A Process of Configuration Management for the Maintenance Approach of Aerospace Platforms and Systems

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Executive Summary

- Configuration Management for aerospace platforms is well documented, mandated and practised; and is supported by a range of IT applications and toolsets in both the military and commercial domains

- Sustainment of aerospace platforms (specifically the maintenance approach) should .be configuration managed to enable on-going iterative analysis of system performance to ensure the optimal availability, safety, and technical compliance of the platform with the lowest cost of maintenance

- Configuration Management of the maintenance approach enables supportability optimisation based on operational data; and verification and impact analysis for design change or modifications – but requires a number of analysis capabilities

- The MADe™ software (a simulation based modelling and analysis tool) will be used to demonstrate an approach to the Configuration Management of a maintenance approach

Background

- The requirement for Configuration Management for aerospace platforms is well defined, understood and practiced
- Sustainment of aerospace platforms is the major cost component in Total Cost of Ownership (generally >70% of TCO)
- Significant economic divergence of sustainment budgets (higher than expected TCO) is a common program outcome - generally higher than forecast based on a combination of operational, technical and environmental factors
- The maintenance approach for the specific configuration of a platform is best determined by the specific operating context (mission profile), the reliability of its systems, environmental conditions and availability requirements
- Configuration Management of the operational data to support the analysis that is used to performed to determine and validate the maintenance requirements for a platform is required to mitigate the risk of divergence

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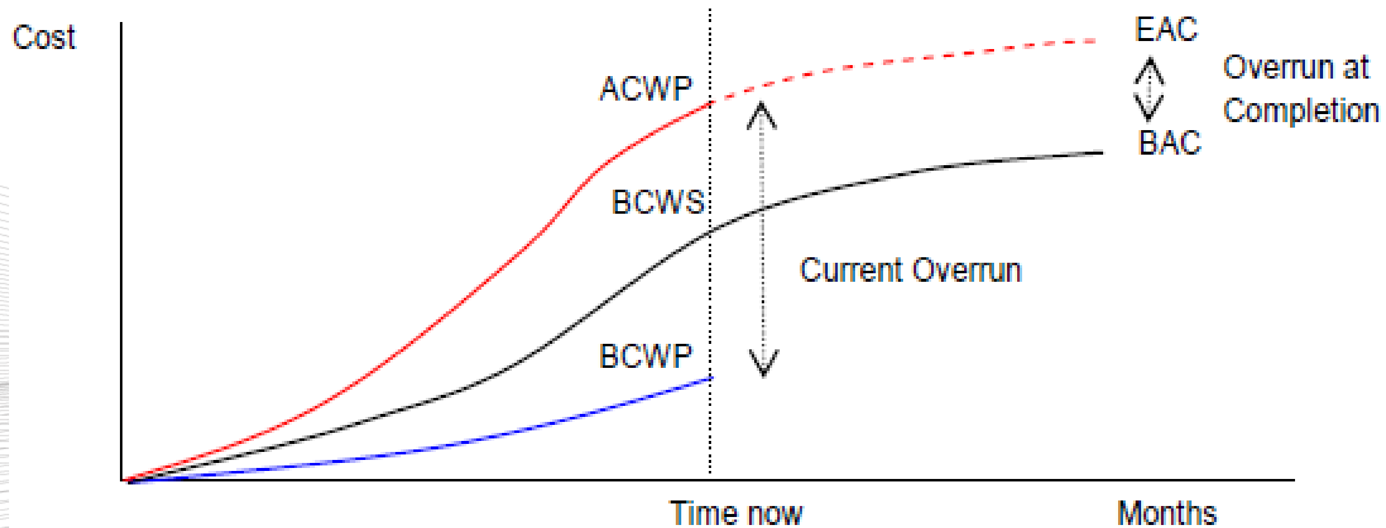
Divergence in supportability costs

'Divergence' is a deviation from expected performance – in the context of aerospace sustainment budgets, the variance between:

- Budgeted Cost of Work Performed (BCWP) - Actual Cost of Work Performed (ACWP)
- Budget at Completion (BAC) - Estimate at Completion (EAC)



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Why does Divergence occur?

Contributing Factors

<u>Usage Profile</u>

Is the platform used in the manner expected by the system designer?

Potential variance based on changes to the:

- mission type
- mission profile
- duration of operation
- system performance levels

<u>Operating Environment</u>

Is the platform used in an environment that were expected by the system designer?

Potential variance based on changes to the theatre of operations.

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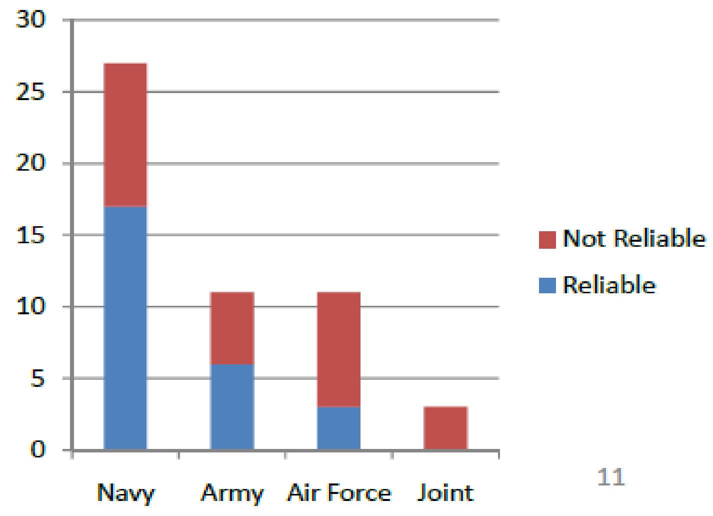
Why does Divergence occur?

Contributing Factors

<u>Reliability</u>

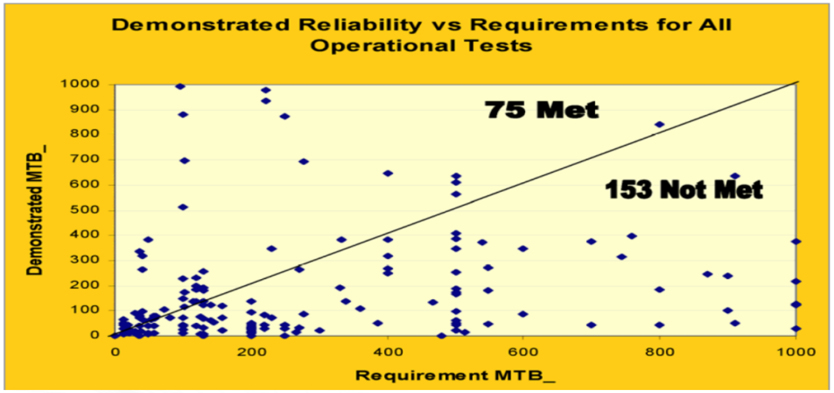
90% of sustainment budgets are directly correlated with system reliability [US DOD DTE 2008]



Does the platform achieve the reliability expected by the system designer?

Potential variance based on:

- usage profile
- operating environment
- configuration (modifications / upgrades)
- system integration
- historical performance



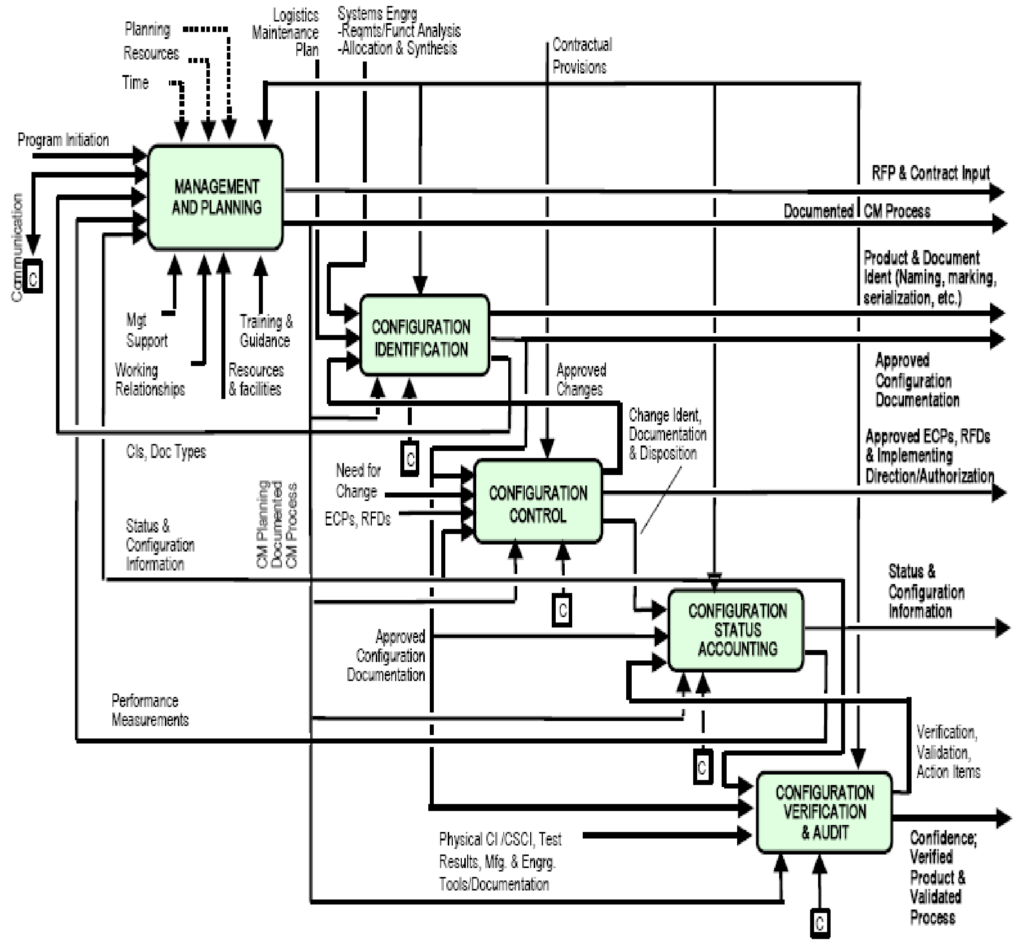
Source: US Army Systems Failing Reliability during OTE (1997-2006)

Configuration Management (CM)

Configuration Management (CM) is the process of establishing and maintaining consistency of a product's performance, functional and physical attributes with its requirements, design and operational information throughout the product lifecycle.

A key outcome from effective CM is identifying performance issues that arise during operations.

For example: Are the support costs within the budgeted range?



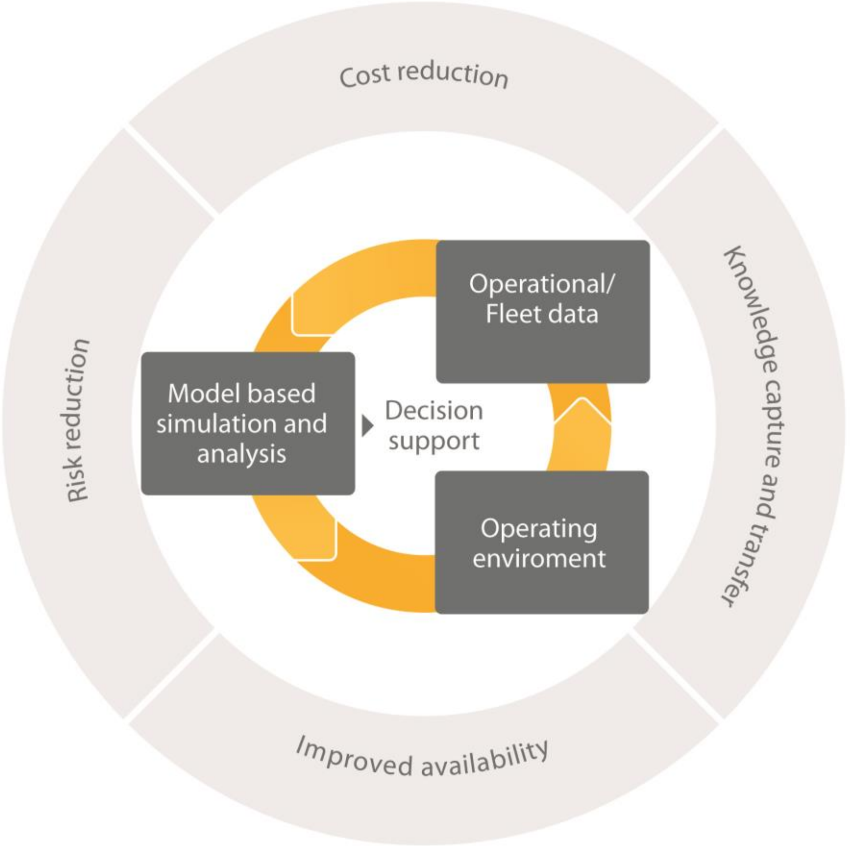
MIL-HDBK-61A - "Military Handbook: Configuration Management Guidance"

CM of supportability analysis

The ability to link functional and physical representations of a platform or system in a modelling tool provides the information base required to conduct analysis to identify and validate maintenance requirements.

A simulation model of the platform or system enables the inputs and analysis of the various engineering disciplines to be consolidated in a 'single point of truth'. This provides configuration management of the analysis

Analysis can be rapidly generated at any stage of the product lifecycle using the available data for the system – a 'what-if' capability that supports 'continuous improvement' and 'affordability' initiatives.



Operational Benefits – RAAF C130J

Australian Aerospace announced the extension of the maintenance interval period for the 12 RAAF C130Js from 30 weeks to 38 weeks.

Based on the C130J LOT this will reduce the number of deep maintenance events by approximately 75 across the projected fleet lifecycle – a substantial cost benefit.

The project focused on maintenance effectiveness, task scheduling, maintaining airworthiness and cost of ownership, using RAAF data as well as global fleet data.

Benefits:

- Reduced scheduled servicing
- Increase in aircraft availability
- No Negative Impact on airworthiness

Issues for CM of Aerospace Platform maintenance

<u>Technical</u>

- identify and validate potential maintenance changes that can generate cost benefits to the operator and maintainer
- identify and assess the technical risks associated with any change
- identify and assess the impact on availability of any change

<u>Organisational</u>

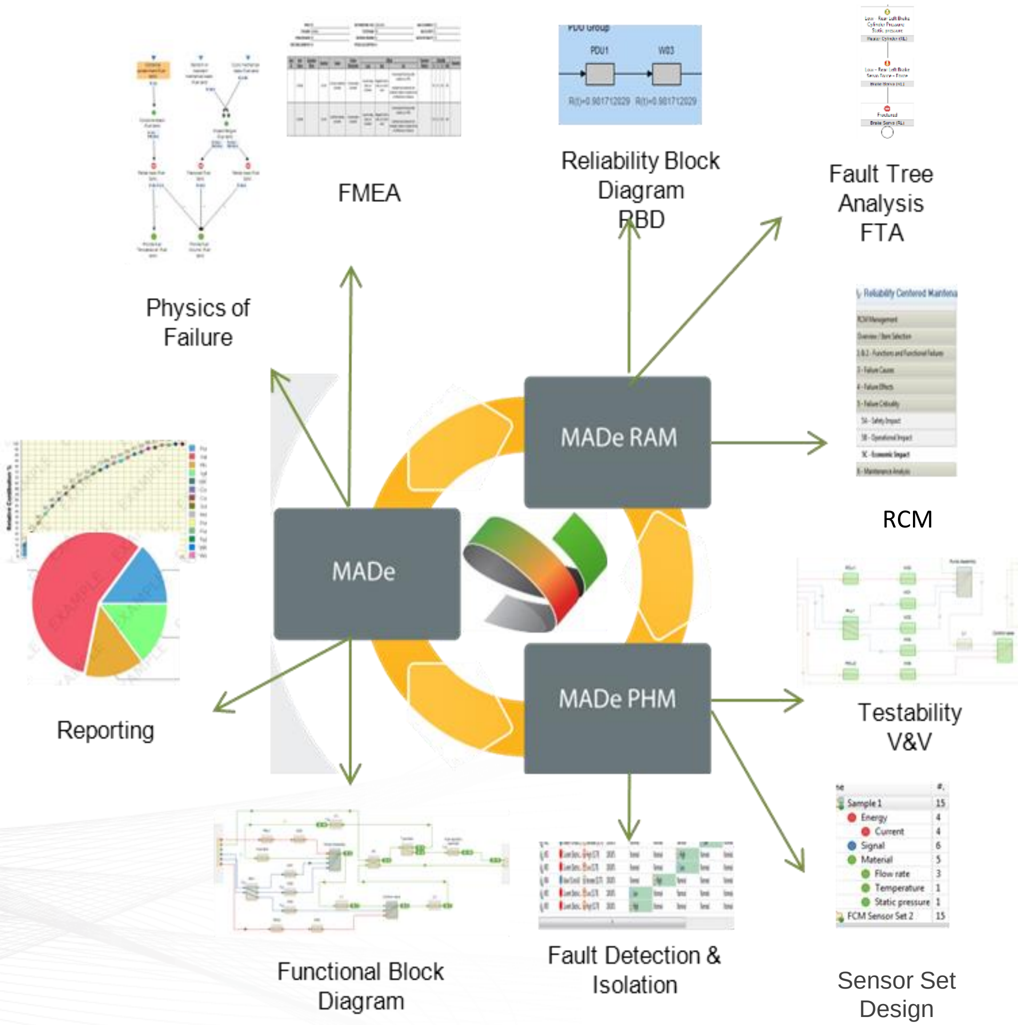
- establish an engineering process to consistently undertake the analysis required on an on-going basis
- conduct maintenance optimisation analysis iteratively through the product lifecycle without substantial cost overhead
- identify the IT applications and architecture required to support an iterative analysis process?
- identify, leverage and integrate 'model-based' / simulation analysis tools

Maintenance analysis requirements

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

Each of these analysis techniques requires common parameters and 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 fit' and 'best value' in keeping with certification requirements.



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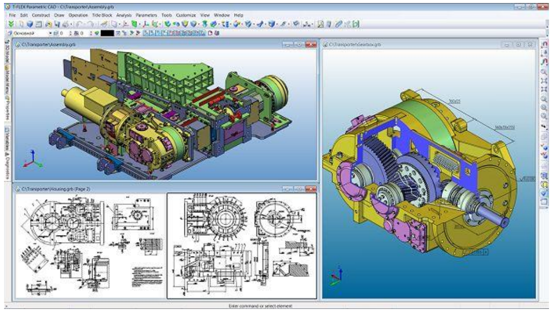
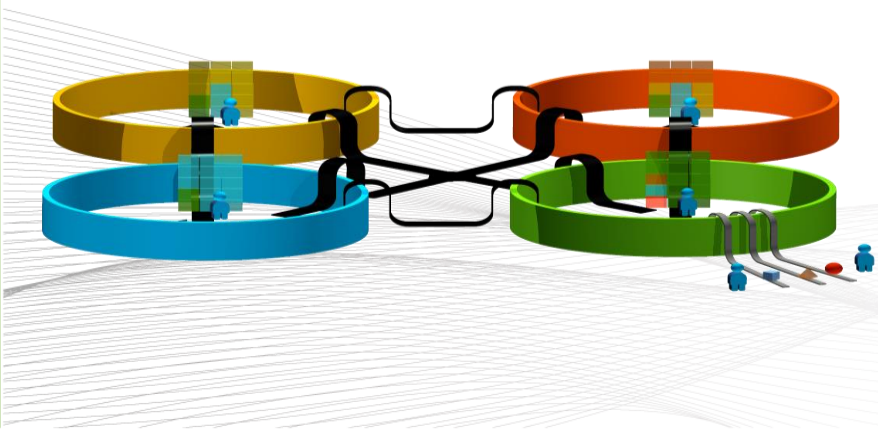
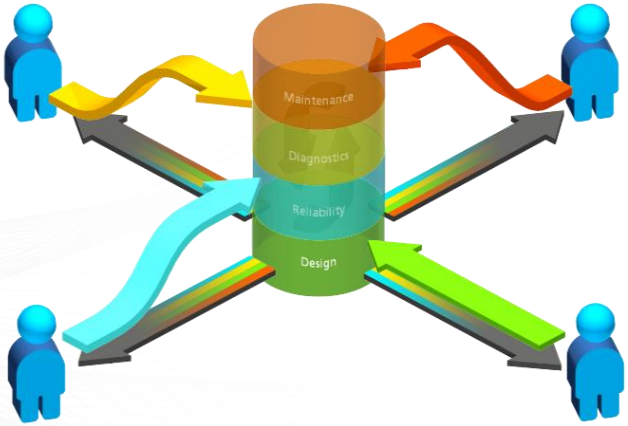
Why a model-based solution?

A simulation based modelling / analysis toolset provides schedule, technical and productivity benefits to the analysis process.







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MRD / MER / MTA / MO / ETC

Maintenance Effectiveness Reviews (MER)

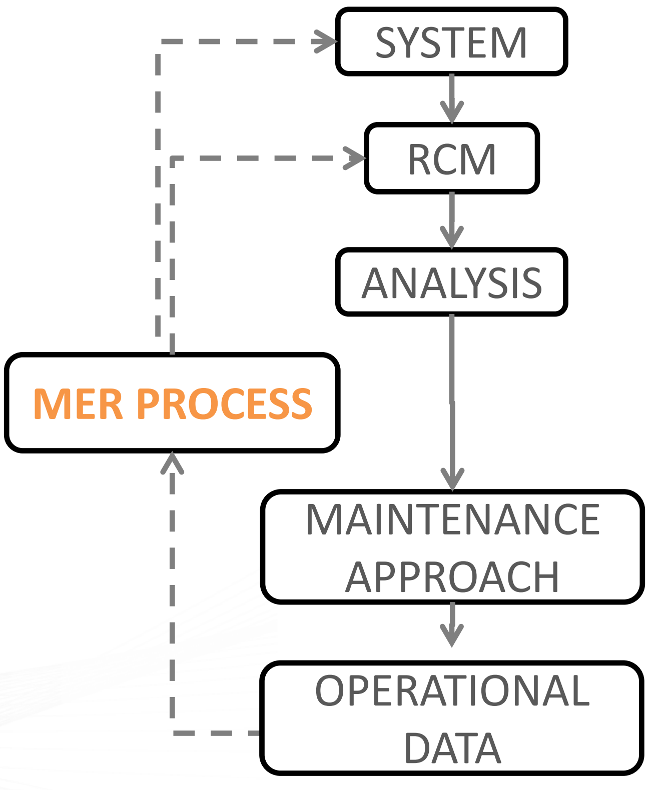
A Maintenance Effectiveness Review is a **continuous improvement** program that utilizes Reliability Centered Maintenance (RCM) to ensure existing Maintenance Tasks / Programs are effective, applicable

What is the value of a MER?

There can be a significant variance between the **anticipated (design) performance and the actual performance** of a complex system in an operational environment – MER resolves this.

What are the benefits of a MER?

The MER ensures **supportability costs are optimized** to achieve target system availability.



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The RCM process

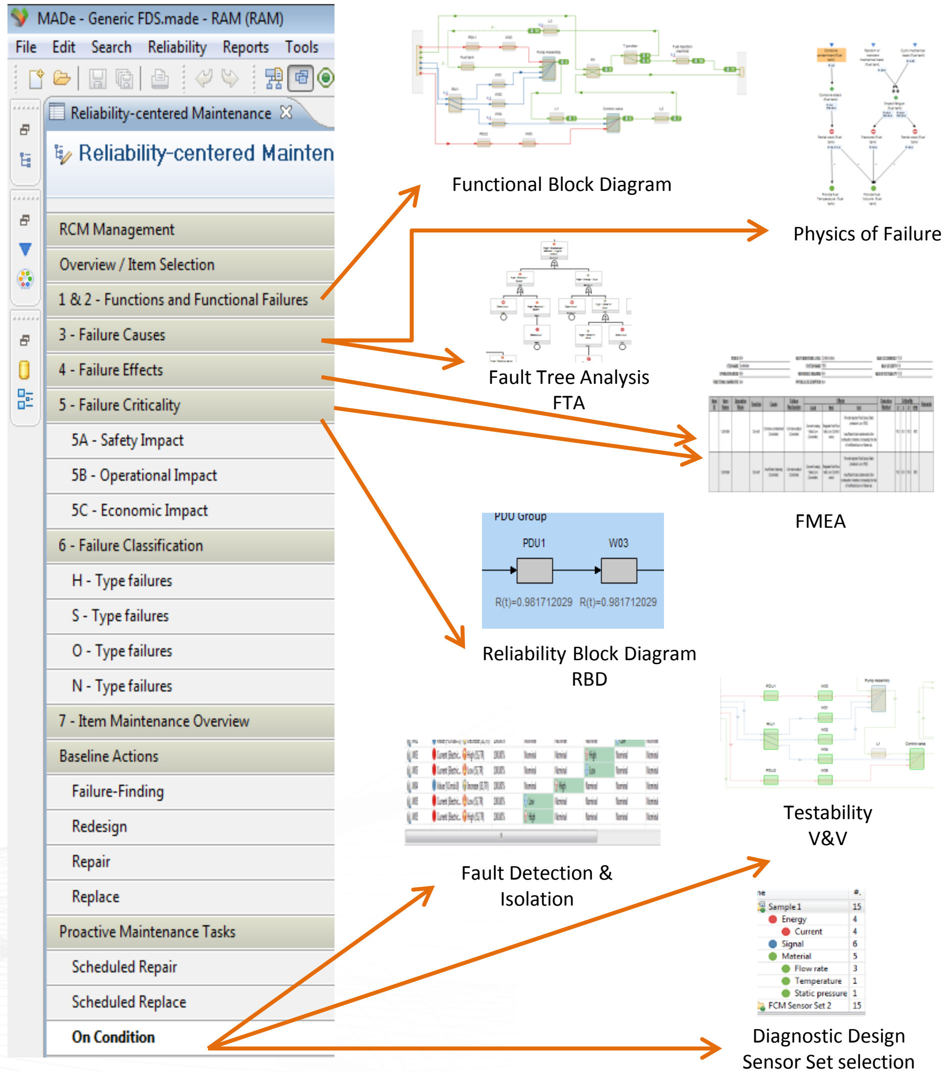
- utilise RCM to understand the impacts of alternate maintenance approaches such as different maintenance intervals or CBM
 – enable 'what-if' trade studies

- validate the technical integrity of the maintenance approach and required actions across the life cycle
 – mitigate engineering risk

- conduct iterative RCM analysis based on operational data (CM of analysis)
 – reduce costs of the analysis process

- model-based simulation technology that is extensible to enable Configuration Management of the analysis based on data
 – improve quality of the analysis

Value: *improve target system availability and optimize (reduce) through-life costs*



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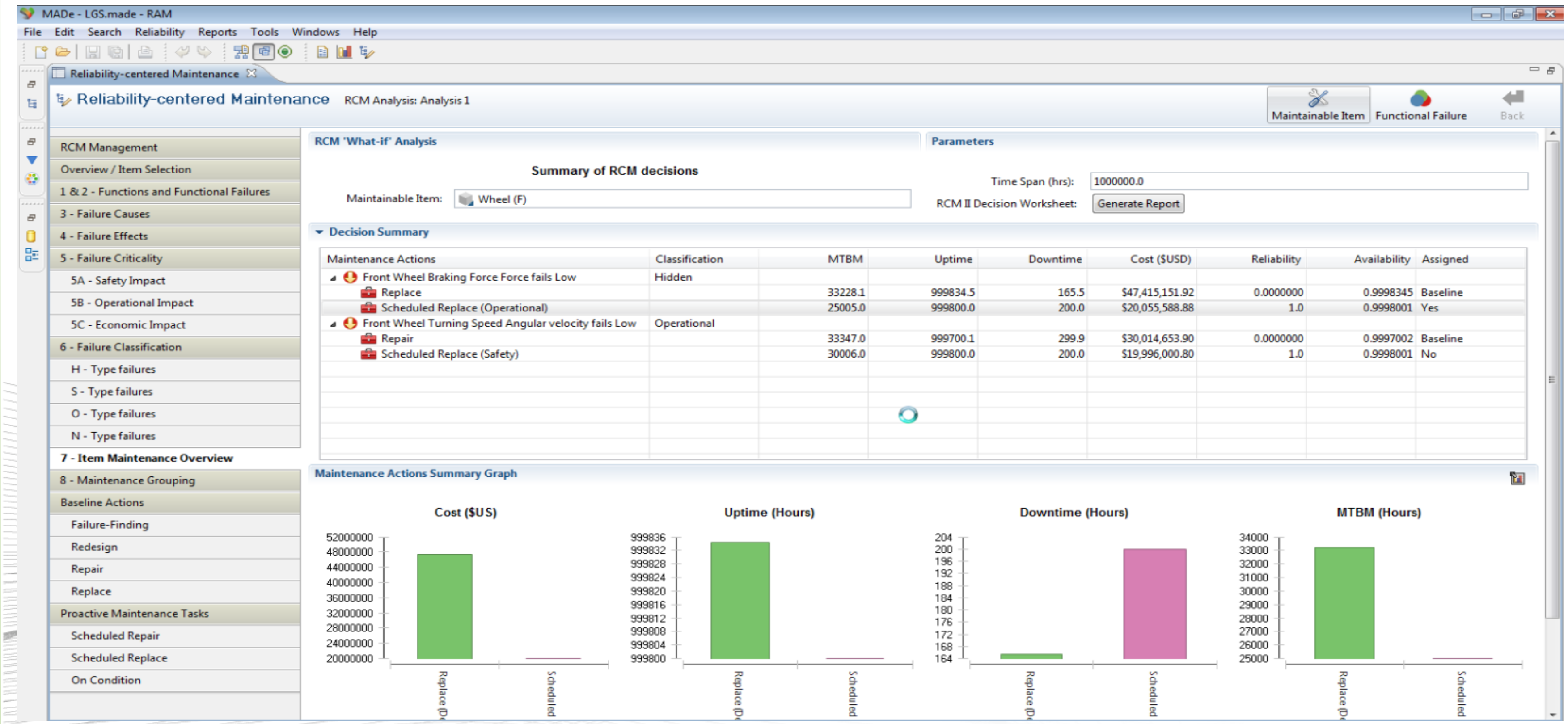
RCM – analysis outputs

Ability to compare alternate maintenance approaches on the basis of cost and availability – iteratively based on operational data as it becomes available.



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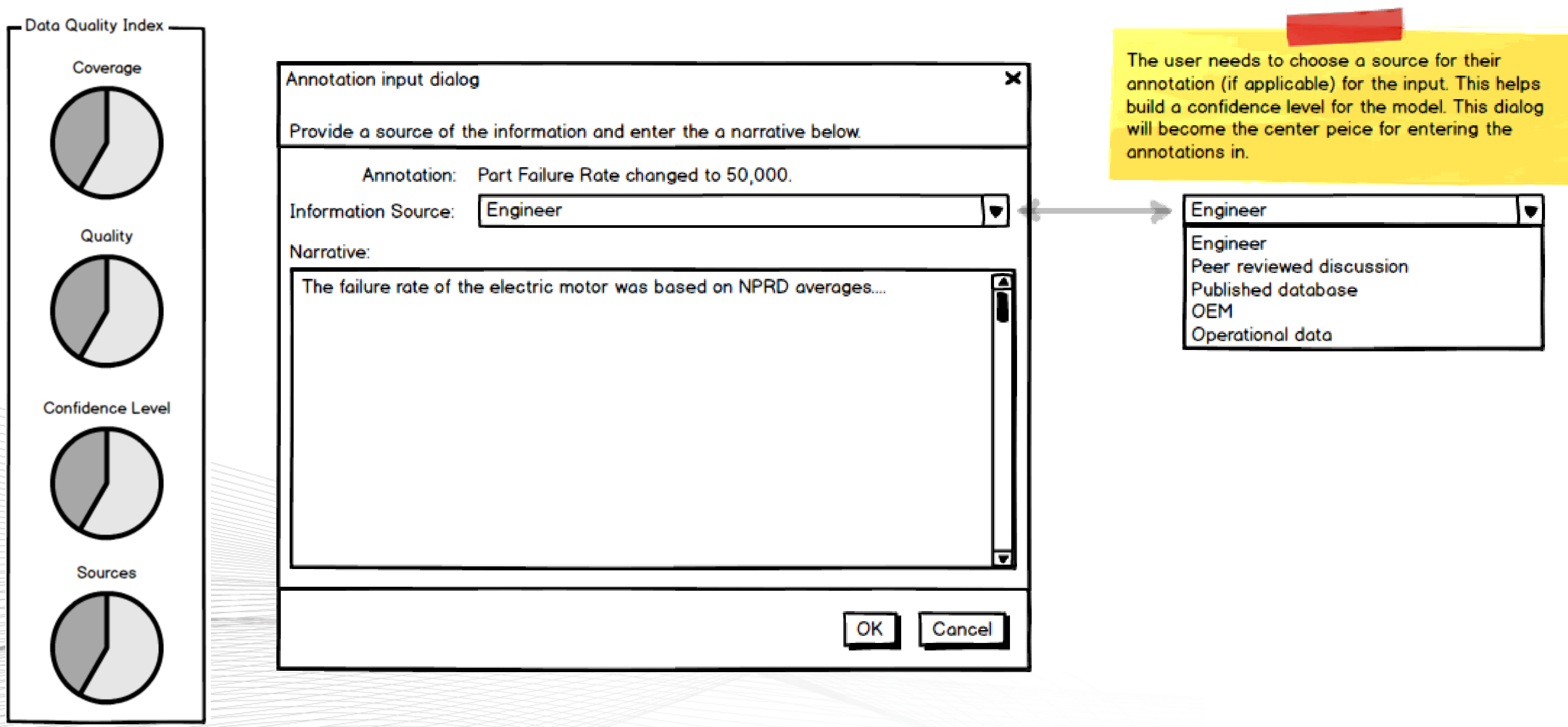
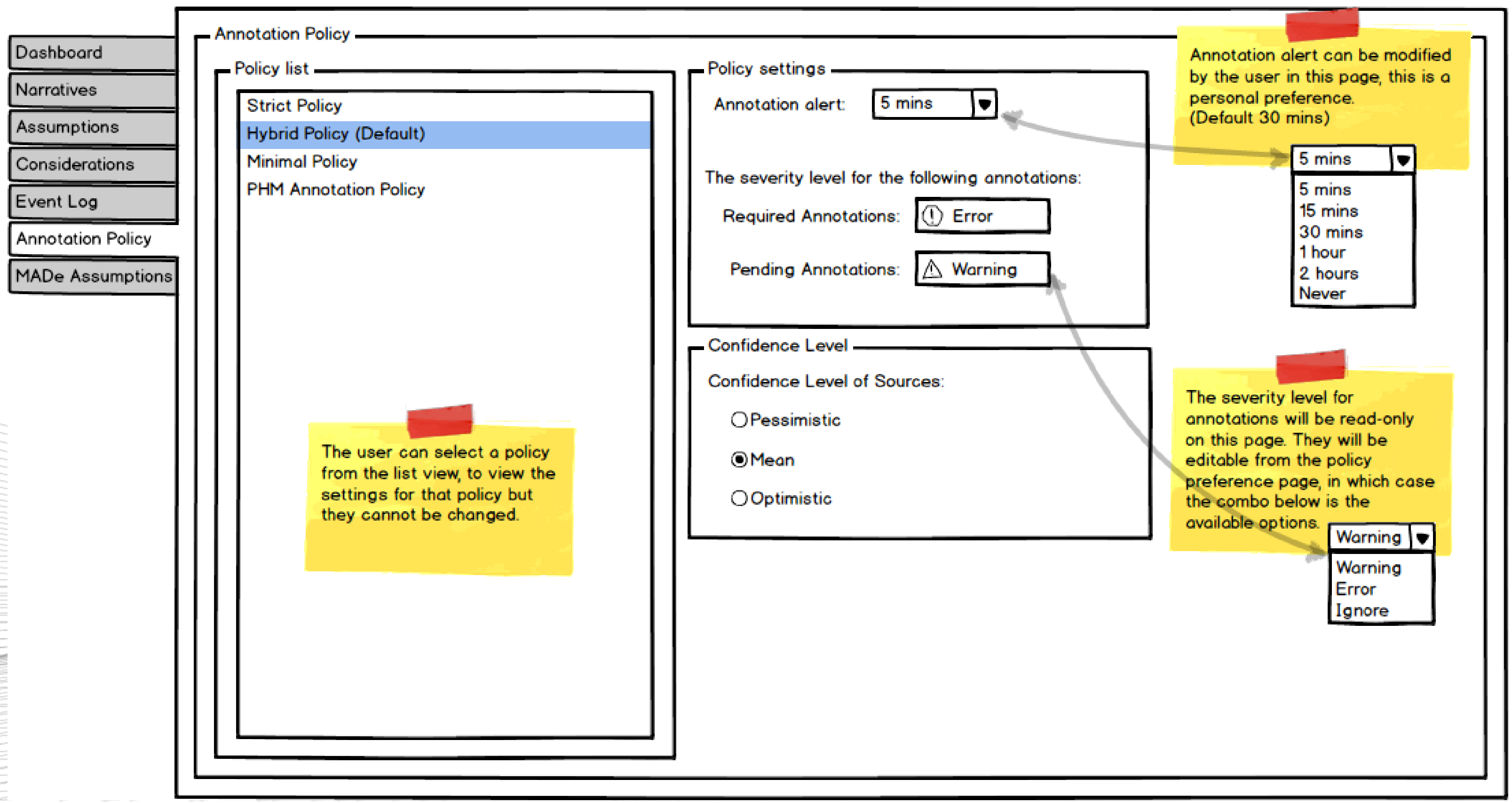
Data quality in the model

Source of data used to support analysis is a key determinant in the confidence level for the analysis outcome, and should be managed.



Data quality policy for a model

Consistency of approach to the source of data is context dependent and should be established by the management function rather than the engineer.



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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).

Current ADF Initiatives

MADe is currently being used to support maintenance optimisation programs for

- ANZAC class (Maintenance Optimisation)
- Collins class (Continuous Improvement Program – CIP).

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Questions?

Thank you

If you would like further information on MADe, go to:
www.phmtechnology.com

To contact the presenter, please email me at:
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