MADe – Failure Diagrams

Structured and consistent modelling of physical failures

Key benefits

- Consistency of failure concept descriptions
- Automation of failure identification
- Traceability of risk identification
- Knowledge capture / transfer – GUI based

Key features

- Comprehensive failure concept taxonomy
- Graphical representation of failure progression
- Auto-generation of Failure Diagrams based upon commonly associated failure concepts

The Problem: Failure analysis informs design and sustainment decisions that will impact on the maintainability, reliability, and safety attributes of a product, reflected in a Failure Mode Effect Analysis (FMEA) or Fault Tree Analysis (FTA). Inconsistent identification, classification or understanding of failure concepts by an organisation and its supply chain could lead to unidentified or undocumented engineering risk that will negatively impact on the quality of these decisions.

The Solution: MADe Failure Diagrams ensure failures are described, displayed and reported consistently and traceably. MADe Failure Diagrams use a graphical interface to represent the physical processes which can lead to an item's failure (cause, mechanism, fault, symptom) and how these can propagate throughout the system (Automated Dependency Mapping). Improving the quality of failure analysis leads to better decisions on how to mitigate these potential risks.

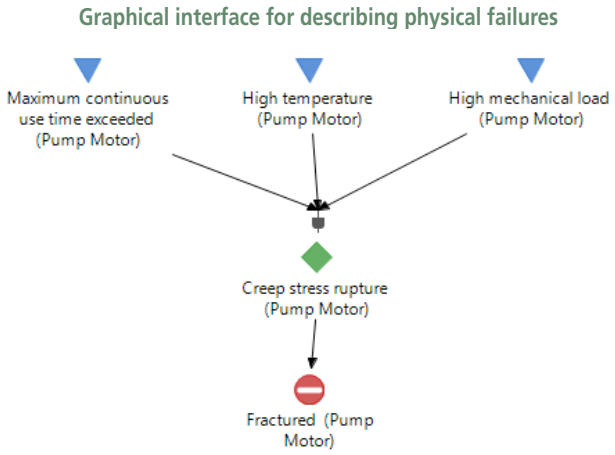

Figure 1: Failure Diagram displaying development of failures in a component

Which analyses benefit from Failure Diagrams?

Failure Diagrams are used to automate a range of engineering analyses and can be developed as the design is progressed, and then updated in the sustainment phase to reflect operational data (enables automated FRACAS based on taxonomy alignment):

- FMEA – Identifying the failures and how they progress through the system
- FTA – Performing root cause analysis to find the initiating cause of failure
- Criticality (FMECA) – Establishing which failures should be prioritised
- Diagnostics – Sensing symptoms of failure
- Maintenance- Developing maintenance activities for critical failures

What makes up Failure Diagram?

Failure Diagrams are made up of five basic concept types that are used in combination to describe the initiation and progression of failure - a graphical tree of concepts that lead to the item failure:

- Causes – Initial conditions precipitating a failure process
- Mechanisms – Physical process leading to degradation of the item
- Faults – Physically degraded state of a failed or failing item
- Failure Modes – Inability for an item to function
- Symptoms – Detectable indication of failure

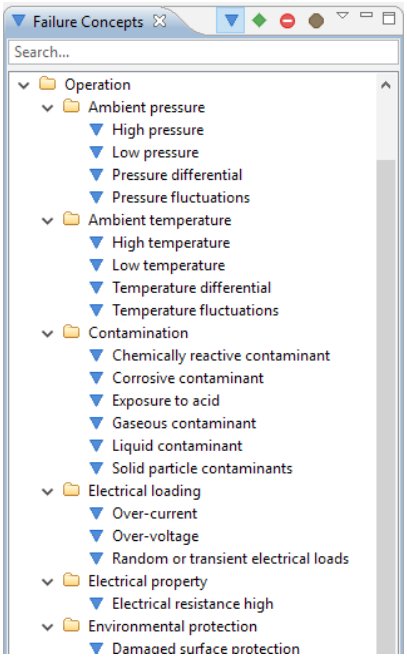

Figure 2: Physical failure modelling utilizing the Failure Concepts taxonomy

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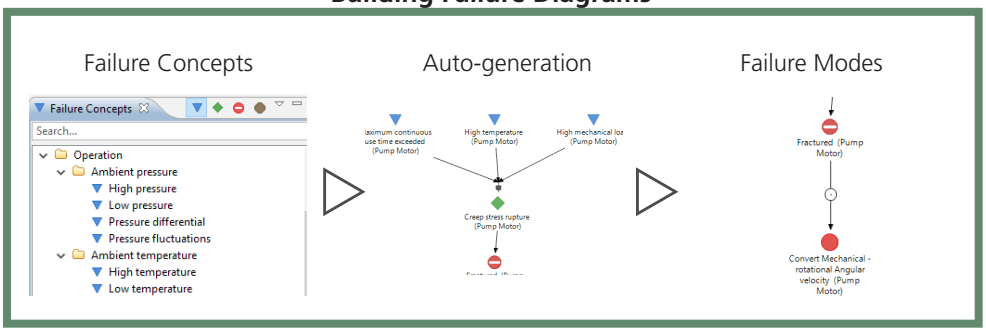
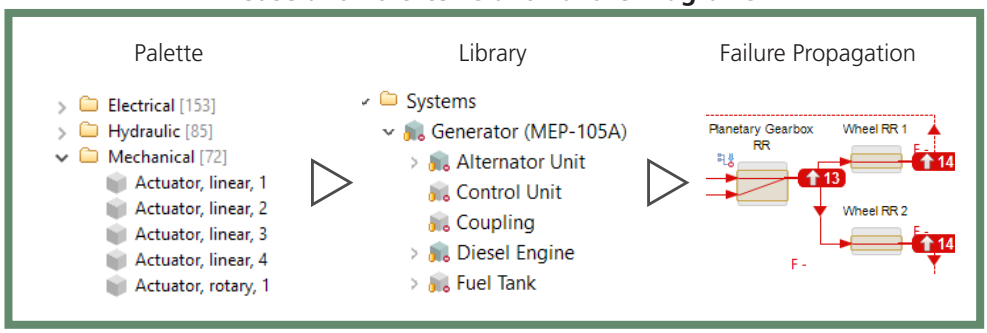
Failure Diagrams in MADe

Building Failure Diagrams



1) A taxonomy of failure concepts is stored in MADe
2) Typically associated failure concepts are linked for auto-generation of diagrams
3) Faults resulting in failure modes link the physical and functional models

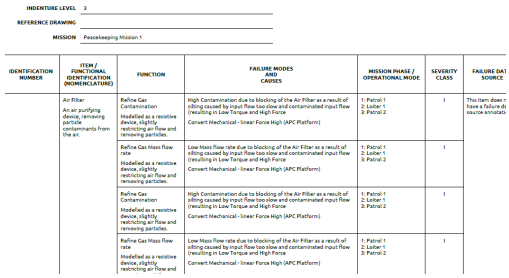
Reuse and Edit Items and Failure Diagrams



1) Generic items with failure diagrams are in the MADe palette
2) Users can save items with failure information in their own library
3) Drag and drop items into the functional model and propagate failures

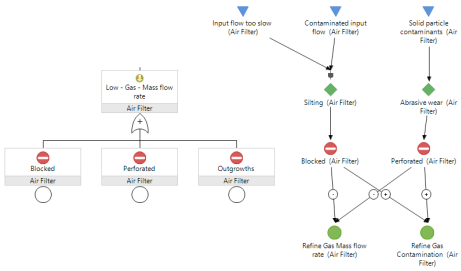
Analytical applications of Failure Diagrams

FMEA/FMECA



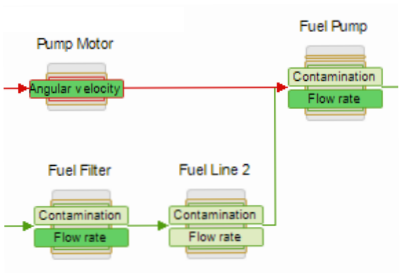
FMEA/FMECA leverage the functional and physical model to track failures

Fault Tree Analysis



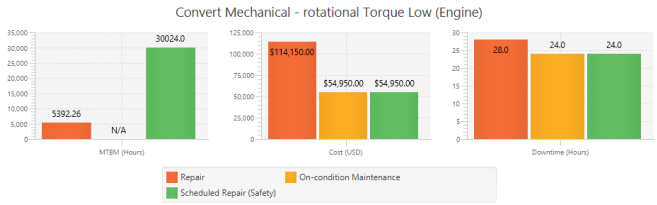
Root cause analysis from failure cause to end-effect in the FTA

PHM - Diagnostics



Sensor suites are designed using symptoms and failure modes as test points

RCM – Maintenance Actions



Maintenance actions are ascribed to item failures

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