MADe – Reliability Allocation

Design for sustainment based on expected reliability

Key benefits

- Generation of reliability targets / requirements
- Comparison of requirements to design/ operational reliability
- Analysis in context of the mission profile
- Traceable data thread over design and operation lifecycle

Key features

- Model-based reliability allocation
- Equal and multiple weighted analyses
- Rapidly define system reliability requirement

The Problem: One of the goals of the design process is to ensure a reliable system. But, reliability targets specified in the design requirements are typically high-level and system oriented. Given system reliability itself is typically defined from the bottom-up there can be a disconnect between component level design and system level requirement, leading to operational risk associated with system availability, maintenance and support costs.

The Solution: MADe Reliability Allocation apportions top-level reliability down to the system's constituent components and parts based upon the system's use case (or mission profile). This provides granular and actionable reliability requirements for each item. Utilised with the model-based environment of MADe reliability can be tracked and as the design progresses, can be assessed against the as-designed and as-maintained performance of the system.

MADe Reliability Allocation for meeting design requirements

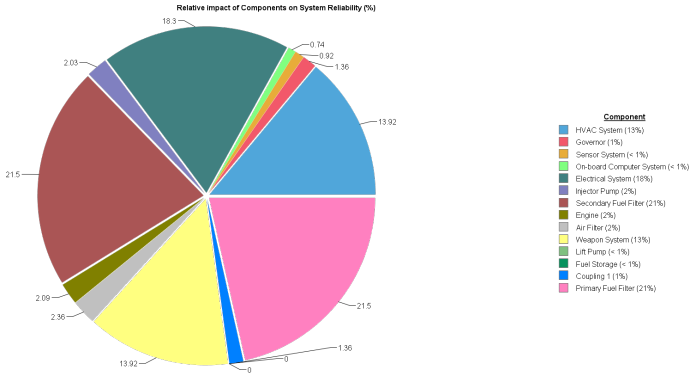
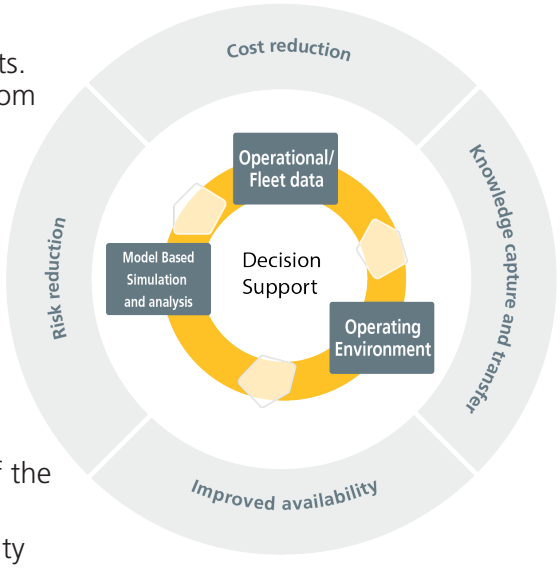


Figure 1: System reliability allocated using hardware complexity as a weighting criteria

How does Reliability Allocation fit into system design?

Reliability Allocation allows high level reliability targets to be broken down and applied to the subsystem, component or part level. Using specific targets as requirements during the system engineering process allows engineers to confidently design or acquire items to meet reliability targets. When items are later integrated into the wider system, less deviations from reliability targets are encountered leading to a reduction in redesign risk and costs.



Which methods of allocation does MADe support?

MADe provides the following industry standard allocation methodologies:

- Weighted Allocation methods:
  - State of the Art – Items are ranked based upon level of technological development with undeveloped items being set lower targets
  - Hardware Complexity – Items are ranked based on complexity of the physical hardware with complex items being set lower targets
  - Functional Complexity – Items are ranked based on the complexity of functions with more complex items being assigned lower targets
  - Historical Reliability Data – Items are ranked on historical reliability data providing lower targets to historically less reliable items
- Equal Allocation – Item reliability is allocated equally at each level of indenture in order to meet the parent item's target reliability with no weighting or bias

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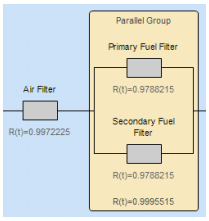
made
decisions better MADe...

Reliability Allocation within the design process

Generating Reliability Allocation Analyses

Reliability Modelling



Reliability Allocation

Allocated Rel...	Allocated Failu...
0.9500000	1455.1289
0.9500000	1455.1289
0.9926992	207.8756
0.7598379	7791.4926
0.8256452	5435.1821

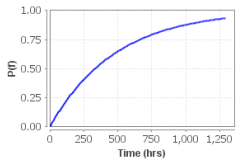
Application to Model

Current MTTF	Allocated MTTF
100000000.00	26739.09
7828849.31	793.90
7828849.31	793.90
100000000.00	402458.25
100000000.00	402458.25
100000000.00	24132.36

1) A Reliability Block Diagram (RBD) is created in MADe
2) An Allocation analysis is conducted
3) Allocated values are to the system model as applied targets or baseline reliability state

Comparing operational data to target reliabilities

Update Model with Current Data



Generate Reliability Analysis

Item	Reliability
Landing Gear System (fixed wing)	0.0603905
Door Sensor	0.0663632
Door Sensor 1	0.9987008
Door Sensor 2	0.9987008
Downlock	0.9997100
Downlock 1	0.9997100
Downlock 2	0.9997100
Downlock Proximity Sensor	0.9987008
Downlock Sensor 1	0.9987008
Downlock Sensor 2	0.9987008
Front Panel (F)	0.9987008

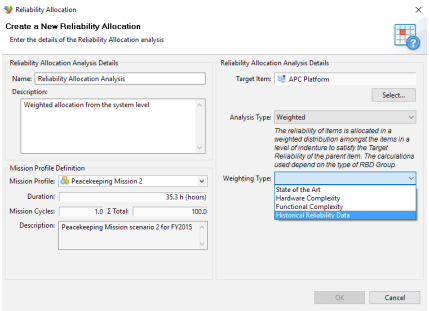
Output Delta Report

RELIABILITY	MTTF
B: 0.0 R: 0.9487131 D: 0.9487131	B: 871.98 R: 4291276.62 D: 4290404.64
B: 0.0 R: 0.9828101 D: 0.9828101	B: 961.54 R: 19865173.66 D: 19864212.12

1) As design of system develops input new data into model
2) Assess expected reliability of the system
3) Run comparison between target and current reliability performance

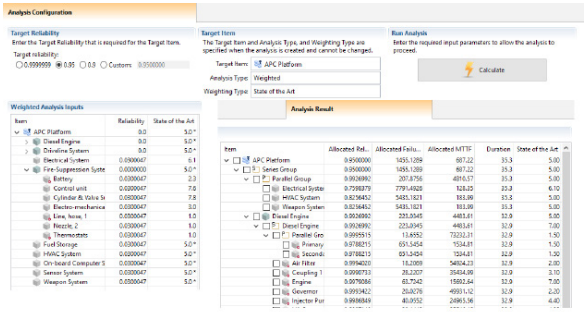
Reliability Allocation

Allocation Settings



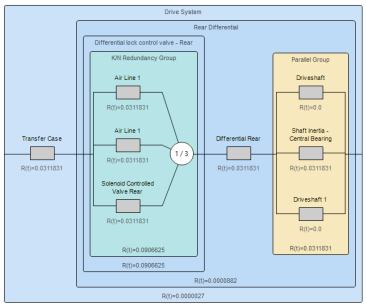
Equal Allocation within MADe

Weighted Allocation



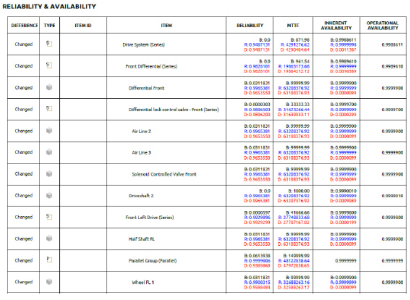
State of the Art, Weighted Allocation within MADe

RBD



Reliability captured within the RBD system structure

Reliability Comparison Report



Comparison between target and operational reliabilities

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