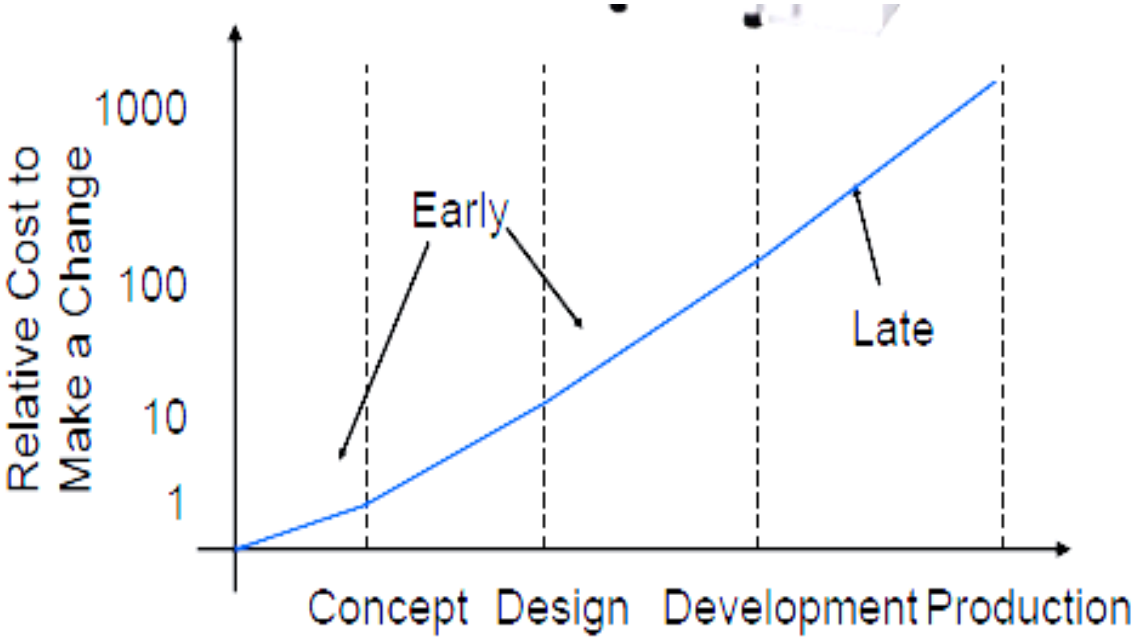
So what?
The benefits of designing for supportability

NEW DESIGN

- Design optimisation (concurrent engineering)
- Risk mitigation / Decision accuracy in the acquisition process
- Platform availability
- Knowledge Capture
- Cost benefits (immediate)

LEGACY PLATFORM

- Platform availability
- Knowledge Capture
- Cost benefits (life-cycle)



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Why the focus on Supportability?

- Historically, significant variances develop in the support costs for complex systems as they age (current publicly documented example is the Collins Class submarine).
- Through Life Support typically represents 65%+ of Total Ownership Cost – budgets are shrinking.
- Optimal sustainment of complex systems requires both a 'Maintenance Aware' design and the potential to conduct maintenance based on the health of the system (CBM / PHM capability).

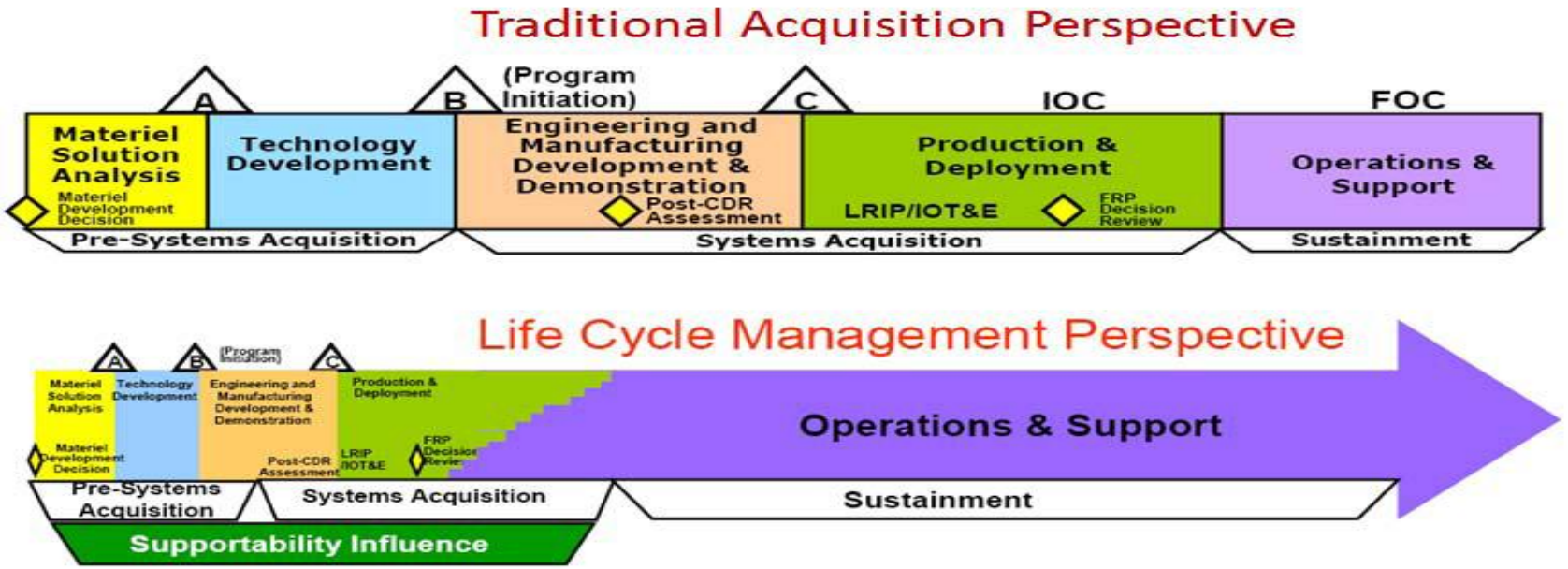

Image source: Patrick M. Dallosta, CPL, Defense Acquisition University, US

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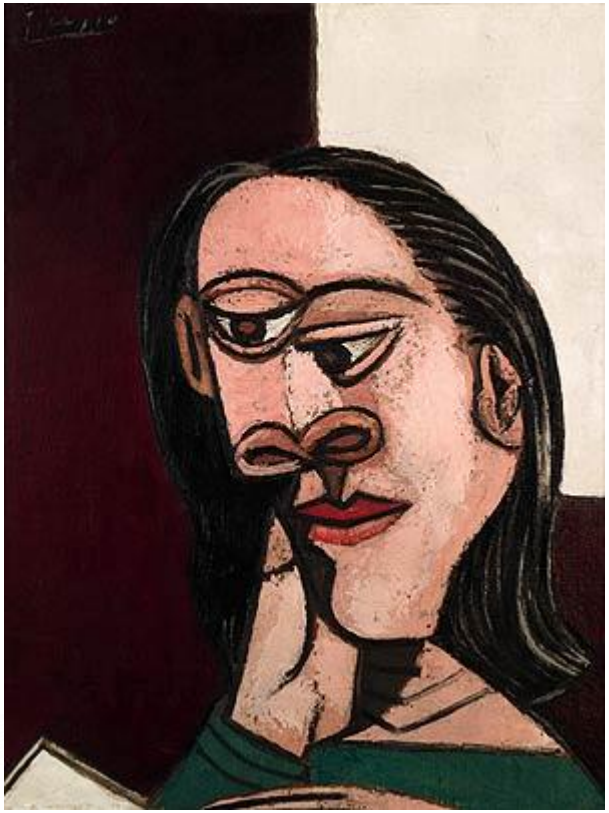
“Performance Based” contracts (PBC)

“Performance Based” contracts seek to transfer the significant financial risk of supportability from the customer to the supplier - based on the engineering performance of the system (normally fleet availability).

Issues: for customers and suppliers include:

- increasing complexity of systems and platforms
- identifying the optimal supportability posture
- assessing the total cost during the acquisition phase
  - can the system design meet the contracted availability metrics?
  - what engineering improvements to the system can be made to improve availability?
  - can the maintenance approach be changed to improve availability or reduce costs?
- appropriate contracting mechanisms



Head of a Woman
Pablo Picasso

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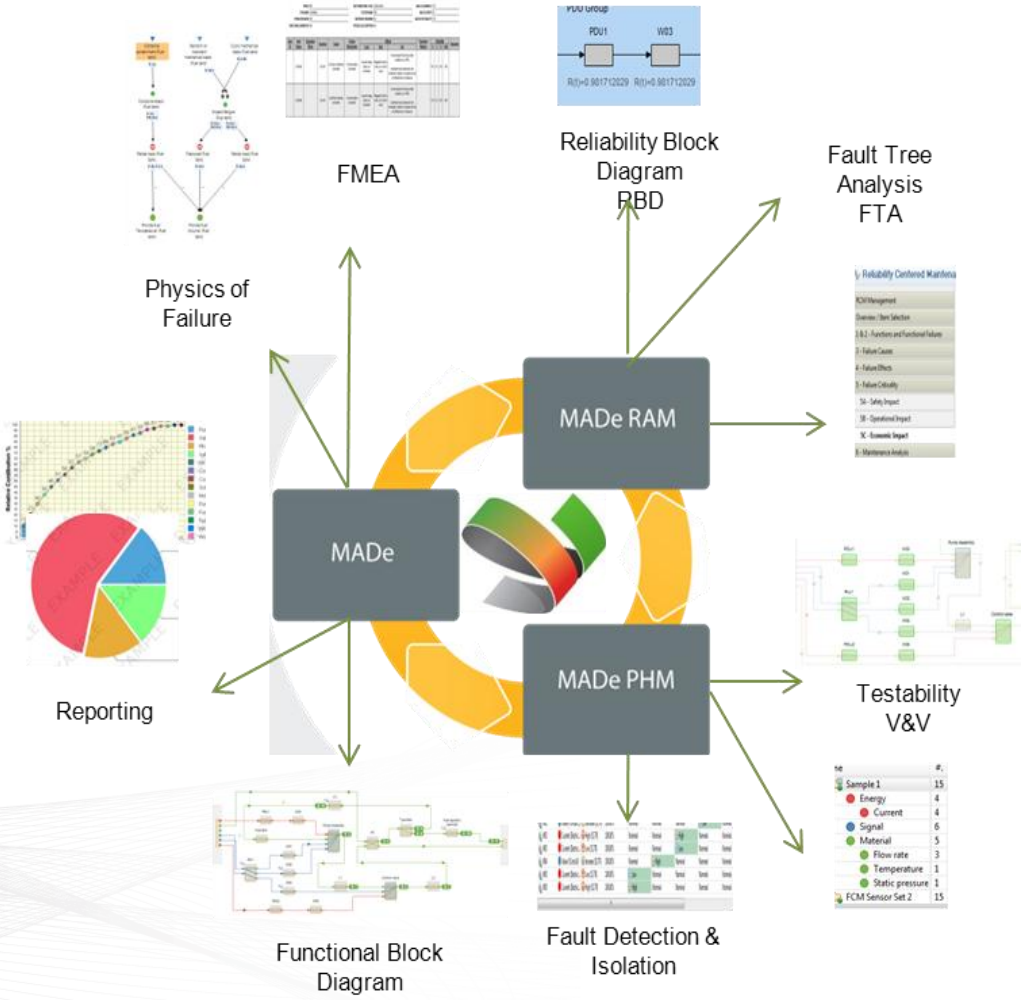
What analysis is required?

A range of reliability and logistics support related analysis needs to be undertaken.

Each of these analysis techniques requires common attributes of the system as key inputs.

The decisions made on the basis of this analysis can be assessed based on alternate ‘what-if’ analysis routines to identify and validate ‘best value’.

Parameters should be updated in the model as operational data becomes available (configuration management).



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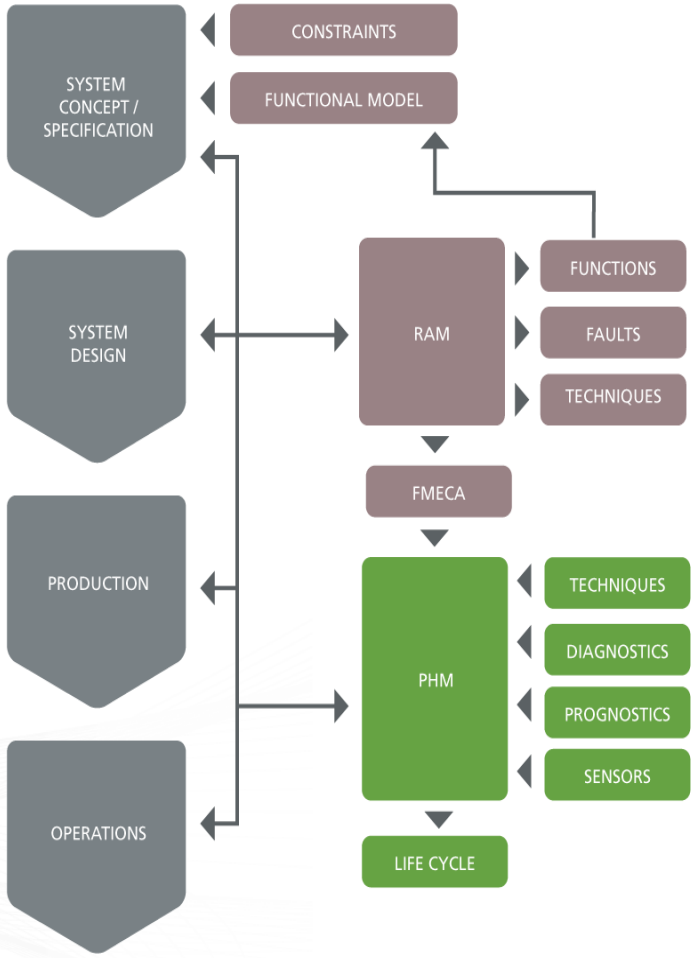
Success determinants for the analysis

- Complex systems demonstrate 'emergent' behaviours – these need to be identified using a functional model of the system that can automatically determine the engineering dependencies and simulate their impacts
- Parameters used for performance estimates will vary significantly throughout the product lifecycle - continuous modelling and analysis is required to ensure currency for support decisions
- Risk of the impact of any failure on the system reliability must be consistently assessed and mitigated against measures of safety, operations and cost.



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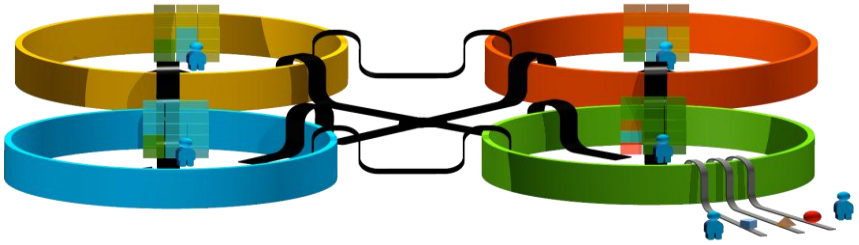
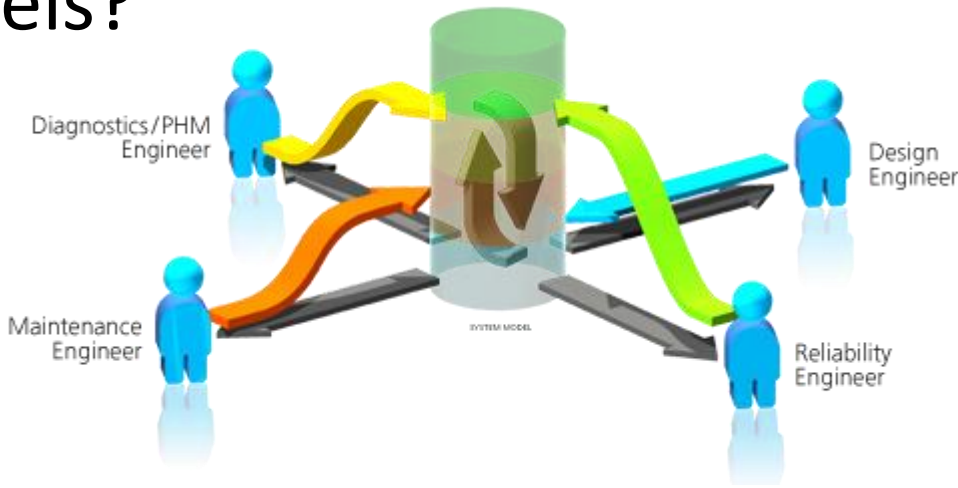
Why use simulation models?





Current process is artefact driven –generated manually based on the attributes of the system that are identified and captured by the analysts in spreadsheets:

- compliance driven (rather than quality)
- subjective (taxonomy issues)
- no configuration management
- costly ‘one-off’ exercises

A model based solution can automatically simulate the functional relationships and dependencies of a system , this offers the potential for:

- compounding analysis
- design influence / optimisation
- configuration management
- continuous improvement
- effective knowledge capture
- ‘single point of truth’

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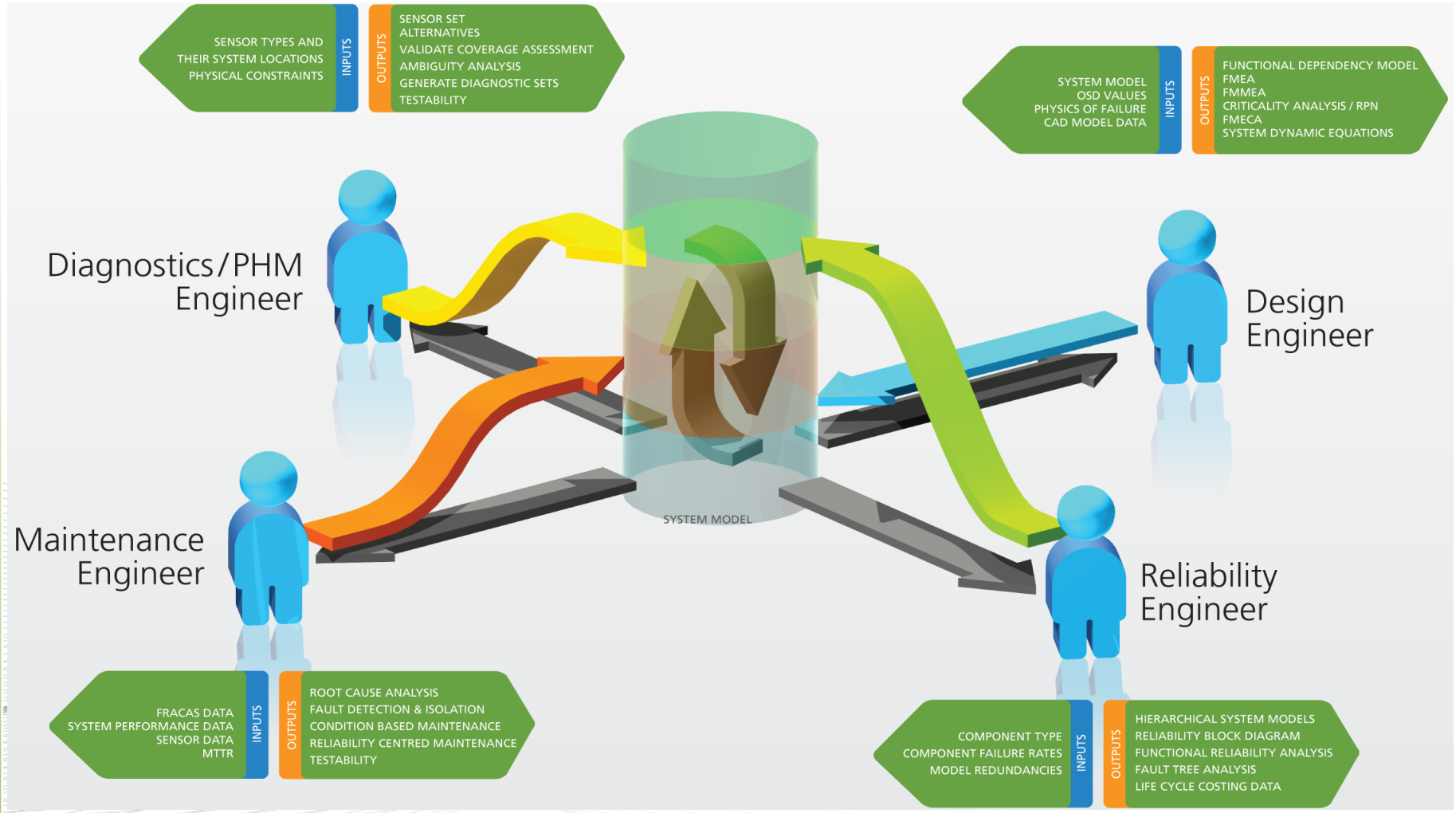
Compounding Analysis



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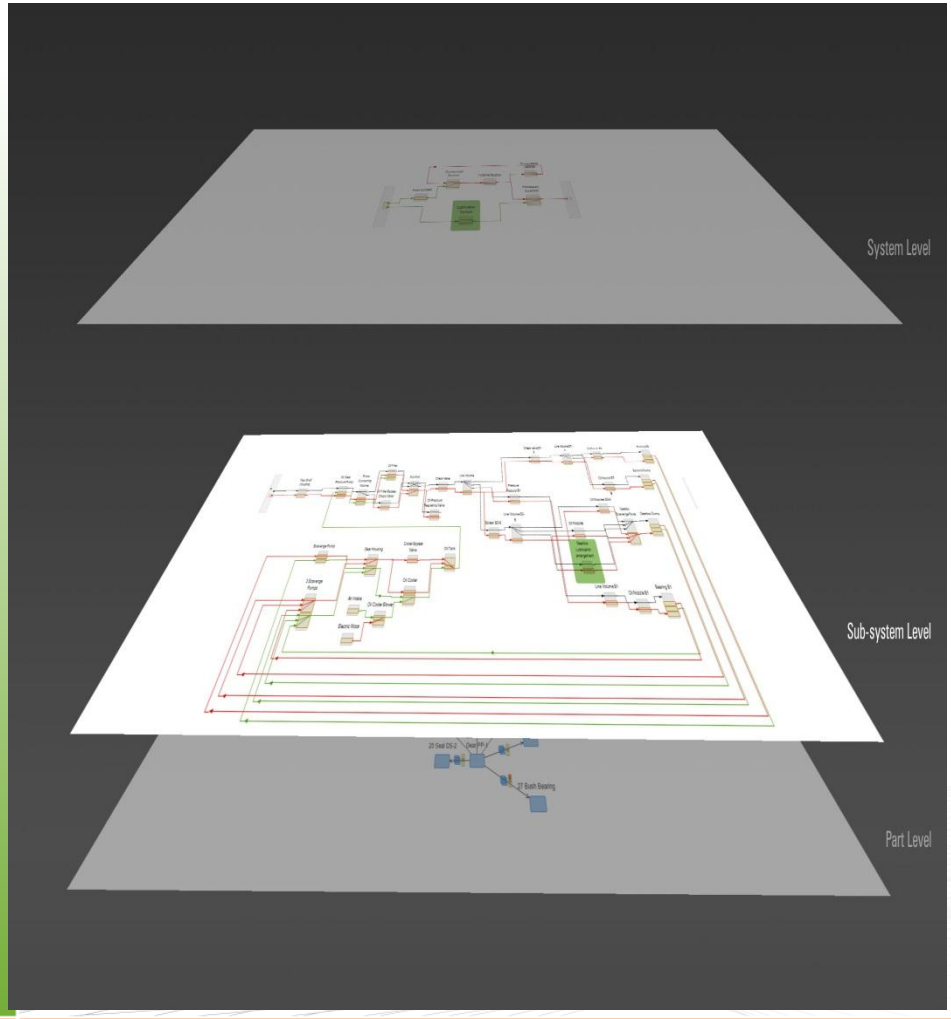
Hierarchies in the system / supply chain



Modern system design is predominantly based on the integration of sub-systems / components from increasingly COTS based global supply chains.

Cultural, linguistic, commercial and environmental differences can significantly vary the integrity and structures of the analysis results from the supply chain.

Both customer and OEM must be aware of the impact of potential inconsistencies in analysis conducted by their supply chain (GIGO).

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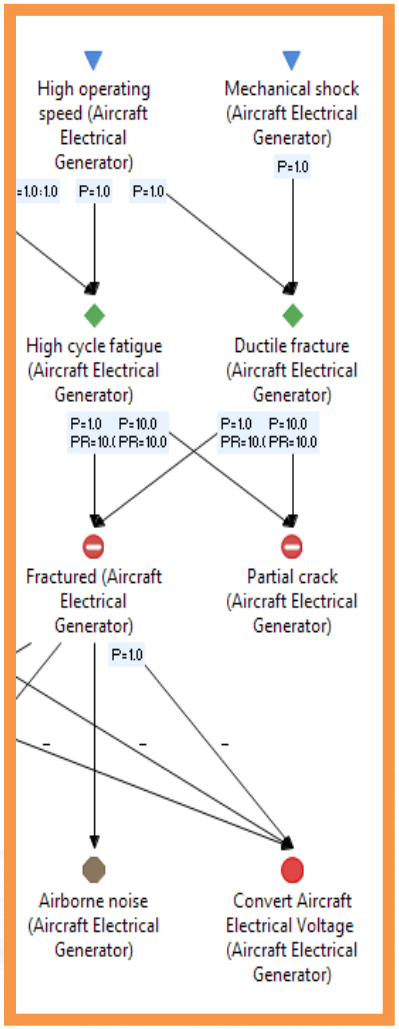
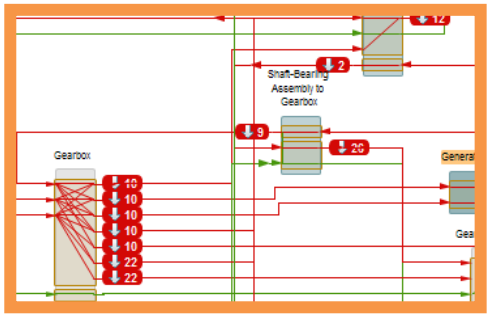
The MADe software

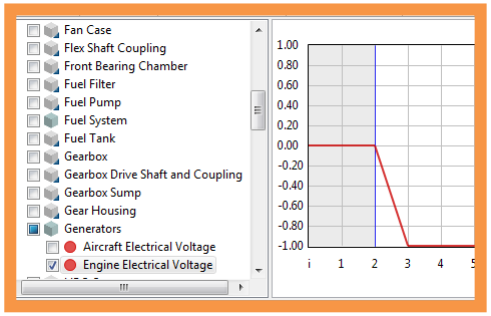
The MADe software is a tools solution that enable s the Design for Support methodology by integrating the modeling and analysis required to support Design and ILS functions.

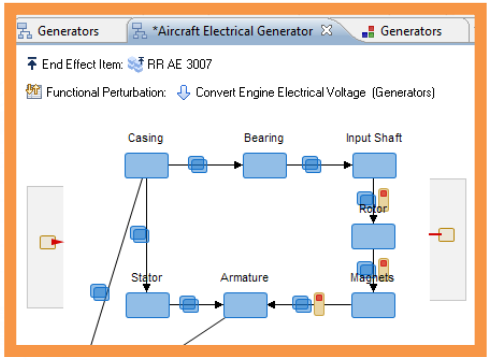
Benefits:

1. accelerate the development of modeling /analysis for new and legacy systems
2. improve the quality of system modeling and analysis (based on automated dependency mapping, etc.)
3. provide rapid / comprehensive decision support for ILS (including MRD)
4. provide analysis & decision support capability for continuous improvement
5. document engineering decisions for the purpose of quality assurance
6. capture system knowledge in the model (develop / retain organisation IP)

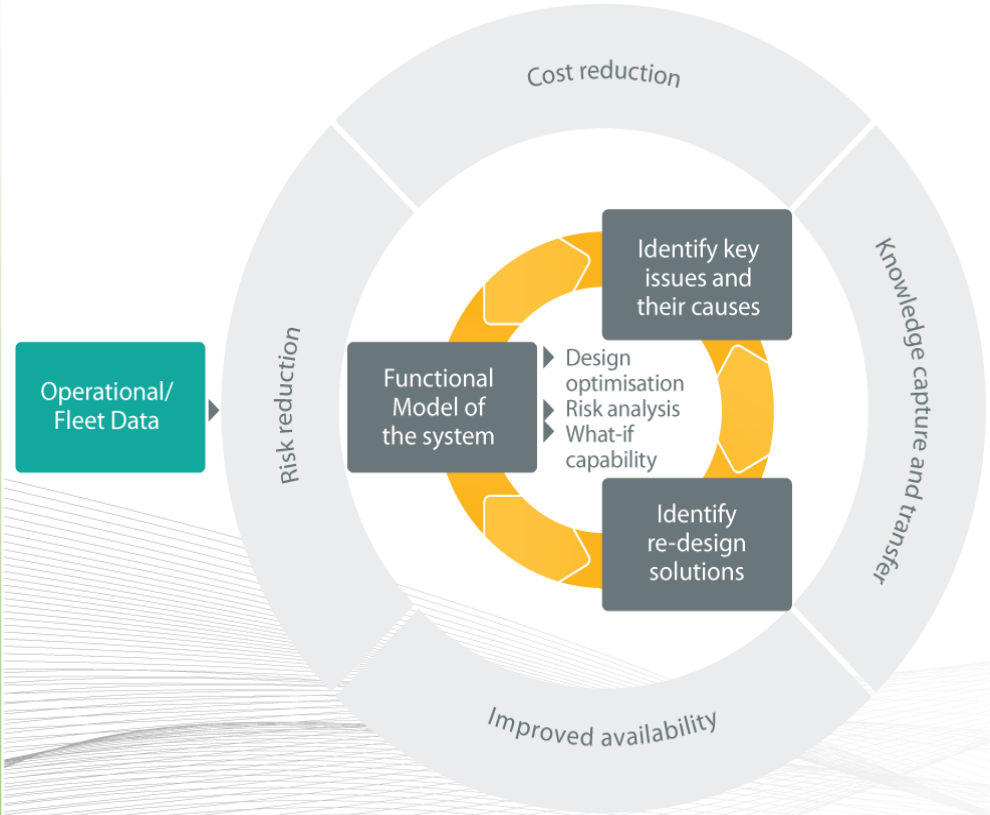








Process Improvements for the Design process



A model based approach is required to generate functional pathing and dependency mapping to support:

- Design Optimisation
- Risk Identification (FMEA)
- Criticality Analysis (FMECA)
- 'What-If' Analysis
- Safety Case Analysis

Currently the outputs of these analysis are not available to RAM / ILS personnel until designs are significantly mature (and hard to change).

The organisation can also 'close the loop' with operational data to update the model with real parameters (e.g. failure rates) to provide 'configuration management' of system engineering and ILS related analysis.

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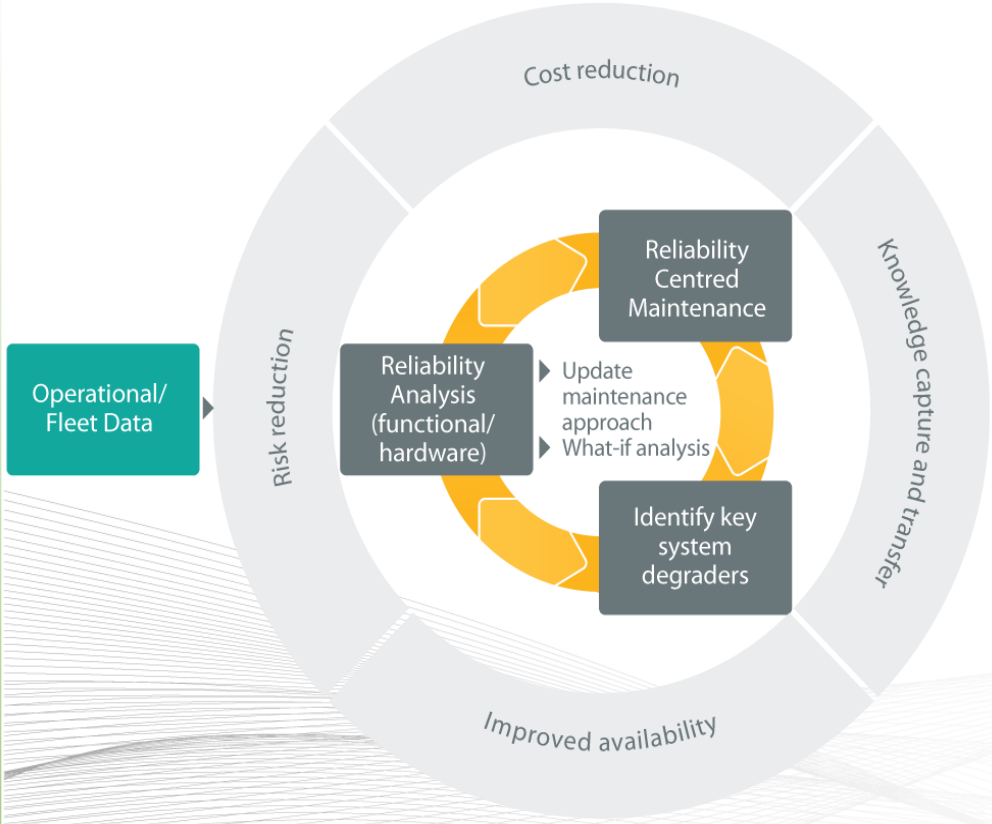
Process Improvements for RAM / ILS analysis



Compounding Analysis allows the user to leverage the existing system model to conduct a range of related analysis.

The RAM / ILS analysis required to support Design for Support includes:

- Reliability Allocation
- Reliability Analysis (RBD)
- Reliability Analysis (functional)
- Fault Tree Analysis
- Identification of key degraders
- Maintenance Requirements Determination (MRD)
- Reliability Centered Maintenance (RCM)

The results of these analyses can be used to support the decision process for Supportability Contracts / Maintenance Optimisation and system redesigns.

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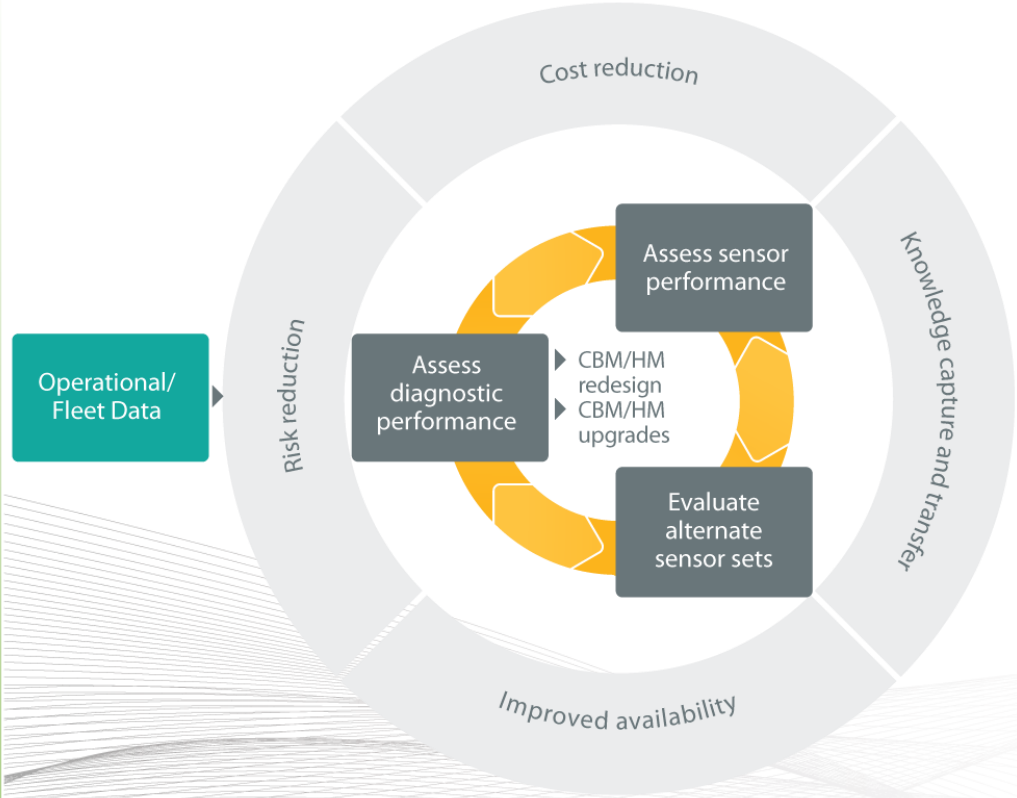
Process Improvements for CBM design



An ability to conduct the design and validation of diagnostic capabilities (sensor sets) during the system design / redesign process based on engineering analysis is not currently available.

The MADe software offers the capability to identify, validate and extend the CBM capabilities of both legacy and planned systems by providing:

- Sensor set design / validation
- Coverage Analysis
- Fault Detection & Isolation analysis
- Sensor performance including Probability of Detection (POD)
- Automated Diagnostic Rule Generation

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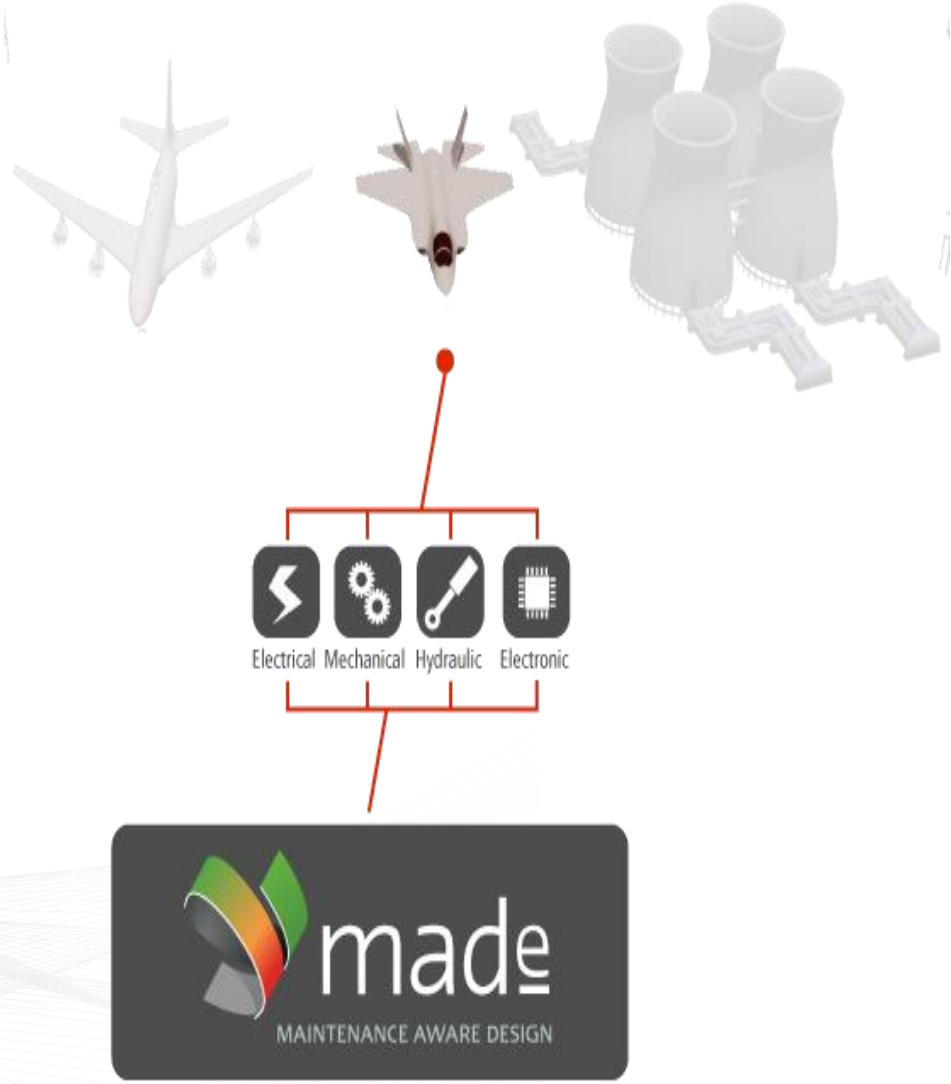
Company Overview

PHM Technology was established in 2006 to develop and commercialize the Maintenance Aware Design environment (MADe).

MADe is a suite of modeling, analysis and decision support tools for the design and support of mission and safety critical systems.

The development of MADe has been supported by US government programs (including the Joint Strike Fighter, DARPA, US Navy Aviation SBIR) and the Australian Department of Defence (New Air Combat Capability technology maturation grant).

MADe is currently in use by organisations including General Atomic, NASA, NAVAIR and Sikorsky.



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For further details on this presentation please contact the Conference Organisers

For further information on Design for Support or the MADe software, please contact:

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