MADe for Condition-Based Maintenance

Design, improve and justify a Condition-Based Maintenance (CBM) capability

Key benefits

- Risk mitigation for critical and catastrophic failures
- CBM capability design/ assessment / validation conducted iteratively
- Analysis conducted at every stage across the life-cycle of the asset
- Enables trade studies for CBM capability – does it 'buy its way onto the system'?

Key features

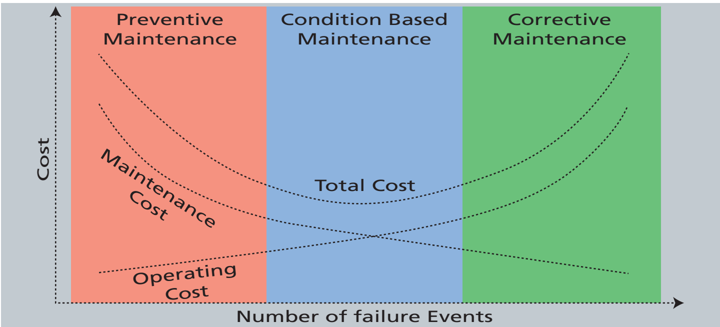
- Automated sensor selection (test points)
- Comparison of alternate sensor sets (coverage, weight, reliability, etc.)
- Automated generation of diagnostic rules
- Supports development of model-based reasoners

When it comes to maintenance and failure management, the key is to possess the "right information in the right time and act accordingly". The optimal maintenance strategy seeks to minimize corrective and preventive maintenance and only conduct those actions that are required to ensure operational availability of the asset – thereby reducing the cost of sustainment.

It is difficult to identify an incipient failure within a complex asset with sufficient notice to respond, particularly when the maintenance approach is predominantly routine or time-based preventive maintenance (which implies occurrence of unnecessary servicing and removing equipment that are still in a healthy state). As a result, the impacts of unnecessary or inadequate maintenance on operating costs, asset reliability and availability are significant but not well understood.

The determination of when maintenance is required is usually based on expected inherent reliability, but should ideally be based on the health-state of the equipment. A condition-based maintenance approach that is technically validated can provide significant economic benefits with a demonstrable Return on Investment (ROI) based on scheduling of maintenance actions based on incipient failure.

How to effectively design, improve and justify a condition-based maintenance capability?



Why use MADe PHM?

MADe is a model-based integrated toolset that enables informed CBM design decisions and trade studies to identify the most cost-effective diagnostic/monitoring approach tailored to a particular asset and its operating profile.

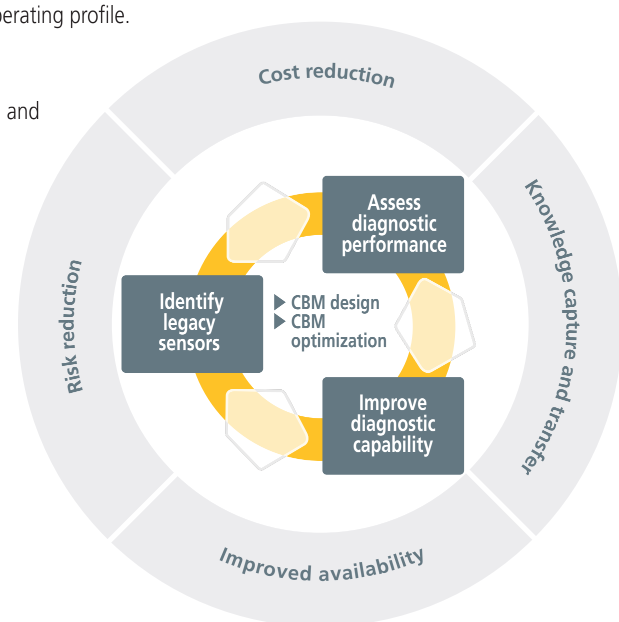
What does MADe PHM provide?

A tool for designing and monitoring CBM capabilities to generate critical failures identification and cost comparison of alternate diagnostic approaches that is:

- configurable to integrate with an organisation's engineering processes
- suitable for new and legacy assets
- efficient and cost effective at each stage of the asset life-cycle

How does MADe PHM optimise diagnostic capabilities?

MADe it is a model-based simulation tool with technical features that include automated dependency mapping and a standardized taxonomy of functions & failure concepts to maximize consistency of the CBM design process.



So what?

Using MADe to design/improve or justify a CBM capability can:

- Optimize overall system availability and reliability across the expected life
- Mitigate the technical and economic risk of unscheduled outages
- Leverage the inherent diagnostic infrastructure of the asset

PHMTechnology

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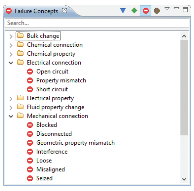
made
decisions better MADe...

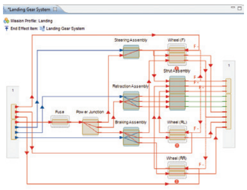
How does MADe support CBM capability design, improvement and justification?

How to identify potential failures?

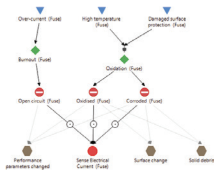
Standardized Taxonomy for Functions and Failure Concepts



Functional Model



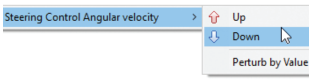
Failure Diagram



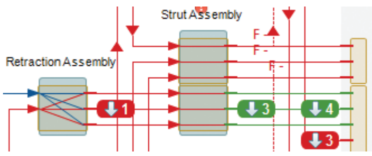
- Failure identification based on functional dependencies within the asset.
- Define and capture causes/ mechanisms/faults/symptoms associated with each failure.

How can local, next and end effects of critical failures be determined?

'What-if' Analysis of Various Failure Scenarios



Automated Failure Propagation and Stepping



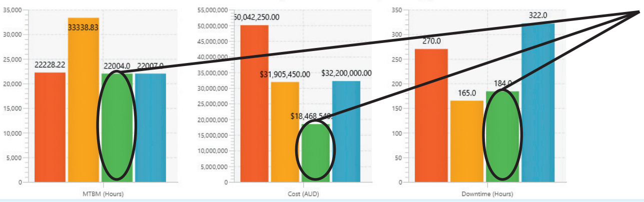
- Understand failure dependencies and effects across the system.
- Generate accurate failure data for analysis (FMECA, RCM, etc.).

Can the failure modes be cost effectively addressed by condition based maintenance?

Yes

Reliability Centered Maintenance

Transfer Front Wheel Braking Force Force Low (Wheel (F))

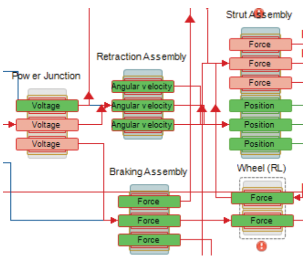


The CBM approach presents the best MTBM, downtime and cost benefits for the selected component

- Assess technical feasibility for application of CBM to critical components.
- Conduct trade studies to compare alternate maintenance approaches.

What monitoring capability is required?

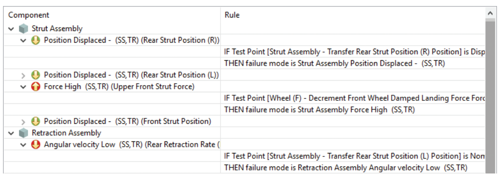
Diagnostic Requirements Assessment



- Define sensors location, expected performance and reliability.
- Leverage the existing diagnostic infrastructure (BIT, control sensors).

How can I detect each particular failure?

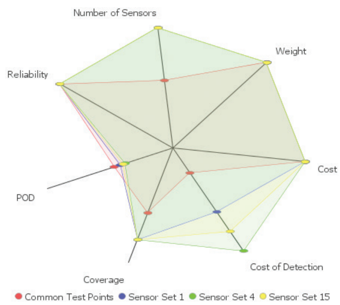
Diagnostic Rules



- Automatically generate diagnostic rules usable by the monitoring systems to detect /distinguish every failure.

What is the best monitoring approach?

'What-if' Analysis/ Trade Studies of Various Sensor Combinations



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