Siemens – MADe Demonstration
Model Driven Reliability Engineering
AGENDA

• Introductions
• PHM Introduction
• MADe Overview
• Use Case Walk Thru
• Summary
The Digital Factory business follows a long-term strategy with the systematic expansion of our portfolio.

- 1958: Siemens receives patent for SIMATIC.
- 1996: TIA enables interaction between all automation components.
- 2007: UGS acquisition
- 2013: LMS acquisition
- 2016: CD-adapco acquisition
- 2017: Mentor Graphics acquisition

$10+ billion in investments since 2007
PHM Overview

• Siemens became an Equity Partner in PHM Technology as of February 2016
  • PHM Technology
    • Australian Company based in Melbourne
    • Maintenance Aware Design Environment (MADe)
    • ‘model-based’ engineering tools for the design, safety, reliability and health management of complex systems
  • MADe Modules
    • MADe
    • Safety and Risk Assessment
    • RAM
    • Prognostics and Health Management
MADe Overview - Modules

• Made Modules Overview
  • MADe Module
    • Create the functional block diagram
    • Assign functions to blocks
    • Assign failure diagrams to blocks
    • Observe flow perturbations
    • Observe flow responses
• Made Modules Overview Continued

• Safety and Risk Assessment Module
  • Entering criticality factors using the Criticality & Reliability Editor
  • Analyzing criticality of the Functional Block Diagram (FBD) system model using:
    • FMEA Reports
    • FMECA Reports
    • Critical Item Analysis editor
    • Analyzing the FBD system model using Functional Fault Tree Analyses (FTA)
PHM – MADe - Modules

• Made Modules Overview Continued

  • RAM Module
    • Enter Reliability data for items/elements in the system model
    • Create Groupings for Availability/Reliability Block Diagram (ABD/RBD) Items
    • Conduct a Reliability analysis on RBD/ABD model
    • Conduct a Functional Fault Tree Analysis
PHM – MADe - Modules

• Made Modules Overview Continued

  • PHM Module
    • Analyzing a Functional Block Diagram (FBD) system to determine sensor test points
    • Modify existing sensor arrangements based on user knowledge or trade-offs
    • Optimizing sensor coverage using Sensor Sets
    • Enter or customize sensor information into a Sensor Library
Demonstration Focus Areas
(MADe Module and RAM Module)

- Reliability Prediction
- Design FMEA
- Design Validation Plan and Report
- Field Reliability
- New Failure Modes
- Existing Failure Modes
- Requirements
- Risk Reduction
- Failure Data
- FRACAS
MADe Overview Flow

Create a New Project

Create Functional Block Diagram

Create & Assign Failure Diagrams

Assign Criticality

Assign Occurrence, Severity & Detectability

Assign Historical Reliability
## MADe Benefits

<table>
<thead>
<tr>
<th>Activity</th>
<th>Benefit</th>
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<tbody>
<tr>
<td>Create a New Project</td>
<td>Central Repository for Project Reliability Data</td>
</tr>
<tr>
<td>Create Functional Block Diagram</td>
<td>Facilitates organizational input and review</td>
</tr>
<tr>
<td>Create &amp; Assign Failure Diagrams</td>
<td>Standard Failure Taxonomy – Consistency and Correctness</td>
</tr>
<tr>
<td>Assign Criticality</td>
<td>Integrated FMEA/FMECA</td>
</tr>
<tr>
<td>Assign Occurrence, Severity &amp; Detectability</td>
<td>Integrated FMECA</td>
</tr>
<tr>
<td>Assign Historical Reliability</td>
<td>More Accurate Predictions</td>
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Use Case Walk Thru

Mission Profile

FMEA/Software
FMEA/Mechanical Fault Injection

Reliability Allocation

Update Reliability Allocation with FRACAS Data

Reliability Block Diagram

Fault Trees

FRACAS

Field Reliability

Existing Failure Modes

Reliability Prediction

New Failure Modes

Design FMEA

Risk Reduction

Requirements

System Design

Design Validation Plan and Report

Failure Data

Existing Failure Modes

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Siemens PLM Software
## Use Case Summary and Benefits

<table>
<thead>
<tr>
<th>Use Case Category</th>
<th>Summary</th>
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<tbody>
<tr>
<td>Mission Profile</td>
<td>Analyze Mission Effects On System Reliability</td>
</tr>
<tr>
<td>FMEA/Software FMEA/Mechanical Fault Injection</td>
<td>Analyze Software Risk As Part Of Overall Mission Risk</td>
</tr>
<tr>
<td>Reliability Allocation</td>
<td>Reliability Prediction Based on Same Model Used to Analyze Risk (FMEA/FMECA)</td>
</tr>
<tr>
<td>Update Reliability Allocation with FRACAS Data</td>
<td>Leads To More Accurate Reliability Predictions</td>
</tr>
<tr>
<td>Reliability Block Diagram</td>
<td>Based on FBD Leading To Consistency Across Artifacts</td>
</tr>
<tr>
<td>Fault Trees</td>
<td>Based on FBD Leading To Consistency Across Artifacts</td>
</tr>
</tbody>
</table>
MADe Value

- Standard Failure and Functions Taxonomy Leads to consistency and reuse.
- One tool to perform multiple analysis (RBD, FMEA, Fault Trees)
- Model based Reliability Provides for Better Understanding and Feedback
- MADe is a standalone product that has an available integration with Teamcenter. MADe does not require Teamcenter
- When Used With the Teamcenter Integration connectivity with DVP&R, Requirements, FRACAS(future capability) – Integrated Reliability Environment
- Siemens/PHM willing to work with companies to develop additional capability i.e. Confidence Level in support of DVP&R