A simulation-based approach to mitigate divergence in military sustainment budgets

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Introduction

Continuing global focus on defence budgets has resulted in increasing pressure for significant economic reductions whilst preserving military capability.

This presentation will address three key themes to meet this requirement:

- **Divergence in military sustainment budgets** - what factors drive cost over-runs and how they can be mitigated
- **Design for Supportability** - how new programs can reduce mitigate the potential for Divergence
- **Maintenance Effectiveness Optimisation (MEO)** - how legacy programs can reduce the potential for Divergence

Divergence in military sustainment budgets

What factors drive cost over-runs and how they can be mitigated

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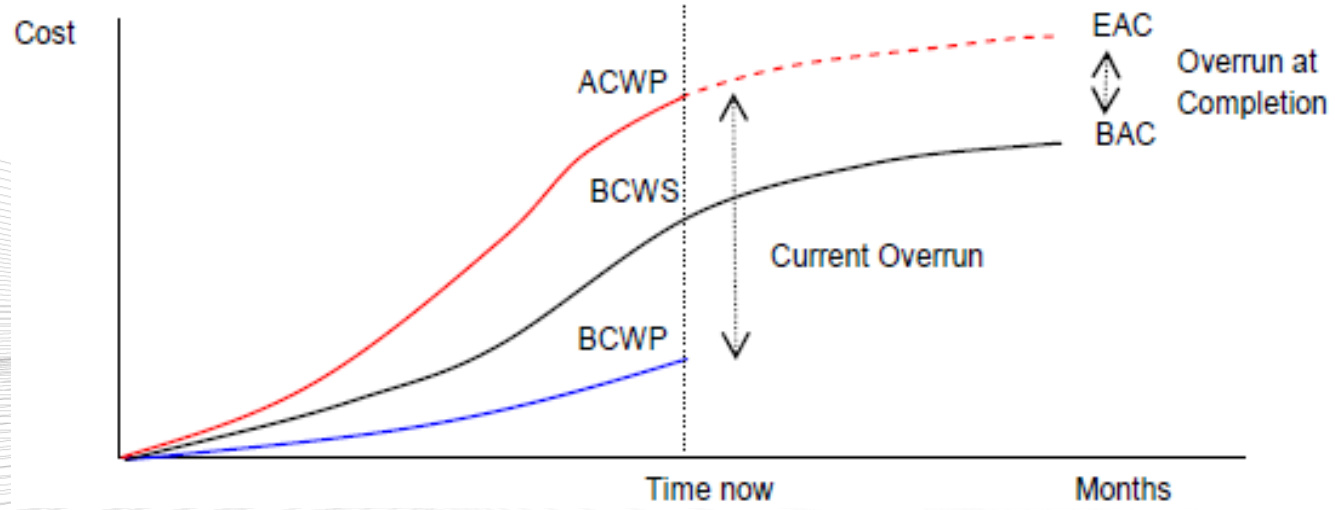
Divergence in sustainment budgets

Definition

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

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



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Divergence in sustainment budgets

Implications

Significant divergence in military sustainment programs can impact:

- military capability
  - Operational Tempo
  - Mission Profiles
  - delayed modernisation / upgrades
  - delayed replacement programs
- defence budgets
  - Total Cost of Ownership (TCO)
  - inventory management / sparing levels
  - LOTE / asset withdrawal
  - negotiation of In Service Support (ISS) contacts (initial / on-going)

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Divergence in sustainment budgets

Contributing Factors

Structural	Operational
Analysis used to support the budget? (FMECA / RAM / RCM / Testability)	How often is the analysis performed? ('one-off' deliverable / periodic / continuous)
Data Accuracy / Integrity (OEM, suppliers, 3rd party, field data)	How is the data sourced? (data range / taxonomy issues)
When is the analysis performed? (stage of design / concurrent)	Data Currency (Configuration Management of Analysis)
Level of system complexity (increasingly electronics based systems)	Level of system integration (are the analysis tools integrated? Linkages to other relevant IT systems: CMMS, PLM)

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Contributing Factors

Usage Profile

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,

Operating Environment

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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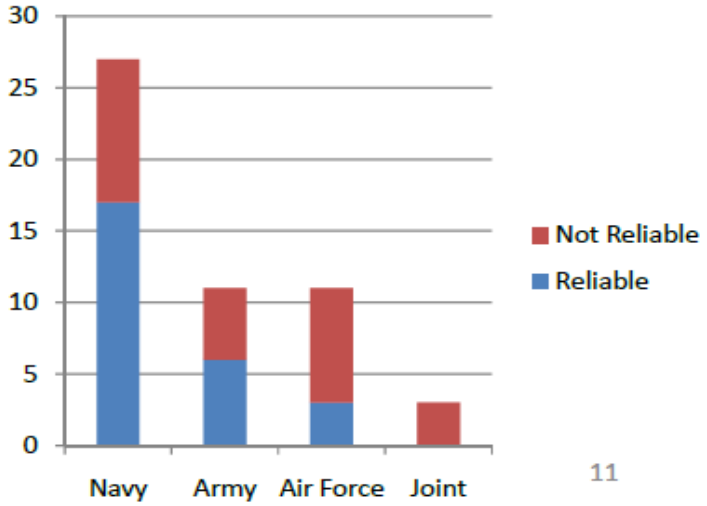
Divergence in sustainment budgets

Contributing Factors

<u>Reliability</u>

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

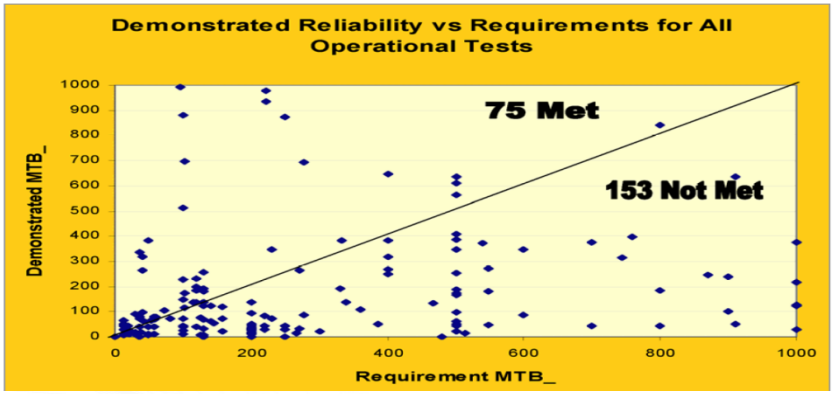


Source: DoD (DOTE) reports to US Congress 2006-11 on 52 programs

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)

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Divergence in sustainment budgets

Solution

Requirements	Benefits
Integrated analysis capability to provide accurate RAM analysis of systems through full lifecycle (concept - LOTE).	Lack of failure prevention during design is the most significant reason for systems failing. [Source: US DOD DTE]
Simulation capability to conduct 'What-If' analysis to identify / evaluate optimal support activities (reliability growth).	Improved RAM decreases life cycle costs and reduces demand on the logistics system. [Source: US DOD DTE]

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Design for Supportability

How new programs can reduce mitigate the potential for Divergence

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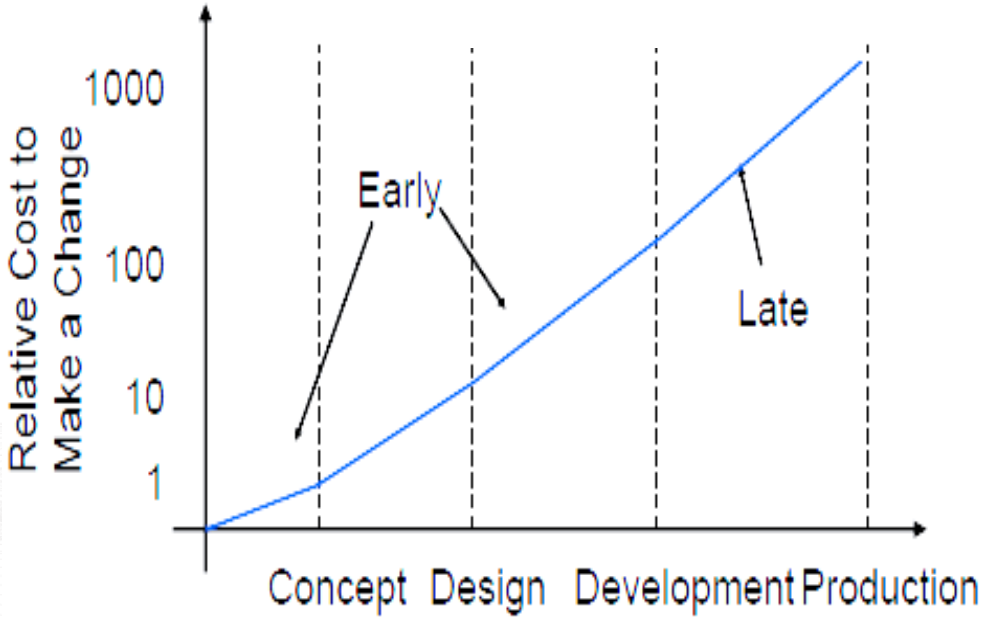
Design for Supportability

Benefits

NEW DESIGN
- Design optimisation (enables concurrent engineering)
- Risk mitigation
- Decision accuracy in the bid / acquisition process
- Platform Availability
- Knowledge Capture
- Cost benefits (design process)

LEGACY PLATFORM
- Platform availability
- Configuration Management of the analysis
- Knowledge Capture
- Cost benefits (life-cycle)



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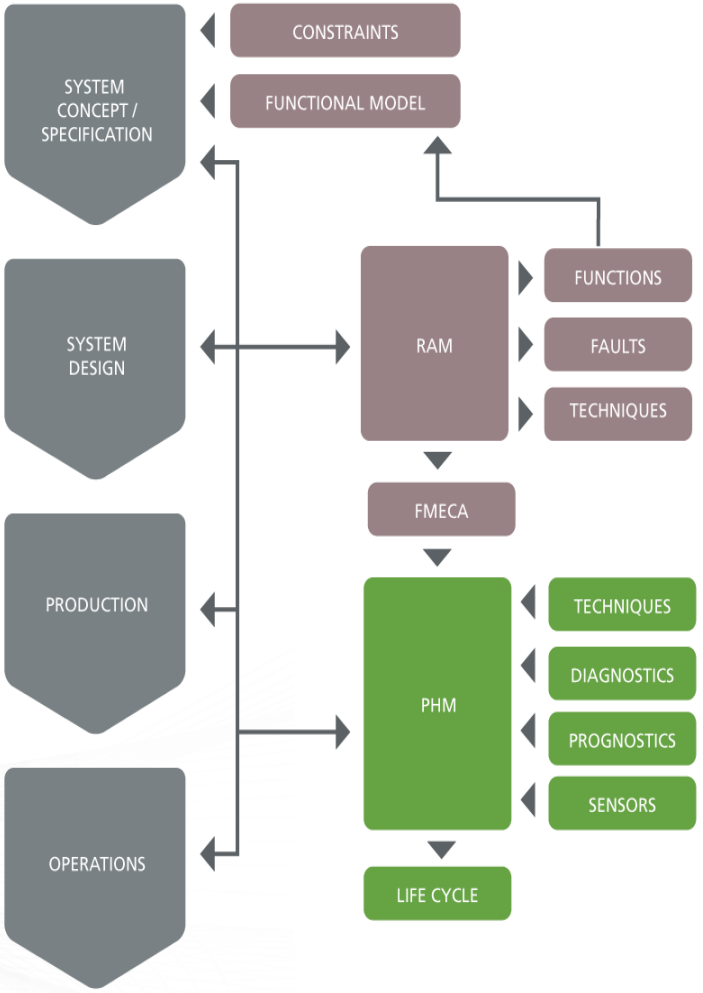
Design for Supportability

Definition & Requirements

- ‘Design for Supportability ‘is a methodology to system engineer the maintenance requirements / approach for each design iteration ***concurrently*** from concept stage***.***
- Requires ***compounding analysis*** to identify, analyse and validate the key engineering decisions that are critical to system performance
- Requires ***simulation capability*** to understand system behavior must be extensible and evolutionary based on configuration management of the analysis



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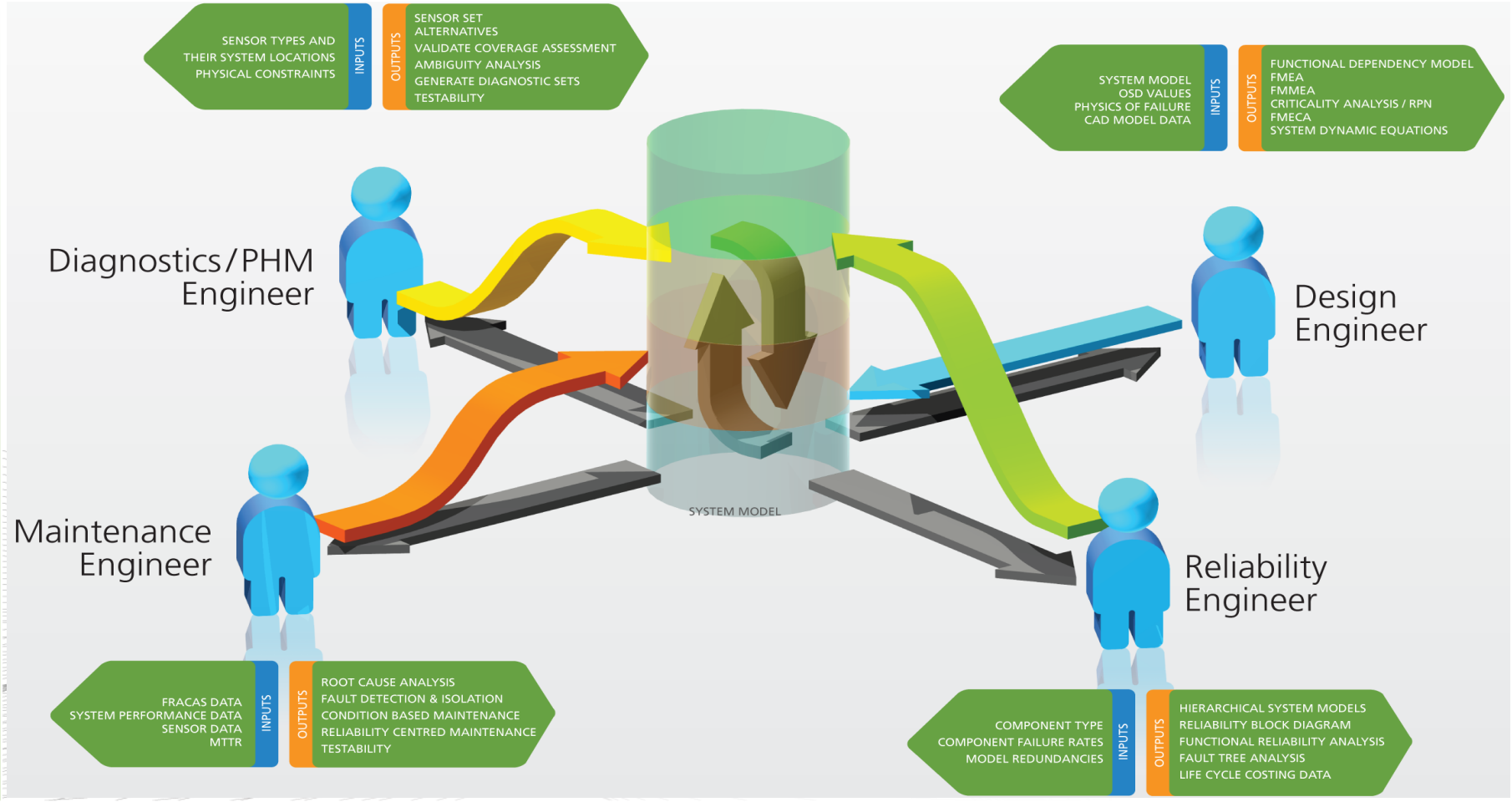
Design for Supportability

Compounding Analysis



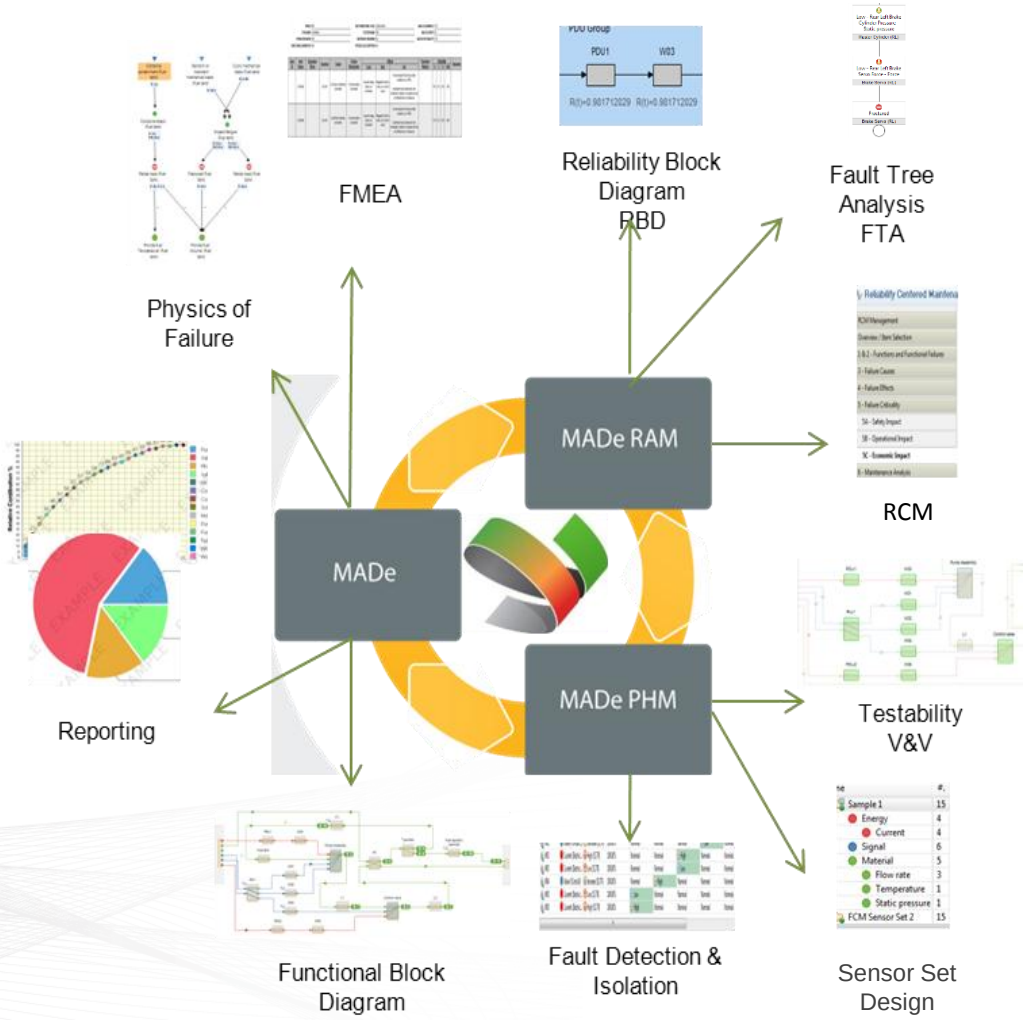
What analysis is required?

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).



Maintenance Effectiveness Optimisation (MEO)

How legacy programs can reduce the potential for Divergence

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Maintenance Effectiveness Reviews (MER)

What is a MER?

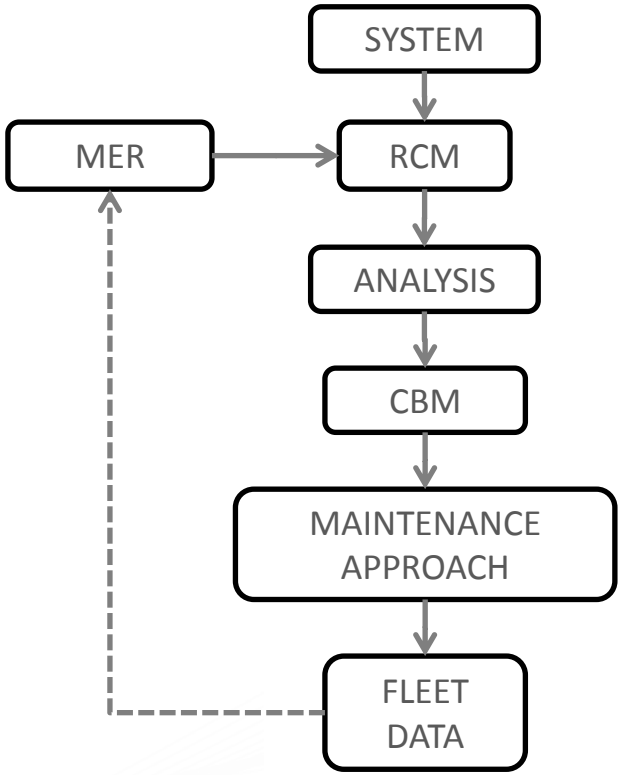
A Maintenance Effectiveness Review is a **continuous improvement** program that utilizes Reliability Centered Maintenance (RCM) to ensure existing Maintenance Tasks / Programs are effective, applicable and based on DOD Condition Based Maintenance Plus (CBM+).

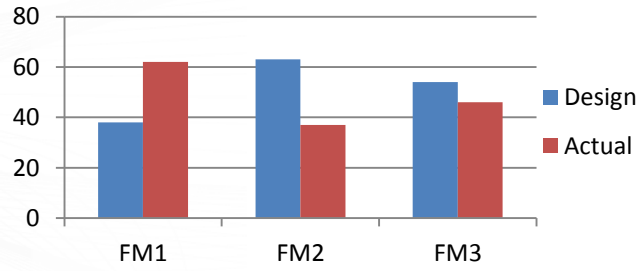
What is the value of a MER?

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.





Current issues in conducting MER

Operational data

Updating the parameters used in the RCM analysis with the configuration changes, design changes and the parameters impacted by the variance between anticipated and operational reliability of a system based on usage, cycles, environment, etc.

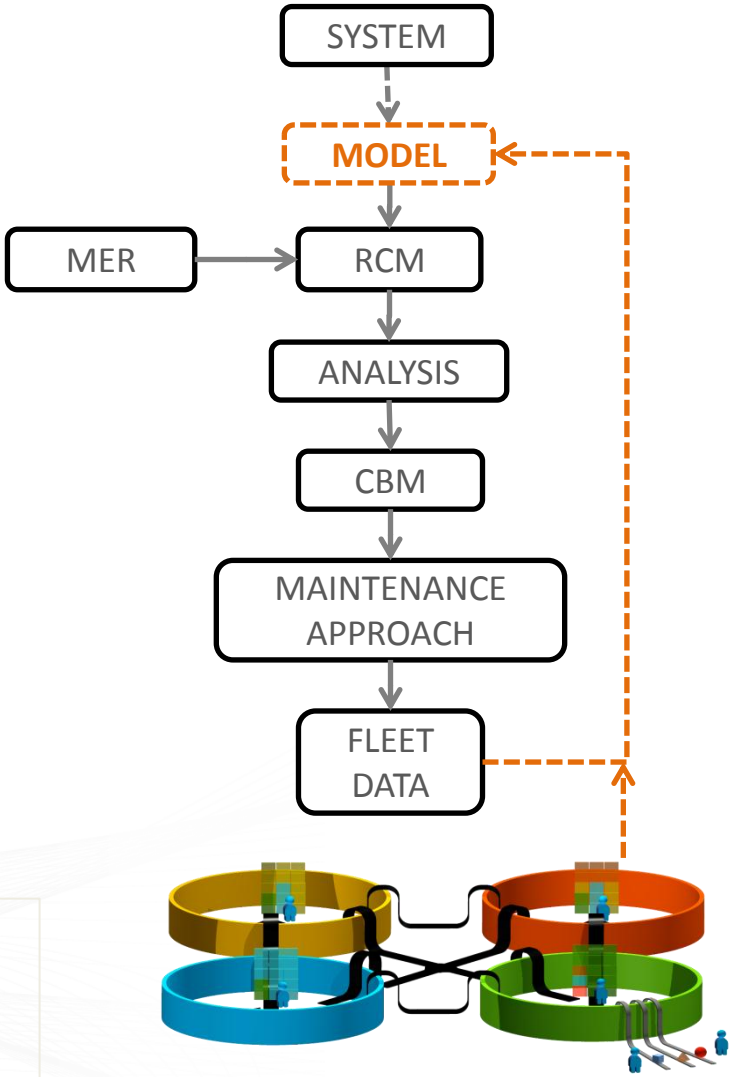
Integrated toolset

Analysis conducted on a common architecture **model that is extensible** and **readily updated with fleet data.**

What-if' capability

Simulate the effects of proposed changes in system performance identified by RCM – particularly **the impact of CBM capability.**

Solution: *a model based simulation tool with an integrated RCM analysis workflow that is readily updated with fleet data and suitable for designing CBM*



Optimising operational data collection

Divergence in sustainment budgets

Establish a ranking of the contributing factors to Divergence:

Contributing Factor	Ranking	Weighting
System Reliability		
Operating Profile		
Operating Environment		
Data Accuracy		
Data Collection		
Analysis tools		
Configuration Management of Analysis		
Changed Supply Chain Assumptions		
Insufficient analysis during early lifecycle		
No investment in reliability improvement		
Insufficient analytical expertise		
Other		

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For further details on this presentation please contact the Conference Organisers

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