

Quick Tour

 **XFMEA**
Version 2018

 **RCM++**
Version 2018

ReliaSoft

Xfmea/RCM++ 2018 Quick Tour

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Quick Tour of Xfmea and RCM++

Xfmea facilitates data management and reporting for all types of **FMEA** (including Design FMEA, Process FMEA, FMECA, etc.). It also supports related analyses such as **P-Diagrams**, **DVP&Rs (Test Plans)**, **Design Reviews Based on Failure Mode (DRBFMs)**, **Process Flow Diagrams** and **Process Control Plans**.

RCM++ facilitates the **Reliability Centered Maintenance (RCM)** approach for creating effective scheduled maintenance plans. It supports traditional RCM decision logic diagrams, and also offers simulation/calculation engines to compare maintenance strategies based on cost and availability.

Answer a wide variety of questions such as:

- What is the risk in a product or process?
- Which components or assemblies pose the greatest risk?
- What failure modes might occur? What is the effect of failure?
- What controls are in place to mitigate the risk?
- What tests need to be performed?
- How can we improve the design?
- How should we plan for scheduled inspections and maintenance?

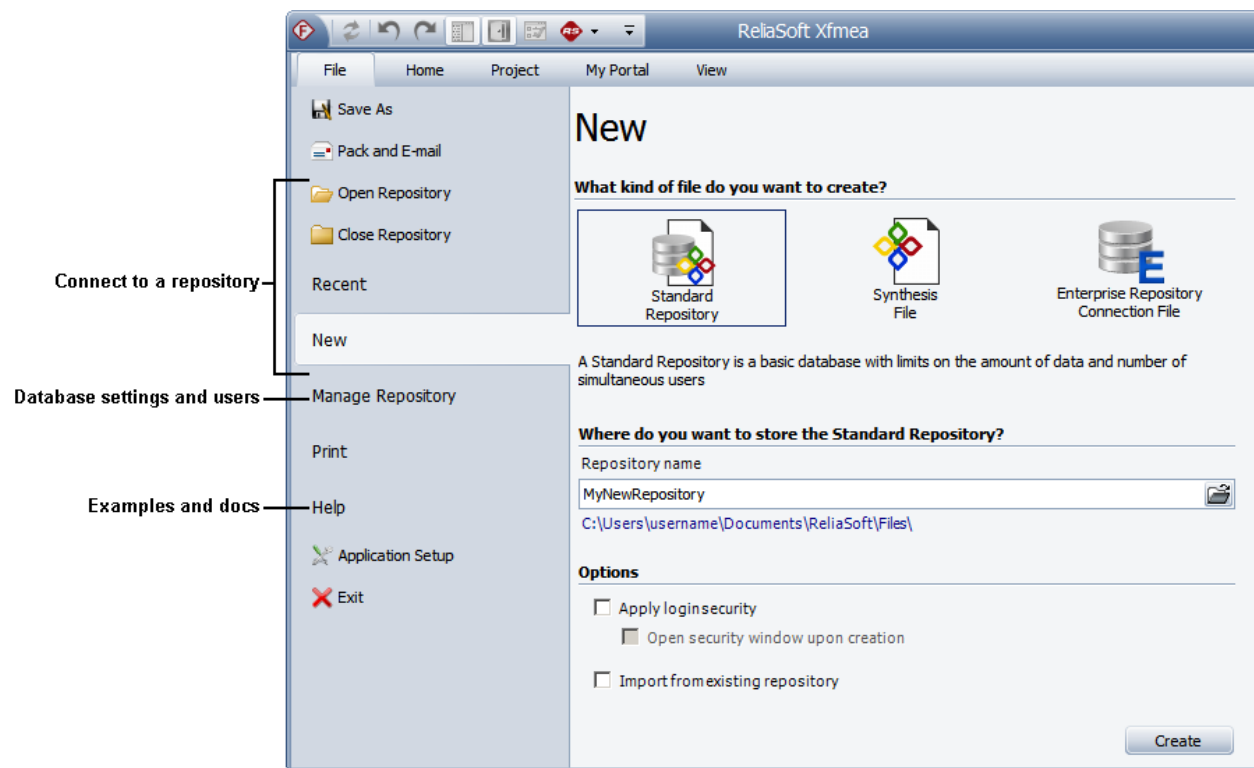
Using Repositories and Projects

File Menu

Use commands on the **File** menu (**New**, **Recent** or **Open Repository**) to create or open a *Synthesis repository* (database).

Each database supports simultaneous access by multiple users. If you have admin permissions, use **File > Manage Repository** to control user access and manage configurable settings that apply throughout the database.

Use **File > Help** to access online help and shipped examples.



Project List

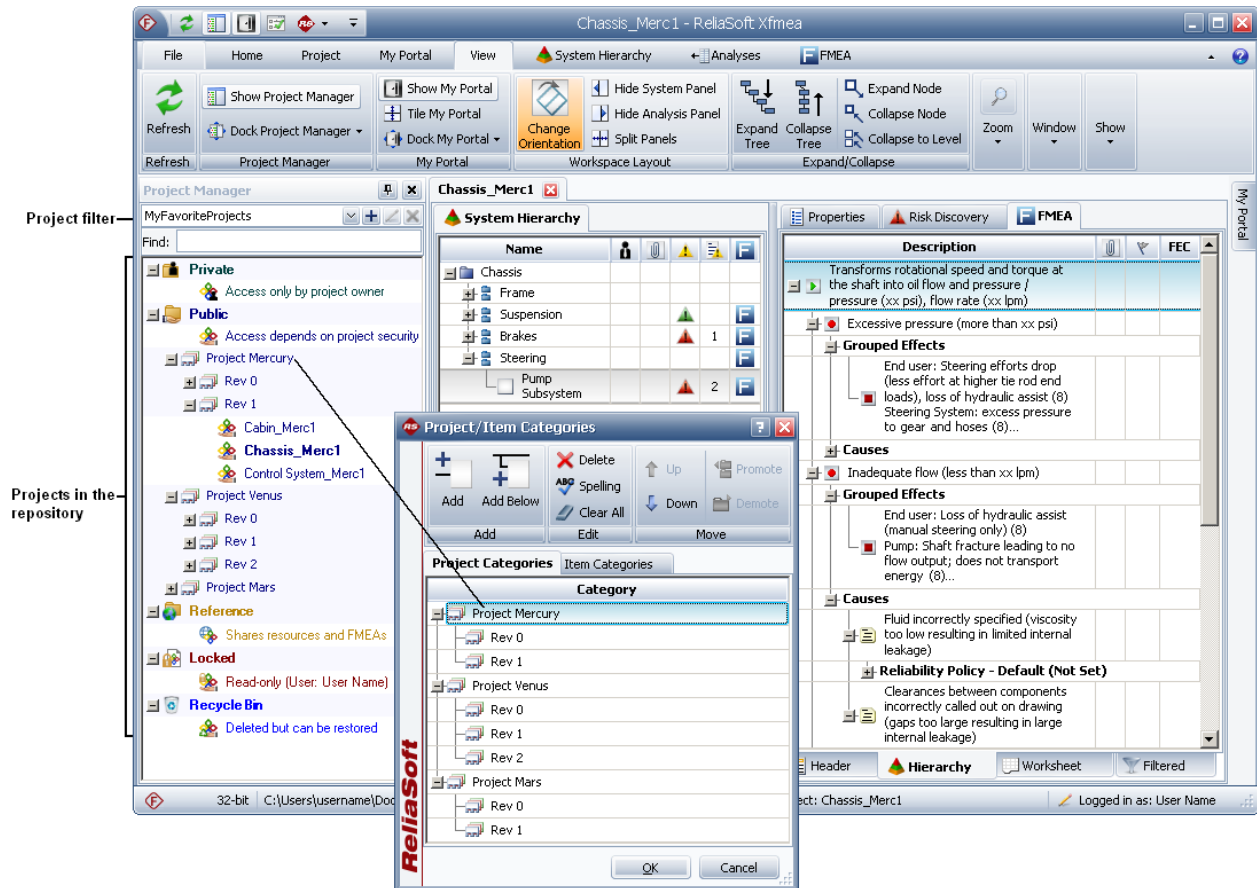
Each database can contain multiple projects. Use the **project list** to create or open a project.

If you have a lot of projects:

- Use the **project filter** to limit what's displayed.

Quick Tour of Xfmea and RCM++

- Use the **project category** to group projects within the list.



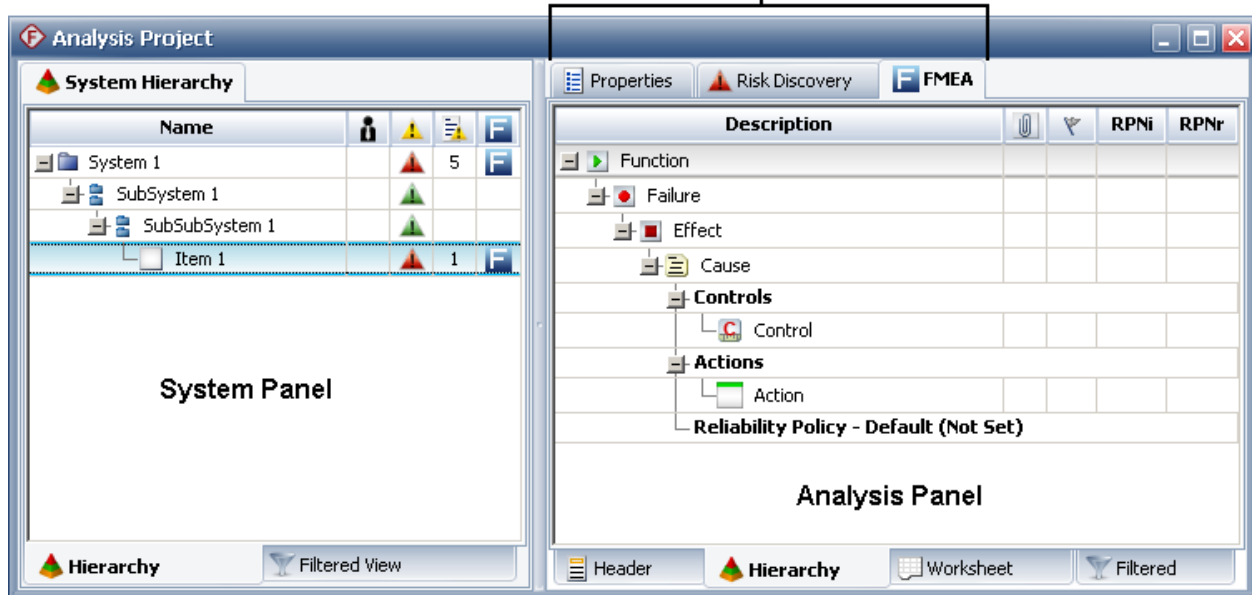
System Panel and Analysis Panel

The **System** panel shows the items that may be analyzed in the project.

- It can be a single item or a complex multi-level system configuration.
- It can be physical components/equipment or steps in a process.

The **Analysis panel** shows properties and analyses for the item that is currently selected.

These tabs allow you to view different analyses for the item that is currently selected.



Project Properties

FMEA Structure

Each project has an **FMEA structure** that will be the same for all FMEAs and RCMs in the project.

- **Grouped Effects and Causes** (commonly used for FMEA)

The effects will be entered as separate records but displayed together in the FMEA; the software calculates RPNs based on the highest severity rating.

Description	Si	Oi	Di	RPNi
Function				
Failure Mode A				
Grouped Effects				
Effect 1 (2) Effect 2 (8)	8			
Causes				
Cause 1		5	5	200
Cause 2		5	5	200
Cause 3		5	5	200

- **Effects Before Causes** (can be used for FMEA or RCM)

Description	Si	Oi	Di	RPNi
Function				
Failure Mode A				
Effect 1	8			
Cause 1		5	5	200
Cause 2		5	5	200
Cause 3		5	5	200

- **Causes Before Effects** (sometimes used for RCM)

Description
Function
Functional Failure
Failure Mode
Effect

Configurable Settings

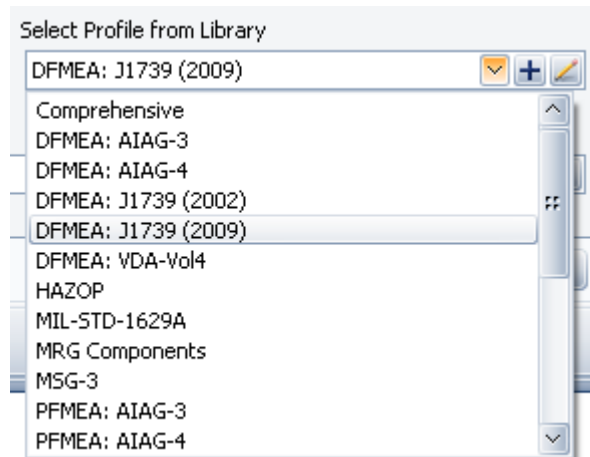
Each project also has its own **configurable settings** that enable you to customize:

<http://xfmea.reliasoft.com>

Quick Tour of Xfmea and RCM++

- Data fields and names
- Classifications, categories and other drop-down lists
- Rating scales and preferences for FMEA risk priority metrics
- Logic for risk discovery and RCM decision charts

Use the **Select Profile from Library** option in the project properties to quickly apply a predefined group of settings.



Using FMEAs

Failure Modes and Effects Analysis (FMEA) and Failure Modes, Effects and Criticality Analysis (FMECA) are methodologies designed to identify potential failure modes for a product or process, to assess the risk associated with those failure modes, to rank the issues in terms of importance and to identify and carry out corrective actions to address the most serious concerns.

The basic steps for using an FMEA are:

1. [Create the project and set project properties](#)

Choose **Project > Management > Create Project**.



In the Project Properties window, specify the **FMEA Structure** and the **Profile** that will be used to set the configurable settings.

FMEA Structure	Select Profile from Library
Grouped Effects and Causes	DFMEA: AIAG-4

2. [Add items in the system hierarchy](#)

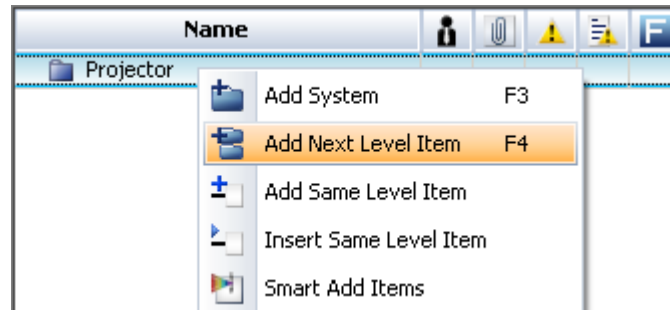
The first item is added to the system hierarchy when you create the project. Use the Properties tab in the Analysis panel to rename it and set other properties.

The screenshot shows the 'Project 1' window. On the left, the 'System Hierarchy' panel displays a tree view with a single item named 'Projector'. Below it, the 'Hierarchy' panel shows a 'Filtered View' button. On the right, the 'Properties' panel is active, showing a table with 'Property Name' and 'Value' columns. The 'Identifiers' section includes fields for 'Image', 'Name' (set to 'Projector'), 'Category' (set to 'No Category'), and 'Keywords'. Below this, there are sections for 'Other Item Properties' and 'History'.

Property Name	Value
Identifiers	
Image	
Name	Projector
Category	No Category
Keywords	
Other Item Properties	
History	

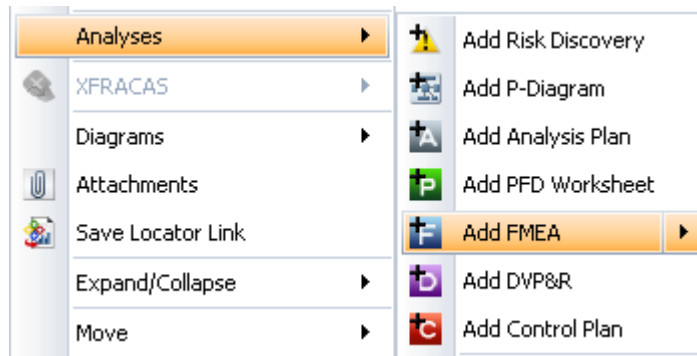
Quick Tour of Xfmea and RCM++

To add items, right-click inside the system hierarchy and choose **Add System**, **Add Next Level Item**, etc.



3. Add a new FMEA

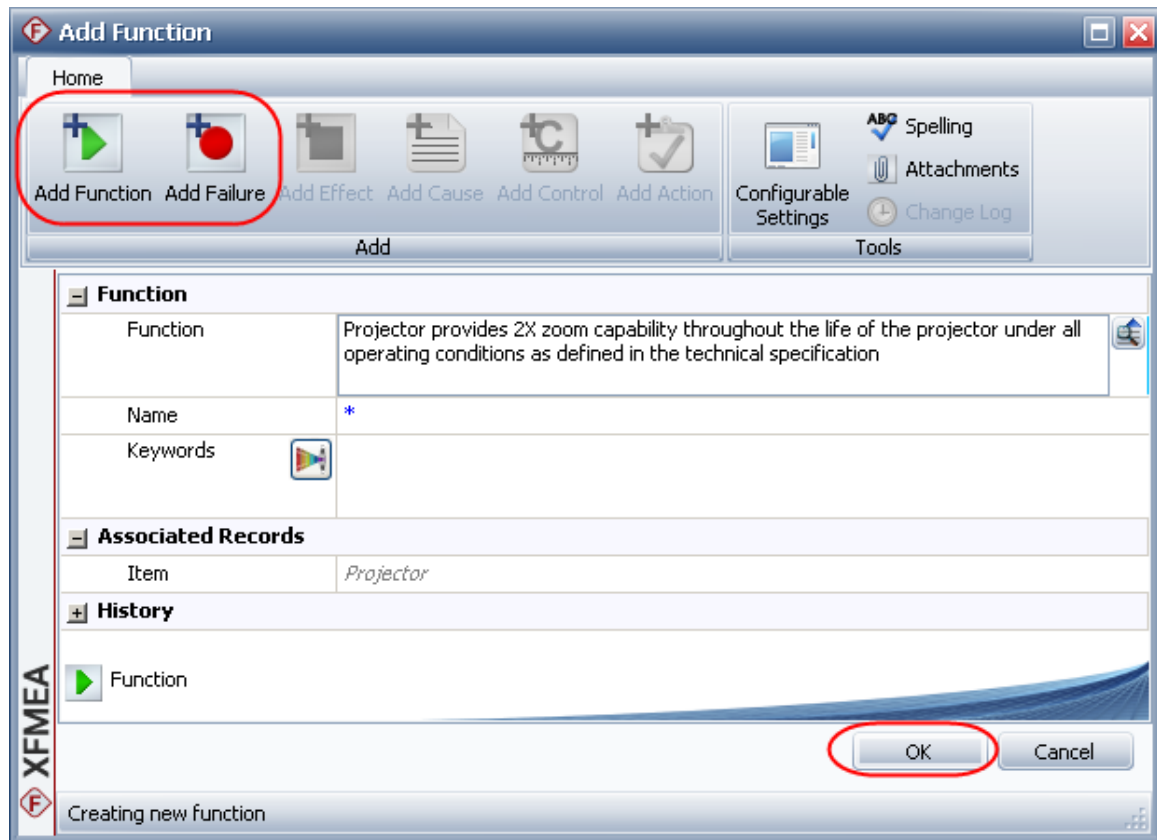
To add an FMEA for an item, right-click the item in the system hierarchy and choose **Analyses > Add FMEA**.



4. Add records in the FMEA hierarchy

The Hierarchy tab for an FMEA displays the analysis records in a hierarchical tree, which tends to be good for viewing a lot of information in a small amount of space. In this view, you will use properties windows to add or edit FMEA records.

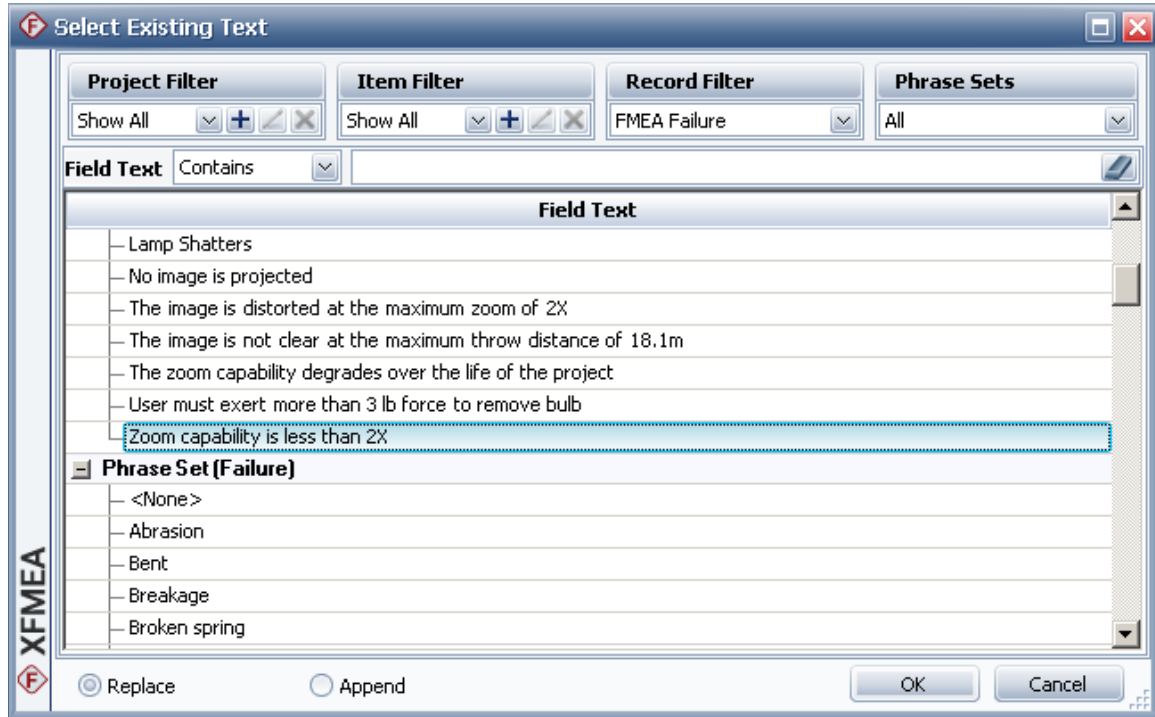
When you add a new FMEA, the Function window will automatically open. Enter the details and click either **Add Function** (to add the next function description), **Add Failure** (to add the first failure mode for this function) or **OK** (to close the window).



5. [Use Select Existing Text utilities](#)

The Select Existing Text window provides a list of existing descriptions that might apply to the current text field or analysis.

If you want to use this utility to replace or append text in an input field, click the icon next to the field.



The Select Existing Text window can also be used to add multiple records at once. For example, right-click a function record and choose **Add Multiple Failures > Select Existing Text**.

6. [View RPNs and related metrics](#)

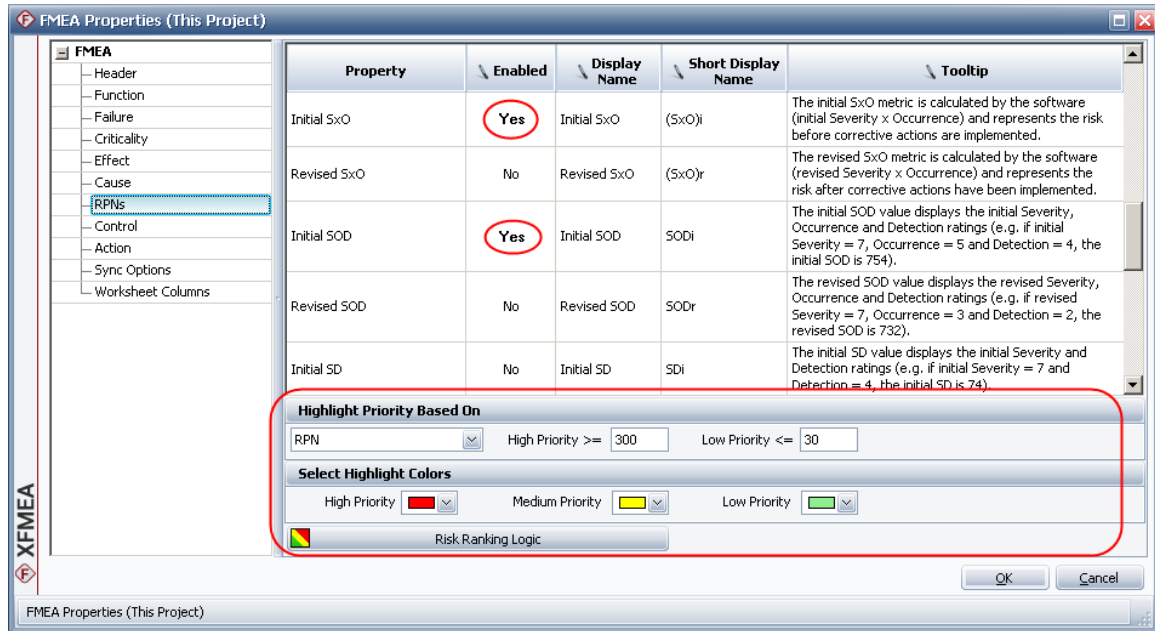
You can choose to calculate and display a variety of metrics based on the Severity, Occurrence and Detection ratings that have been assigned for effects and causes in the FMEA: RPN, SxO, SOD, SD or QCPN.

To configure the metrics that are enabled for the current project, choose **FMEA > Tools > Configurable Settings**.

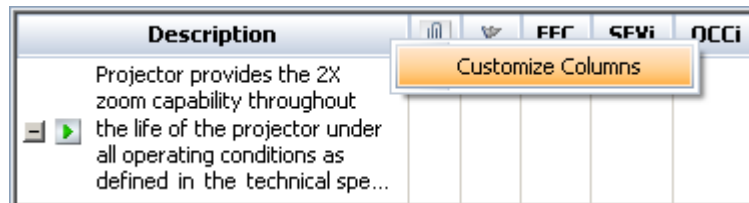


On the RPNs page, use the Enabled column to specify which metrics will be available in the current project.

Use the **Highlight Priority Based On** area to configure the logic that will be employed when a user turns on the priority highlights feature.



To choose which metrics will be displayed in the FMEA hierarchy for your computer, right-click a column header in the FMEA and choose **Customize Columns**.



To turn on priority highlighting, choose **FMEA > Tools > Highlight Priority**.



7. Use the filtered and worksheet views

a. Filtered view

Click the Filtered tab at the bottom of the FMEA to open the filtered view. This view presents a sortable list of all records of a particular type, such as causes sorted by RPN or actions sorted by due date.

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Use the **Filter By** drop-down list to select which records are displayed. Then click inside the column header you wish to sort by.

	Recommended Action(s)	Action Status	Review Status	Priority	Responsibility	Planned Completion Date
1	Perform Heat Aging test (M-389) on the Focus Rings	Past Start Date	No Review Required	Medium		8/24/2017
2	Conduct tolerance analysis between lamp and casting	Past Start Date	No Review Required	Medium		6/30/2017
3	Investigate the use of metal rather than plastic for rings	In Progress	No Review Required	Medium		5/26/2017
4	Add screw bosses to bottom case	Completed - Late	No Review Required	Medium		4/18/2017
5	Review different filter designs for cleanability	Completed - On Time	No Review Required	Medium		4/14/2017
6	Conduct a customer maintenance assessment	Past Due	No Review Required	Medium		4/5/2017

b. [FMEA worksheet](#)

Click the Worksheet tab at the bottom of the FMEA to open the worksheet view. This view allows you to type directly into the worksheet cells and tab through the analysis as you would in a spreadsheet application.

	Function	Potential Failure Mode	Potential Effect(s) of Failure	SEVi	Classification
1	Projector provides the 2X zoom capability throughout the life of the projector under all operating conditions as defined in the technical specification	Zoom capability is less than 2X	Unable to enlarge image to required specification. Image is too small for close-up projection. (7)	7	
2					
3		The image is distorted at the maximum zoom of 2X	Image is unclear, difficult to read printed words (7)	7	
4					
5		The zoom capability degrades over the life of the project	Unable to enlarge image to required specification. Image is too small for close-up projection. (7)	7	

To use the entire workspace for the worksheet view, choose **View > Workspace Layout > Hide System Panel**.



To return to a split workspace, choose **View > Workspace Layout > Split Panels**.

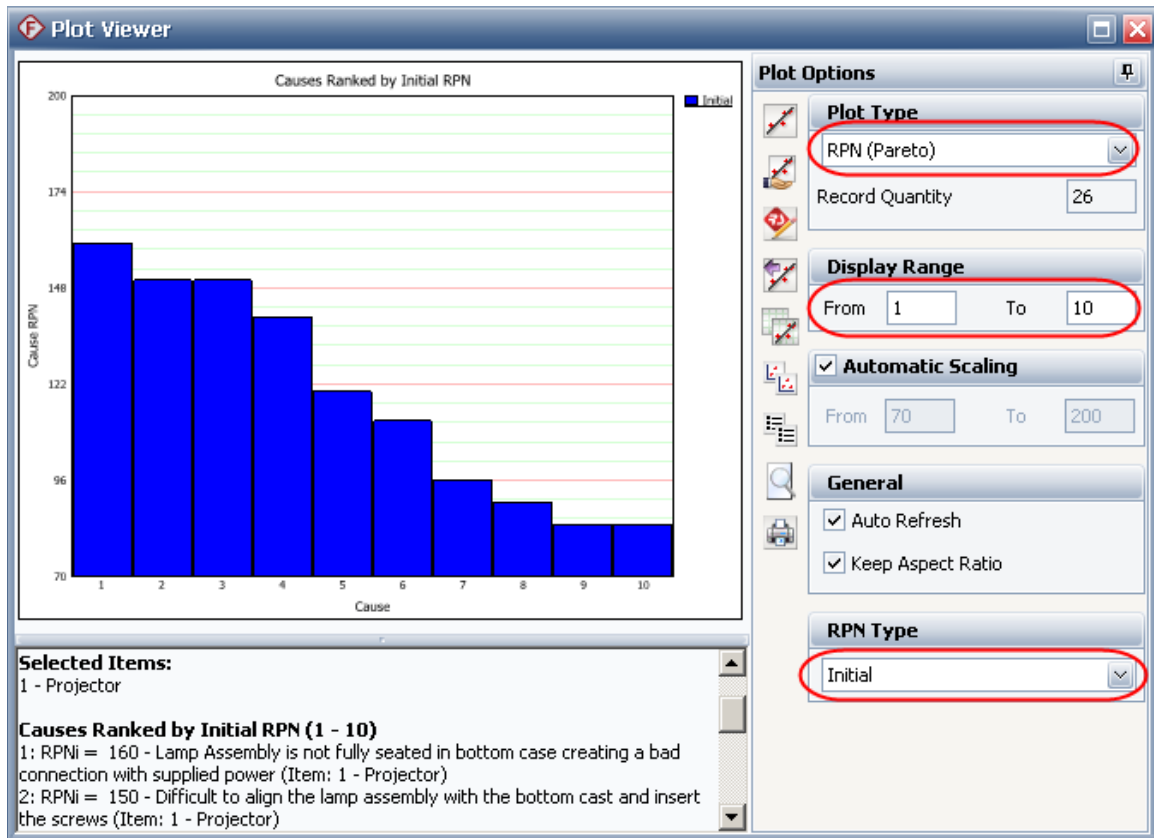
8. [Create plots](#)

Choose **Home > Reporting > Plots**.



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Select the item(s) that you want to include in the plot. Then use the control panel to select the plot type and other settings.



9. Run a query

Choose **Home > Reporting > Queries**.



First use the left panel to specify the data source (selected projects throughout the database or selected items within the current project). Then use the right panel to specify the query criteria and output preferences.

Select the type of record you wish to query

Query

FMEA Causes Show Project Show Priority Colors

Criteria Headers Customization Results

Match the criteria from: All rows Any row

Property Name	Include in Results	Criterion 1	And/Or	Criterion 2
- Initial RPN	<input checked="" type="checkbox"/>	is greater than or equal to 100	AND	is less than or equal to
- Revised RPN	<input type="checkbox"/>	is greater than or equal to	AND	is less than or equal to
- % Reduction in Cause RPN	<input type="checkbox"/>			
- Initial SxO	<input type="checkbox"/>	is greater than or equal to	AND	is less than or equal to
- Initial SOD	<input type="checkbox"/>			
- URD	<input type="checkbox"/>	Contains	OR	Contains
- Reliability model	<input type="checkbox"/>			
- Current Reliability	<input type="checkbox"/>			
- Probability of Failure	<input type="checkbox"/>			
- Has Actions	<input type="checkbox"/>	is	AND	is
- Has Controls	<input type="checkbox"/>	is	AND	is
- Created By	<input type="checkbox"/>	is	OR	is
- Date Created	<input type="checkbox"/>	is greater than or equal to	AND	is less than or equal to
- Last Updated By	<input type="checkbox"/>	is	OR	is
- Last Updated	<input type="checkbox"/>	is greater than or equal to	AND	is less than or equal to
Effects Properties	<input type="checkbox"/>			
- Effect ID	<input type="checkbox"/>	is greater than or equal to	AND	is less than or equal to
- Effect #	<input type="checkbox"/>	is greater than or equal to	AND	is less than or equal to
- Potential Effect(s) of Failure	<input type="checkbox"/>	Contains	OR	Contains
- Name	<input type="checkbox"/>	Contains	OR	Contains
- Keywords	<input type="checkbox"/>	Contains	OR	Contains
- Initial Severity	<input checked="" type="checkbox"/>	is greater than or equal to 8 - Loss of Primary Function	AND	is less than or equal to

Select which columns to display in the results

Specify criteria to limit the query results

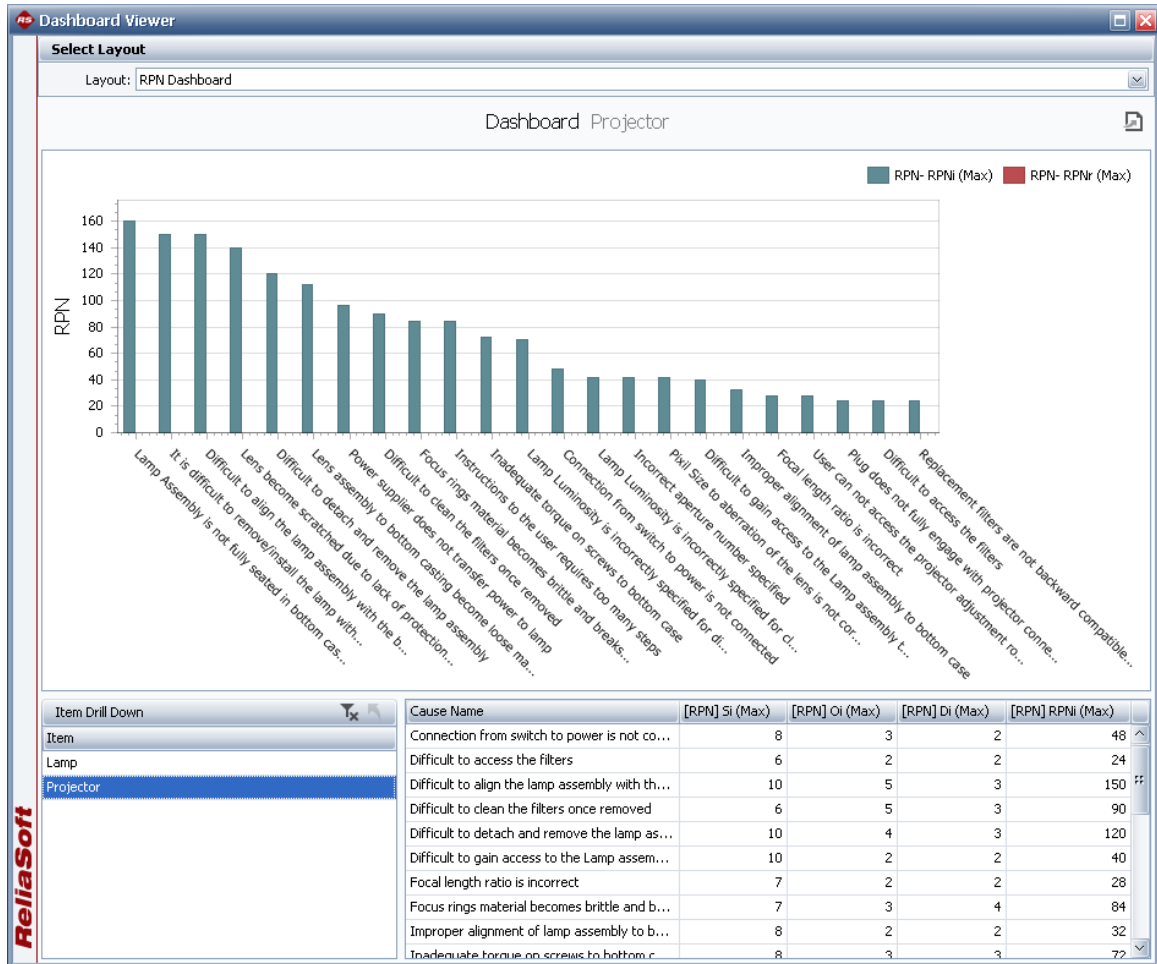
Click **Run Query** to view the records that match the criteria.

10. [View a dashboard](#)

Choose **Home > Reporting > Dashboard > Dashboard Viewer**.



In the **Layout** drop-down list, select one of the layouts that have been predefined for FMEA data and then use the dashboard to view the desired information. For example, in the RPN Dashboard you can click an item in the **Item Drill Down** panel to select which item's data will be displayed in the other 2 panels.

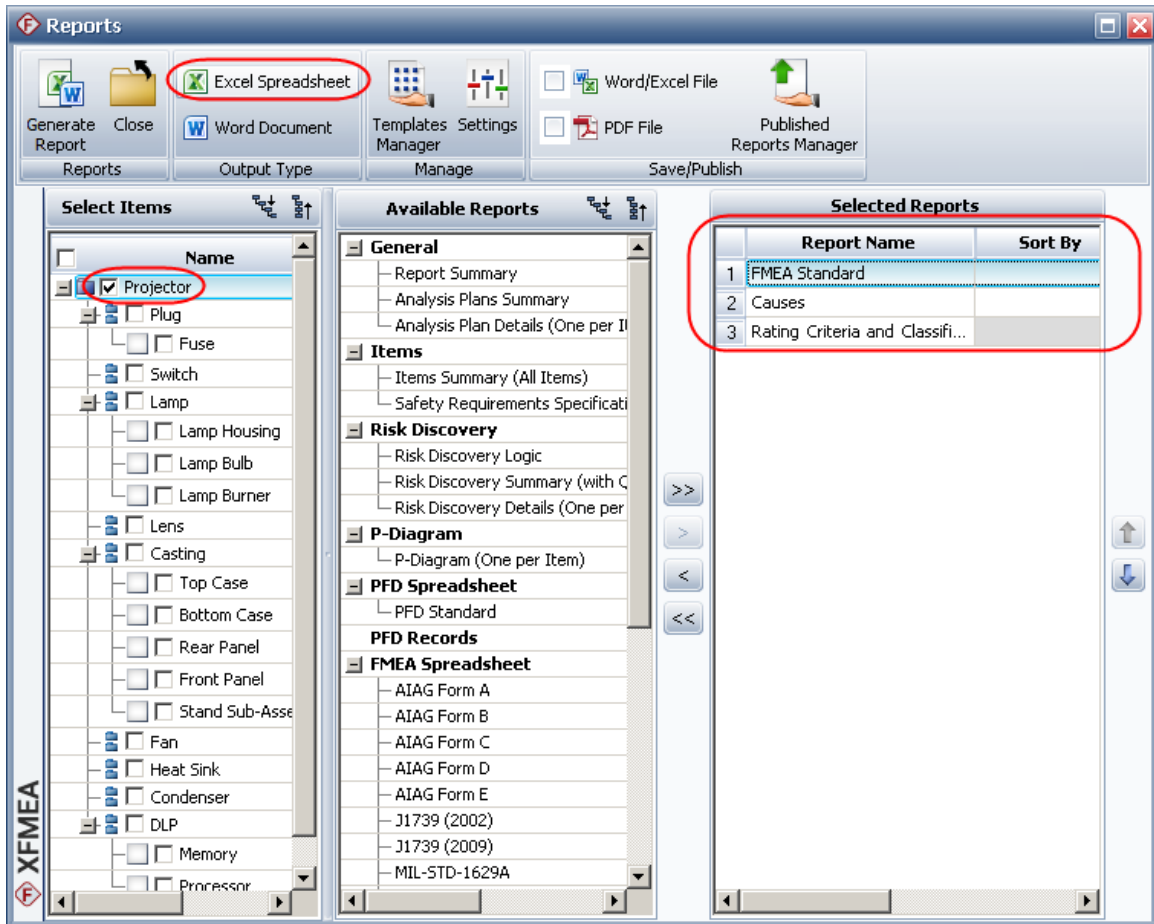


11. Generate a report

Choose **Home > Reporting > Reports.**



Select the items that you want to create a report for, the report forms you want to include in the generated report and the desired output type (Excel or Word).



Click **Generate Report** to create the report.

Using RCMs

Reliability Centered Maintenance (RCM) analysis provides a structured framework for analyzing the functions and potential failures for a physical asset in order to develop a scheduled maintenance plan that will provide an acceptable level of operability, with an acceptable level of risk, in an efficient and cost effective manner.

The basic steps for performing RCM analysis are:

1. [Create the project and set project properties](#)

Choose **Project > Management > Create Project**.



In the Project Properties window, specify the **FMEA Structure** and the **Profile** that will be used to set the configurable settings.

FMEA Structure	Select Profile from Library
Effects Before Causes	Standard RCM

2. [Add items in the system hierarchy](#)

The first item is added to the system hierarchy when you create the project. Use the Properties tab in the Analysis panel to rename it and set other properties.

The screenshot shows the 'Project 2' window. On the left is the 'System Hierarchy' panel with a table:

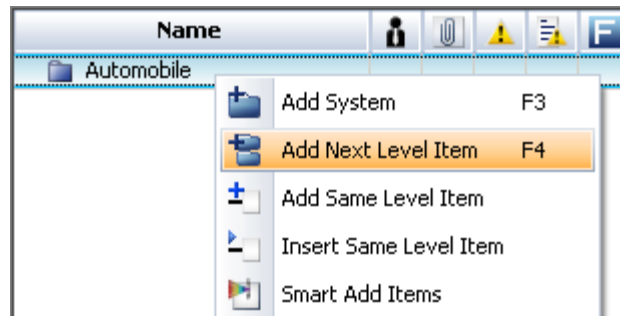
Name					
Automobile					

At the bottom of the hierarchy panel are 'Hierarchy' and 'Filtered View' buttons. On the right is the 'Properties' panel with a table:

Property Name	Value
Identifiers	
Image	
Name	Automobile
Category	No Category
Part Number	
Supplier	
Application	
Description	
Comments	
Keywords	
Other Item Properties	
History	

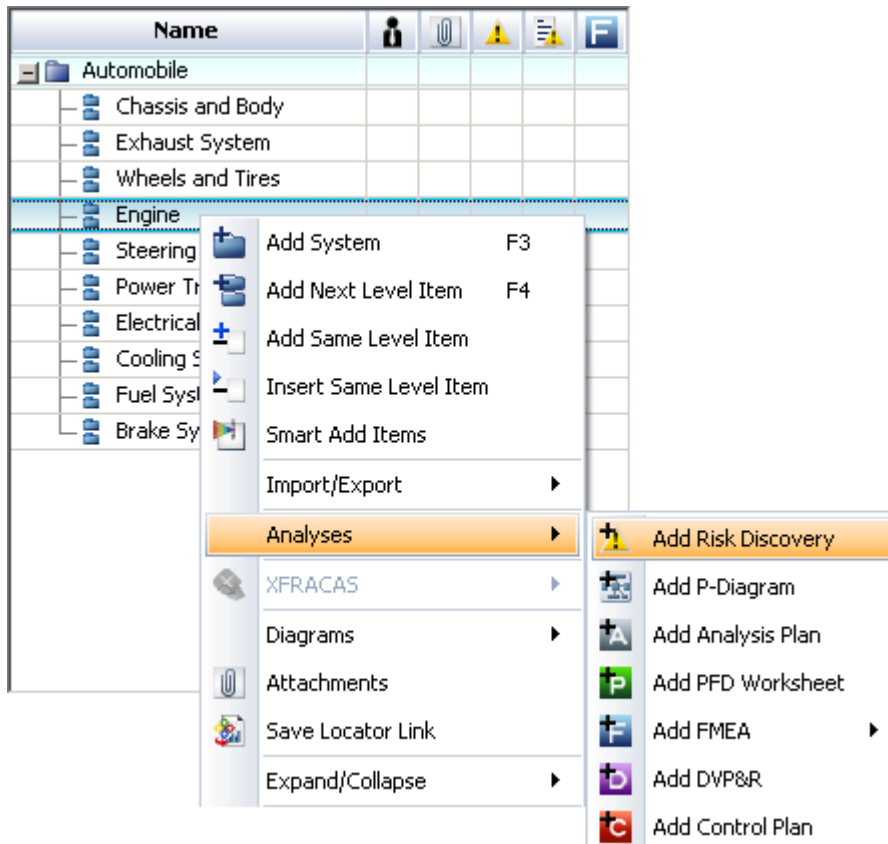
Quick Tour of Xfmea and RCM++

To add items, right-click inside the system hierarchy and choose **Add System**, **Add Next Level Item**, etc.



3. Perform equipment selection

For each system hierarchy item that you want to perform equipment selection for, right-click the item and choose **Analyses > Add Risk Discovery**.



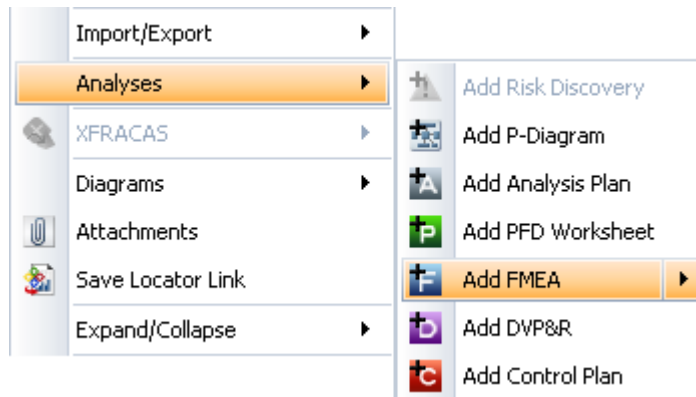
Depending on the configurable settings for the project, this can be a list of yes/no questions or a set of rating scales.

Label	Question	Response	Comments
Safety	Could failure affect safety or have other hazardous consequences?	Yes	
Detectability	Could failure be undetectable or not likely to be detected during normal operation?	No	
Operational	Could failure have significant operational impact?	Yes	
Economic	Could failure have significant economic impact?	Yes	

Mark item for more detailed analysis

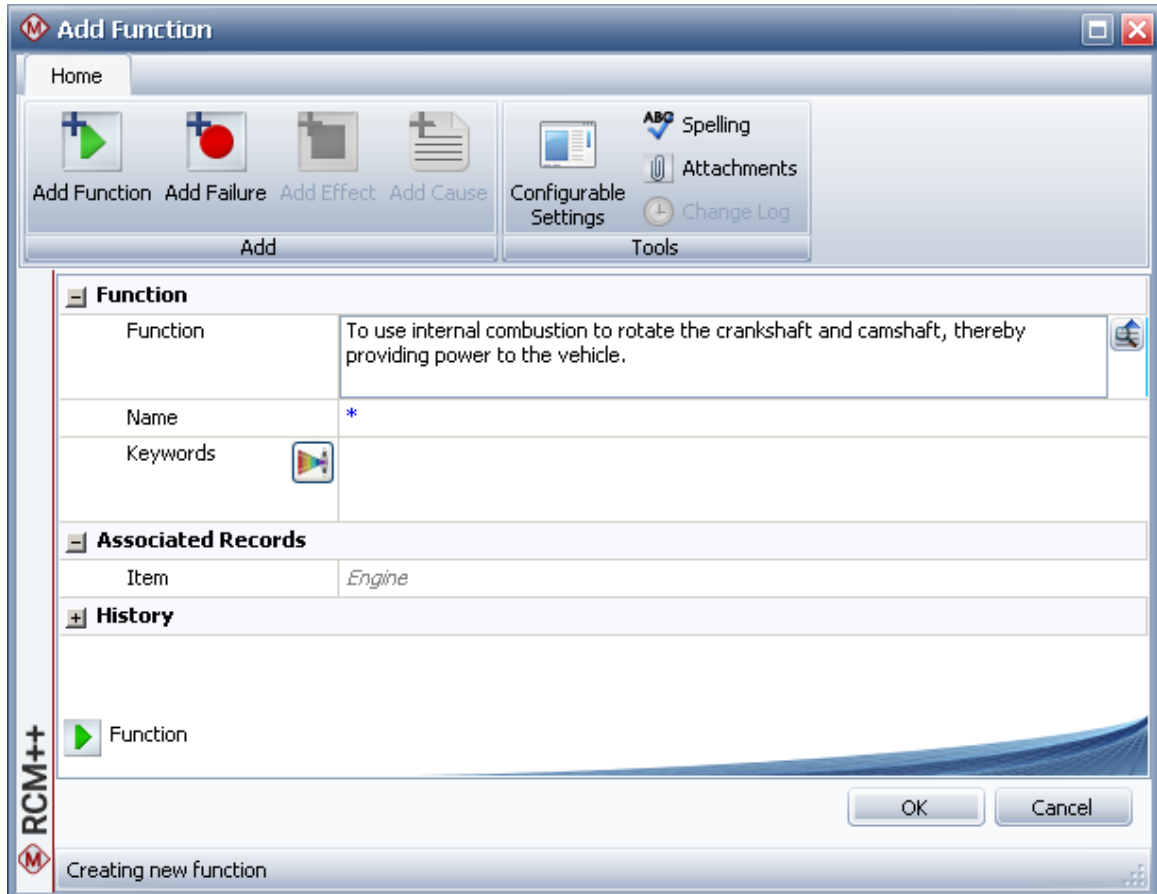
4. Add a new functional failure analysis

Right-click the system hierarchy item that you want to create a functional failure analysis for and choose **Analyses > Add FMEA**.



5. Add functional failure analysis records

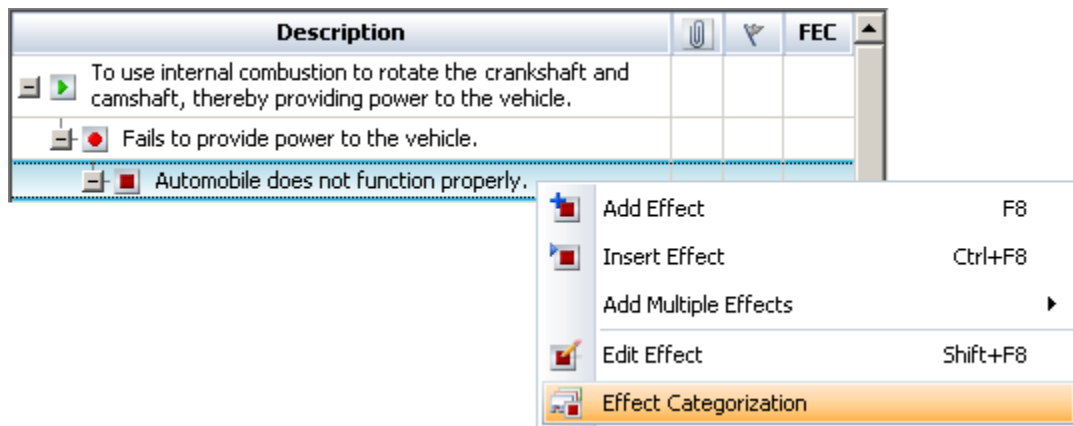
When you add the analysis, the Function window will automatically open. Enter the details and click either **Add Function** (to add the next function description), **Add Failure** (to add the first functional failure for this function) or **OK** (to close the window).



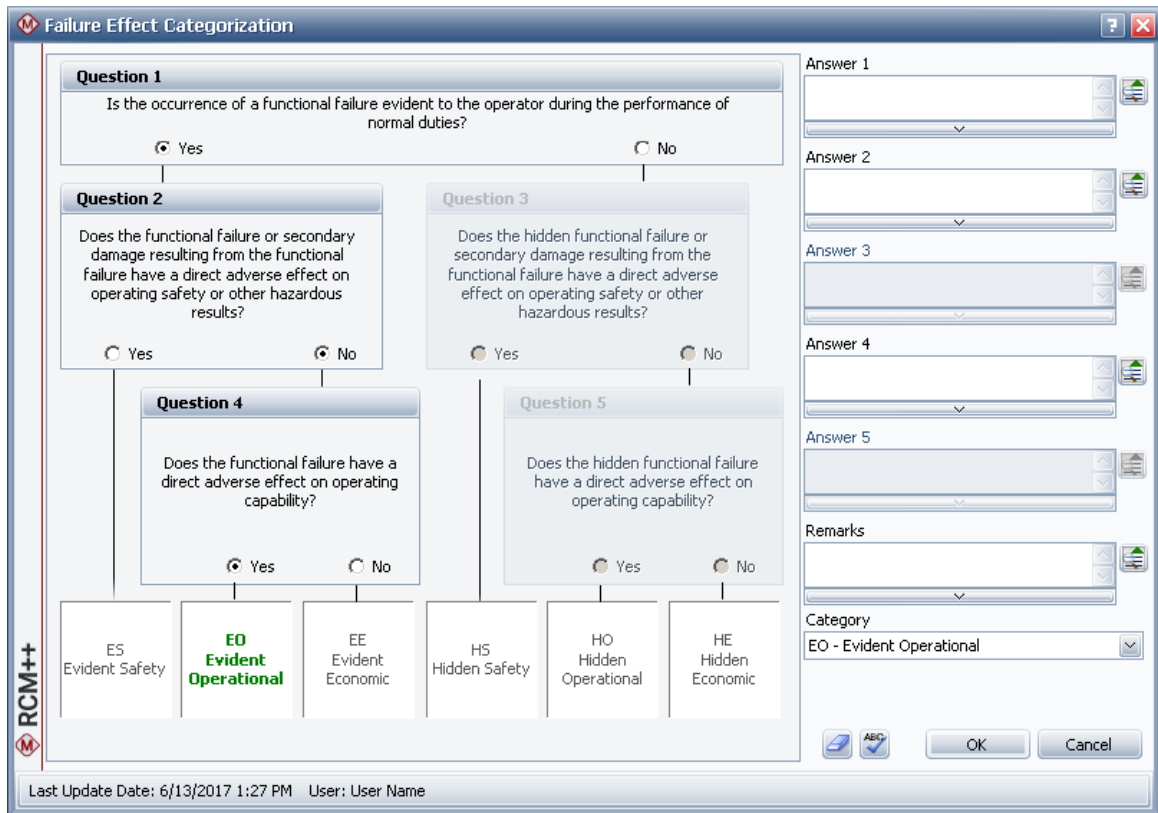
Continue adding analysis records as needed. Note that RCM failure modes are described using the cause record type.

6. Perform failure effect categorization

Right-click an effect in the functional failure analysis and choose **Effect Categorization**.



The questions and categories depend on the configurable settings for the project.



7. Perform maintenance task selection and add a task

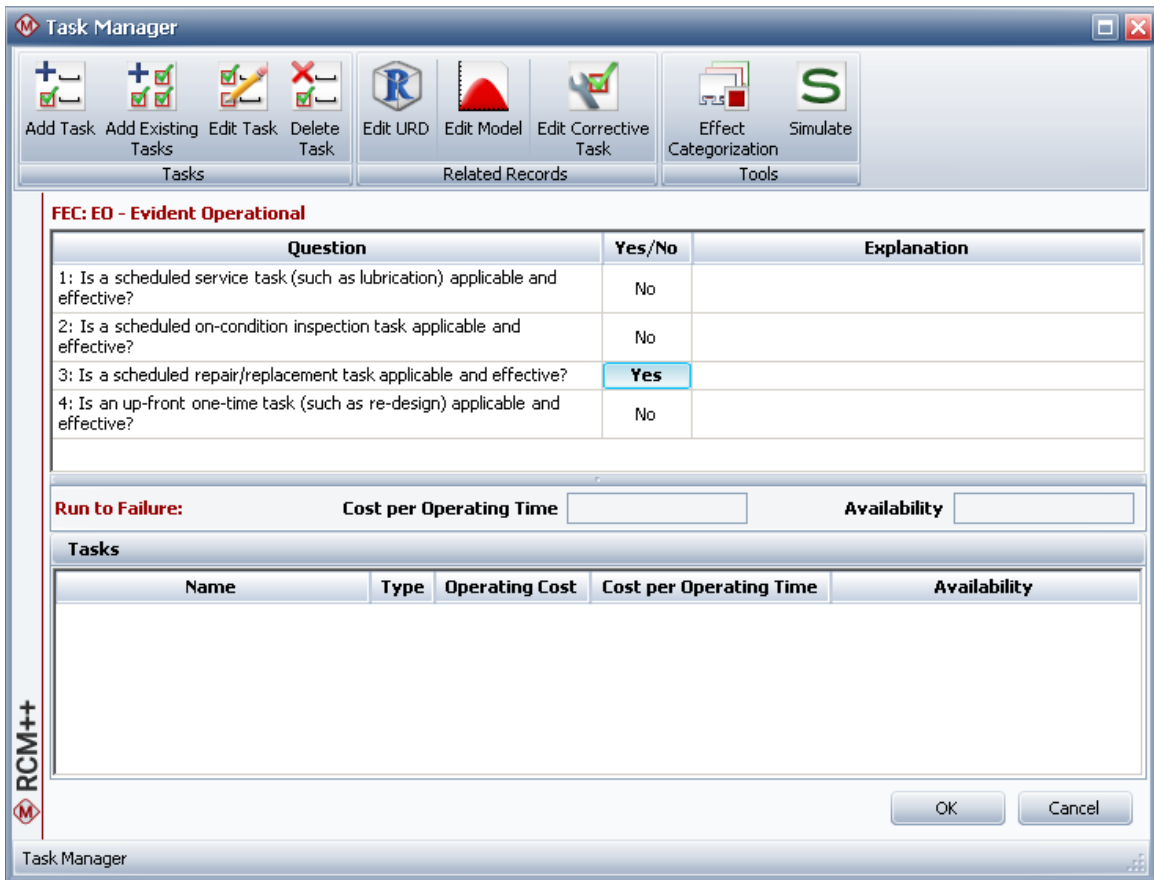
Right-click a failure mode (cause) and choose **Task Manager**.

The screenshot shows a software interface with a table of failure modes. The table has columns for 'Description', a clipboard icon, a flag icon, and 'FEC'. The 'Description' column contains a hierarchy of failure modes. The last row, 'Problem with the timing belt.', is selected. A context menu is open over this row, listing several actions: 'Add Cause' (F9), 'Insert Cause' (Ctrl+F9), 'Add Multiple Causes', 'Edit Cause' (Shift+F9), and 'Task Manager' (highlighted in orange).

Description			FEC
To use internal combustion to rotate the crankshaft and camshaft, thereby providing power to the vehicle.			
└─ Fails to provide power to the vehicle.			
└─ Automobile does not function properly.			EO
└─ Engine oil is depleted or dirty; oil filter is dirty.			
└─ Engine air filter is damaged.			
└─ Problem with spark plugs.			
└─ Problem with engine valve clearance.			
└─ Problem with the timing belt.			

- Add Cause F9
- Insert Cause Ctrl+F9
- Add Multiple Causes
- Edit Cause Shift+F9
- Task Manager**

In the Task Manager, answer the questions by clicking inside the Yes/No column. These questions may or may not be dependent on the failure effect categorization, depending on the task selection logic defined for the project.



To add a task, click **Add Task**.



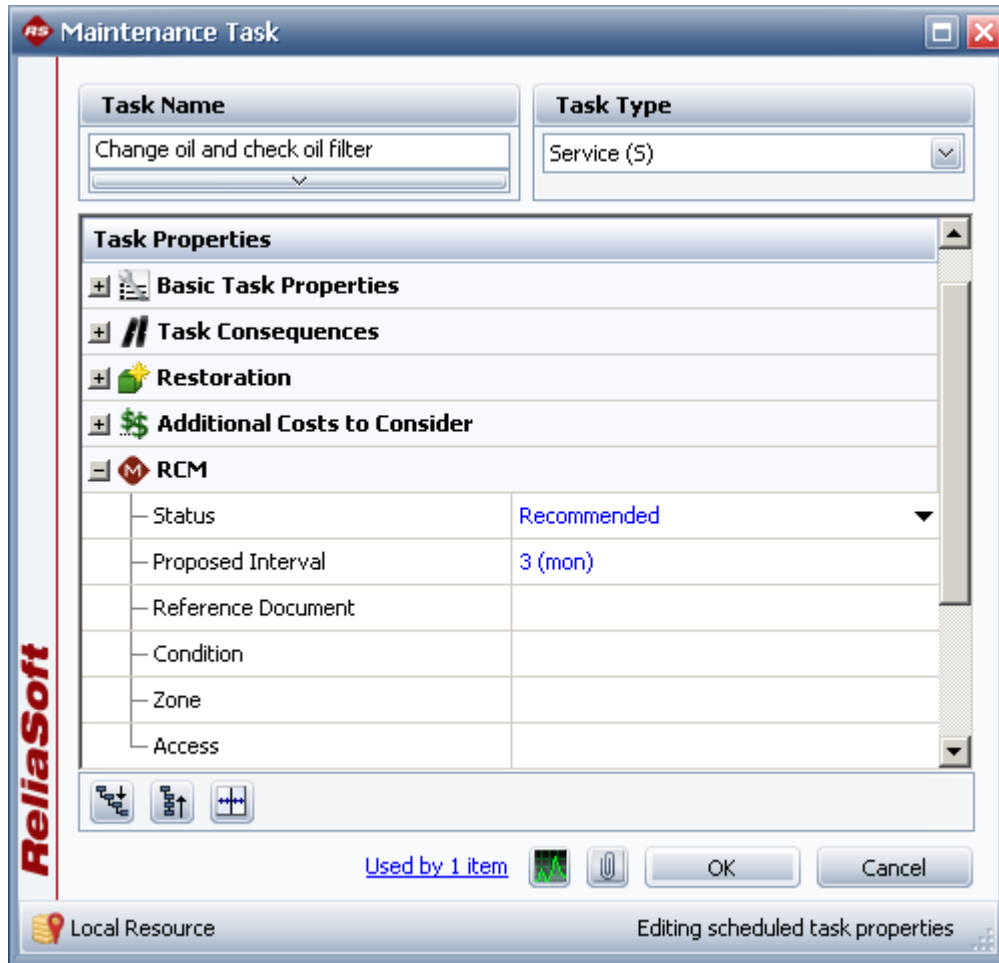
- Specify the task name and task type, then indicate when the task is to be performed.

A screenshot of the 'Maintenance Task' dialog box in ReliaSoft software. The dialog has a title bar with the ReliaSoft logo and window controls. It contains two input fields at the top: 'Task Name' with the text 'Change oil and check oil filter' and 'Task Type' with a dropdown menu showing 'Service (S)'. Below these is a 'Task Properties' section with a vertical scrollbar. The 'Task Scheduling' section is expanded, showing a table with the following data:

When is this task performed?	Fixed time frame based on calendar time
Fixed interval	3
Unit	Month (mon)

Below the table is a checkbox labeled 'Override task scheduling properties with a task package'. Other sections in the 'Task Properties' list include 'Basic Task Properties', 'Task Consequences', 'Restoration', 'Additional Costs to Consider', and 'RCM'. At the bottom of the dialog are 'OK' and 'Cancel' buttons, and a status bar at the very bottom reads 'Creating new scheduled task'.

- Continue to specify task properties as needed. The configurable fields for traditional RCM are entered under the **RCM** node.



More Analyses and Tools

Analysis Plans

Analysis Plans allow you to keep track of team members, ground rules, estimated completion dates, scheduled work sessions and other details that will help you to plan and manage your FMEA and RCM projects.

1 - Projector: Analysis Plan

Name
Projector

Description

In Progress
 Planned Start Date: 11/28/2016
 Actual Start Date: 1/9/2017
 Due Date: 11/6/2017
 Completion Date:

Team | Analysis Checklist | **Ground Rules and Assumptions** | Work Sessions | Quality Survey

Ground Rules and Assumptions

Assume that parts are made to print
 Assume that parts are properly assembled
 Assumptions about how the Project will age:
 - Buttons on the user interface become harder to press
 - Computer connection loosens
 - Dust build-up inside projector
 - Plastics age become brittle
 Assumptions about use conditions:
 - Extended use - up to 12 hours
 - May be suspended from the ceiling

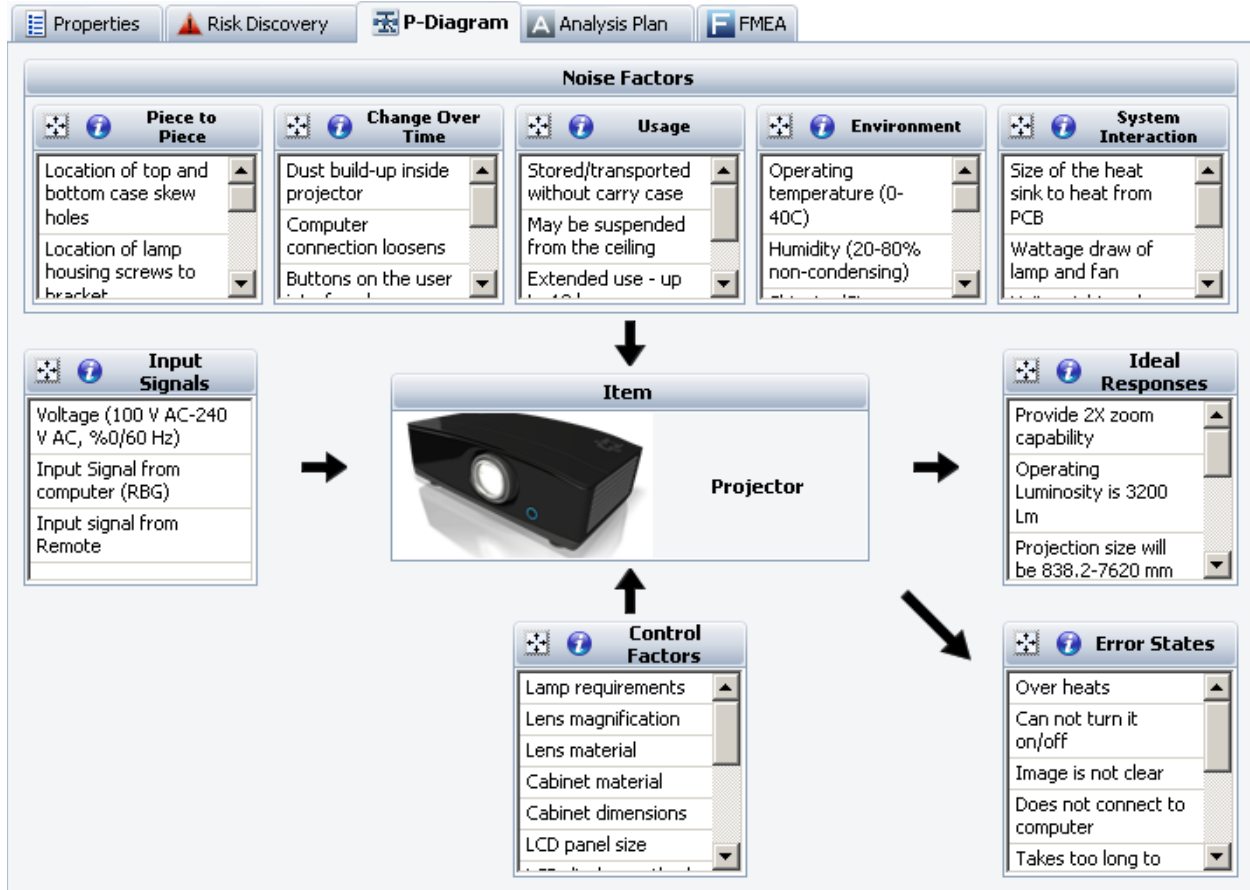
Delete Row | Insert Row | Move Up | Move Down | Select Existing Text

Reset Assumptions from Library: [Dropdown] Save Assumptions in Library

Last Update Date: 11/29/2016 1:51 PM User:

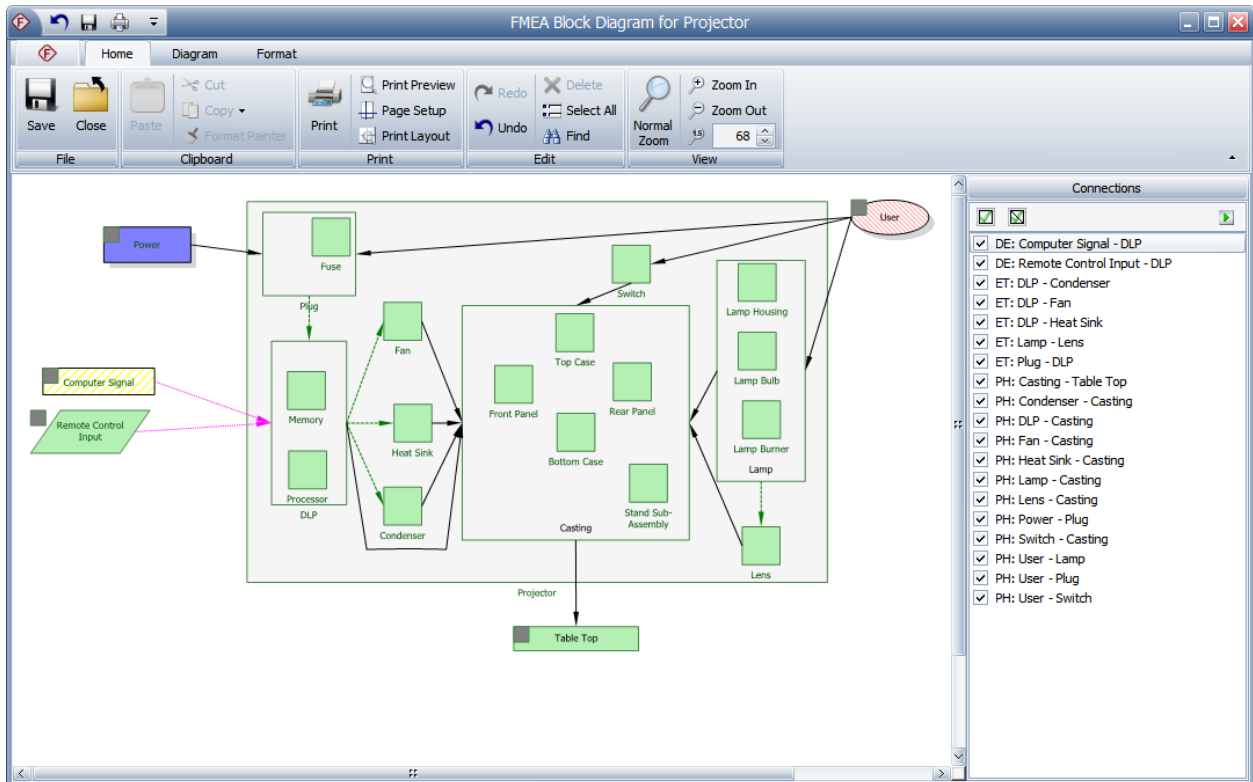
Parameter Diagrams (P-Diagrams)

A Parameter Diagram (P-Diagram) is a structured tool that identifies the inputs from a system and relates those inputs to the desired system outputs, while considering the controlled and uncontrolled factors.



FMEA Block Diagrams

An FMEA Block Diagram visually depicts the system assembly that will be analyzed in a design FMEA. These diagrams help to define the scope of a particular analysis project and also may provide additional information that will be useful to the analysis team when they attempt to identify potential failure modes.



PFD Worksheets

A PFD worksheet records detailed information, including process characteristics (inputs) and product characteristics (outputs), for each step of the manufacturing or assembly process. The complete PFD worksheet provides a structure for preparing process FMEAs (PFMEAs) and control plans.

Op Seq Number	Operation Description	Operation Type	Symbol	Changeover	Class	Significant Product Characteristics (Outputs)	Class	Significant Process Characteristics (Inputs)
1.1.1	Front Door L.H. - Hang Process							
1.1.1.1	Remove door assembly from conveyor using fixture xyz & move to vehicle body	Move	○	P,T				
1.1.1.2	Align hinge attachment holes on door to body & finger start 4 bolts	Fab	◇					
1.1.1.3	Secure alignment fixture to opening & remove transfer fixture	Move	○	P,T				
1.1.1.4	Bring automatic bolt driver to assembly and drive 4 bolts	Fab	◇	T	C	Clamp load between hinge strap and hinge pillar	C	Bolt torque (4)
1.1.1.5	Remove bolt driver when cycle is complete	Move	○					

Control Plans

Control plans are used to track critical characteristics that must be kept in control during a manufacturing or assembly process, and record the methods for maintaining control.

Part/ Process Number	Process Name/Operation Description	Machine, Device, Jig, Tools for Mfg	No.	Product	Process	Special Char. Class	Specification/ Tolerance	Evaluation/ Measurement Technique	Sample Size	Sample Frequency	Control Method	Reaction Plan
1	Op 70: Manual application of wax inside door. Cover inner door, lower surfaces with wax to specification thickness.	Wax Sprayer AB12345	1	Wax thickness.	Manually inserted spray head not inserted far enough.	5	Wax thickness must be between X and Y.	Instrument XY12345	10	per Hour	Variables check for film thickness.	Check the insertion of the spray head and re-apply wax to affected units.
							Wax must cover the entire surface of the door panel.	Visual	10	per Hour	Visual check for coverage.	Check the insertion of the spray head and re-apply wax to affected units.
			2		Spray head clogged because viscosity is too high, temperature is too low or pressure is too low.	5	Viscosity must be AA to BB. Temperature must be CC to DD. Pressure must be EE to FF.	Instrument PQ12345		At start-up and after idle periods.	Test spray pattern at start-up and after idle periods.	Spray head maintenance.
			3		Spray head deformed due to impact.	5	Full inspection and cleaning of the spray head.			Monthly	Preventive maintenance program to maintain heads.	
			4		Spray time insufficient.	5	Wax must cover the following critical areas: XXX, YYY and ZZZ.	Visual	10	per Hour	Lot sampling and visual check for coverage of critical areas.	Remind the operator of the appropriate spray time and re-apply wax to affected units.

Test Plans

A test plan displays a list of actions that describe specific tests that need to be performed.

Recommended Action(s)	Planned Start Date	Planned Completion Date	Actual Start Date	Actual Completion Date	Specification Methodology
Design of Experiments (DOE) on wax thickness	4/6/2017	4/17/2017	4/10/2017		Two Level Factorial DOE
Laboratory accelerated corrosion test	3/13/2017	3/13/2017	3/13/2017	3/13/2017	ALT Corrosion Test #AB123
Team evaluation using design aid buck and spray head	3/13/2017	3/13/2017	3/13/2017		
Team evaluation using production spray equipment and specified wax	3/20/2017	3/21/2017	3/13/2017		

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