SOX User Guide

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SOX User Guide

General SOX Concepts

Summary

- The same object (e.g., a requirement, system element or function) can be used in multiple documents and diagrams within a project. Modifying the object in one document affects ALL occurrences of the object.
- The system design (Model Explorer view) contains all objects available in the project. Other documents and diagrams contain only a subset of these objects. Creating (or importing) a new object in a document automatically adds the object to the system design. Deleting an object from a document does not delete the object in the system design unless explicitly done so.
- Exception: The set of SysML requirements available in the system design is exactly the same as the set of requirements in the “Requirements” module.
- The main relationships between objects relevant over different documents (e.g., allocation of a function to a system element) are kept consistent over all documents, too.
- If a change in a document or the system design could affect other documents, a Refactoring dialog appears, which displays the consequences.
- Benefits for the user:

  - All documents are always automatically consistent.

  - All created or imported elements are automatically available in the SysML system design.

Details

In SOX, the same objects can be used in multiple modules and documents. For instance, a system element "A" can be defined in the System Design module and can then be used in multiple safety analyses, e.g., multiple FMEA documents FMEA1 and FMEA2. There are no copies of "A": All documents (System Design, FMEA1, FMEA2) refer to the same object. This means that modifying the object A within one of these documents automatically results in a modification of all other documents that contain the same element.

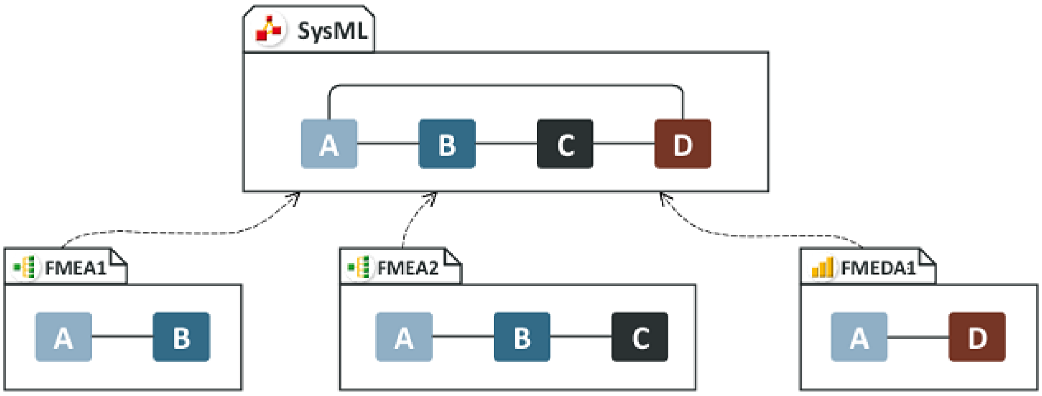


fig. An example of elements across documents

The system design contains all objects to be reused within multiple modules. Those reusable objects are represented by SOX-specific SysML stereotypes in the system design. (A stereotype represents a custom variation of a standard SysML/UML element – for instance, the stereotype System Element represents a specific SysML block that is interpreted in SOX as a system element.) The supported reusable objects (represented by stereotypes) are: system element, function (including subtypes such as safety functions, diagnoses and process characteristics), malfunction, requirement, and safety goal.

An exception are project tasks which can also be used in multiple documents but are independent from the system design and are managed in the "project task" view.

Whenever a new instance of one of these objects is created (e.g. a new system element in an FMEA) it is automatically added to the system design. All existing system design elements are listed in the "Model Explorer" view (see below) and can be reused from there, e.g., by dragging and dropping them into other documents.

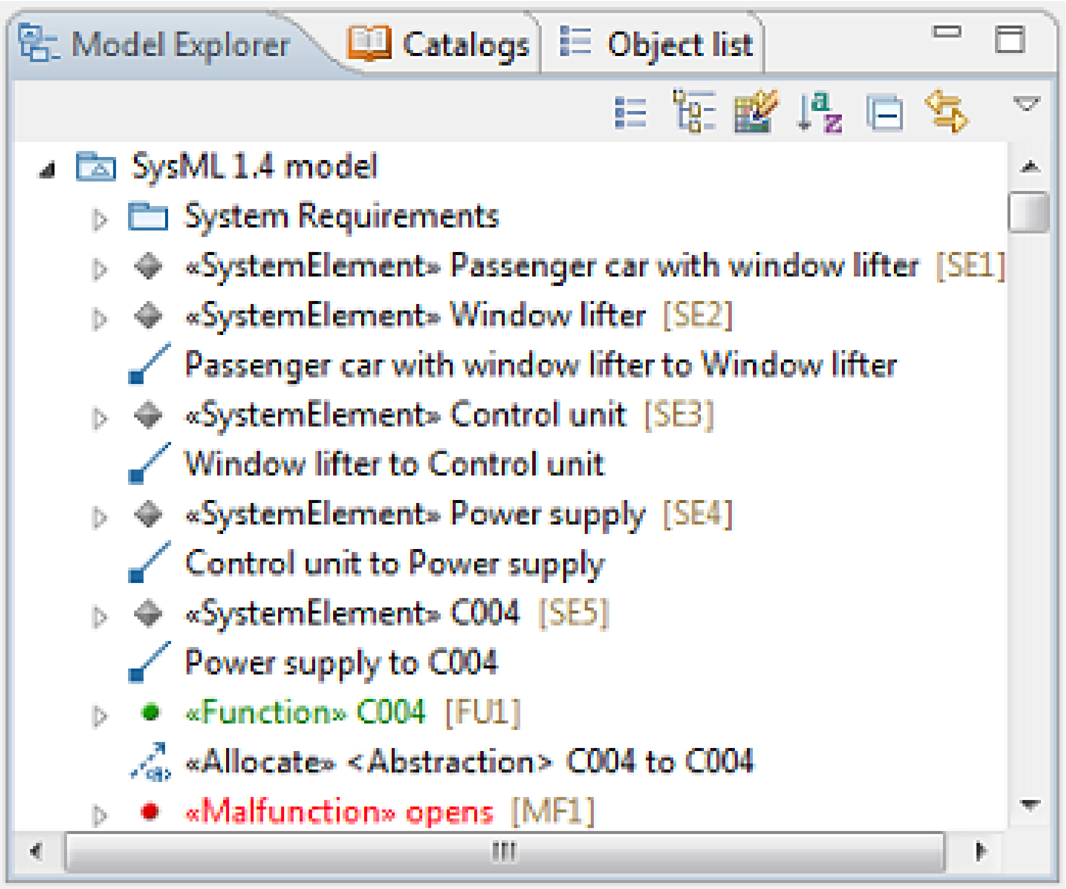

Model Explorer
Catalogs
Object list
SysML 1.4 model
System Requirements
«SystemElement» Passenger car with window lifter [SE1]
«SystemElement» Window lifter [SE2]
Passenger car with window lifter to Window lifter
«SystemElement» Control unit [SE3]
Window lifter to Control unit
«SystemElement» Power supply [SE4]
Control unit to Power supply
«SystemElement» C004 [SE5]
Power supply to C004
«Function» C004 [FU1]
«Allocate» <Abstraction> C004 to C004
«Malfunction» opens [MF1]

fig. The "Model explore"r view

Alternatively, it is possible to open one or more "Object List" views (see below) to show lists of all existing elements of a specific type.

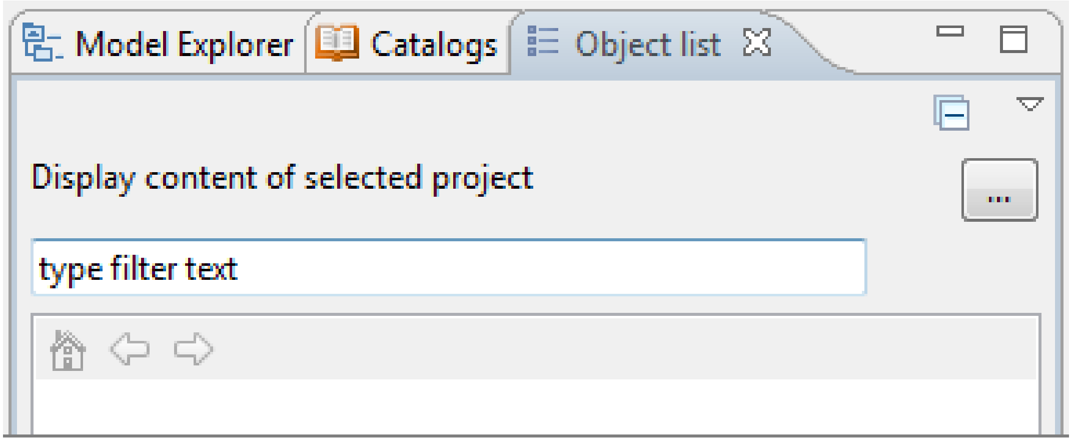
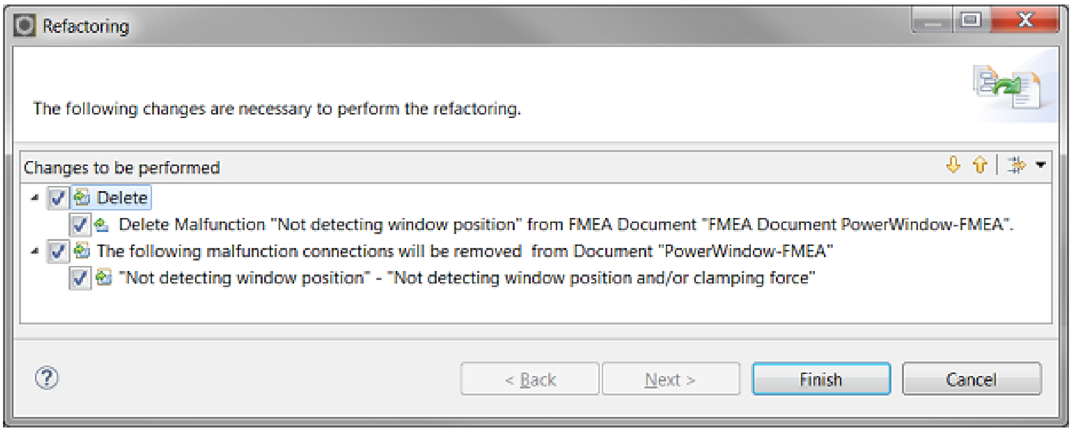


fig. The "Object lis"t view

The system design always contains all existing reusable objects (listed in the Model Explorer). But a specific document (e.g., FMEA, FMEDA, FTA document) or diagram (e.g., SysML Block Definition Diagram) contains only a subset of them. For instance, an FMEA document displays only those system elements that are relevant in the context of this specific document. Different documents (e.g., FMEAs) can contain different subsets of elements. As a consequence, creating a new object within an FMEA document automatically adds this object to the system design, but creating a new object within the system design does not automatically affect other documents/diagrams (as those contain only subsets). Analogously, deleting an object in the system design deletes the object also in all other documents/ diagrams, but deleting an object within a document/diagram does not automatically result in deletion from the system design. SOX provides a refactoring dialog (see below) which prompts information about the consequences of object deletion whenever an object is referred to by other documents.



The following changes are necessary to perform the refactoring.

- ☑ Delete
  - ☑ Delete Malfunction "Not detecting window position" from FMEA Document "FMEA Document PowerWindow-FMEA".
- ☑ The following malfunction connections will be removed from Document "PowerWindow-FMEA"
  - ☑ "Not detecting window position" - "Not detecting window position and/or clamping force"

fig. The "Refactorin"g dialog

An exception are requirement documents (RM documents), as there should never be a requirement that exists only in the system design but is not contained in a RM document. Hence, the relationship between requirements in the system design and requirements in RM documents is 1:1, i.e., adding/ deleting a requirement on one side automatically results in addition/deletion on the other side. (By default, Requirements created in a RM document are added in the system design into a package with the same name as the RM document, but they can be freely moved within the system design without effects on the RM documents.) This means that imported requirements (e.g., using ReqIF import) become directly available in the system design, e.g., to link them with system design elements.

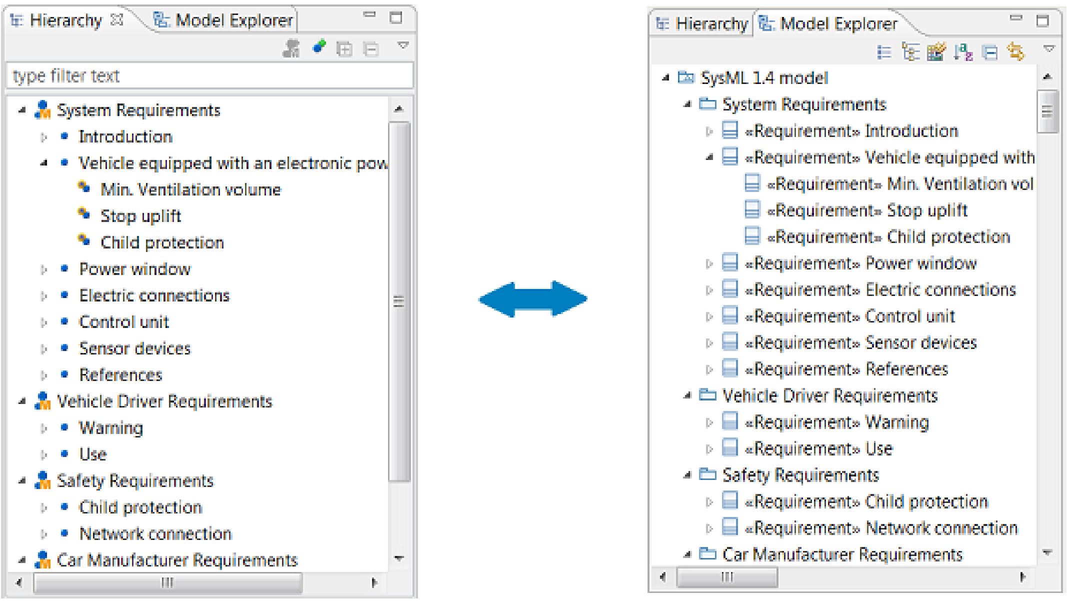
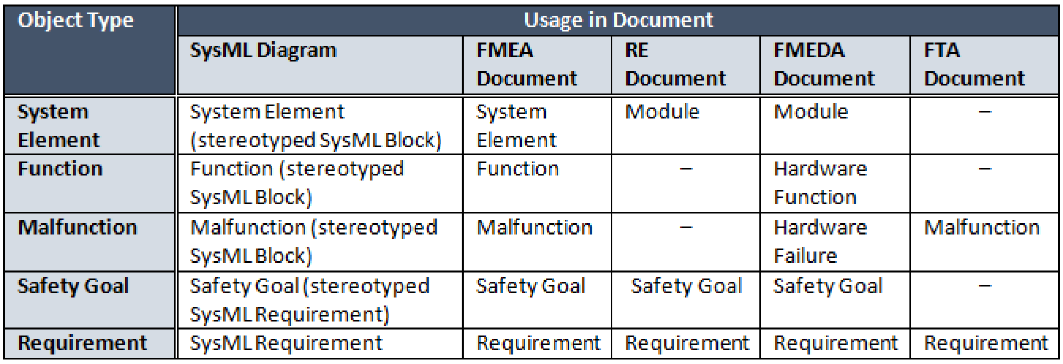

Hierarchy
Model Explorer
type filter text
System Requirements
Introduction
Vehicle equipped with an electronic pow
Min. Ventilation volume
Stop uplift
Child protection
Power window
Electric connections
Control unit
Sensor devices
References
Vehicle Driver Requirements
Warning
Use
Safety Requirements
Child protection
Network connection
Car Manufacturer Requirements
Hierarchy
Model Explorer
SysML 1.4 model
System Requirements
«Requirement» Introduction
«Requirement» Vehicle equipped with
«Requirement» Min. Ventilation vol
«Requirement» Stop uplift
«Requirement» Child protection
«Requirement» Power window
«Requirement» Electric connections
«Requirement» Control unit
«Requirement» Sensor devices
«Requirement» References
Vehicle Driver Requirements
«Requirement» Warning
«Requirement» Use
Safety Requirements
«Requirement» Child protection
«Requirement» Network connection
Car Manufacturer Requirements

fig. Requirements across SOX modules

The following table lists the types of objects that can be used over multiple documents/diagrams (leftmost column) and their representation within a specific document (other columns):

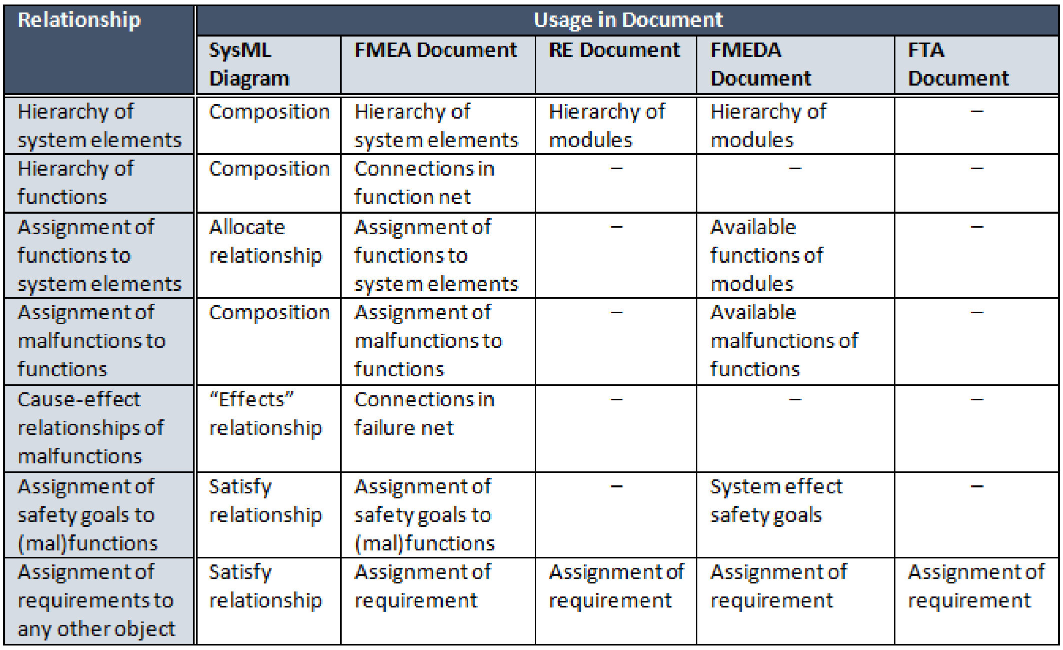


Object Type	Usage in Document				
	SysML Diagram	FMEA Document	RE Document	FMEDA Document	FTA Document
System Element	System Element (stereotyped SysML Block)	System Element	Module	Module	–
Function	Function (stereotyped SysML Block)	Function	–	Hardware Function	–
Malfunction	Malfunction (stereotyped SysML Block)	Malfunction	–	Hardware Failure	Malfunction
Safety Goal	Safety Goal (stereotyped SysML Requirement)	Safety Goal	Safety Goal	Safety Goal	–
Requirement	SysML Requirement	Requirement	Requirement	Requirement	Requirement

fig. Objects that can be used over multiple documents

The main relationships between elements are stored in the system design as well and, hence, kept consistent across all documents: Containment between system elements, assignment of functions to system elements, assignment of malfunction to functions, assignment of safety goals to functions. Again, adding such a relationship in one document automatically creates a corresponding relationship in the system design (but not vice versa) and deleting such a relationship in the system design can result in appearance of a “Refactoring” dialog that informs about the consequences.

The following table lists the relationships that are relevant in multiple types of documents/diagrams and their meaning within a certain document/diagram type:



Relationship	Usage in Document				
	SysML Diagram	FMEA Document	RE Document	FMEDA Document	FTA Document
Hierarchy of system elements	Composition	Hierarchy of system elements	Hierarchy of modules	Hierarchy of modules	–
Hierarchy of functions	Composition	Connections in function net	–	–	–
Assignment of functions to system elements	Allocate relationship	Assignment of functions to system elements	–	Available functions of modules	–
Assignment of malfunctions to functions	Composition	Assignment of malfunctions to functions	–	Available malfunctions of functions	–
Cause-effect relationships of malfunctions	“Effects” relationship	Connections in failure net	–	–	–
Assignment of safety goals to (mal)functions	Satisfy relationship	Assignment of safety goals to (mal)functions	–	System effect safety goals	–
Assignment of requirements to any other object	Satisfy relationship	Assignment of requirement	Assignment of requirement	Assignment of requirement	Assignment of requirement

fig. Relationships that are relevant in multiple types of documents

Starting SOX

Logging in

This dialog appears when starting SOX:

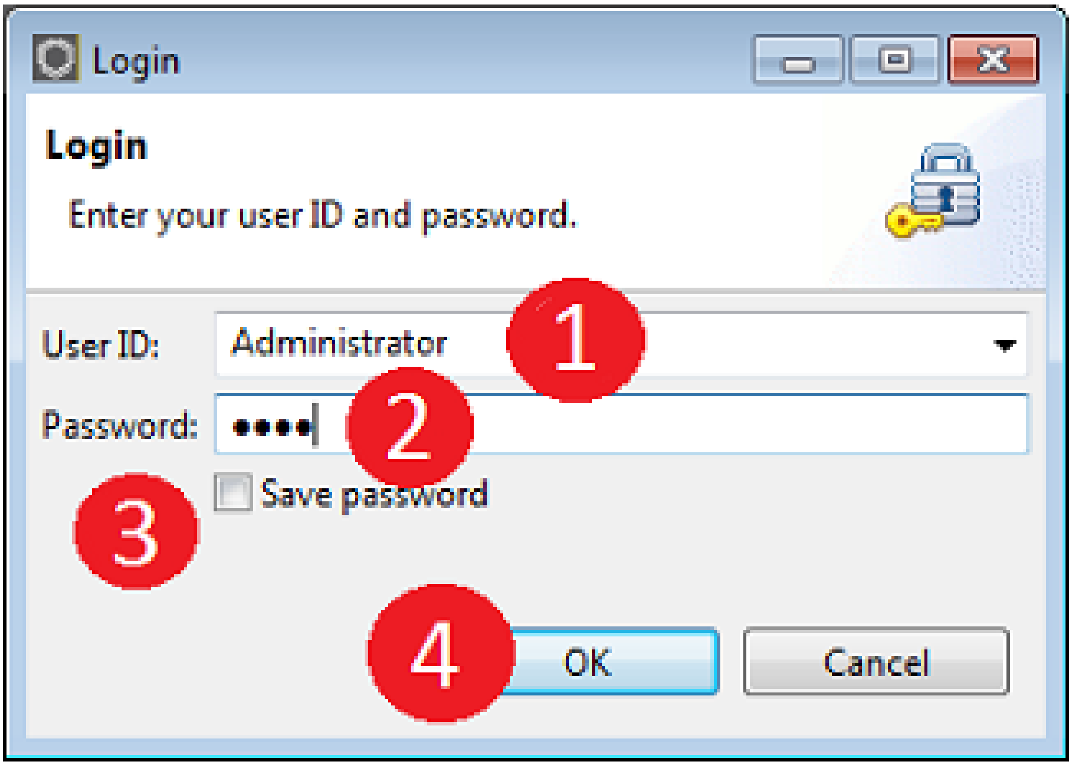


fig. The Login dialog

1. Enter your user ID.

2. Enter your password.

3. Choose whether you want to save the password, so you do not have to type it in on every startup.

4. Click on **OK**.

→ You are now logged in.

Setting up the Workspace and Repository

When starting SOX, a dialog opens, asking you to select a workspace.

Workspace:

A workspace is a folder on your hard drive that contains internal data about connections to a repository and the projects that you have imported from this repository.

Repository:

A repository is a database that contains the actual files of the projects. If you connect to an existing repository, you can then import its contained projects.

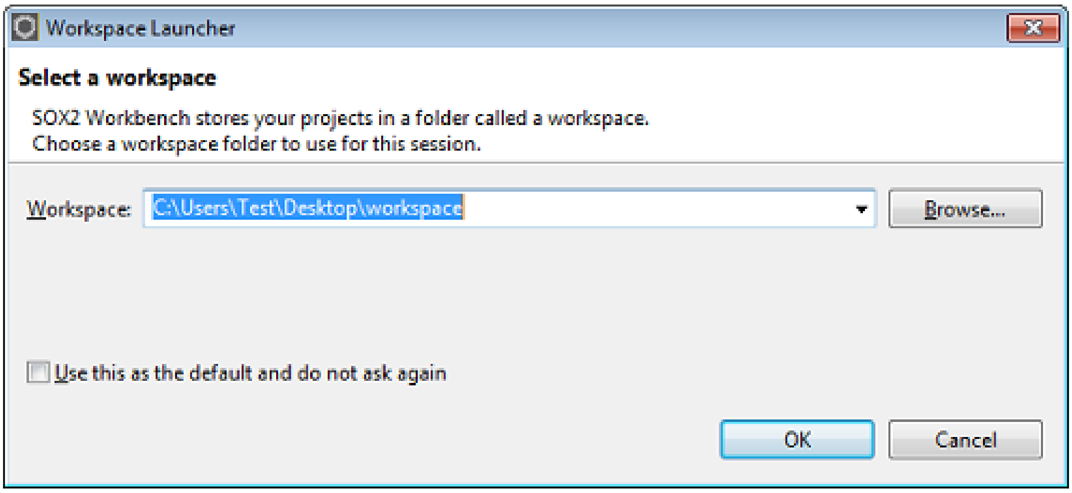
There are two types of repositories:

- **Local repository:** This is stored locally on your computer. This option is an easy way to test SOX but it does not allow you to share or access data or catalogs from/with users on other computers (except using import/export).

- **Remote repository:** This is stored on a central server, allowing parallel multi-user access and data sharing. This requires installation of a SOX server, e.g., by your system administrator.

Each workspace is associated with ONE repository. You can create multiple workspaces on your computer corresponding to multiple repository connections. Whenever you want to connect to another repository, you have to switch to another workspace. It is possible to have several workspaces for the same repository, if there are a lot of projects stored in the repository and you only want to import specific projects.

To switch between workspaces or to create a new workspace, restart SOX. The dialog "Workspace Launcher" opens:



Workspace Launcher

Select a workspace

SOX2 Workbench stores your projects in a folder called a workspace.
Choose a workspace folder to use for this session.

Workspace: C:\Users\Test\Desktop\workspace

fig. "Workspace Launche"r dialog

As a default, there is a folder called “workspace” in the folder in which you installed SOX. You can also choose another folder by clicking on **Browse…**

Important: A new workspace needs to be an empty folder! Do not change its content in the Windows file explorer, only in SOX.

If you always want to use this folder in the future, click on the check box at the bottom of the dialog. (If you choose this option, you can still select another workspace later: In the menu bar of SOX, go to **File** > **Switch Workspace**. Here you can also see the workspaces that you used last)

Approve the selected folder by clicking **OK.**

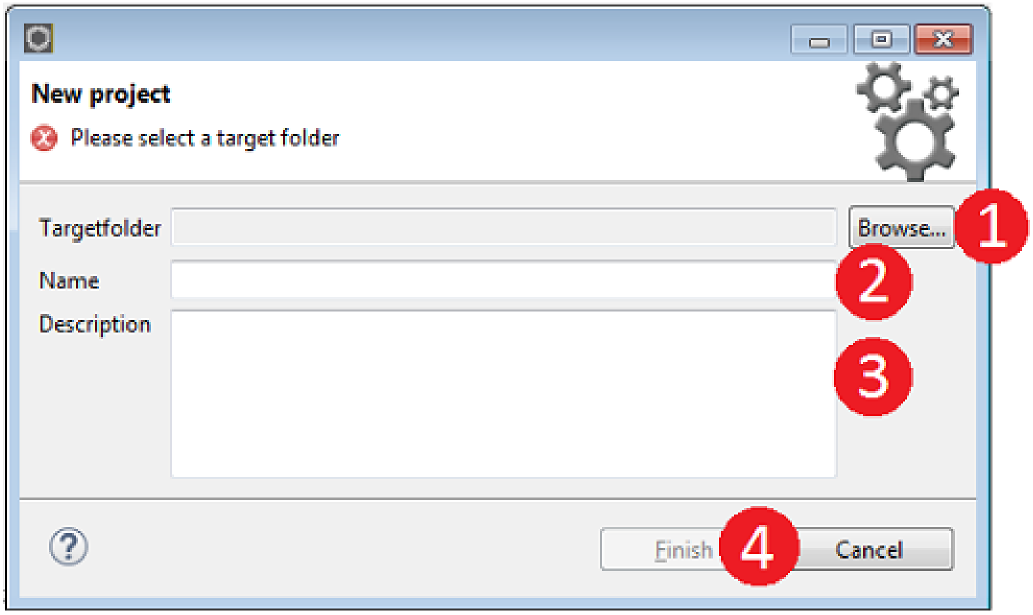
Getting started with Projects

Creating a new SOX Project

1. Right-click inside the repository view. You usually find it on the left when starting SOX.

2. Choose **New** > **SOX Project**.

   ► The "New project" dialog opens.


New project

Please select a target folder

fig. "New Projec"t dialog

1. Click on **Browse...** to choose the target folder on your system or server where the SOX project will be saved.

2. Choose a name for your SOX project.

3. Write a description of the project (optional).

4. Click on **Finish.**

→ A new SOX project with all module folders has been added to the project explorer (repository).

Creating a new Folder

Creating a new folder in the project:

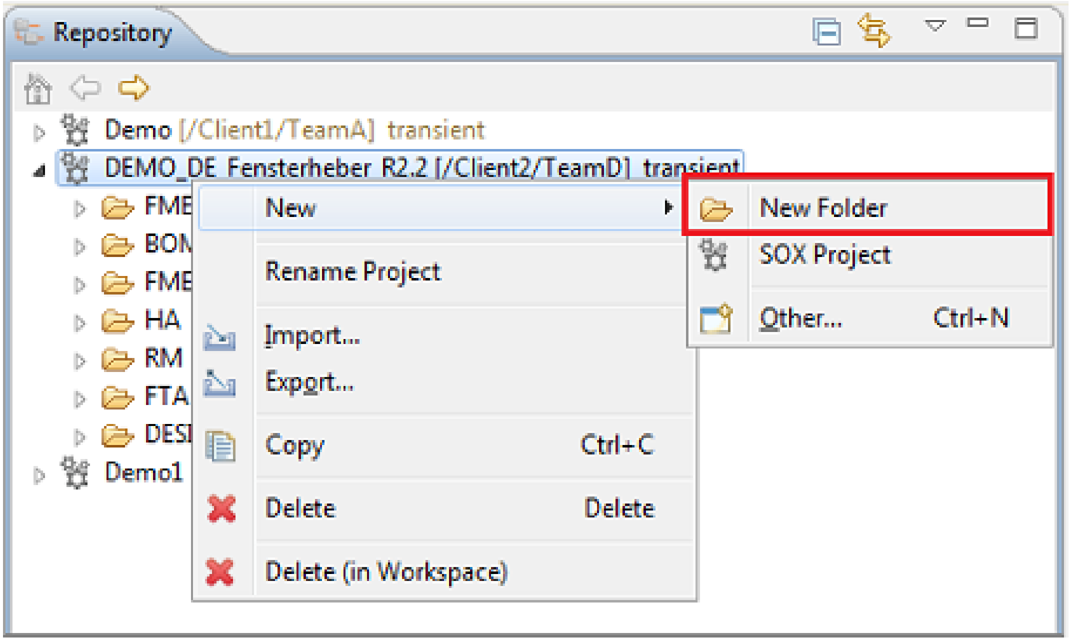


fig. Context menu for new folder

1. Right-click on a SOX project.
2. Choose **New** > **New Folder**.

   ► The dialog "Create new folder" opens.

3. Enter a name for the folder.

→ A folder was created in your project.

In the same way you can create a new sub-folder inside a module folder:

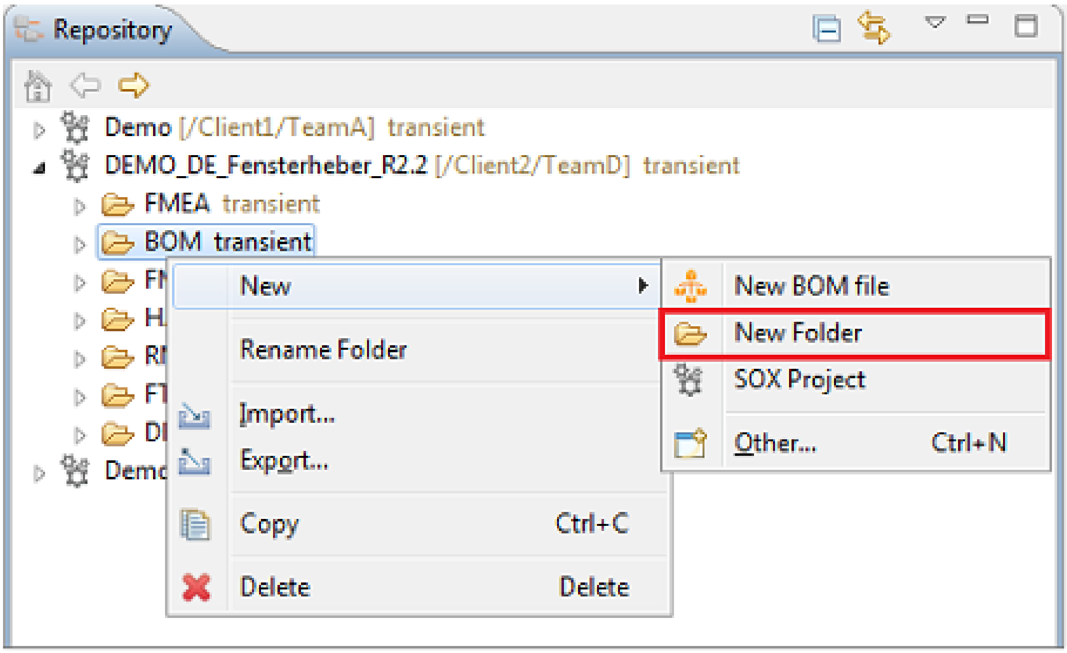


fig. Context menu when creating a sub-folder

1. Right-click on a module folder.
2. Choose **New** > **New Folder.**

   ► The dialog "Create new folder" opens.

3. Enter a name for the folder.

→ A sub-folder was created inside your module folder.

Importing a SOX Project

Note

There are two ways to import a project:

- Importing a .zip-file. The imported project will also be added to the repository database you are connected to.
- Importing a project from the repository into your workspace. This makes the project available to you locally from your workspace.

Importing a project:

Right-click inside the repository view and choose **Import**.

► The "Import" wizard opens.

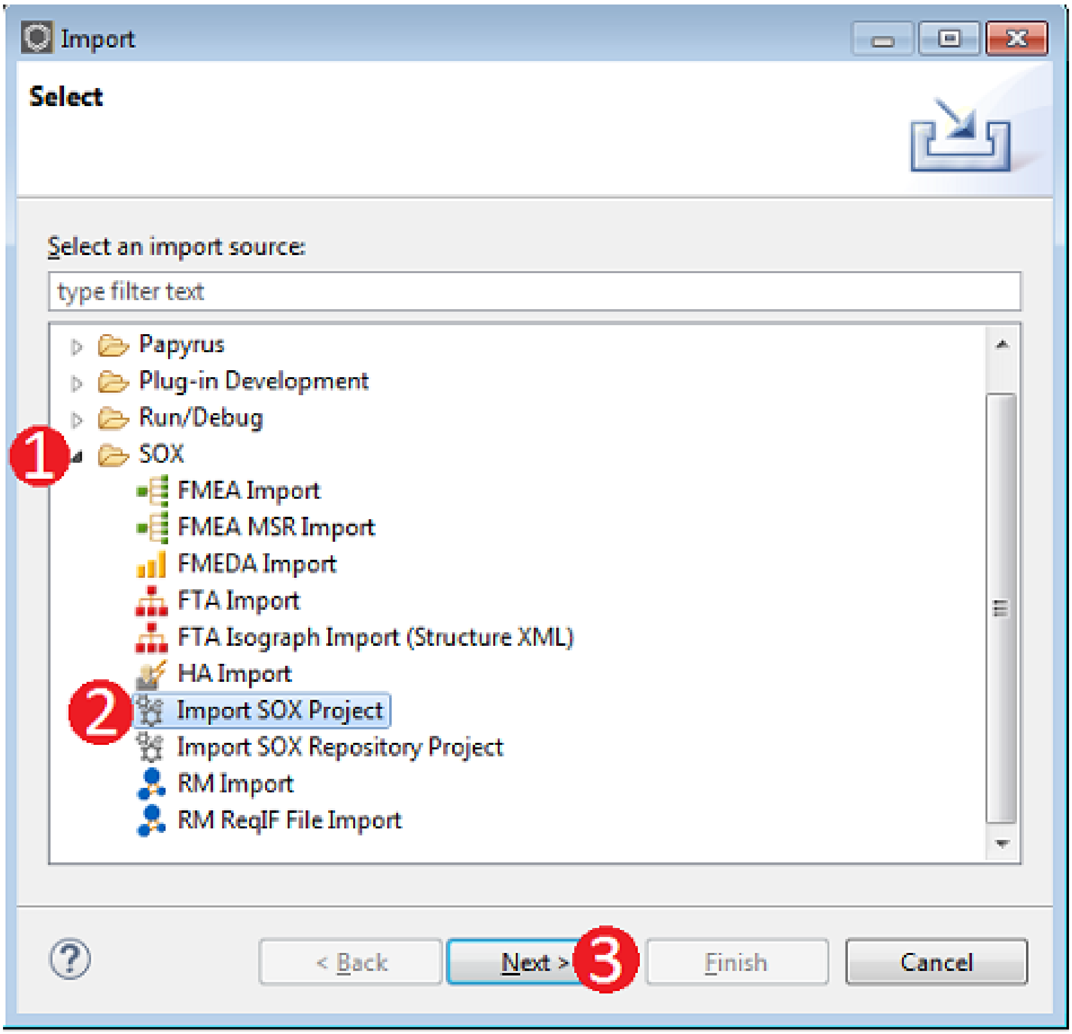


fig. "Impor"t wizard

1. Click on the arrow next to "SOX".

   ► A drop-down menu opens.

2. a) Choose **Import SOX Project** to import a .zip file.

   b) Choose **Import SOX Repository Project** from the repository you are connected to.

3. Click on **Next.**

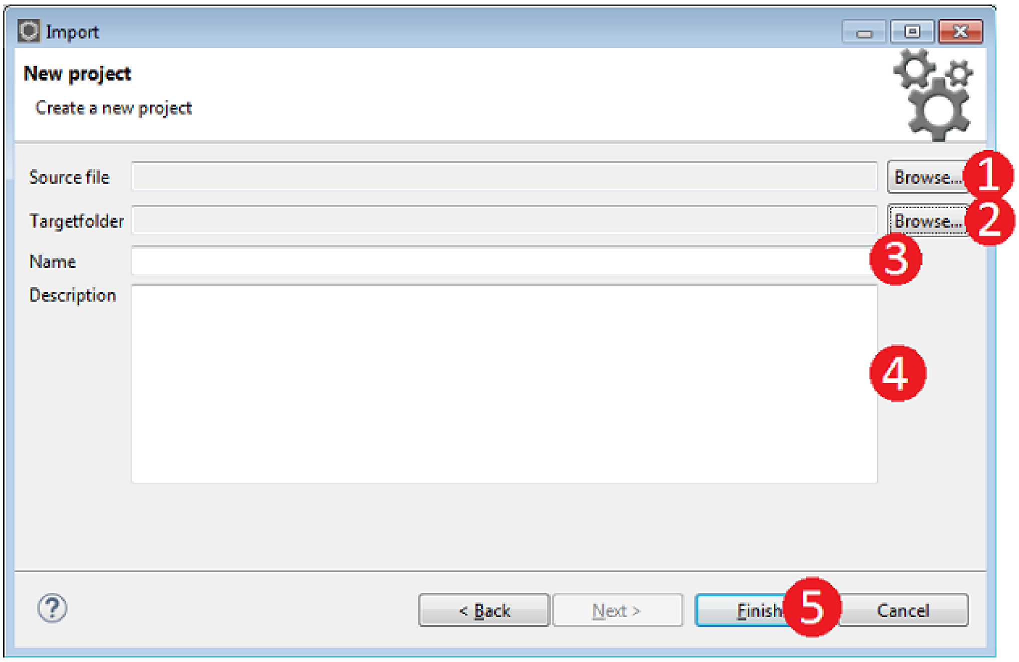


fig. "Impor"t wizard page 2

1. Click on **Browse...** to choose a source file.

2. Click on **Browse...** to choose the target folder on your system or server where the changes on the SOX project will be saved.

3. Choose a name for your SOX project.

4. Write a description of the project (optional).

5. Click on **Finish.**

→ A SOX project has been imported and added to your repository.

Exporting a SOX Project

1. Right-click inside the repository view.

2. Choose **Export**.

   ► The "Export" wizard opens.

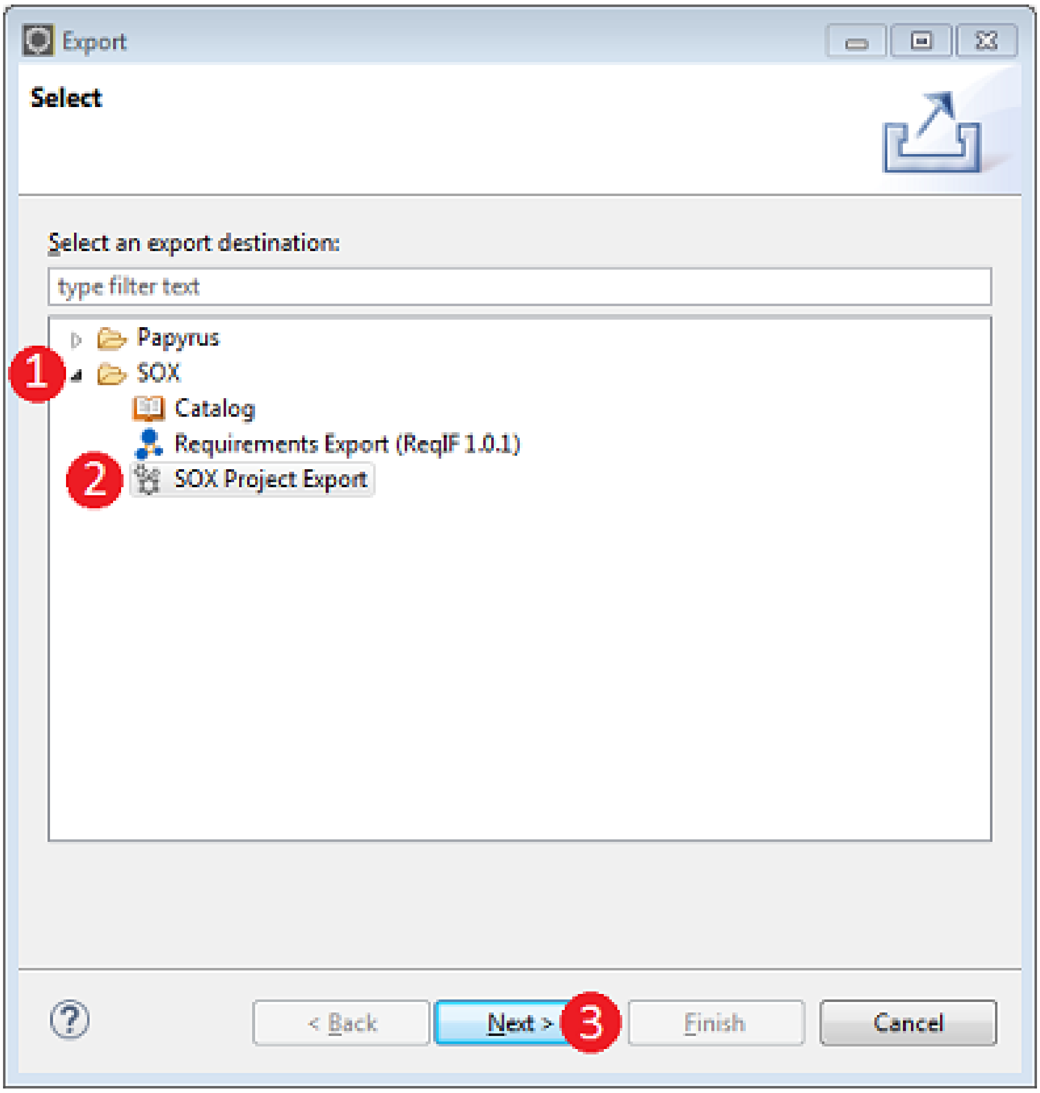


fig. "Expor"t wizard

1. Click the arrow next to "SOX".

   ► The drop-down menu opens.

2. Choose **SOX Project Export** to export a SOX project as a .zip file.

3. Click on **Next**.

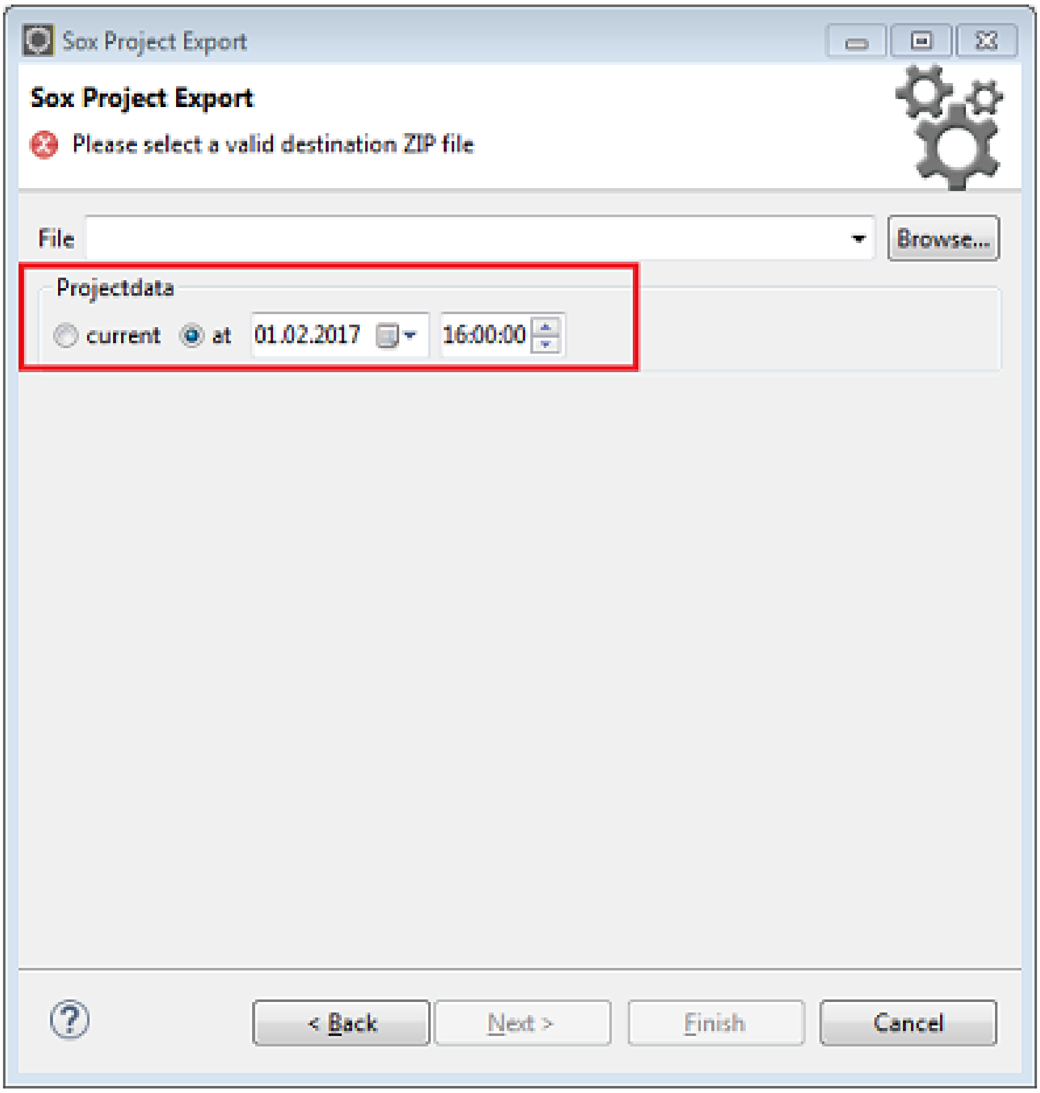


fig. "SOX Project Expor"t dialog

► The SOX Project Export dialog opens.

Note

You have the possibility to export a SOX project from a earlier date. So incorrect project data can be reseted.

4. Click on **Browse** to choose a location for the .zip file.

5. Enter a name for the .zip file.

6. Click on **Finish**.

→ A SOX project will be exported and saved as a .zip file.

Deleting a SOX Project

Note

There are two ways to delete a project:

- Deleting the project in the workspace you are currently working in. All your CONNECTIONS to the files in the repository are erased. The project is no longer visible in your workspace but it will still exist in the repository. You can later import the project again from the repository into your workspace.

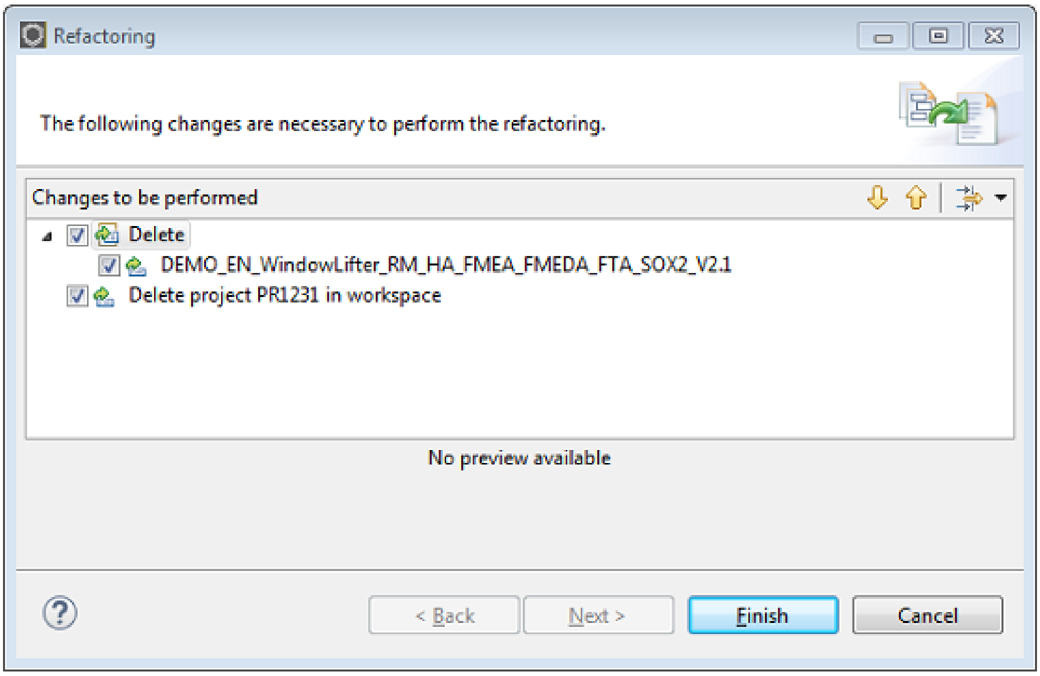
- Deleting the project from the repository (Warning: All the project files are erased, from your workbench AND the repository database, for you and every other user of the repository!).

Deleting the whole project from the repository:

1. In the repository view, right-click on the name of the project.

2. Choose **Delete.**

   ► The "Refactoring" dialog opens.



The following changes are necessary to perform the refactoring.

- ☑ Delete
  - ☑ DEMO_EN_WindowLifter_RM_HA_FMEA_FMEDA_FTA_SOX2_V2.1
- ☑ Delete project PR1231 in workspace

No preview available

fig. "Refactorin"g dialog

3. Make sure you really want to delete everything that has a checked check box.

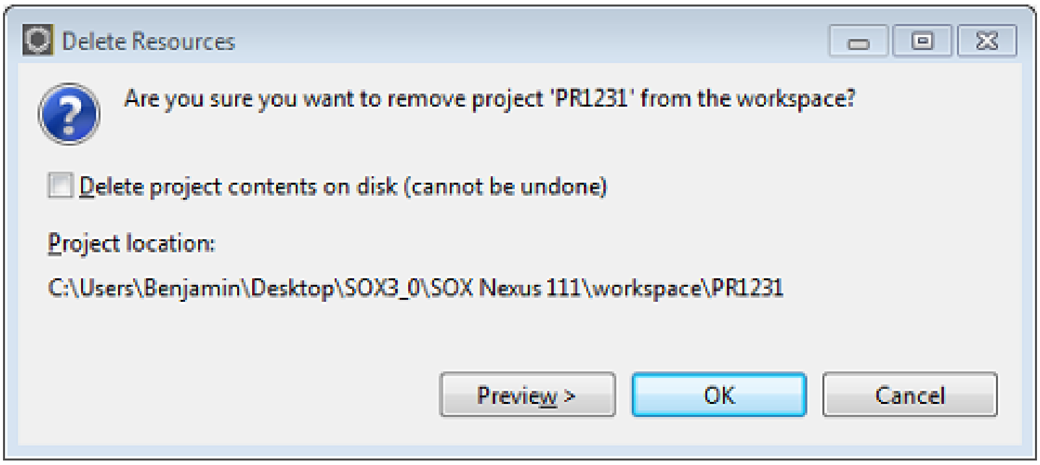
4. Click on **Finish**.

→ All the project files are erased from your workbench and the repository.

Deleting only the connections to a project in your workspace:

1. In the repository view, right-click on the name of the project.

   ► The "Delete Resources" dialog opens.



Are you sure you want to remove project 'PR1231' from the workspace?

☐ Delete project contents on disk (cannot be undone)

Project location:

C:\Users\Benjamin\Desktop\SOX3_0\SOX Nexus 111\workspace\PR1231

fig. "Delete Resource"s dialog

2. Let the box "Delete project contents on disk" unchecked.
3. Click on **Preview >** if you want to see more about what will be deleted.
4. Click on OK.

→ The project has been deleted from your workbench.

General SOX Functions

Importing SOX Objects

You can import the following SOX objects by using the EnCo Excel template:

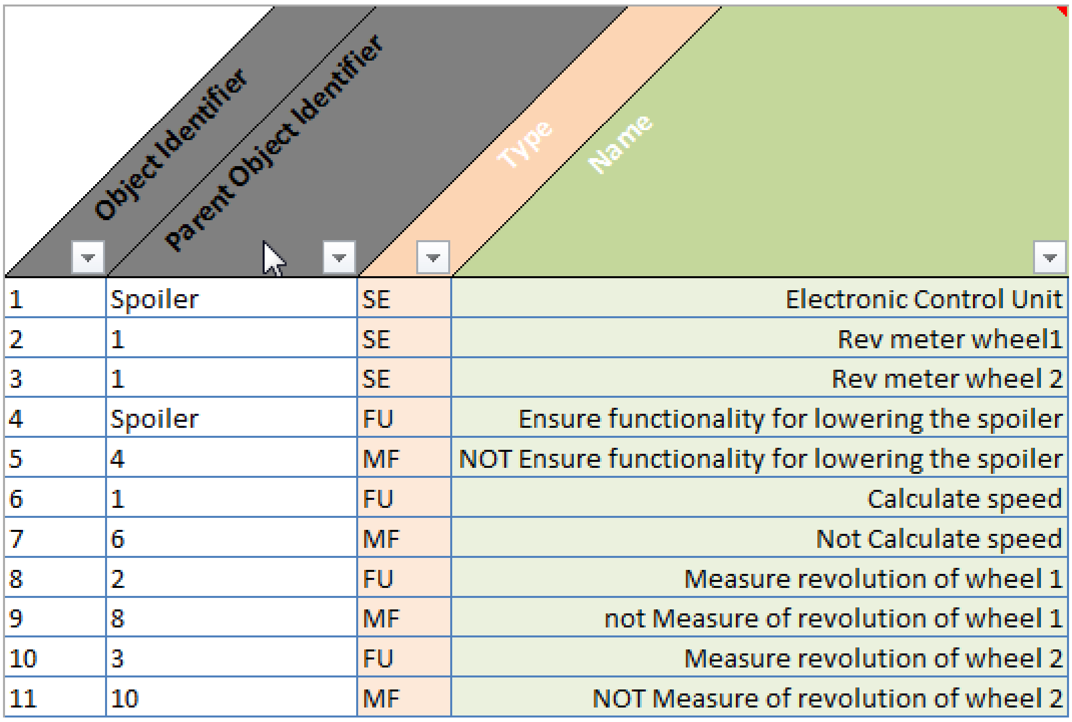
Note

You can only import SOX objects, if parent objects exists, which can be used as container.

Object	**Container (Parent Object)**
System Element	System Element (the imported Object will be created on a new level at the FMEA)
Function	System Element, FMEDA > Unassigned functions
Malfunction	Function
Diagnosis	Diagnosis Group, FMEDA > Diagnoses
Diagnosis Group	FMEDA Document
Safety Function	System Element
Product Characteristics	System Element
Process Characteristics	System Element
Interface Function	System Element
Governement Function	System Element

You can open the import wizard by using the according context menu entry of the corresponding Parent Object.

The following procedure explains how to import System Elements, Functions and Malfunction to a FMEA. The template which is used looks like this.



Object Identifier	Parent Object Identifier	Type	Name
1	Spoiler	SE	Electronic Control Unit
2	1	SE	Rev meter wheel1
3	1	SE	Rev meter wheel 2
4	Spoiler	FU	Ensure functionality for lowering the spoiler
5	4	MF	NOT Ensure functionality for lowering the spoiler
6	1	FU	Calculate speed
7	6	MF	Not Calculate speed
8	2	FU	Measure revolution of wheel 1
9	8	MF	not Measure of revolution of wheel 1
10	3	FU	Measure revolution of wheel 2
11	10	MF	NOT Measure of revolution of wheel 2

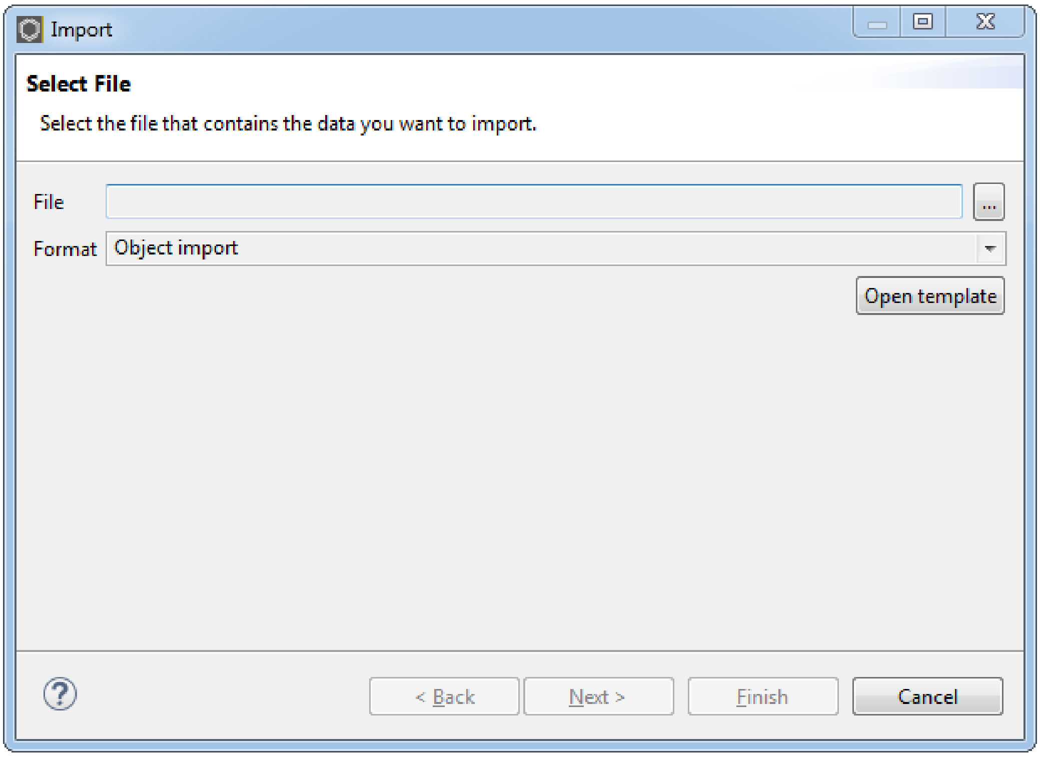
fig. Template with SEs, FUs and MFs.

Precondition: A FMEA with "Spoile"r as root element and an Excel file based on the EnCo template were created.

1. Right click in the repository view on the created FMEA file.

2. Choose **Import > Add objects to FMEA.**

   ► The Importing wizard opens.



Select File

Select the file that contains the data you want to import.

File

Format: Object import

fig. Import wizard.

Click on the Browse button to select your desired excel file. With the Open template button you can save the EnCo template on your system and edit it afterwards with Excel.

3. Click Next.

► Errors and warning will be shown if available.

4. Click Finish.

→ The objects from the chosen Excel file will be imported.

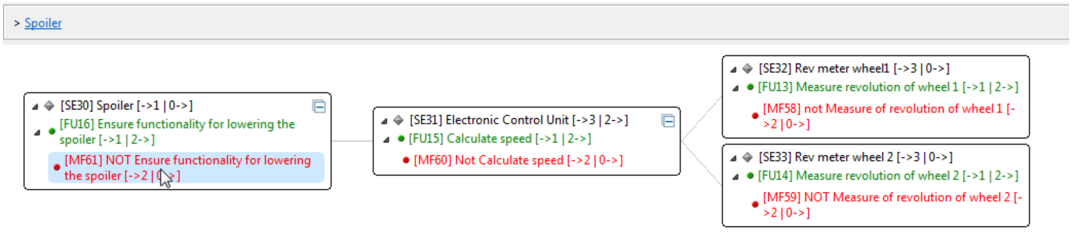

> Spoiler
[SE30] Spoiler [->1 | 0->]
[FU16] Ensure functionality for lowering the spoiler [->1 | 2->]
[MF61] NOT Ensure functionality for lowering the spoiler [->2 | 0->]
[SE31] Electronic Control Unit [->3 | 2->]
[FU15] Calculate speed [->1 | 2->]
[MF60] Not Calculate speed [->2 | 0->]
[SE32] Rev meter wheel1 [->3 | 0->]
[FU13] Measure revolution of wheel 1 [->1 | 2->]
[MF58] not Measure of revolution of wheel 1 [->2 | 0->]
[SE33] Rev meter wheel 2 [->3 | 0->]
[FU14] Measure revolution of wheel 2 [->1 | 2->]
[MF59] NOT Measure of revolution of wheel 2 [->2 | 0->]

fig. FMEA with imported objects in SOX.

Document Checksum

To address error cases during export and import of projects in SOX (in SOX internal format), a checksum is calculated from the exported/imported data: Before export, a checksum is calculated and stored in the exported file. At the end of each import, the checksum is re-calculated and compared to the checksum stored in the imported file. A match between the checksums shows that the imported data exactly matches the original data before export.

In SOX, a generic algorithm has been implemented that traverses any SOX data object (e.g., a BOM document) and all its contained objects (e.g., components) and calculates a checksum over them. The checksum for a single data object is created by generation a checksum for each of its properties and each of its references to other data objects. The checksum for a single property (e.g., component name) is a checksum for a String composed of the property name and its value. The checksum for a reference is a checksum for a String composed of the reference name the internal unique IDs of the referenced elements. For instance, a component refers to its contained failure modes and to the module it is contained in. Note that we consider containment references as well as references to elements contained elsewhere.

Cecksum Calculations

Calculate a checksum for BOM content in Excel and in SOX and compare them:

To address error cases during import from an Excel file, a formula is added to the Excel template that calculates a checksum (e.g., MD5, SHA) from the data in the Excel file. As the formula is contained in the Excel file, the user has the possibility to check that all relevant data is covered by the formula. In parallel, SOX calculates a checksum using the same checksum algorithm after importing the data. SOX then compares the two checksums to ensure that the imported data exactly matches the data in the Excel sheet.

Calculate checksum for FMEDA evaluation report in SOX and Excel and compare them:

To detect any errors in the FMEDA evaluation report (in Excel format), a checksum (see Appendix A) is calculated from the relevant data in SOX and displayed to the user. In addition, a formula is generated into the evaluation report that enables to re-calculate the checksum within Excel based on the data in the Excel file. The user can ensure that the data in the Excel file is identical to the data in SOX by comparing the two checksums.

Review catalog and calculate and store a checksum for the catalog to detect modifications:

To detect errors in standard failure rate catalogs or standard failure mode catalogs, each relevant standard catalog was reviewed manually by an expert. Afterwards, a checksum was calculated to from the catalog data that is stored as part of the catalog to detect any changes in the catalog. Each time SOX starts, the checksum is re-calculated and compared to the checksum stored in the catalog. A match indicates that the catalog is identical to the reviewed catalog.

Review failure mode catalog and calculate and store a checksum for the catalog to detect modifications:

The measure has been applied to the standard failure rate catalogs delivered with SOX:

- Birolini
- IEC 62380

Causes for Checksum Mismatch

External modification of exported project files:

If the exported project file is modified externally, e.g., by incomplete file transfer or manual modification, the checksum will be mismatch.

Errors in SOX import/export:

If any project content after importing a project differs to the original project content before the export, the checksum will mismatch.

Changes in the internal SOX data model between different SOX versions:

Importing a project that was exported with an earlier version of SOX can lead to a checksum mismatch if the internal SOX data model differs. For instance, if a property with a default value is added to the data model in a new SOX version, all imported projects will be initialized with the default value during project import, resulting in a different checksum compared to the same project in earlier versions. To mitigate this case, SOX internally stores changes in the data model and which SOX document types are affected by this change. In this way, SOX can indicate the user (for each document type) whether a checksum mismatch was expected due to changes in the SOX data model.

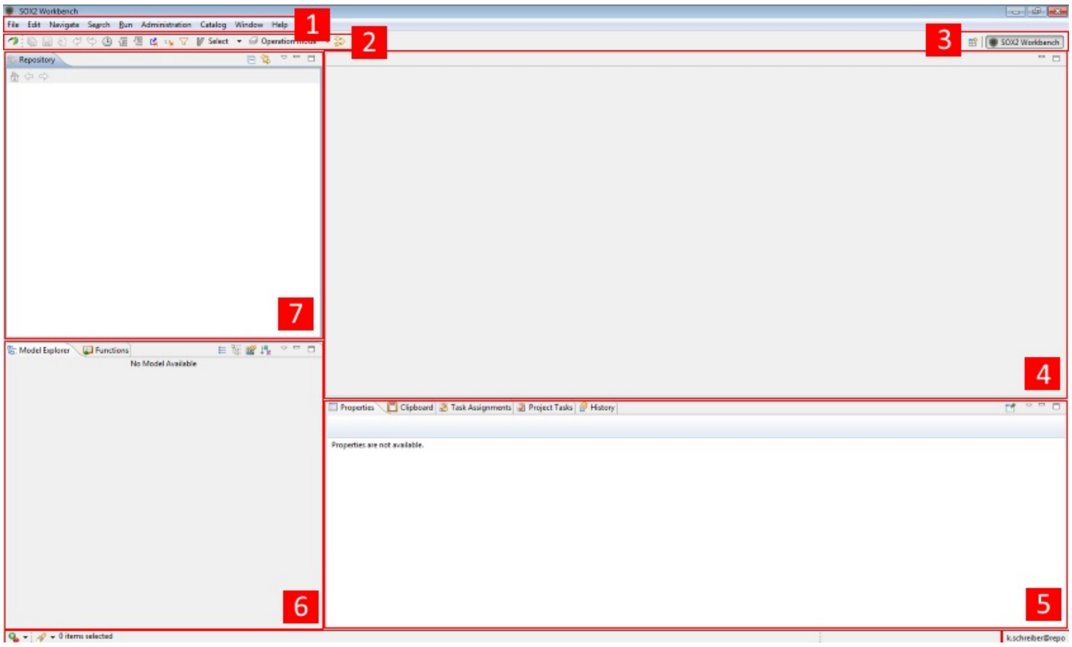
Limitations

In case of changes in the data model between different SOX versions, SOX can only indicate the user that a mismatch is expected due to data model changes. But there is no way to find out if the data model change is the only cause of the mismatch. However, SOX can in addition indicate which document(s) mismatch and, in case of BOM/FMEDA documents, which modules and components (if any).

The User Interface of SOX

Overview of the User Interface

1. User Interface



No Model Available

Properties are not available.

fig. User interface overview

[1] Menu bar

[2] Toolbar

[3] Perspective picker

[4] Editor

[5] General views

[6] Model Explorer

[7] Repository

General Concepts of the User Interface

Views

The user interface of SOX consists of multiple "views", rectangular parts of the user interface. Views are typically used to navigate a list or hierarchy of information or display properties for the active editor. The views can be freely opened, closed and arranged.

The most important and special views are the repository view and the editor.

The repository view:

The repository view is where you can find all of your SOX projects and files. You usually find it on the left when starting SOX. You always start here, whether you create a new project, import a project or open an existing project. You get more information on that in the chapter "Getting started with Projects".

The editor:

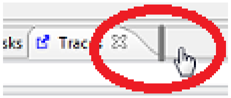
You will mostly work within the editor, using the other views as an aid. You get a specific editor for every module.

Rearranging views:

You can change a view´s location on the screen with drag & drop:

1. Click on a view´s tab and hold the mouse button.
2. Move the cursor to another location in the same stack of views, or even to a different stack of views.

   ► A gray vertical line indicates where it will be placed.

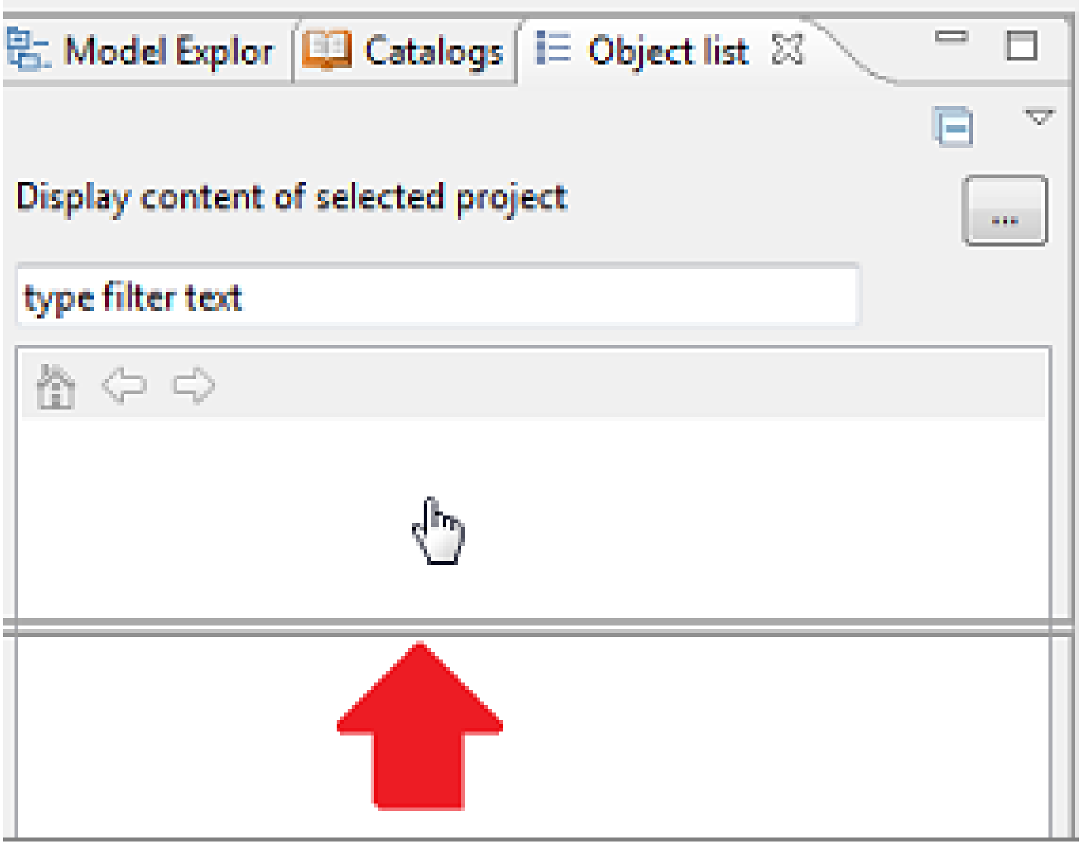


3. Release the mouse button.

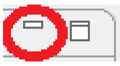
→ The view´s tab has been placed at the new location.

You can even create a new stack (or area) for views:

When you drag a view around the screen, you can see that at certain places a double gray line appears. This indicates that a new stack will be created, if you release the mouse button there.



Minimizing views:

In the upper right corner of a view click on .

→ The whole stack of views has been minimized and moved to the left or right of the screen.

Maximizing views:

In the upper right corner of a view, click on .

→ All the other sets of views have been minimized and moved to the left or right of the screen.

Restoring views that have been minimized:

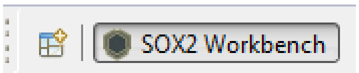
1. Find the minimized views to the left or right of the screen.
2. Click on the "restore" button to the left or right of the screen:

→ The stack of views has been restored.

Perspectives

Perspectives are predefined collections of views for the specific modules.

You find all the currently open perspectives to the very upper right:



"SOX Workbench" is the default perspective, you start from here. Here you find the repository view, which lets you access all your files.

If you double-click on a file in the repository view in the workbench perspective, the corresponding perspective will open.

Perspectives can also be customized to fit your own workflow. It is even possible to create new perspectives.

1. Click on the **Open Perspective** icon:

   ► The "Open Perspective" dialog opens.

2. Choose the desired perspective.
3. Click the **OK** button to finish.

→ SOX is opened in the chosen perspective with the corresponding views.

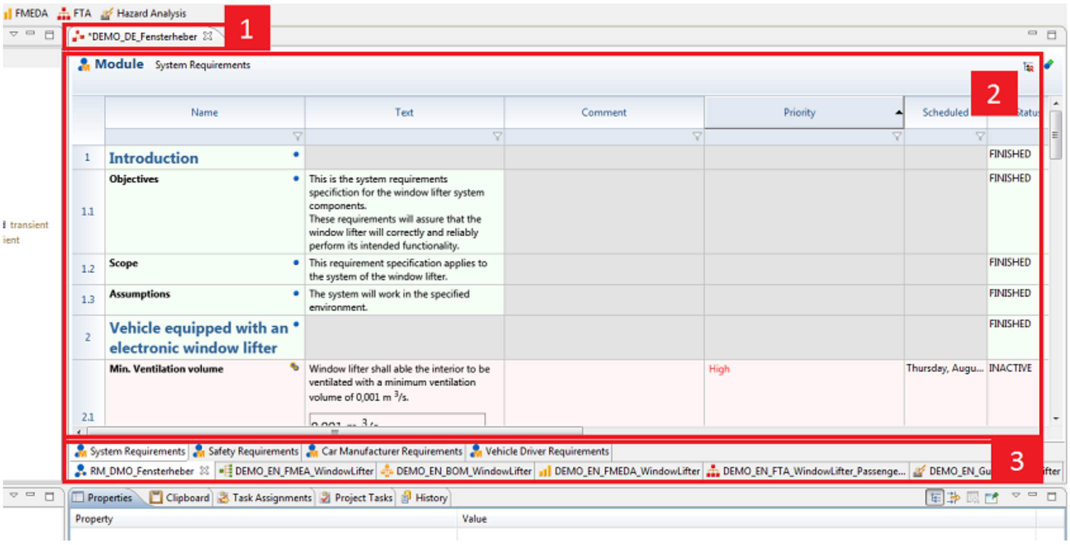
To customize the perspective, click on **Window** in the menu bar.

For more information on each perspective, read the chapters about each module:

- System Designer
- Reliability
- FMEA
- FMEDA

- Requirements
- FTA
- Hazard Analysis

Editor



	Name	Text	Comment	Priority	Scheduled	tatus
1	Introduction					FINISHED
1.1	Objectives	This is the system requirements specifiction for the window lifter system components. These requirements will assure that the window lifter will correctly and reliably perform its intended functionality.				FINISHED
1.2	Scope	This requirement specification applies to the system of the window lifter.				FINISHED
1.3	Assumptions	The system will work in the specified environment.				FINISHED
2	Vehicle equipped with an electronic window lifter					FINISHED
2.1	Min. Ventilation volume	Window lifter shall able the interior to be ventilated with a minimum ventilation volume of 0,001 m ^{3}/s.		High	Thursday, Augu...	INACTIVE

fig. Editor overview

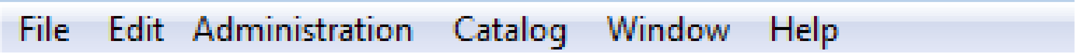
These are the three main parts of the editor:

The register [1] at the top shows the currently opened project.

The documents will be displayed and can be edited in the main part of the editor [2].

The register at the bottom [3] shows the currently opened documents.

Menu Bar



File

- **Close**

  Close single/all windows in the explorer.

- **Save**

  Save single/all changes in your current project.

- **Print**

  Print FMEDA, BOM, Hazard, Requirements.

- **Switch Workspace**

  SOX stores your projects in a folder called workspace. Choose a workspace folder to use for this session.

- **Restart**

  Restart SOX.

- **Import**

  Import FMEDA, BOM, Requirements, Excel.

- **Document Properties**

  Change general properties of the selected document.

- **Exit**

  Closes the application.

Edit

- **Preferences**

  Opens the "Preferences" dialog to get options to change the preferences of your installation of SOX.

Administration

- **User administration**

  Opens the security management view for administrators.

- **Change passwords**

  Change the administrator password.

Window

- **Hide Toolbar**

  The toolbar can be hidden and shown.

- **Show view**

  Views can be added to the currently open perspective.

- **Open Perspective**

  Different perspectives can be opened here.

- **Save Perspective As**

  Perspectives can be customized by adding or removing views and added to the default perspectives.

- **Reset Perspective**

  Reset the current perspective to its defaults.

- **Close Perspective**

  Closes the current perspective.

- **Close All Perspectives**

  Closes all open perspectives.

Help

- **Help Contents**

  Opens the help viewer.

- **Search**

  Searches for terms from the help contents.

- **License Manager**

  Shows informations about your license. Furthermore you can request a new license or copy the current ID.

- **About**

  Shows information about your SOX version.

Variant

Note

> The menu "Variant" will be added to the menu bar, after you have opened a SOX project or document.

You can **add**, **edit** or **delete** variants for the selected document. Variants are listed at the "Select variant" icon at the toolbar Select variant ▾ or in the PSS view.

Precondition: Your document needs to be open and selected.

Adding a variant:

1. Navigate to **Variants** in the menu bar.
2. Click on **add variant**.

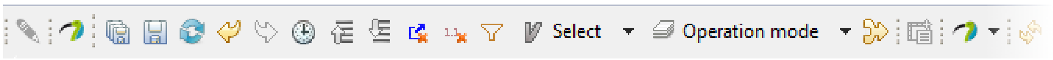
   ► The Variant dialog opens.
3. Choose a name for this variant.
4. a) Click on **Finish**.

   → A variant with all objects of the selected document has been added.

   b) Click on **Next**.
5. Select the objects that include the variant.
6. Click on **Finish**.

→ A variant with the selected objects has been added.

Toolbar



All icons in the toolbar explained:

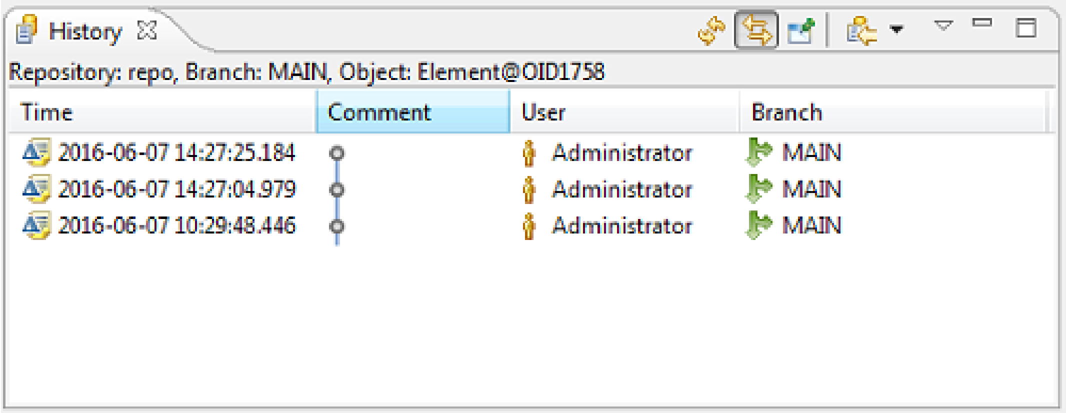
Icon	Name	Function
	Enable write	Make it possible to write in the selected area.
	Disable write	Make it impossible to write in the selected area.
	Save all	Save all changes of the current project.
	Save	Save only the changes of the current document.
	Refresh	Refreshes all entries. It often solves calculation problems.
	Undo	Undo the last step.
	Redo	Redo the last step.
	Move selected element up	Move the selected element up.
	Move selected element down	Move the selected element down.
	Show trace decorators	Show trace decorators
1.1	Show sequential decorators	Show sequential decorators
	Hide filtered parts	Hide all filtered parts.
Select ▾	Variant select	Select an applied variant.
Operation mode ▾	Operation mode	Select an applied operation mode.
	Create a new table from the configurations catalog	Create a new table from the configurations catalog.
	Refresh the current diagram	Refresh the current diagram.
→ ▾	Line style action	Line style action
▾	Select action	Select action

Icon	Name	Function
⧉ ▾	Arrange action	Arrange action
⊞ ▾	Align action	Align action
≡ ▾	Align text	Text align left/center/right
☜ ▾	Show/Hide action	Show/Hide action
⇢ ▾	Routing action	Routing action
↔ ▾	Distribute action	Distribute action
⊡ ▾	Make same size	Make same size of objects
▦ ▾	Create a new table	Create a new table
▣ ▾	Create a new diagram	Create a new diagram

General Views

These views are available in each default SOX perspective. They contain information and functionalities that can be used in the whole project and are not specific to a certain SOX module.

History



Repository: repo, Branch: MAIN, Object: Element@OID1758

Time	Comment	User	Branch
2016-06-07 14:27:25.184		Administrator	MAIN
2016-06-07 14:27:04.979		Administrator	MAIN
2016-06-07 10:29:48.446		Administrator	MAIN

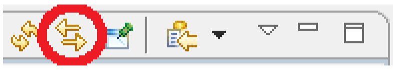
fig. The "Histor"y view

The history view shows you details about a selected object´s history, e.g. when and by whom it was created and edited.

Checking the history of an object:

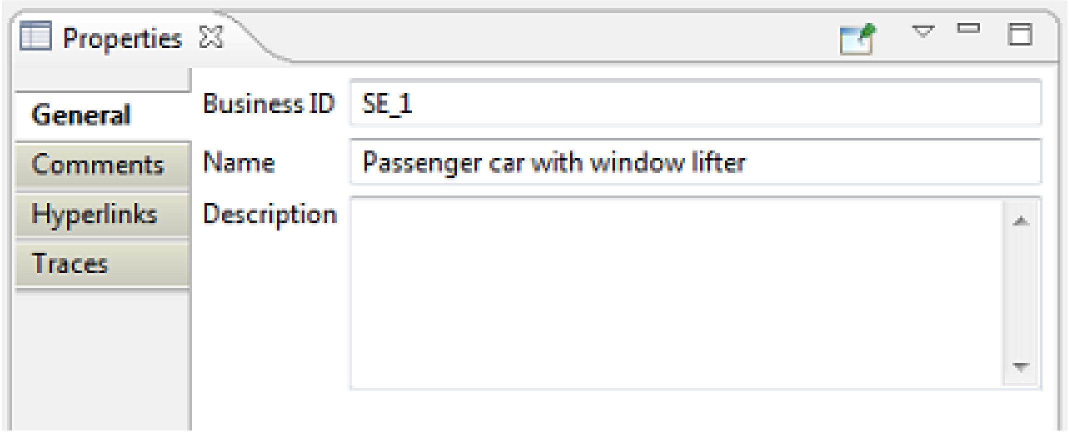
1. Select an object in the editor.

2. Click on the the button "Link with Editor and Selection":



→ You can now see the history of the object.

Properties



Business ID SE_1

Name Passenger car with window lifter

Description

fig. The "Propertie"s view

In the properties view you find the following options to the left:

- General:

  The properties view displays general information about a selected object. Also, this information can be edited.

- Comments:

  All comments of a selected object will be shown in this register.

  Creating a new comment:

  1. Right-click on an object.

  2. Choose **New > New Comment.**

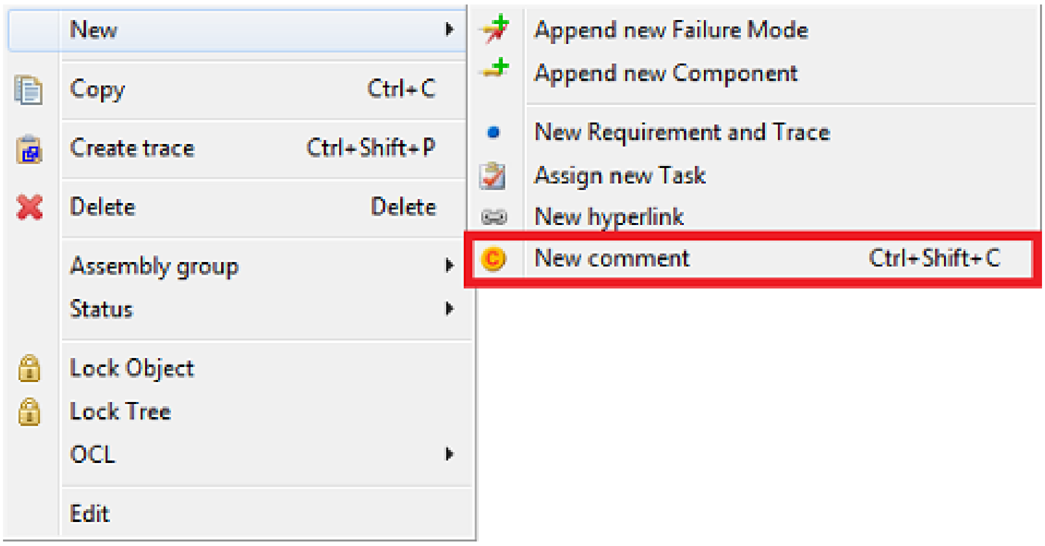


fig. Context menu for new comment

→ A new comment has been added to an object and provided with the comment icon.

- Hyperlinks:

All hyperlinks of a selected object will be shown in this register.

Creating a new hyperlink:

1. Right-click on an object.
2. Choose **New > New Hyperlink**.

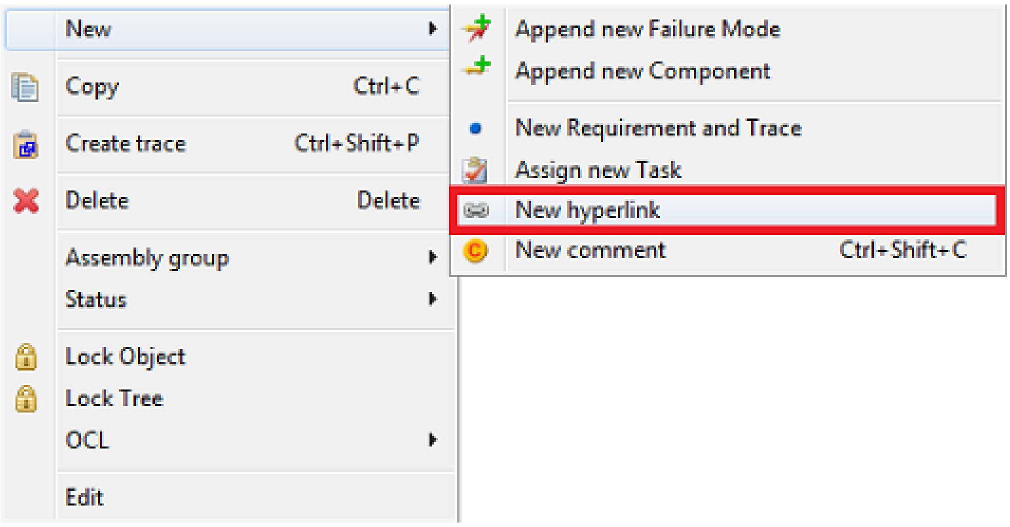


fig. Context menu for new hyperlink

▶ The "Add Hyperlink" dialog opens.

3. Enter a name for the hyperlink.
4. Enter the URL.
5. Click the **OK** button to finish.

→ A new hyperlink has been added to the object and will be shown in the properties view.

- Traces:

  The traces of an object will be shown in this register.

Clipboard

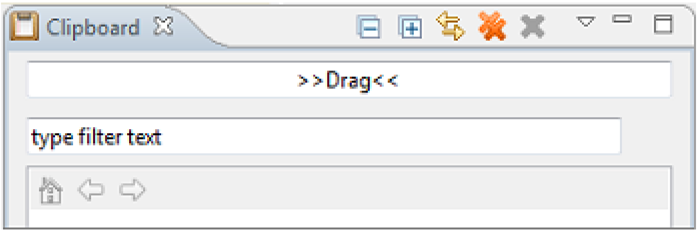


fig. The "Clipboar"d view

The clipboard is for storing objects, e.g. system elements, functions, malfunctions.

Place objects here with drag & drop so you can use them later:

1. Click on the object and hold the left mouse button.

   ▶ The cursor changes to a circle with a bar crossing through it.

2. Hold the mouse button and move the cursor to the clipboard view, over the field **>>Drag<<**.

   ▶ The cursor changes. A plus sign appears next to the cursor.

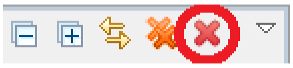
3. Release the mouse button.

   ▶ The object appears in the lower part of the clipboard.

→ The object is now constantly available in the clipboard.

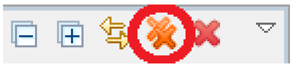
You can drag it from the clipboard onto other objects.

Removing an object from the clipboard:

1. Select an object in the clipboard.
2. Click on "Remove selection from clipboard": 

→ The selected object has been removed from the clipboard.

Removing all objects from the clipboard:

1. Select any object from the clipboard.
2. Click on "Clear clipboard": 

→ All objects have been removed from the clipboard (they still exist everywhere else).

Model Explorer

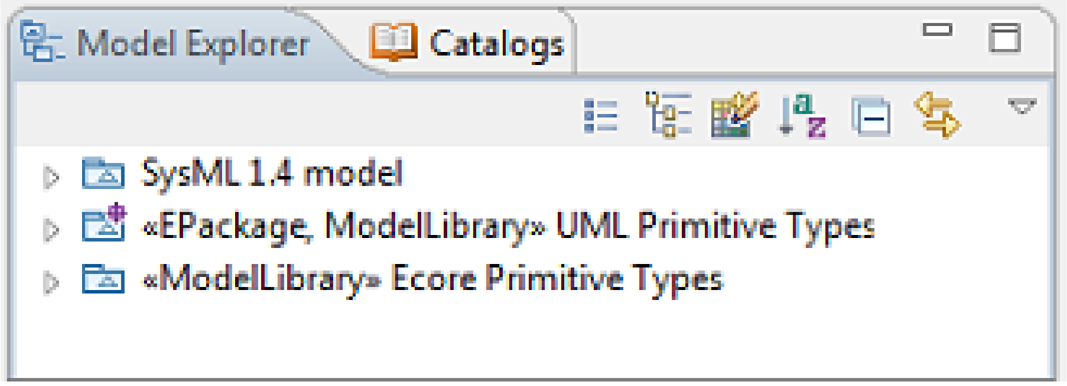

Model Explorer
Catalogs
SysML 1.4 model
«EPackage, ModelLibrary» UML Primitive Types
«ModelLibrary» Ecore Primitive Types

fig. The "Model Explore"r view

All existing system design elements (in the same project you are currently working in) are listed in the "Model Explorer" view and can be reused from there, e.g., by dragging and dropping them into other documents. Alternatively, it is possible to open one or more "Object list" views to show lists of all existing elements of a specific type.

↓az	Sort elements alphabetically.
	Customize the Model Explorer.
	Toggle advanced Model Explorer.
	Link with editor. This feature makes it easier to select objects: If this is active, every object you select in the editor will also be immediately selected in the model explorer and the other way round.
	Show diagrams. This shows all diagrams in the model and filters out everything else.

Object List

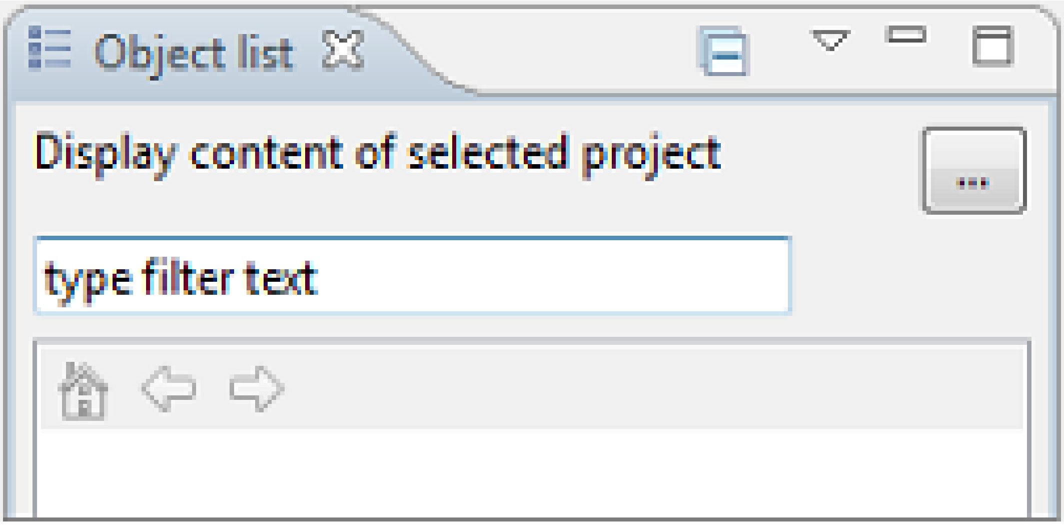


fig. The "Object lis"t view

The "Object list" view shows a list of often needed objects. At first this view is empty.

Showing a list:

1. Click on the browse button [...].

   ► The "Catalog selection" dialog opens.

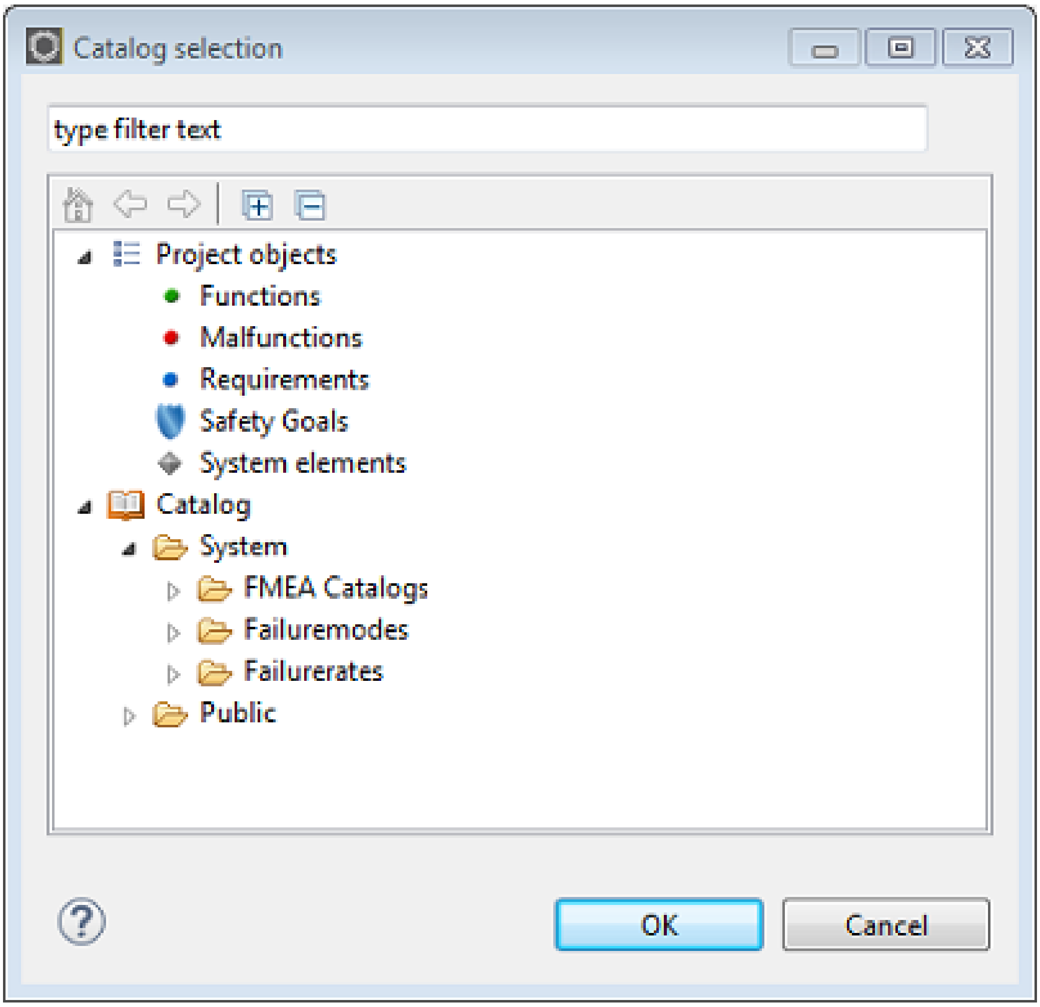


fig. "Catalog selectio"n dialog

2. Select the desired object type.

3. Click **OK**.

→ The selected objects will be shown in the object list view.

Note that you can open as many of these object list views as you need! Just click on **"New Catalog View"** and a new object list view will be added. The purpose of this view is to make it easier and faster for you to get access to all the objects in your project.

Catalogs

Norm Catalogs

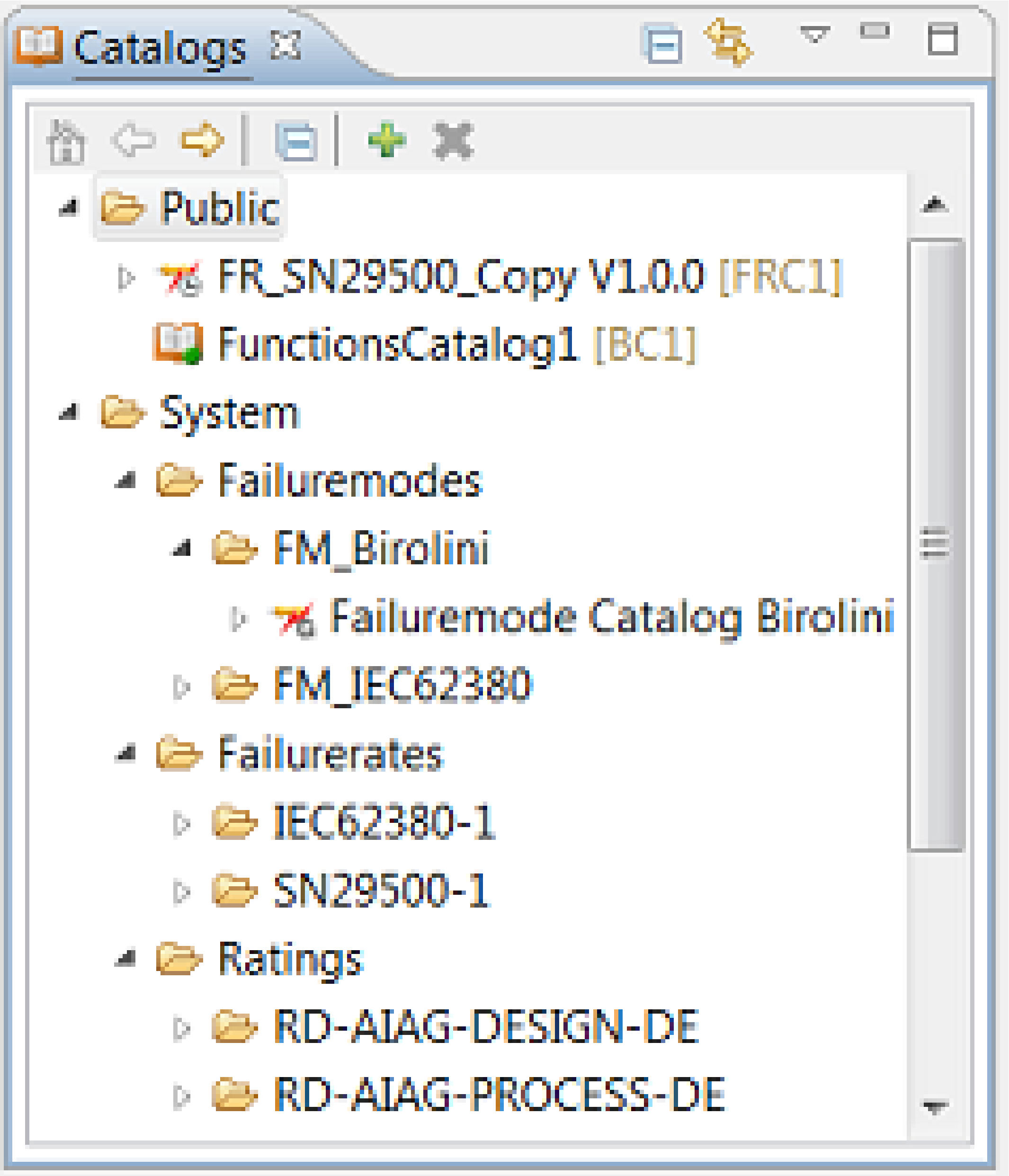


fig. The "Catalog"s view

In this view you can find all the catalogs (norms) that are shipped with SOX. You can also copy those catalogs and then edit them to fit your own demands. There are two folders in this view: "System" and "Public".

System:

The system folder contains all the catalogs that are shipped with SOX. You cannot edit the catalogs in the system folder!

Copying a catalog:

1. Right-click on a catalog.

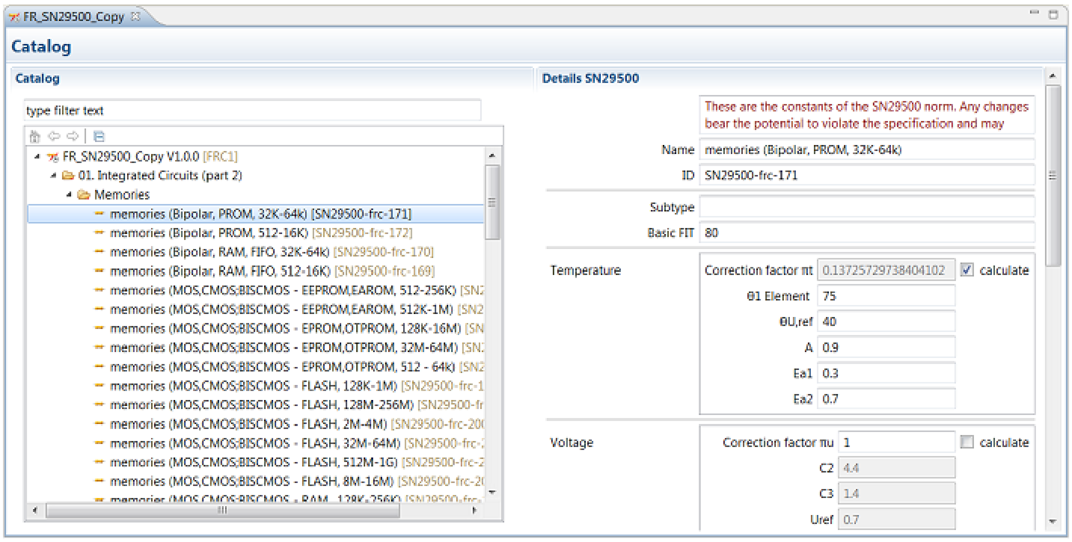
2. Choose **Copy**.

→ A copy of the catalog appears in the folder "Public".

Public:

Here you can find the copied catalogs. You can also create new catalogs by right-clicking inside the public folder and choosing **New**. All users of the same repository can access the "Public" folder.

To edit a catalog, double-click on it, and the catalog editor will open:


FR_SN29500_Copy
Catalog
Catalog
type filter text
FR_SN29500_Copy V1.0.0 [FRC1]
01. Integrated Circuits (part 2)
Memories
memories (Bipolar, PROM, 32K-64k) [SN29500-frc-171]
memories (Bipolar, PROM, 512-16K) [SN29500-frc-172]
memories (Bipolar, RAM, FIFO, 32K-64k) [SN29500-frc-170]
memories (Bipolar, RAM, FIFO, 512-16K) [SN29500-frc-169]
memories (MOS,CMOS;BISCMOS - EEPROM,EAROM, 512-256K) [SN
memories (MOS,CMOS;BISCMOS - EEPROM,EAROM, 512K-1M) [SN2
memories (MOS,CMOS;BISCMOS - EPROM,OTPROM, 128K-16M) [SN
memories (MOS,CMOS;BISCMOS - EPROM,OTPROM, 32M-64M) [SN
memories (MOS,CMOS;BISCMOS - EPROM,OTPROM, 512 - 64k) [SN2
memories (MOS,CMOS;BISCMOS - FLASH, 128K-1M) [SN29500-frc-1
memories (MOS,CMOS;BISCMOS - FLASH, 128M-256M) [SN29500-fr
memories (MOS,CMOS;BISCMOS - FLASH, 2M-4M) [SN29500-frc-20
memories (MOS,CMOS;BISCMOS - FLASH, 32M-64M) [SN29500-frc-
memories (MOS,CMOS;BISCMOS - FLASH, 512M-1G) [SN29500-frc-2
memories (MOS,CMOS;BISCMOS - FLASH, 8M-16M) [SN29500-frc-2
Details SN29500
Temperature
Voltage

These are the constants of the SN29500 norm. Any changes bear the potential to violate the specification and may

Name: memories (Bipolar, PROM, 32K-64k)
ID: SN29500-frc-171
Subtype:
Basic FIT: 80

Temperature
Correction factor πt: 0.13725729738404102 ☑ calculate
θ1 Element: 75
θU,ref: 40
A: 0.9
Ea1: 0.3
Ea2: 0.7

Voltage
Correction factor πu: 1 ☐ calculate
C2: 4.4
C3: 1.4
Uref: 0.7

fig. The catalog editor

Employee Catalog

In the employee catalog you can define team members. You can access the whole catalog of employees across your projects. In the catalog you can assign team members to projects, add contact information and, later on, you can assign those team members to tasks.

Opening the employee catalog:

Precondition: The "Catalog"s view is open.

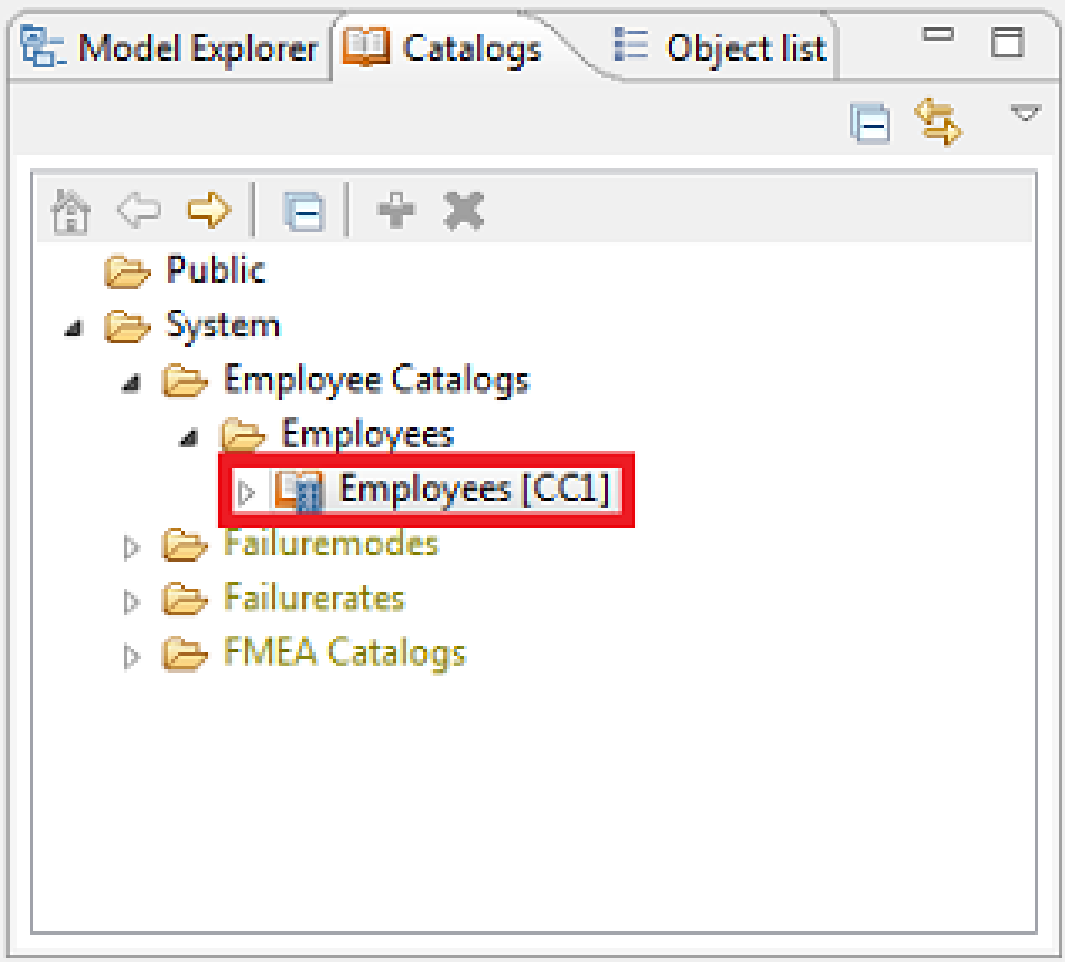
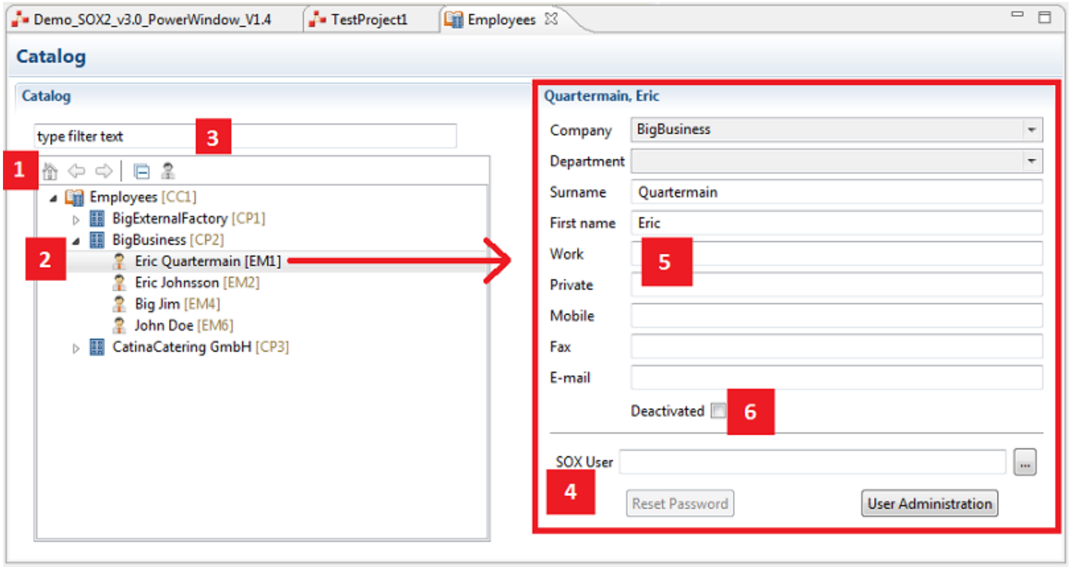


fig. Location of employee catalog

1. In the view "Catalogs", open System > Employee Catalogs > Employees.

2. Double-click on **Employees**.

→ The employee catalog is open.



Quartermain, Eric

Company: BigBusiness

Department:

Surname: Quartermain

First name: Eric

Work:

Private:

Mobile:

Fax:

E-mail:

Deactivated ☐

SOX User:

fig. The employee catalog editor

To the left of the employee catalog editor you find the hierarchical structure of companies, departments and employees [2].

At the top there is a filter field [3]. Type in text and it filters the list.

You find a bar of buttons [1]:

"Home" takes you back to the beginning of the list ("Employees"), after navigating down the hierarchy.

"Back" moves you back in the hierarchy (you have to select an entry first).

"Go into" moves you deeper into the structure.

"Collapse all" closes all the expanded levels.

"Show deactivated employees": Normally all the employees that are deactivated (=deleted) are not shown in the list. This lets you see them again. They are shown in gray.

When you click on an employees name, information about this employee appears to the right [5]. You can see and enter contact information for this employee, the full name and where the employee works.

You can also deactivate the employee if he / she no longer works for the project [6].

If you have an account with the rights to manage SOX user accounts, you can also edit SOX user information [4] (optional).

--

Adding a new company:

Right-click on **Employees** and choose **New** > **Company**.

--

Adding a new department:

Right-click on a company and choose **New** > **Department**.

--

Adding a new employee:

Right-click on a company or a department and choose **New** > **Employee**.

--

You can edit the structure with drag and drop, e.g. you can move an employee to a different department or another company.

--

Deleting / deactivating employees:

You can either click the checkbox "Deactivated" [6] or right-click on an employee and click **Delete**.

PSS

The Project System Structure (PSS) view gives an overview of all related objects which have been created within your project. Furthermore objects can be created and managed for each module.

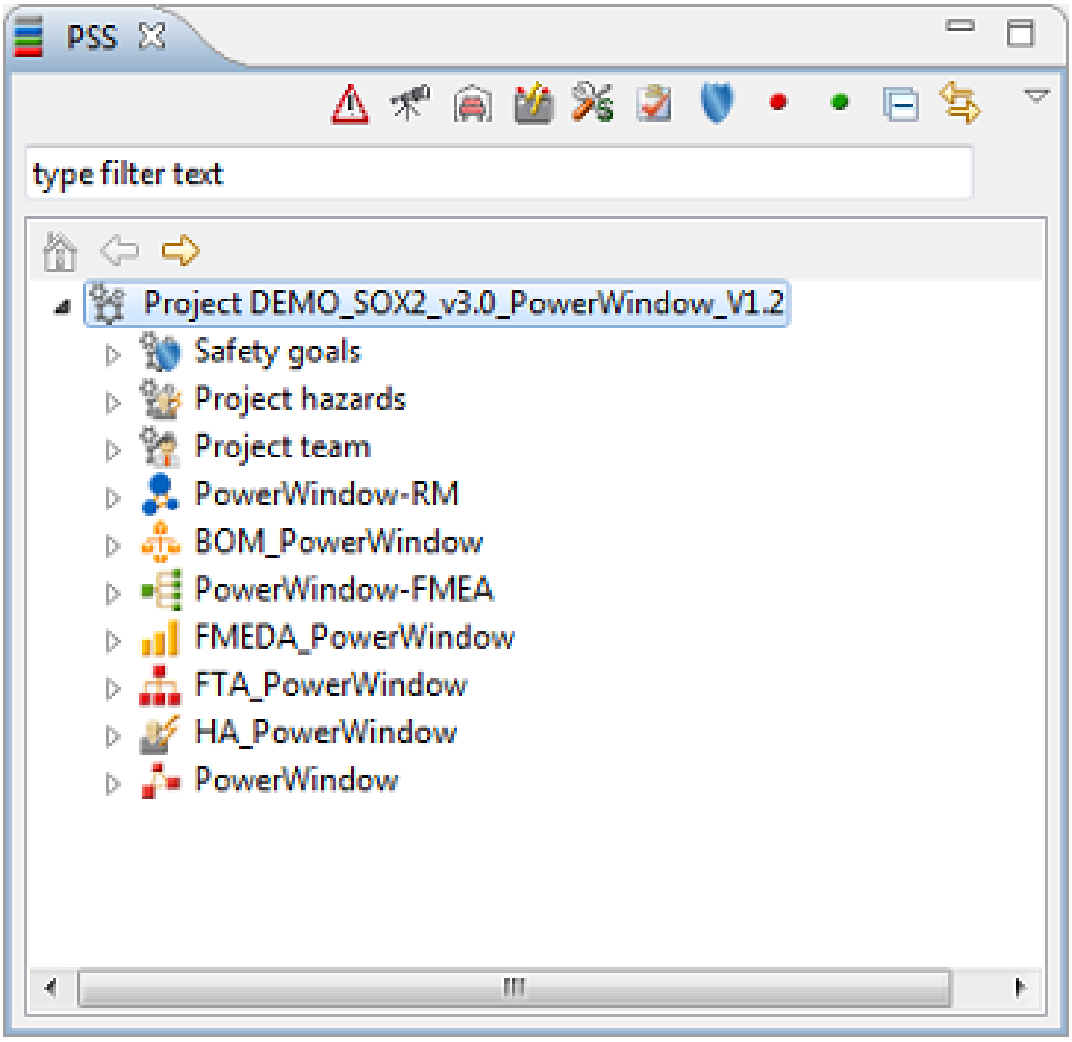


fig. The "PS"S view

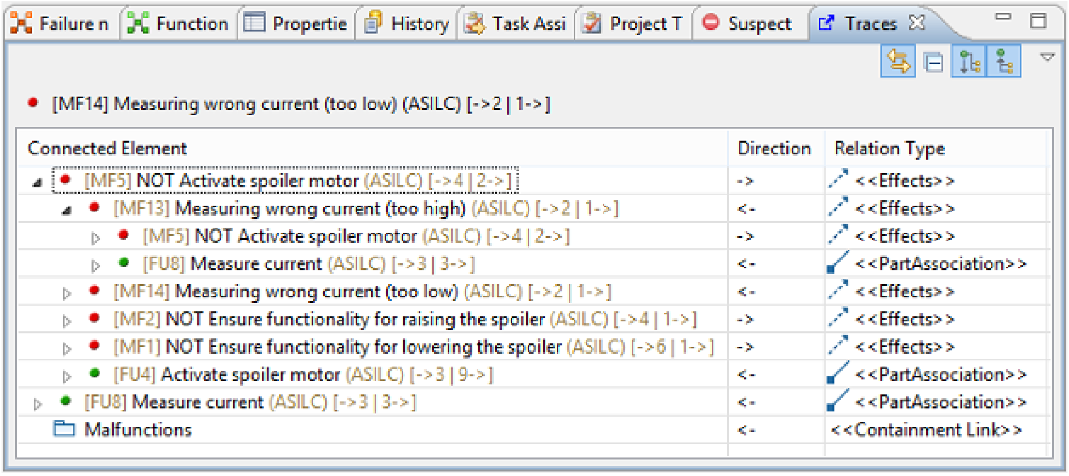
One of the most important functions in the PSS is the drag & drop function. This allows you to assign existing objects to other objects. For example, a system element can thus be linked with a requirement.

Traces

The view "Traces" shows all objects in a project that are related to the object that you selected.

You can see the names of the related objects, the direction of the relationship and the relation type.

Check the filters in the upper right corner for "Incoming references" and "Outgoing references".



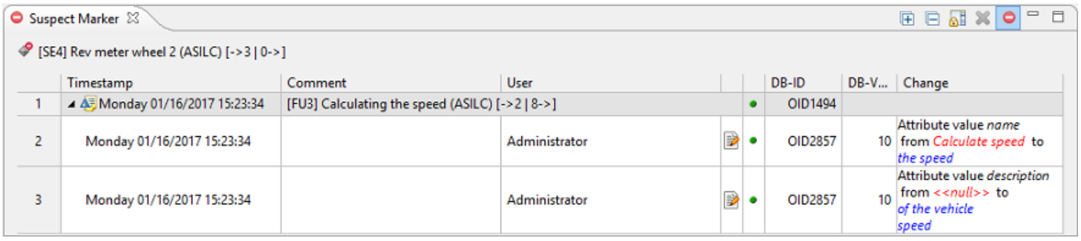
● [MF14] Measuring wrong current (too low) (ASILC) [->2 | 1->]

Connected Element	Direction	Relation Type
◢ ● [MF5] NOT Activate spoiler motor (ASILC) [->4 | 2->]	->	<<Effects>>
◢ ● [MF13] Measuring wrong current (too high) (ASILC) [->2 | 1->]	<-	<<Effects>>
▷ ● [MF5] NOT Activate spoiler motor (ASILC) [->4 | 2->]	->	<<Effects>>
▷ ● [FU8] Measure current (ASILC) [->3 | 3->]	<-	<<PartAssociation>>
▷ ● [MF14] Measuring wrong current (too low) (ASILC) [->2 | 1->]	<-	<<Effects>>
▷ ● [MF2] NOT Ensure functionality for raising the spoiler (ASILC) [->4 | 1->]	->	<<Effects>>
▷ ● [MF1] NOT Ensure functionality for lowering the spoiler (ASILC) [->6 | 1->]	->	<<Effects>>
▷ ● [FU4] Activate spoiler motor (ASILC) [->3 | 9->]	<-	<<PartAssociation>>
▷ ● [FU8] Measure current (ASILC) [->3 | 3->]	<-	<<PartAssociation>>
Malfunctions	<-	<<Containment Link>>

fig. "Trace"s view

For an overview of all the traces in a project, open the trace matrix.

Suspect Marker



[SE4] Rev meter wheel 2 (ASILC) [->3 | 0->]

	Timestamp	Comment	User			DB-ID	DB-V...	Change
1	◢ Monday 01/16/2017 15:23:34	[FU3] Calculating the speed (ASILC) [->2 | 8->]			●	OID1494		
2	Monday 01/16/2017 15:23:34		Administrator		●	OID2857	10	Attribute value *name* from *Calculate speed* to *the speed*
3	Monday 01/16/2017 15:23:34		Administrator		●	OID2857	10	Attribute value *description* from *<<null>>* to *of the vehicle speed*

Suspect markers (⛔) indicate that a related object has been changed. Use this as a tool to make sure that changes to an object do not have unintended consequences elsewhere. After a change has been made to an object, the icons of all the related objects in the project receive a suspect marker.

After you made sure that the related objects do not need to be adjusted, you can delete the markers for the object.

Suspected links have to be enabled for each project. You do this when creating a new project, or you can do it later in the document properties by making a check mark at "Enable suspected links".

When the suspected links have been enabled in a project, the suspect marker filter gets enabled at top of the Suspect Marker view.

Deleting suspect markers:

1. Select the object with the marker (you can also select multiple objects by keeping the **Ctrl** key pressed).

2. Select the suspected links in the suspect marker view.

3. Choose **Delete**.

→ The suspect marker has been deleted.

Select the object with the marker (you can also select multiple objects by keeping the **Ctrl** key pressed). Now select the suspected links in the suspect marker view and choose **Delete**.

Working with Variants

You can add variants to your documents. This way you can analyze different versions of your system without having to create entirely new documents for each version. You decide which objects (for example which functions) are relevant to a certain variant.

Adding Variants

Adding a variant:

1. In the menu bar at the top, click on **Variants** > **Add variant**.

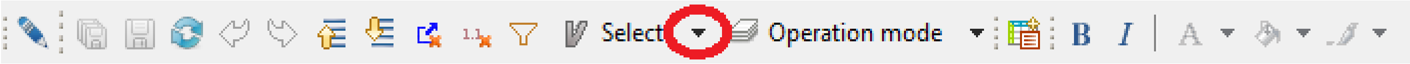
   ► The "Variant" wizard opens.

2. Enter a name.
3. Click on **Next >**.
4. Select the elements that you want to be part of the variant.
5. Click on **Finish**.

→ A new variant has been added.

Selecting Variants

To select a variant, look in the menu bar: Click on the triangle next to "V select".



Then click on the name of a variant. All the objects that are not part of the variant will now be displayed in gray.

To deselect a variant, click again on the triangle, then on "Deselect variant".

Editing Variants

You can add objects to the variant (or remove the objects from them) by right-clicking on the object and choosing **Edit...**. Then go to the tab "Variants".

You can also get an overview over your variants and edit them in the variant matrix:

In the repository view in the perspective "SOX Workbench", right-click on a document (e.g. your FMEA document), then choose **Open with** > **Variant matrix**. Here you see the objects in your file, plus a column for each variant that you created.

The objects displayed are: elements, functions, malfunctions, action groups.

In the columns, checkboxes mark which object is part of the variant. This gives you a good overview over your variants. You can edit the variants here by clicking the checkboxes. In the right upper corner you have a button that lets you create a new variant.

Deleting Variants

Delete a variant by going to the menu bar, clicking **Variants** > **Delete variant**, then choose the respective variant.

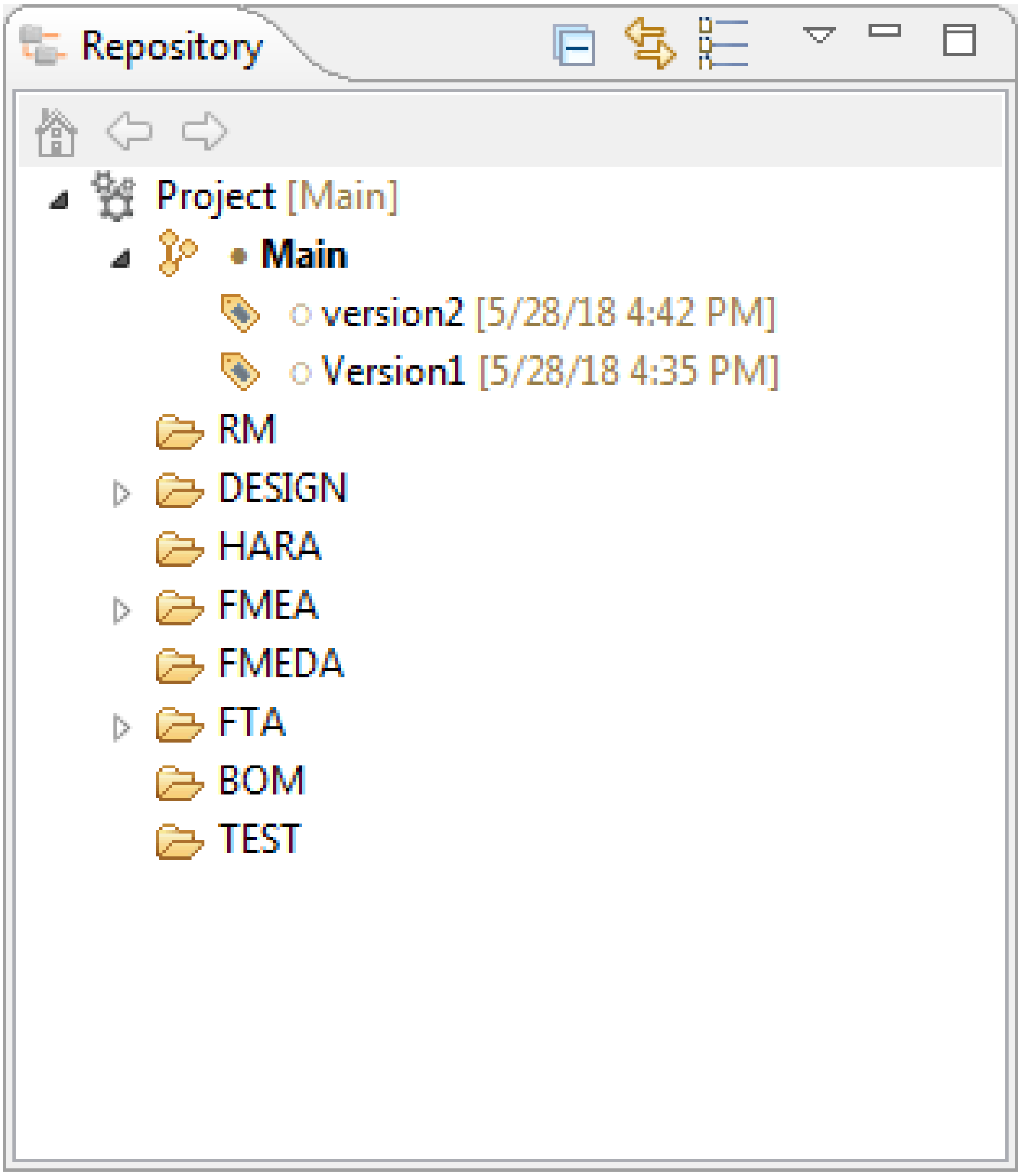
You can also delete variants in the variant matrix: Right-click on the name of the variant and click on **Delete**.

Working with Versions

SOX allows you to save projects in different versions. This means SOX freezes the project to its current state and provide it with a timestamp. They are mainly intended for comparison purpsoes.

Each project starts at a branch called "Main". Branching means you diverge from the "Main" line of development and continue without messing with that main line. A green decorator behind the project name shows on which branch the project currently is ▷ Project [Main] , and which timestamp the version or project has • Version1.2 [5/30/18 1:35 PM] (Use the register "Team" at the SOX preferences dialog for activating or deactivating these decorators).

If you are opening the project directory, you can see the branching directory which contains all created versions. Furthermore you can switch between versions with a double click on the according one, or using the "Select branch\version" dialog which can be opened by making a right-click on the project or branch directory and choose Team > Switch to head or version.



Repository

Project [Main]
- Main
  - version2 [5/28/18 4:42 PM]
  - Version1 [5/28/18 4:35 PM]
- RM
- DESIGN
- HARA
- FMEA
- FMEDA
- FTA
- BOM
- TEST

fig. Repository View with opened Branching Directory.

Creating a Version

Precondition: A SOX project was created and the repository view is active.

1. Make a right-click on the branch directory or the project.
2. Choose **Team** > **Create version**.

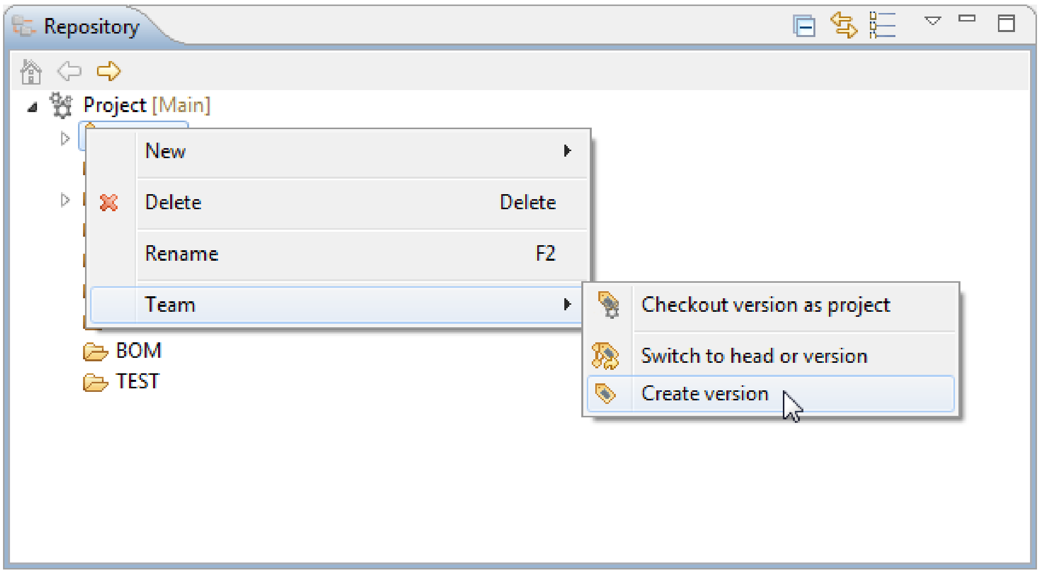
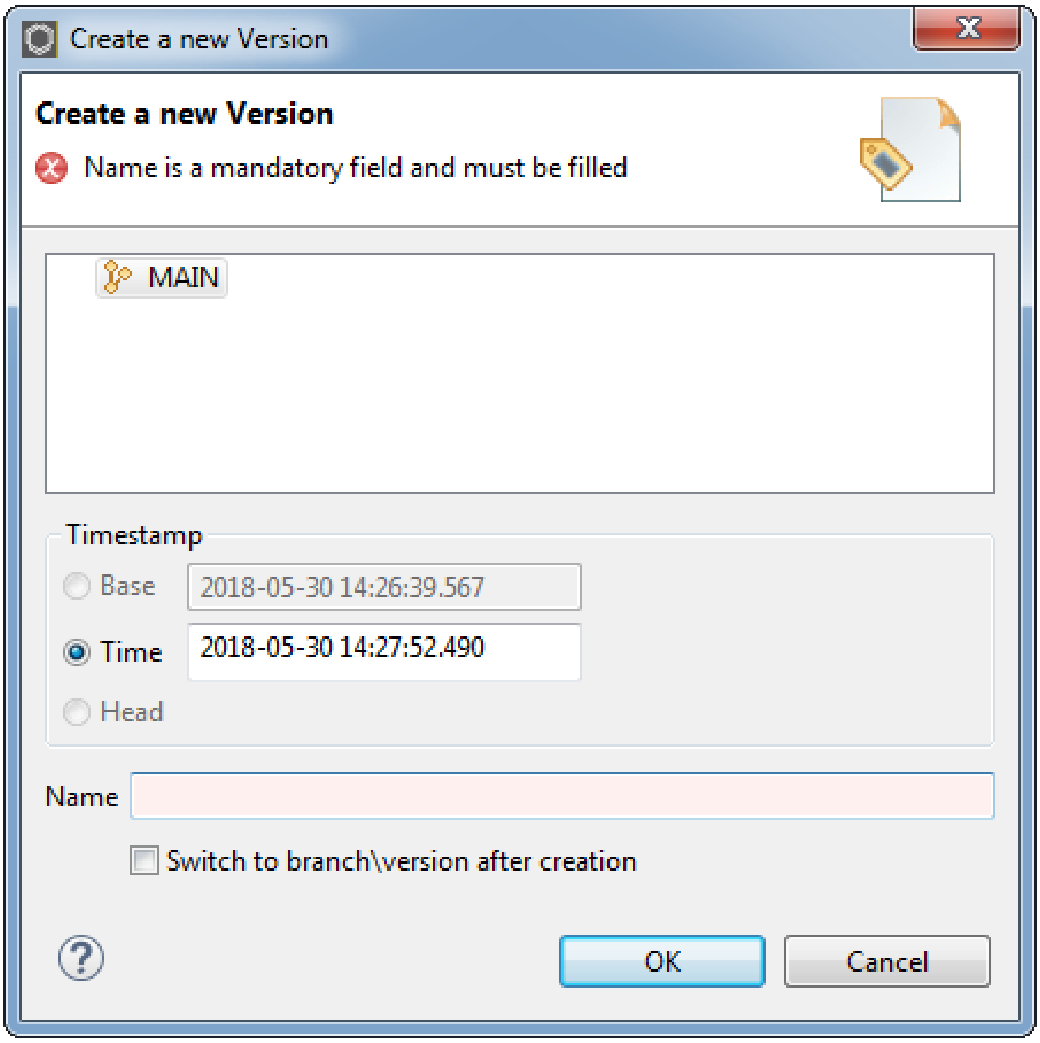


fig. Context Menu of Branch Directory.

► The Create a new Version dialog opens.



Create a new Version

Name is a mandatory field and must be filled

○ Base 2018-05-30 14:26:39.567

● Time 2018-05-30 14:27:52.490

○ Head

Name

☐ Switch to branch\version after creation

fig. Create a new Version dialog.

3. Select a branch
4. Choose **Time** for diverging the version at the current state.
5. Enter a Name for the version.
6. Activate the checkbox for opening the project in this version.
7. Click **OK**.

→ The version will be created and added to the branch directory.

Deleting a Version

Versions can be delete by making a right-click on the according version and choose delete.

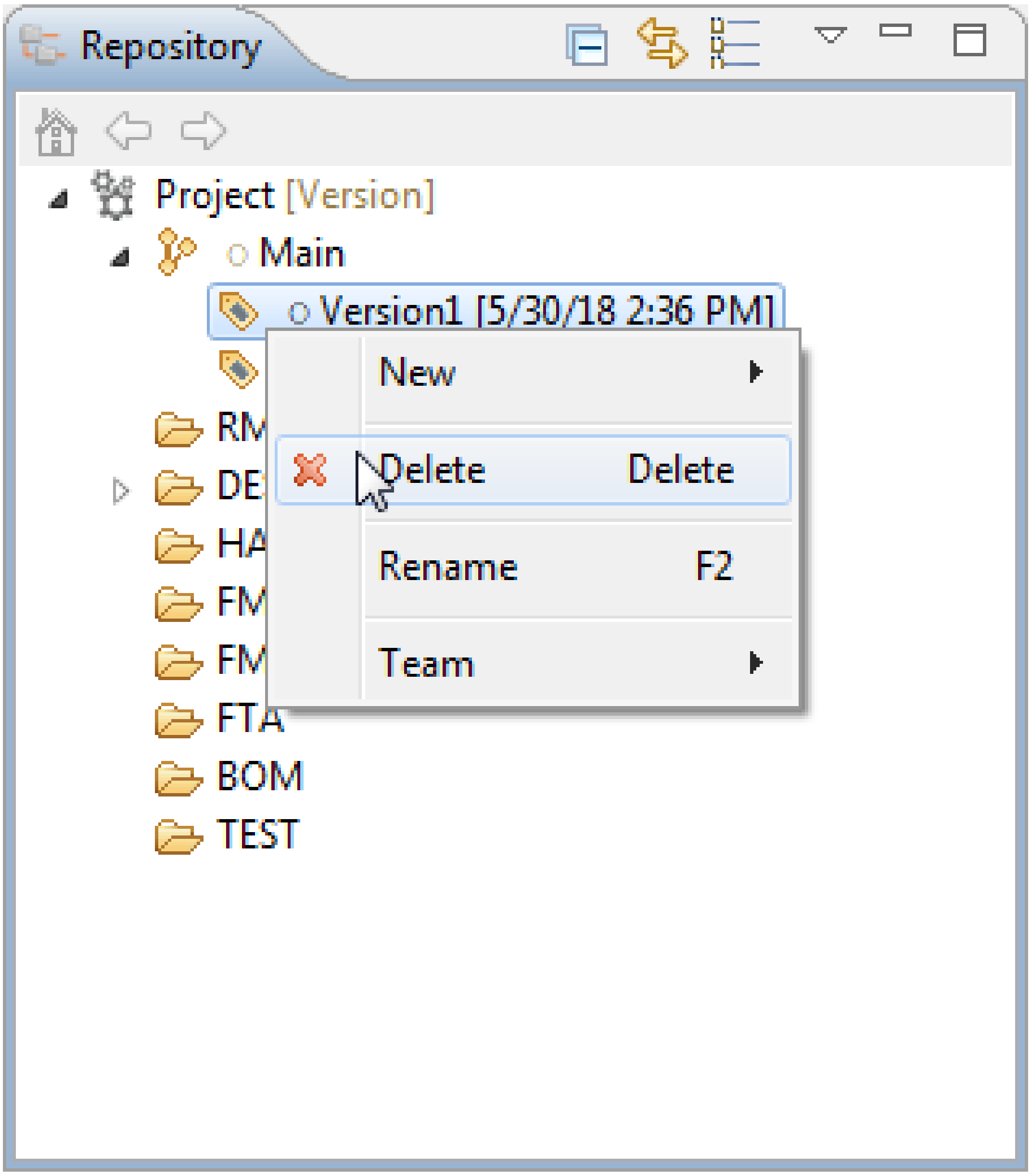


fig. Deleting a Version.

User Administration

The User Administration editor provides access to all operations for managing SOX user accounts and permissons. You can find the User Administration editor at:

1. Menubar, Administration > User Administration

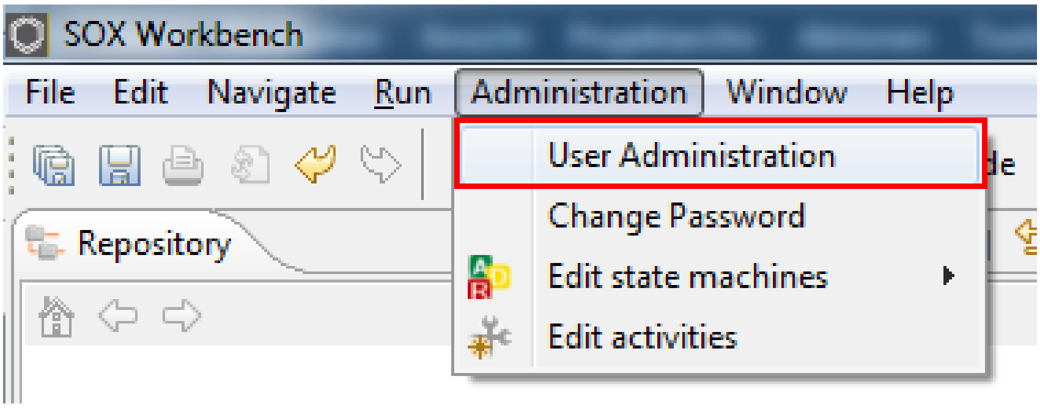


fig. Menubar Administration

This opens an editor that presents users, groups, and roles in a convenient layout with the most commonly used properties editable right in the editor. Intuitive drag-and-drop gestures associate users, groups, and roles as you would expect.

User Administration Editor

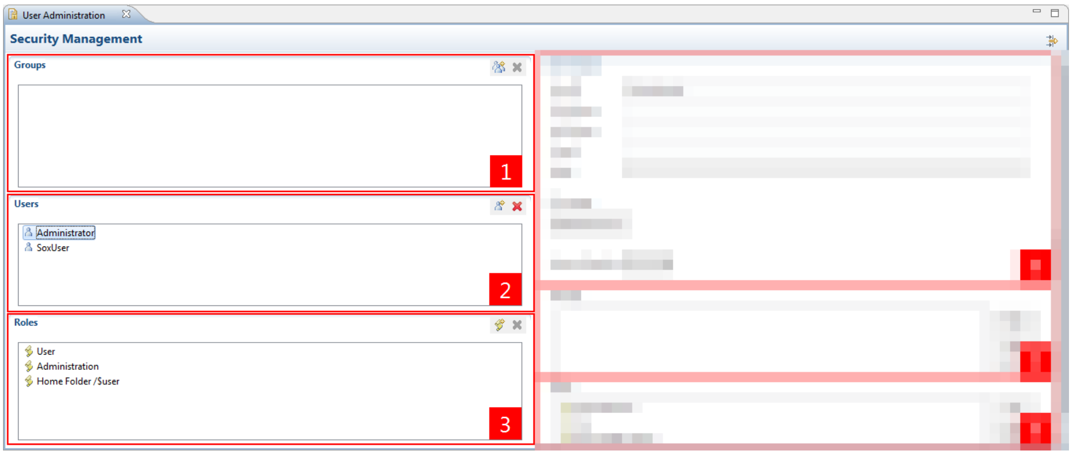


fig. User Administration View

[1] User Groups

[2] Users

[3] Roles

User Groups

In this section you can create and manage user groups. User groups are a collection of users and can be usefull e.g. for displaying different departments. Click on the "new group" icon for creating a group. To delete a group, select the desired one and click on the "delete" icon ✖.

Groups can be assigned with roles by selecting the deisred group and clicking the New or Add... button at the Roles section for creating or adding roles.

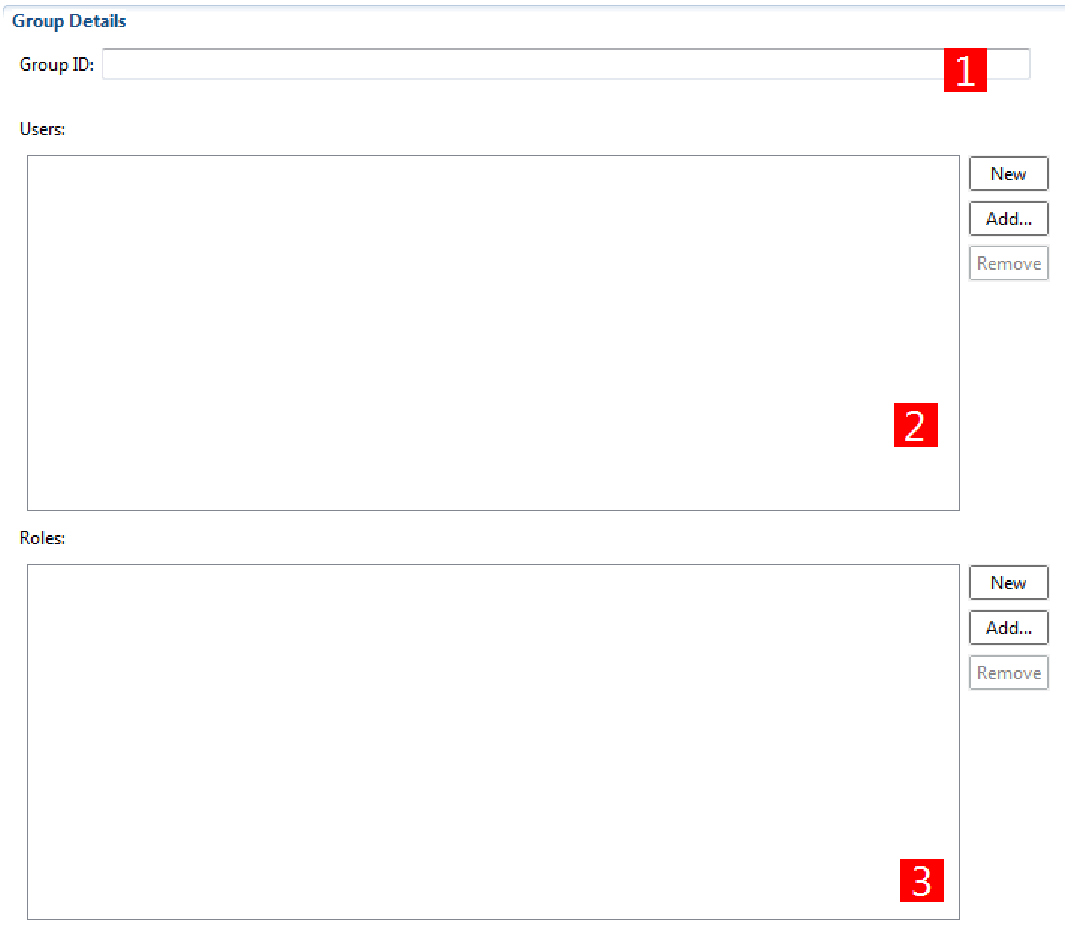


fig. Group Details

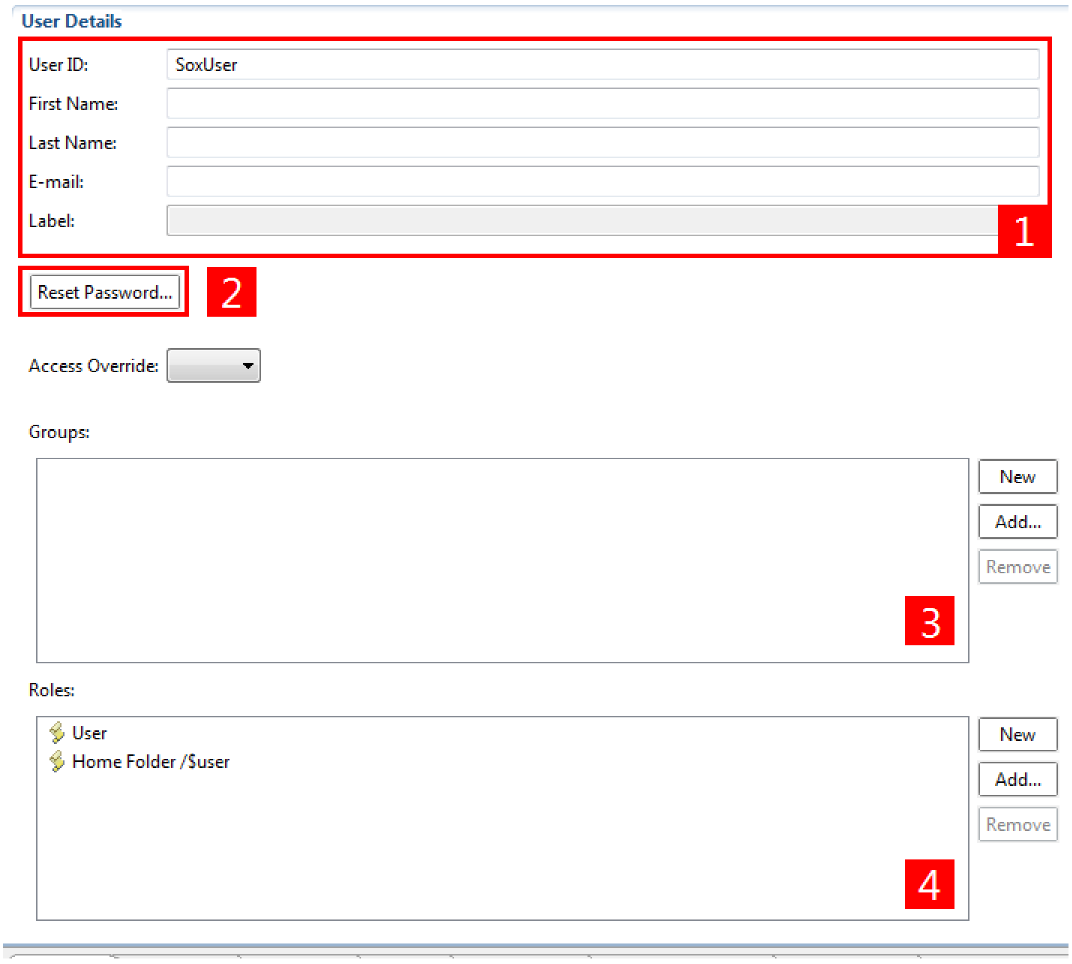
[1] The given group ID is also the displayed name of the group.

[2] In the users section you can (un-)assign users to the selected group.

[3] In the roles section you can (un-)assign roles to the selected group.

Users

A SOX user is a member of your projects with individual access to SOX. SOX users can be provided with different roles and permissions. Click on the "new user" icon for creating a user. To delete a user, select the desired one and click on the "delete" icon . Users can be assigned with roles by selecting the desired user and clicking the New or Add... button at the roles section for creating or adding roles.


User ID: SoxUser

Roles:
User
Home Folder /$user

fig. User detials.

[1] Section for providing the selected user with basic information. The given user ID is also the displayed name in SOX.

[2] Button for resetting the password.

[3] In the groups section you can (un-)assign groups to the selected user.

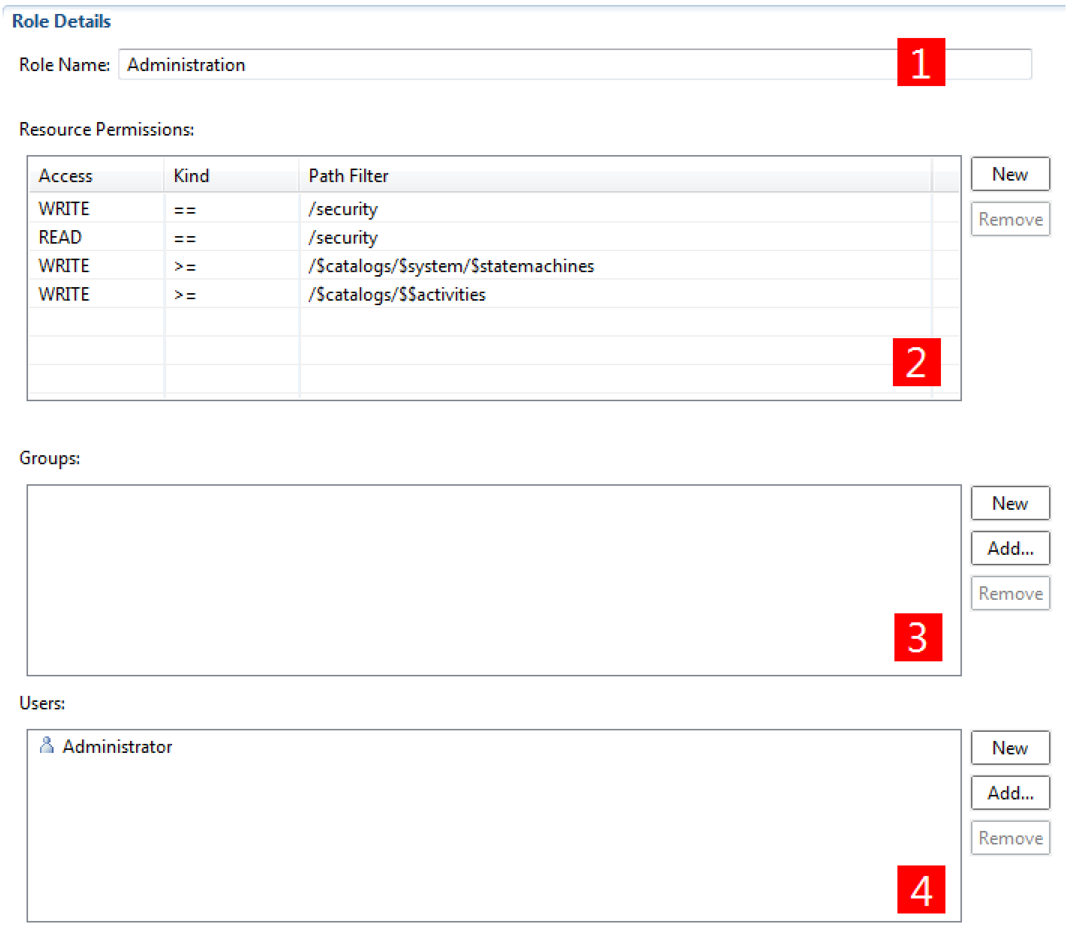
[4] In the roles section you can (un-)assign roles to the selected user.

Note

New created SOX users are not provided with a password by default. Only the User ID is required for their first login. We recommend to alert the user to create a password after logging in for the first time.

Roles

In this section you can create and manage roles. Click on the "New Role" icon for creating a new role. To delete a role, select the desired one and click on the "delete" icon .



Role Name: Administration

Resource Permissions:

Access	Kind	Path Filter
WRITE	==	/security
READ	==	/security
WRITE	>=	/$catalogs/$system/$statemachines
WRITE	>=	/$catalogs/$$activities

Groups:

Users:

Administrator

fig. Roles detials

[1] Name of the selected role.

[2] Section for defining persmissions for resources (folder, projects, documents, etc.)

Acess:

- WRITE

  The user/group can open and edit the defined resource

- READ

  The user/group only can see and open the defined resource

Kind

- EXACT

  Exact the defined resource is affected.

- TREE

  The complete defined directory of the defined resource is affected.

- ANT/REGEX

  Regular expressions for the resources.

Path Filter

- Resource of the SOX repository.

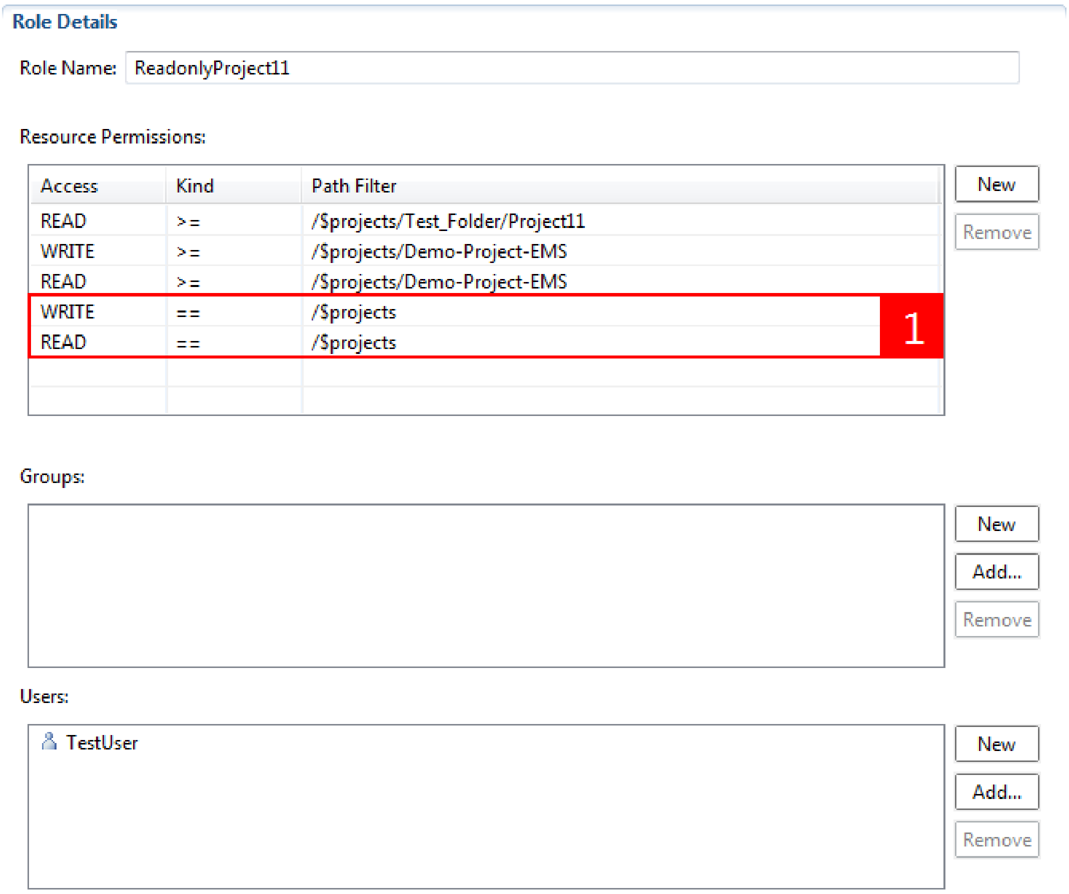
[3] In the groups section you can (un-)assign groups to the selected role.

[4] In the users section you can (un-)assign users to the selected role.

The following screenshot shows an example for providing an user (TestUser) with READ-ing rights for Project11 and WRITE-ing rights for Demo-Project-EMS.

Note

It's importand to have reading and writing rights for the root directory. This is necessary for importing reasons.



Role Details

Role Name: ReadonlyProject11

Resource Permissions:

Access	Kind	Path Filter
READ	>=	/$projects/Test_Folder/Project11
WRITE	>=	/$projects/Demo-Project-EMS
READ	>=	/$projects/Demo-Project-EMS
WRITE	==	/$projects
READ	==	/$projects

Groups:

Users:

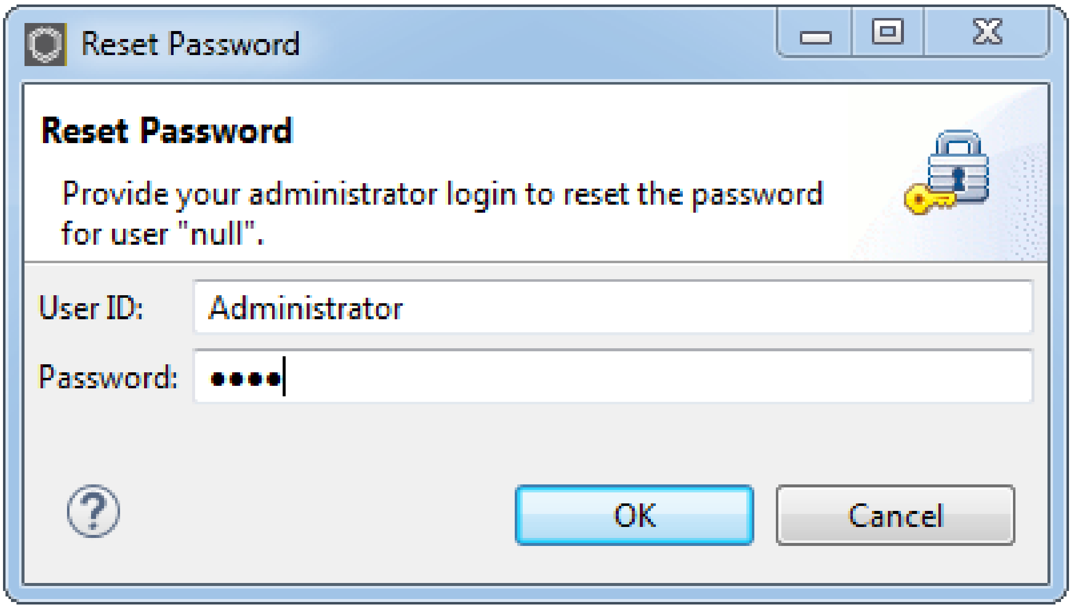
TestUser

fig. Example Reading and Writng Rights

In the example screen you can see reading and writing rights for $projects[1], which is the root folder for other projects. The kind EXACT is choosen, so only the project folder is affected. That makes sure that the folder $projects can be edited and other projects imported to this directory, and rights not passed to the sub directory and folders.

Resetting User Password

The Reset Password... button lets the Administrator reset a user's password e.g. it has been forgotten.



Reset Password

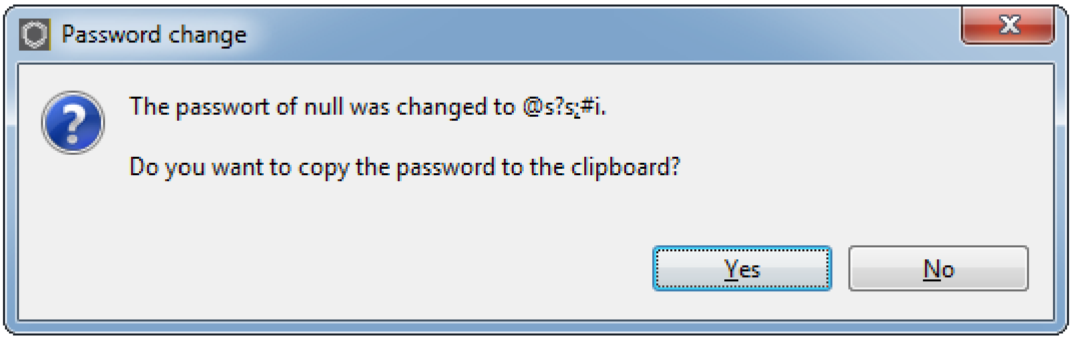
Provide your administrator login to reset the password for user "null".

User ID: Administrator

Password: ••••

fig. Reset Password dialog.

On successful reset, an info dialog shows the new randomly-generated password to the Administrator with a button to copy it to the clipboard to easily share it with the user, who then should change it at the next opportunity.



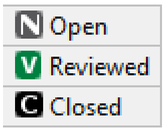
The passwort of null was changed to @s?s¿#i.

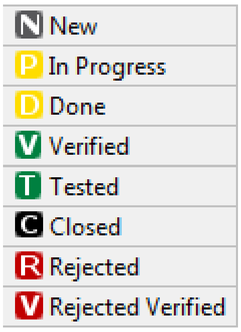
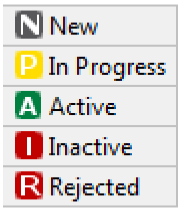
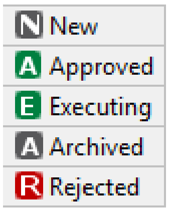
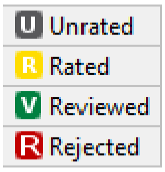
Do you want to copy the password to the clipboard?

fig. Password change dialog.

State Machines and Workflows

A workflow is a set of statuses and transitions that and object moves through during its lifecylcle and typically represents processes within your organization. There are individual workflows for the modules Requirements, Test, Hazard, Reliability and FMEDA. This workflows are binded on to the listed modules and can only used for the according ones. The workflows will be saved in your repository and affects all projects. The following table shows which objects of the modules can be assigned with states:

SOX Modul	Object	State
FMEDA/BOM	Modules, Components	 N Open V Reviewed C Closed

Requirements	Modules, Requirements	 N New P In Progress D Done V Verified T Tested C Closed R Rejected V Rejected Verified
Test	Test Case	 N New P In Progress A Active I Inactive R Rejected
	Test Run	 N New A Approved E Executing A Archived R Rejected
Hazard	Ratings	 U Unrated R Rated V Reviewed R Rejected

Customizing Workflows

Workflows can be customized to your desire. You can define or edit transitions, states or actions.

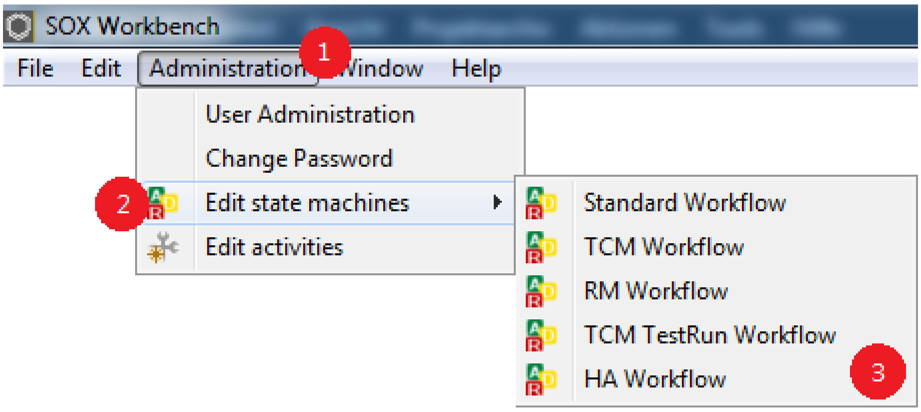


fig. Open Workflows

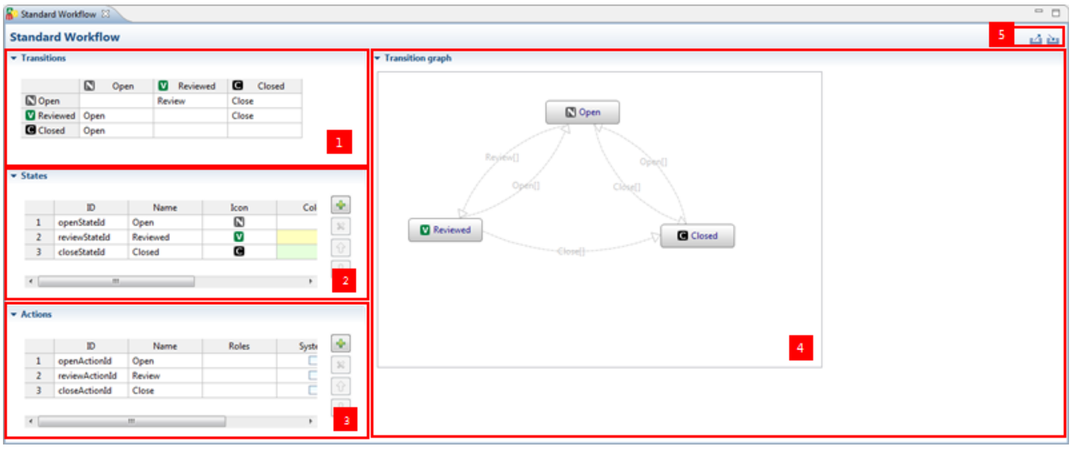
For opening the workflows

1. Click on the menu point Administration.
2. Choose Edit state machines.
3. Select your desired workflow.

► The selected workflow will be opened.

Note

Edits at workflows are not saved automatically. Be sure to click on Save 💾 or (Ctrl + S) if you are leaving the workflow editor. A (*) symbol in front of the workflow name displays changes at the workflow which aren't already saved.



	Open	Reviewed	Closed
Open		Review	Close
Reviewed	Open		Close
Closed	Open		

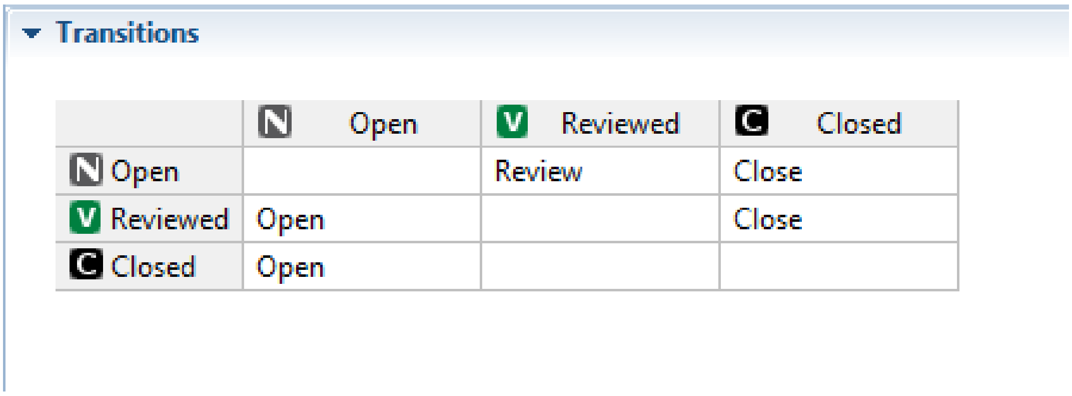
	ID	Name	Icon	Col
1	openStateId	Open	N	
2	reviewStateId	Reviewed	V	
3	closeStateId	Closed	C	

	ID	Name	Roles	Syste
1	openActionId	Open		☐
2	reviewActionId	Review		☐
3	closeActionId	Close		☐

fig. Workflow Editor

The workflow editor is simmilar to all workflows and is divided into the following parts:

Transistions [1]

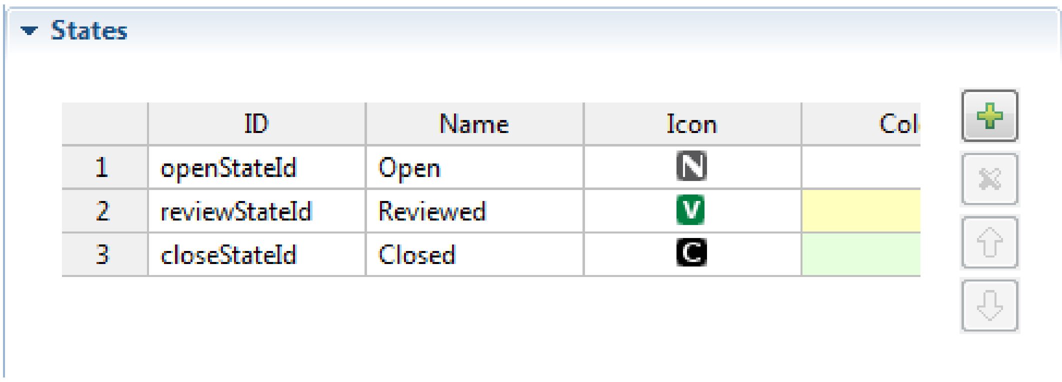


	Open	Reviewed	Closed
Open		Review	Close
Reviewed	Open		Close
Closed	Open		

fig. Transition Matrix

In the transistion matrix you can edit the transitions and consequently set actions between two statuses. After you have created a new state and action you can click in the empty cell between two states and choose the desired action.

States [2]



	ID	Name	Icon	Col
1	openStateId	Open	N	
2	reviewStateId	Reviewed	V	🟨
3	closeStateId	Closed	C	🟩

fig. State Matrix

In the state matrix you can organize your states for the current workflow. You can create, delete and provide them with custom icons, colours, description and set them as initial state.

Create a new state:

1. Click on the plus icon (✚)at the state matrix.

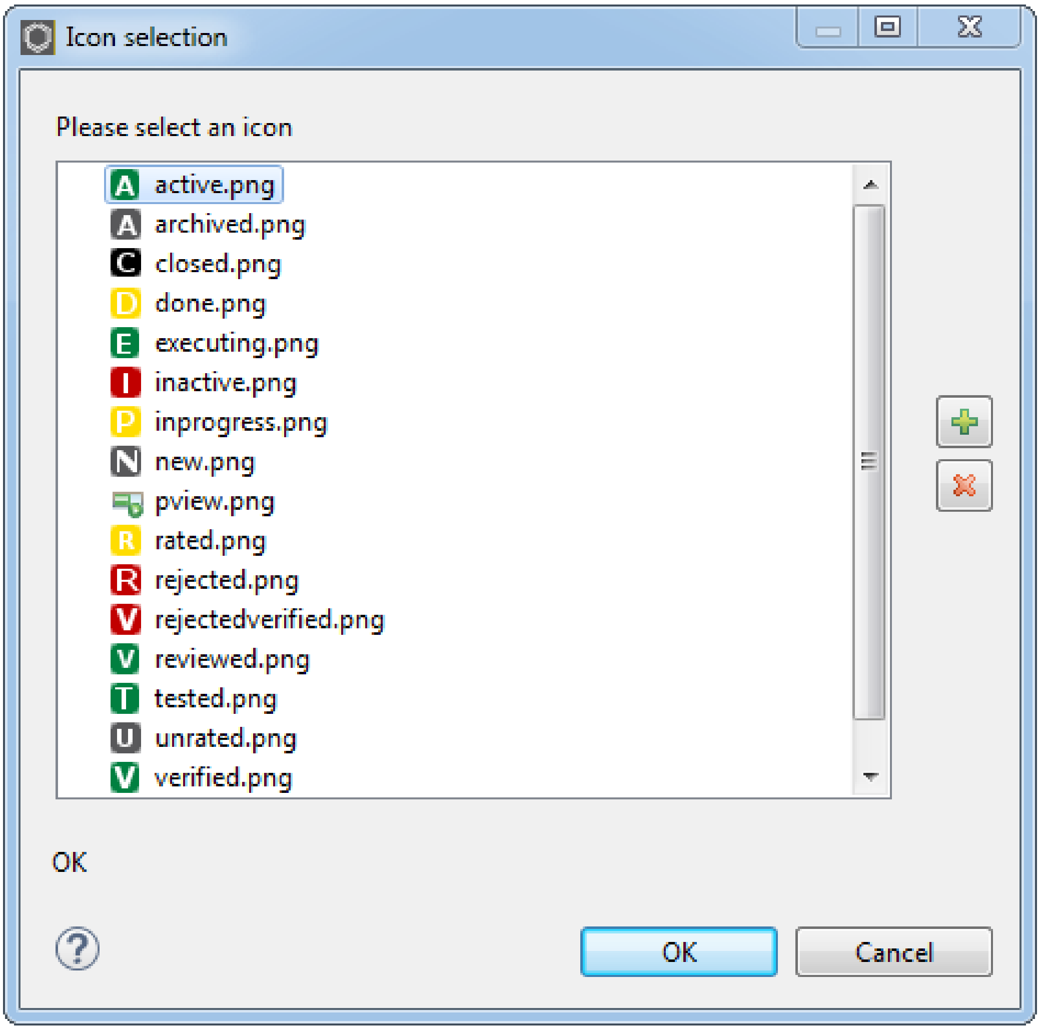
   ► New rows will be added to the state and transition matrix and a new state object will be added to the transition graph.

2. Enter a unique ID at the ID column (Recommendation: name + State + Id).

3. Enter a name at the name column.

4. Make a double-click into the cell at the icon column.

   ► The Icon selection dialog opens.



Please select an icon

- active.png
- archived.png
- closed.png
- done.png
- executing.png
- inactive.png
- inprogress.png
- new.png
- pview.png
- rated.png
- rejected.png
- rejectedverified.png
- reviewed.png
- tested.png
- unrated.png
- verified.png

OK

fig. Icon selection dialog.

In this dialog you can find all default SOX states icons. With the plus symbol (✚) you can add icons (.png) from your system. The icon size (16x16) should not be exceeded. With the x symbol (✖) you can remove a selected icon from the SOX database.

5. Select your desired icon and click OK.

6. Make a double-click into the cell at the color column.

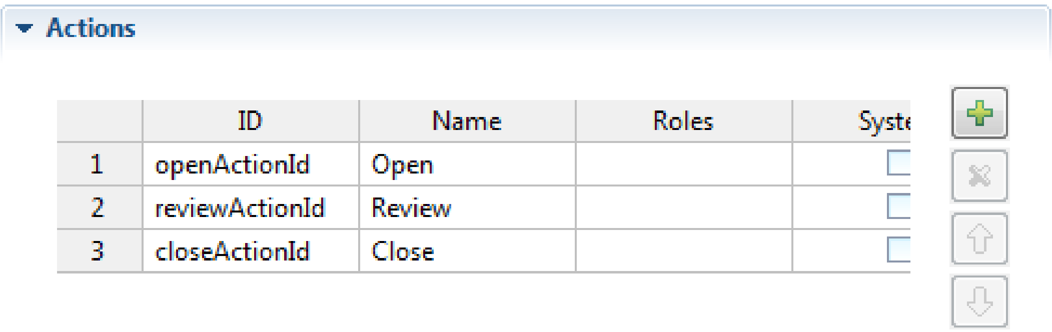
   This color will be set as background color for the according object at the defined state.

7. Activate the checkbox at the initial column for setting the according state as starting state when creating a new object. Initial states can't be deleted.

8. Optionally, enter a description for the according state.

→ A state with the defined properties was created and added to the states matrix, transition matrix and transition graph.

Actions [3]



	ID	Name	Roles	Syste
1	openActionId	Open		☐
2	reviewActionId	Review		☐
3	closeActionId	Close		☐

fig. Actions Matrix

In the action matrix you can define new actions, which are necessary for trigger a transition between to states.

Create a new action:

1. Click on the plus icon (✚)at the action matrix.

   ► A new row will be added to the action matrix.

2. Enter a unique ID at the ID column (Recommendation: name + Action + Id).

3. Enter a name at the name column.

4. Make a double-click into the cell at the roles column for giving a SOX user the permissions for executing the according action.

5. Optionally, you can activate the checkbox at the auto on change column. If the auto on change function is active, every change and edit at a object leads to the transition which is assigned to this action.

→ A new action was created and added to the action matrix, transition graph and can be selected at the transition matrix.

Transisition Graph [4]

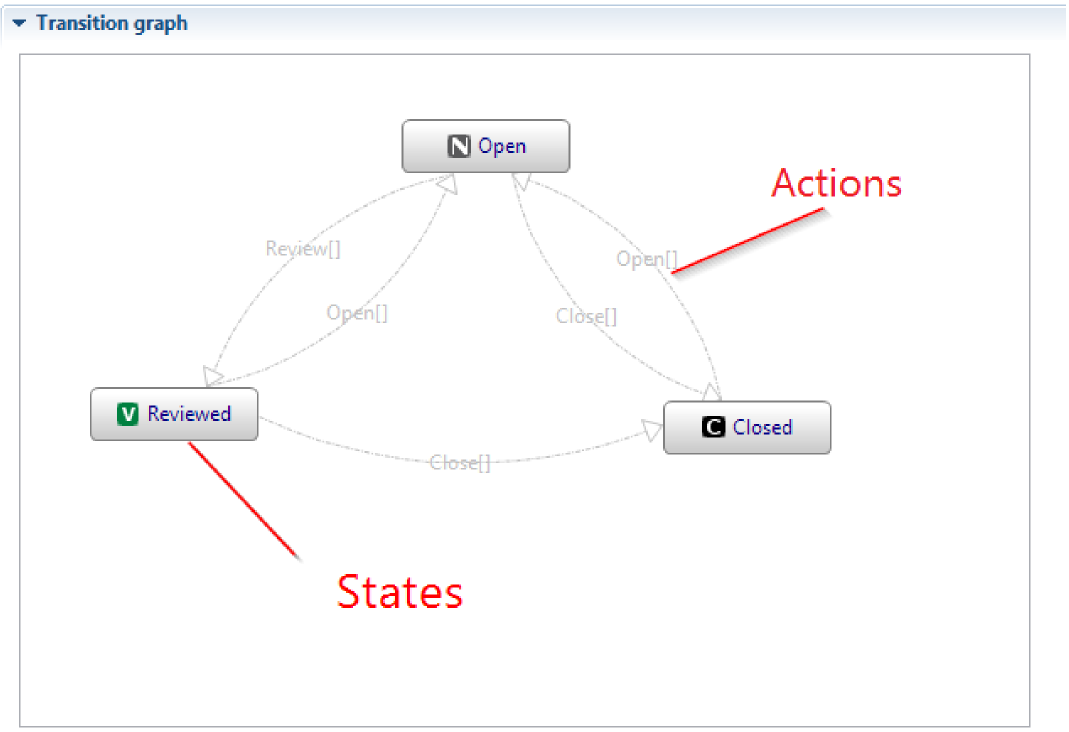


fig. Transistion Graph

The transition graph displays the worklfow as a diagram. You can move the statuses for designing the structure of the diagram to your desire.

Importing/Exporting Workflows

With the buttons in the right upper corner, you can export ( ) or import ( ) workflows in SOX. The workflows will be saved as .sxcat which is a SOX catalogs format and XML as base language.

The Trace Matrix

The trace matrix shows the relations between all the objects in your project.

You open the trace matrix by clicking on the icon in the menu bar:

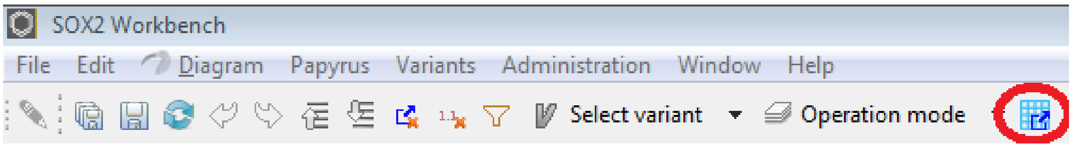
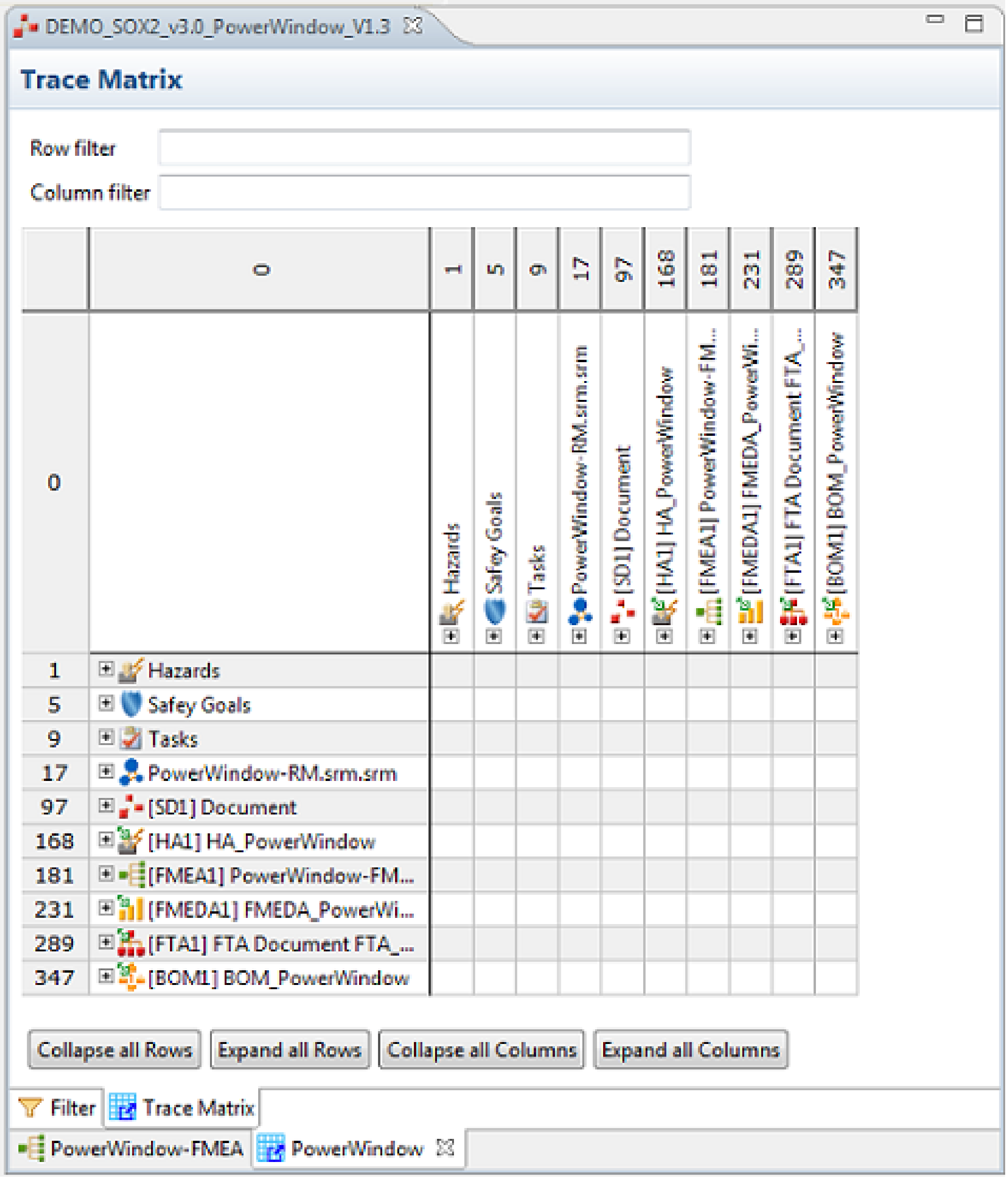


fig. Icon Trace Matrix

Then the trace matrix opens. Here is an example:



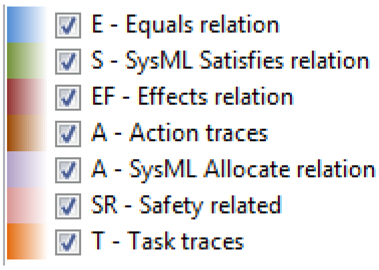
	0	1	5	9	17	97	168	181	231	289	347
0		⊞ Hazards	⊞ Safey Goals	⊞ Tasks	⊞ PowerWindow-RM.srm.srm	⊞ [SD1] Document	⊞ [HA1] HA_PowerWindow	⊞ [FMEA1] PowerWindow-FM...	⊞ [FMEDA1] FMEDA_PowerWi...	⊞ [FTA1] FTA Document FTA_...	⊞ [BOM1] BOM_PowerWindow
1	⊞ Hazards										
5	⊞ Safey Goals										
9	⊞ Tasks										
17	⊞ PowerWindow-RM.srm.srm										
97	⊞ [SD1] Document										
168	⊞ [HA1] HA_PowerWindow										
181	⊞ [FMEA1] PowerWindow-FM...										
231	⊞ [FMEDA1] FMEDA_PowerWi...										
289	⊞ [FTA1] FTA Document FTA_...										
347	⊞ [BOM1] BOM_PowerWindow										

fig. The Trace Matrix

Click on the plus signs in the rows and columns to expand the columns.

You can also use the **Collapse...** and **Expand...** buttons below the table to show or hide rows.

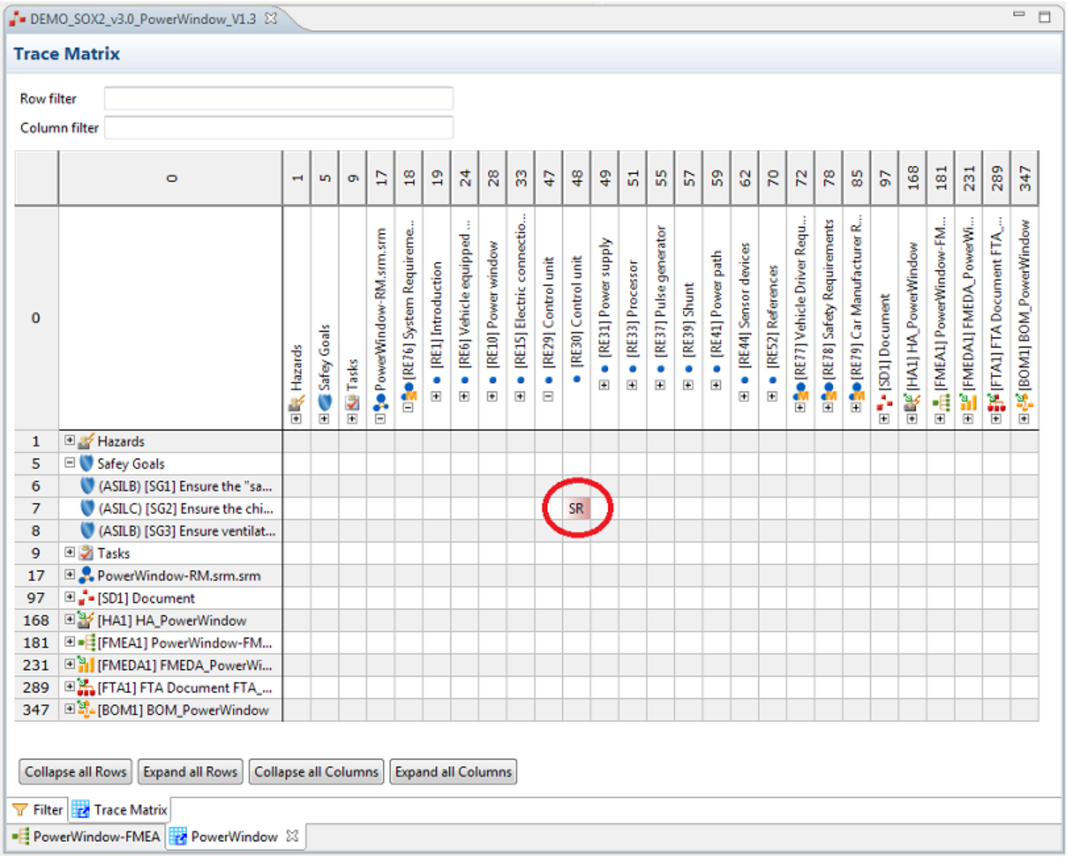
You can find these abbreviations in the table:



☑ E - Equals relation
☑ S - SysML Satisfies relation
☑ EF - Effects relation
☑ A - Action traces
☑ A - SysML Allocate relation
☑ SR - Safety related
☑ T - Task traces

fig. The abbreviations in the Trace Matrix

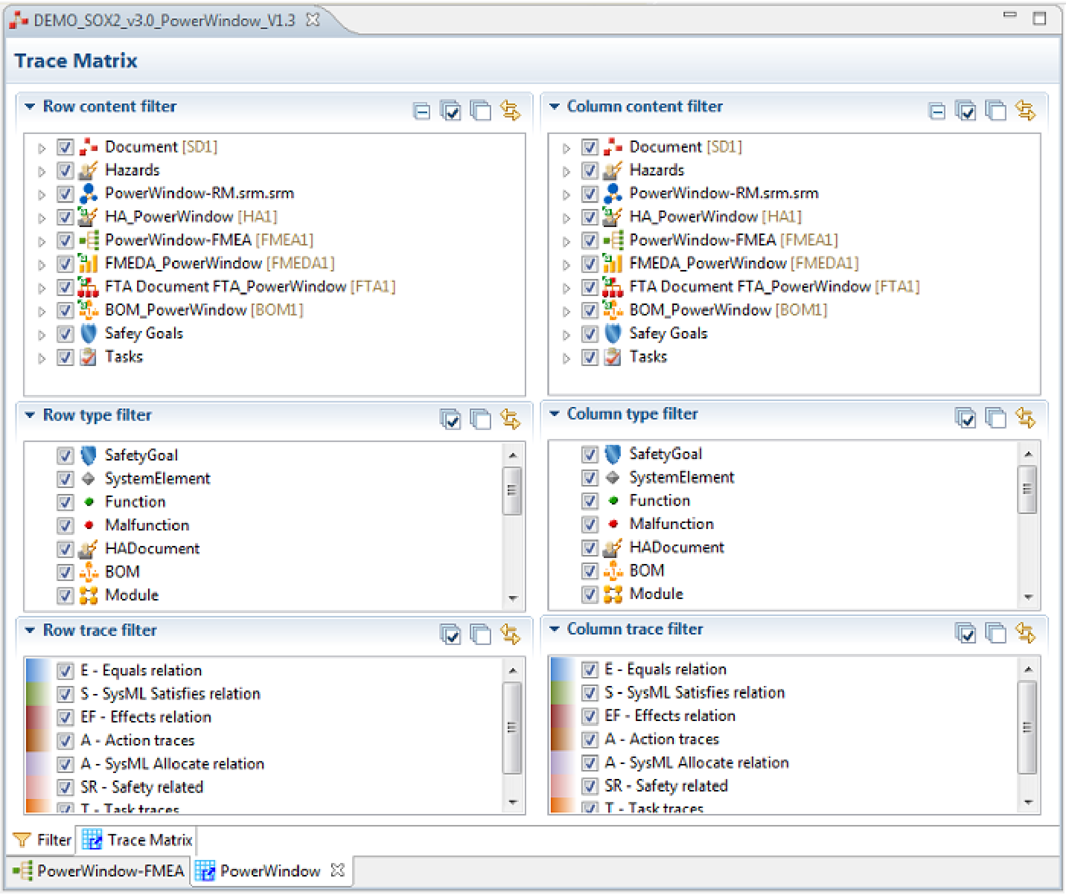
Notice that in the table the colors of a cell fade to white either to the left or to the right. This indicates the direction of the relationship:



	0	1	5	9	17	18	19	24	28	33	47	48	49	51	55	57	59	62	70	72	78	85	97	168	181	231	289	347
0		Hazards	Safey Goals	Tasks	PowerWindow-RM.srm.srm	[RE76] System Requireme...	[RE1] Introduction	[RE6] Vehicle equipped ...	[RE10] Power window	[RE15] Electric connectio...	[RE29] Control unit	[RE30] Control unit	[RE31] Power supply	[RE33] Processor	[RE37] Pulse generator	[RE39] Shunt	[RE41] Power path	[RE44] Sensor devices	[RE52] References	[RE77] Vehicle Driver Requ...	[RE78] Safety Requirements	[RE79] Car Manufacturer R...	[SD1] Document	[HA1] HA_PowerWindow	[FMEA1] PowerWindow-FM...	[FMEDA1] FMEDA_PowerWi...	[FTA1] FTA Document FTA_...	[BOM1] BOM_PowerWindow
1	Hazards																											
5	Safey Goals																											
6	(ASILB) [SG1] Ensure the "sa...																											
7	(ASILC) [SG2] Ensure the chi...											SR																
8	(ASILB) [SG3] Ensure ventilat...																											
9	Tasks																											
17	PowerWindow-RM.srm.srm																											
97	[SD1] Document																											
168	[HA1] HA_PowerWindow																											
181	[FMEA1] PowerWindow-FM...																											
231	[FMEDA1] FMEDA_PowerWi...																											
289	[FTA1] FTA Document FTA_...																											
347	[BOM1] BOM_PowerWindow																											

fig. A Relation in the Trace Matrix

To find more easily what you are looking for, there are filtering options:



DEMO_SOX2_v3.0_PowerWindow_V1.3

Trace Matrix

Row content filter

- ☑ Document [SD1]
- ☑ Hazards
- ☑ PowerWindow-RM.srm.srm
- ☑ HA_PowerWindow [HA1]
- ☑ PowerWindow-FMEA [FMEA1]
- ☑ FMEDA_PowerWindow [FMEDA1]
- ☑ FTA Document FTA_PowerWindow [FTA1]
- ☑ BOM_PowerWindow [BOM1]
- ☑ Safey Goals
- ☑ Tasks

Column content filter

- ☑ Document [SD1]
- ☑ Hazards
- ☑ PowerWindow-RM.srm.srm
- ☑ HA_PowerWindow [HA1]
- ☑ PowerWindow-FMEA [FMEA1]
- ☑ FMEDA_PowerWindow [FMEDA1]
- ☑ FTA Document FTA_PowerWindow [FTA1]
- ☑ BOM_PowerWindow [BOM1]
- ☑ Safey Goals
- ☑ Tasks

Row type filter

- ☑ SafetyGoal
- ☑ SystemElement
- ☑ Function
- ☑ Malfunction
- ☑ HADocument
- ☑ BOM
- ☑ Module

Column type filter

- ☑ SafetyGoal
- ☑ SystemElement
- ☑ Function
- ☑ Malfunction
- ☑ HADocument
- ☑ BOM
- ☑ Module

Row trace filter

- ☑ E - Equals relation
- ☑ S - SysML Satisfies relation
- ☑ EF - Effects relation
- ☑ A - Action traces
- ☑ A - SysML Allocate relation
- ☑ SR - Safety related
- ☑ T - Task traces

Column trace filter

- ☑ E - Equals relation
- ☑ S - SysML Satisfies relation
- ☑ EF - Effects relation
- ☑ A - Action traces
- ☑ A - SysML Allocate relation
- ☑ SR - Safety related
- ☑ T - Task traces

fig. Filter for the Trace Matrix

Above the table there are text filters for the rows and for the columns.

When you click the "Filter" tab at the bottom you can filter the rows and columns for content, type and traces:

Click on the check boxes and go back to the trace matrix.

The matrix is now filtered.

Icons in SOX

Icons for SOX Modules

Icon	Description
	Workbench
	System Design module
	Requirements module
	Hazard module
	FMEA module
	FMEDA module

Icon	Description
	FTA module
	SOX project

Icons for Views

Icons	Description
	Clipboard
	Repository
	Model Explorer
	Catalogs
	Dynamic Help
	Object list
	Task Assignments
	Project Tasks
	Traces
	Failure net
	Function net
	Failure net explorer
	PSS
	Project safety goals
	Structure content
	FIT Details
	Properties view
	Temperature Profiles
	Mission Profiles
	Failure rate catalogs
	Failure mode catalogs
	Overview
	Diagnoses view
	Relationship matrix

Icons	Description
	Form sheet
	Control Plan
	Risk Matrix
	Malfunction Analysis
	Pareto Analysis
	Diagnoses
	Miniature view
	Variant Matrix

Icons in Views

View	Icon	Description
various views	▽	Minimize view
various views	☐	Maximize view
various views	⧉	restore view
various views	⧉	Link with editor
various views	✚	Add object
various views	type filter text	Text filter
various views	⛔	Suspect marker
Clipboard	✖	Clear clipboard
Clipboard	✖	Remove selection from clipboard
Traces view		Show outgoing references
Traces view		Show incoming references
Model Explorer		Toggle Advanced Model Explorer
Model Explorer		Customize Model Explorer
Model Explorer	az	Sort elements
PSS	⚠	Hide prevention actions
PSS		Hide detection actions
PSS		Hide service actions

View	Icon	Description
PSS		Hide operation actions
PSS		Hide construction actions
PSS		Hide tasks
PSS	🛡	Hide safety goals
PSS	🔵	Hide requirements
PSS	🔴	Hide malfunction
PSS	🟢	Hide functions
Properties view		Pin to current selection
Object list view		Sort by safety level
Task Assignments view		Switch to horizontal layout
Task Assignments view		Switch to vertical layout
Editor FMEA & FMEDA	🟢	Functions on/off
Editor FMEA & FMEDA	🔴	Malfunctions on/off
Editor FMEA & FMEDA	🛡	Safety goals on/off
Editor FMEA & FMEDA	🔵	Requirements on/off
Editor FMEA & FMEDA		Tasks on/off
Modules view		Hide components
Functions view		Hide diagnoses
Project tasks view		Switch to horizontal layout
Project tasks view		Switch to vertical layout

Icons for Catalogs

Icon	Description
	Failure mode catalog
	Failure rate catalog
	Function catalog
	Machine catalog
	Malfunction catalog
	Rating catalog

Icon	Description
📖	System element catalog

Icons in the Reliability Module

Icon	Description
▦	Component module
▬	Component
▬	imported component
▬	changed component
▬	deleted component
↗	Failure mode

Icons in the FMEA Module

Icon	Description
C	Comment
◆	System element
●	Function
●	Malfunction
●	Connected function
📝	Action group
✂	Construction action
🔧	Operation action
🔧	Service action
⚠	Prevention action
🔍	Detection action
🛡	Safety goal
⚙	Process characteristic
⚙	Product characteristic
🔒	Security function
⚙	Interface function
§	Government function

Icon	Description
📝	Edit significance rating
📋	Edit classification
📋	Form sheet
CP	Control plan
●	Requirement
Ⓣ	Task (active/rejected/proposed)
Ⓣ	Task (inactive/proposed)
🛡	Edit Safety Goal Assignments

Icons in the RM Module

Icon	Description
🛡	Safety Goal
●	Requirement
ⓐ	Requirement Attribute
✚	Requirement Type
<>	Type Definition
Ⓡ	Element linked with Requirement
●	Safety goal linked with Requirement
●●●	Open Status Impact Dialog

Icons in the HA Module

Icon	Description
Ⓒ	Comment
V	Variants
●	Function
●	Malfunction
🛡	Safety goal
⚠	Hazard
🚗	Combined situation

Icon	Description
	Effect
	Relationship matrix
	Motivation

Icons in the FMEDA Module

Icon	Description
C	Comment
	Operation modes
V	Variants
●	Function
●	Malfunction
	Safety goal
	Failure mode catalogs
	Component module
	Component
	imported component
	changed component
	deleted component
	Failure mode

Icons in the FTA Module

Icon	Description
	OR
	AND
n m	VOTING
○	Base event
⌂	House event
◇	Intermediate event
	Page break
	Failure model

Other Icons

Icon	Description
📄	Copy
✖	Delete
📥	Import
📤	Export
⊟	Collapse
⊞	Expand
⚙	Open preferences
C	Comment
▤	Operation modes
V	Variant
T	Task (active/rejected/proposed)
●	Task (inactive/proposed)
⚙	Preferences
	Decompose ASIL level

FMEA

FMEA

Failure Mode and Effects Analysis.

The FMEA module of SOX supports you in the risk analysis according to VDA 6 and AIAG.

Here you can create nets of elements, function nets and failure nets, define actions and rate objects.

You can work with different variants and operation statuses.

You can link information with other SOX modules.

The FMEA analysis tools include the risk matrix, malfunction analysis and Pareto analysis.

You can create form sheets and control plans.

In this help guide, you will learn about the customizable user interface and the many ways to complete a task.

An easy step-by-step guide will help beginners of SOX to quickly get familiar with the software.

Step-by-Step Guide

In this chapter you will learn the basics of the module, while creating a simple FMEA, from start to finish.

We recommend going through this guide and actually performing all the steps. Performing a simple FMEA from start to finish with SOX will give you a real understanding of the software.

This chapter requires knowledge on the basic SOX principles and standard views described in the chapter Workbench.

Creating a new FMEA File

Precondition: *A SOX project was created.*

1. You start in the repository view in the workbench perspective. Here, right-click on the FMEA folder in your project.

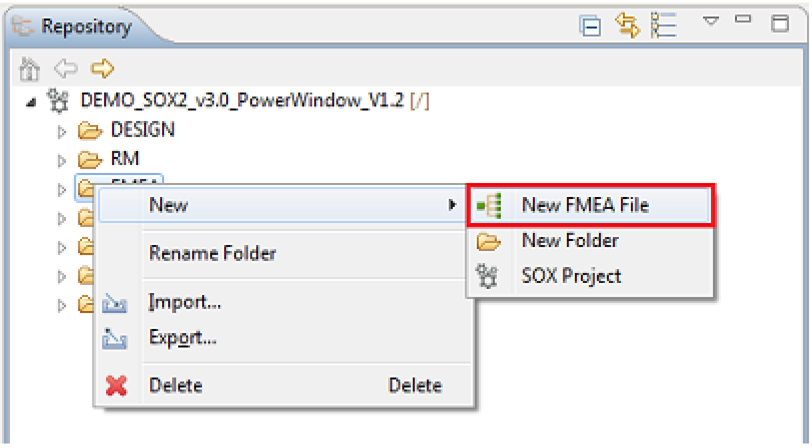
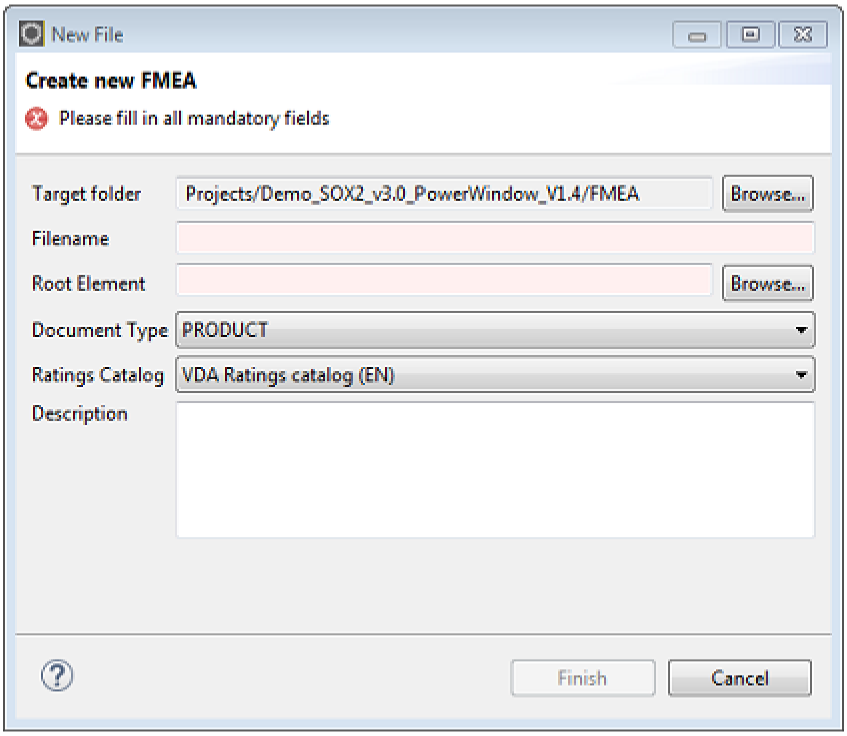


fig. New FMEA file from repository

2. Choose **New** > **New FMEA File**.

   ► The "New File" dialog opens.



New File

Create new FMEA

Please fill in all mandatory fields

Target folder: Projects/Demo_SOX2_v3.0_PowerWindow_V1.4/FMEA

Filename:

Root Element:

Document Type: PRODUCT

Ratings Catalog: VDA Ratings catalog (EN)

Description:

fig. "New fil"e dialog

3. In the now opened dialog, click on **Browse...** next to "Target folder".

4. Choose the desired folder.

5. Enter a name for your file.

6. You need to define a system element that acts as the root of your FMEA.

   a) Define a new root element by entering a name for it.

   b) *If you already have an element in your project that you want to use as a root element:* Choose an existing root element by clicking on **Browse...** next to "Root Element" and clicking on your element of choice in the list.

7. Choose the type of FMEA that you want to create ("PRODUCT"; "PROCESS" or "DESIGN").

8. Choose the ratings catalog. (Later, in the view Catalogs, you can also define your own catalogs.)

9. Write a description of the file (optional).

10. Click on **Finish**.

11. In the alert that opens, click on **Yes** to open the editor in the FMEA perspective. (If you previously marked the check box to "Remember..." and clicked **No**, you have to open the perspective in the menu bar: **Windows** > **Perspectives** > **FMEA**.)

→ A new FMEA file has been created and opened.

Creating System Elements

Note

There are multiple views in which you can create new objects. The result will always be the same, regardless if you do it in the FMEA editor or another view.

1. Right-click on the root element.

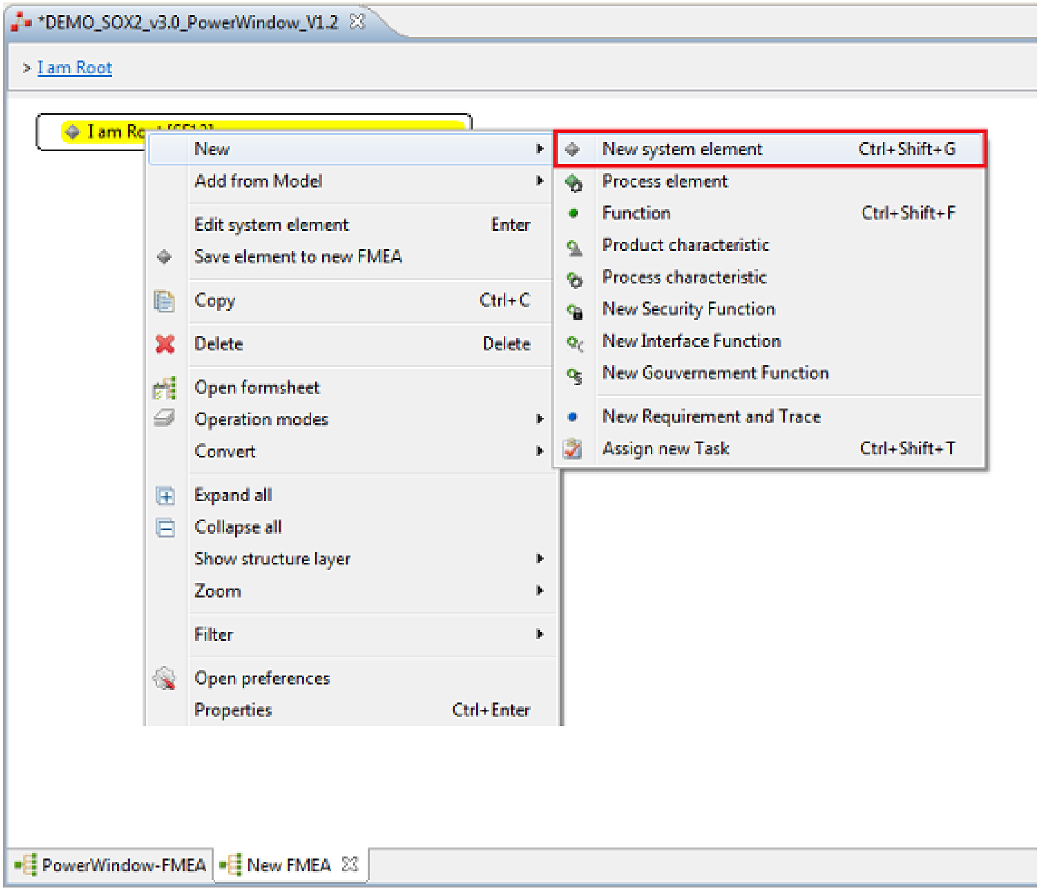


fig. New system element

2. Choose **New** > **New system element**.

► The "Add new system element" dialog opens.

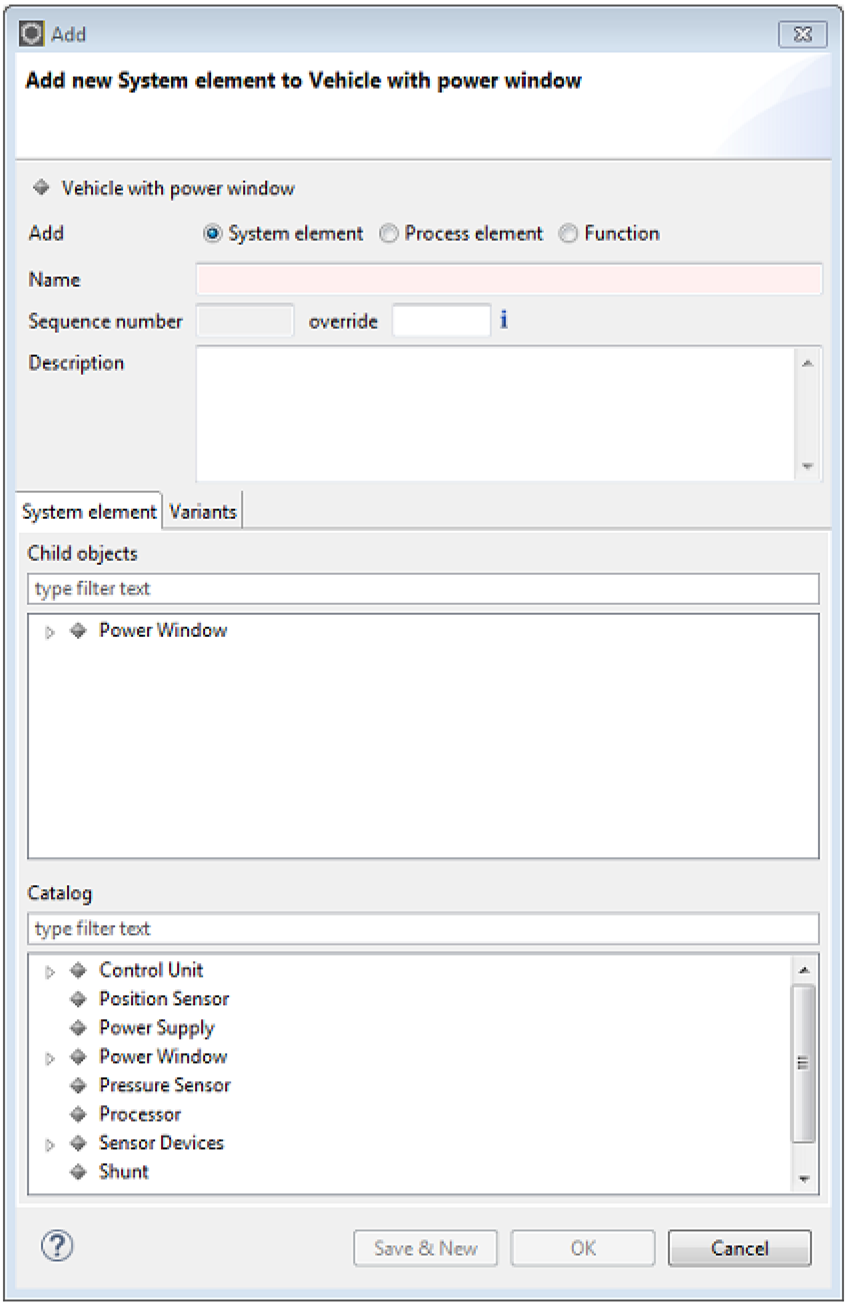


fig. "Add new system elemen"t dialog

3. In the first line, "Add", make sure "System element" is selected.

4. Enter a name for the new system element.

5. Decide whether you want the sequence number of the system element to be determined automatically by SOX with a consecutive number. You can enter your own sequence number (optional).

6. Type a description into the "Description" box (optional).

7. If you are working with variants in your project, you can assign the new system element to a variant. Click on **Variants** and choose one (optional). (See also the chapter Working with Variants.)

8. If you want to add another system element, click on **Save & New**.

9. When you are done adding elements, click on **OK**.

→ The new system elements have been added.

Now add lower level system elements: Just repeat the process, starting with a right-click on the parent system element.

Adding Functions to a System Element

Note

There are multiple views in which you can select a system element and add functions to it: The FMEA editor, the structure content view and the PSS view. The result will always be the same.

1. Right-click on the system element.

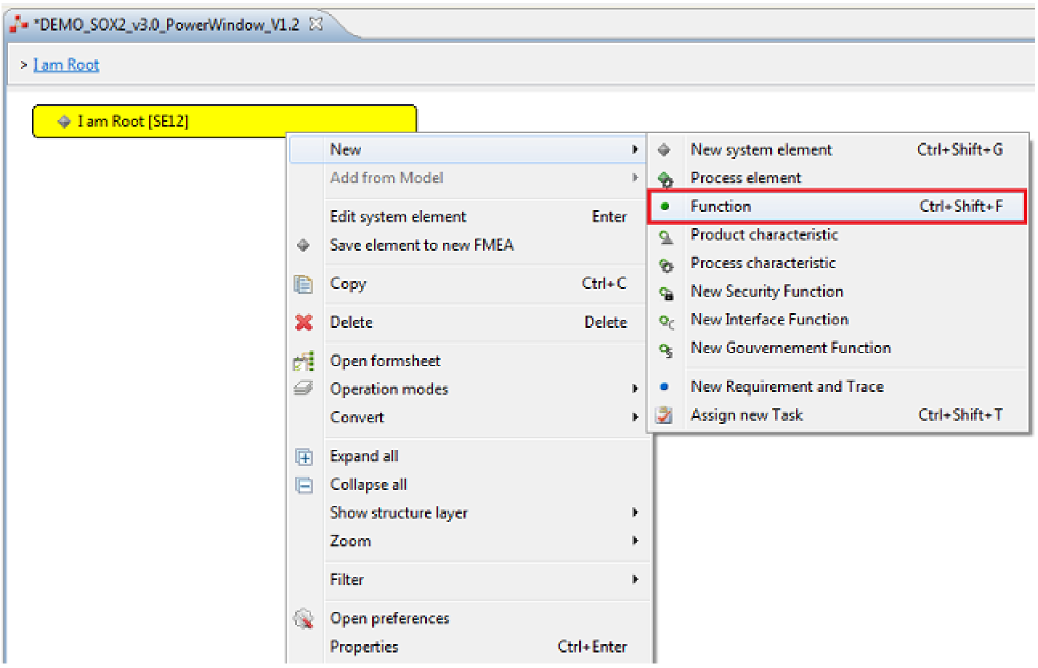
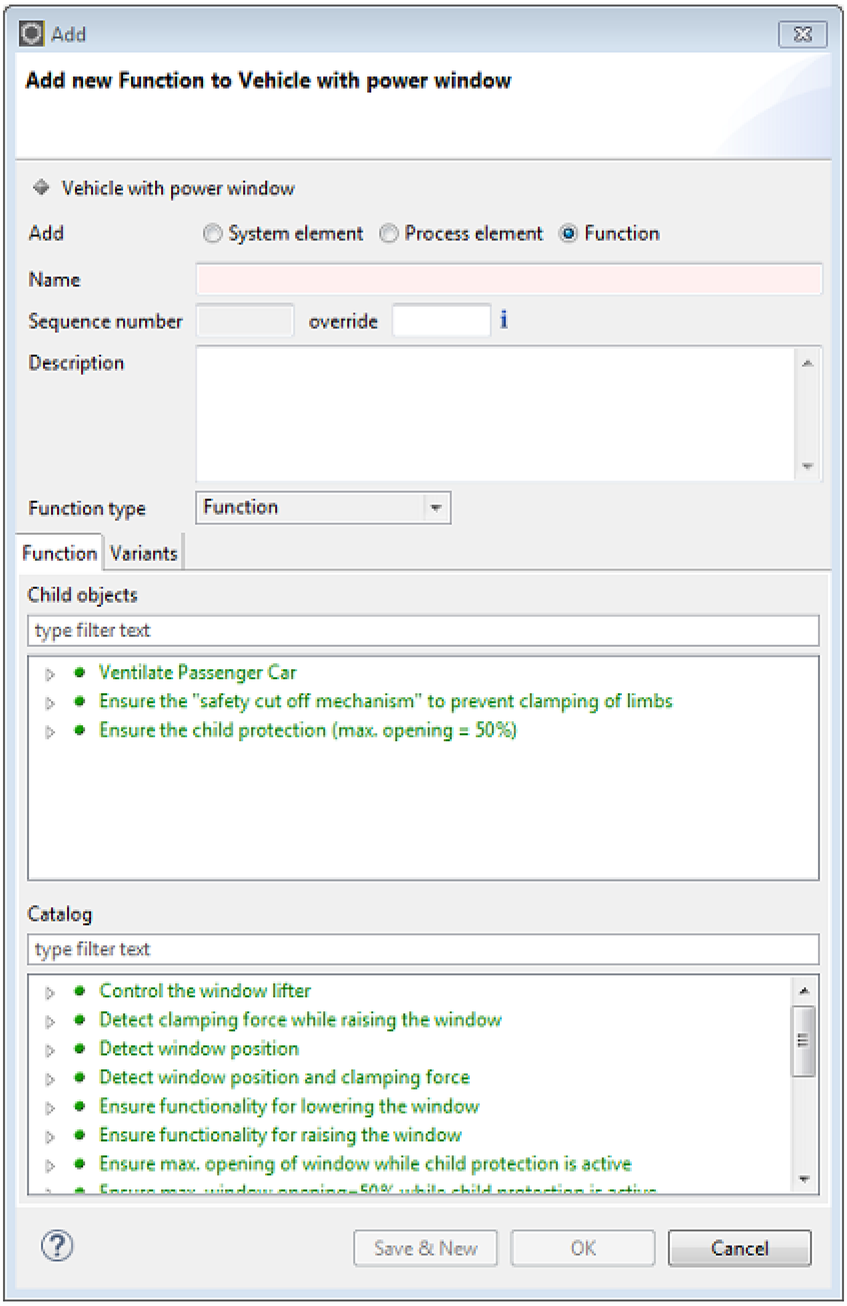


fig. New function

2. Choose **New** > **Function**.

► The "Add new function" dialog opens.



Add

Add new Function to Vehicle with power window

Vehicle with power window

Add ○ System element ○ Process element ● Function

Name

Sequence number override

Description

Function type: Function

Child objects

- Ventilate Passenger Car
- Ensure the "safety cut off mechanism" to prevent clamping of limbs
- Ensure the child protection (max. opening = 50%)

Catalog

- Control the window lifter
- Detect clamping force while raising the window
- Detect window position
- Detect window position and clamping force
- Ensure functionality for lowering the window
- Ensure functionality for raising the window
- Ensure max. opening of window while child protection is active

fig. "Add new functio"n dialog

3. In the first line, "Add", make sure "Function" is selected.

4. Enter a name for the new function.

5. Decide whether or not you want the sequence number of the function to be determined automatically by SOX. You can enter your own sequence number (optional).

6. Type a description into the "Description" box (optional).

7. Choose the function type (function, diagnosis, safety function, product characteristics, process characteristics). The standard type is "function". Choosing "diagnosis" adds another tab to the dialog, giving you the option to add more attributes regarding diagnosis.

8. If you want to add another function, click on **Save & New**.

9. When you are done adding functions to this system element, click on **OK**.

→ The functions have been added.

Further explanation of the "Add Function" dialog:

Under the tab "Functions" you can see if there are other functions already added to this system element. Under the tab "Variants" you can assign the function to an existing variant (if you already have variants; see also the chapter Working with Variants). Under "Catalog" you can see all functions of your project.

Adding Malfunctions to a Function

Note

There are multiple views in which you can create new objects or edit them. The result will always be the same, regardless if you do it in the FMEA editor or another view.

1. Right-click on a function.

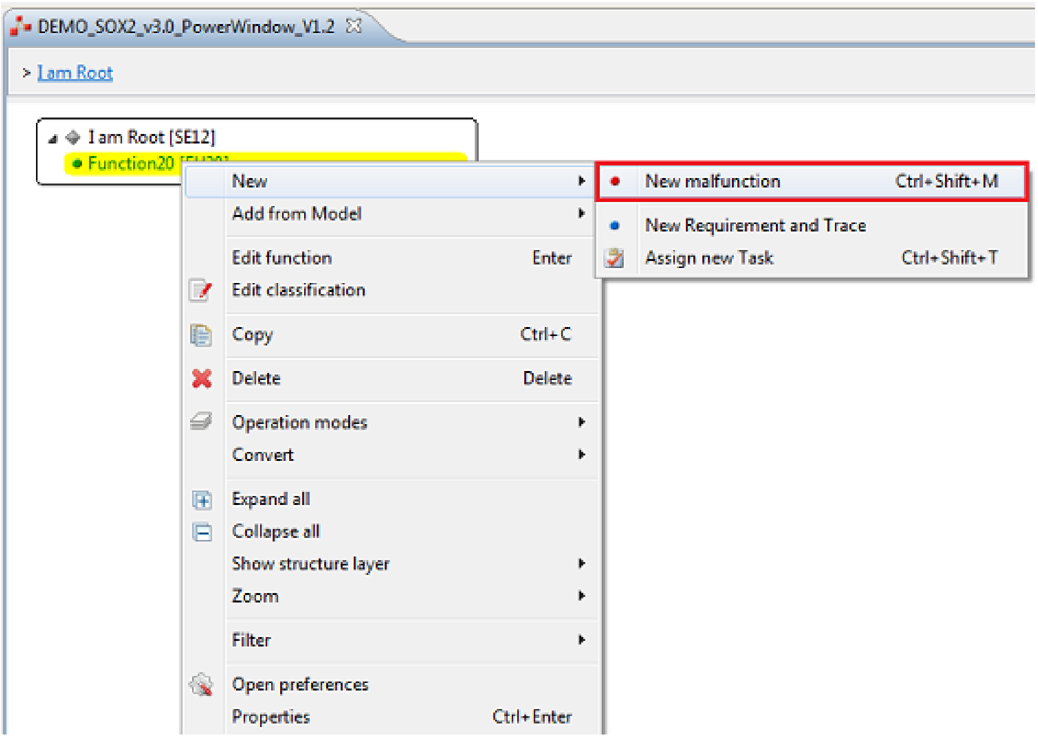
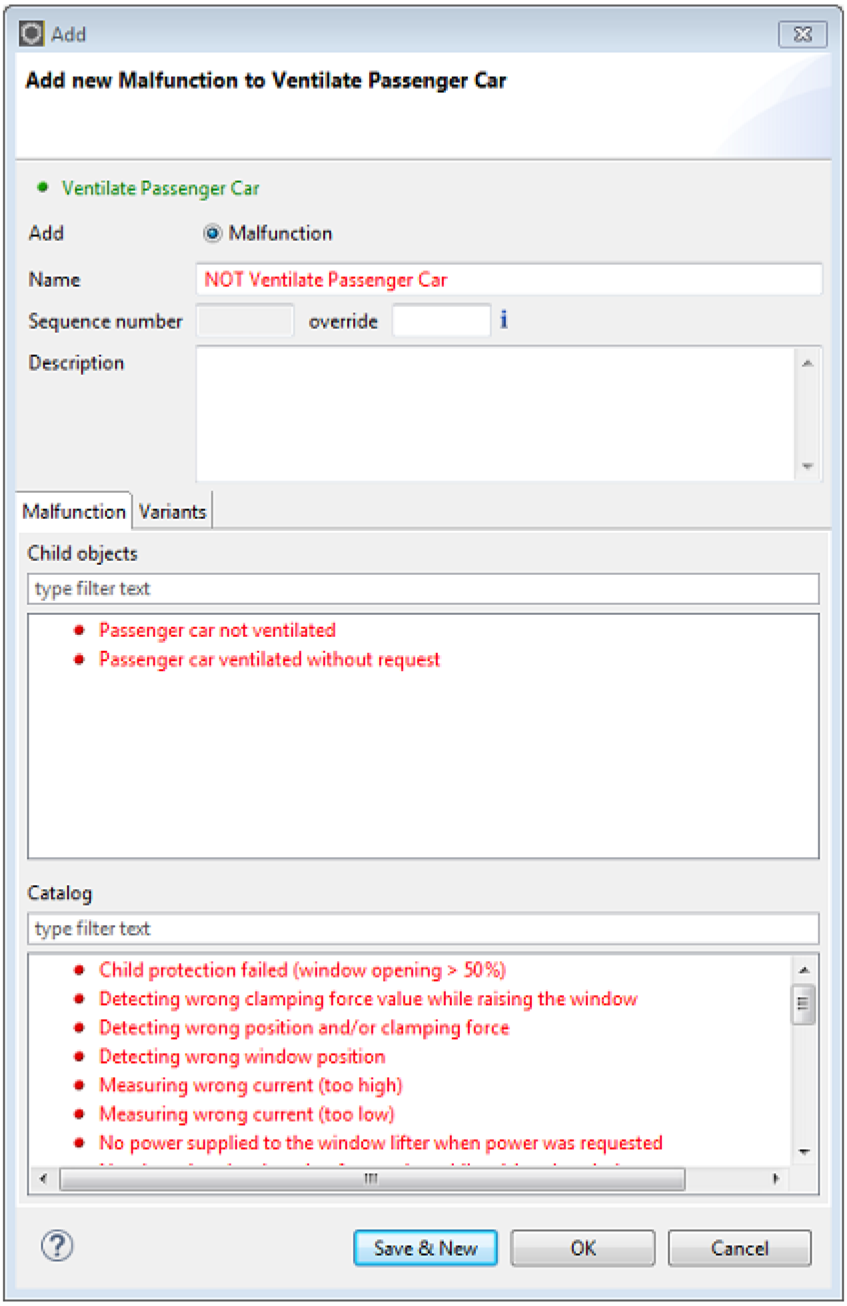


fig. New malfunction

2. Choose **New** > **New malfunction**.

► The "Add new malfunction" dialog opens.



Add

Add new Malfunction to Ventilate Passenger Car

- Ventilate Passenger Car

Add ● Malfunction

Name: NOT Ventilate Passenger Car

Sequence number ____ override ____

Description

Child objects

type filter text

- Passenger car not ventilated
- Passenger car ventilated without request

Catalog

type filter text

- Child protection failed (window opening > 50%)
- Detecting wrong clamping force value while raising the window
- Detecting wrong position and/or clamping force
- Detecting wrong window position
- Measuring wrong current (too high)
- Measuring wrong current (too low)
- No power supplied to the window lifter when power was requested

fig. "Add new malfunctio"n dialog

3. Enter a name for the new malfunction.

4. Decide whether you want the sequence number of the malfunction to be determined automatically by SOX. You can enter your own sequence number (optional).

5. Type a description of the new malfunction into the "Description" box (optional).

6. If you want to add another malfunction, click on **Save & New**.

7. When you are done adding malfunctions to this function, click on **OK**.

→ The new malfunctions have been added.

Connecting Functions/Malfunctions

Creating a function net and creating a failure net both work the same. You connect a function with another function (or a malfunction with another malfunction respectively) with drag & drop:

1. With the mouse cursor over a function, press the left mouse button and hold it.

   ► The function is highlighted with a yellow background.

2. Move the cursor over the function that you want to connect it with.

   ► Next to the cursor a rectangle and a plus sign appear.

3. Move the cursor to the left and to the right: You will notice that the function´s background becomes yellow either to the left or to the right side. To connect a function with a lower level system element, the background has to light up on the right (facing the function it connects to).

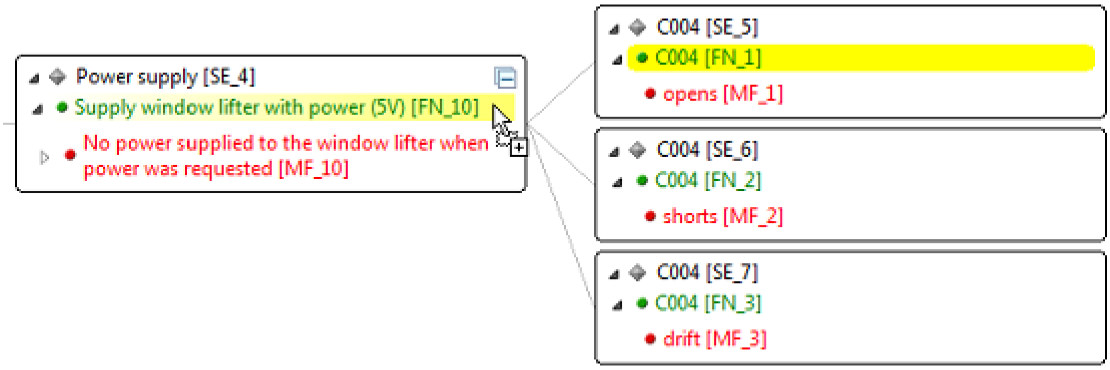


fig. Connecting functions

4. Release the mouse button.

   ► The icons next to the two functions´ names change: They now also have two smaller dots, pointing to the other function.

→ The two functions are now connected.

Do the same with the malfunctions.

Now that you have connected the (mal)functions, you can see them (and work with them!) in other views:

The Function net explorer and Failure net explorer:

The Function net explorer and Failure net explorer show hierarchical structures (top-down) of the system elements and functions / malfunctions.

The Function net / Failure net views:

These two views show how a function or malfunction is connected to others. Just double-click on a function / malfunction in the editor and the respective view shows how it is connected to the others.

For more information on these views, read the respective chapters:

Function net view

Failure net view

Function net explorer

Failure net explorer

Editing the FMEA Structure

Moving Objects

In the FMEA editor you have the possibility to restructure the objects. For this you can change the position of system elements, functions and malfunctions with drag and drop.

You can also move several objects at once. For this you need to hold the **Ctrl** key, click on the elements you want to select and then drag them to the desired target position.

Copying Objects

In order to copy objects, you have the following possibilities:

- In the editor you can copy an object with drag and **Ctrl** + drop. You need to drag the selected object to the desired position and then press **Ctrl** when you want to drop the object. In that way a copy will be saved at the target location.
- Right-click and choose the options **Copy** or **Paste**.
- Select the object you want to copy. Press the key combinations **Ctrl** + **C** in order to copy an object and **Ctrl** + **V** to paste it again at the desired location.

  Within the PSS you can make copies in the same way.
- With Drag and **Ctrl** + drop you can also copy objects from the PSS to the editor.
- It is also possible to copy several objects at once. Select the desired objects while holding pressed the **Ctrl** key and then copy them.

Deleting Objects

In any view, you have the following options to delete an object:

- open the context menu with a right-click on the object and then click on **Delete**.
- select the object by clicking on it, then press the **Del** key.

You can select multiple objects at once by pressing the **Ctrl** key while selecting further objects.

When deleting there will always appear the "Refactoring" dialog, which informs you of the changes regarding the objects´connections in the SOX project. Using the check boxes, make sure that only the desired objects will be removed, then click on **Finish**.

Deleting Connections between Functions/Malfunctions

After you created a function net or failure net (see Connecting Functions and Malfunctions) you can delete connections between (mal)functions in the function net view and the failure net view.

Here you can delete connections in two ways:

- open the context menu with a right-click on the line between two (mal)functions and then click on **Delete**.
- select the line by clicking on it, then press the **Del** key.

Adding Safety Goals to a Function

Precondition: *The "Project safety goal"s view needs to be open and contain safety goals. If the view is not already open, click on **Window** in the menu bar, then **Show view** > **Project safety goals**. Usually the safety goals are defined in the Requirements module, but you can also add new safety goals here by right-clicking in the "Project safety goal"s view.*

Use drag & drop to add a safety goal to a function:

1. In the Project safety goals view, click on your safety goal and hold the mouse button.
2. Move the cursor to the desired function.

   ► Next to the cursor, a rectangle and a plus sign appear.

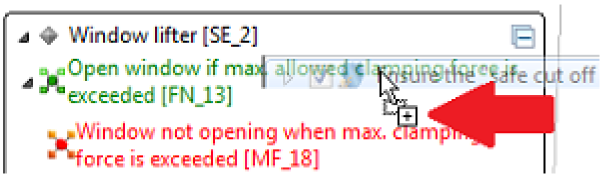

Window lifter [SE_2]
Open window if max allowed clamping force is exceeded [FN_13]
Ensure the safe cut off
Window not opening when max. clamping force is exceeded [MF_18]

fig. Adding safety goal

3. Release the mouse button.

→ The safety goal is added to the function.

Adding Action Groups

Note

There are multiple views in which you can create new objects or edit them. The result will always be the same, regardless if you do it in the FMEA editor or another view.

First you add an action group to a malfunction. Action groups consist of construction actions, operation actions, service actions, and each of those have prevention actions and detection actions. After that you rate the actions and add tasks to them.

Adding a new action group:

1. Right-click on a malfunction.

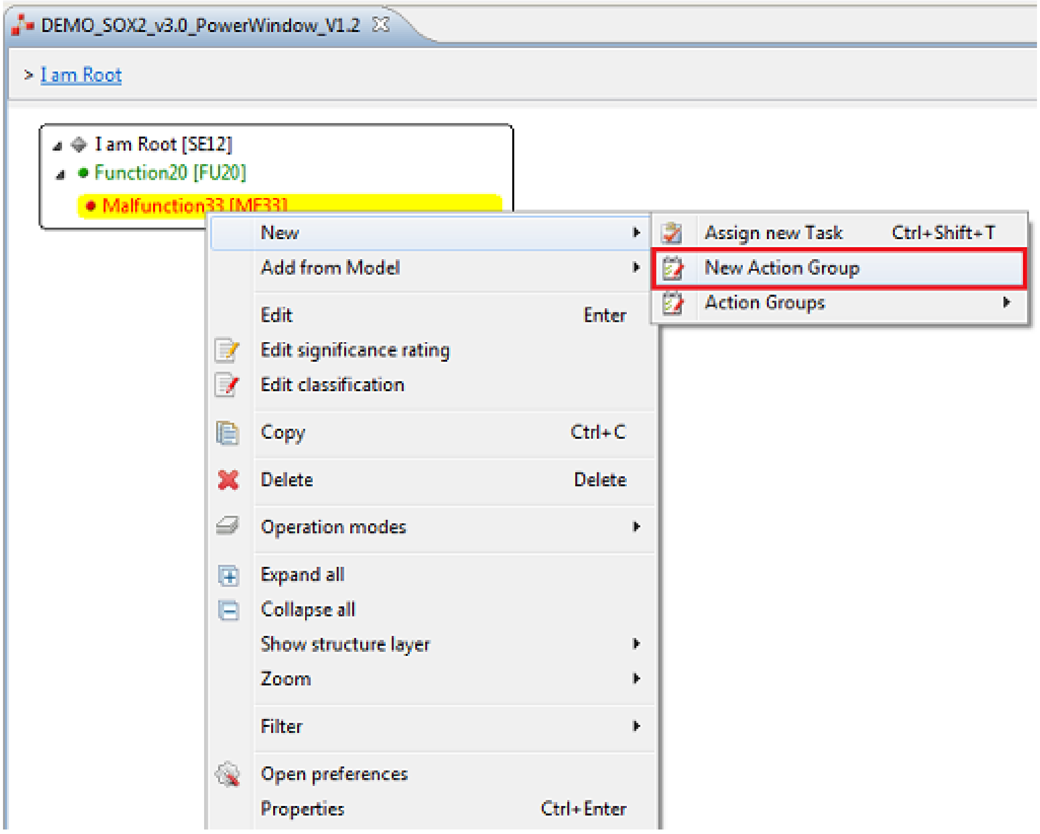
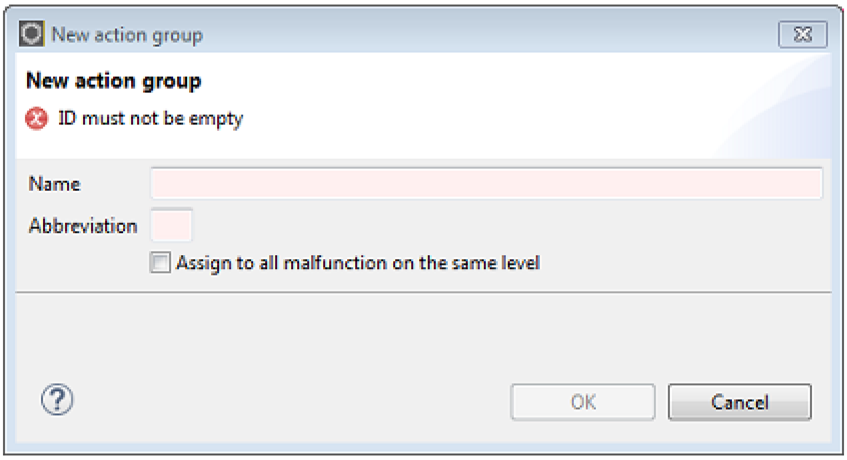


fig. Context menu on malfunction

2. Choose **New** > **New Action Group**.

► The dialog "New action group" appears.



New action group

ID must not be empty

fig. "New action grou"p dialog

3. Enter a name for the new action group.

4. Enter an abbreviation. It is restricted to one character. The abbreviation is meant for the table in the project tasks view. There it will be the name of a column, allowing easy authentication.

5. With the check box, decide if you want to assign the new action group to all malfunctions on the same level.

6. Click **OK**.

► A triangle appears next to the malfunction. ▷●

→ A new action group has been added and been assigned to the malfunction.

If you did not assign the new action group to all malfunctions of the same structure layer, you still have the option to do this afterwards:

Right-click on an action group, then choose **New** > **Assign to all malfunctions of the same layer**.

SOX offers you the possibility to use revision states multiple times once they have been established. In that way, you can assign one action group to several malfunctions.

Adding an existing action group:

1. Right-click on a malfunction.

2. Choose **New** > **Action Groups** and then your desired action group.

→ The action group has been added to the malfunction.

Rating Malfunctions and Actions

The following ratings are possible:

- ● significance rating (or severity rating) for malfunctions (S)

- ⚠ prevention rating (or occurrence rating) for actions (O)

- 🔭 detection rating for actions (D)

Rating Malfunctions

Note

The ratings that are available depend on the ratings catalog that you chose.

Editing the significance (or severity) rating of a malfunction:

1. In the editor or any other view, right-click on a malfunction.

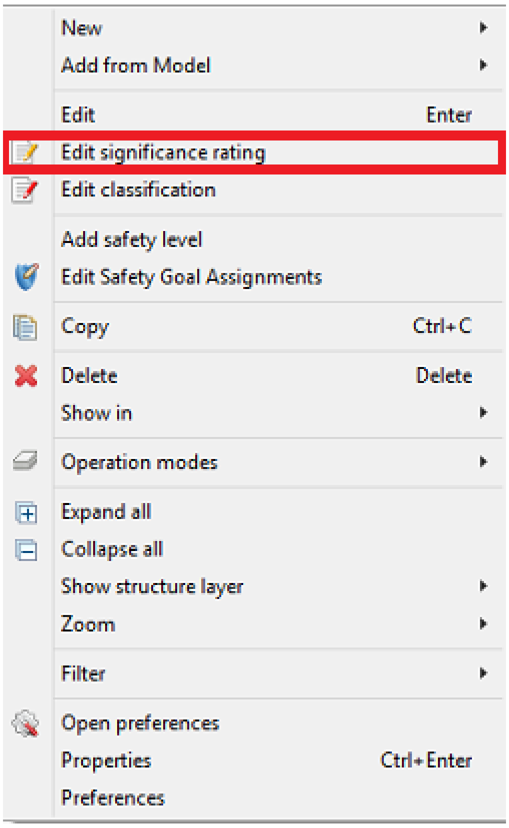
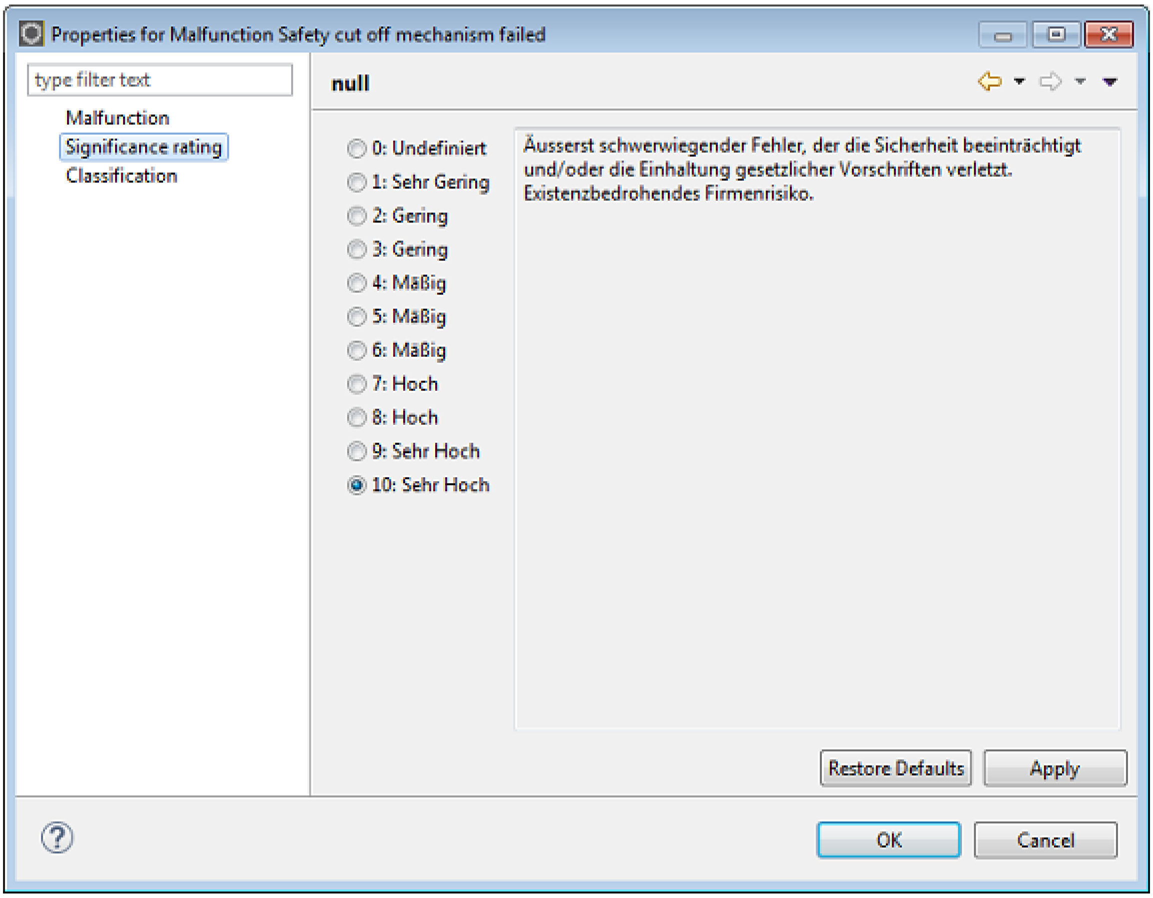


fig. Context menu on malfunction

2. Choose **Edit significance rating**.

► The dialog "Properties for Malfunction" opens.



○ 0: Undefiniert
○ 1: Sehr Gering
○ 2: Gering
○ 3: Gering
○ 4: Mäßig
○ 5: Mäßig
○ 6: Mäßig
○ 7: Hoch
○ 8: Hoch
○ 9: Sehr Hoch
● 10: Sehr Hoch

Äusserst schwerwiegender Fehler, der die Sicherheit beeinträchtigt und/oder die Einhaltung gesetzlicher Vorschriften verletzt. Existenzbedrohendes Firmenrisiko.

fig. Dialog significance rating

3. Choose a rating.

4. Click on **Finish**.

→ The malfunction now has a rating.

Classifying Malfunctions and Functions

You can add a classification to a cause of failure. If you do so, you can then see the classification in the form sheet.

Adding a classification:

1. Right-click on a function or malfunction.

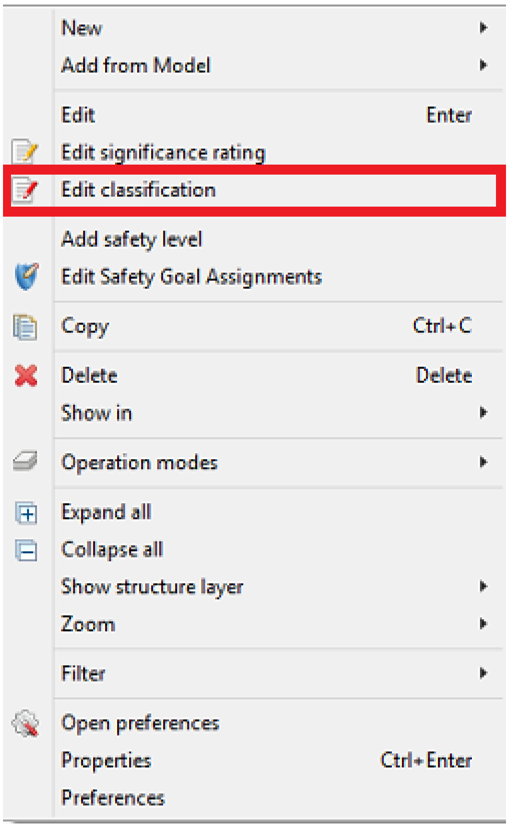
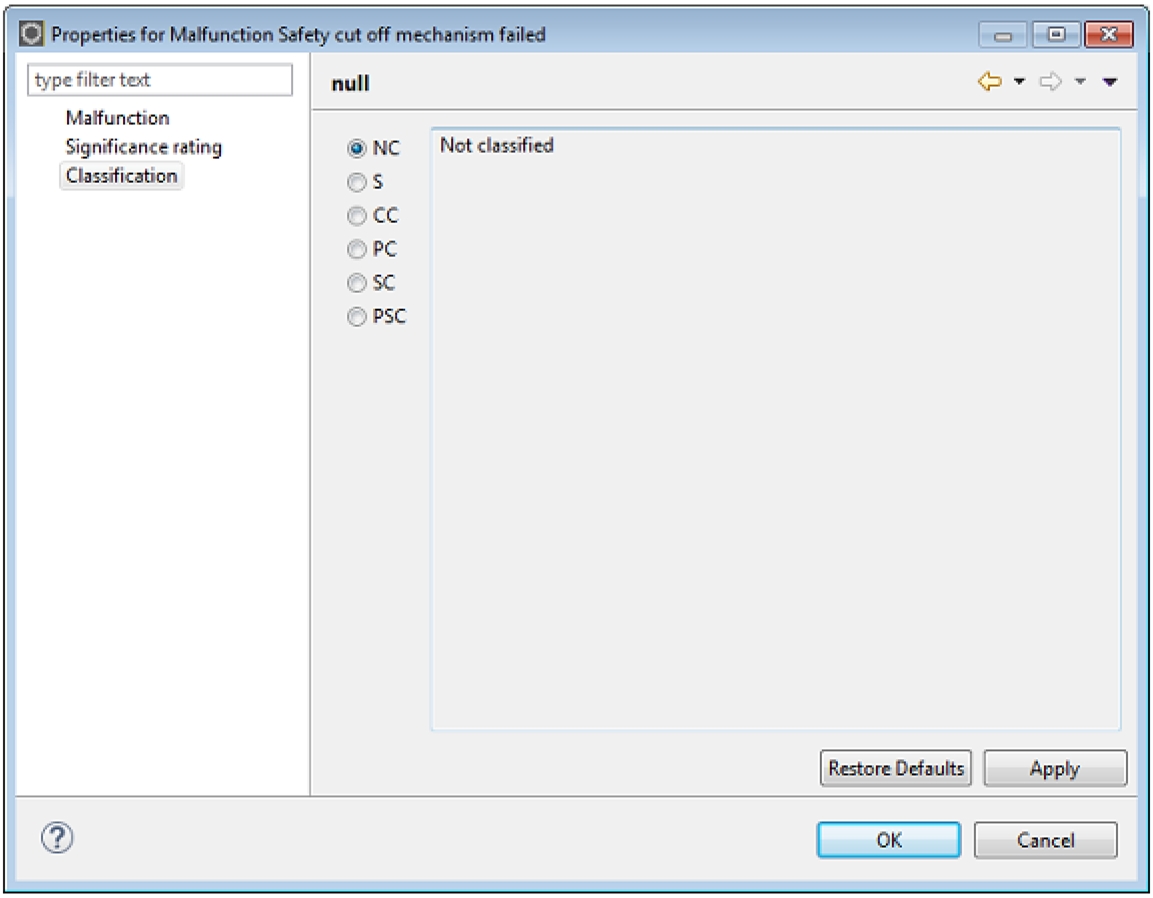


fig. Context menu on function/malfunction

2. Choose **Edit classification**.

► The classification dialog opens.



● NC
○ S
○ CC
○ PC
○ SC
○ PSC

Not classified

fig. Dialog classification

3. Choose from one of the following:

   NC: Not classified

   S: Safety compliant

   CC: Critical characteristic

   PC: Potential critical characteristic

   SC: Significant characteristic

   PSC: Potential significant characteristic

4. Click **OK**.

→ A classification has been added.

Rating Actions

To rate the actions in your new group:

1. Click on the triangle next to the malfunction.

   You see the assigned action group(s).

2. Click on the triangle next to the action group.

   ► The list of actions expands.

3. You will see three types of actions: "construction actions", "operation actions" and "service actions". Each of the three are divided into "prevention action" and "detection action". Choose one and make a right-click on it to open the context menu.

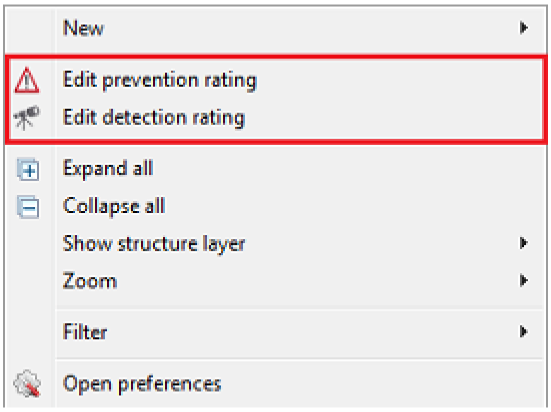


fig. Context menu on action types

4. Choose **Edit prevention rating**.

   ► The dialog for the occurrence rating opens.

5. Choose a rating.

6. Click **OK**.

7. Right-click on **Detection action**.

8. Choose **Edit detection rating**.

   ► The dialog for the detection rating opens.

9. Choose a rating.

10. Click **OK.**

11. Make sure you repeated all this for construction actions, operation action and service action.

→ Your actions now have a rating.

Adding Tasks

You can assign tasks to all objects (system elements, functions, requirements). These are shown in the window "project tasks". This is especially important for the actions.

Note

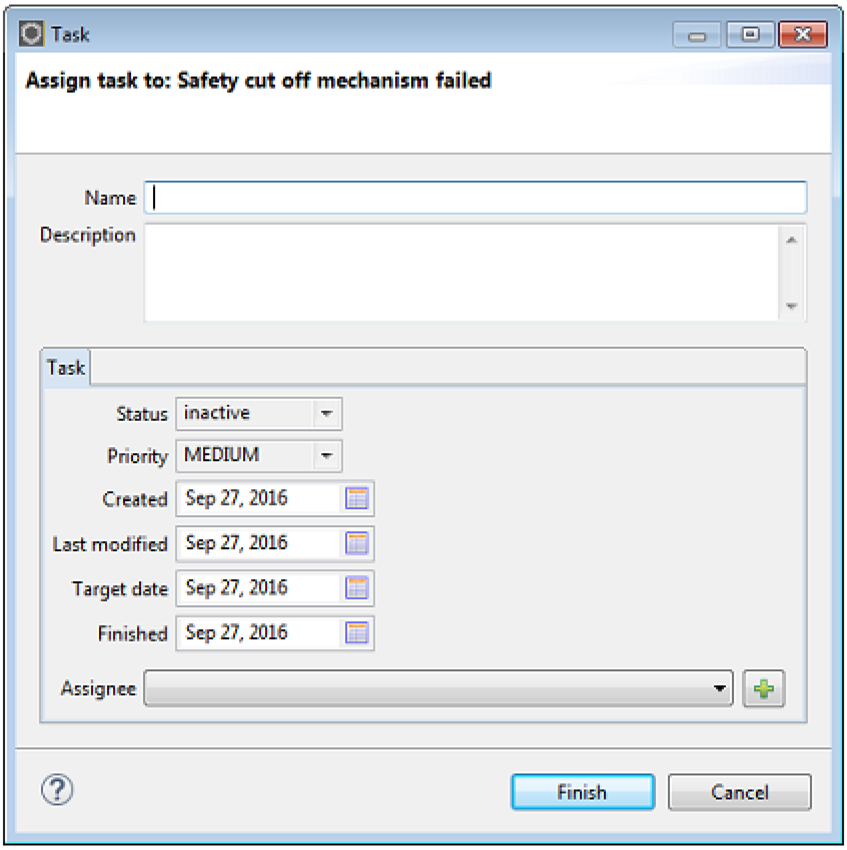
There are multiple views in which you can create new objects or edit them. The result will always be the same, regardless if you do it in the FMEA editor or another view.

Adding a new task:

1. Right-click on an object.

2. Choose **New** > **Assign new Task**.

   ► The dialog "Assign new task to: ..." appears:



Task

Assign task to: Safety cut off mechanism failed

Name

Description

Task

Status: inactive

Priority: MEDIUM

Created: Sep 27, 2016

Last modified: Sep 27, 2016

Target date: Sep 27, 2016

Finished: Sep 27, 2016

Assignee

fig. "Assign task to: ..". dialog

3. Enter a name for the new task.

4. Enter a description (optional).

5. Set the status.

6. Set the priority.

7. Set the correct dates.

8. Assign a responsible person.

    a) Choose an existing one from the drop-down menu.

    b) Or create a new one by clicking on the plus sign.

9. Click on **Finish**.

→ The task has been added.

The icon of a malfunction changes when a task has been added:

All tasks are shown in the view "Project tasks".

Creating a Form Sheet

You can create a form sheet for system elements. If you have a process FMEA, read about control plans.

Creating a form sheet:

1. Right-click on a system element.

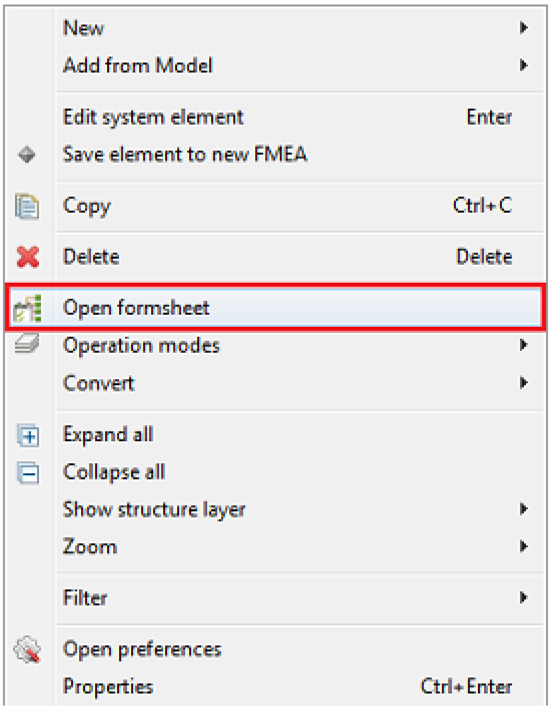


fig. Context menu on system element

2. Choose **Open form sheet**.

   ► The "Form sheets" dialog opens.

3. a) Click "Select existing" to choose from existing form sheets.

   b) Click "New" and enter a name for a new form sheet.

→ The form sheet editor opens.

You can go back to to the normal FMEA editor using the tab at the bottom of the editor. You can close the form sheet by clicking the x button in the form sheet tab at the bottom of the view.

You can get a more detailed description of the form sheet editor here.

Opening the FMEA Analysis

SOX supports the analysis of FMEA including a risk matrix, evaluation of malfunctions, and a pareto analysis. To start the analysis perform the following steps:

1. Go to the repository view in the workbench perspective.

2. Right-click on your FMEA file.

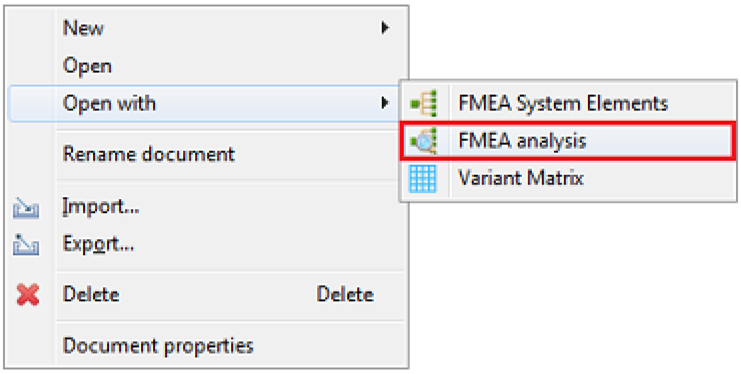
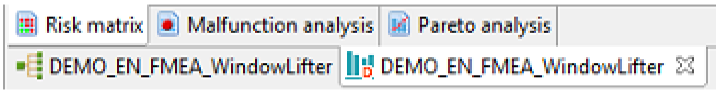


fig. Context menu on FMEA file

3. Choose **Open with** > **FMEA analysis**.

→ The editor has changed to the FMEA analysis.

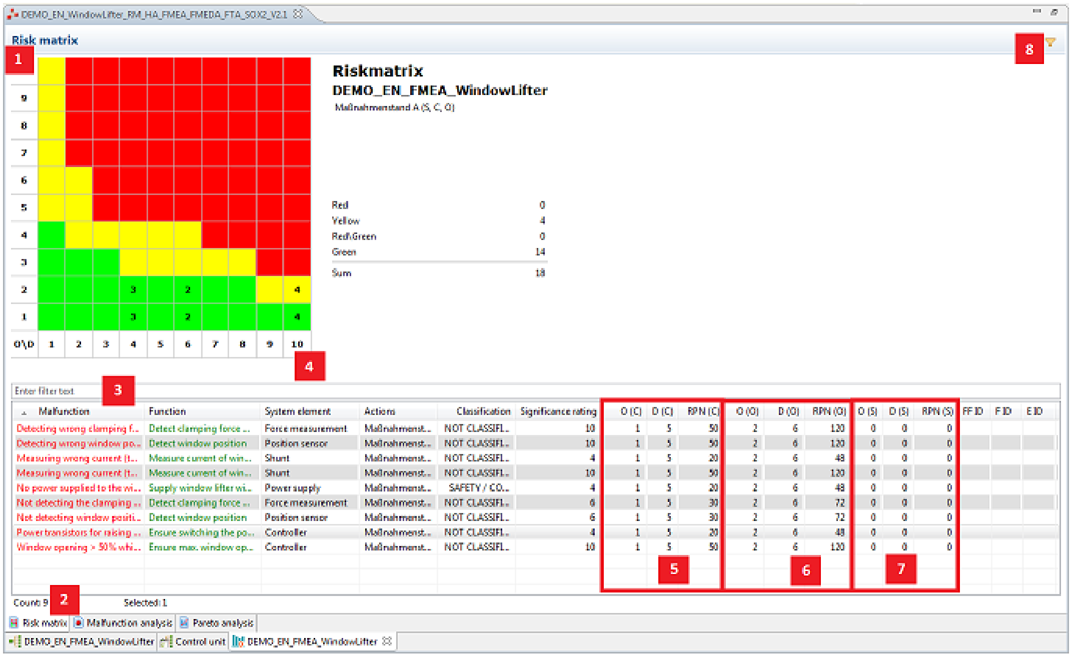
Note that you will see these tabs at the bottom of the editor:



Use these tabs to navigate between the risk matrix, the malfunction analysis and the Pareto analysis, and to go back to the FMEA editor.

Working with the Risk Matrix

Here is an example of a risk matrix:



Riskmatrix
DEMO_EN_FMEA_WindowLifter
Maßnahmenstand A (S, C, O)

Red	0
Yellow	4
Red\Green	0
Green	14
Sum	18

Malfunction	Function	System element	Actions	Classification	Significance rating	O (C)	D (C)	RPN (C)	O (O)	D (O)	RPN (O)	O (S)	D (S)	RPN (S)	FF ID	F ID	E ID
Detecting wrong clamping f...	Detect clamping force ...	Force measurement	Maßnahmenst...	NOT CLASSIFI...	10	1	5	50	2	6	120	0	0	0			
Detecting wrong window po...	Detect window position	Position sensor	Maßnahmenst...	NOT CLASSIFI...	10	1	5	50	2	6	120	0	0	0			
Measuring wrong current (t...	Measure current of win...	Shunt	Maßnahmenst...	NOT CLASSIFI...	4	1	5	20	2	6	48	0	0	0			
Measuring wrong current (t...	Measure current of win...	Shunt	Maßnahmenst...	NOT CLASSIFI...	10	1	5	50	2	6	120	0	0	0			
No power supplied to the wi...	Supply window lifter wi...	Power supply	Maßnahmenst...	SAFETY / CO...	4	1	5	20	2	6	48	0	0	0			
Not detecting the clamping ...	Detect clamping force ...	Force measurement	Maßnahmenst...	NOT CLASSIFI...	6	1	5	30	2	6	72	0	0	0			
Not detecting window positi...	Detect window position	Position sensor	Maßnahmenst...	NOT CLASSIFI...	6	1	5	30	2	6	72	0	0	0			
Power transistors for raising ...	Ensure switching the po...	Controller	Maßnahmenst...	NOT CLASSIFI...	4	1	5	20	2	6	48	0	0	0			
Window opening > 50% whi...	Ensure max. window op...	Controller	Maßnahmenst...	NOT CLASSIFI...	10	1	5	50	2	6	120	0	0	0			

Count: 9
Selected: 1

fig. Risk matrix

The x-axis [4] shows the severity and the y-axis [1] shows the occurrence probability rating.

Directly below the risk matrix, there is a table summarizing the key figures of the malfunctions. If this table is not visible, make the view bigger by clicking and dragging the lower line further down.

The first six columns of the table are: malfunction, function, system element, actions, classification, significance rating.

Then you can see the occurrence rating, detection rating and RPN for the assigned construction actions [5], for the operation actions [6] and for the service actions [7].

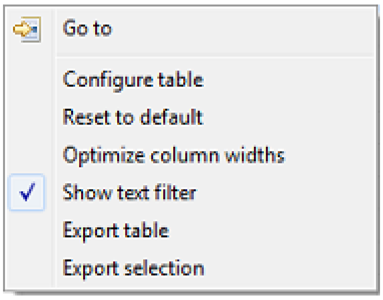
Below the table, there is a counter [2] showing the number of malfunctions that are shown in the table.

Filtering options for the table:

- Directly above the table, there is a filter [3] where you can enter text to filter for certain objects.
- You can click on a square in the risk matrix. (De-select the square by clicking on one of the white squares.) You can select multiple squares at once by holding **Ctrl** while clicking.
- You can click on the filter button in the right upper corner of the view. This opens the "Choose action groups" dialog.

Note that in the preferences menu you have options to adjust the size and to hide columns. You can also change the style of the risk matrix from the VDA style (red, yellow and green) to the RG style (red and green). You can change the detection value split for the RG style. You can decide which squares of the risk matrix have which color. You do this by selecting a square, and then clicking on one of the buttons labeled with a color name. You can select multiple squares at once by holding **Ctrl** while clicking.

A right-click in the table below the matrix opens a context menu:



- **Go To**

  Opens the FMEA editor and shows the selected object.

- **Configure table**

  Opens a dialog with check boxes that can show or hide certain columns.

- **Reset to default**

  Resets your choice about which columns you wanted to show or hide.

- **Show text filter**

  Here you can show or hide the "Enter filter text" field above the table.

- **Export table**

  This exports the table to Excel.

- **Export selection**

  Opens the selected part of the table in Excel.

For a better filtering possibility for your malfunctions, go to the Malfunction analysis by clicking on the tab **Malfunction analysis** at the bottom of the view.

Evaluating Malfunctions

The malfunction analysis (or malfunction evaluation) gives you the possibility to conduct a detailed search for elements with the help of different filters.

To use the filters, collapse the filter options by clicking on the plus signs.

The filtered data will be displayed in the table below.

Enter your data and then click on the button "Filter" to get the results.

In the first filter block, you can filter for malfunctions. You can also filter for classification or S rating. For this you need to enter a range you want to filter at the respective places. You can use the signs < (smaller), <= (smaller or equal), > (bigger), >= (bigger or equal) or = (equal).

It is also possible to filter the malfunctions according to the respective actions. This is what the filter in the middle is there for.

There you can also decide, whether you want to filter for construction and/or operation and/or service. The following criteria can be used here: A rating, S rating and RPN. You can again choose one of the comparing signs and enter a corresponding value.

In the last filter block, you can filter for malfunction tasks. You have the following possibilities:

Name, state with or without comparing signs, priority with or without comparing signs, responsible, created (period of time), last changes (period of time), deadline (period of time) and completed (period of time).

Performing a Pareto Analysis

The last element in the lower tab of the FMEA Analysis is the Pareto analysis.

With the help of a Pareto diagram, from a multitude of problem causes you can extract those problem causes which have the strongest impact. You can see the importance of a cause directly in the diagram.

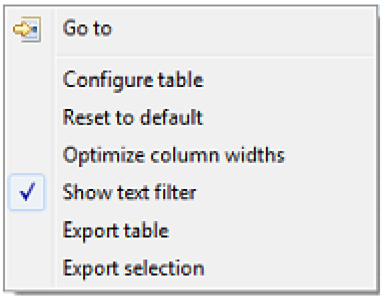
In your diagram you can see the RPN, the risk share and the revision state A (B).

If you move your mouse over the diagram, the values will be shown directly. If you click in the diagram, the respective element will also be highlighted in blue in the table.

Below the diagram, there is a table with the malfunctions. You can filter this table by entering a certain word into the filter field above it.

Note that you have the option to filter the results by clicking on the filter button in the right upper corner of the view. This opens the "Choose action groups" dialog.

A right-click in the table opens a context menu:



Here you have the following options:

- **Go To**

Opens the FMEA editor and shows the selected malfunction.

- **Configure table**

  Opens a dialog with check boxes that can show or hide certain columns.

- **Reset to default**

  Resets your choice about which columns you wanted to show or hide.

- **Show text filter**

  Here you can show or hide the "Enter filter text" field above the table.

- **Export table**

  This exports the table to Excel.

- **Export selection**

  Opens the selected part of the table in Excel.

Note that there are options regrading the pareto analysis in the preferences menu: You can adjust the x- and y-axis and change the labeling of the axis and the diagrams title. You can also show grid lines.

User Interface

Below you see all the standard views in the FMEA perspective. Remember that you can always open views by going to the menu bar and clicking **Window** > **Show View**. You can also rearrange the views with drag & drop.

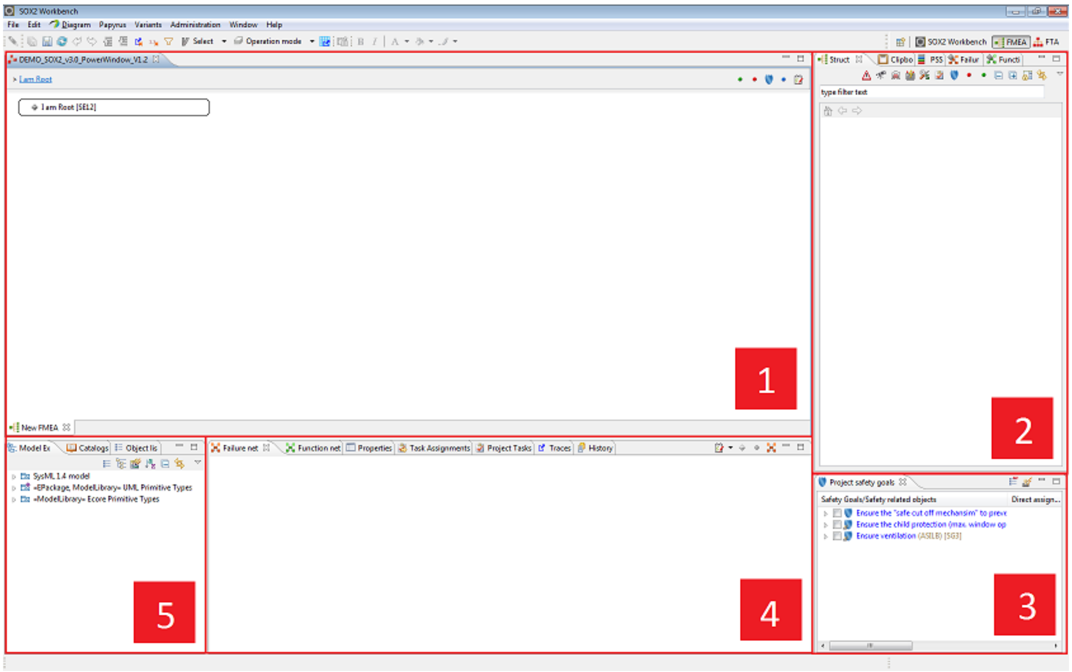


fig. FMEA perspective

[1] FMEA editor

[2] Structure Content View / Clipboard / PSS / Failure net explorer / Function net explorer

[3] Project safety goals

[4] Failure net / Function net

[5] Model Explorer / Catalogs / Object list

FMEA Editor

The FMEA editor shows all process- and system elements of an FMEA document. You can also see the associated functions, malfunctions, product features, process features, diagnosis and the project safety goals. It is possible to create and edit all objects right here in the editor.

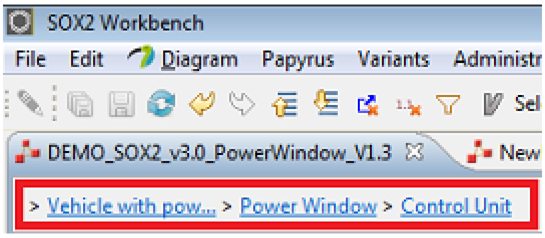
Note that you can edit some general settings for the FMEA editor in the preferences menu:

You can choose the width of the boxes representing the elements. You can enable animations. You can show comments as a tool tip: If you activate this, every comment will be shown as an overlay tool tip when the mouse cursor is above an object in the editor.

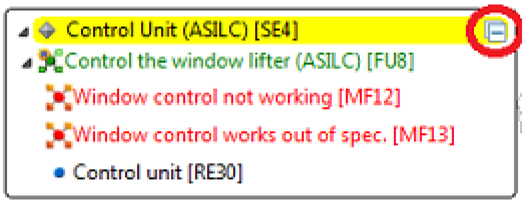
Here you see the elements and how they are connected.

If you double-click on an element, all the structure layers to its left disappear. Show them again by clicking on the names of the elements that are shown in the left upper corner of the editor:

E.g.:

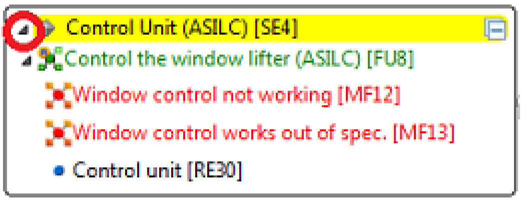

SOX2 Workbench
File
Edit
Diagram
Papyrus
Variants
Administr
Sel
DEMO_SOX2_v3.0_PowerWindow_V1.3
New
> Vehicle with pow... > Power Window > Control Unit

You can show or hide the elements to an element´s right by clicking on the + or - sign:


Control Unit (ASILC) [SE4]
Control the window lifter (ASILC) [FU8]
Window control not working [MF12]
Window control works out of spec. [MF13]
Control unit [RE30]

The other objects that are associated with the elements (functions, malfunctions etc.) are shown beneath each element.

You can collapse and expand the list of objects under an element by clicking on the triangle in front of the name:


Control Unit (ASILC) [SE4]
Control the window lifter (ASILC) [FU8]
Window control not working [MF12]
Window control works out of spec. [MF13]
Control unit [RE30]

In the right upper corner of the view you find these filtering options:

- ● Show/Hide functions
- ● Show/Hide malfunctions

- Show/Hide safety goals
- Show/Hide requirements
- Show/Hide tasks

The Context Menu

Clicking with the right mouse button anywhere in the editor and also in views (e.g. the function net and failure net views) will open the context menu. In it you will find a lot of different options, ranging from the adjustment of the editor (e.g. zoom) to working with elements (e.g. adding new functions).

First we will look at the options you get when right-clicking on an empty space. Then we will look at the options you get when right-clicking on certain objects.

Options when making a right-click on a free space

When making a right-click on a free space in the FMEA document, you will get to choose from several options, which are also available when selecting an object:

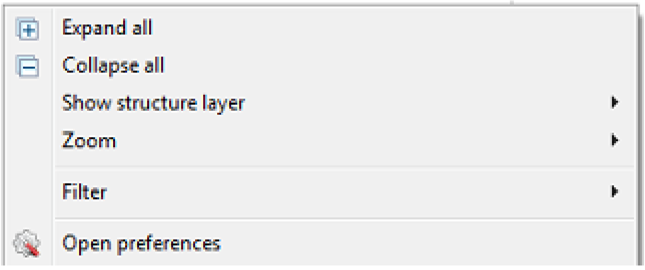


fig. Context menu on free space

- **Expand all**

  Expands all children of all system elements.

- **Collapse all**

  Collapses all children of all system elements.

- **Show structure layer**

  Here you can select which structure layer will be displayed.

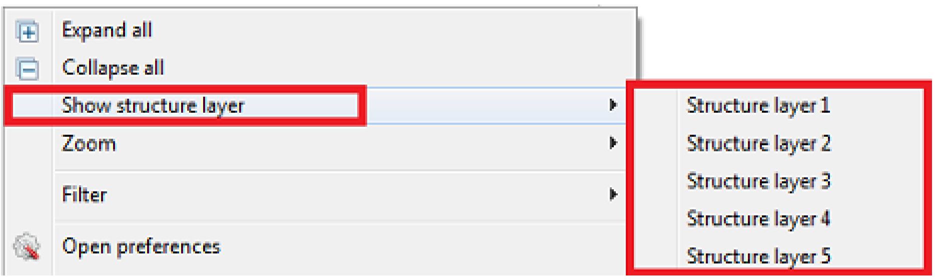


fig. Show structure layer

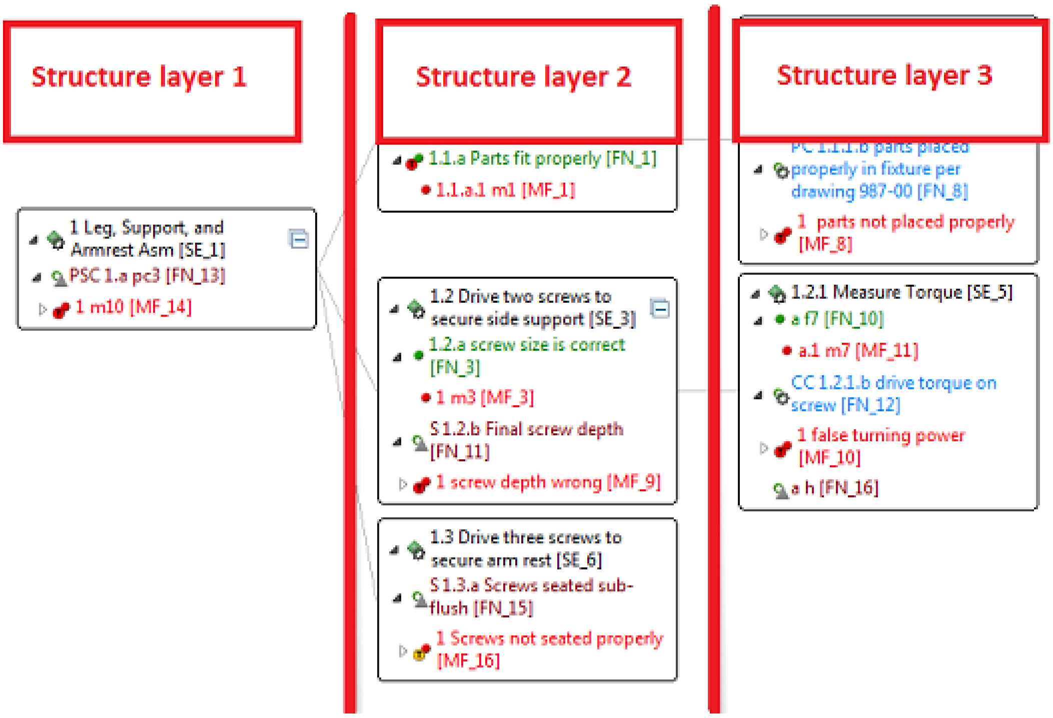

Structure layer 1
Structure layer 2
Structure layer 3
1 Leg, Support, and Armrest Asm [SE_1]
PSC 1.a pc3 [FN_13]
1 m10 [MF_14]
1.1.a Parts fit properly [FN_1]
1.1.a.1 m1 [MF_1]
1.2 Drive two screws to secure side support [SE_3]
1.2.a screw size is correct [FN_3]
1 m3 [MF_3]
S 1.2.b Final screw depth [FN_11]
1 screw depth wrong [MF_9]
1.3 Drive three screws to secure arm rest [SE_6]
S 1.3.a Screws seated sub-flush [FN_15]
1 Screws not seated properly [MF_16]
PC 1.1.1.b parts placed properly in fixture per drawing 987-00 [FN_8]
1 parts not placed properly [MF_8]
1.2.1 Measure Torque [SE_5]
a f7 [FN_10]
a.1 m7 [MF_11]
CC 1.2.1.b drive torque on screw [FN_12]
1 false turning power [MF_10]
a h [FN_16]

fig. Example of structure layers

- **Zoom**

  Here you can zoom in or out in the respective view, depending on the chosen factor.

- **Filter**

  Here you can decide which kinds of elements are shown in the FMEA editor. This can make it easier for you to get a clear overview. You can also access these filters as buttons in the upper right corner of the FMEA editor.

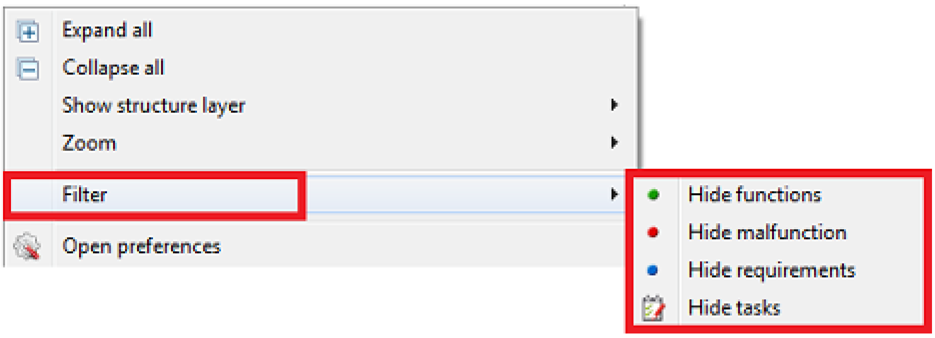


fig. Filter

- ● Show/Hide functions
- ● Show/Hide malfunctions
- ● Show/Hide requirements
- Show/Hide tasks

- **Open preferences**

  Select this option to open the preferences menu.

Options when making a right-click on a system element

Right-click on a system element in order to access the following options:

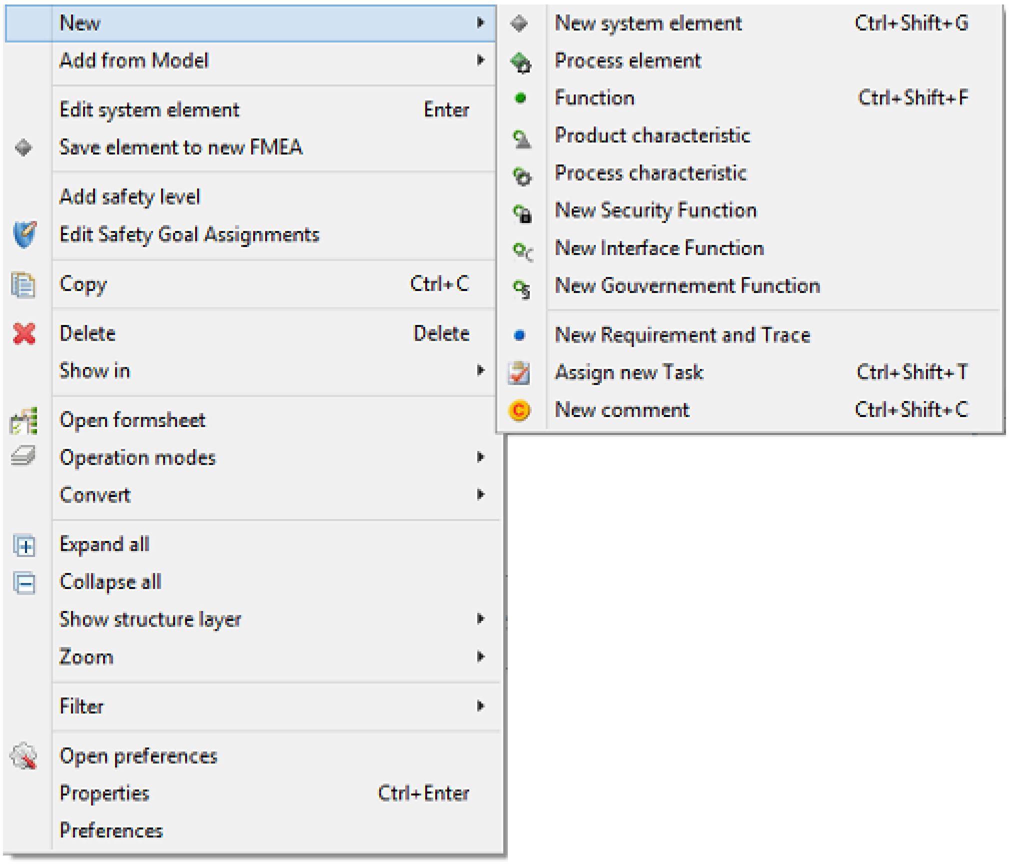


fig. Context menu on system element

- **New**
  - **System element**

    Here you can create a new system/process element. Alternatively, you can also create a new system element by using the key combination **Ctrl** + **Shift** + **G**.

    More information can be found in the chapter Creating System Elements.

  - **Process element**

    Here you can create a process element. This is done in the same way as you create a system element.

  - ● **New function**

    Here you can add functions to a system element. Alternatively, you can also use the key combination **Ctrl** + **Shift** + **F** to create a new function.

    More information can be found in the chapter Adding Functions to a System Element.

  - **Product characteristics**

    Adds a product characteristic to the selected system/process element.

  - **Process characteristics**

    Adds a process characteristic to the selected system/process element.

  - **New Security Function**

    Adds a security function to the selected system/process element.

  - **New Interface Function**

    Adds an interface function to the selected system/process element.

  - **New Government Function**

    Adds a government function to the selected system/process element.

  - **Requirements and trace**

    Assigns a new requirement to the selected element. More information on this topic can be found in the chapter Creating new Requirements.

  - **Assign new task**

    Assigns a new task to the selected element. Alternatively, you can also use the key combination **Ctrl** + **Shift** + **T** in order to assign a new task.

    More information on this topic can be found in the chapter Assigning a new Task.

  - **New Comment**

    Adds a new comment to the selected element. More information on this can be found in the chapter Comments.

    Alternatively, you can also select the object, then use the key combination **Ctrl** + **Shift** + **C** to insert a new comment.

    Or you select the object, go to the properties view, then Comments. Then click on the plus sign in the upper right corner of the view.

- **Edit system element**

  Select this option in order to edit the system elements you have created.

- **Edit**

  With this option you can edit the selected system/process element. Clicking on this option opens the characteristics dialog of the system/process element.

  Alternatively, you can also edit your system element by using the **Return** key.

- **Save a system element as a new FMEA**

Choose the location in the project where you want to save the document.

- **Copy**

  Choose this option in order to copy the selected object or system/process element.

  Alternatively, you can also copy the selected system element by pressing the key combination **Ctrl** + **C**.

- **Delete**

  Choose this option in order to delete the selected object or system/process element.

  It should be taken into consideration that the children of the object will also be deleted.

  Alternatively, you can also delete the selected system element with the **Del** key.

- **Form sheet editor**

  Choose this option in order to open the form sheet editor. Here you can add or edit further information on the FMEA project .

  More information on the form sheet editor can be found in the respective section.

- **Control plan**

  This is only visible for process elements. Choose this option to create a control plan.

- **Operation modes**

  By choosing this function, the operation or service of the selected element is included or excluded, depending on the respective selection.

- **Convert**

  With this option, you can convert a system element into a process element or a process element into a system element.

- **Expand all**

- **Collapse all**

- **Show structure layer**

  Reduces the view to the selected structure level.

- **Zoom**

  Lets you zoom in or out in the respective view, depending on the chosen factor.

- **Filter**

  Hide or show different system/process elements.

- **Properties**

  Opens the properties dialog.

- **Preferences**

Choose this option to open the preferences dialog.

Options when making a right-click on a function

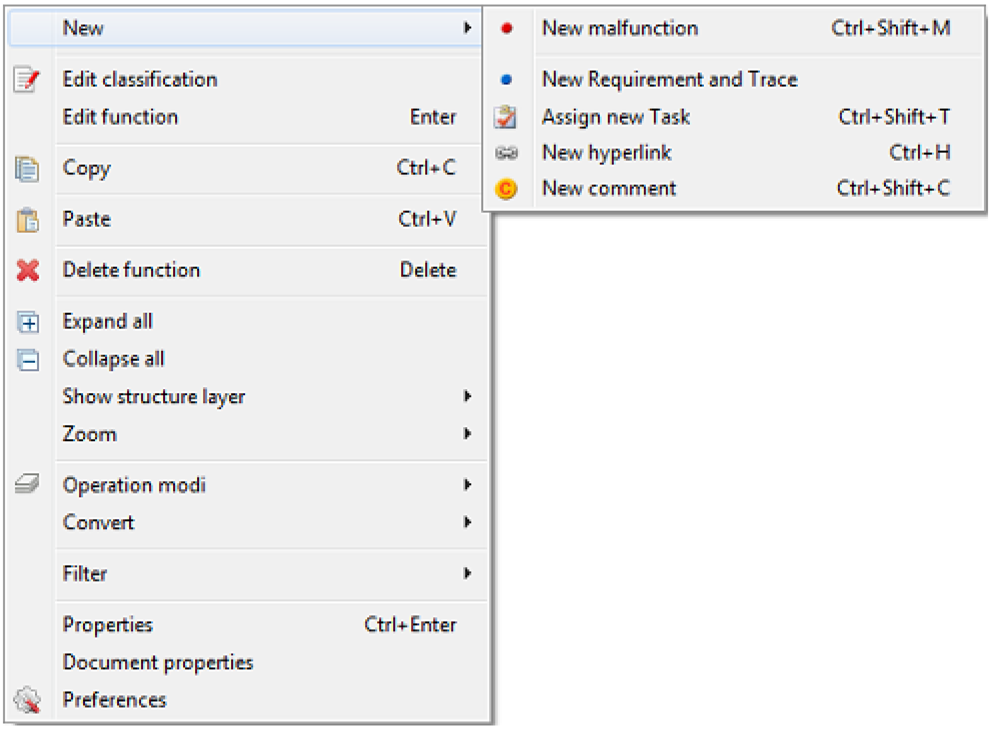


fig. Context menu on function

- **New**
  - ● **New malfunction**

    Creates a new malfunction for the selected function. Read more on this in the chapter Adding Malfunctions to a Function.

    Alternatively, you can also use the key combination **Ctrl** + **Shift** + **M** to create a new malfunction.

  - ● **New Requirement and Trace**

    Assigns a new requirement to the selected element. More information on this topic can be found in the chapter Creating new Requirements.

  - **Assign new Task**

    Assigns a new task to the selected element.

    Alternatively, you can also use the key combination **Ctrl** + **Shift** + **T** to assign a new task.

    More information on this topic can be found in the chapter Assigning a new Task.

  - **Comment**

    Adds a new comment to the selected element. More information on this can be found in the chapter Comments.

Alternatively, you can also use the key combination **Ctrl** + **Shift** + **C** to insert a new comment.

- **Edit classification**

  Edits the safety classification of the selected function.

  If you have chosen a safety classification, an abbreviation of the selected classification will be shown in front of the edited function.

- **Edit function**

  Opens the dialog for editing the selected function.

  Alternatively, you can also edit your function by using the **Return** key.

- **Copy**

  Choose this option in order to copy the selected object or system/process elements.

  Alternatively, you can also copy your selected function by using the key combination **Ctrl** + **C**.

- **Delete**

  Choose this option to delete the selected function or functions.

  Alternatively, you can also use the **Del** key to delete your function.

- **Expand all**

- **Collapse all**

- **Display structure level**

  Reduces the view to the selected structure level.

- **Zoom**

  Lets you zoom in or out in the respective view, depending on the chosen factor.

- **Operating mode**

  By choosing this function, the operation or service of the selected element is included or excluded, depending on the respective selection.

- **Convert**

  Convert into a process characteristic

  Converts the selected function into a process characteristic.

  Convert into a product characteristic

  Converts the selected function into a product characteristic.

  Convert into a safety function.

Converts the selected function into a safety function.

- **Properties**

  Opens the properties dialog of the function.

- **Open Preferences**

  Choose this option to open the preferences dialog.

Options when making a right-click on a malfunction

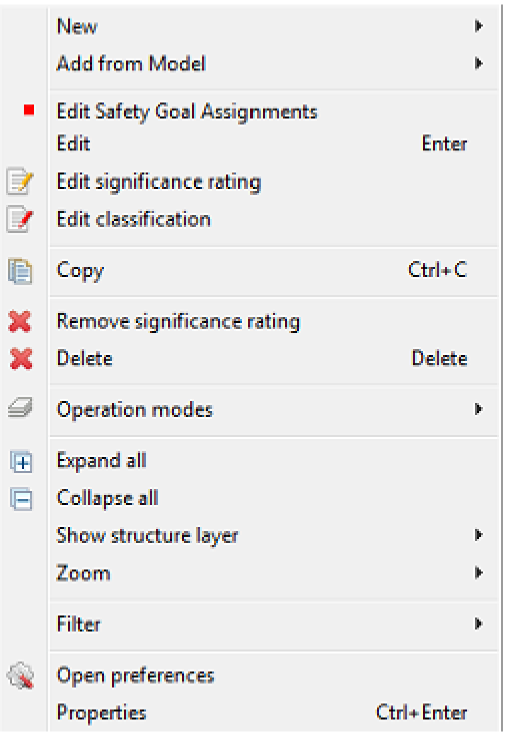


fig. Context menu on malfunction

- **New**

  - **Assign new Task**

    Assigns a new task to the selected element.

    Alternatively, you can also use the key combination **Ctrl** + **Shift** + **T** to assign a new task.

    More information on this topic can be found in the chapter Assigning a new Task.

  - **New Action Group**

    Choose this option in order to create a new group of actions (or measures). Read more on this in the section Adding Actions.

  - **Action Groups**

    Choose this option in order to integrate your selected malfunction into a group of actions.

  - **New comment**

    Adds a new comment to the selected element. More details on this can be found in the chapter Comments.

    You can also insert a new comment by using the key combination **Ctrl** + **Shift** + **C**.

- **Add from Model**

  If you added an object in the System Design module, you can quickly add this object to another object in the FMEA module here. See: Adding from Model

- **Edit Safety Goal Assignments**

  Assign or remove safety goals from the selected element.

- **Edit**

  Opens the "Edit" dialog.

  Alternatively, you can also edit your malfunction by using the **Return** key.

- **Edit significance rating (severity rating)**

  If you have added a rating catalog to your FMEA, you can edit your S rating here.

- **Edit classification**

  Edits the safety classification of the selected function.

  If you have selected one of these safety classifications, an abbreviation of the selected classification will be shown in front of the edited malfunction in your editor.

- **Copy**

  Choose this option in order to copy the selected object or system elements.

  Alternatively, you can also use the key combination **Ctrl** + **C** to copy your selected function.

- Remove significance rating

  Only visible if the malfunction already has a significance rating.

- **Delete**

  Choose this option in order to delete the selected function or functions.

  You can also delete your function by pressing the **Del** key.

- **Operation mode**

  By choosing this function, the operation or service of the selected element is included or excluded, depending on the respective selection.

- **Expand all**

- **Collapse all**
- **Display structure level**

  Reduces the view to the selected structure level.
- **Zoom**

  Lets you zoom in or out in the respective view, depending on the factor chosen.
- **Filter**

  Lets you show or hide different system elements.
- **Properties**

  Opens the properties dialog of the function.
- **Open Preferences**

  Opens the preferences dialog.

Structure Content View

In the structure content view you can get an overview of the contents (child-objects) of the selected system- or process element.

Furthermore, you can create and edit new actions, system- / process elements, functions and malfunctions here.

You can also add tasks (tasks are converted into FMEA measures here) and safety goals. In the header of this view you will find the following functions:

- **Hide / show prevention actions**
- **Hide / show detection actions**
- **Hide / show service actions**
- **Hide / Show operation actions**
- **Hide / Show construction action**
- **Hide / show tasks**
- **Hide / show safety goals**
- ● **Hide / show malfunctions**
- ● **Hide / show functions**
- **Collapse all**

Hides all layers except for the root element.

You can also use the key combination **Ctrl** + **Shift** + **Numpad_Divide**.

- **Link with editor**

  If this option is activated, the structure view will be linked with the FMEA editor. If you then select an element in the structure view, this element will automatically be selected in the FMEA editor as well. The same happens if you select an element in the FMEA view.

FMEA Ratings Catalogs

You can create several ratings catalogs or you can edit the existing, active ratings catalogs. The editing dialog for the rating catalogs can be opened from the Catalog view with a right click on the public folder:

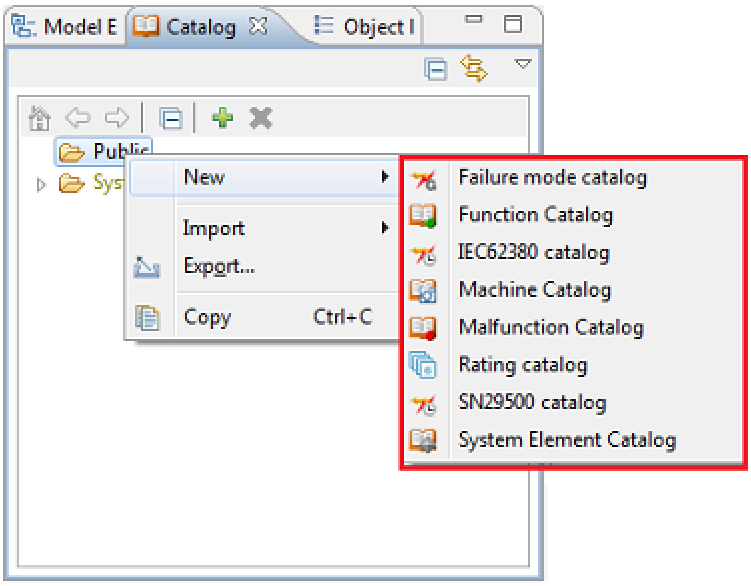


fig. Catalogs view.

Note

The standardized catalogs in the system folder can't be edited.

Edit FMEA ratings catalogs

Select the ratings catalog you want to edit in the list. Afterwards, you can edit the name of the ratings catalog or modify the descriptions of the individual entries. In order to modify the properties of an entry, please click on the desired field in the table. You can then directly enter your changes in the table. Standard ratings catalogs included in the software package cannot be edited. However, they can be copied and then edited afterwards.

Create, edit, delete ratings catalogs

In order to create a new rating catalog please click on **New.** Then a new rating catalog with the title "New rating catalog" is established. This can then be edited according to your needs. In order to delete a ratings catalog, select the respective catalog in the drop-down list and then click on **Delete**. Please bear in mind that there has to be always at least one rating catalog.

Import & export ratings catalogs

Ratings catalogs can be saved as a file and then restored.

To export a ratings catalog, right-click on it, then choose Export .

Click on **Export** in order to export a ratings catalog.

PSS View - Project System Structure

The Project System Structure view gives you an overview of all documents that belong to your project. This overview is not limited to FMEA documents, but also includes FMEDA, HA and other documents.

In this view, you also have the possibility to drag elements to the FMEA or to other SOX modules, for example the FMEDA.

In the upper right corner you can find the following symbols for the structuring of the PSS:

- Hide / show prevention actions
- Hide / show detection actions
- Hide / show service actions
- Hide / show operation actions
- Hide / show construction actions
- Hide / show tasks
- Hide / show safety goals
- ● Hide / show malfunctions
- ● Hide / show functions
- Collapse all (**Ctrl** + **Shift** + **Numpad_Divide**)
- Expand all (**Ctrl** + **Shift** + **Numpad_Multiply**)
- Link to editor
- View menu
- Minimize

- ☐ Maximize

The PSS:

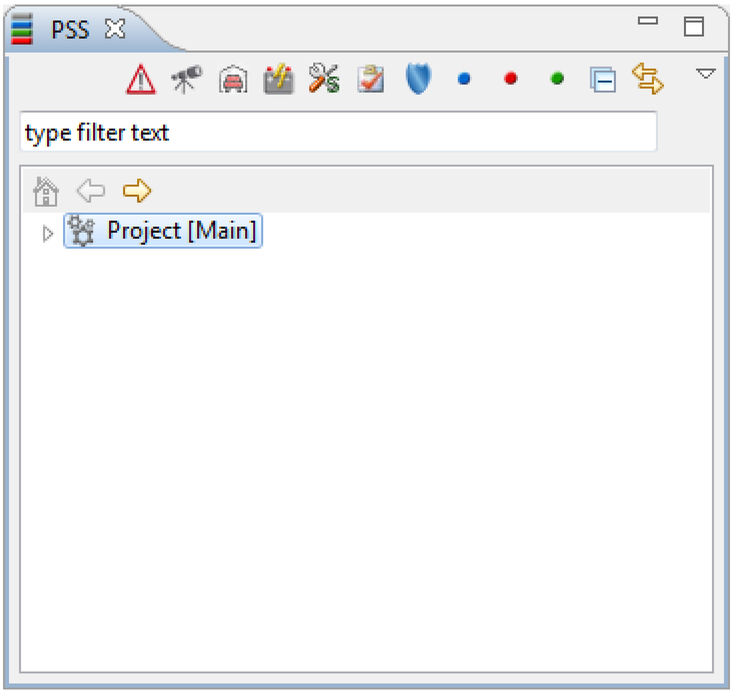


fig. The PSS view

- **Safety goals**

  For a more detailed description, please go to the section Performing a Pareto Analysis.

- **Project hazards**

  Here you see the hazards that are in your projects.

- **Project team**

  Here you will find a list of all team members.

  Add a new team member:

  When making a right-click on **Project team** and then on **New member**, the following dialog will open:

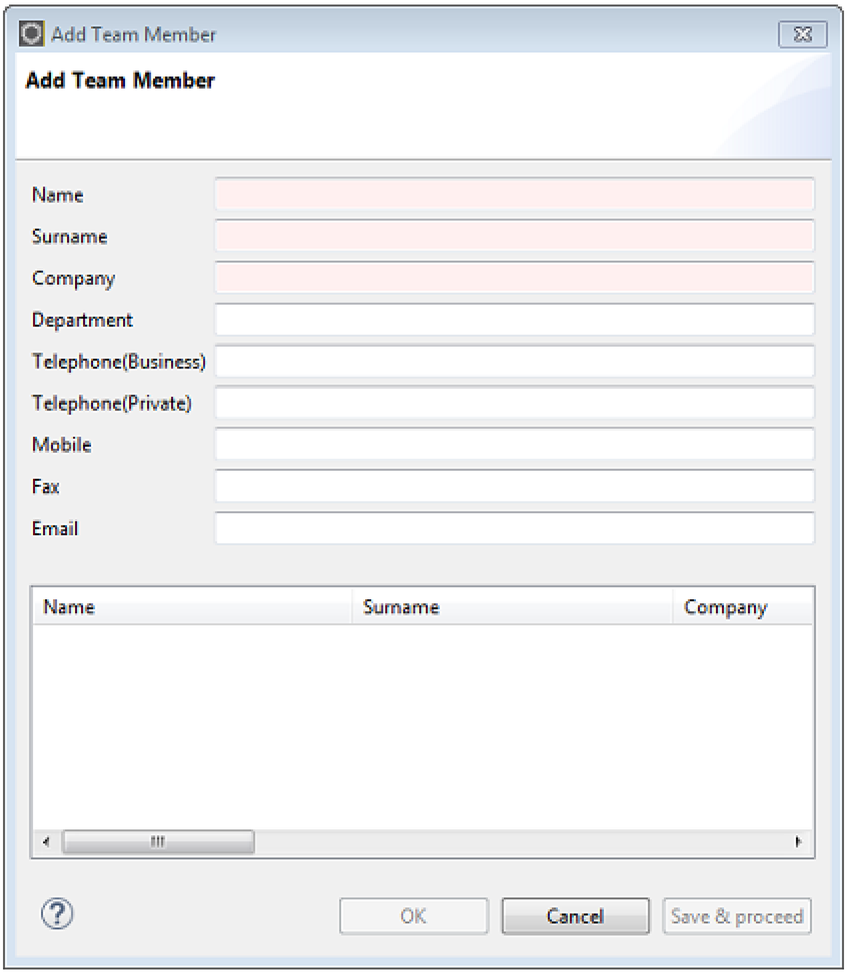


fig. "Add Team Membe"r dialog

Name, Surname and Company are mandatory fields.

Optionally, you can add the following information: Department, Telephone (business), Telephone (private), Mobile, Fax, Email.

- **BOM**
- **FMEA**
- **FMEDA**
- **FTA**
- **HA**

Note

You have to manually save a document first and you possibly also have to update the Project System Structure in order to get a complete and correct list of all objects of the respective modules.

There are options in the preferences menu for the PSS view regarding FMEA: You can filter what is shown and you can decide how the view expands when opening it and when adding parts

Project Safety Goals View

This view provides you with an overview of your project and safety goals summarized in a table. The following attributes are included: name, safety level, current, safe state, coverage EOT, FTT, FTZI, FIT, save reduction, warning concept.

By making a right-click on a safety goal, you will get to the following options:

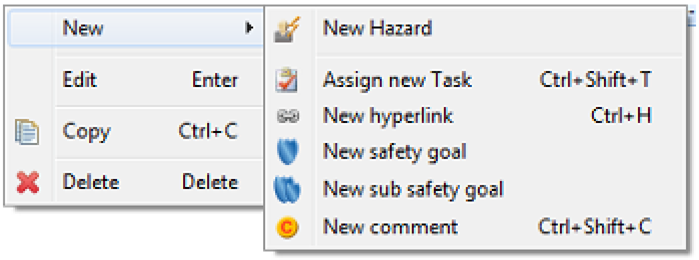


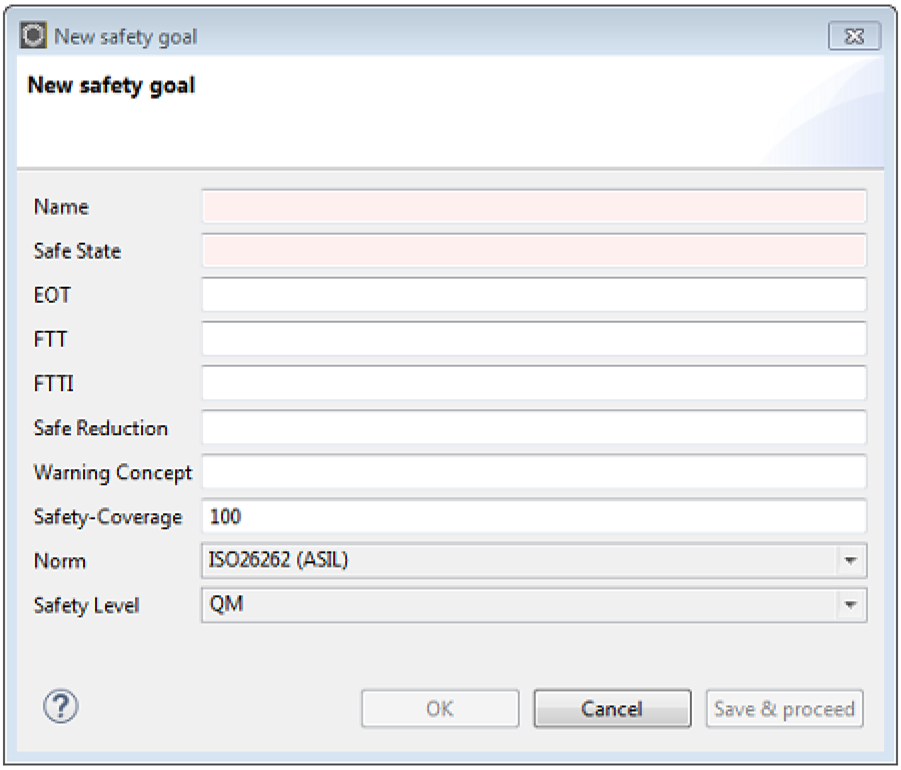
fig. Context menu on safety goal

- **New**
  - **New hazard**

    This will open the dialog "Add new hazard".
  - **Assign new task**

    Choose this option to assign a new task or use the key combination **Ctrl** + **Shift** + **T**.
  - **New safety goal**

    This will lead you to the dialog "New safety goal":



Safety-Coverage: 100

Norm: ISO26262 (ASIL)

Safety Level: QM

fig. "New safety goa"l dialog

Please insert the name of the safety goal and the safe state.

Optionally, you can also add the following information:

EOT, FTT, FTZI, FIT, safe reduction, warning concept, safety coverage, norm, safety level.

Clicking on **OK** will confirm the safety goal and close the dialog, clicking on **Save & proceed** will save the safety goal and directly reopen the dialog "New safety goal".

- **New sub safety goal**

  To assign a new secondary safety goal to a selected safety goal, make a right-click on the desired safety goal and then click on **New sub safety goal**.

- **Comment**

  Opens the "Add comment" dialog..

- **Edit**

  This opens the "Edit safety goal" dialog.

- **Copy**

  Choose this option to copy your safety goal or use the key combination **Ctrl** + **C**.

- **Delete**

  This automatically opens the dialog "Refactoring".

  Here you get information about the consequences and can delete all elements which are linked to your selected safety goal.

Function Net View

This view shows how a function is connected to others. Just double-click on a function / malfunction in the editor and the function net view shows how it is connected to the others.

In the header of this view you can choose between the following options:

Hide / show system- / process elements

This option gives you the possibility to hide or show the system / process elements which belong to a certain function.

Hide / show malfunctions

This option gives you the possibility to hide or show the malfunctions which belong to a certain function.

Additionally, you can minimize or maximize the view with the respective buttons.

Note that in the preferences menu under "FMEA" you have filtering options for the function net view and the malfunction net view.

Creating Function Nets

There are two possibilities to create a function net. Either in the view "Function net" or directly in the FMEA editor. Function nets can be created by using the drag & drop function.

Creating a function net in the function net view:

In order to create a new function net, double-click on a function in the FMEA editor first. The respective function will then be displayed in the **Function net view**.

Afterwards, you can create the function net by dragging further functions from the structure content view or the FMEA editor onto already existing functions in the function net.

Here it is important where you drop the functions: If you drop them in the front part of a function, they will be placed in front of the function, if you drop them in the rear part of a function, they will be placed behind the function.

The functions are then all linked:

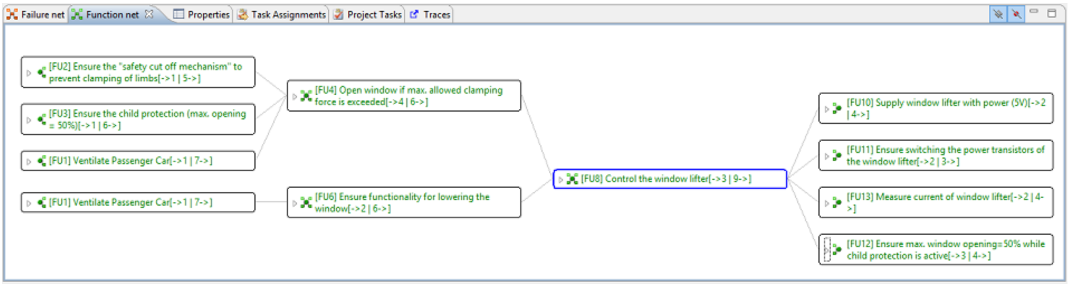

Failure net
Function net
Properties
Task Assignments
Project Tasks
Traces
[FU2] Ensure the "safety cut off mechanism" to prevent clamping of limbs[->1 | 5->]
[FU3] Ensure the child protection (max. opening = 50%)[->1 | 6->]
[FU1] Ventilate Passenger Car[->1 | 7->]
[FU1] Ventilate Passenger Car[->1 | 7->]
[FU4] Open window if max. allowed clamping force is exceeded[->4 | 6->]
[FU6] Ensure functionality for lowering the window[->2 | 6->]
[FU8] Control the window lifter[->3 | 9->]
[FU10] Supply window lifter with power (5V)[->2 | 4->]
[FU11] Ensure switching the power transistors of the window lifter[->2 | 3->]
[FU13] Measure current of window lifter[->2 | 4->]
[FU12] Ensure max. window opening=50% while child protection is active[->3 | 4->]

fig. Function net view

Creating a function net in the FMEA editor:

Drag a function from within the FMEA editor or from the PSS or structure content view and drop it onto another function, in order to link them in the function net.

The icons of the functions can change. This shows you whether functions are already included in a function net or not. The icon shows you how the functions are linked with each other:

- Function has no links
- Function has one or more successors.
- Function has one or more predecessors
- Function has one or more successors and predecessors

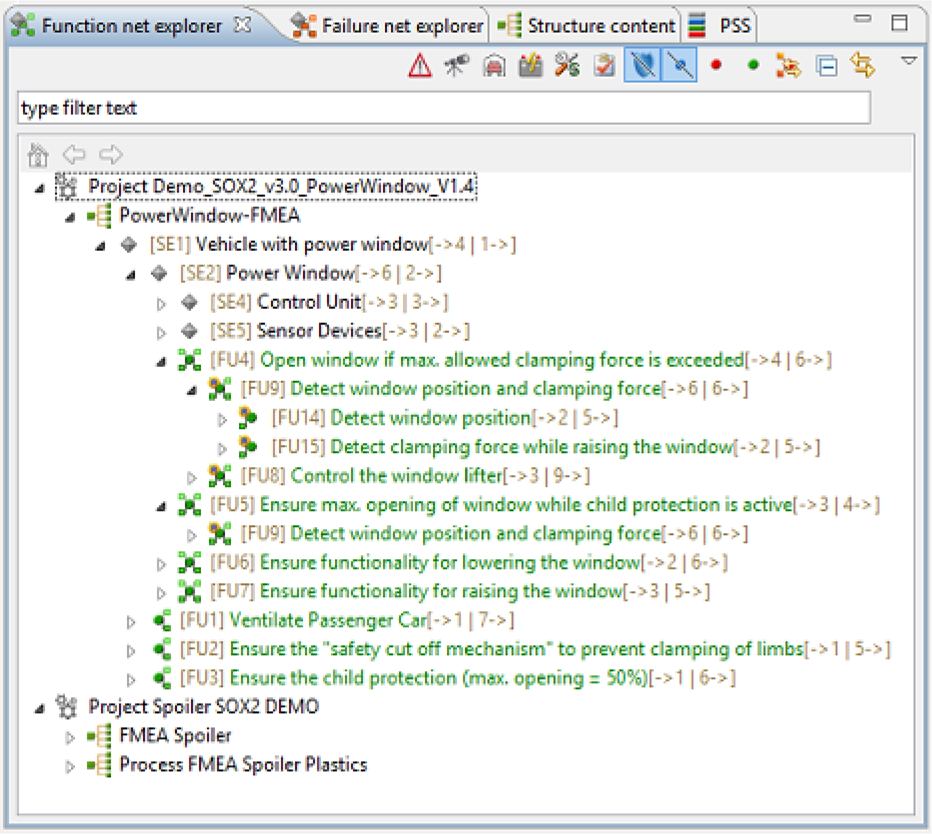
Deleting a link:

Right-click on the link line in the function net and choose the option **Delete**.

Function Net Explorer

If you have created a function net, this and all other previously created function nets will be displayed in the function net explorer.

The Function net explorer shows hierarchical structures (top-down) of the system elements and functions.



- Project Demo_SOX2_v3.0_PowerWindow_V1.4
  - PowerWindow-FMEA
    - [SE1] Vehicle with power window[->4 | 1->]
      - [SE2] Power Window[->6 | 2->]
        - [SE4] Control Unit[->3 | 3->]
        - [SE5] Sensor Devices[->3 | 2->]
        - [FU4] Open window if max. allowed clamping force is exceeded[->4 | 6->]
          - [FU9] Detect window position and clamping force[->6 | 6->]
            - [FU14] Detect window position[->2 | 5->]
            - [FU15] Detect clamping force while raising the window[->2 | 5->]
          - [FU8] Control the window lifter[->3 | 9->]
        - [FU5] Ensure max. opening of window while child protection is active[->3 | 4->]
          - [FU9] Detect window position and clamping force[->6 | 6->]
        - [FU6] Ensure functionality for lowering the window[->2 | 6->]
        - [FU7] Ensure functionality for raising the window[->3 | 5->]
      - [FU1] Ventilate Passenger Car[->1 | 7->]
      - [FU2] Ensure the "safety cut off mechanism" to prevent clamping of limbs[->1 | 5->]
      - [FU3] Ensure the child protection (max. opening = 50%)[->1 | 6->]
- Project Spoiler SOX2 DEMO
  - FMEA Spoiler
  - Process FMEA Spoiler Plastics

fig. Function net explorer

Failure Net View

This view shows how a malfunction is connected to others. Just double-click on a function / malfunction in the editor and the failure net view shows how it is connected to the others.

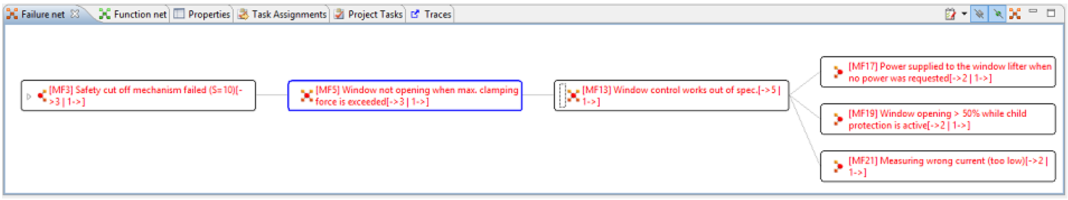

Failure net
Function net
Properties
Task Assignments
Project Tasks
Traces
[MF3] Safety cut off mechanism failed (S=10)[->3 | 1->]
[MF5] Window not opening when max. clamping force is exceeded[->3 | 1->]
[MF13] Window control works out of spec.[->5 | 1->]
[MF17] Power supplied to the window lifter when no power was requested[->2 | 1->]
[MF19] Window opening > 50% while child protection is active[->2 | 1->]
[MF21] Measuring wrong current (too low)[->2 | 1->]

fig. Failure net view

The icons at the top of the view let you hide certain objects.

Note that in the preferences menu under "FMEA" you have filtering options for the function net view and the malfunction net view.

Creating Failure Nets

You have two options to create a failure net. One in the failure net view and one directly in the FMEA editor. You can create failure nets with drag & drop.

<u>Creating a failure net in the failure net view:</u>

To create a new failure net, double-click on a malfunction in the FMEA editor. The selected malfunction will then be displayed in the **failure net view**.

Then you can create the failure net by dragging further malfunctions from the structure content view or the FMEA editor onto already existing malfunctions in the failure net.

Here it is important where you drop the malfunctions: If you drop them in the front part of a malfunction, they will be placed in front of this malfunction, if you drop them in the rear part of a malfunction, they will be placed behind this malfunction.

Creating a failure net in the FMEA editor:

Drag a malfunction from within the FMEA editor or from the PSS or structure content view and drop it onto a malfunction in order to link it in the failure net.

Note that the icons of the malfunctions can change. This shows you if malfunctions are already part of other failure nets. The icon shows how the malfunctions are interlinked:

● Malfunction has no link

Malfunction has one or more successors

Malfunction has one or more predecessors

Malfunction has one or more predecessors and successors.

In order to create further failure nets, please go to the FMEA view. Double-click on a malfunction here. As a result, a new failure net will be shown in the failure net view. In the same way you can also return to previously created failure nets. In case the malfunction is already part of a failure net, this failure net will be opened.

Deleting a link:

Right-click on the link line in the failure net and choose the option **Delete**.

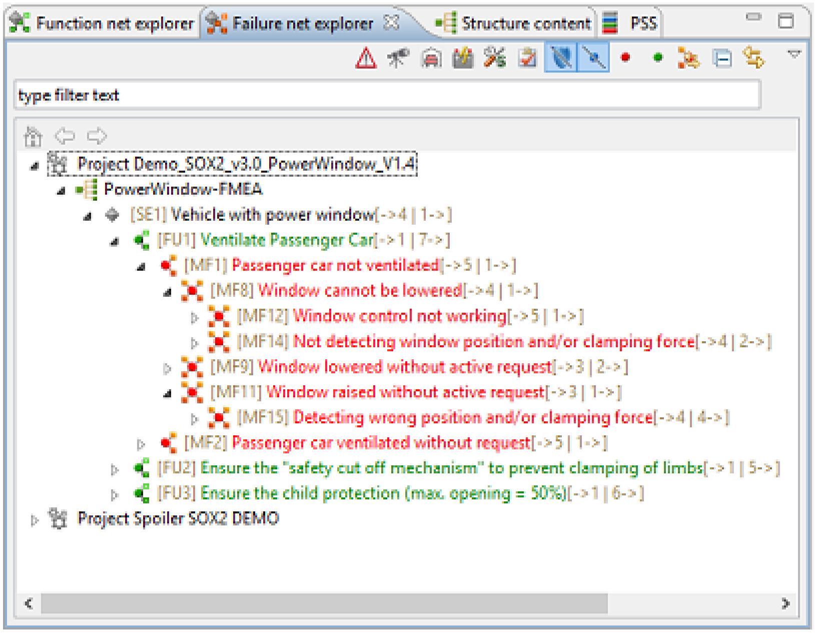
You can automatically create the function net related to your failure net:

Go to the preferences dialog (right-click an empty space in the editor, then click **Open preferences**) and then under **FMEA > Malfunction net** you need to activate the option "Connect functions if malfunctions connected".

Failure Net Explorer

If you have created a failure net, this and all previously created failure nets will be displayed in the Failure net explorer .

The Function net explorer and Failure net explorer show hierarchical structures (top-down) of the system elements and functions / malfunctions.



- Project Demo_SOX2_v3.0_PowerWindow_V1.4
  - PowerWindow-FMEA
    - [SE1] Vehicle with power window[->4 | 1->]
      - [FU1] Ventilate Passenger Car[->1 | 7->]
        - [MF1] Passenger car not ventilated[->5 | 1->]
          - [MF8] Window cannot be lowered[->4 | 1->]
            - [MF12] Window control not working[->5 | 1->]
            - [MF14] Not detecting window position and/or clamping force[->4 | 2->]
          - [MF9] Window lowered without active request[->3 | 2->]
          - [MF11] Window raised without active request[->3 | 1->]
            - [MF15] Detecting wrong position and/or clamping force[->4 | 4->]
        - [MF2] Passenger car ventilated without request[->5 | 1->]
      - [FU2] Ensure the "safety cut off mechanism" to prevent clamping of limbs[->1 | 5->]
      - [FU3] Ensure the child protection (max. opening = 50%)[->1 | 6->]
- Project Spoiler SOX2 DEMO

fig. failure net explorer

The Form Sheet editor

The form sheet editor gives you an overview of everything in your FMEA document.

You can edit the objects in the form sheet. You will see these changes immediately in the FMEA editor.

If you have not created a form sheet yet, read this chapter first: Creating a Form sheet.

Filtering and adjusting the Display of the Form sheet Editor

You can change the appearance of the form sheet. In the right upper corner you have to following options:

- **Show comments**

  Shows or hides the comments

- **ASIL/SIL on/off**

  Shows or hides ASIL/SIL

- **Elements on/off**

  Shows or hides the elements

- **Functions on/off**

  Shows or hides the functions

- **Background for tasks on/off**

  Turns the color of the background for the tasks´ status on or off

Note that there are options in the preferences menu regarding the form sheet editor: showing and hiding responsibilities and comments and adjusting the layout to fit the window width. You can also adjust the layout according to the catalogs. You can choose how many levels of effects are shown and how many levels of the causes are shown.

Editing in the Form sheet Editor

Note

When editing values in the form sheet editor keep in mind that they will be changed throughout the FMEA. Some values are derived or inherited from other values. Changing them will changed the values in other places in the FMEA, e.g.: In AIAG the S rating of an action is inherited from the top level malfunction, so changing the S rating of an action will change the S rating of the top level malfunction.

To change the name of an element in the form sheet, double-click on it. The "Edit..." dialog opens. Change the name of the element and confirm your change by clicking on **OK**.

A drop-down menu opens when you double-click on ratings, dates, task statuses. Click on one entry in the drop-down list to assign this choice to the object.

Responsible persons are linked with the employee catalog in the catalogs view. So if you want to set responsible persons to prevention and detection actions you have to create a employee catalog.

Just like in the FMEA editor, you can create new objects, e.g. add a new malfunction to a function. Make a right-click on an object and choose **New**. Like in the FMEA editor, the "Add" dialog will open.

Further Information on the Form sheet Editor

The color of the tasks depends on a task´s status:

- green:

  "finished", "proposed/taken"

- yellow:

  "active", "reviewing", "rejected",

- red:

  "proposed", "inactive"

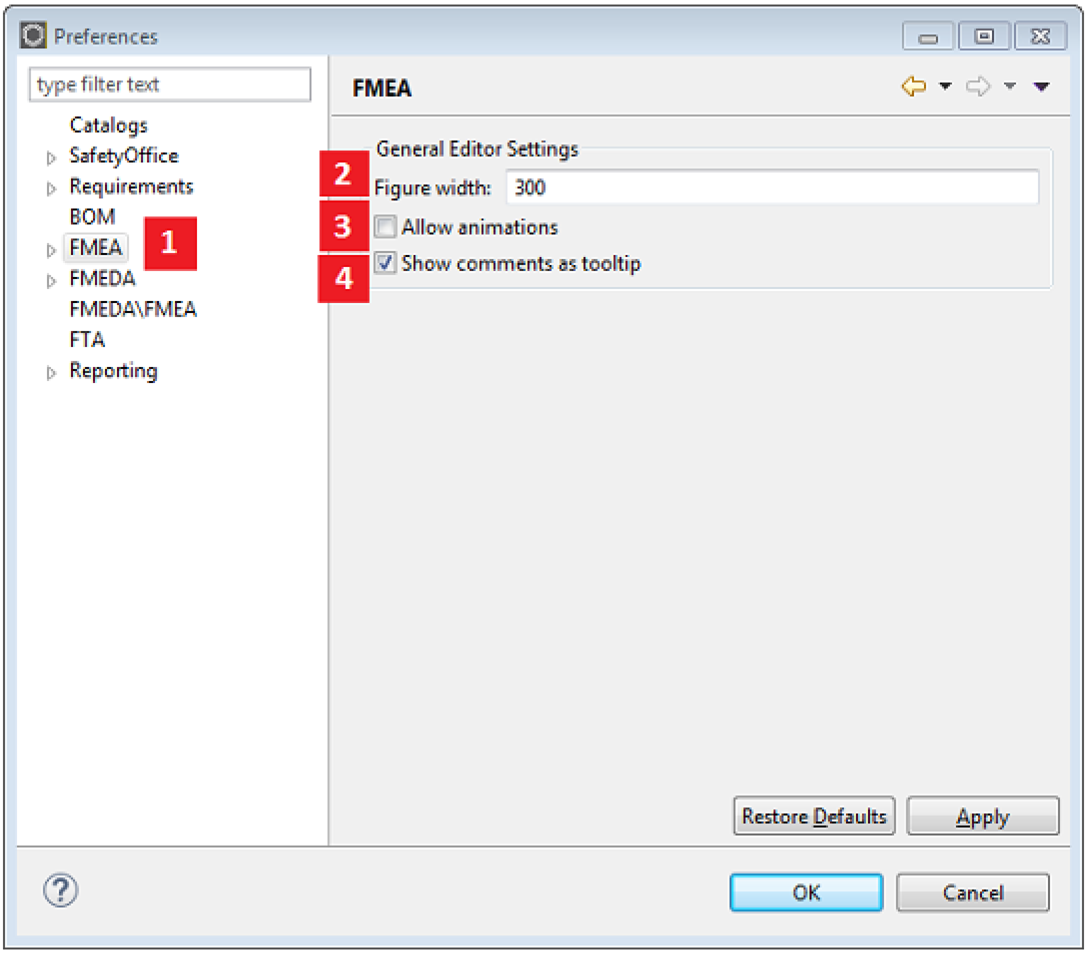
Printing form sheets:

You can export a form sheet as a PDF or Excel file. See Printing Form sheets and Control Plans to PDF and Excel.

The Preferences Menu

You can open the preferences menu either from the menu bar (**Edit** > **Preferences**), or by making a right-click in the editor.

Then the dialog with all the settings for SOX opens:



FMEA

General Editor Settings

Figure width: 300

☐ Allow animations

☑ Show comments as tooltip

fig. Preferences dialog

When you click on FMEA [1] you can see the general editor settings.

[2] You can choose the width of the boxes representing the elements in the FMEA editor. Possible values are 100 to 999.

[3] You can make a check mark to allow animations.

[4] You can make a check mark to show comments as a tool tip. If you activate this, every comment will be shown as an overlay tool tip when the mouse cursor is above an object in the editor.

Click on the triangle in front of FMEA, or double-click in FMEA, then the list expands.

You see that you have options for the form sheet and control plan: showing and hiding responsibilities and comments and adjusting the layout to fit the window width.

For the form sheet you can adjust the layout according to the catalogs, you can choose how many levels of effects are shown and how many levels of the causes are shown.

For the "Structure details" view you can choose whether to use the Root S rating and you can filter the objects for a better overview.

For the "PSS" view you can filter what is shown and you can decide how the view expands when opening it and when adding parts.

You have filtering options for the function net view and the malfunction net view.

Regarding action groups you have options to decide whether the system will open dialogs to ask things in certain situations regarding action groups.

For the risk matrix you have options to adjust the size and to hide columns. You can also change the style of the risk matrix from the VDA style (red, yellow and green) to the RG style (red and green). You can change the detection value split for the RG style. You can decide which squares of the risk matrix have which color. You do this by selecting a square, and then clicking on one of the buttons labeled with a color name. You can select multiple squares at once by holding **Ctrl** while clicking.

Regarding the pareto analysis you can adjust the x- and y-axis and change the labeling of the axis and the diagrams title. You can also show grid lines.

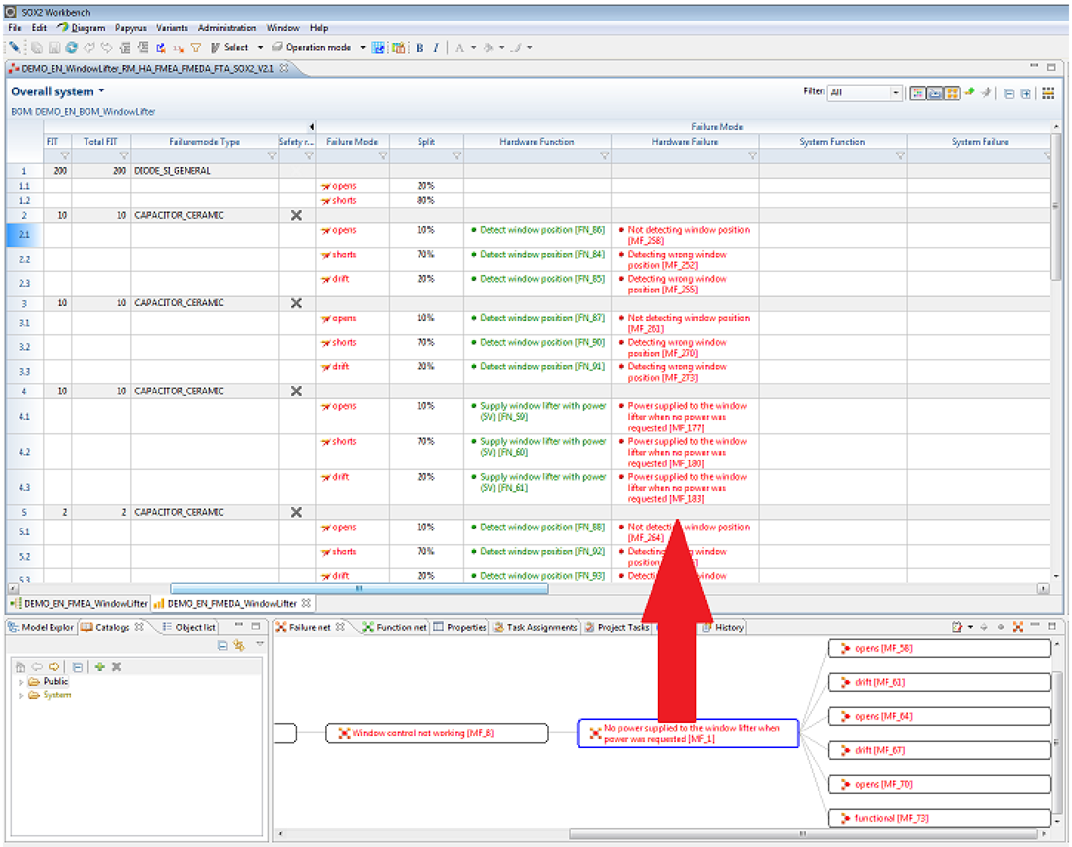
Additional Functionality

Links to other SOX Modules

You can link the FMEA with other SOX modules with drag & drop.

Linking the FMEA with the FMEDA

You can insert a hardware failure or a system failure from the failure net view of the FMEA into the columns "Hardware Failure" or "System Failure" of the FMEDA by simply dragging the desired element from the failure net to the respective column.



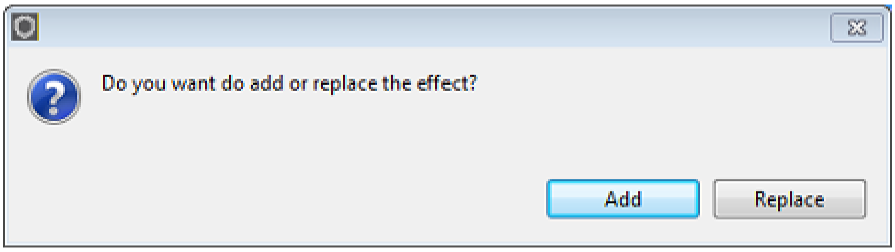
BOM: DEMO_EN_BOM_WindowLifter

	FIT	Total FIT	Failuremode Type	Safety r...	Failure Mode	Split	Failure Mode			
							Hardware Function	Hardware Failure	System Function	System Failure
1	200	200	DIODE_SI_GENERAL							
1.1					opens	20%				
1.2					shorts	80%				
2	10	10	CAPACITOR_CERAMIC	✕						
2.1					opens	10%	Detect window position [FN_86]	Not detecting window position [MF_258]		
2.2					shorts	70%	Detect window position [FN_84]	Detecting wrong window position [MF_252]		
2.3					drift	20%	Detect window position [FN_85]	Detecting wrong window position [MF_255]		
3	10	10	CAPACITOR_CERAMIC	✕						
3.1					opens	10%	Detect window position [FN_87]	Not detecting window position [MF_261]		
3.2					shorts	70%	Detect window position [FN_90]	Detecting wrong window position [MF_270]		
3.3					drift	20%	Detect window position [FN_91]	Detecting wrong window position [MF_273]		
4	10	10	CAPACITOR_CERAMIC	✕						
4.1					opens	10%	Supply window lifter with power (SV) [FN_59]	Power supplied to the window lifter when no power was requested [MF_177]		
4.2					shorts	70%	Supply window lifter with power (SV) [FN_60]	Power supplied to the window lifter when no power was requested [MF_180]		
4.3					drift	20%	Supply window lifter with power (SV) [FN_61]	Power supplied to the window lifter when no power was requested [MF_183]		
5	2	2	CAPACITOR_CERAMIC	✕						
5.1					opens	10%	Detect window position [FN_88]	Not detecti [illegible] window position [MF_264]		
5.2					shorts	70%	Detect window position [FN_92]	Detecting [illegible] window position [illegible]		
5.3					drift	20%	Detect window position [FN_93]	Detecti [illegible] window		

Window control not working [MF_8]
No power supplied to the window lifter when power was requested [MF_1]
opens [MF_58]
drift [MF_61]
opens [MF_64]
drift [MF_67]
opens [MF_70]
functional [MF_73]

fig. Link hardware failure

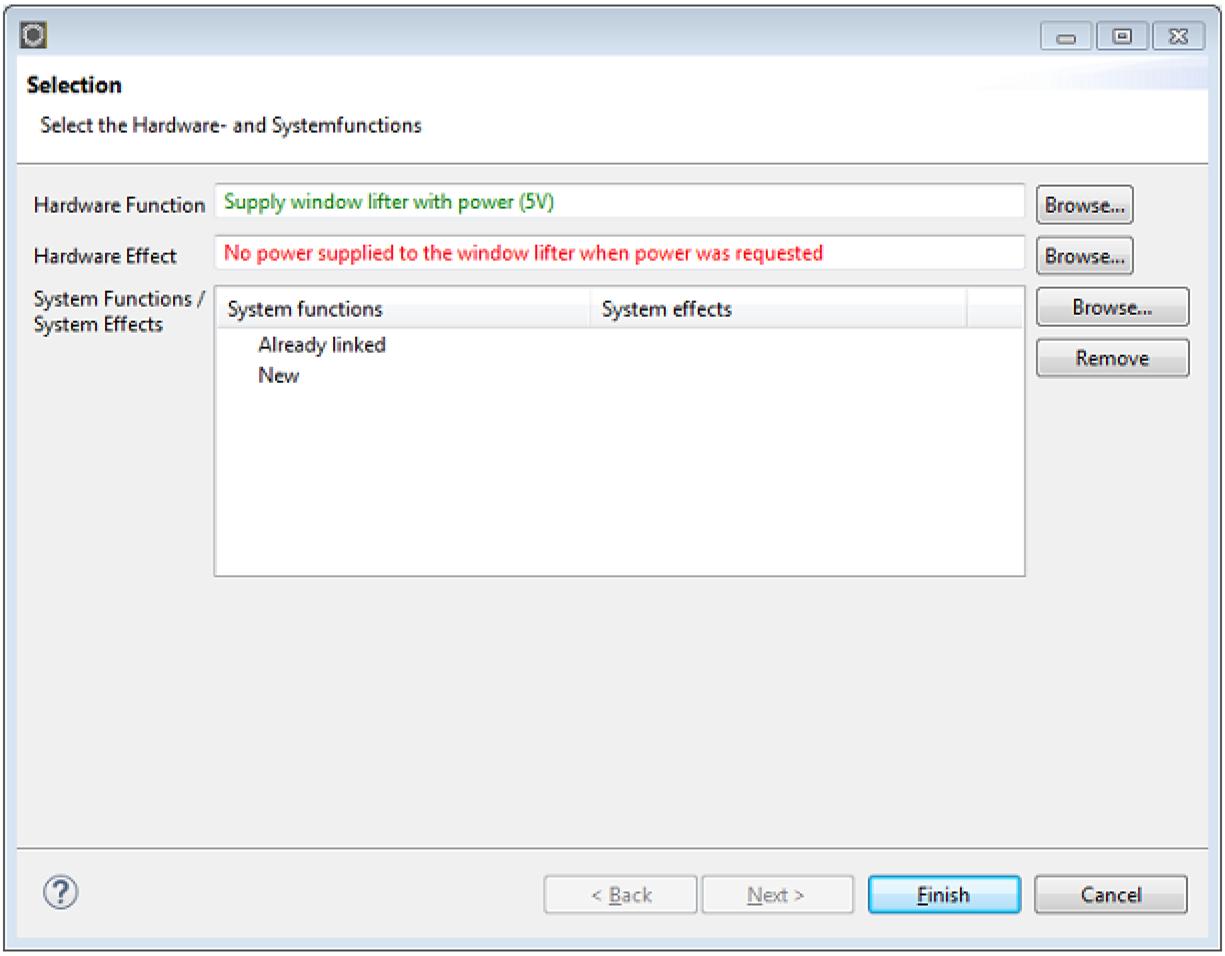
A dialog will ask if you want to add the effect to the FMEDA or replace it:



Do you want do add or replace the effect?

fig. Dialog "Replace effec"t

Then the "Selection" wizard opens. With the buttons **Browse...** select the required effects and functions.



Selection

Select the Hardware- and Systemfunctions

Hardware Function: Supply window lifter with power (5V)

Hardware Effect: No power supplied to the window lifter when power was requested

System Functions / System Effects

System functions	System effects
Already linked	
New	

fig. "Selectio"n wizard

When you are done, click **Finish**.

The hardware effect with the respective HE function, the corresponding system effect with the related SE function and the related safety goals will now be listed in the FMEDA.

Linking FMEA with RM

You can create requirements for each element from the FMEA by right-clicking on them, or you can drag & drop already existing requirements from an RM document (from your project) into the FMEA.

Note that the cursor changes when it is above an element that you can link the requirement to: Next to the cursor a rectangle with an arrow inside appears.

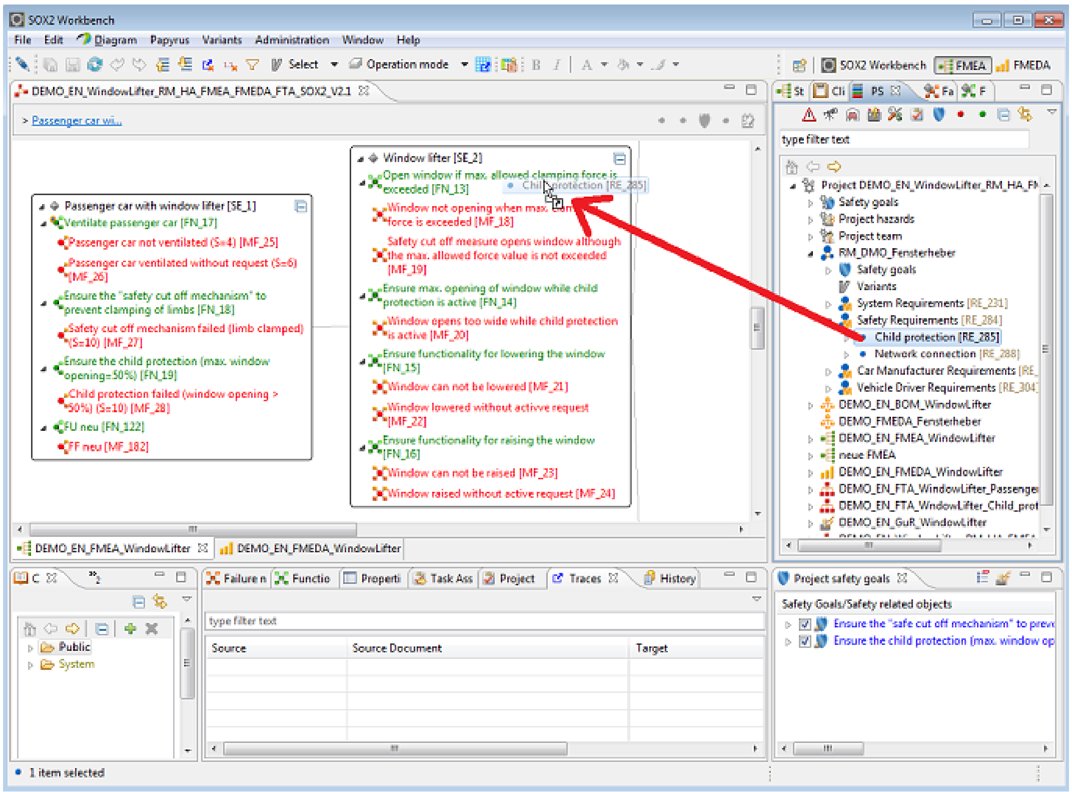
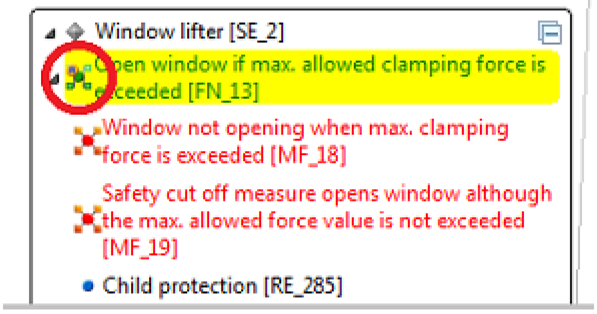

SOX2 Workbench
File Edit Diagram Papyrus Variants Administration Window Help
Select
Operation mode
DEMO_EN_WindowLifter_RM_HA_FMEA_FMEDA_FTA_SOX2_V2.1
Passenger car with window lifter [SE_1]
Ventilate passenger car [FN_17]
Passenger car not ventilated (S=4) [MF_25]
Passenger car ventilated without request (S=6) [MF_26]
Ensure the "safety cut off mechanism" to prevent clamping of limbs [FN_18]
Safety cut off mechanism failed (limb clamped) (S=10) [MF_27]
Ensure the child protection (max. window opening=50%) [FN_19]
Child protection failed (window opening > 50%) (S=10) [MF_28]
FU neu [FN_122]
FF neu [MF_182]
Window lifter [SE_2]
Open window if max. allowed clamping force is exceeded [FN_13]
Child protection [RE_285]
Window not opening when max. clamping force is exceeded [MF_18]
Safety cut off measure opens window although the max. allowed force value is not exceeded [MF_19]
Ensure max. opening of window while child protection is active [FN_14]
Window opens too wide while child protection is active [MF_20]
Ensure functionality for lowering the window [FN_15]
Window can not be lowered [MF_21]
Window lowered without activve request [MF_22]
Ensure functionality for raising the window [FN_16]
Window can not be raised [MF_23]
Window raised without active request [MF_24]
SOX2 Workbench
FMEA
FMEDA
type filter text
Project DEMO_EN_WindowLifter_RM_HA_FMEA
Safety goals
Project hazards
Project team
RM_DMO_Fensterheber
Safety goals
Variants
System Requirements [RE_231]
Safety Requirements [RE_284]
Child protection [RE_285]
Network connection [RE_288]
Car Manufacturer Requirements [RE_
Vehicle Driver Requirements [RE_304]
DEMO_EN_BOM_WindowLifter
DEMO_FMEDA_Fensterheber
DEMO_EN_FMEA_WindowLifter
neue FMEA
DEMO_EN_FMEDA_WindowLifter
DEMO_EN_FTA_WindowLifter_Passenger
DEMO_EN_FTA_WindowLifter_Child_prot
DEMO_EN_GuR_WindowLifter
DEMO_EN_FMEA_WindowLifter
DEMO_EN_FMEDA_WindowLifter
Public
System
Failure n
Functio
Properti
Task Ass
Project
Traces
History
type filter text
Source
Source Document
Target
Project safety goals
Safety Goals/Safety related objects
Ensure the "safe cut off mechanism" to preve
Ensure the child protection (max. window op
1 item selected

fig. Linking FMEA and RM

If you have dragged a requirement to an element in the FMEA, the respective element symbol will be marked with a small R. This indicates the link to a requirement in the RM module:

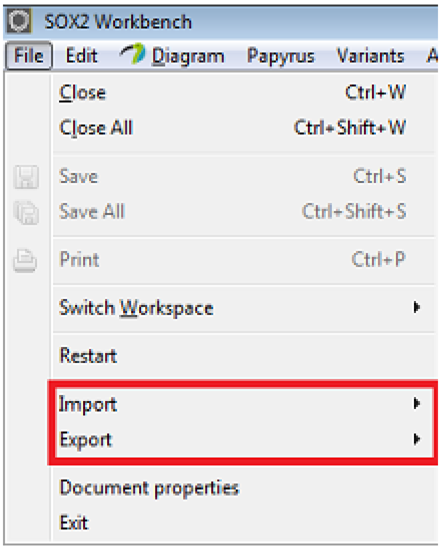

Window lifter [SE_2]
Open window if max. allowed clamping force is exceeded [FN_13]
Window not opening when max. clamping force is exceeded [MF_18]
Safety cut off measure opens window although the max. allowed force value is not exceeded [MF_19]
Child protection [RE_285]

In the "Traces" view you can get an overview of your links related to the selected element.

Import-Export of FMEA Files

SOX offers you the possibility to either import existing FMEA files or to export documents created with SOX. Note that SOX gives you options to fit the import to your needs!

You will find these options in the FMEA editor under the tab **File**:



Importing FMEA Files

Import an already existing MSR FMEA document, either through the menu bar or in the repository view.

Go the repository view in the workbench perspective, then make a right-click and choose the option **Import**. This will open the "Import" wizard:

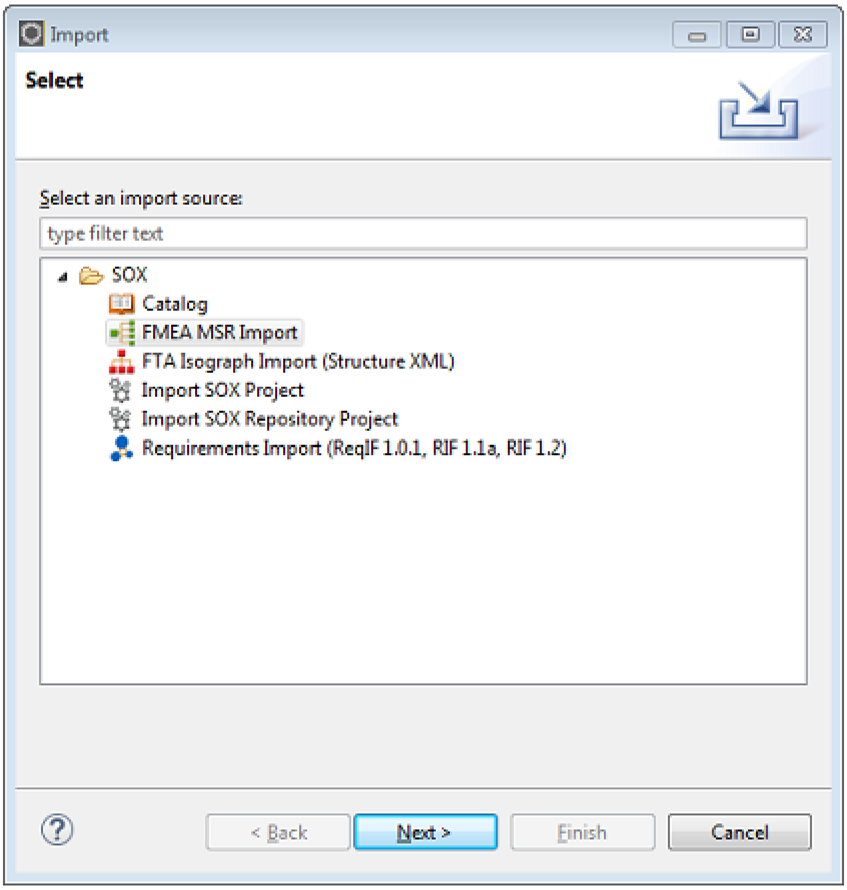


fig. "Impor"t wizard

Choose "FMEA MSR Import", then click on **Next >**.

Now you can select an FMEA document in XML format. Afterwards, the FMEA documents created within this file will be displayed. By selecting one of these documents, you can then import the file.

This dialog also offers the following check boxes:

Malfunction nets

Malfunction nets will be imported.

Check input

The input of the selected document will be checked.

RPNs

The Risk Priority Number of the document will be adopted.

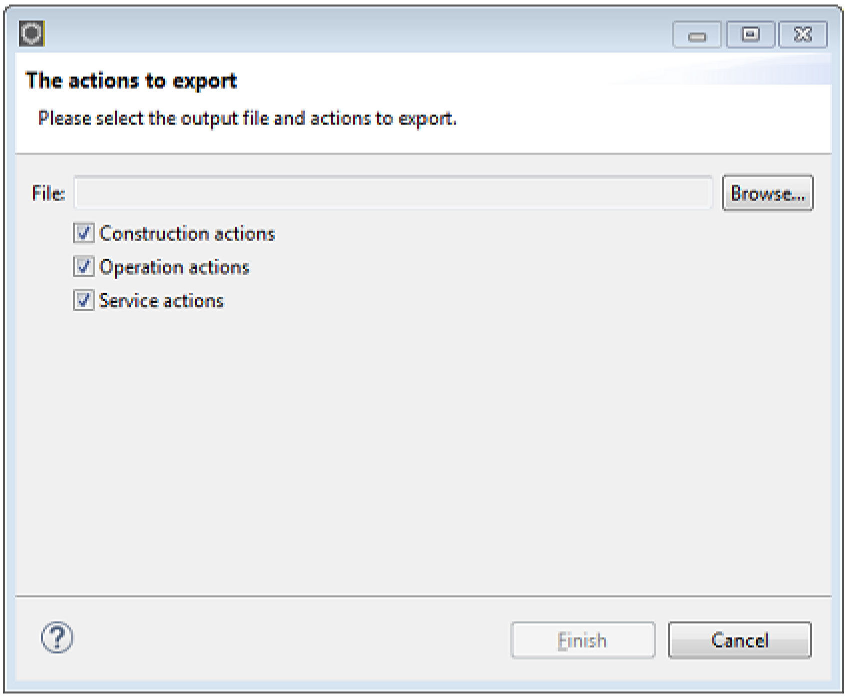
Add tasks to

The tasks of the imported document will be adopted. You can then decide which layer the tasks shall be assigned to.

Exporting FMEA Files

You can export the currently selected document as an MSR FMEA document. In the menu bar, go to File > Export MSR FMEA.

This opens the following dialog:



The actions to export

Please select the output file and actions to export.

File:

☑ Construction actions

☑ Operation actions

☑ Service actions

fig. MSR export dialog

Here you can define the output location for the file you want to export. Furthermore, you can decide whether and from which layer actions will be exported.

Saving a System-Process Element as a New FMEA

Saving one of your system- / process elements as a new FMEA:

1. Right-click on the system- / process element.
2. Choose **Save as new FMEA**.
3. Select the target folder and the file name.
4. Click on **Finish**.

→ A new, independent FMEA document has been created, which displays your system element as a root element.

Linking two FMEA Documents

Via the project system structure view (PSS) you can link different documents with each other. You have these possibilities:

- You can drag a system- / process element from another FMEA document onto one of your current system- / process elements in order to interlink them.
- You can drag any function from the PSS and drop it onto any desired system- / process element in order to assign this function to the system- / process element.

  All related malfunctions are automatically dragged along as well.
- In the same way you can also drag diagnoses, malfunctions, safety goals, product characteristics and process characteristics into your existing document.

Using Control Plans

A control plan is a detailed document linking manufacturing process steps to key inspection and control activities. A control plan lists all product and process inspection points required to deliver a defect-free outcome, and is essential for maintaining process control over the long run.

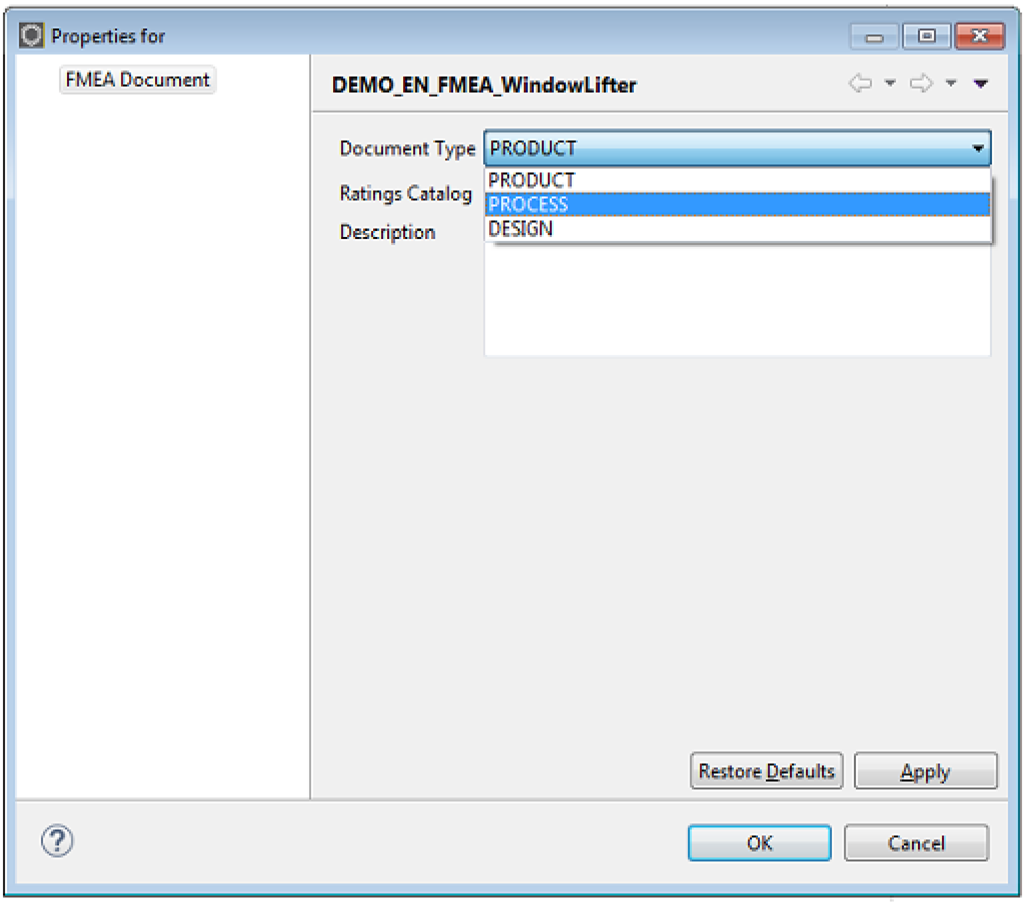
A control plan is usually developed based on an existing process or system structure.

Creating a Control Plan

Note

To be able to generate a control plan, the document type of the structure has to be PROCESS.

To change the document type, right-click somewhere in the FMEA editor. Then select **Document Properties** (or in the menu bar: **File** > **Document properties**). The properties dialog will appear. Choose the document type PROCESS. You can also change the document type by right-clicking on the FMEA project name (under the FMEA file of the project while in the SOX Workbench/PSS view) and then selecting **Properties**.



Document Type: PRODUCT

fig. Document properties dialog

To create a control plan at least one process element must be defined in the FMEA editor. To create a control plan, go to the FMEA editor and right-click on the desired process element. Then choose **Control Plan**. You can also select multiple process elements by keeping the **Ctrl** key pressed down while clicking on the process elements.

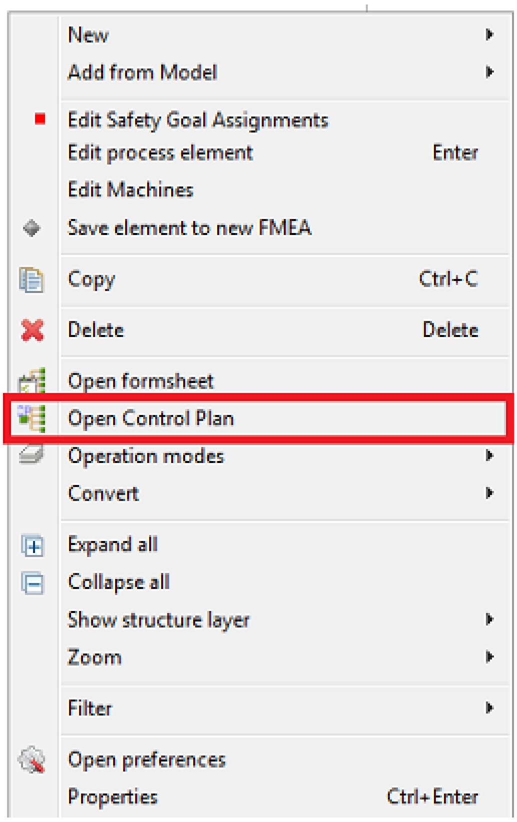
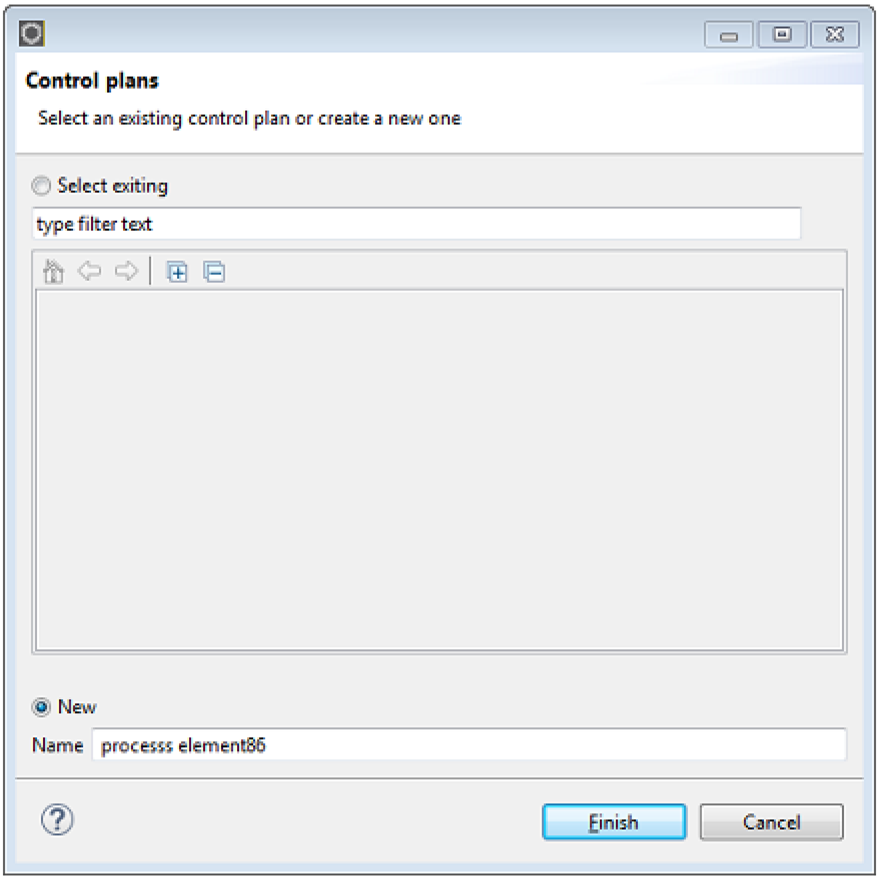


fig. Context menu on process element

A dialog will appear, in which you can choose between already existing control plans or create a new one:



Control plans

Select an existing control plan or create a new one

○ Select exiting

type filter text

● New

Name: processs element86

fig. Control plan dialog

Select an existing control plan or create a new control plan by entering a name. Then click on **Finish**.

→ The control plan opens.

Filtering and adjusting the Display of the Control Plan Editor

You can change the appearance of the control plan. In the right upper corner you have to following options:

- **Show/Hide comments**

  Shows or hides the comments

- **Elements on/off**

  Shows or hides the elements

- **Functions on/off**

  Shows or hides the functions

- **Background for tasks on/off**

  Turns the color of the background for the tasks´ status on or off

- **Show/Hide responsibilities**

Shows or hides the responsible persons regarding control method and reaction plan

Note that there are options in the preferences menu regarding the Control Plan editor: showing and hiding responsibilities and comments and adjusting the layout to fit the window width.

Editing a Control Plan

In a control plan table you can edit all fields that are already labeled by double-clicking on them.

In the left upper corner of the table you find check boxes for "prototype", "prelaunch" and "production".

Adding-Removing Process Elements

Adding new process elements to a control plan:

You can add a new element to the control plan in two ways:

- directly in the control plan

- in the FMEA editor by right-clicking on a process (parent) element and selecting **New** > **System/ Process element**.

If the control plan is created from the root element, all the changes will automatically be visible in the control plan.

Removing process elements from a control plan:

You can remove a process element from the control plan by right-clicking on it and selecting **Delete elements.**

You can also delete an element by clicking on it and then pressing the **del** key (**delete)**.

Changing the Name of a Control Plan

You can change the name of the control plan by finding the control plan file in the PSS view and double-clicking on it.

The control plan file can be found in the **PSS view** in your project under the name of the FMEA file and then under **Control Plans**.

Editing Process Number-Process Description-Machines

Editing the Part/Process Number:

To edit the part/process number directly in the control plan, double-click on the field "Number" in the control plan. The number will then be highlighted and you can edit it by typing a number. Click somewhere else on the screen to save the changes.

The process number is automatically generated when you create the project. A corresponding number is then assigned to the system/process elements and their functions. If you change a part/process number, the number of all child-elements / functions will be changed and adjusted to the parent's number.

Adding /Editing a Machine directly in the control plan:

To add a new machine to your process element, right-click on the process element. Then go to **New > Machine**.

Note that machines must be defined in a catalog for assigning machines to the process element.

If the machines catalog is empty click on **New**. A dialog will appear where you can enter the name of the machine.

In the "Catalog" field, you can rename any machine by double-clicking on it. You can also delete a machine by selecting it and then clicking on **Delete**. To save the changes click on **OK.**

If you click on **Restore Defaults** any unsaved changes will be lost.

You can enter more than one machine for each process.

Adding-Editing Characteristics

Adding Characteristics in the Control Plan:

You can add product characteristics by right-clicking on the process element and then on **New** > **Product Characteristic**. A dialog will appear where you can enter the name of the characteristic and edit it.

To insert a process characteristic, you first have to create a sub-process element (child-element). Then right-click on the sub-element and choose **New** > **Process characteristic**. Product characteristics are for the element itself, while process characteristics belong to the sub-element.

Editing Characteristics in the Control Plan:

To edit an already existing characteristic you can either click on it and press **Return** or you can right-click on it and then click on **Edit Process/Product Characteristics**.

If you only want to rename the characteristic, you can double-click on it.

Editing Classification

To edit the field "Classification", you can just double-click on it. A drop-down list will appear where you can choose the classification of the element.

You can also right-click on it and then select **Edit classification**.

Adding-Editing Specifications

Adding/Editing Specifications directly in the Control Plan:

In order to edit the field "Specification", the system/process element has to have a product or process characteristic.

To edit a specification, right-click on the field "Specification" and select **Edit specification**. A pop-up dialog will appear where you can edit the specification. You can only add a specification if your process element has a product/process characteristic.

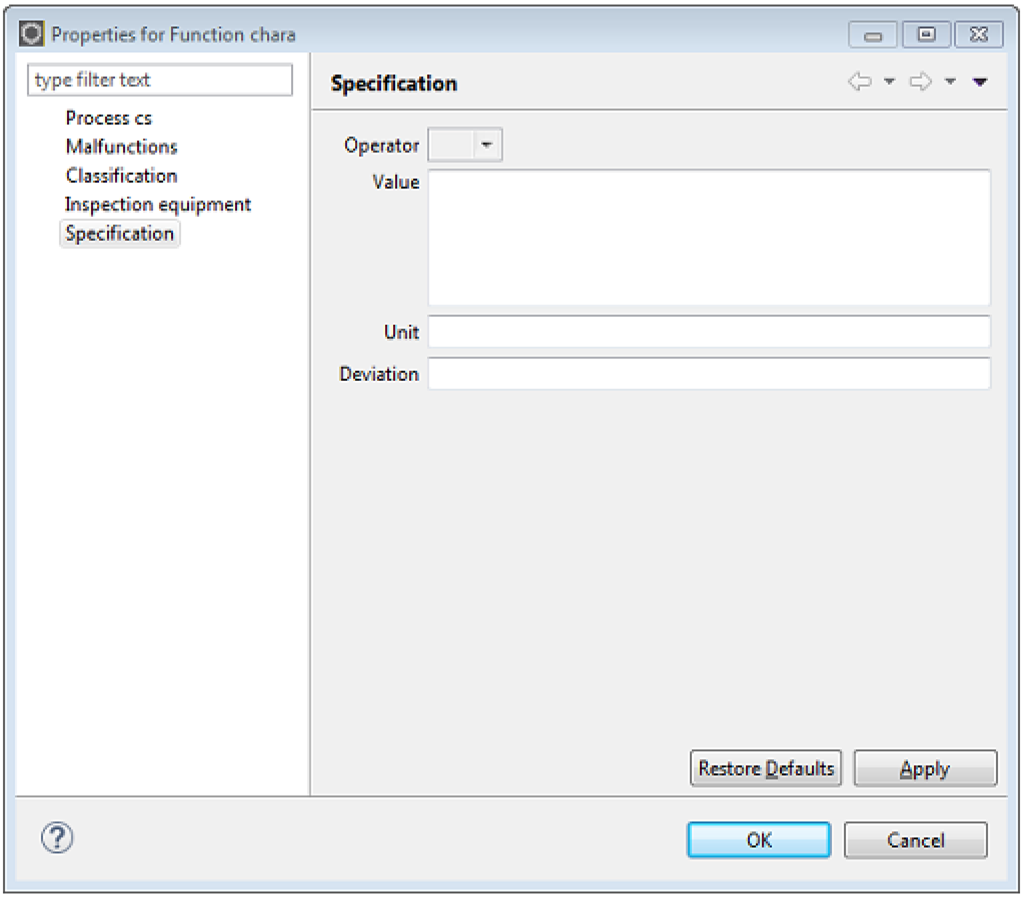


fig. "Properties for functio"n dialog

Adding/Editing Inspection Equipment directly in the Control Plan:

In order to add an inspection equipment in the control plan, right-click on the field "Specification" and select **Edit inspection equipment**.

You can then edit the inspection equipment by double-clicking on it or right-clicking on it and then selecting **Edit inspection equipment**.

Adding/Editing Responsibilities:

You can edit the field "Responsible" by double-clicking on it. A drop-down list will appear with your team members. Then you can select the person, the process is assigned to, by clicking on their name. You can only edit the field "Responsible" if the field "Specification" is labeled.

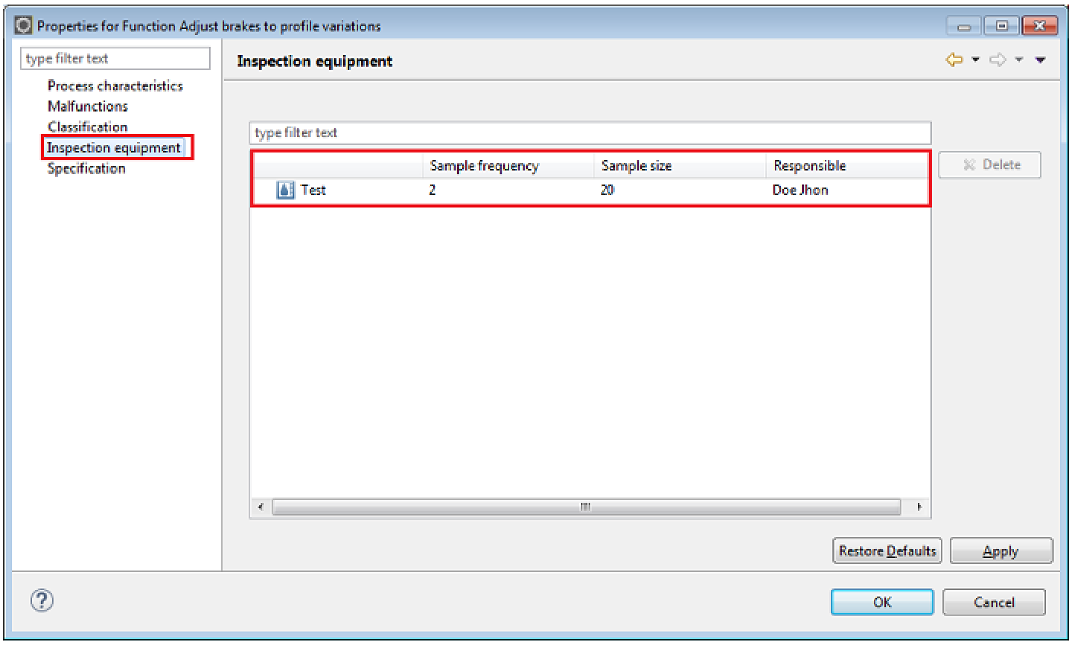
Responsible persons are linked with the employee catalog in the catalogs view. So if you want to set responsible persons to prevention and detection actions you have to create a employee catalog.

Adding Inspection equipments:

Note that inspection equipments are stored in a inspection equipment catalog in the catalog view. So if you want to assign an inspection equipment you have to create a inspection equipment catalog.

Right-click on the process characteristics and choose New > Inspection equipment. A dialog appears where you can assign the inspection equipment.

For editing responsible, samples, size & frequency use the inspection equipment dialog.



	Sample frequency	Sample size	Responsible
Test	2	20	Doe Jhon

fig. Inspection equipment dialog.

Creating and Editing Control Methods and Reaction Plans

Prevention and detection actions can be assigned to process/product characteristics. They will then become visible in the control plan as control methods (detection actions) and reaction plans (prevention actions).

Note

In order to assign an element characteristic to a control method and/or a reaction plan, you have to assign an action group first. Action groups can only be assigned to malfunctions.

Entering Control Methods and Reaction Plans using the PSS

You can also enter new tasks using the PSS view. Go to your project and unfold the root element. Then unfold the element which you want to assign a task to. Find the process/product characteristic and the corresponding malfunction and right-click on it. Then select **New** > **New Action Group**.

A dialog will then appear where you can define a new action group (already defined action groups will be visible under **New Action Group**). Now you can unfold the malfunction and there you can unfold the action group, too. Right-click on **Construction actions** and then select **New Prevention/ Detection action**.

A dialog will appear. There you can define the name of the task, and optionally enter a description, a status (depending on the status of the task, the field in the control plan will be in a different color), priority, date the task was created/finished and/or deadlines and an assignee. Click on **Finish** at the bottom of the dialog when ready. The task will now become visible in the control plan.

Editing Control Methods and Reaction Plans

To edit an already existing control method or reaction plan, right-click on the task in the control plan. Then click on **Edit**.

You can also click on the task and then press **Return**.

Or you can go to the PSS view and there unfold all the relevant functions until you find the **Construction actions**. There you can right-click on the action, and then on **Edit**.

Printing Form sheets and Control Plans to PDF and Excel

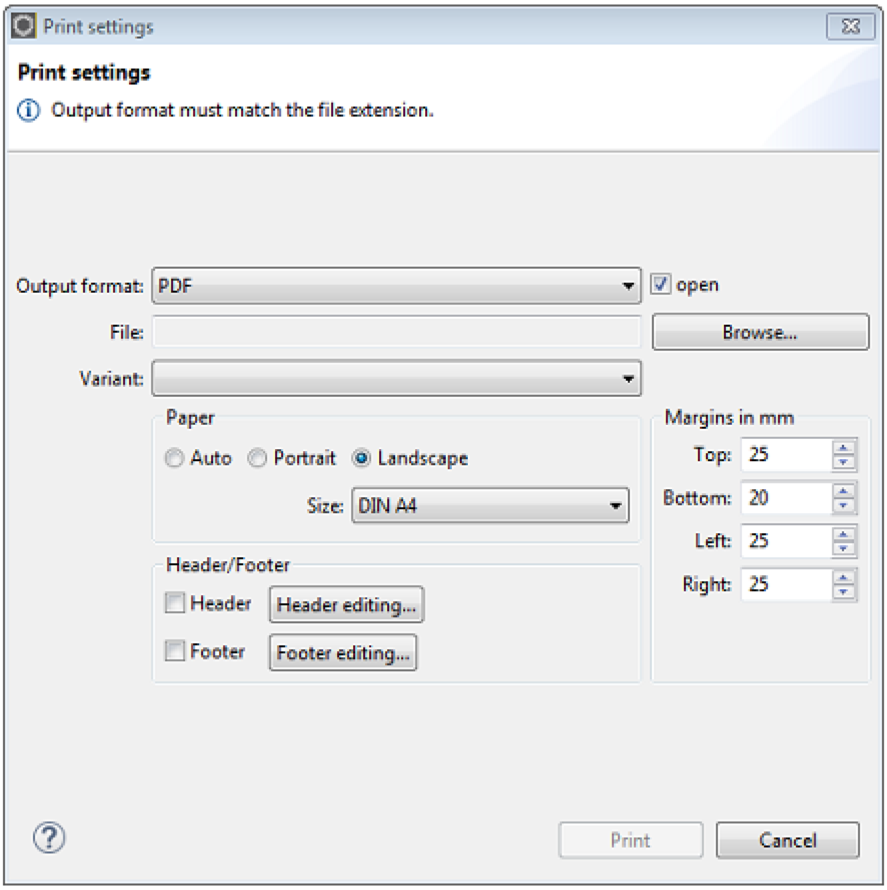
You can print form sheets and control plans to PDF format and Microsoft Excel.

Printing a PDF file:

Prerequisites: A form sheet or a control plan needs to be open.

1. Go to the menu bar and click on **File**.
2. Choose **Print**.

   ► The "Print settings" dialog opens.



Print settings

Print settings

ⓘ Output format must match the file extension.

Output format: PDF ☑ open

File:

Variant:

Paper

○ Auto ○ Portrait ● Landscape

Size: DIN A4

Header/Footer

☐ Header

☐ Footer

Margins in mm

Top: 25

Bottom: 20

Left: 25

Right: 25

fig. "Print setting"s dialog

3. Choose the output format (PDF or Excel).
4. Choose whether you want the printed file to immediately open after generating the output file.
5. Click on **Browse...**.

   ► The Windows file manager opens.

6. Choose a folder and enter a name, then click on **Save**.
7. Choose a variant if you have one.
8. Set the orientation of the content on the sheet and its size.
9. Set the margins.

10.You can enter text to appear as a header or a footer (optional).

11.Click on **Print**.

→ A new file has been created and saved to the chosen location. If you chose **Open**, the file will open automatically.

Printing a file for Microsoft Excel:

This works the same as printing a PDF file except you cannot enter a header/footer or choose a margin.

Inheritance of ASIL Level

If the ASIL level changes anywhere in the SOX project, this level gets passed on along the failure net. This happens across the different modules of SOX. Here is an example: You change a severity rating in the Hazard Analysis module. The HA module now calculates a new ASIL level for the associated safety goal. You have used the same safety goal in the FMEA module, so the new ASIL level also changes in the FMEA module and it gets passed along the failure net.

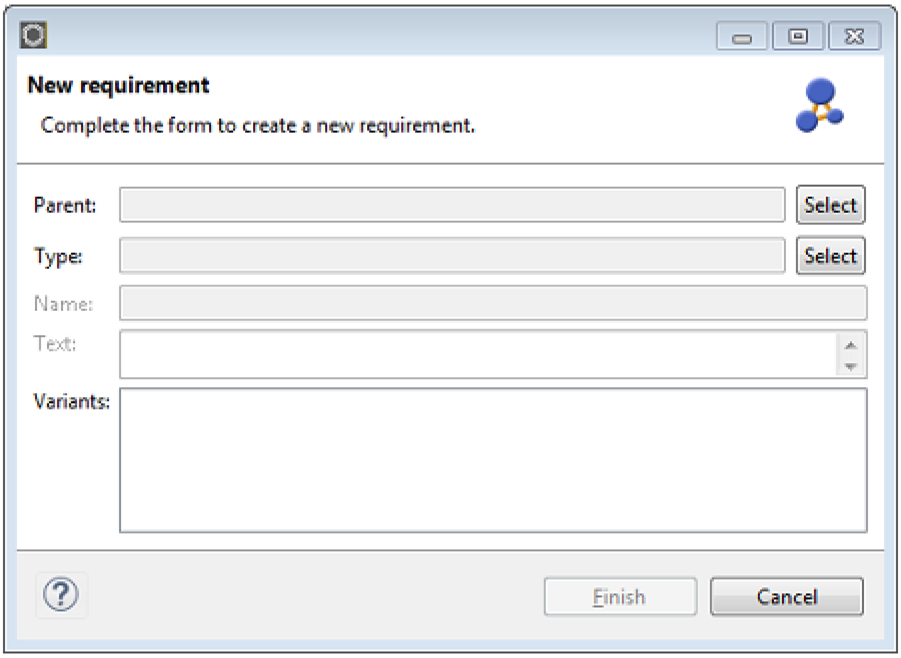
Creating new Requirements

To create a new requirement, right-click on a function or system/characteristic and choose **New** > **New Requirement and Trace**.

Requirements consist of a certain number and kind of characteristics and attributes.

These attributes can be summarized as a type of requirement. Every requirement needs to be assigned to a type of requirement.

To create and edit requirements, the following dialog will open:



New requirement

Complete the form to create a new requirement.

fig. Dialog "New requiremen"t

Here you can edit the characteristics of a new requirement. These include:

- **Parent node:**

  Desired parent node of the new requirement. In this field, you can choose between all previously created requirement parent nodes of the selected project. If there is no selection available, you have to create a module first.

- **Type**:

  Desired type of the new requirement. In this field, you can choose between all previously created types of requirements.

- **Name:**

  Name of the new requirement. (This field will be inactive in case the chosen type does not have an attribute with the name ReqIF.Name.)

- **Text:**

  In case the type of the new requirement allows it, you can enter a text about the requirement here.

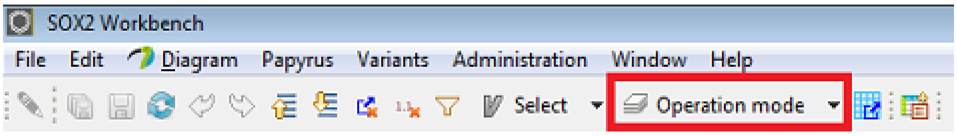
- **Variants:**

  Here you can assign the new requirement to a variant.

Complete the process by clicking on **Finish.**

Operation Mode

In the toolbar you can choose an operation mode (construction, operation, service).



You can include or exclude elements with one operation mode at a time.

That means, in case a malfunction no longer has an effect in operation due to defined diagnoses and Diagnostic Coverage (DC), this malfunction can be excluded for operation. The malfunction is thus marked as inactive.

To do that, you go to the context menu (right-click on a malfunction) and click on the option **Operation modes** where you can then choose between the following possibilities:

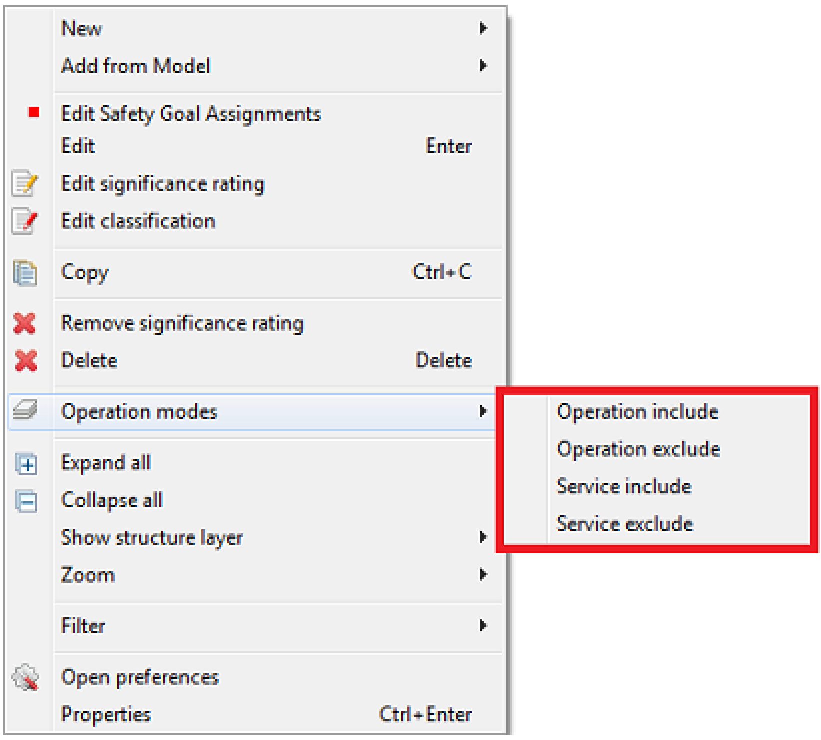


fig. Context menu on malfunction

If you have for example excluded a malfunction for operation, this malfunction will be marked with "(Ox)" before it´s name. When switching to the operation mode, this malfunction will be grayed out (i.e. deactivated).

Adding from Model

If you added an object (system element, function etc.) in the System Design module, you can quickly and easily add this object to another object in the FMEA module.

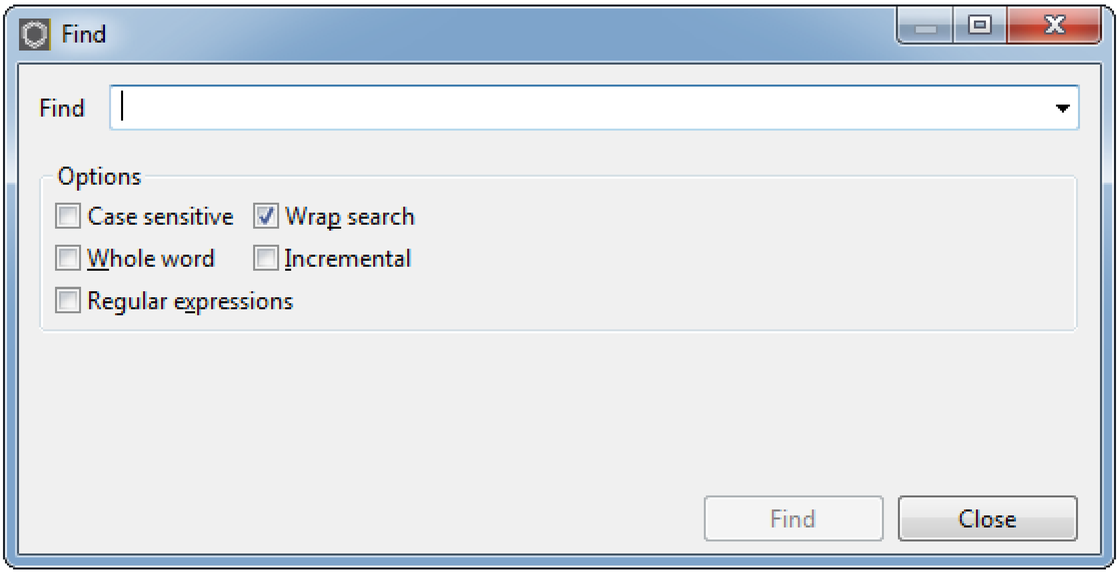
You can do this in the FMEA editor and in all the views:

1. Right-click on the object that you want to add the new object to.
2. Choose **Add from Model**.
3. Choose the respective object or choose **Add all**.

→ The object from the System Design has been added to the FMEA.

Text Find Function

You can use the text find function by using the shortcut **Ctrl** + **F.** This function is possible for the FMEA Editor, Failure net and Function net.



Find

Find

Options

☐ Case sensitive ☑ Wrap search

☐ Whole word ☐ Incremental

☐ Regular expressions

fig. Find dialog.

Activate a checkbox for using different search algorithm.

HARA User Guide

Introduction

Hazard and Risk analysis. The HARA module of SOX supports you in listing your security needs and assembling safety reviews.

SOX provides you with the following norms for determining the safety level according to the level definitions from each respective norms.

- ISO 26262 Automotive Safety Integrity Level (ASIL)
- ISO 26262 Motorcycle Safety Integrity Level (MSIL)
- IEC 61508 Safety Integrity Level (ASIL)
- IEC 13849 Performance Level (PL)
- ISO 25119 Agricultural Performance Level (AgPL)

You can work with different variants and operation statuses.

Step-by-Step-Guide

This guide leads you step-by-step through the creation of a Hazard and Risk Analysis.

Creating a new HARA file

Precondition: A SOX project was created and the workbench perspective is active.

1. Go to the Repository view and right-click on the HARA folder in your project.

   fig. New HARA File context menu.

2. Choose **New > New HARA File**

   ► The "New HA file" dialog opens.

   fig. New HA file dialog.

3. Click on **Browse...** and choose HARA as target folder.
4. Enter a filename for the HARA file.
5. If you have already created system elements, you can assign them by clicking the **Add...** button.

   ► The Add system elements dialog opens.

   fig. Add system elements dialog.

   This dialog shows all your created system elements of your project [1]. Select the desired elements and click **OK** (multiple selection is possible). With the plus icon [2] you can create new system elements.

Note

System elements, functions and malfunctions are necessary for a hazard and risk analysis. In the chapter System Designer Exemplary Method for Designing the System Structure you can find more information about designing a system (creating system elements, functions and malfunctions in the System Designer) and using them for the HARA.

6. Choose the safety level specification according to the Norm.

Note

Please contact us if you need customized profiles for norm catalogs. If not, choose a (Standard) profile or leave the field empty.

7. The Description, Objective and Foundation fields are optional and can be used for detailed descriptions of your hazard document.

8. Click **Finish.**

→ A HARA file will be created and added to the HARA folder.

Creating System Elements

You can create system elements in the Repository and Model Explorer view by adding system elements to your project. There is also the possibility to create system elements directly at the HARA editor or using the Add system element dialog which can be opened at the "HARA document properties" or at the context menu of "Rated system elements" in the Overview view.

The following procedure is an example for creating a system element at the HARA editor.

Precondition: A HARA file was created and is active.

fig. HARA editor tool bar add empty rating.

1. Add an empty rating by clicking the plus icon at the HARA editor tool bar.

   ► A new row (rating) appears.

2. Make a double-click into the Element cell and type in a name for the system element.

   (The drop down menu shows already assigned system elements.)

→ The system element will be added as object to your project and assigned to the HARA document.

Creating Functions

You can create functions in the context menu of system elements. The context menu is available in every view in which a system element exists. For example: Editor, Overview, PSS, Repository,.... You can also create functions directly in the HARA editor by clicking into the according function cell.

The following procedure is an example for creating a function in the Overview view of the Hazard Analysis perspective.

Precondition: System elements were created and the Hazard Analysis perspective is active.

1. Go to the "Overview" view and make a right-click on the system element that should be provided with a function.

fig. New Function context menu.

2. Choose **New > Function.**

Note

A FMEA can be useful for a detailed analysis about possible functions and malfunctions. Select a system element, click on Create FMEA, choose FMEA as your Target folder and name the file. Now you can start the FMEA with the selected system element as root element.

▶ The Add dialog opens.

3. Name the function.

4. Click **OK.**

→ A function will be created and added to the chosen system element.

Creating Malfunctions

You can create malfunctions in the context menu of functions. The context menu is available in every view in which a functions exists. For example: Editor, Overview, PSS, Repository,.... You can also create malfunctions directly in the HARA editor by clicking into the according malfunction cell.

Precondition: Functions were created and the Hazard Analysis perspective is active.

1. Go to the "Overview" view and make a right-click on the function which should be provided with a malfunction.

fig. New Malfunction context menu.

2. Choose **New > Malfunction.**

Note

A FMEA can be useful for a detailed analysis about possible functions and malfunctions. Select a system element, click on Create FMEA, choose FMEA as your Target folder and name the file. Now you can start the FMEA with the selected system element as root element.

▶ The Add dialog opens.

3. Name the malfunction.

4. Click **OK.**

→ A malfunction will be created and added to the chosen system element.

Adding Situation Parameters and Effects

Note

SOX provides catalogs which contain standard values for the situation parameters. But you also can define individually catalogs and values. Read the chapter Customized Choice Lists for more information.

Precondition: System elements, functions and malfunctions were created.

fig. HARA editor Add ratings button

1. Click the Add ratings button in the editor tool bar

   ► A new row (rating) appears.

2. Make a double-click into the element cell and select a system element.
3. Make a double-click into the function cell and select a function.
4. Make a double-click into the malfunction cell and select a malfunction.
5. Edit the values of situations by editing the according cell with a double-click into it.

   ### Note

   Manually entered values of the situation parameters will be labeled with a pen and stored in a catalog which is local to the current project. The local project catalogs can be accessed from the Catalogs View.

   fig. Manually entered value.

   Note that content of local project catalogs is only available to the project itself. If you want to re-use the catalog content it needs to be moved to a public catalog.

   fig. Context menu Move to.

   Or you can use the "Add permutations" function.

6. Click on **Add permutations** .

   ► The permutation matrix definition dialog opens.

   fig. Permutation matrix definition dialog

7. Select at least one malfunction (system elements and functions that are assigned to malfunctions) which should be provided with situation parameters.

   Click the **Restore last selections** button if you want selection settings from earlier permutations.

8. Click on the Add\Remove catalogs button to select the default SOX choice lists.

   ► The choice lists dialog opens.

   ### Note

   You can also edit the values with clicking the **Edit catalogs** button. You can make new entries or edit already existing values. If you are editing values of catalogs which are stored in the public folder (Global), the changes will be applied in all other projects and documents where the value is used. The available catalog is displayed in bold letters.

   Project catalog: This catalogs are stored together with the project. They are not available to other projects. If you want to make their content available for other projects you need to move the content to a public catalog.

9. After choosing the desired choice list, you can now select the items which are to be considered for the permutation.

10. Click **Next.**

    ► The select permutations dialog opens in which all possible permutations according to your selection are listed.

11. Select your desired permutations

12. Click **Finish.**

    → All selected permutations will be created and added to the HARA document.

Evaluation of the Safety-/Performance Level

- **For ISO26262 (ASIL or MSIL)**

  Evaluations for S (severity), E (exposure) and C (controllability).

- **For IEC61508 (SIL)**

  Evaluations for S (severity), A (presence), G (avoidance), W (probability of endurance).

- **For IECI3849 (PL)**

  Evaluations for S (severity), F (presence), P (avoidance).

- **For ISO25119 (AgPL)**

  Evaluations for S (severity), E (exposure), C (controllability)

Make a double-click to into the cell to edit the according value. For reason, effect and hazard parameters there is the possibility to create customized choice lists.

The following procedure shows how to use customized choice lists for reason parameters.

Precondition: A HARA document was created and a rating was added.

1. Double-click into the reason cell.

2. Choose **Select choice list...**

   ► The choice list selection dialog opens.

3. Select your desired choice list.

4. Click **OK.**

   ► The values of the choice list are now available at the drop down menu of the reason cell.

5. Double-click again into the reason cell.

6. Select the desired value.

→ The value for the reason cell and the according E-Value will be added to the rating.

Creating Safety Goals

In the "PSS" view or in the "Overview", make a right-click on **Safety Goal** and choose **New** > **New safety goal**.

Or make a right-click anywhere in the "Project safety goals" view.

The "New safety goal" dialog opens:

---

fig. Dialog "New safety goa"l

Enter at least a name and a safe state. Then click on **OK**.

The User Interface

Below you see all the standard views in the HA perspective. Remember that you can always (re-)open views by going to the menu bar and clicking **Window** > **Show View**. You can also arrange the views with drag & drop.

---

fig. The User interface of the HARA module

[1] HARA editor

[2] Overview / PSS

[3] Project safety goals

[4] Relationship matrix / Properties / Task Assignments / Project tasks / Traces / History

[5] Model Explorer / Catalogs / Object list

The HARA Editor

The HA editor shows a table with malfunctions that are assigned to functions and certain situations.

Then these malfunctions get effects and the effects get hazards. These hazards are then evaluated according to the norm you have chosen when creating the HARA document:

You add safety goals and then their safe states are shown.

You can rate the priority of each line in the "Priority" column: i star (low), 2 stars (medium), 3 stars (high priority).

You get a drop-down menu that lets you choose an entry for the cell, by clicking on a cell in the table and then clicking on the triangle that appears.

if you right-click in the editor, a context menu opens:

---

fig. Context menu in the HA editor

You can add tasks and comments, and copy the selected element.

With **Add rating**, a new rating with the selected system element will be added.

With **Change State** you can change the state of the selected rating according to the state machine rules.

With **Delete rating** you can delete the selected rating.

With **Set "No effect"** you can provide the rating with no effect ► The rating will be greyed.

With **Transfer ratings to other malfunctions** you can transfer the ratings to other already created malfunction with no ratings.

The Situation Matrix

The situation matrix represents the connection between malfunctions and operational situations and can be opened with the "Open situation matrix" icon at the HARA editor tool bar.

fig. Icon "Open situation matri"x.

You can de-select a malfunction from a situation:

fig. Situation matrix.

Click into the check box. The "delete related ratings" alert opens:

fig. Alert "delete related rating"s

The Overview View

The view "Overview" is similar to the "PSS" view, but concentrates on the HA documents.

Here (and in the "PSS" view) you can create new functions, malfunctions. You can also create new system elements, functions, malfunctions, hazards and safety goals.

Additional Functionality

Customized Choice Lists

Customized choice lists are catalogs for working modular. This means the catalog are stored on the server (global) and can be used by all users. So if you change this catalogs, this effects on all projects and documents in which the catalog is be used. But you also can use the catalogs only on your local system.

fig. Choice list selection dialog.

In this dialog you can select SOX and your created choice lists [2]. Your selection will be displayed at the according drop down menu of the displayed parameter [1]. With the **Add new catalog** button [3] you can create a new choice list.

fig. Catalog editor with choice list.

In this editor you can edit the choice list. The type [2] is necessary to assign the catalogs to the according parameter.

Table 1. Choicelist Types assigned to Category

Choicelist Type	HARA Situation Category
<sox2.ha.place>	Place

<sox2.ha.endangered.persons>	Endangered persons
<sox2.ha.driving.dynamics>	Driving dynamics
<sox2.ha.characteristics>	Characteristics

For adding new values select the language and click the plus icon on the right.

If you need your values in different languages, you can add your language with a right-click [1] and New > Language.

fig. Add language dialog.

Type in the country abbreviation and click **OK.** The chosen language will be added to the catalog.

FTA User Guide

Introduction

Calculate required probabilities in the SOX module FTA and track the progress of your analysis with the possibility to consign a status and to assign tasks. The SOX module FTA provides the possibility, besides the option to display variants, to take over hardware and system effects of the FMEA or failure modes from the FMEDA and to link them simply by drag & drop. Sources and effects of risks are therefore systematically identified and eliminated with appropriate countermeasures (e.g. diagnoses).

Step-by-Step-Guide

Creating a New File

Precondition: A SOX project was created and the Repository view is active.

1. In the Repository view, right-click on the FTA folder.
2. Choose **New > New FTA File** .

   ► The "New FTA file" dialog opens.

fig. Dialog "New FTA Fil"e

1. Click on **Browse...** to choose the target folder where the FTA file should be saved.
2. Choose a filename for the FTA file.
3. Choose the Mission Time (in hours) for this FTA.
4. Assign a Safety Goal for the FTA file. (Can be assigned later)
5. Assigned hazards can be selected with a check mark. (Can be assigned later)

→ An FTA file was created and added to the repository.

Now you can **drag & drop the objects** from the sidebar to **form a fault tree**, derive an FTA from an FMEA or use **single failures and components** from the FMEA **out of the PSS view.**

Importing an FTA

The XML structure (gates, events and their relations) of an IsoGraph FTA can be imported for a further analysis with SOX.

Precondition: A SOX project was created and the Repository view is active.

1. In the Repository view, right-click on the FTA folder.
2. Choose **Import**.

   ►The Import wizard opens.

fig. "Impor"t wizard

3. Choose **FTA Isograph Import (Structure XML)**.
4. Click **Next** >.

► The wizard switches to its next page.

fig. "Impor"t wizard page 2

5. Click on **Browse...** and choose FTA as the Target folder.
6. Click on **Browse...** and choose an FTA XML file.
7. Choose a filename for the FTA.
8. Click on **Finish**.

→ An FTA structure was imported.

Creating a Gate

Precondition: An FTA document is selected and the FTA editor is active.

1. To the right of the editor, in the column "Palette", click on the desired gate.

   ► The type of gate is selected.

2. Click in the editor.

   ►The gate dialog opens.

fig. Gate dialog

3. Choose a name for the gate. This will be **the name of the malfunction.**
4. Write a description (optional).
5. Click on **Color...** to adjust a background color.
6. Click on **OK**.

→ A gate with the malfunction was created.

Creating an Event

Precondition: An FTA document is selected, the FTA editor is active and gates were created.

1. To the right of the editor, click on the desired **Event**.
2. Click on a gate in the editor.

   ► The event dialog opens.

fig. Event dialog

3. Choose a name for the event.
4. Write a description (optional).
5. If necessary change the status of the event.
6. Type in the component life time in hours. **This will influence the probability calculations!**
7. Click on **Color...** to adjust a Background color.

8. Choose **Local Failure model** to crate a new failure rate value or choose **Document** to use a manually created failure model.
9. If necessary choose a common cause failure (CCF).
10. Click on **OK**.

→ An event was created.

Creating a Page Break

Note

Page breaks are useful to get a better overview over your FTAs. The page breaks will not influence the probability calculation of the whole system.

1. In the editor, right-click on the desired gate/malfunction (not event) where the page break should be.

   ► The context menu opens.

2. Choose **Create page break.**

   ► The page break will be shown as triangle.

3. Double-click on the triangle to open the page break.

4. Double-click on the triangle under the malfunction to get a level above.

Editing an FTA

The FTA can be edited on document, module and object level.

1. In the Repository view, right-click on an FTA document.

fig. Context menu for document properties

2. Choose **Document properties**.

   ► The Properties for dialog with th entries "FTA Document" and "FTA module" opens.

Document

fig. Dialog "Properties for FTA Documen"t

In this dialog the Mission Time in hours can be changed. The default value is 1.0E9 from the FIT calculation. If safety goals have been created, they can be assigned here or in the Safety Goals view.

Module

Note

The changes will be active for every FTA document.

fig. Dialog "Properties for FTA Modul"e

In this dialog the general FTA module properties can be changed.

Object

Right-click on a gate/event and choose **Properties**.

► The gate dialog opens.

►The event dialog opens.

If only the *type* of the object should be changed, right-click on a gate/event and choose **Change gate/ event type**.

fig. Context menu for changing gate/event type

Exporting as a Picture

Precondition: The desired FTA is open.

1. Right-click in the FTA editor.

   ► The context menu opens.

   fig. Context menu for exporting diagrams

2. Choose **Export Diagram...**

   ► The "Export Diagram" dialog opens.

   fig. Dialog "Export diagra"m

   Note: You can also export only one object, if you select the desired one and do a right-click on it.

3. Change the export preferences to your desire with the following image formatting possibilities:

   - BMP (Windows Bitmap)
   - GIF (Graphics Interchange Format)
   - JPG (Joint Photographic Experts Group)
   - PNG (Portable Network Graphic)
   - RLE (Run-Length encoding)
   - SVG (Scalable Vector Graphic) - the SVG-File will only be converted properly to PDF if Inkscape (File -> Save as...) is used - printing the file to PDF (with any tool) did not perform very well.

   Use a higher Scale-factor (Pixel), for a more detailed resolution.

4. Click on **OK.**

5. Choose a file path.

→ The FTA is exported with the chosen preferences.

Print

Precondition: The desired FTA has to be opened.

1. Right-click somewhere in the FTA editor.

   ▶ The context menu opens.

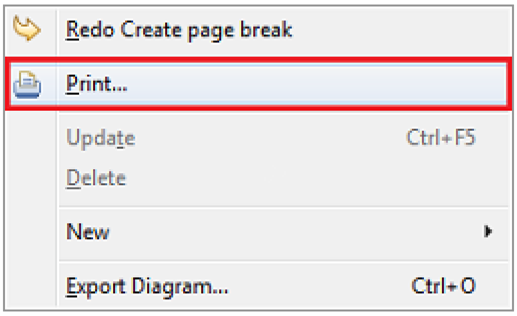
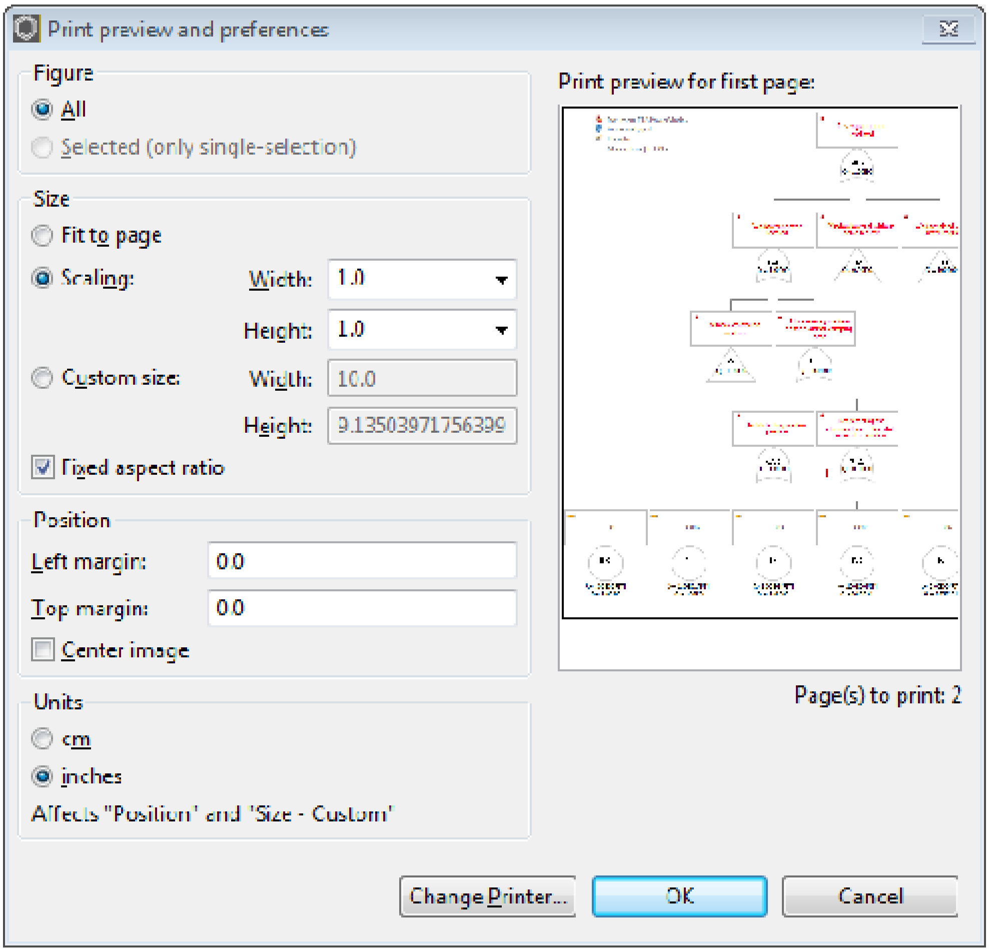


fig. Context menu for printing

2. Choose **Print...**

   ▶ The "Print preview and preferences" dialog opens.



Print preview and preferences

Figure
● All
○ Selected (only single-selection)

Size
○ Fit to page
● Scaling: Width: 1.0 Height: 1.0
○ Custom size: Width: 10.0 Height: 9.13503971756399
☑ Fixed aspect ratio

Position
Left margin: 0.0
Top margin: 0.0
☐ Center image

Units
○ cm
● inches
Affects "Position" and "Size - Custom"

Print preview for first page:

Page(s) to print: 2

fig. Dialog "Print preview and preference"s

3. Change the printing preferences to your desire.
4. Click on **OK**.

→ The FTA will be printed with the chosen preferences.

The User Interface

This is the default FTA perspective:

fig. The user interface

[1] PSS view, Project safety goals view

[2] Miniature View of the opened FTA document

[3] FTA Analysis View

[4] FTA Editor

[5] Sidebar

PSS/Project Safety Goals View

The Project System Structure view (PSS) gives you an overview of all documents that belong to the project.

fig. "PS"S view

The Project safety goals view shows all created safety goals of the project. They can be edited here.

fig. "Project safety goal"s view

Miniature View

The miniature view shows the active FTA or active page breaks. The miniature view is synchronized with the editor, so you can use the view to navigate in the FTA.

fig. "Miniatur"e view

FTA Analysis View

- Minimal cut sets

  fig. Minimal cut sets

  If the "Filter page" function is active, only the gates and events will be shown which are part of the active page break.

  The Minimal cut sets table shows:

  - the gate ID (event ID)

- the calculated probability

- the calculated importance

of an opened FTA document.

The table can be exported and saved to your system.

fig. Context menu for exporting the table

- Gates

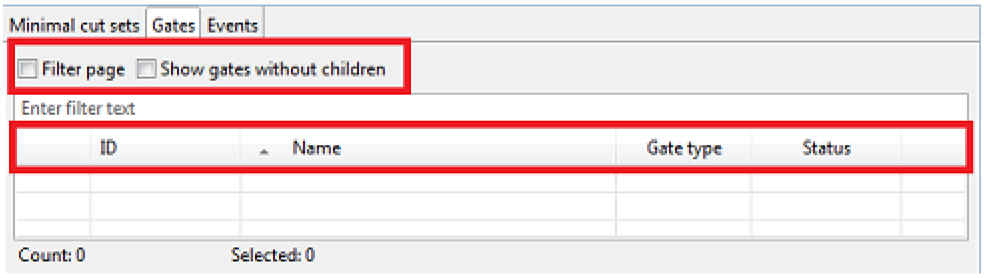


fig. Gates

If the "Filter page" function is activated by a check mark, only the gates and events will be shown which are part of the active page break.

If the "Show gates without children" function is activated by a check mark, only the gates without a base-, house- or intermediate event will be shown.

The Gates table shows the ID, name, gate type and status of an open FTA document.

- Events

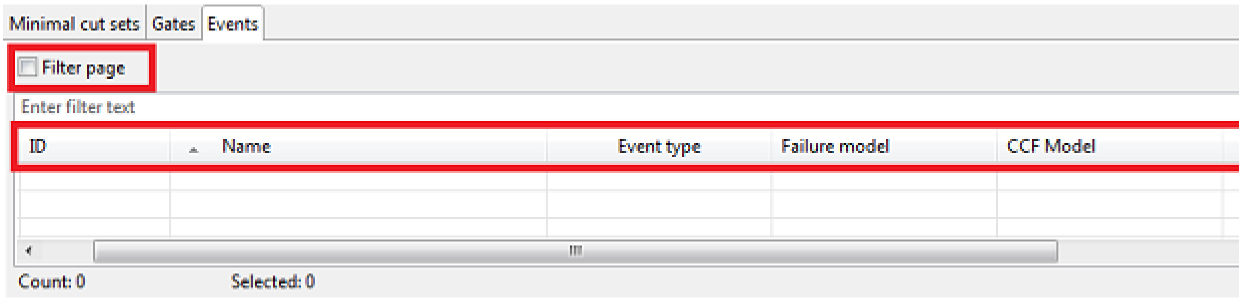


fig. Events

If the "Filter page" function is active, only the gates and events will be shown which are part of the active page break.

The Events table shows the ID, name, event type, failure model, CCF (Common Cause Failure) model, status, Fussel Veseley, Birnbaum, criticality.

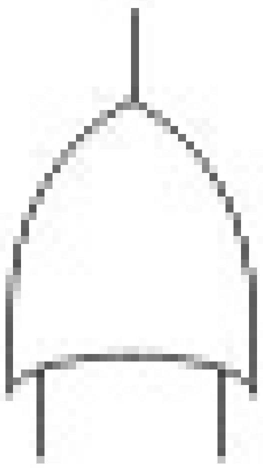
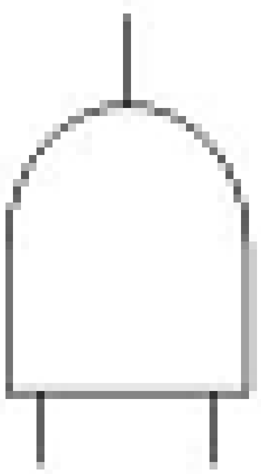
FTA Editor

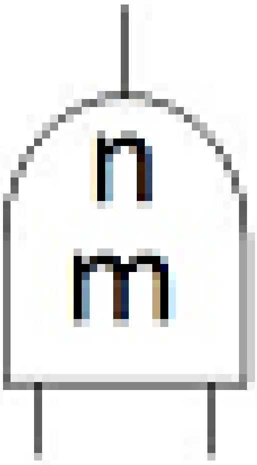
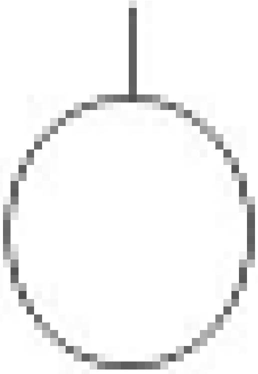
Sidebar

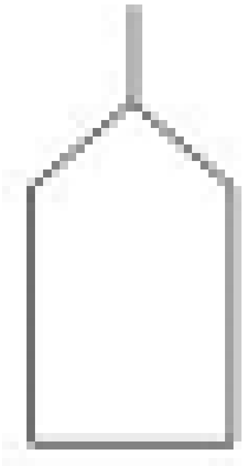
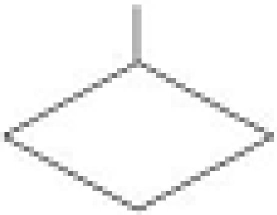
- Palette

Select	Select individual objects
Marquee	Select several objects

- Objects

	OR	The output occurs only if at least one of the inputs occurs.
	AND	The output occurs only if all of the inputs occur together.

	VOTING	The voting gate used to show M of N combinations of inputs causing the output to occur.
	Base Event	The Base Event represents the inherent of primary failure mode of a component; a component failure that cannot be further defined in detail. (Primary failure)

	House Event	The House event represents an event or action that is expected to occur as part of normal system operation.
	Intermediate Event	The Intermediate Event represents a failure that is induced by an external event or failure. It also represents a failure mode that could be developed in more detail if desired. (Secondary failure)

Additional Functionality

Evaluation

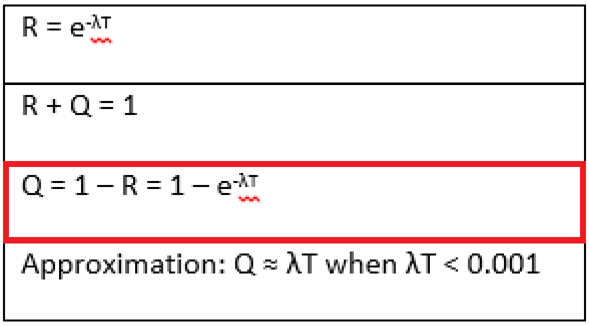
Precondition: The FTA has to be completed until the base events.

1. Right-click on the desired gate.
2. Choose **Calculate probabilities**.

→ The probability of failure for every gate and event will be calculated.

You can see the probability of failure of the undesired event and the input failure event probabilities in the minimal cut sets view .

The following reliability equations are used to calculate the probability of failure for the base events (component failure):



$R = e^{-\lambda T}$
$R + Q = 1$
$Q = 1 - R = 1 - e^{-\lambda T}$
Approximation: $Q \approx \lambda T$ when $\lambda T < 0.001$

R = Probability of success (Reliability)

Q = Probability of failure

λ = Component failure rate

T = Time interval (mission/component life time or exposure time [h])

Deriving an FTA from FMEA

Precondition: A new FTA document was created and the PSS view is active.

fig. Drag & drop malfunction from FMEA

1. Drag the *top undesired event* (In this example it is the malfunction "Passenger car not ventilated") from the PSS view.
2. Drop it into the FTA editor.

   ► The "Add fault tree" dialog opens.

   fig. Dialog "Add fault tre"e

3. Click on **Add fault tree** to derive the structure from the FMEA.

→ The fault tree has been created and is shown in the FTA editor.

fig. Fault tree derived from FMEA

Using Calculated FIT Values from the FMEDA

Precondition: An FTA has been created and the PSS view is active.

fig. Drag & drop component from FMEDA

1. Drag the desired component (Base Event) from the FMEDA part of the PSS view.
2. Drop it on a gate in the FTA editor.

   ► The calculated FIT value will be adapted.

Note

In this case you have to make sure that the TF (Total FIT) Failure model on document level is active.

Creating Failure Models manually

The TF (Total FIT) failure model is the default generated model for every FTA document. Use this model to adopt the calculated FIT values from the FMEDA/BOM for the FTA. Further more it is possible to manually create failure models for each FTA document which can be used via drag & drop or assigned in the properties dialog.

Precondition: The PSS view is active.

1. Open the desired FTA document in the PSS view.

fig. Failure models in the PSS view

2. Right click on **Failure models** > **New Failure model**.

   ►The "Add failure model" dialog opens.

fig. Dialog "Add failure mode"l

3. Choose the failure model type and its values.
4. Click on **OK**.

→ A new failure model has been added to the FTA document.

TM User Guide

Introduction

Create test cases based on your requirements in SOX and pass them to their specific testing tools. Use guided test runs with workflow and user rights assistance.

Please approach us for specific data outputs. We will adjust the output in XML so you can pass SOX test cases along to your test tools and read back the status, so as to generate maximum assistance in the preparation of your project-related traceability.

Step-by-Step-Guide

Creating a Test Specification

A SOX test specification contains a test plan, analysis and test group section.

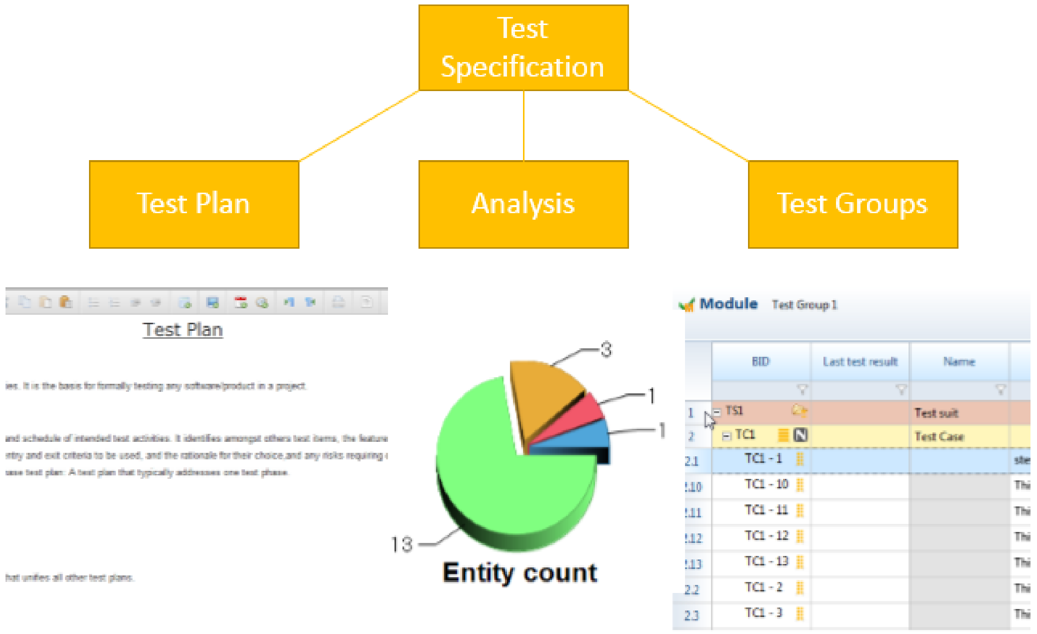


fig. Structure of test specification.

Precondition: A SOX project was created and the Repository view is active.

1. Open the SOX project in the repository view.
2. Right-click on the Test folder
3. Choose **New > Test Specification**

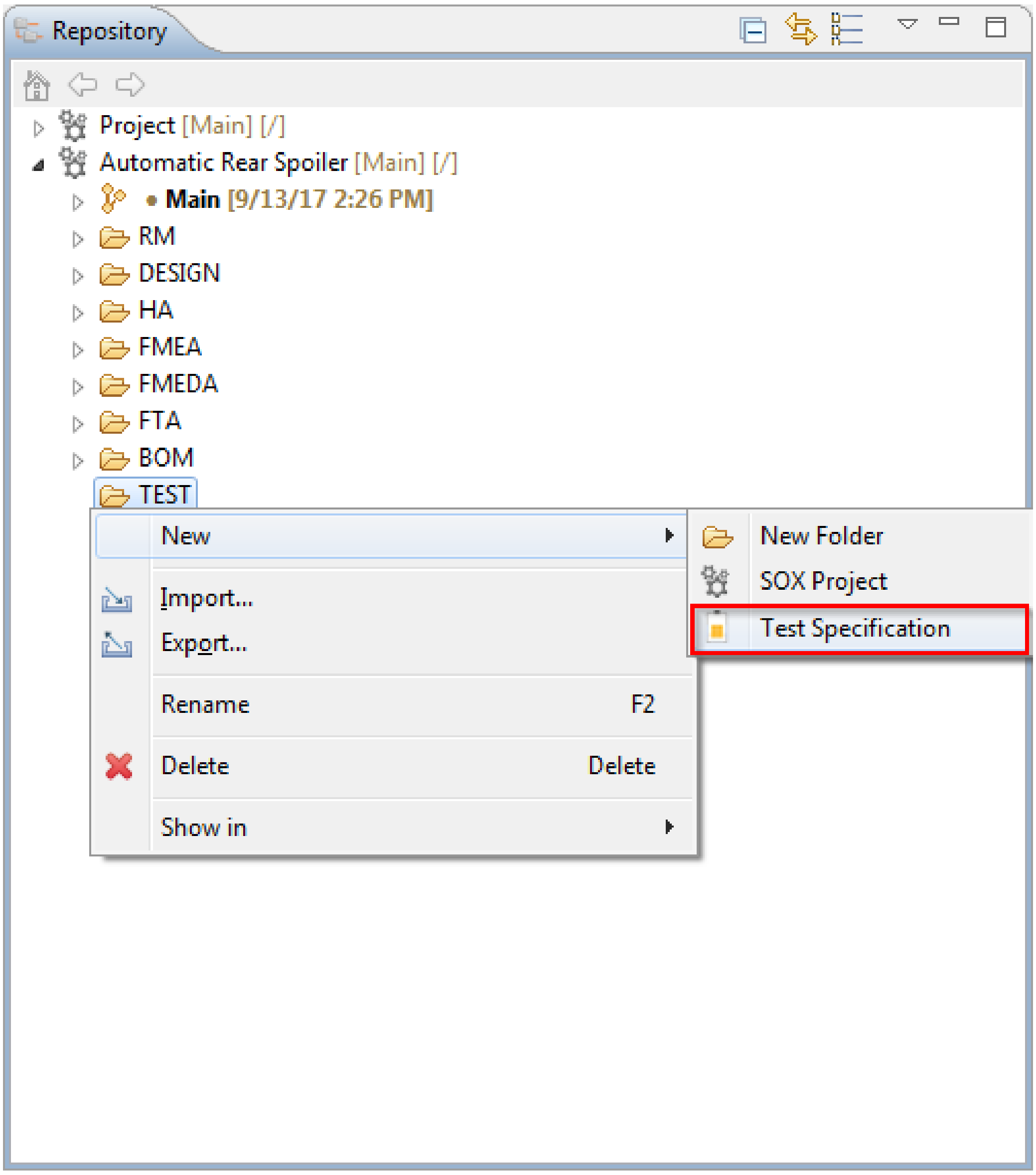


fig. New Test Specification.

► The dialog "Create new Test Specification" opens.

4. Click on **Browse** to specify the file location.

5. Enter a filename.

6. Choose the Template language (a template for the test plan which helps you to provide your test plan with all necessary information).

7. Click on **Finish.**

→ A new test specification with test plan, analysis and test groups was added to the repository.

Creating Test Groups

Test groups can be organized at the Hierarchy view of the Test perspective. Test groups are necessary for test suits and test cases because they are used as containers and root elements.

The following procedure explains how to create test groups at the hierarchy view.

Precondition: A test specification was created and the Hierarchy view is active.

1. Right-click in the hierarchy view.
2. Choose **New > New Test Group.**

   ► The "Add Test Group" dialog opens.

3. Enter a name for the modul.
4. Click on the **Browse** button to choose a responsible employee for this test group.

   ### Note

   The employee must be defined at the employee catalog. Read the employee catalog chapter for more information.

5. Click on **Finish.**

→ A test group was created and added to the hierarchy view and the test specification.

Creating Test Cases

Test cases can be stored in test groups or test suites. Test suites are used for sup groups in test groups.

To execute test cases, you have to create test runs and link them with test cases.

The following procedure explains how to create test cases in the hierarchy view or in the editor.

Precondition: A test group was created.

1. Right-click on a test group.

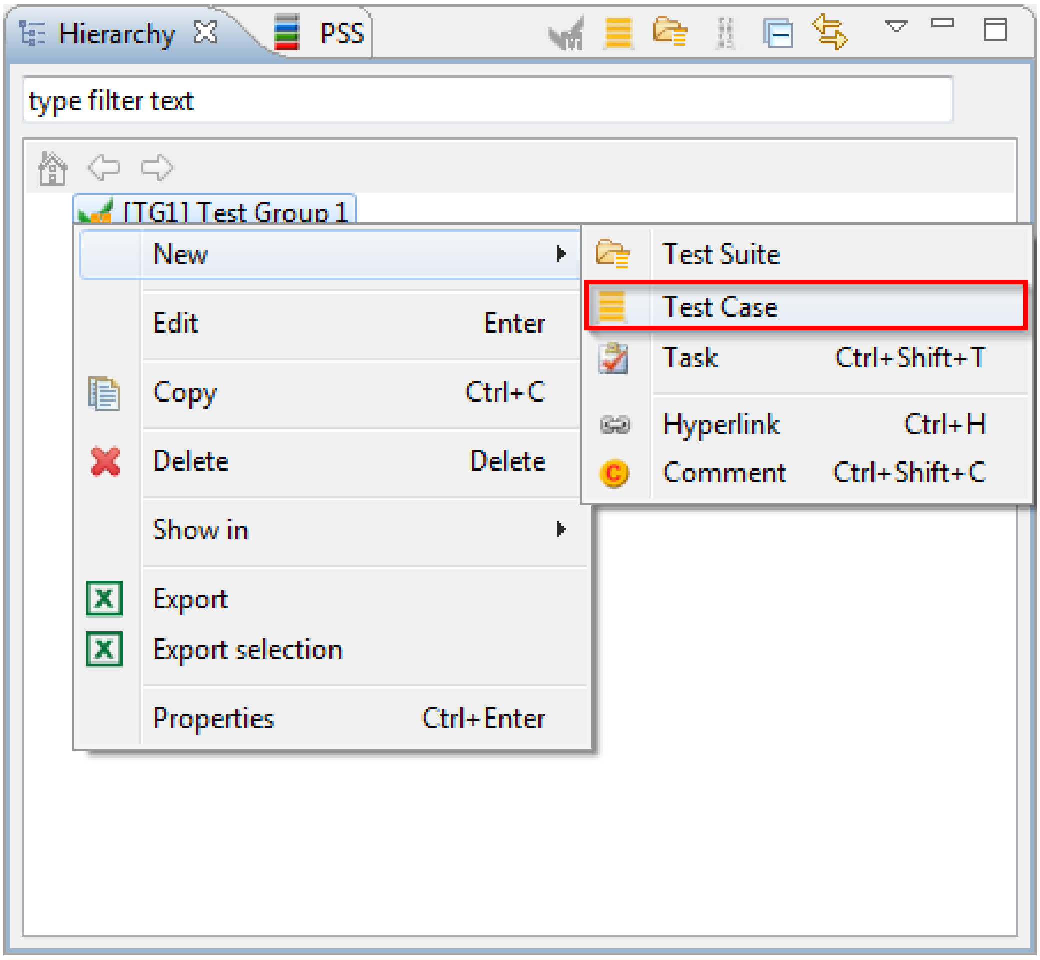
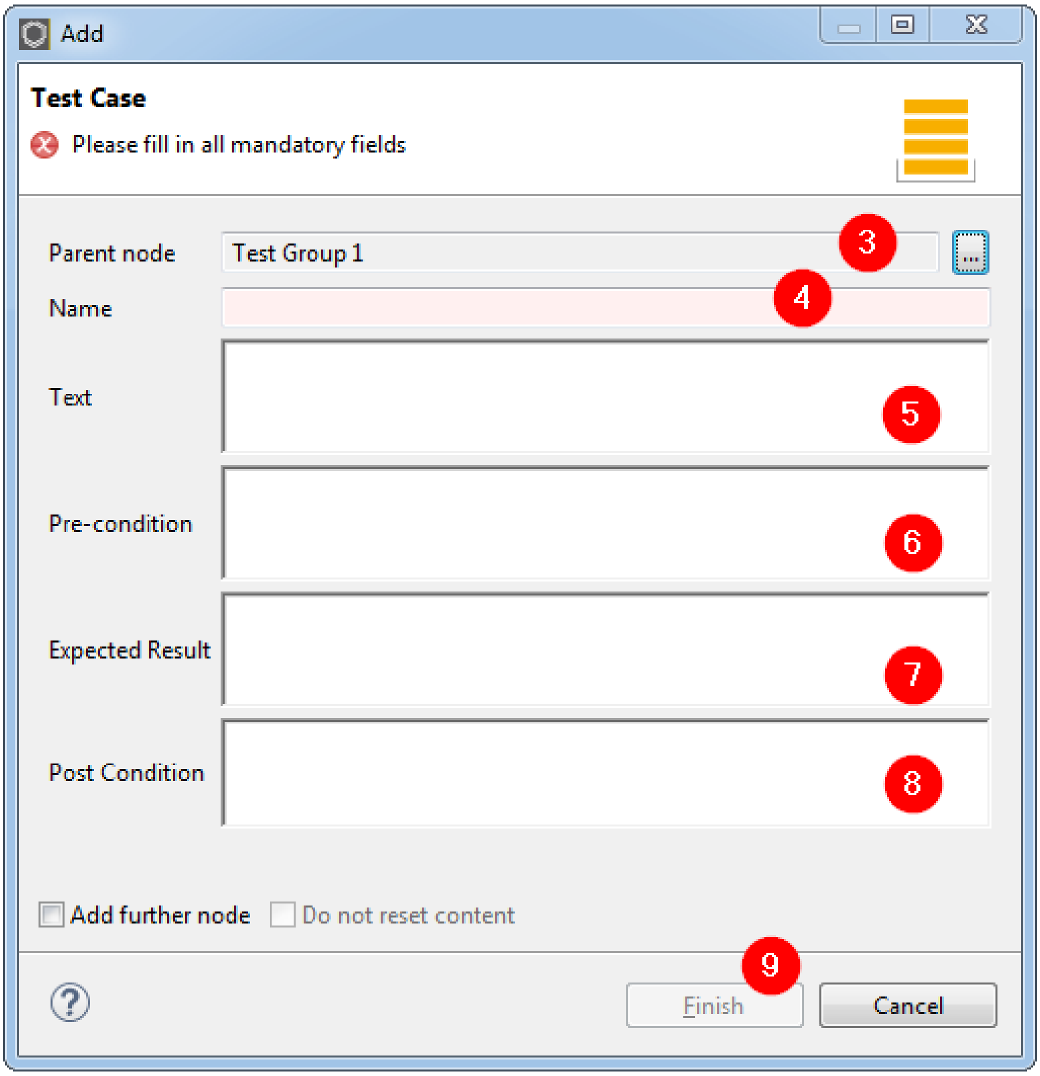


fig. New test case in the hierarchy view.

2. Choose **New > Test Case.**

► The "Add Test Case" dialog opens.



Test Case

Please fill in all mandatory fields

Parent node: Test Group 1

fig. Add Test Case dialog.

3. With the browse button you can change the test group/suite in which the test case will be stored. By default it will be the test group which was selected.

4. Enter a name for the test case.

5. Enter a text e.g. which will describe the procedure for this test case.

6. Enter a precondition.

7. Enter a expected result

8. Enter a post condition.

Note

The content of the fields (5)(6)(7)(8) are optional and can be edited later. They can be edited with XHMTL formatting. With a click into the field you'll get a tool bar with all possible formatting. If there appears no tool bar, change the size of the dialog.

fig. XHTML tool bar.

9. Click **Finish.**

→ A test case with all entries was added to the selected test group/suite.

Creating Test Steps

Precondition: A test case was created.

1. Right-click on a test case.

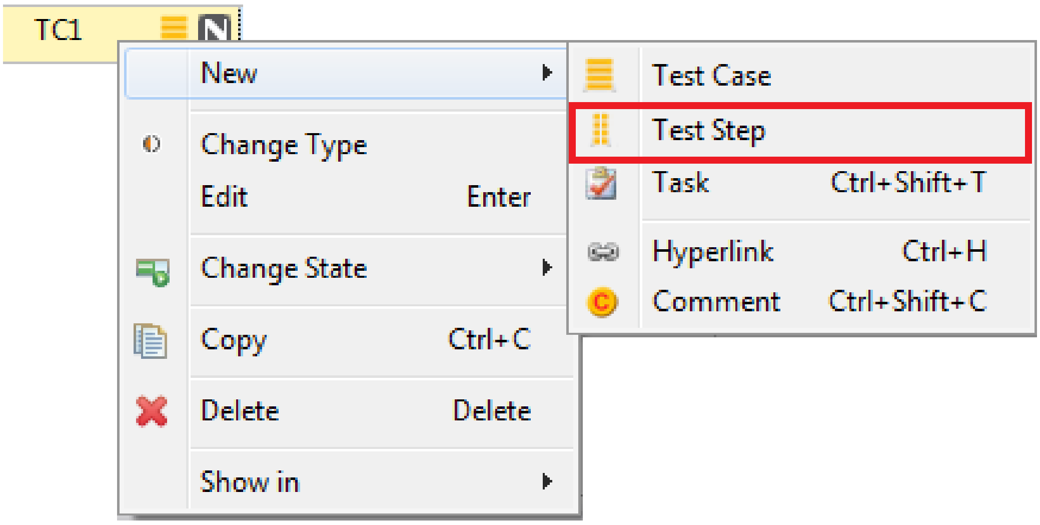


fig. New Test Step.

2. Choose **New > Test Step.**

► The "Add Test Step" dialog opens.

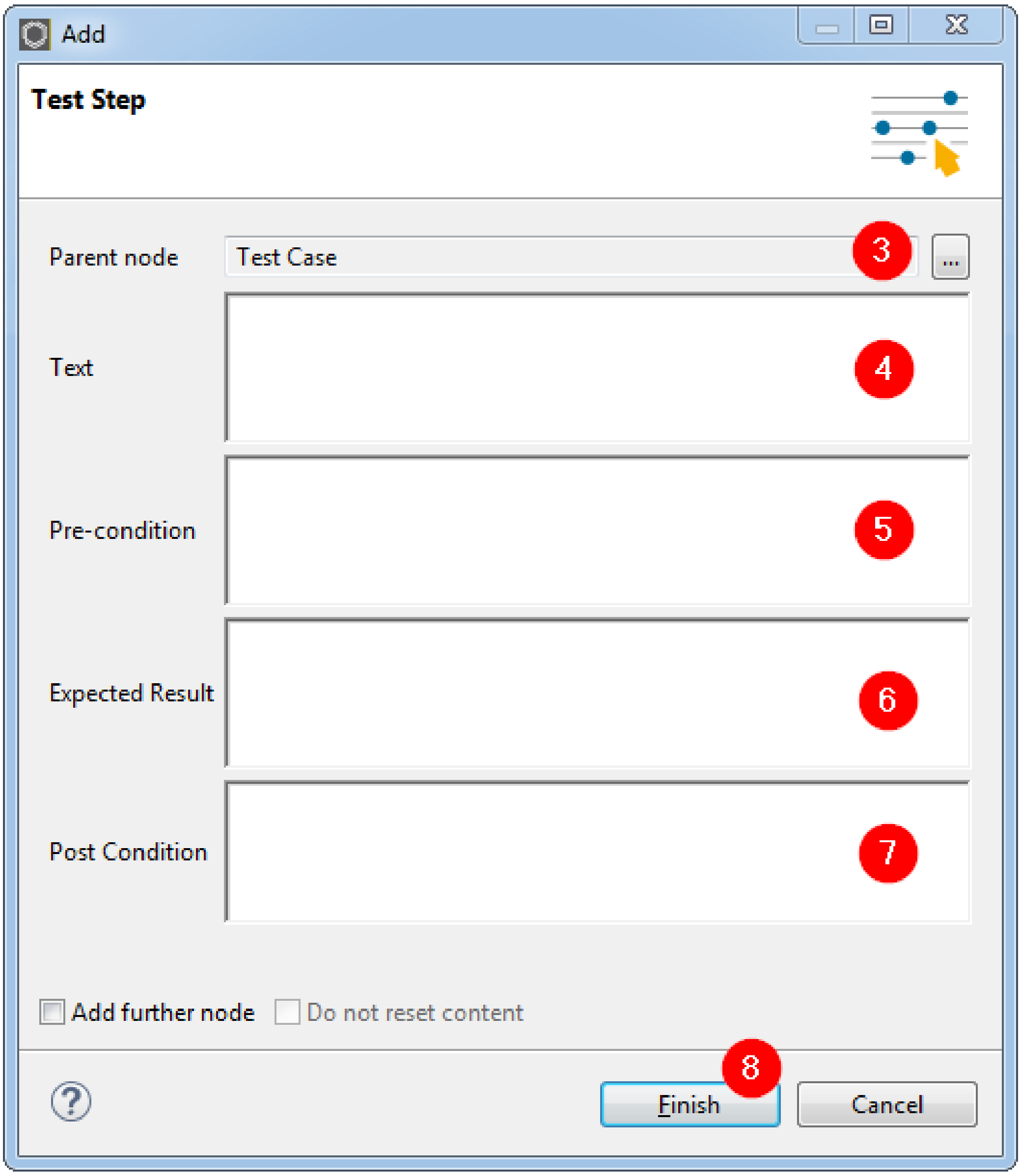


fig. Add Test Step dialog.

3. With the browse button you can change the test case in which the test case will be stored. By default it will be the test case which was selected.
4. Enter a text e.g. which will describe the procedure for this test step.
5. Enter a precondition.
6. Enter an expected result.
7. Enter a post condition.

Note

The content of the fields (4)(5)(6)(7) are optional and can be edited later. They can be edited with XHMTL formatting. With a click into the field you'll get a tool bar with all possible formatting. If there appears no tool bar, change the size of the dialog.

fig. XHTML tool bar.

→ A test case with all entries was added to the selected test case.

Creating Test Runs

Test runs are necessary for executing a defined set of test cases. They also contain information about results and status of the test run.

Precondition: The Test perspective is active.

1. Right-click into the Test Runs view.

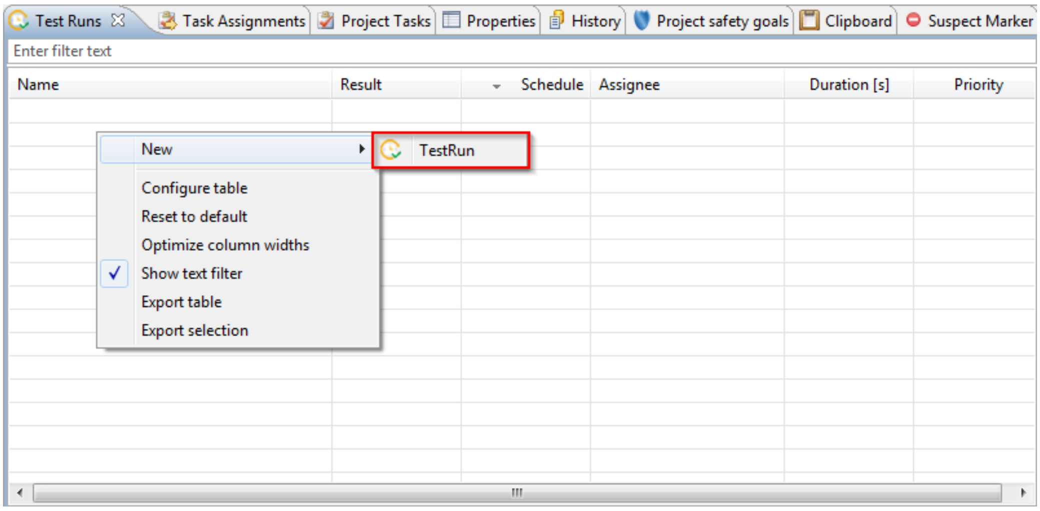
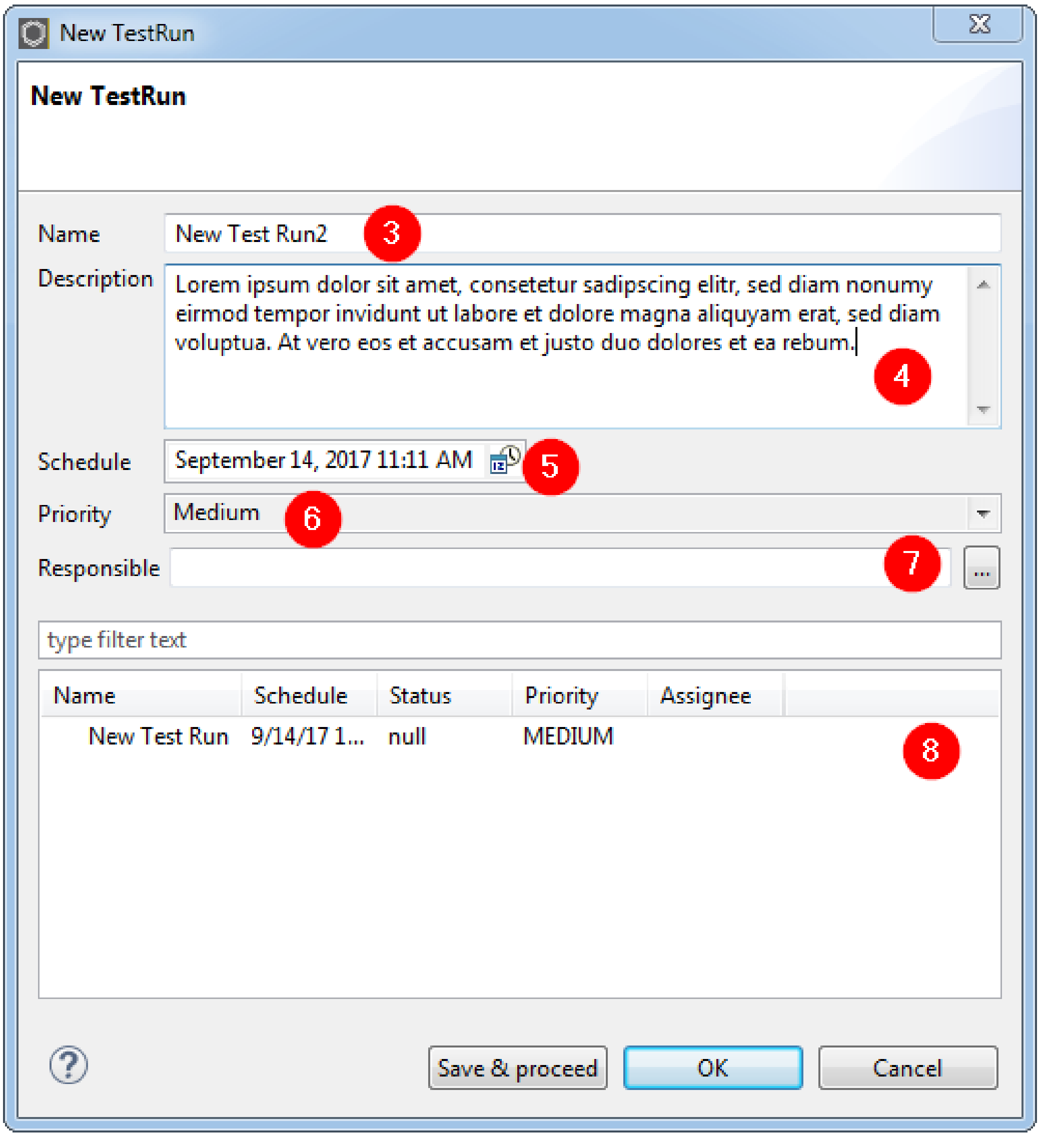


fig. Context menu new TestRun

2. Choose **New > TestRun**

► "New TestRun" dialog opens.



Name: New Test Run2

Description: Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. At vero eos et accusam et justo duo dolores et ea rebum.

Schedule: September 14, 2017 11:11 AM

Priority: Medium

Responsible:

type filter text

Name	Schedule	Status	Priority	Assignee
New Test Run	9/14/17 1...	null	MEDIUM	

fig. New TestRun dialog.

3. Enter a name for the test run.
4. Optional enter a description for the test run.
5. Click on the Schedule icon to set an appointment for the execution of the test run.
6. Select a Priority for this test run.
7. Click on the **Browse** button to choose a responsible employee for this test group.

Note

The employee must be defined at the employee catalog. Read the employee catalog chapter for more information.

8. If you are using the Save & proceed function, the already created test runs will be displayed in this field.
9. Click **OK.**

→ A test run was created and added to the Test Runs view.

Adding Test Cases to Test Runs

Test runs are necessary for executing a defined set of test cases. Test cases can be added to any number of different test runs. You also can assign whole test groups and test suites.

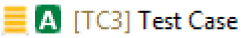
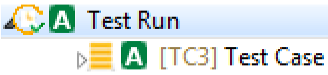
Drag your desired test- case/suite or group **and drop** it on a test run.

Note

If you want to remove a test- case/suite or group, use the context menu entry **Delete** at the Test Runs view. The object will be only removed from the test run, not from the project.

Executing Test Runs

For executing test runs, approve that your test run and the test cases have the following status:

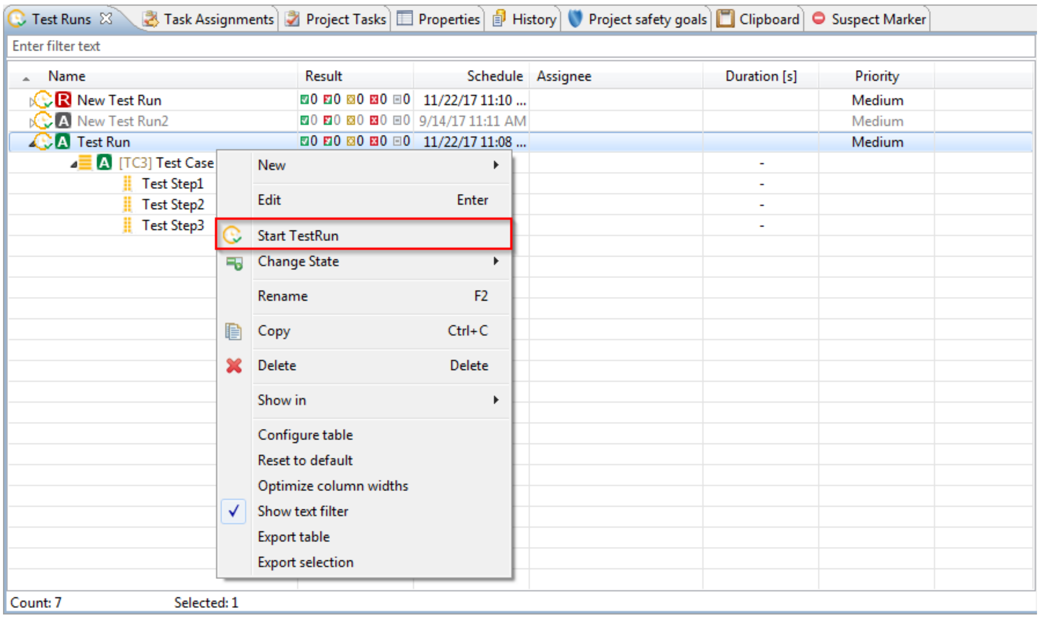
 A [TC3] Test Case	 A Test Run A [TC3] Test Case
The test case must be **Active**	The Test Run must be **Approved**

Note

This is the default SOX work flow which is defined in the state machine. Please contact us for implementing a customized state machine and work flow. Read the chapter State Machine for more information.

Precondition: Test cases are added to the test run. The status of the test run is approved and the containing test cases are active. The Test Runs view is active.

1. Right-click on the test run which should be executed.

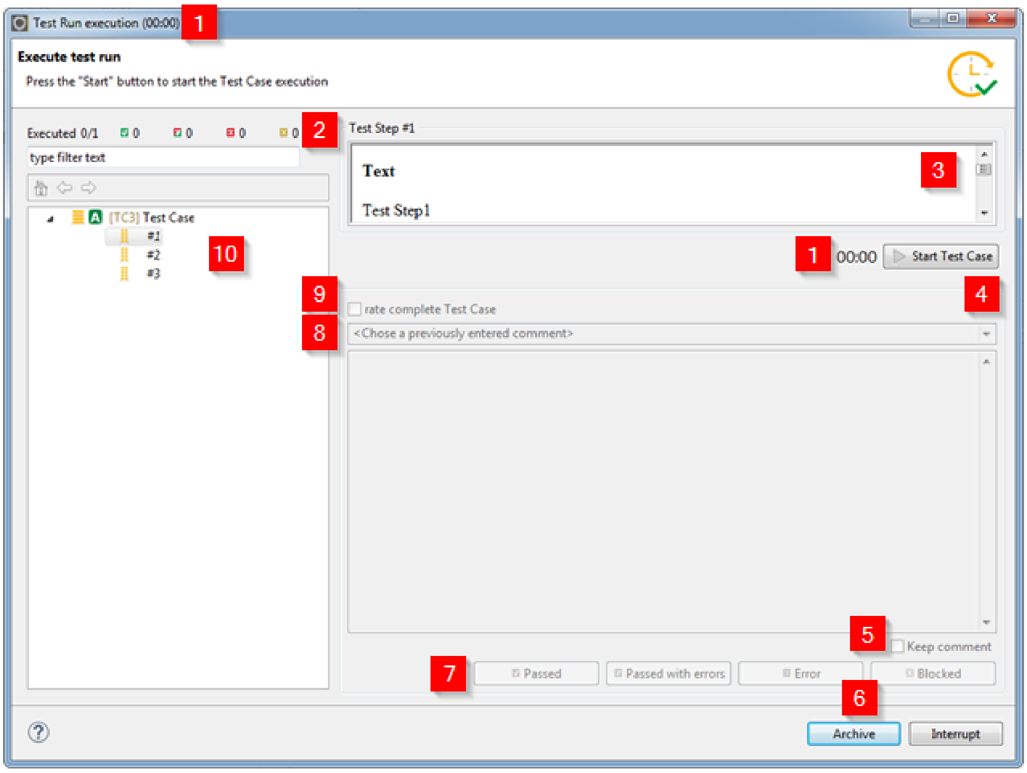


Name	Result	Schedule	Assignee	Duration [s]	Priority
R New Test Run	☑0 ☒0 ☒0 ☒0 ⊟0	11/22/17 11:10 ...			Medium
A New Test Run2	☑0 ☒0 ☒0 ☒0 ⊟0	9/14/17 11:11 AM			Medium
A Test Run	☑0 ☒0 ☒0 ☒0 ⊟0	11/22/17 11:08 ...			Medium
A [TC3] Test Case				-	
Test Step1				-	
Test Step2				-	
Test Step3				-	

fig. Starting the test run.

2. Choose **Start TestRun.**

► The "Test Run execution" dialog opens.



Execute test run

Press the "Start" button to start the Test Case execution

fig. Test Run execution dialog.

[1] Counter for test run duration.	[2] Status of executed test cases. (Passed/Passed with Errors/Error/Blocked)
[3] Test case and test step content.	[4] Start/Pause Test Case.
[5] Keep comment. If active the last entered comment stays in the comment box.	[6] Archive/Interrupt Test Run
[7] Buttons for rating the test steps.	[8] Previously entered comments can be selected here and used for the current executed test step.
[9] Rate complete Test Case, if active the complete test case will be rated with your selected rating.	[10] Structure of test case and test steps which are included to this test run.

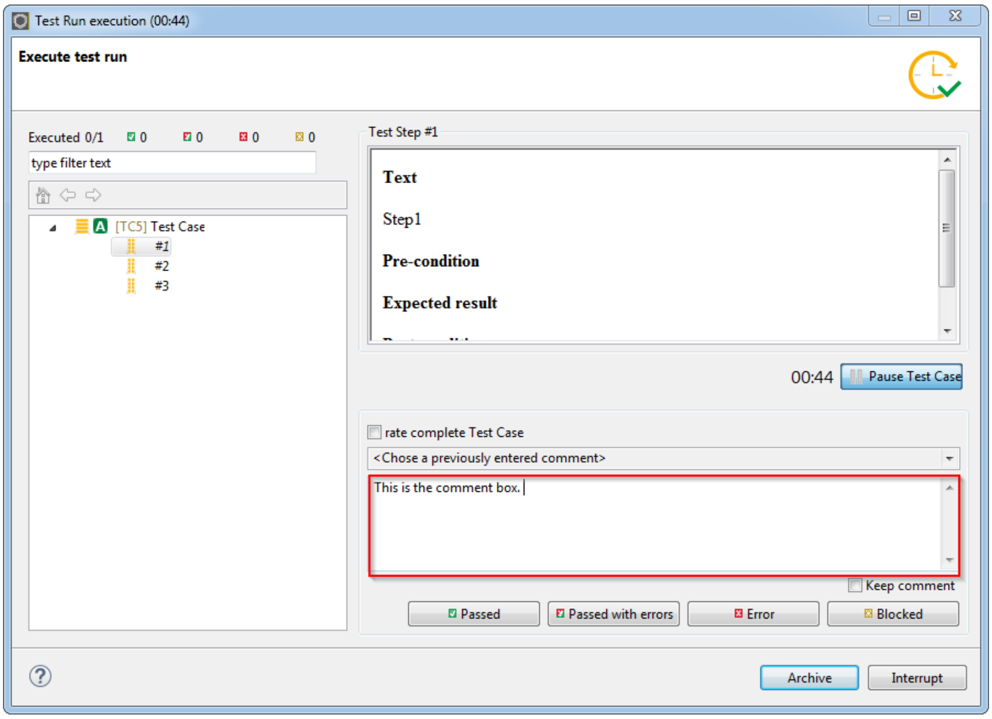
3. Click on **Start Test Case.**

   ► The counter [1] for this test run starts.

4. Rate the current test step.

Note

If you want to rate the current test step with Passed with errors, Error or Blocked, you have enter a comment at the comment box.


Test Run execution (00:44)

Execute test run

Executed 0/1 ☑ 0 ☒ 0 ☒ 0 ☒ 0

type filter text

[TC5] Test Case
#1
#2
#3

Test Step #1

Text

Step1

Pre-condition

Expected result

00:44

☐ rate complete Test Case

<Chose a previously entered comment>

This is the comment box.

☐ Keep comment

fig. Test Run execution dialog comment box.

5. After you have rated all test steps and test case, click on **Archive** to finish the test execution.

→ The test run was executed.

The User Interface

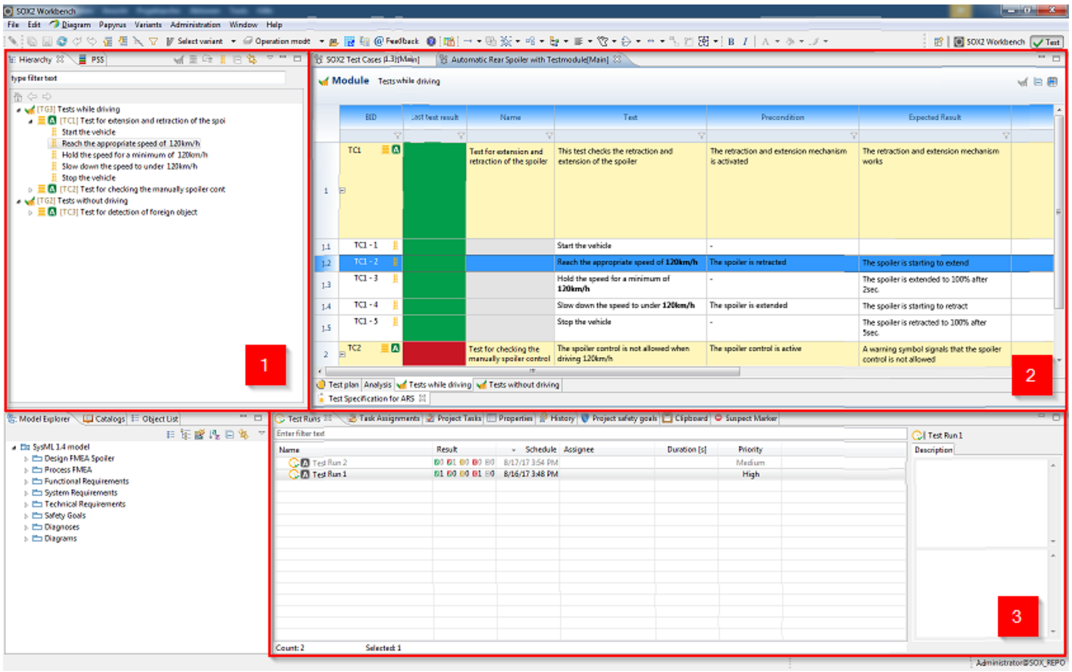


fig. User interface of Test perspective.

[1] Hierarchy View

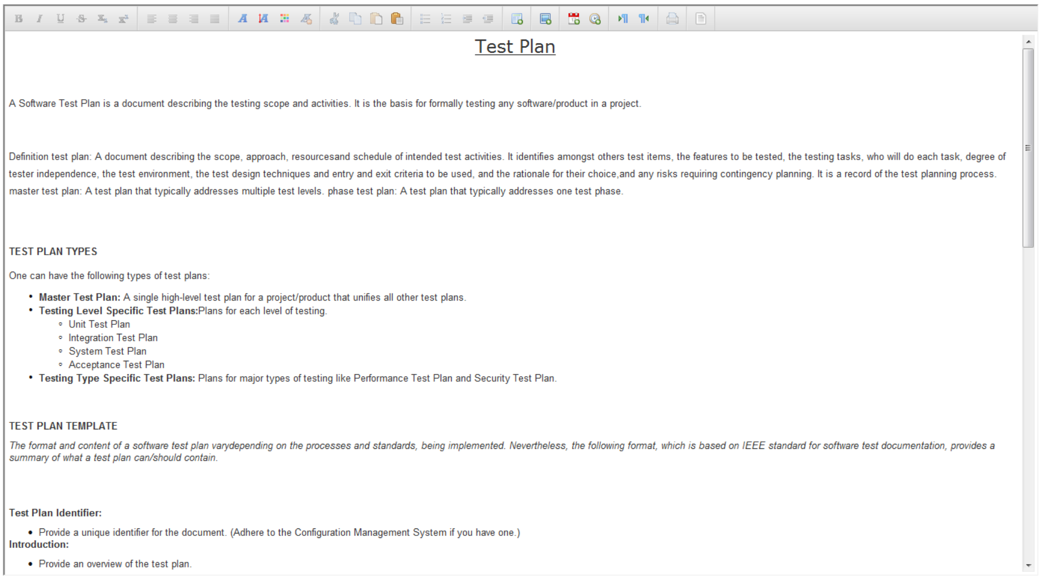
[2] Test Modul Editor

[3] Test Run View

Test Modul Editor

The test modul editor contains the three register:

- Test Plan



Test Plan

A Software Test Plan is a document describing the testing scope and activities. It is the basis for formally testing any software/product in a project.

Definition test plan: A document describing the scope, approach, resourcesand schedule of intended test activities. It identifies amongst others test items, the features to be tested, the testing tasks, who will do each task, degree of tester independence, the test environment, the test design techniques and entry and exit criteria to be used, and the rationale for their choice,and any risks requiring contingency planning. It is a record of the test planning process. master test plan: A test plan that typically addresses multiple test levels. phase test plan: A test plan that typically addresses one test phase.

TEST PLAN TYPES

One can have the following types of test plans:

- **Master Test Plan:** A single high-level test plan for a project/product that unifies all other test plans.
- **Testing Level Specific Test Plans:**Plans for each level of testing.
  - Unit Test Plan
  - Integration Test Plan
  - System Test Plan
  - Acceptance Test Plan
- **Testing Type Specific Test Plans:** Plans for major types of testing like Performance Test Plan and Security Test Plan.

TEST PLAN TEMPLATE

The format and content of a software test plan varydepending on the processes and standards, being implemented. Nevertheless, the following format, which is based on IEEE standard for software test documentation, provides a summary of what a test plan can/should contain.

Test Plan Identifier:

- Provide a unique identifier for the document. (Adhere to the Configuration Management System if you have one.)

Introduction:

- Provide an overview of the test plan.

fig. Test plan register.

The test plan contains by default a template which helps you to provide your test plan with all necessary information. The content can be edited in XHMTL formatting.

- Analysis

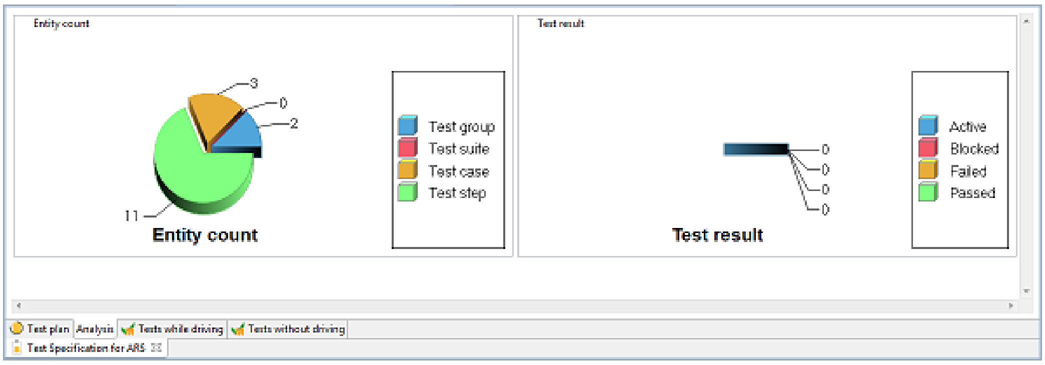
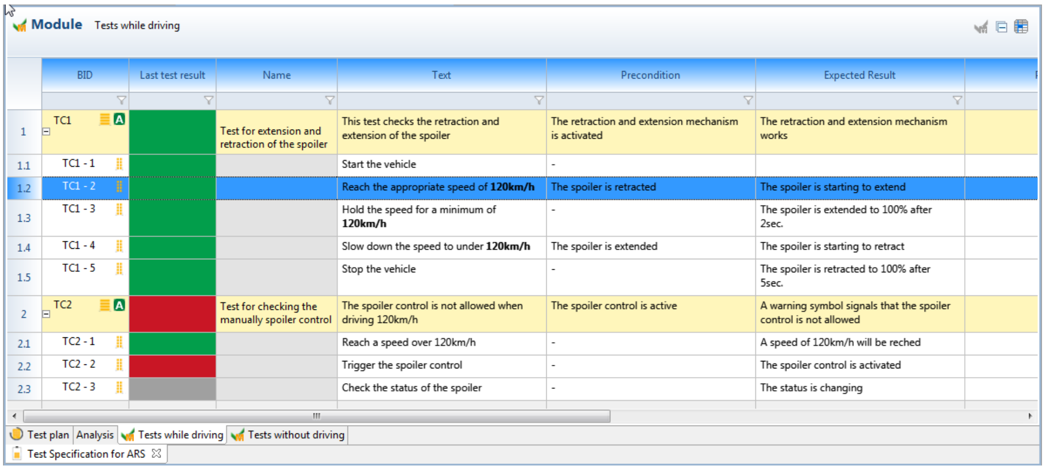


fig. Analysis register.

The Analysis register contains a pie chart and block diagram which gives you information about the entity count and test results. It's only an overview and not editable.

- Test Groups



Module Tests while driving

	BID	Last test result	Name	Text	Precondition	Expected Result
1	TC1	🟩	Test for extension and retraction of the spoiler	This test checks the retraction and extension of the spoiler	The retraction and extension mechanism is activated	The retraction and extension mechanism works
1.1	TC1 - 1	🟩		Start the vehicle	-	
1.2	TC1 - 2	🟩		Reach the appropriate speed of **120km/h**	The spoiler is retracted	The spoiler is starting to extend
1.3	TC1 - 3	🟩		Hold the speed for a minimum of **120km/h**	-	The spoiler is extended to 100% after 2sec.
1.4	TC1 - 4	🟩		Slow down the speed to under **120km/h**	The spoiler is extended	The spoiler is starting to retract
1.5	TC1 - 5	🟩		Stop the vehicle	-	The spoiler is retracted to 100% after 5sec.
2	TC2	🟥	Test for checking the manually spoiler control	The spoiler control is not allowed when driving 120km/h	The spoiler control is active	A warning symbol signals that the spoiler control is not allowed
2.1	TC2 - 1	🟩		Reach a speed over 120km/h	-	A speed of 120km/h will be reched
2.2	TC2 - 2	🟥		Trigger the spoiler control	-	The spoiler control is activated
2.3	TC2 - 3	▨		Check the status of the spoiler	-	The status is changing

fig. Test group register.

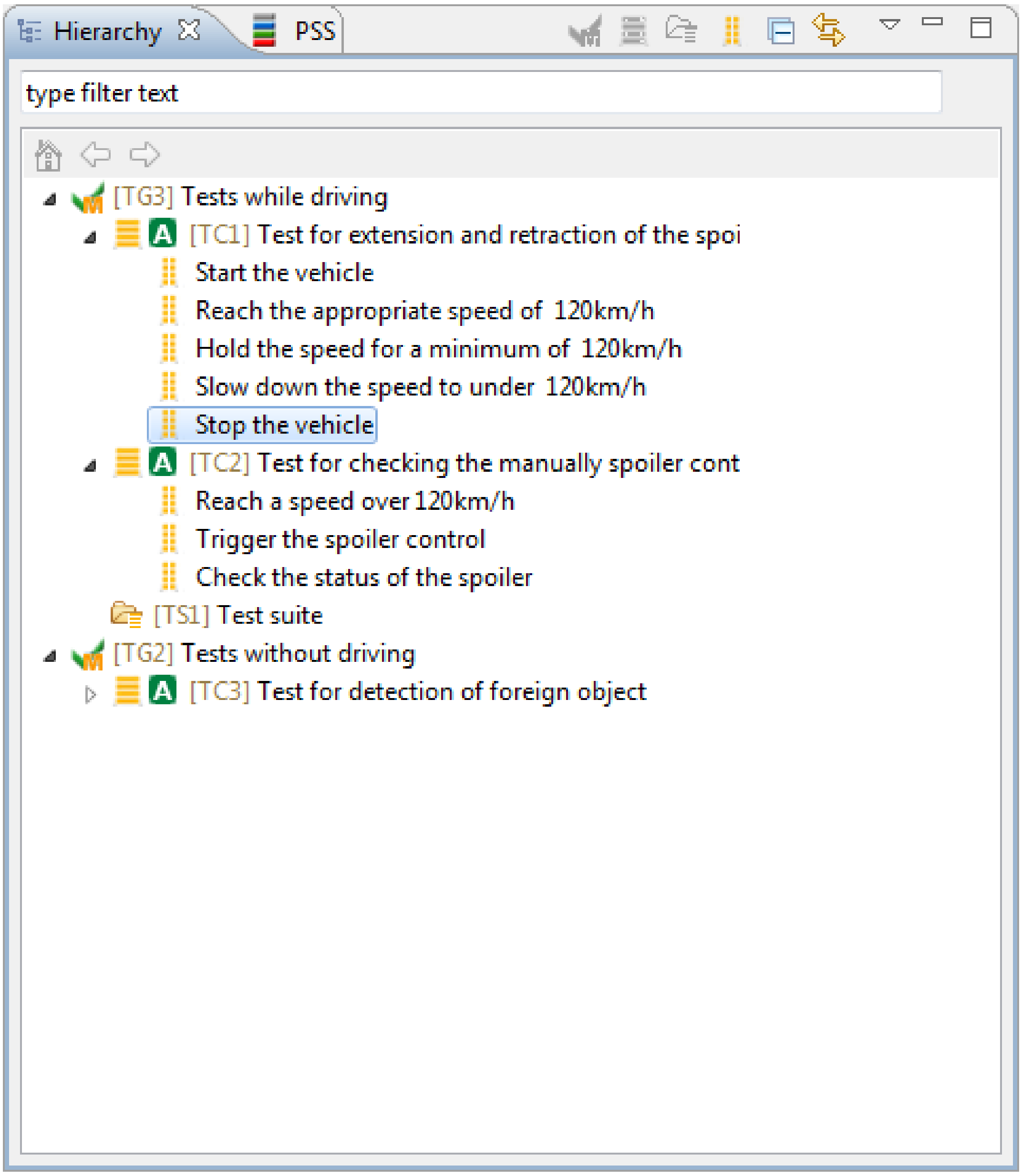
The test group register shows all contained test- suits/cases and steps. It also gives you information about last test results, linked requirements and test run information.

Meaning of colors:

Brown	Test suites
Beige	Test cases
Green	Passed
Green/Red	Passed with errors
Yellow	Blocked
Red	Error
Grey	Not executed

Hierarchy View

The Hierarchy view displays the test groups and their related test- suites/cases and steps. Furthermore Test- groups/suites/cases and steps can be created and organized here.



type filter text

[TG3] Tests while driving
[TC1] Test for extension and retraction of the spoi
Start the vehicle
Reach the appropriate speed of 120km/h
Hold the speed for a minimum of 120km/h
Slow down the speed to under 120km/h
Stop the vehicle
[TC2] Test for checking the manually spoiler cont
Reach a speed over 120km/h
Trigger the spoiler control
Check the status of the spoiler
[TS1] Test suite
[TG2] Tests without driving
[TC3] Test for detection of foreign object

fig. Hierarchy view.

- New test group

  Triggers the New test module dialog.

- New Test suite

  Triggers the New test suite dialog.

- New Test case

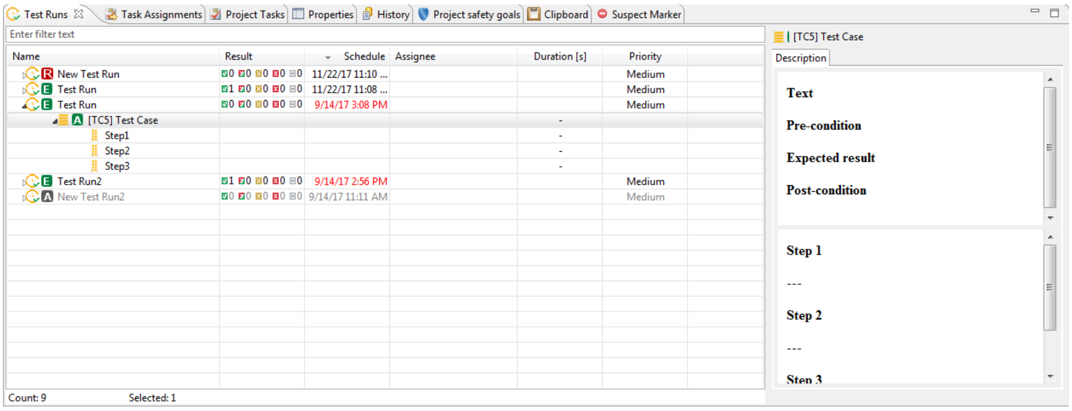
  Triggers the New test case dialog.

- New Test step

  Triggers the New test step dialog.

Test Runs View

The test runs view displays all test runs and their information. In this view you can also create and organize test runs.



Name	Result	Schedule	Assignee	Duration [s]	Priority
New Test Run	0 0 0 0 0	11/22/17 11:10 ...			Medium
Test Run	1 0 0 0 0	11/22/17 11:08 ...			Medium
Test Run	0 0 0 0 0	9/14/17 3:08 PM			Medium
[TC5] Test Case				-	
Step1				-	
Step2				-	
Step3				-	
Test Run2	1 0 0 0 0	9/14/17 2:56 PM			Medium
New Test Run2	0 0 0 0 0	9/14/17 11:11 AM			Medium

fig. Test run view.

The description part on the right shows the content of a selected test case.

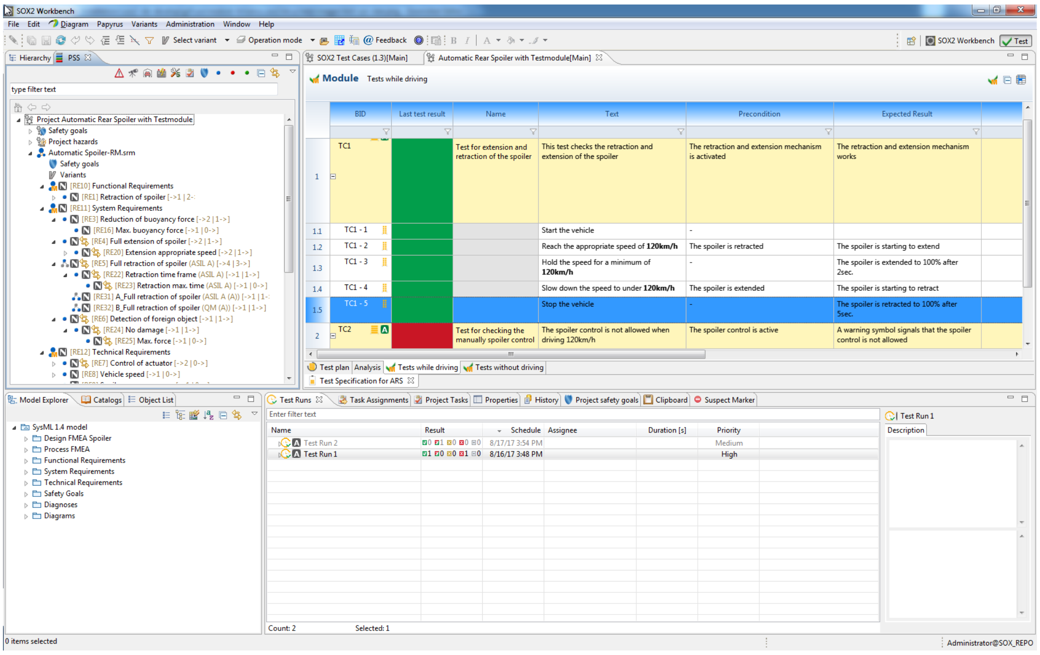
Additional Functionality

Linking Requirements

Precondition: Requirements and test cases were created.

1. Open the test specification and the according test group register which contains the test cases for linking.
2. Open the PSS view and the requirements structure until the requirement which should be linked

► You should have a similar interface like fig. Linking requirements with test cases.


SOX2 Workbench
File
Edit
Diagram
Papyrus
Variants
Administration
Window
Help
Select variant
Operation mode
Feedback
SOX2 Workbench
Test
Hierarchy
PSS
type filter text
Project Automatic Rear Spoiler with Testmodule
Safety goals
Project hazards
Automatic Spoiler-RM.srm
Safety goals
Variants
[RE10] Functional Requirements
[RE1] Retraction of spoiler [->1 | 2-
[RE11] System Requirements
[RE3] Reduction of buoyancy force [->2 | 1->]
[RE16] Max. buoyancy force [->1 | 0->]
[RE4] Full extension of spoiler [->2 | 1->]
[RE20] Extension appropriate speed [->2 | 1->]
[RE5] Full retraction of spoiler (ASIL A) [->4 | 3->]
[RE22] Retraction time frame (ASIL A) [->1 | 1->]
[RE23] Retraction max. time (ASIL A) [->1 | 0->]
[RE31] A_Full retraction of spoiler (ASIL A (A)) [->1 | 1-
[RE32] B_Full retraction of spoiler (QM (A)) [->1 | 1->]
[RE6] Detection of foreign object [->1 | 1->]
[RE24] No damage [->1 | 1->]
[RE25] Max. force [->1 | 0->]
[RE12] Technical Requirements
[RE7] Control of actuator [->2 | 0->]
[RE8] Vehicle speed [->1 | 0->]
SOX2 Test Cases (1.3)[Main]
Automatic Rear Spoiler with Testmodule[Main]
Module
Tests while driving
Test plan
Analysis
Tests while driving
Tests without driving
Test Specification for ARS
Model Explorer
Catalogs
Object List
SysML 1.4 model
Design FMEA Spoiler
Process FMEA
Functional Requirements
System Requirements
Technical Requirements
Safety Goals
Diagnoses
Diagrams
0 items selected
Test Runs
Task Assignments
Project Tasks
Properties
History
Project safety goals
Clipboard
Suspect Marker
Enter filter text
Test Run 1
Description
Count: 2
Selected: 1
Administrator@SOX_REPO

	BID	Last test result	Name	Text	Precondition	Expected Result
1	TC1	🟩	Test for extension and retraction of the spoiler	This test checks the retraction and extension of the spoiler	The retraction and extension mechanism is activated	The retraction and extension mechanism works
1.1	TC1 - 1	🟩		Start the vehicle	-	
1.2	TC1 - 2	🟩		Reach the appropriate speed of **120km/h**	The spoiler is retracted	The spoiler is starting to extend
1.3	TC1 - 3	🟩		Hold the speed for a minimum of **120km/h**	-	The spoiler is extended to 100% after 2sec.
1.4	TC1 - 4	🟩		Slow down the speed to under **120km/h**	The spoiler is extended	The spoiler is starting to retract
1.5	TC1 - 5	🟩		Stop the vehicle	-	The spoiler is retracted to 100% after 5sec.
2	TC2	🟥	Test for checking the manually spoiler control	The spoiler control is not allowed when driving 120km/h	The spoiler control is active	A warning symbol signals that the spoiler control is not allowed

Name	Result	Schedule	Assignee	Duration [s]	Priority
Test Run 2	0 1 0 0 0	8/17/17 3:54 PM			Medium
Test Run 1	1 0 0 1 0	8/16/17 3:48 PM			High

fig. Linking requirements with test cases.

3. Drag the desired requirement and drop it on to the to be linked test case

   ► The requirement will be displayed in the editor at the requirements column.

→ A requirement was linked with and test case.

Reliability

Reliability

Import or create Bills of Materials (BOMs) in the SOX Reliability module. FIT values are calculated in the SOX RE module in compliance with project-specific profiles and can be used for various analyses.

Step-by-Step-Guide

Creating a New File

Precondition: A SOX project has been created and the Repository view is active.

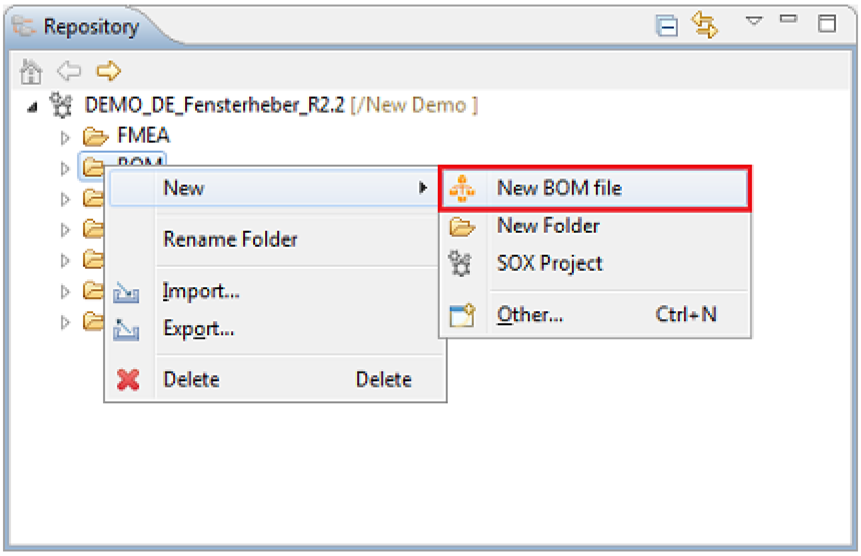
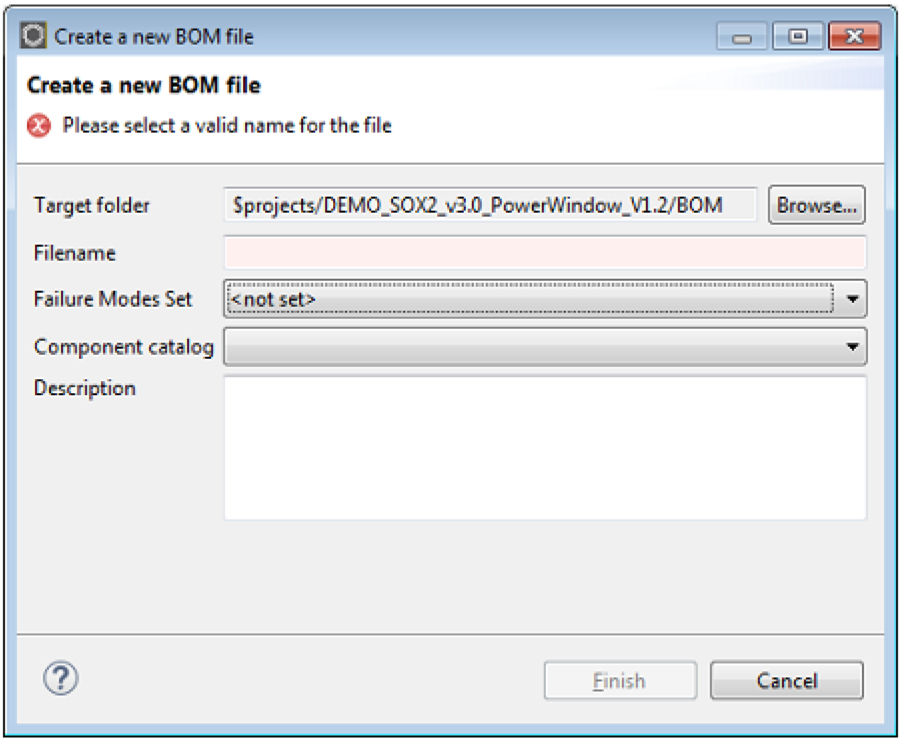


fig. "Repositor"y view

1. Open the SOX project in the repository view.
2. Right-click on the BOM folder.
3. Choose **New > New BOM file.**

► The dialog "Create a new BOM file" opens.



Create a new BOM file

Please select a valid name for the file

Target folder: $projects/DEMO_SOX2_v3.0_PowerWindow_V1.2/BOM

Filename

Failure Modes Set: <not set>

Component catalog

Description

fig. "Create a new BOM fil"e dialog

4. Click on **Browse...** and choose BOM as the target folder.

5. Enter a filename for the BOM file.

6. Choose the method for failure mode catalog handling. Choose here between Birolini and IEC62380.

7. Choose a failure rate catalog. FIT rates can be calculated according to different norms (i.e. IEC62380, SN29500).

8. Optionally, enter a description that helps to understand the content.

9. Click **Finish**.

→ A BOM file was created and added to the repository.

Creating a New Module

Precondition: A reliability file was created and the BOM Modules view is active.

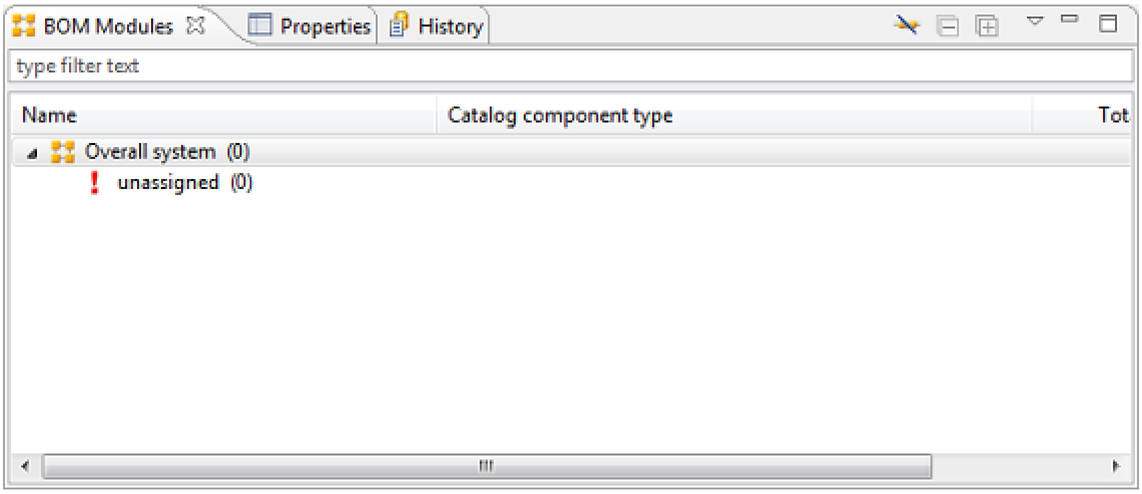


fig. "BOM Module"s view

1. Right-click in the BOM Modules view on the element **Overall system**. This virtual assembly group provides all assembly groups of the BOM.
2. Choose **New > New Module...**

   ► The dialog "New assembly group" opens.

3. Enter a name for the module.
4. Click **OK.**

→ A new module was created and added to the "Overall system".

Creating a New Component

Precondition: A module has been created.

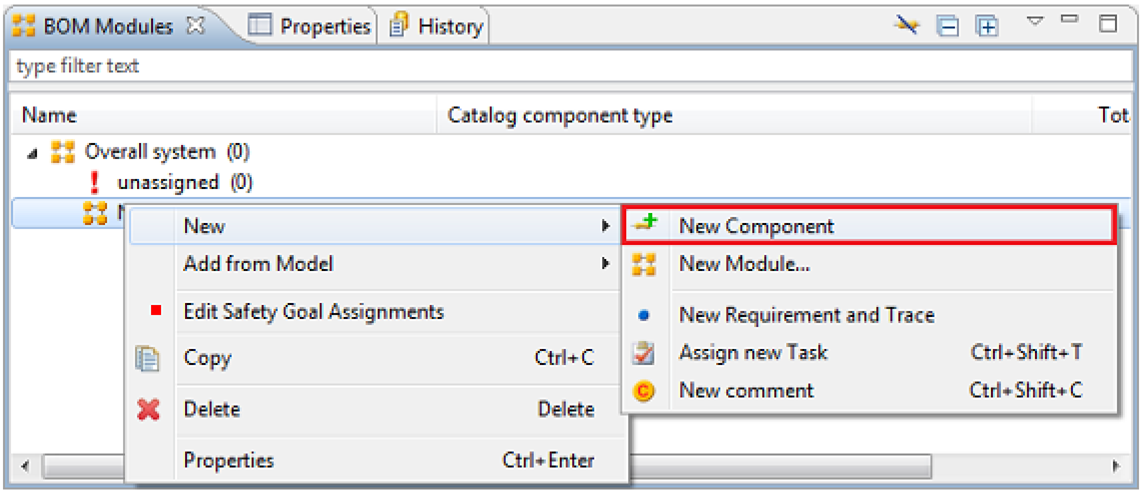


fig. Context menu for new component

1. In the BOM Modules view, right-click on a module.
2. Choose **New > New Component**

► The dialog "New component" opens.

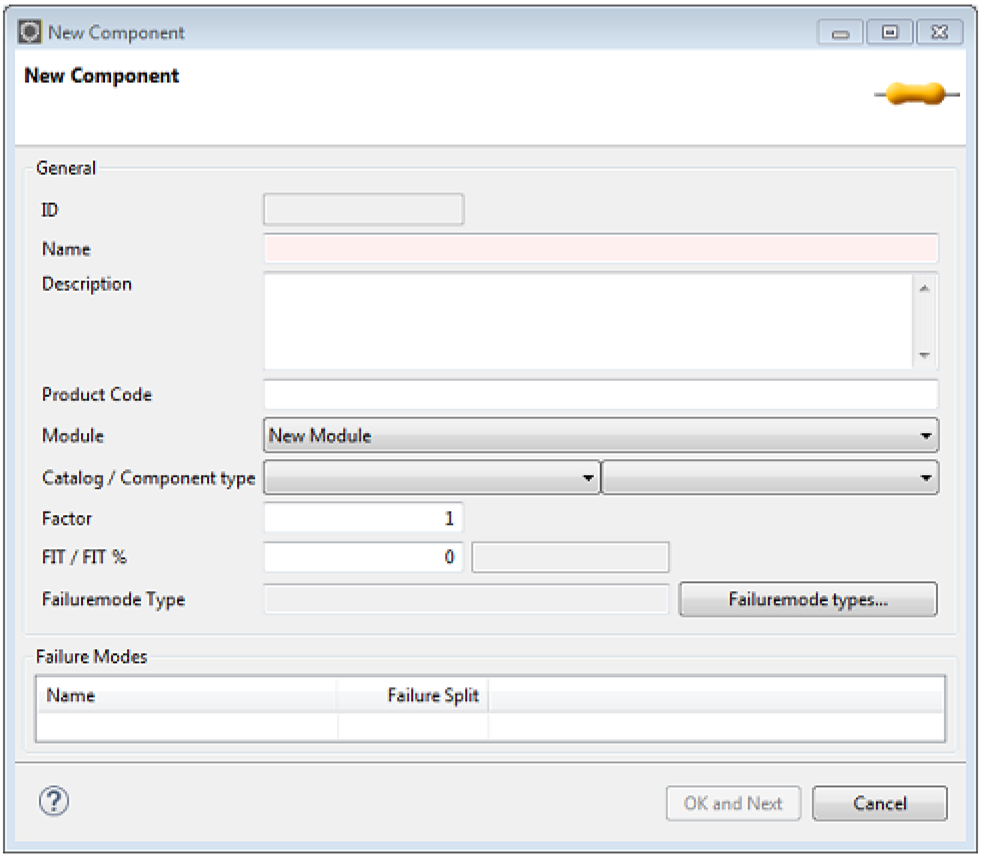


fig. "New Componen"t dialog

1. Enter a name for the component.
2. Optionally, enter a description that helps to understand the content.
3. Enter a product code.
4. Select a module that contains the new component.
5. a) Choose a failure rate catalog and component type if the new component was defined in a catalog.

   b) If you want to manually set the FIT value for the new component, leave these two sections empty.
6. If there are several components of the same type, assign a factor (i.e. the quantity of the component; has direct impact on the value "Total FIT").
7. The FIT value of a component is **defined in the failure rate catalogs** and will be **set automatically**.
8. Click on **Failure mode types...** to choose a failure mode type from the failure mode catalogs.
9. Click **OK and Next** to confirm and create a further component.

→ A component was created and added to the selected module.

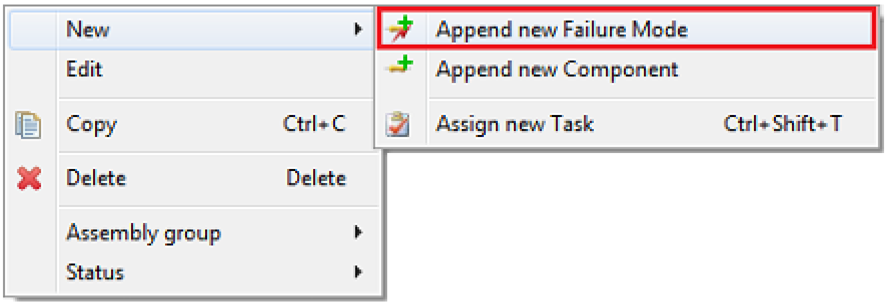
Note

The FIT for components of the IEC62380 catalog can only be calculated if there is a mission and temperature profile determined and selected in the FIT Details view.

Creating New Failure Modes

Precondition: A component was created.

1. Right-click on a component in the BOM editor.



2. Choose **New > Append New Failure Mode.**

   ► The dialog "New Failure Mode" opens.

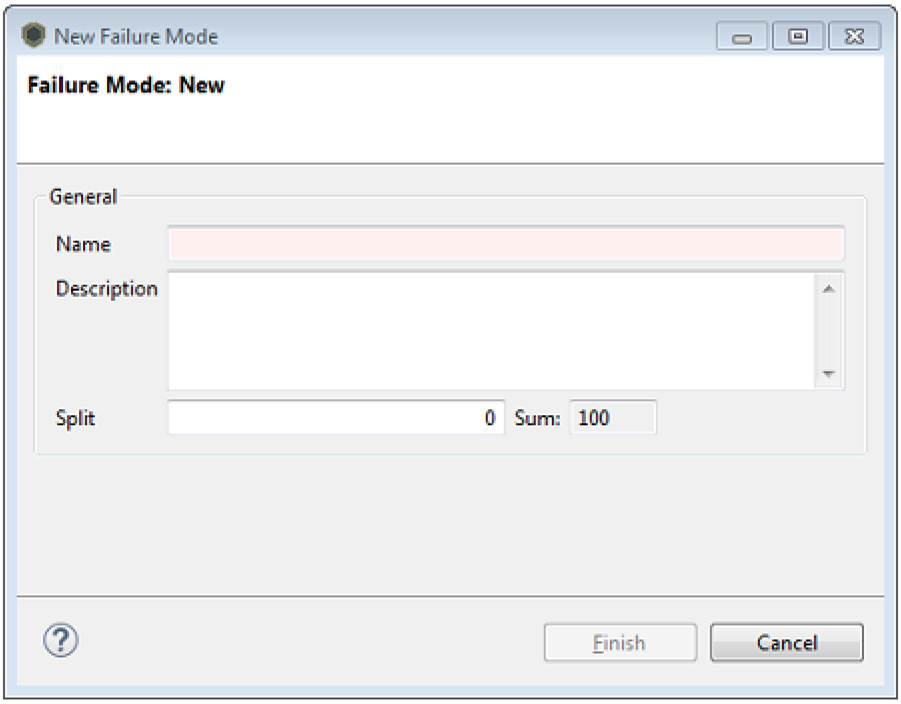


fig. "New Failure Mod"e dialog

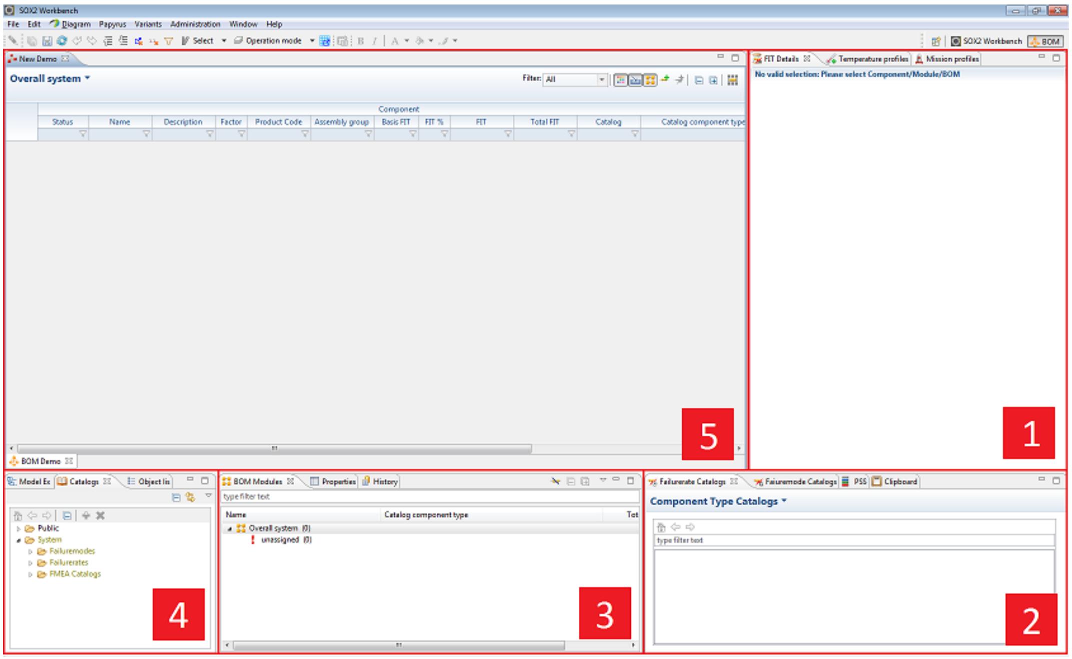
The distribution (in percent) for the failure mode is used for calculating the probability for this failure mode to occur for this type of element. The sum of all possible failure modes for an element's type must be equal to 1.

If the sum of failure mode distribution is not 1, SOX issues a warning.

Print

The BOM can be printed as an FMEDA report. Click on **File** > **Print** to get to the "FMEDA Report" wizard.

The User Interface



No valid selection: Please select Component/Module/BOM

fig. Reliability User Interface

[1] FIT Details view, Temperature profiles view, Mission profiles view

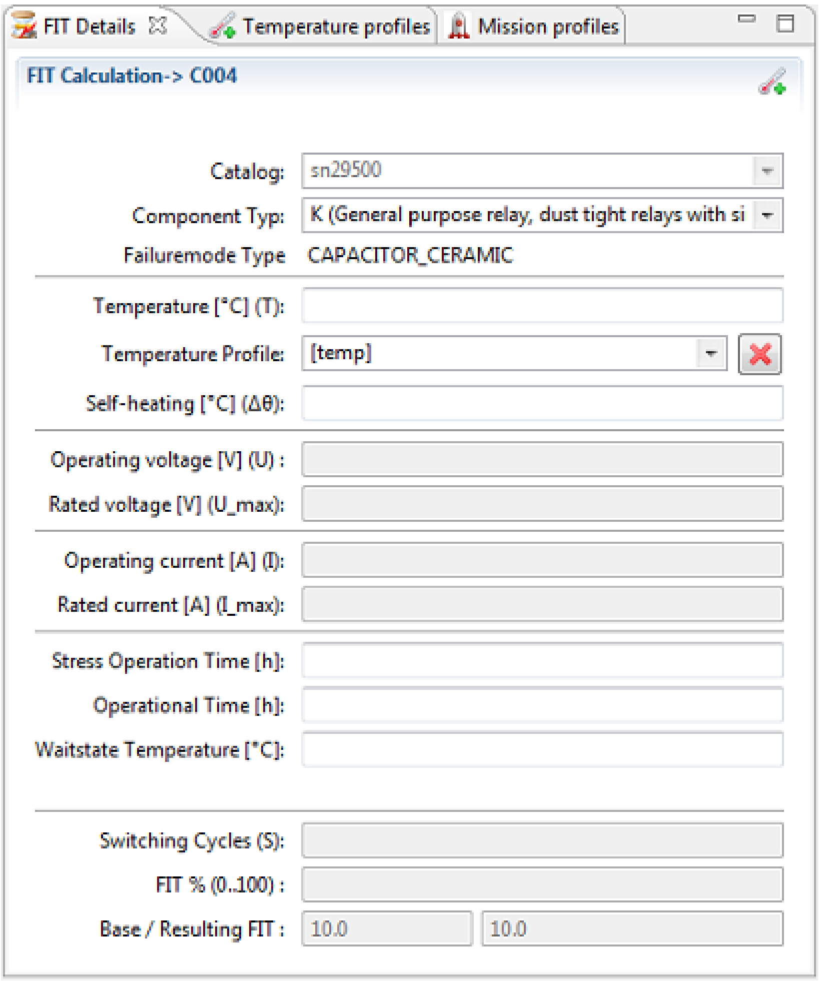
[2] Failure rate Catalogs, Failure mode Catalogs, PSS, Clipboard

[3] BOM Modules, Properties, History

[4] Model Explorer, Catalogs, Object list

[5] BOM Editor

FIT Details



FIT Calculation-> C004

Catalog: sn29500
Component Typ: K (General purpose relay, dust tight relays with si
Failuremode Type CAPACITOR_CERAMIC
Temperature [°C] (T):
Temperature Profile: [temp]
Self-heating [°C] (Δθ):
Operating voltage [V] (U) :
Rated voltage [V] (U_max):
Operating current [A] (I):
Rated current [A] (I_max):
Stress Operation Time [h]:
Operational Time [h]:
Waitstate Temperature [°C]:
Switching Cycles (S):
FIT % (0..100) :
Base / Resulting FIT : 10.0 10.0

fig. "FIT Detail"s view (sn29500)

( ) = Physical symbol

[ ] = Physical unit

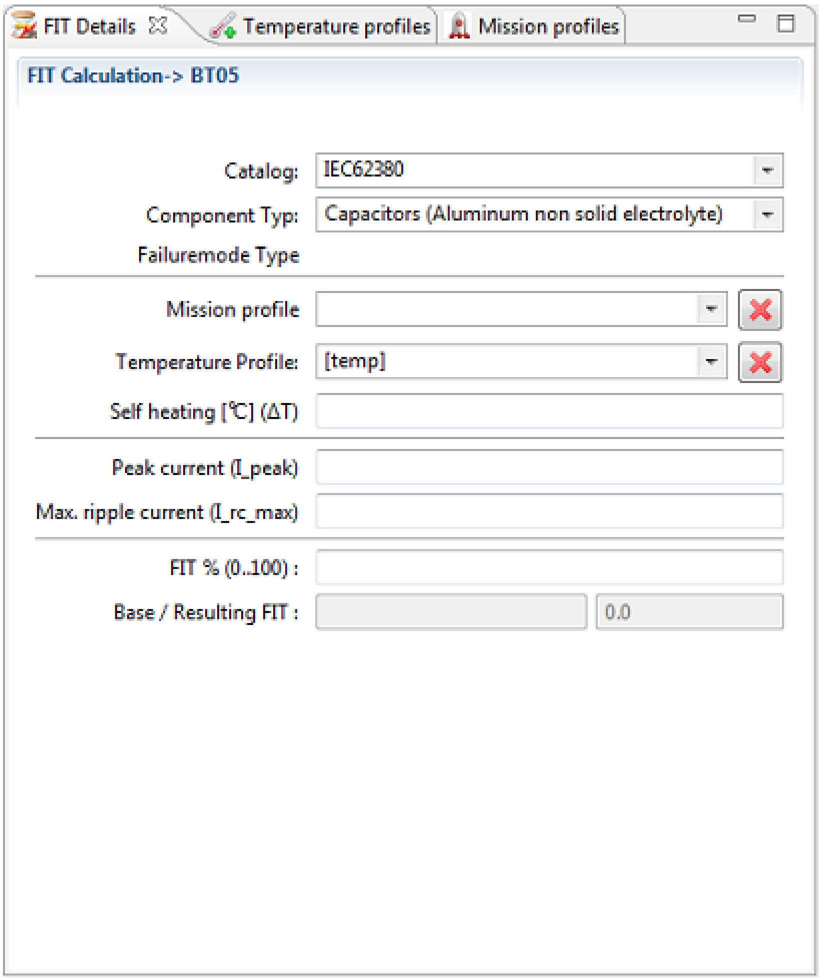
At first you need to select a component that is connected to a catalog and component type. If you click on this component this view appears to the right of the BOM editor. **Some fields are grayed out so you cannot enter values. This depends on the catalog and component type you use.** In the example above we used the catalog "sn29500" and the component type "K (General purpose relay...)". For this type there is only the "Stress Operation Time", "Operational Time" and "Waitstate Temperature" available.

- Catalog: Component catalog. Either "sn29500" or "IEC62380".

- Component type: The type of your component that you have chosen in the "New Component" dialog.

- Failure mode type: Your selected failure mode if you have chosen one from the catalog. If you have created your own failure mode in the "New Failure mode" dialog, this line will not be shown here, only the types from a catalog.

The values of the attributes are from the corresponding norm "sn29500" or "IEC62380". To change the values, you have to edit the failure mode catalog.



FIT Calculation-> BT05

Catalog: IEC62380
Component Typ: Capacitors (Aluminum non solid electrolyte)
Failuremode Type
Mission profile
Temperature Profile: [temp]
Self heating [°C] (ΔT)
Peak current (I_peak)
Max. ripple current (I_rc_max)
FIT % (0..100) :
Base / Resulting FIT : 0.0

fig. "FIT Detail"s view (IEC62380)

- Catalog: Comes from your selection in the "New Component" dialog.

- Component Type: Comes from your selection in the "New Component" dialog.

- Failure Mode Type: If there is a Failure mode type connected to your component, this type will be shown here. If there is no failure mode or you have created your own, this field is empty.

- Mission profile: In this section you have to select an existing mission profile. Dealing with mission profiles will be shown in the chapter Mission profiles.

- Temperature Profile: You need a temperature profile for the FIT calculation. If you have more than one profile, choose a specific profile from the list after clicking the arrow. Temperature profiles will be discussed in the next chapter.

Temperature Profiles

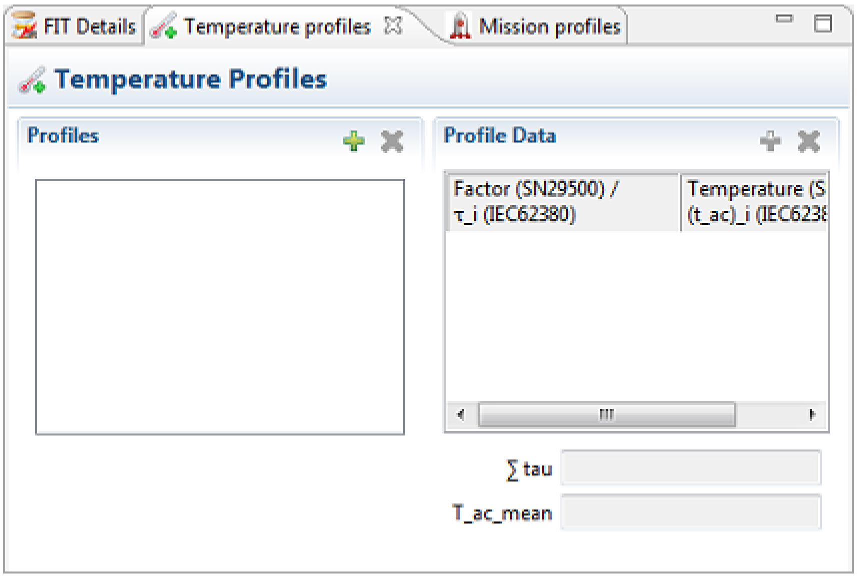


fig. "Temperature profile"s view

In this section we will discuss the functions and values of the temperature profiles view. In the picture above you can see the standard view without any content. In the first step you have to add a profile:

Precondition: The Temperature profiles view is opened.

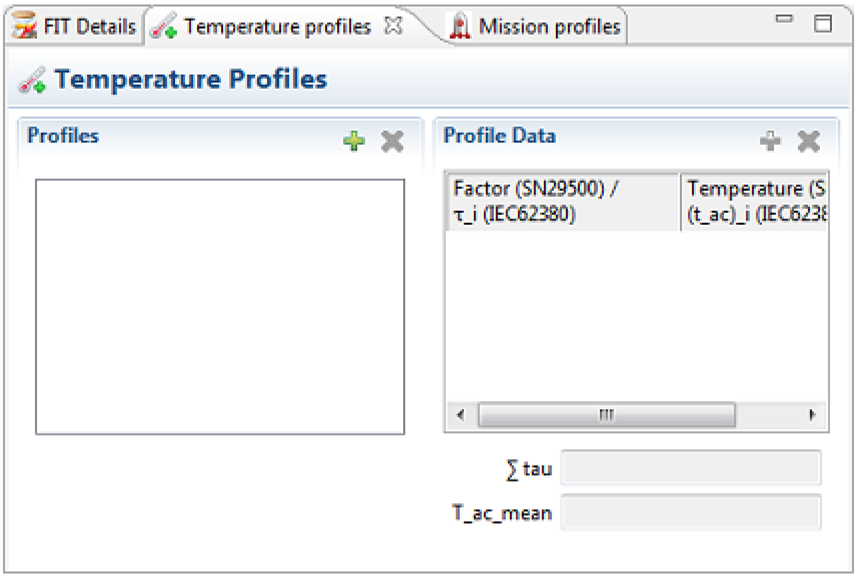


fig. "Temperature profile"s view

1. In the profiles section, click on the plus icon: ✚

   ► The "New profile" dialog opens.

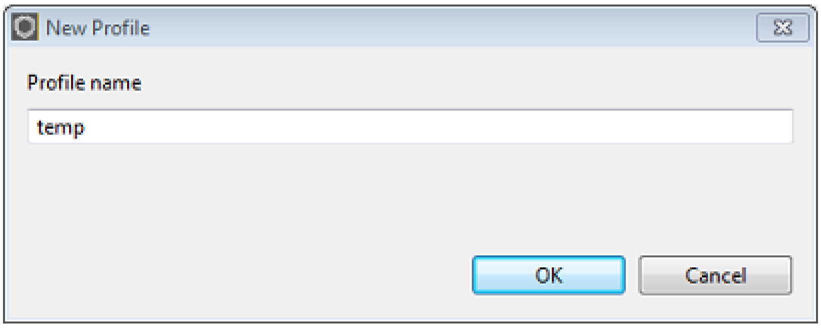


fig. "New Profil"e dialog

2. Click **OK**.

► The new temperature profile was added to the "Profiles" section.

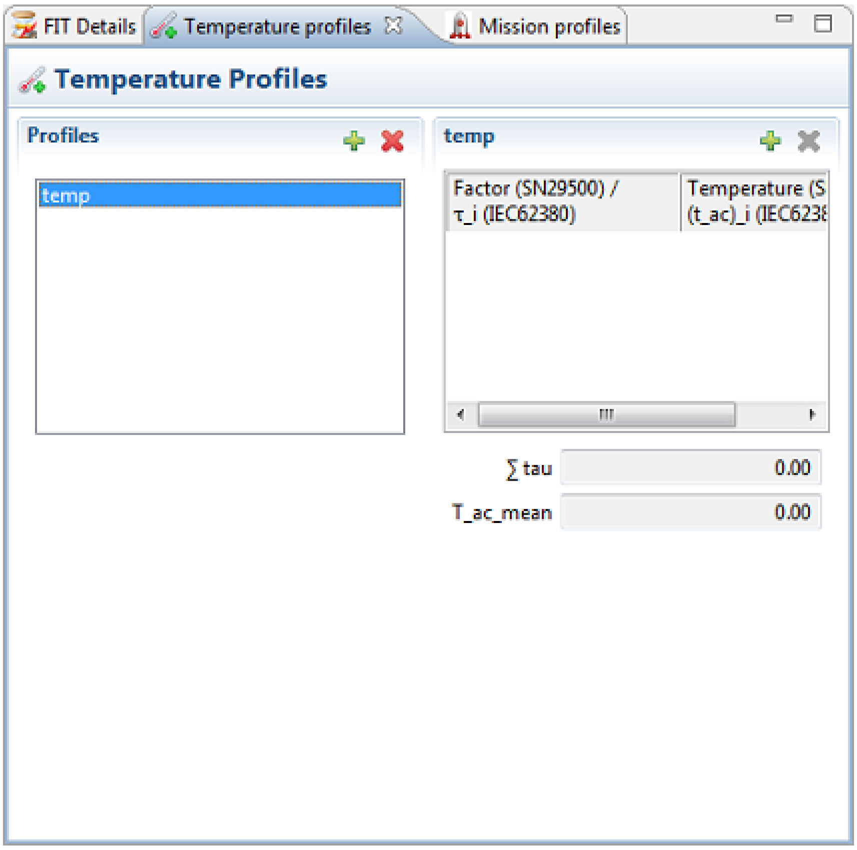
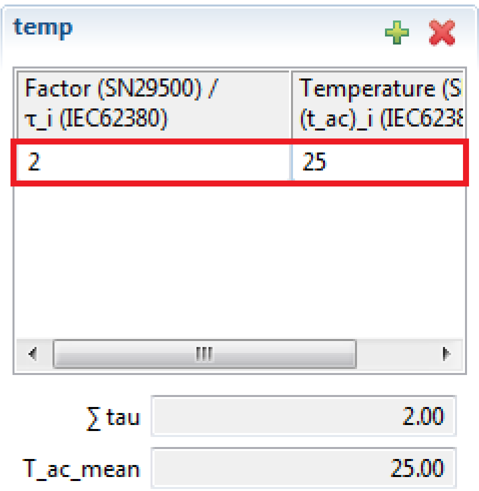


fig. "Temperature profil"es view with custom profile

3. Select a temperature profile with a left-click.

4. Click on the plus icon ✚ in the temp value section.

► Cells for factor and temperature appear.



Factor (SN29500) / τ_i (IEC62380)	Temperature (S (t_ac)_i (IEC623
2	25

∑ tau 2.00

T_ac_mean 25.00

fig. Temp value section

5. Enter values for factor (i.e. the weighting of the temperature) and temperature. Further values can be entered by clicking on the plus button: ✚

→ A temperature profile with its values was created and can be assigned to components.

(t_ac)_i	Environmental temperature
τ_i	Factor for calculation with the according temperature (t_ac)_i . (Weighting of the temperature)
Σ tau	Sum of all τ_i
T_ac_mean	Average environmental temperature

Mission Profiles

Another important feature for the calculation of Total FIT is the Mission profiles view.

This view is only relevant for IEC62380.

Mission profiles are used to define working phases. Any number of working phases may be included within a mission profile.

Later, the mission profiles can be assigned in the FIT Details view.

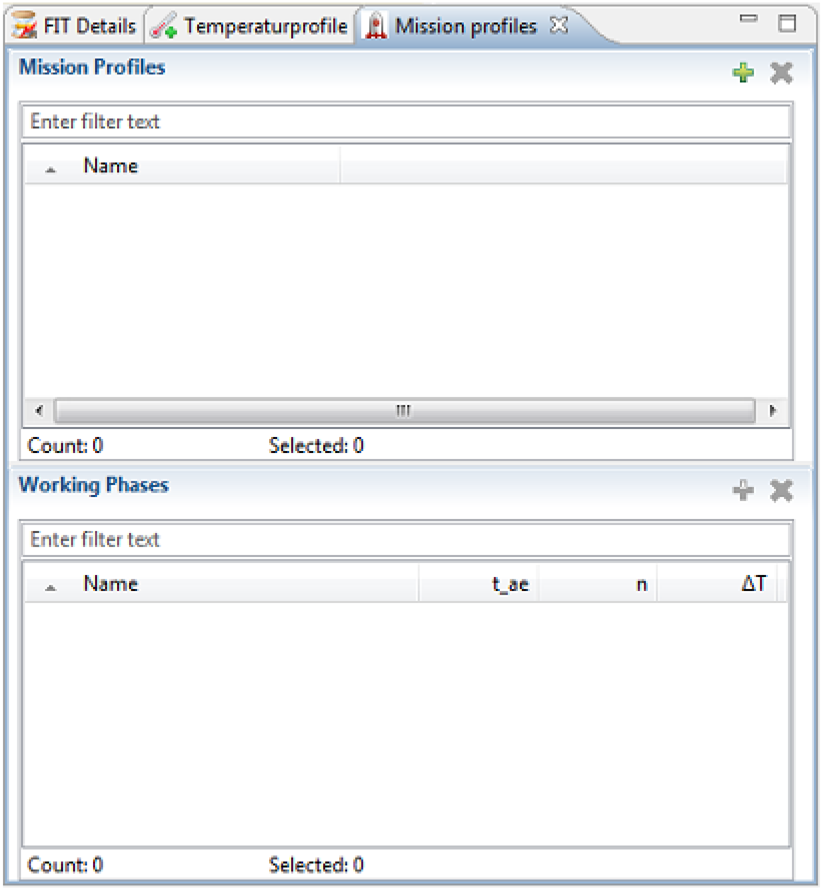


fig. "Mission Profile"s view

Here in the Missions profiles view you can add and edit profiles. To add a new mission profile, click the green plus symbol ✚ on the upper right corner.

A mission profile has to be broken down into several homogeneous working phases, on the basis of a typical year of use. The following phases have to be taken into account:

- On/off working phases with various average outside temperatures

- Permanent-working phases with various average outside temperature swings

- Storage/dormant phases mode with various average outside temperature swings. For a reliability calculation, the time quantity is the number of calendar hours of the installed population of this equipment, including working as well as storage/dormant hours.

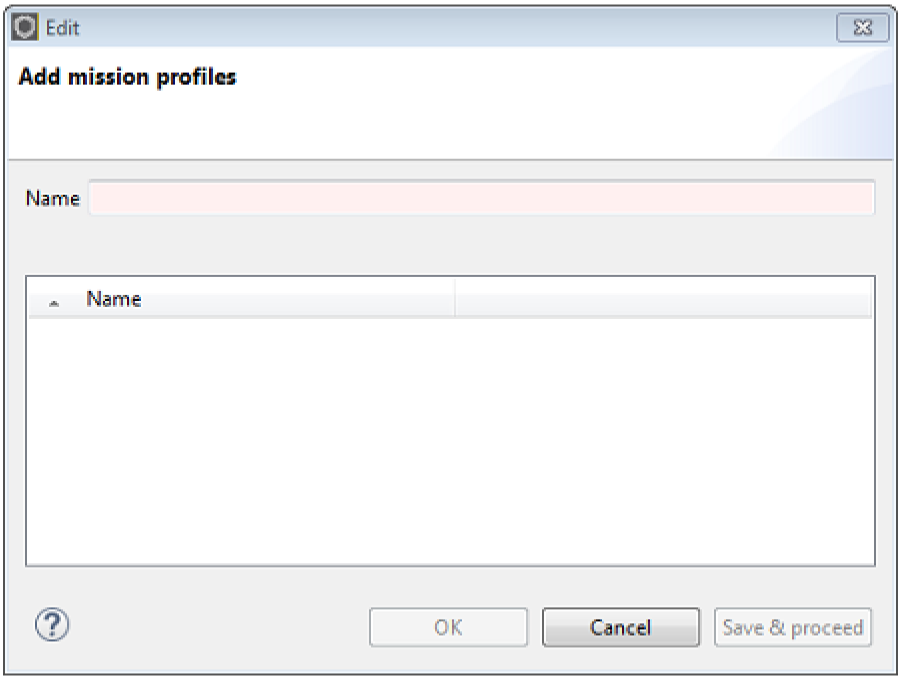


fig. "Add mission profile"s dialog

Enter here the name for your mission profile and click **OK** to add it. If you want to create more profiles immediately, click **Save & proceed**.

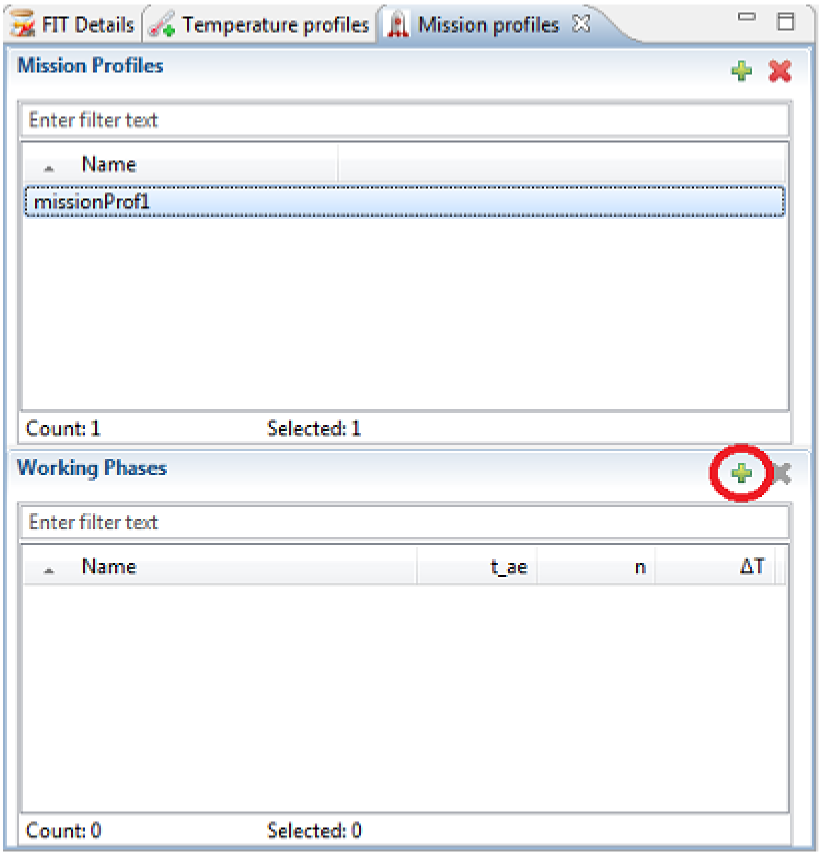
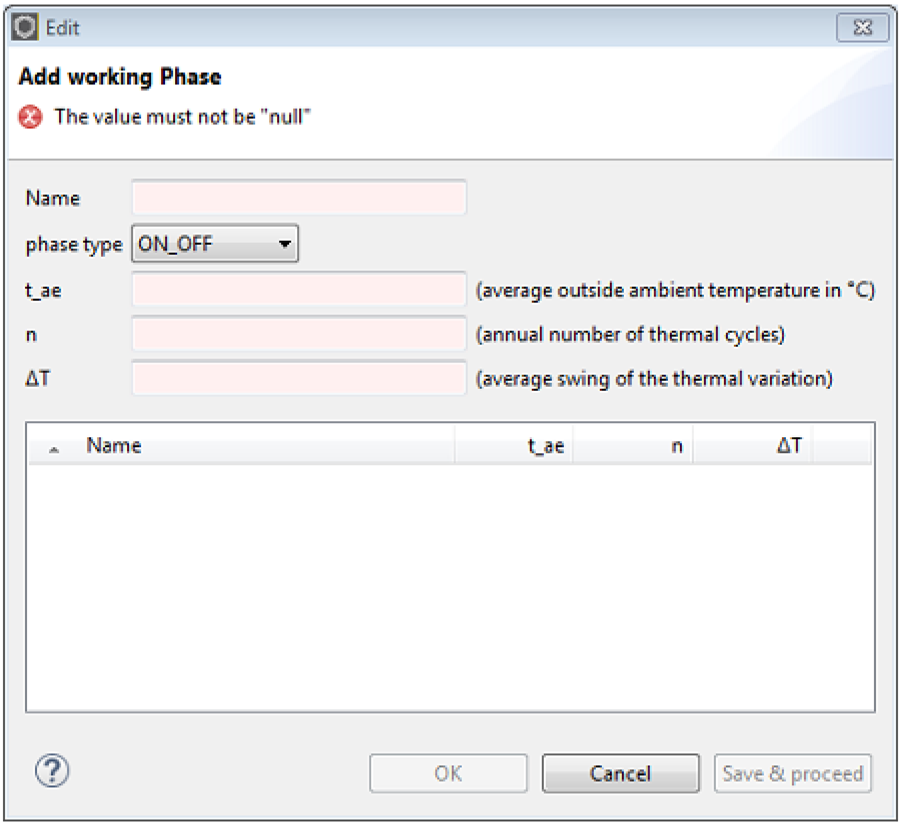


fig. Adding a Working Phase

If you have created a mission profile, select it and add a working phase with a click on the green plus ✚ symbol.



Add working Phase

The value must not be "null"

Name

phase type ON_OFF

t_ae (average outside ambient temperature in °C)

n (annual number of thermal cycles)

ΔT (average swing of the thermal variation)

Name	t_ae	n	ΔT

fig. "Add working Phas"e dialog

Now you have to add information to the working phase in this dialog. The following list describes the values which have to be entered:

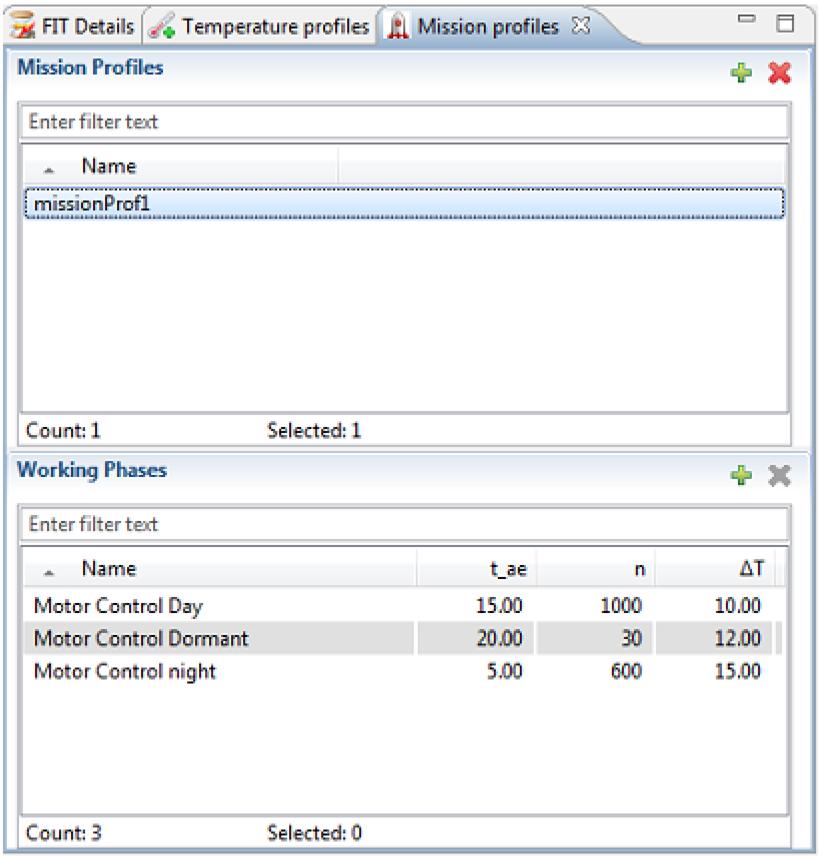
- Name: The name of this working phase.

- phase type: ON_OFF, Permanent or dormant

- t_ae: average outside environmental temperature surrounding the equipment, during the i^th phase of the mission profile.

- n: annual number of thermal cycles seen by the components of the PCB, corresponding to the i^th phase of the mission profile with an average swing Δ T.

- ΔT : average swing of the thermal variation seen by the components of the PCB, corresponding to the i^th phase of the mission profile.



Name
missionProf1

Count: 1 Selected: 1

Name	t_ae	n	ΔT
Motor Control Day	15.00	1000	10.00
Motor Control Dormant	20.00	30	12.00
Motor Control night	5.00	600	15.00

Count: 3 Selected: 0

fig. Mission Profiles

If you are done, use this mission profile in the FIT details for IEC62380 catalogs.

Failure Rate Catalogs

SOX provides the **IEC62380** and the **SN29500** failure rate catalogs which contain categories and component Types. They are implemented with installing SOX. The catalogs are stored in the System folder in the Catalogs view.

Note

Failure rate- and failure mode catalogs in the System folder can not be edited!

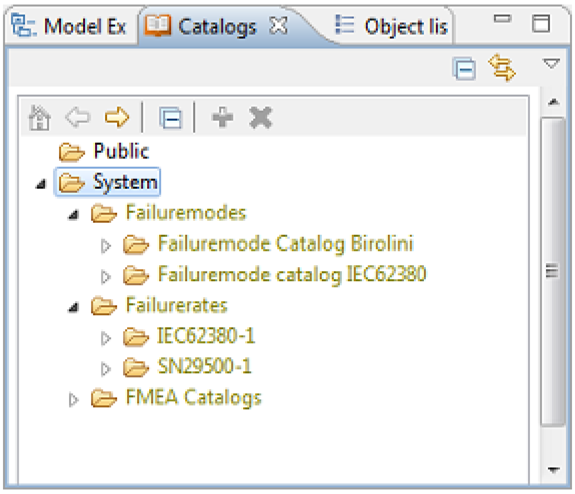
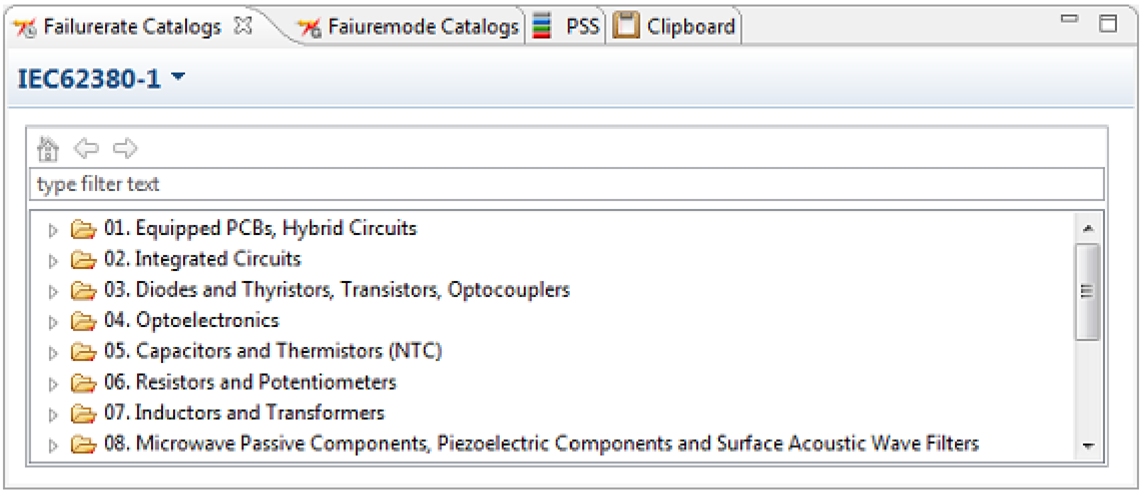


fig. "Catalog"s view

The Failure Rate Catalogs view displays all failure rate catalogs from the System and Public folder. Use this view to assign failure rates to components via drag & drop. Different catalogs can be selected with the triangle ▼ symbol.



- 01. Equipped PCBs, Hybrid Circuits
- 02. Integrated Circuits
- 03. Diodes and Thyristors, Transistors, Optocouplers
- 04. Optoelectronics
- 05. Capacitors and Thermistors (NTC)
- 06. Resistors and Potentiometers
- 07. Inductors and Transformers
- 08. Microwave Passive Components, Piezoelectric Components and Surface Acoustic Wave Filters

fig. "Failure Rate Catalog"s view

Note

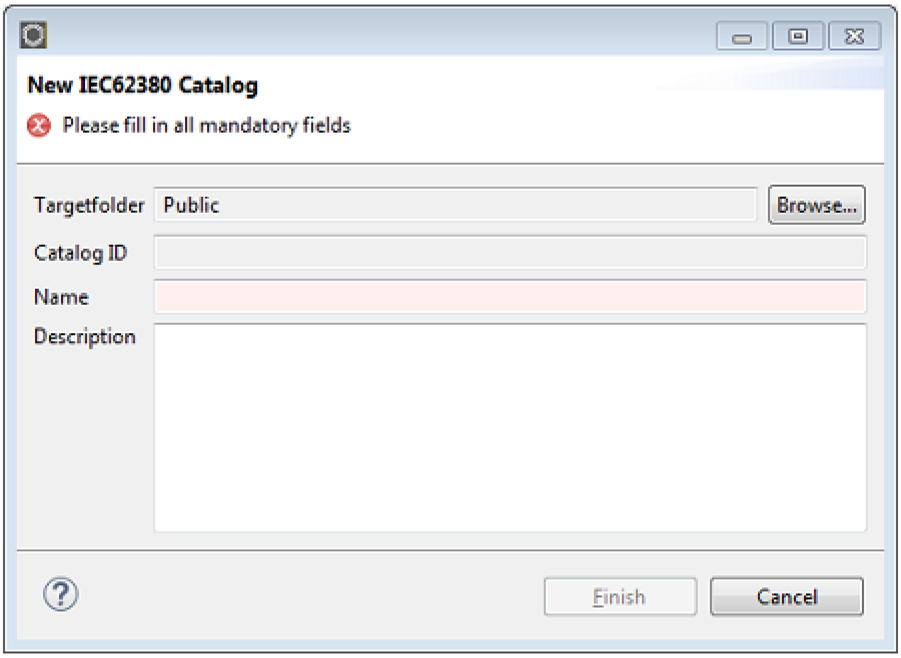
In this view the catalogs can not be edited. Use the public folder in the Catalogs view for creating, importing and editing catalogs.

Creating a New Failure Rate Catalog

Precondition: The Catalogs view is active.

1. Right-click on the Public folder.
2. Choose **New** > **Failure rate catalog (IEC62380 or SN29500)**

   ► The dialog "New IEC62380/SN29500 Catalog" opens.


New IEC62380 Catalog

Please fill in all mandatory fields

Targetfolder: Public

Catalog ID:

Name:

Description:

fig. "New IEC62380 Catalo"g dialog

3. Use the **Browse** button to specify the file location.

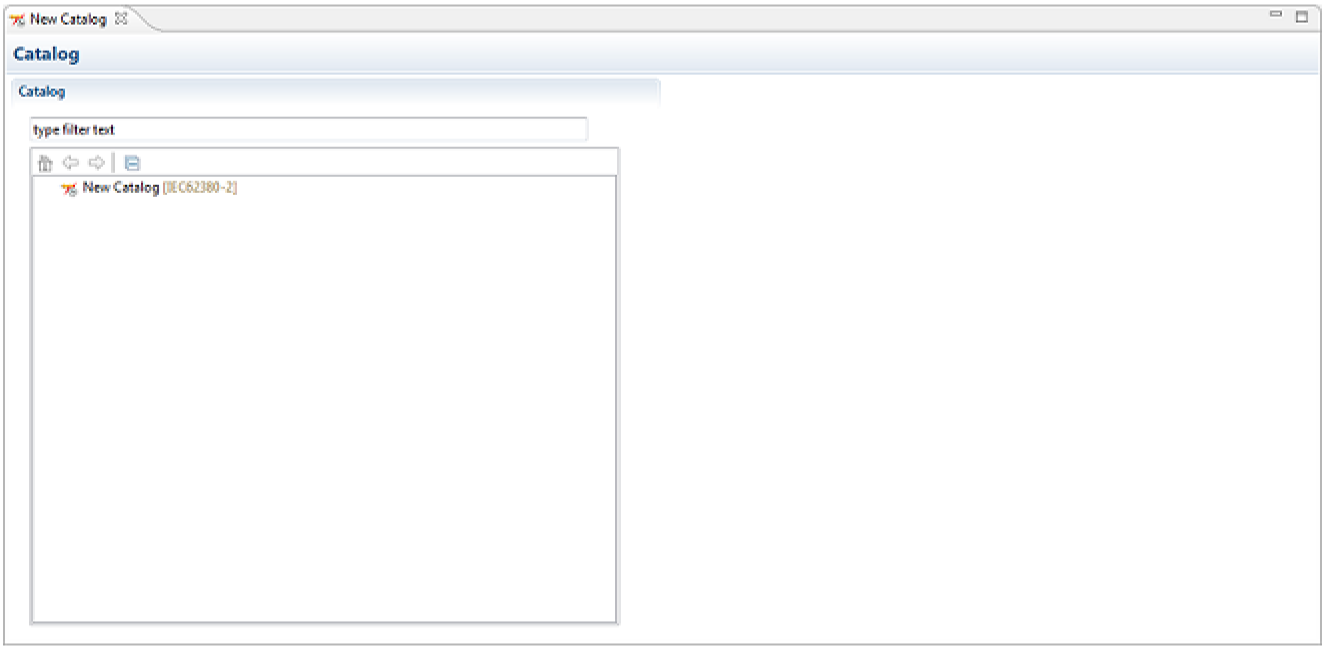
4. The Catalog ID will be set automatically.

5. Enter a name for the catalog.

6. Optionally, enter a description.

7. Click **Finish**.

→ A new catalog was created and opened in the editor.



New Catalog [IEC62380-2]

fig. Catalog editor (IEC62380)

A failure rate catalog is subdivided into categories and failure mode types.

Creating Categories

Precondition: A catalog was created and the catalog editor is active.

1. Right-click on the catalog in the editor.

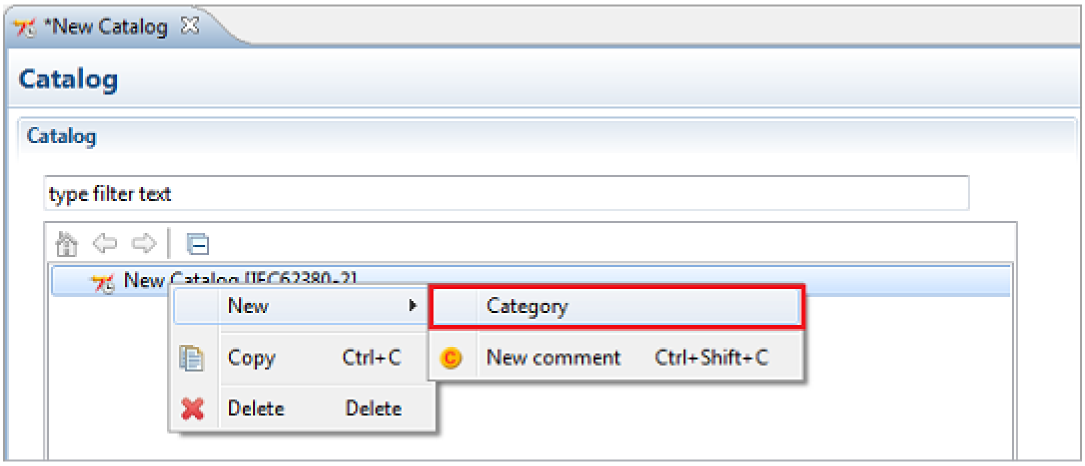


fig. Context menu for new category

2. Choose **New** > **Category**.

   ► The dialog "Create new Category" opens.

3. Enter a name for the category.

4. Click **OK** to finish or **Save & proceed** to create further categories.

→ A category was created.

To create sub-categories you have to select a parent category at first and than repeat the procedure create categories.

Creating Component Types

Precondition: A component category was created.

1. Right-click on the category folder which shall contain the component type.

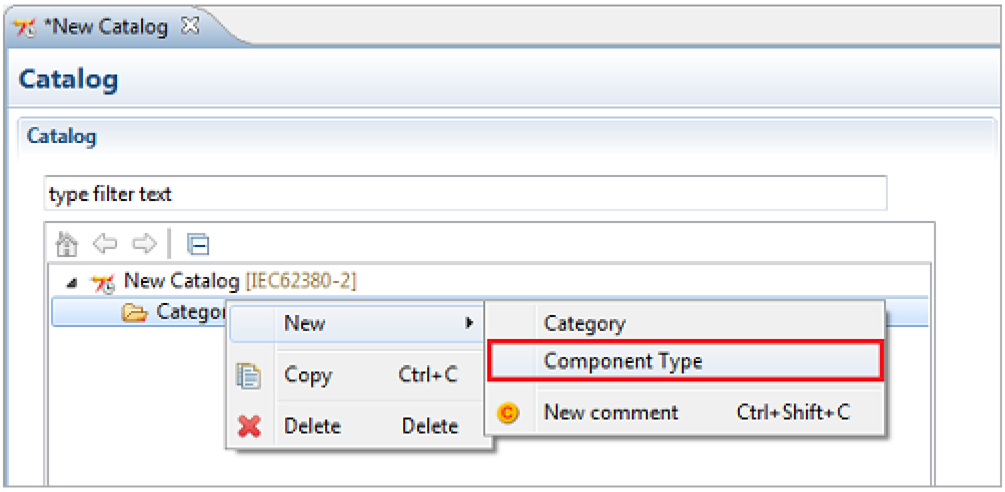
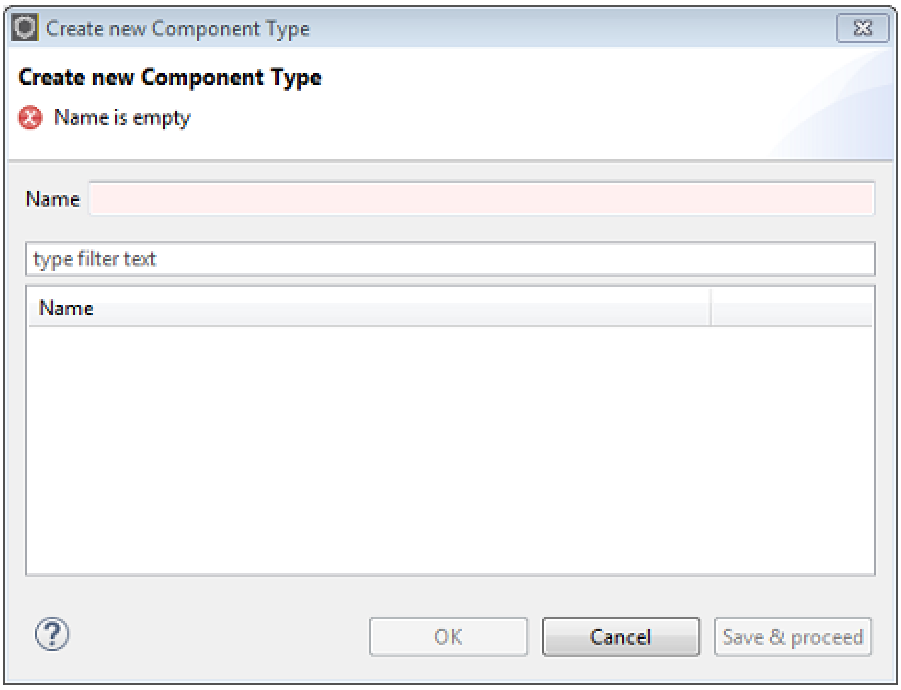


fig. Context menu for new component type

2. Choose **New** > **Component Type**.

   ► The dilalog "Create new Component Type" opens.



Create new Component Type

Name is empty

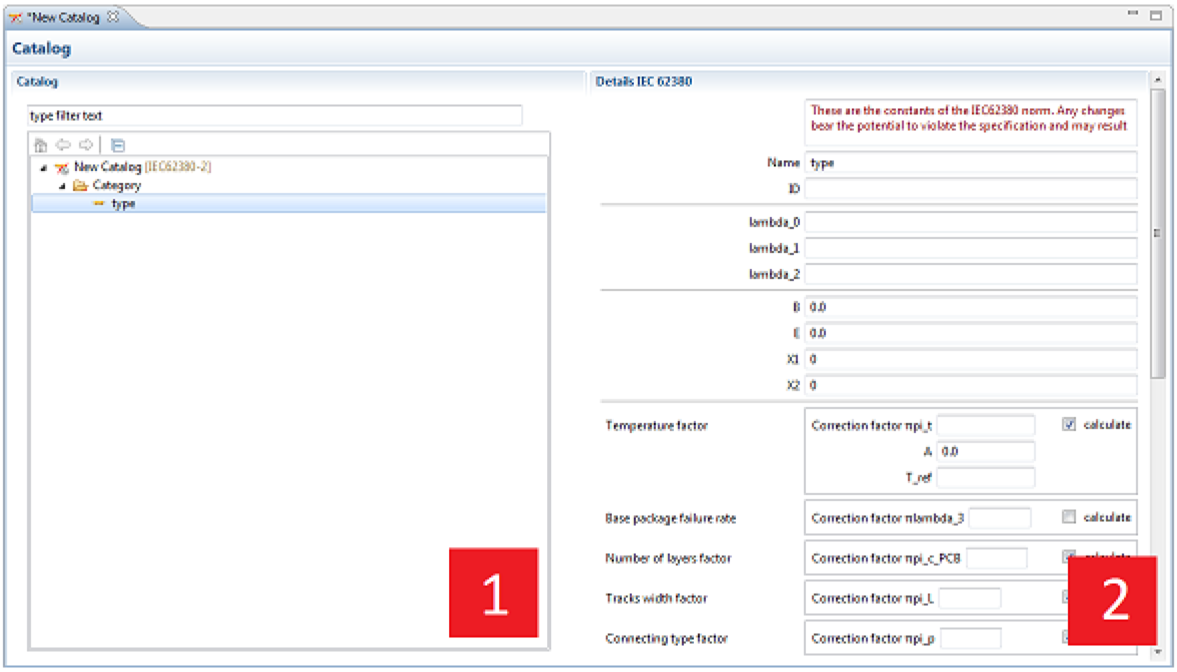
fig. Dialog "Create new Component Typ"e

3. Enter a name for the component type.

4. Click **OK** to finish or **Save & proceed** to create further component types.

→ A new component type was created and added to the selected category.

Now the component type can be edited in the Details part of the Catalog editor.



These are the constants of the IEC62380 norm. Any changes bear the potential to violate the specification and may result

Name: type

ID:

lambda_0:

lambda_1:

lambda_2:

B: 0.0

E: 0.0

X1: 0

X2: 0

Temperature factor: Correction factor npi_t ☑ calculate; A: 0.0; T_ref:

Base package failure rate: Correction factor nlambda_3 ☐ calculate

Number of layers factor: Correction factor npi_c_PCB

Tracks width factor: Correction factor npi_L

Connecting type factor: Correction factor npi_p *fig. Catalog editor with Details according to the IEC62380 scheme*

[1] Catalog explorer

[2] Details of a component type (IEC62380 in this example)

Importing a Failure Rate Catalog

Note

Catalogs can only be imported in the public folder.

1. Right-click in the Catalogs view on the public folder.
2. Choose **Import** > **Catalog**.

   ► The "Import" dialog opens.

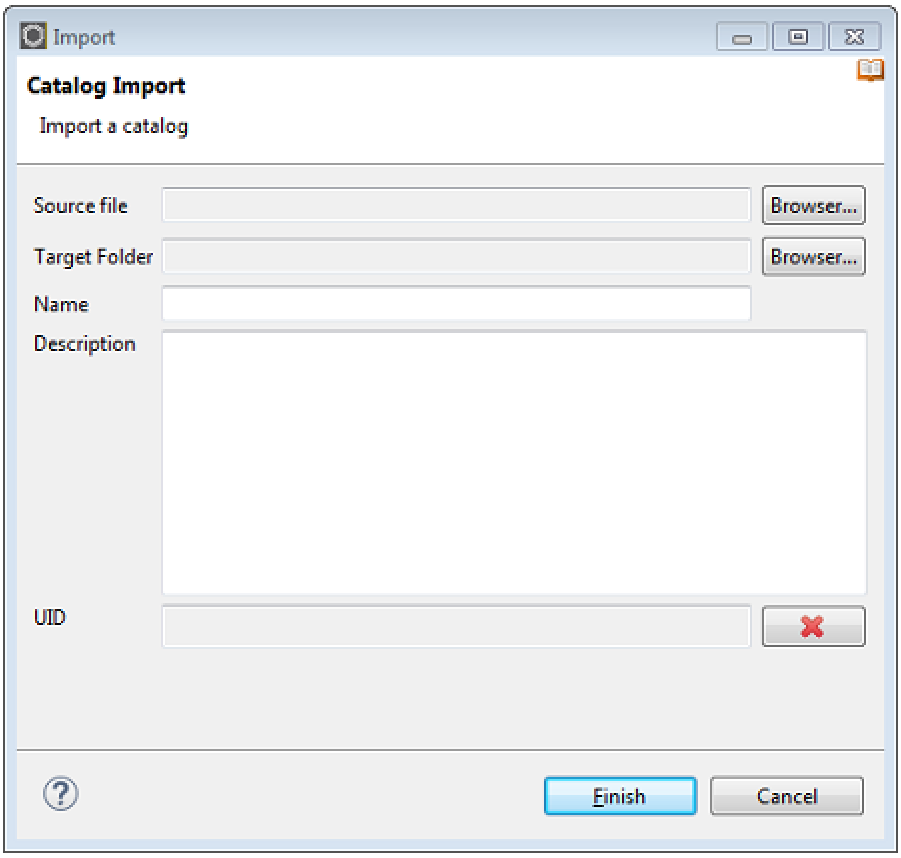
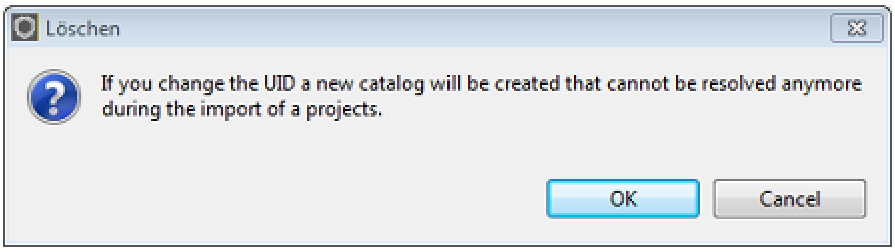


fig. Dialog "Catalog impor"t

3. Click on **Browse...** to choose the desired source file.
4. Click on **Browse...** to choose the target folder
5. Enter a name for the catalog.
6. Optionally, enter a description.
7. The UID will be set automatically. If the UID already exists, click on the button ✖ to generate a new one.



If you change the UID a new catalog will be created that cannot be resolved anymore during the import of a projects.

fig. Alert "Delete UI"D

8. Click on **Finish.**

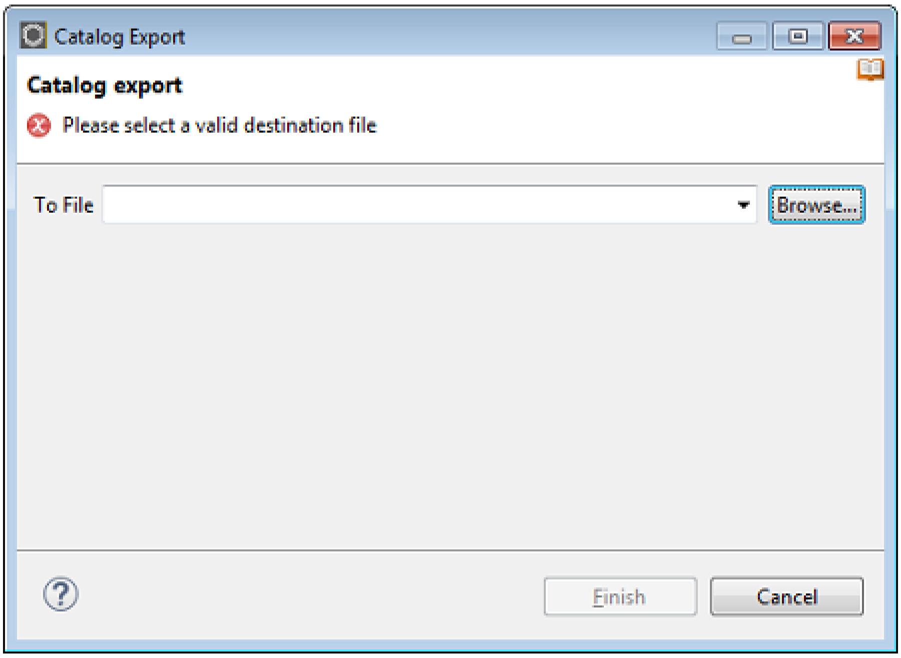
→ A catalog was imported and added to the Public folder in the catalogs view.

Exporting a Failure Rate Catalog

Catalogs can be exported from the System and Public folder.

1. **Right-click** in the Catalogs view on the desired catalog.
2. Choose **Export** > **Catalog**.

► The dialog "Catalog Export" opens.



Catalog export

Please select a valid destination file

To File

fig. Dialog "Catalog Expor"t

3. Click on **Browse** to specify the file location.
4. Click on **Finish**.

→ A catalog was exported and saved to the choose location.

Assign Failure Rates to Components

Failure rates can be assigned in the creating a component procedure or with drag & drop out from the Failure Rate Catalogs view into the editor:

Precondition: A component was created. The Failure Rate Catalogs view and the BOM editor are active.

1. Click on the arrow ▾ button to select a failure rate catalog.

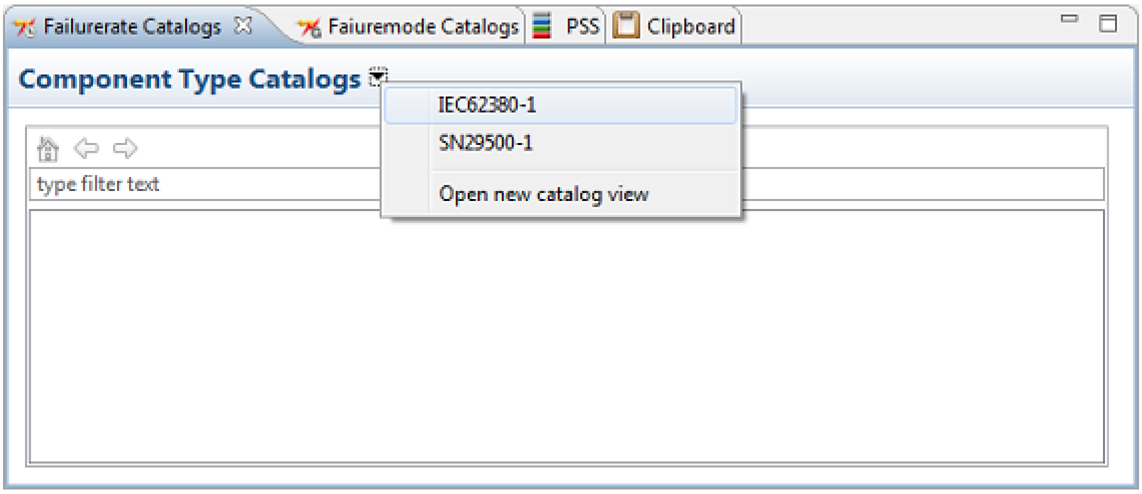


fig. Failure rate catalog selection

► The selected catalog will be displayed.

2. Select the desired failure rate.

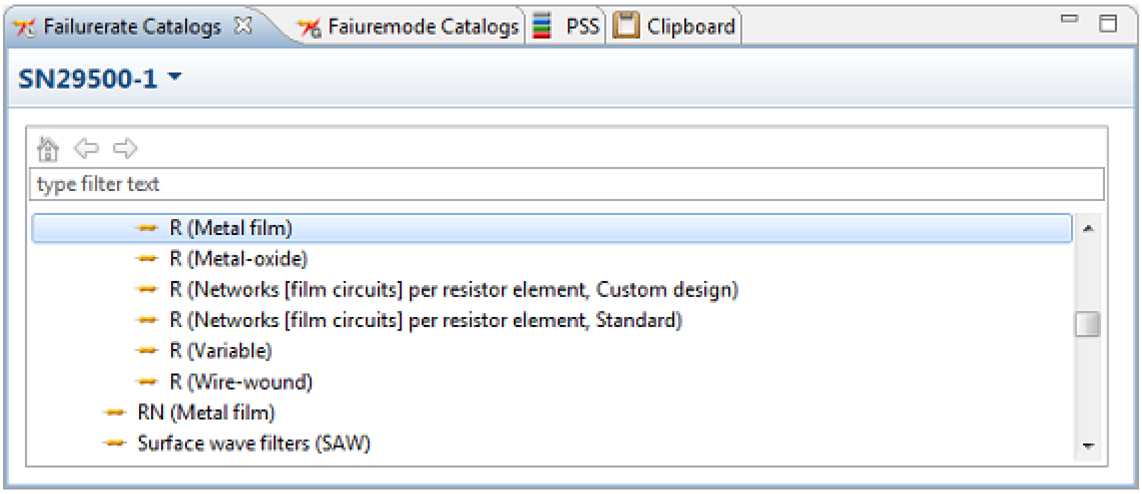
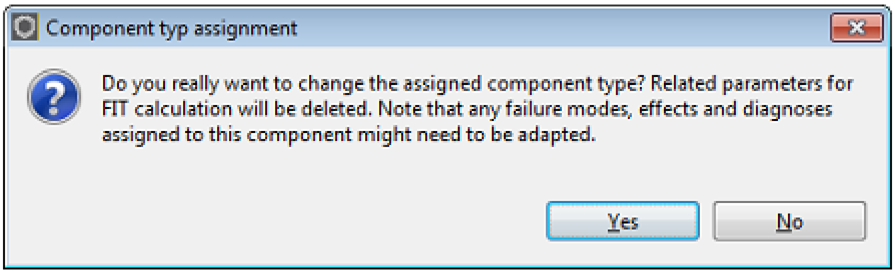

Failurerate Catalogs
Faiuremode Catalogs
PSS
Clipboard
SN29500-1
type filter text
R (Metal film)
R (Metal-oxide)
R (Networks [film circuits] per resistor element, Custom design)
R (Networks [film circuits] per resistor element, Standard)
R (Variable)
R (Wire-wound)
RN (Metal film)
Surface wave filters (SAW)

fig. Failure rate selection

3. Drag & drop it into the convenient column in the BOM editor.

►The alert "Component type assignment" opens.


Component typ assignment

Do you really want to change the assigned component type? Related parameters for FIT calculation will be deleted. Note that any failure modes, effects and diagnoses assigned to this component might need to be adapted.

fig. Component type assignment alert

4. Click **Yes** to adopt the parameters.

→ A failure rate with its parameters has been assigned to a component.

Failure Mode Catalogs

SOX provides the **IEC62380** and the **Birolini** failure mode catalogs which contain failure mode types and failure modes. They are implemented with installing SOX. The catalogs are stored in the System folder in the Catalogs view.

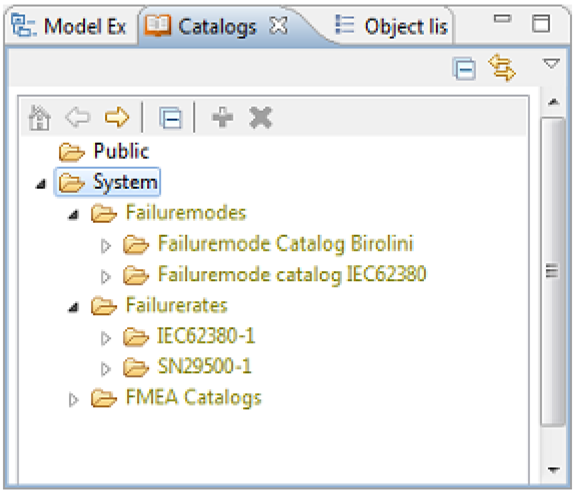


fig. "Catalog"s view

The Failure mode catalogs view displays all failure mode catalogs from the System and Public folder. Use this view to assign failure modes to components via drag & drop. Different catalogs can be selected with the triangle ▼ symbol.

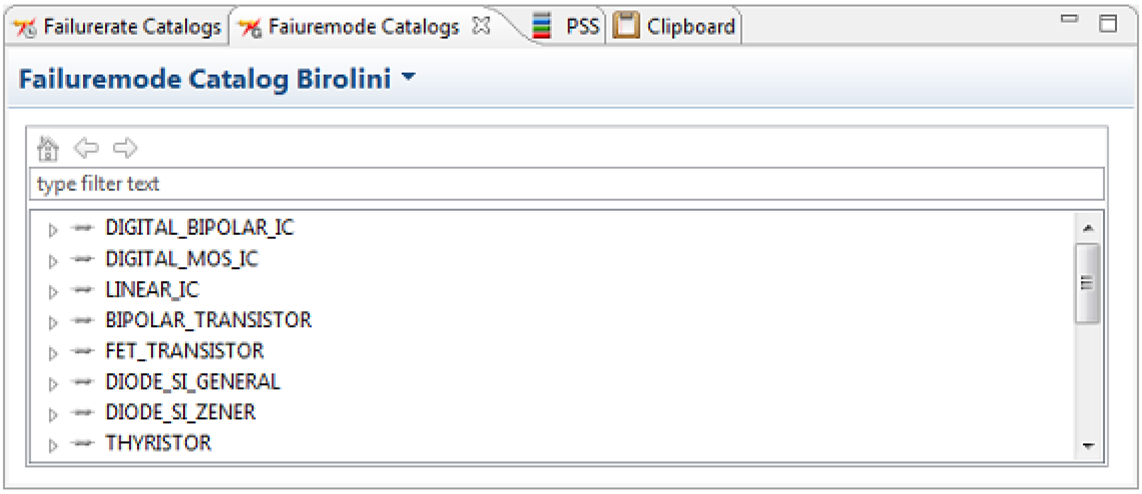


fig. "Failure mode catalog"s view

Note

In this view the catalogs can not be edited. Use the public folder in the Catalogs view for creating, importing and editing catalogs.

Note

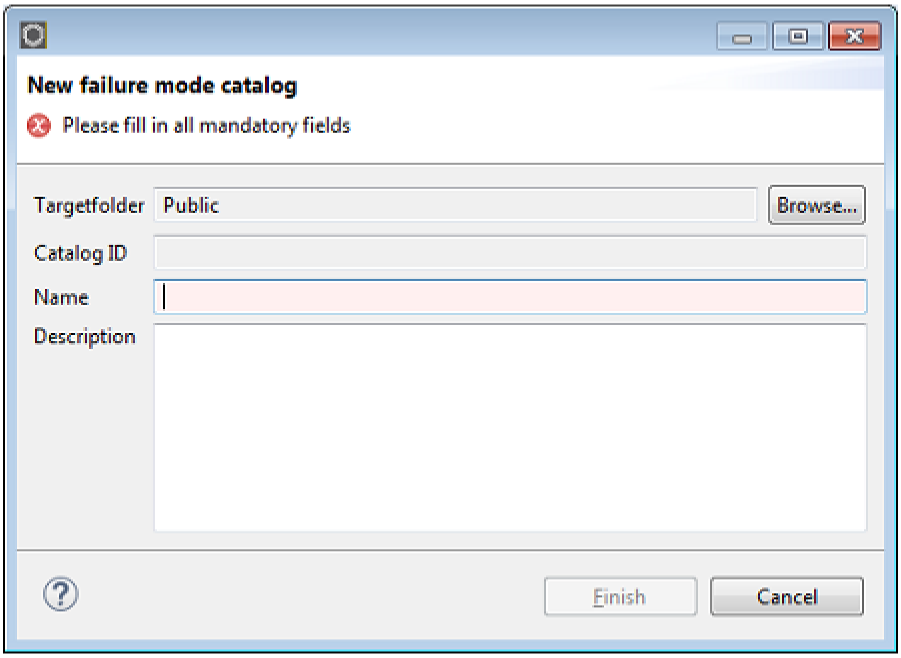
Failure rate- and failure mode catalogs in the System folder can not be edited!

Creating a New Failure Rate Catalog

Precondition: The Catalogs view is active.

1. Right-click on the Public folder.
2. Choose **New** > **Failure mode catalog**.

► The dialog "New failure mode catalog" opens.



New failure mode catalog

Please fill in all mandatory fields

Targetfolder: Public

fig. Dialog "New failure mode catalo"g

3. Click **Browse** to specify the file location.
4. The Catalog ID will be set automatically.
5. Enter a name for the catalog.
6. Optionally, enter a description.
7. Click **Finish**.

→ A new catalog has been created and opened as an editor.

Creating New Failure Mode Types.

Precondition: A catalog was created and the catalog editor is active.

1. Right-click on the catalog in the editor.

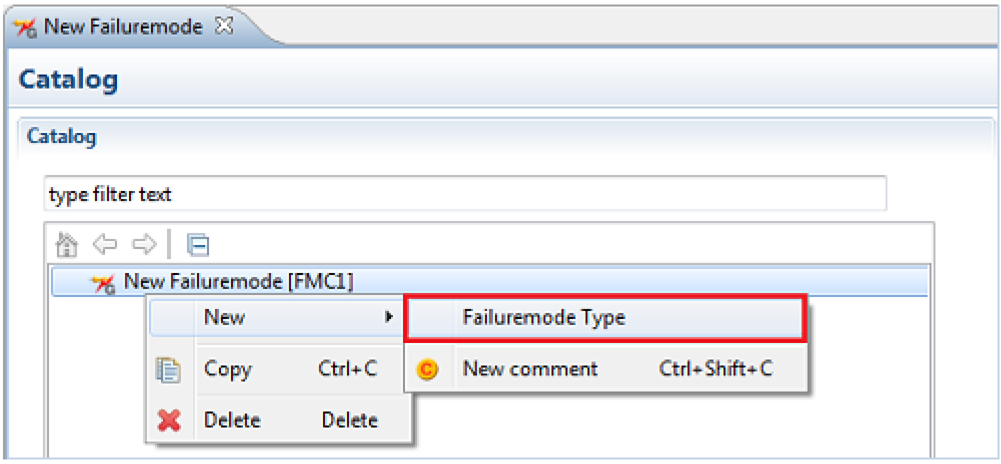
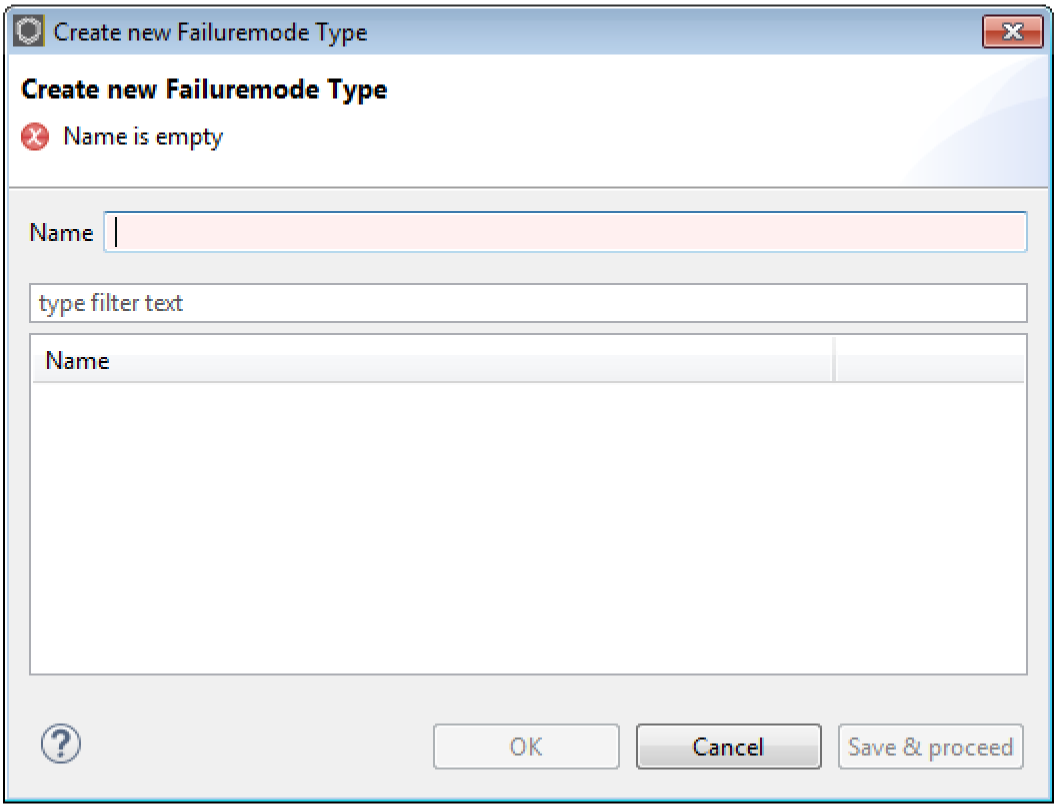


fig. Context menu for new failure mode type

2. Choose **New** > **Failure mode type**

► The dialog "Create new Failure Mode Type" opens.



Name is empty

fig. Dialog "Create new Failure Mode Typ"e

3. Enter a name for the failure mode type.

4. Click **OK** to finish or **Save & proceed** for creating further failure mode types.

→ A failure mode type has been created.

Creating Failure Modes

Precondition: A failure mode type was created.

1. Right-click on the failure mode type which shall contain the component type.

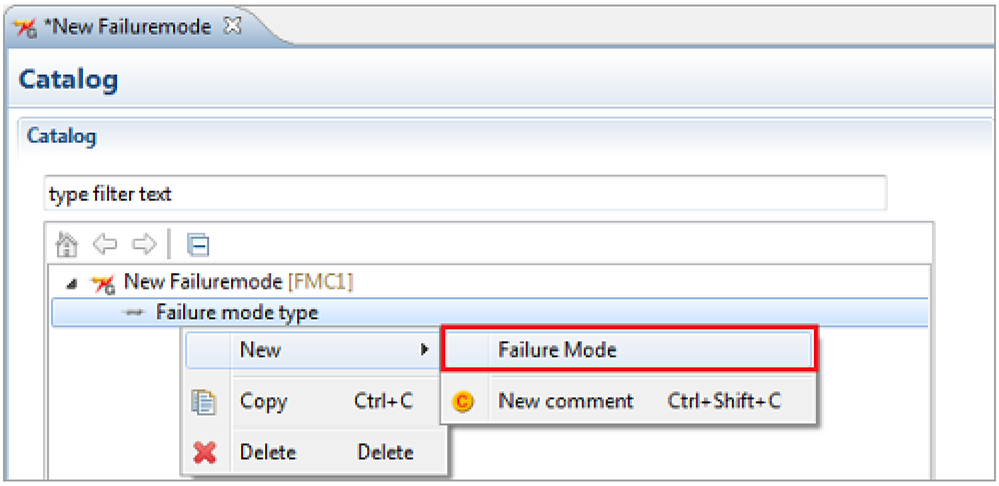


fig. Context menu for new failure mode

2. Choose **New** > **Failure Mode**.

► The dialog "Create new Failure Mode" opens.

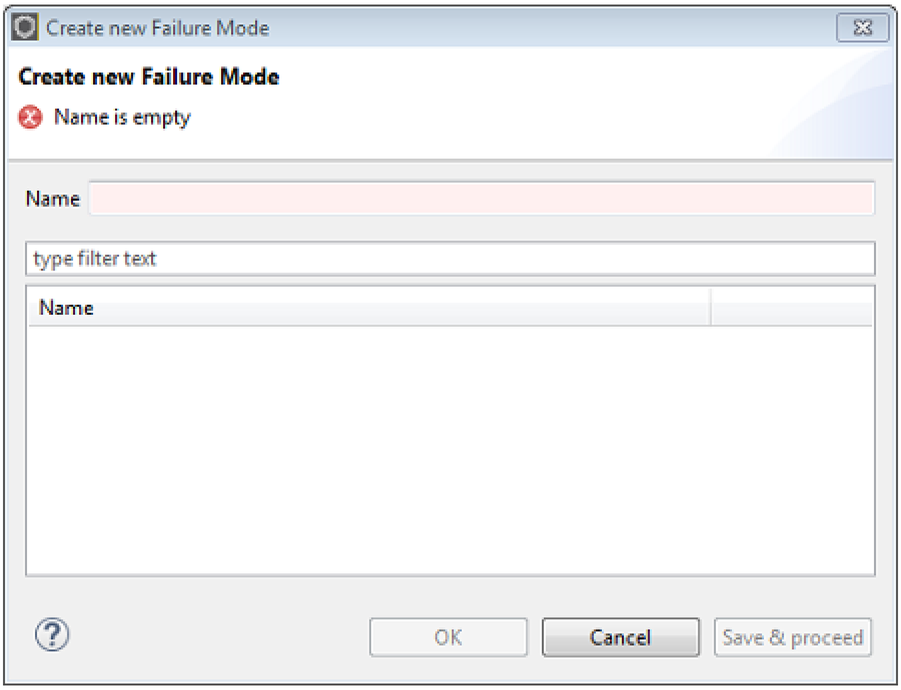


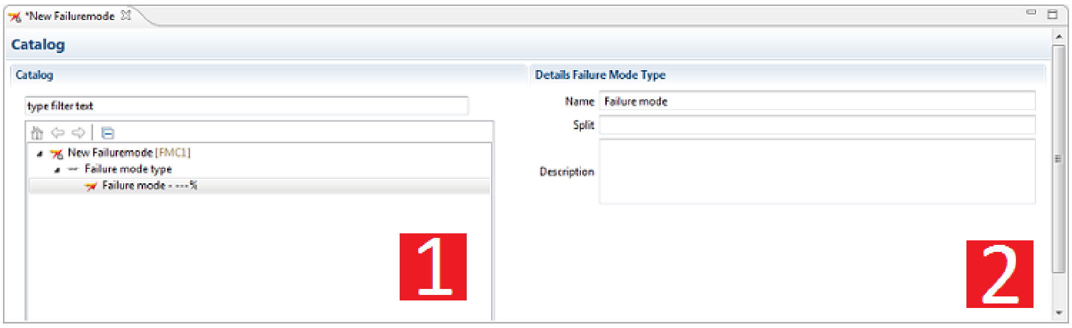
fig. Create new Failure Mode dialog

3. Enter a name for the failure mode.

4. Click **OK** to finish or **Save & proceed** to create further failure modes.

→ A new failure mode was created and added to the selected failure mode type.

Now the failure mode can be edited in the Details part of the Catalog editor.



Name: Failure mode

Split:

fig. Failure mode catalog editor

[1] Catalog explorer

[2] Details of a failure mode type.

Note

The split value of all failure modes has to be 100%.

Assign Failure Modes to Components

Failure modes can be assigned in the creating a component procedure or with drag & drop out from the Failure mode Catalogs view into the editor:

Precondition: A component was created. The Failure Mode Catalogs view and the BOM editor are active.

1. Click on the arrow ▼ button to select a failure mode catalog.

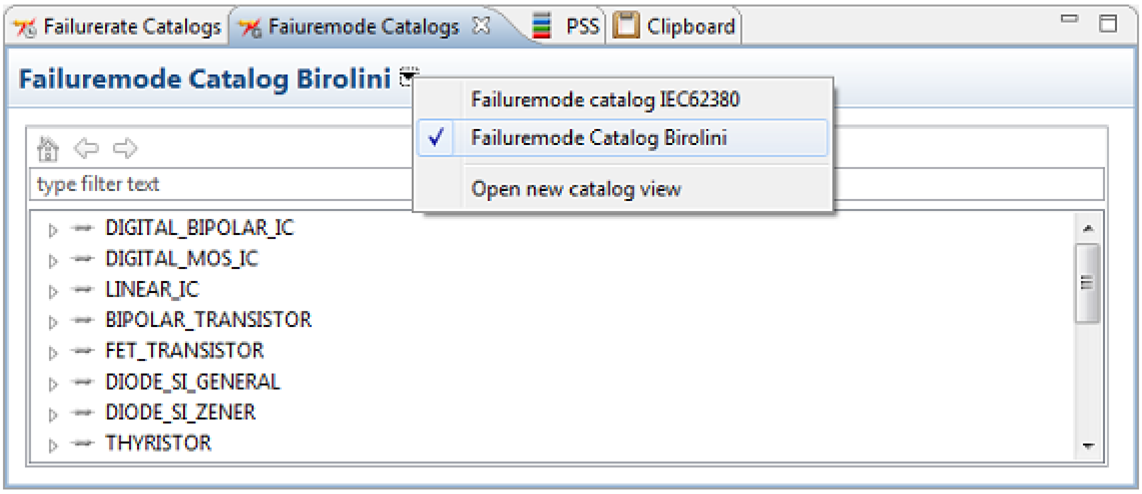


fig. Failure mode catalog selection

►The selected catalog will be displayed.

2. Select the desired failure mode.

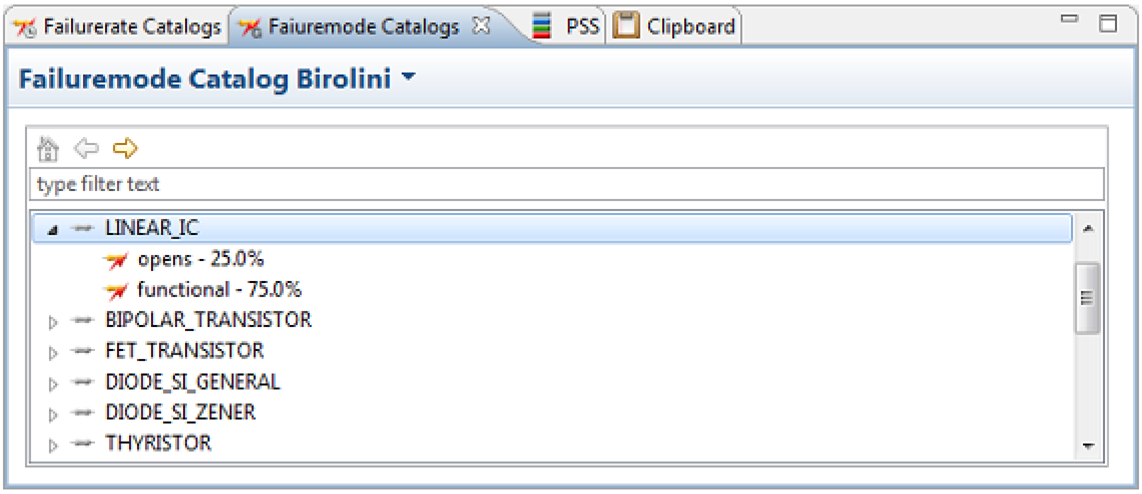


fig. Failure mode selection

3. Drag & drop it into the convenient column in the BOM editor.

→ A failure mode with its parameters was assigned to a component.

BOM Modules

Modules can be defined here so that FIT rates can be calculated modularly (modular FIT calculation for different functional groups).

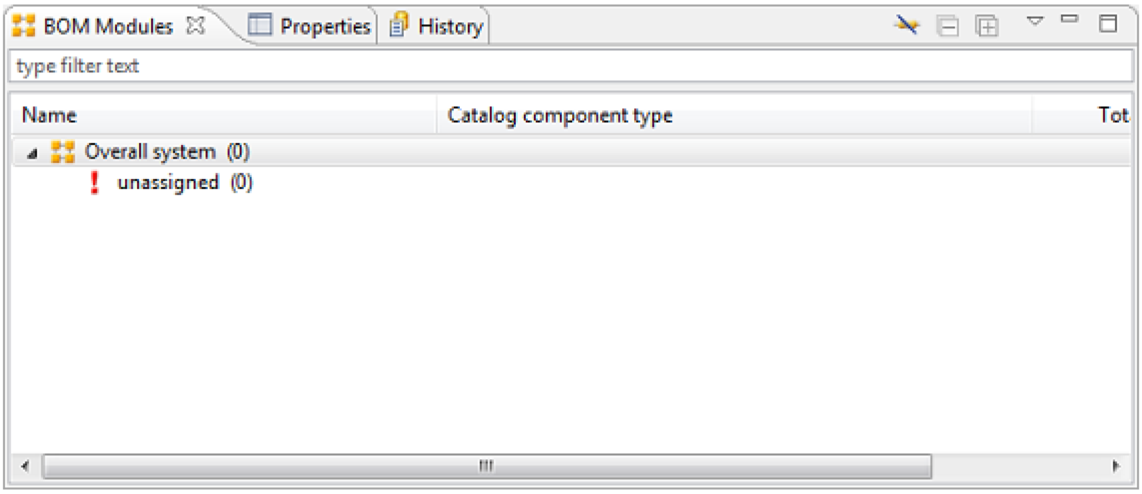


fig. BOM Modules view

The BOM Modules view shows you the overall system with the different component groups of your BOM and Total FIT/ FIT.

- FIT (Failure in time): This number is calculated from FIT details, temperature profile and mission profiles.

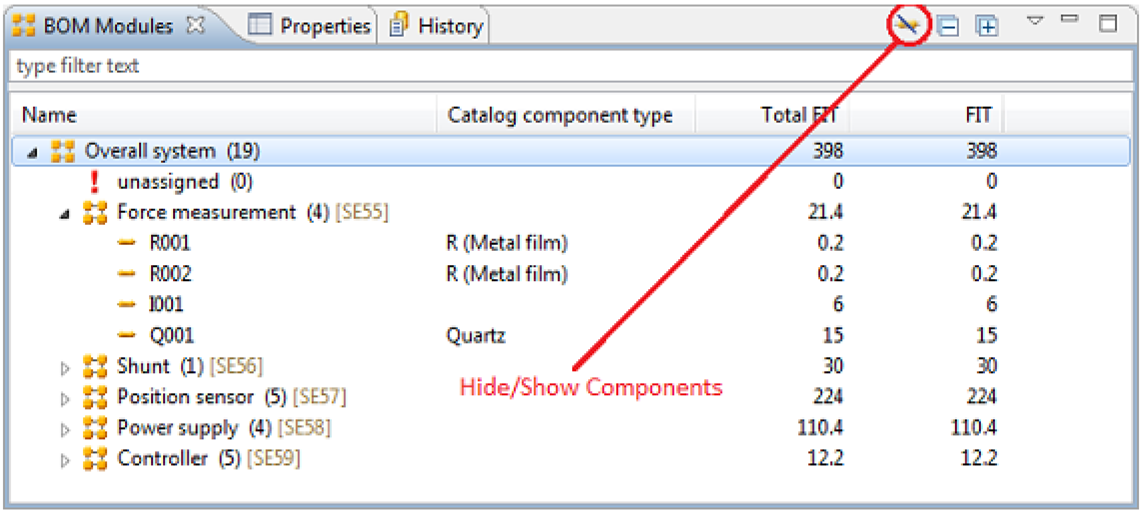
- Total FIT: FIT * Factor = Total FIT

The number in brackets behind modules shows you the number of components in the module. If there are components which are not yet connected to a group, the counter behind "unassigned" will increase.

You can create submodules in the same way as creating BOM modules: Right-click on an existing assembly group and follow the same steps as shown to create a submodule.

Note

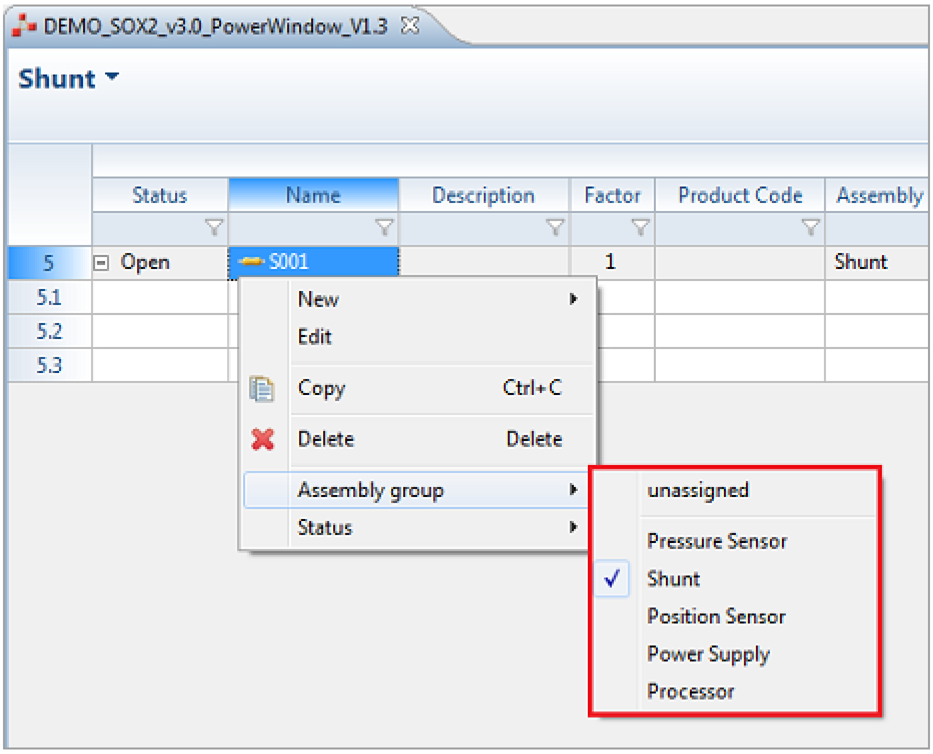
Notice: It's not possible to create more levels of subgroups below an assembly group than one. If you import an Excel project with more than one level of submodules there will be an error message and the import aborts. If this happens please adapt your BOM Excel data so that there are no more than one subgroup.



Name	Catalog component type	Total FIT	FIT
Overall system (19)		398	398
unassigned (0)		0	0
Force measurement (4) [SE55]		21.4	21.4
R001	R (Metal film)	0.2	0.2
R002	R (Metal film)	0.2	0.2
I001		6	6
Q001	Quartz	15	15
Shunt (1) [SE56]		30	30
Position sensor (5) [SE57]		224	224
Power supply (4) [SE58]		110.4	110.4
Controller (5) [SE59]		12.2	12.2

fig. Show / Hide components

To connect components with an assembly group, right-click on the component, go to **Assembly group** and choose the group you need. Another way is to double-click the section in the Assembly group column of your component. Choose your group from the list as shown in the picture below.



	Status	Name	Description	Factor	Product Code	Assembly
5	Open	S001		1		Shunt
5.1						
5.2						
5.3						

fig. Context menu for switching assembly group

BOM Editor

The BOM editor gives an overview on all your components, failure modes, FIT values and much more.

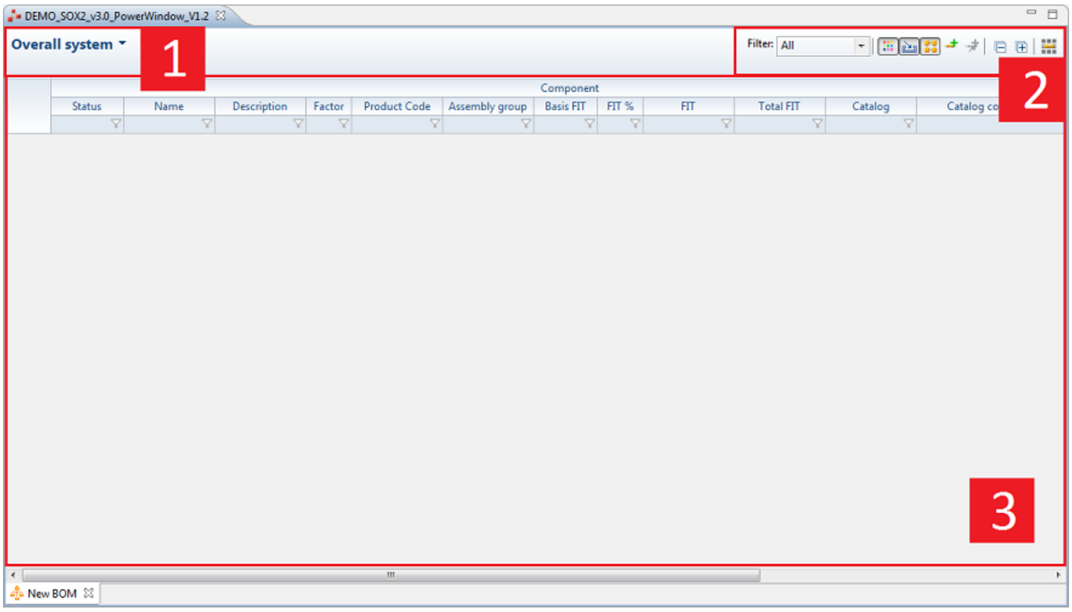


fig. BOM editor

[1] This area shows the actual BOM module. With a click on the triangle ▼ the BOM module can be changed by selecting the desired one.

[2] Tool bar with the following functions:

Filter: All ▾	Decide with this filter which elements should be shown. (All, Not Imported, New, Changed, Deleted)
▦	Toggle Status Colors: Every component status has it's own color (e.g. Review = yellow). Press this button to turn the colors on or off .
⤵	Show state of import: Turn on or off the import status with this button.
▦	Modules: Activate this first if you want to filter for certain modules. Then click on the corresponding module in the BOM Modules view below. Now the BOM editor only shows elements of the selected module.
+	New component: Create a new component with this button.
+	New Failure Mode: Create a new failure mode with this button. This button will be disabled if you haven't selected a component.
⊟ ⊞	Expand-/Collapse all
▦	Switch views Modules/Components: Use this button to change the table either to the Modules view where you see just the BOM modules or to the components view where you can see your components with failure modes.

[3] In this area the BOM is displayed and can be edited.

Status: You can change the status of each component with a double-click on the component in the status column. Then a little list pops up with "Open" (set as standard), "Review" and "Closed". If you want to hide the failure modes of an component, just click the "-" symbol. Click "+" to show them.

Name: This column represents the name of the component. You can change the name with a double-click on the component in the name column.

Description: If you have set a description in the "New Component" dialog, this description will appear in this column. You can add or change the description with a double-click on the field.

Factor: The number of times this component exists in the system. Important for Total FIT:

FIT * Factor = Total FIT

Product Code: Enter your product code for this component.

Assembly group: If there is an existing assembly group, you can connect your component to this group by double-clicking on the component in the assembly group column. A list will pop up from which you have to choose the group if there is more than one.

Basis FIT: The value of "Basis FIT" comes from the Siemens catalog and is fixed. This is set automatically, so you can't change this value if you have chosen a catalog and component type.

FIT %: This is only relevant for modules defined as a component type. FIT % describes the proportion of the component in percent, relative to the Total FIT.

FIT: Is the failure in time value without the factor. The value comes from the chosen catalog. It changes with the manipulation of "FIT Details", "Temperature profiles" and "Mission profiles".

Total FIT: The value of total FIT is calculated from FIT * Factor.

Catalog: The catalog column shows you the catalog of your component. This catalog is set in the "New Component" dialog and can be sn29500, IEC62380 or custom. You can set the FIT value for yourself if you haven't chosen a catalog. This isn't possible if you have chosen a catalog.

Catalog component type: You can find the component type in this column which you have set in the "New Component" dialog.

Additional Functionality

Importing Data from Excel

About the SOX BOM template:

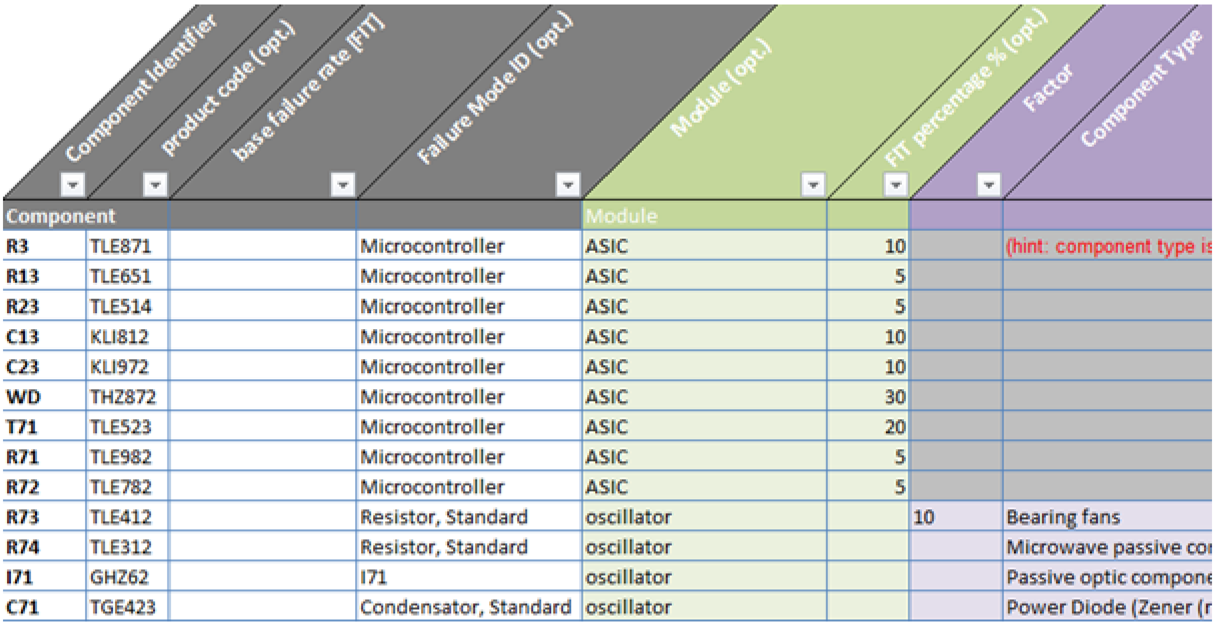
With the SOX BOM template you can exchange data between SOX and Microsoft Excel. You can download the SOX BOM template at the EnCo template section at the Welcome Screen or at the download center. [http://www.enco-software.com/download-site/]It is avlailable for the norms IEC62380 an SN29500.

Decsription of the structure of the BOM template:

The BOM template for Excel has a certain structure that SOX will recognize. Do not change the structure. However, you can add or change information right in Excel. For example, you can add components in the sheet “BOM”. Later when you import the Excel file into SOX2, these changes will be applied in SOX. When you import it into your BOM document, just choose the “EnCo Internal” file format in the import dialog.

The Excel file:

The first sheet in the Excel file („BOM Master File Data“) contains the master file data or metadata about the BOM file. The second sheet (“BOM”) contains the actual bill of materials:



Component Identifier	product code (opt.)	base failure rate [FIT]	Failure Mode ID (opt.)	Module (opt.)	FIT percentage % (opt.)	Factor	Component Type
Component				Module			
R3	TLE871		Microcontroller	ASIC	10		(hint: component type is
R13	TLE651		Microcontroller	ASIC	5		
R23	TLE514		Microcontroller	ASIC	5		
C13	KLI812		Microcontroller	ASIC	10		
C23	KLI972		Microcontroller	ASIC	10		
WD	THZ872		Microcontroller	ASIC	30		
T71	TLE523		Microcontroller	ASIC	20		
R71	TLE982		Microcontroller	ASIC	5		
R72	TLE782		Microcontroller	ASIC	5		
R73	TLE412		Resistor, Standard	oscillator		10	Bearing fans
R74	TLE312		Resistor, Standard	oscillator			Microwave passive co
I71	GHZ62		I71	oscillator			Passive optic compone
C71	TGE423		Condensator, Standard	oscillator			Power Diode (Zener (r

fig. BOM template for Excel, sheet no. 2

The third sheet lists the modules. The forth contains all the component types in the norm. The sheet "Failure Modes" lists the failure modes with ID, name and split (%). The sixth contains the temperature profiles. For the norm IEC62380 there also is a sheet for mission profiles.

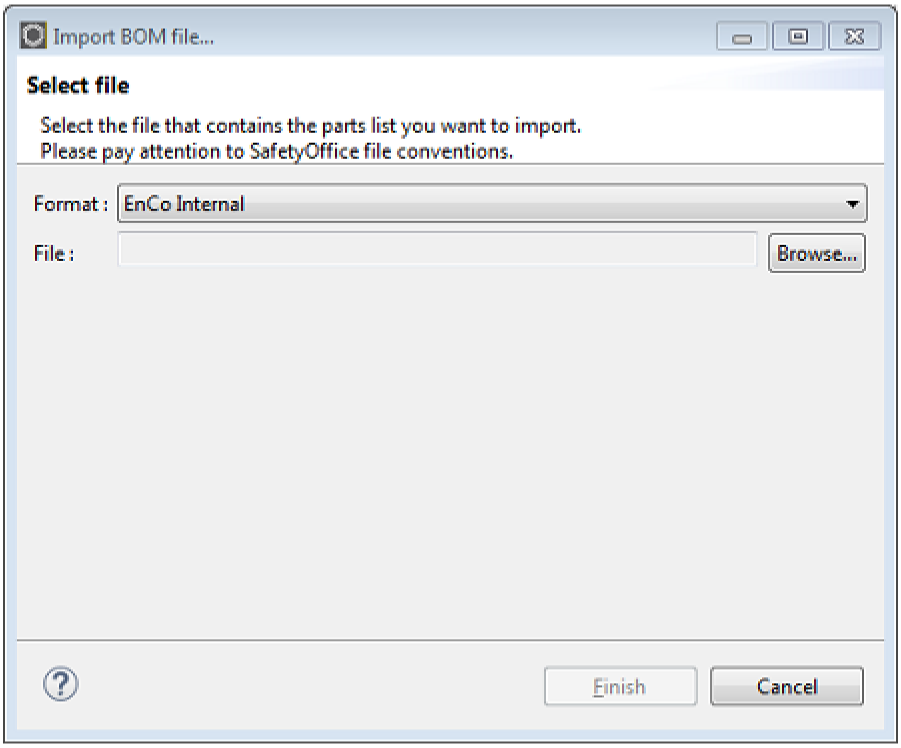
Importing data from Excel:

Precondition: A BOM document was created and opened. The content to be imported is available as an Excel file compliant to the Excel template provided by EnCo Software.

1. Open the menu bar point **File**.

2. Choose **Import** > **BOM Import**.

   ►The BOM import wizard opens.



Select file

Select the file that contains the parts list you want to import.
Please pay attention to SafetyOffice file conventions.

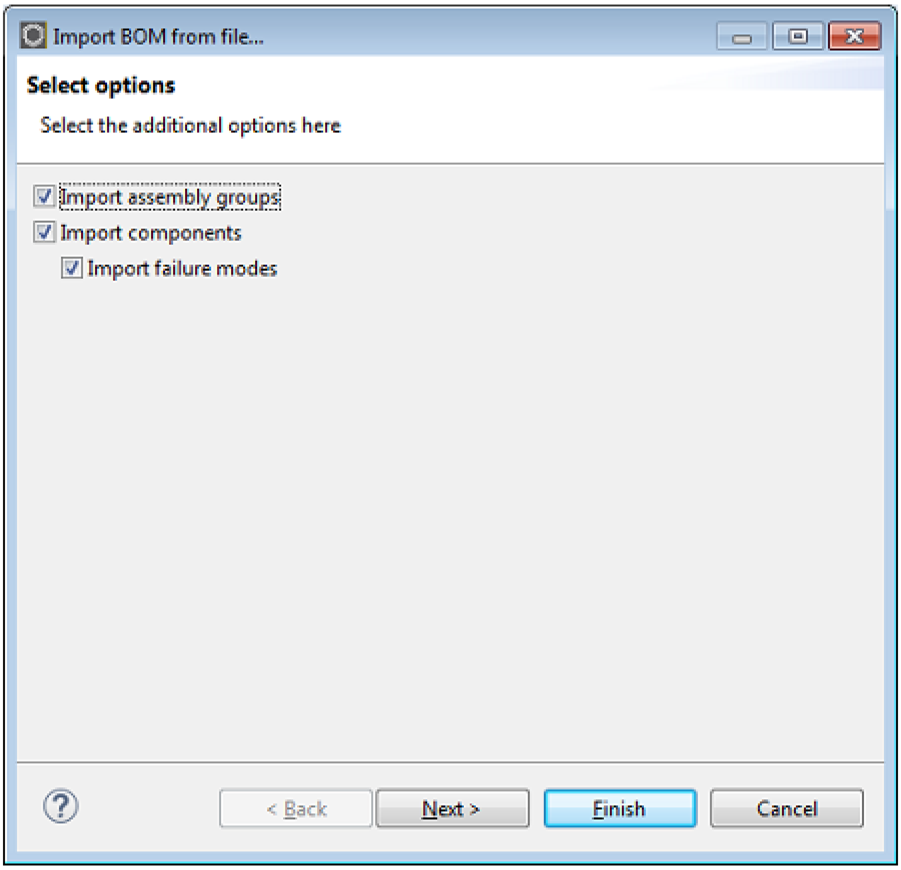
Format : EnCo Internal

File :

fig. BOM import wizard

3. Choose the EnCo Internal format.
4. Click on **Browse...** to choose the desired file.
5. Click on **Finish**.

► The dialog "Select options" opens.


Import BOM from file...

Select options

Select the additional options here

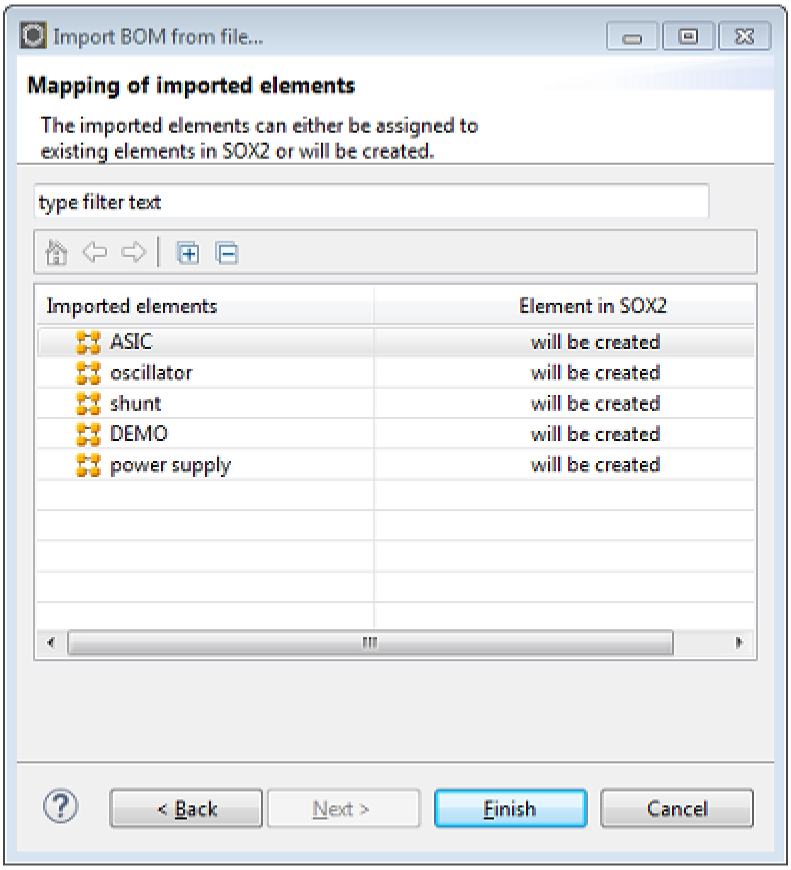
☑ Import assembly groups
☑ Import components
  ☑ Import failure modes

fig. BOM import wizard

6. Select the content that should be imported.

7. Click **Next** >.

► The dialog "Mapping of imported elements" opens.



Mapping of imported elements

The imported elements can either be assigned to existing elements in SOX2 or will be created.

Imported elements	Element in SOX2
ASIC	will be created
oscillator	will be created
shunt	will be created
DEMO	will be created
power supply	will be created

fig. BOM import wizard

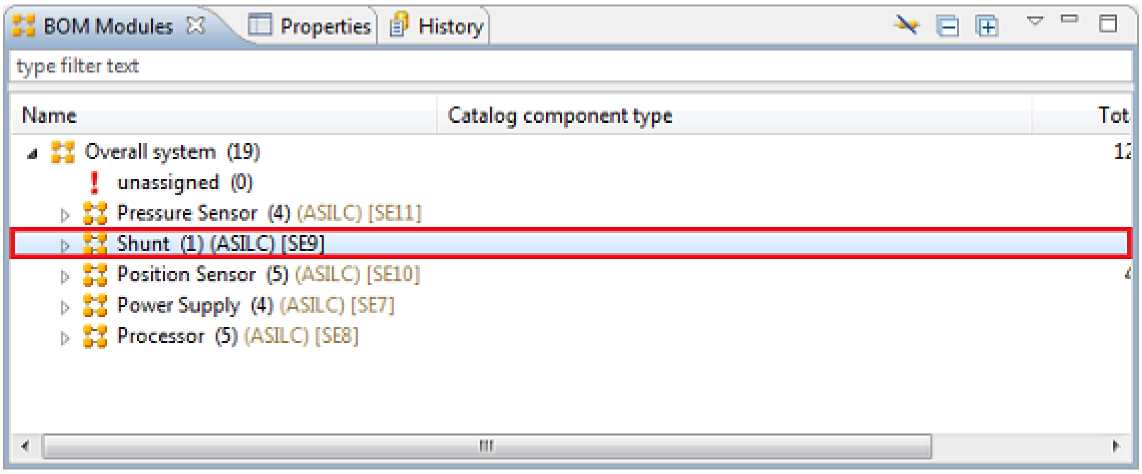
8. Click on **Finish**.

→ A BOM was imported and added to the repository.

Creating Project Data

Precondition: A BOM document, the BOM Modules view and the FIT Details view are open.

1. Select a module or the overall system in the BOM Modules view.



- Overall system (19)
  - unassigned (0)
  - Pressure Sensor (4) (ASILC) [SE11]
  - Shunt (1) (ASILC) [SE9]
  - Position Sensor (5) (ASILC) [SE10]
  - Power Supply (4) (ASILC) [SE7]
  - Processor (5) (ASILC) [SE8]

fig. Selection in the BOM Modules view

2. Select a failure rate catalog in the FIT Details view.

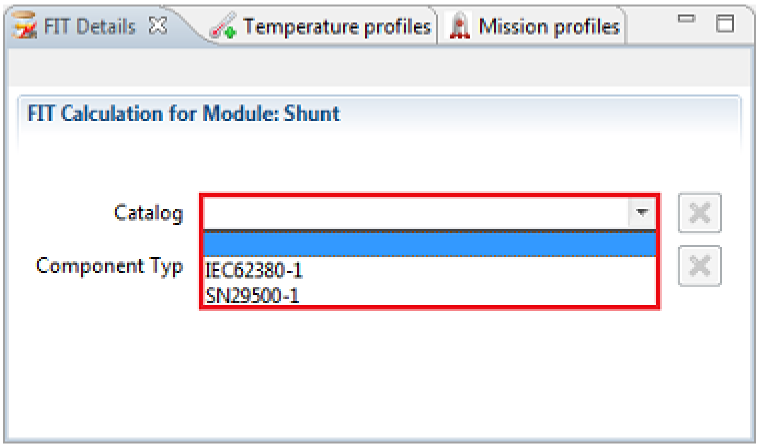
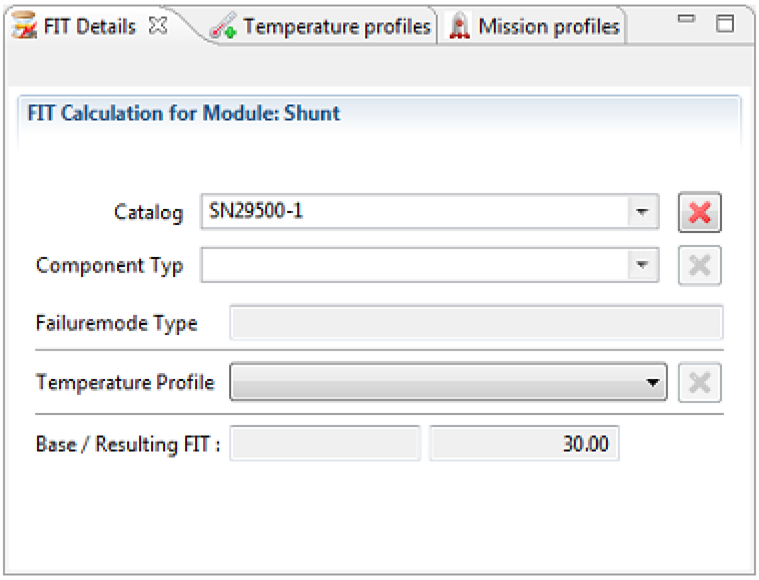


fig. Failure rate catalog selection in the FIT Details view

3. Assign a temperature profile. (Create a temperature profile).



FIT Calculation for Module: Shunt

Catalog: SN29500-1

Component Typ

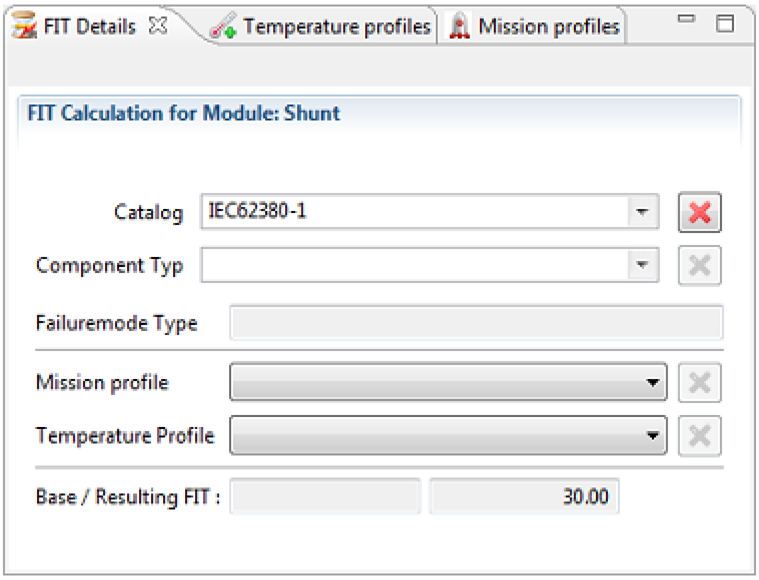
Failuremode Type

Temperature Profile

Base / Resulting FIT : 30.00

fig. FIT Details SN29500

4. Assign a mission profile (if IEC62380). (Create a mission profile)



FIT Calculation for Module: Shunt

Catalog: IEC62380-1

Component Typ

Failuremode Type

Mission profile

Temperature Profile

Base / Resulting FIT : 30.00

fig. FIT Details IEC62380

→ The FIT value will be calculated in consideration of the chosen failure rate and the temperature/ mission profile.

System Designer

The SOX System Designer module offers extensive solutions for modeling your systems with OMG SysML 1.4 and UML 2.0 standards. Define your system with different diagram types and link requirements from the SOX Requirements Module to system design elements.

In SOX, objects that can be reused over multiple documents (requirements, functions, malfunctions, diagnoses, safety goals) and relationships between them are automatically in the system design as stereotyped SysML elements. A stereotype is a specific "marker" that can be applied to SysML elements to mark a specific meaning of the element. SOX uses the following stereotypes: *SystemElement*, *Function* (including subtypes such as *SafetyFunction*, *Diagnosis* or *ProcessCharacteristics*), *Malfunction*, *Requirement*, and *SafetyGoal*.

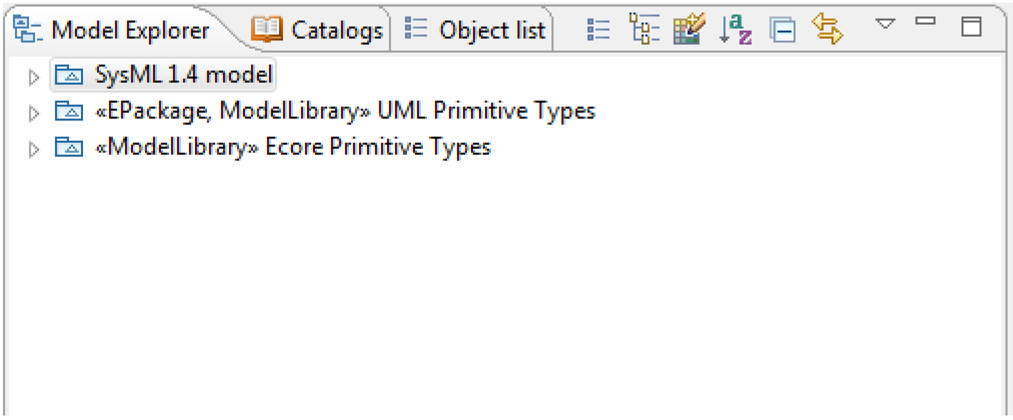
Diagrams

With SOX you can use and create all SysML 1.4 diagrams and the basic UML diagrams. In addition, SOX provides two additional diagram types, *SOX Functions* diagram and *SOX Requirements* diagram, to be used to create SOX-specific stereotypes in a convenient manner.

As in other SysML/UML modeling tools, a diagram presents only a specific view on the overall system. One element can appear in multiple diagrams and you can delete an element from diagram without deleting it from the overall model. The overall system is available in the "Model Explorer" view. To add an already existing element to a diagram, just drag it from the "Model Explorer" view or "Object List" view into the diagram. Please note that elements created in other SOX modules are automatically added to the system design and do not need to be re-created there.

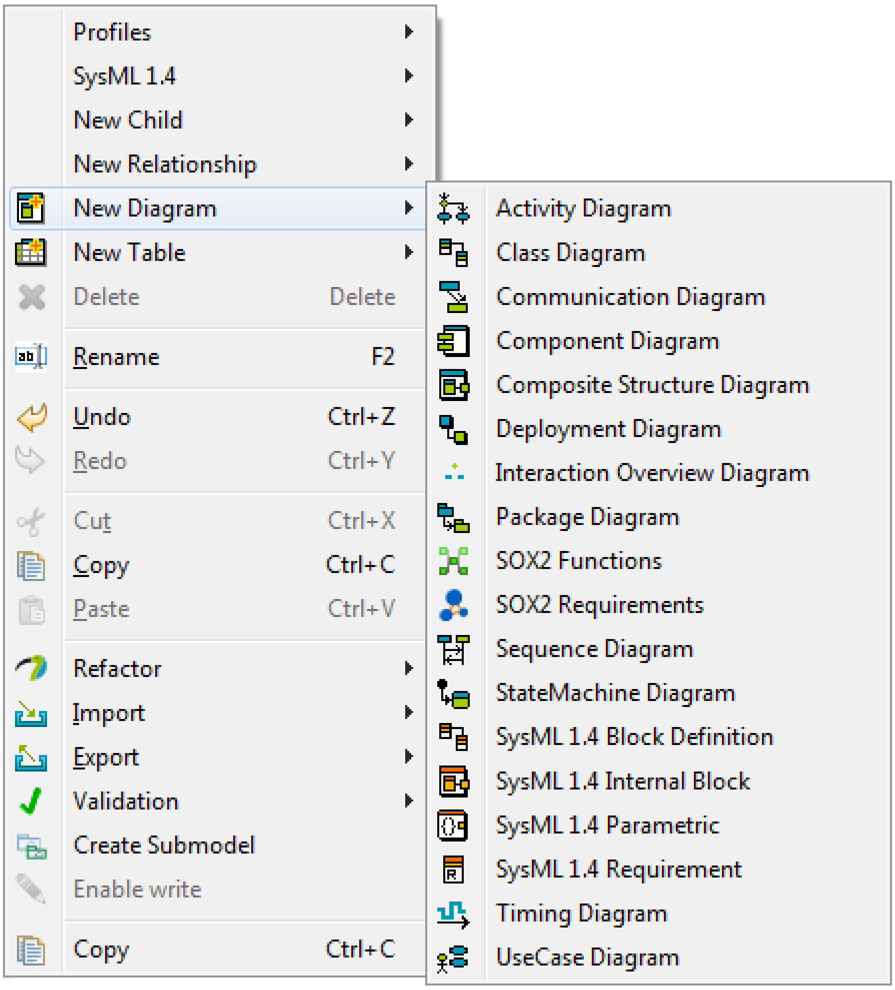
Create Diagrams

Diagrams can be created from the **Model Explorer view.** Creating a diagram can be performed by right clicking on one of the shown model classes on the picture . The selected element will be the owner of the diagram.


Model Explorer
Catalogs
Object list
SysML 1.4 model
«EPackage, ModelLibrary» UML Primitive Types
«ModelLibrary» Ecore Primitive Types

1. **Right-click** SysML 1.4 model.

2. Choose **New Diagram.**



3. Choose your desired **diagram type**.

   ► A name dialog window opens.

4. Choose a name for the diagram.

5. Click **OK**.

   ► The diagram editor opens.

Note

The diagrams will be saved and can be found in the Model Explorer view.

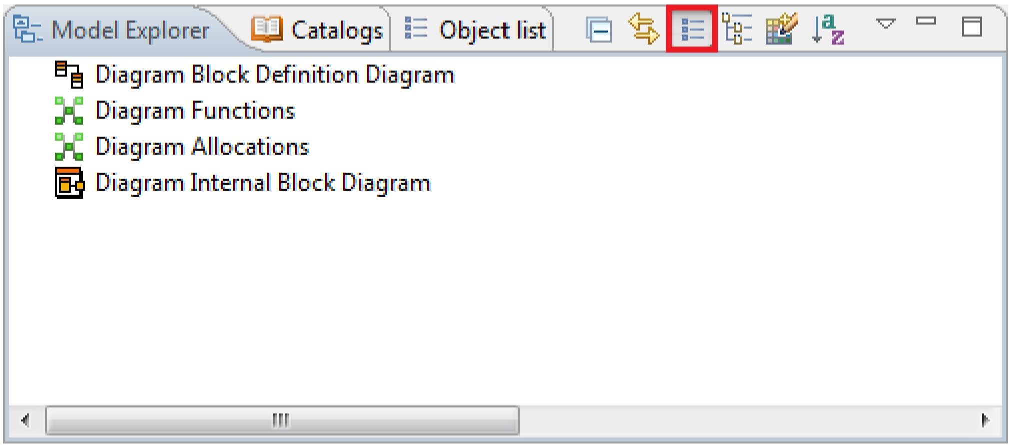
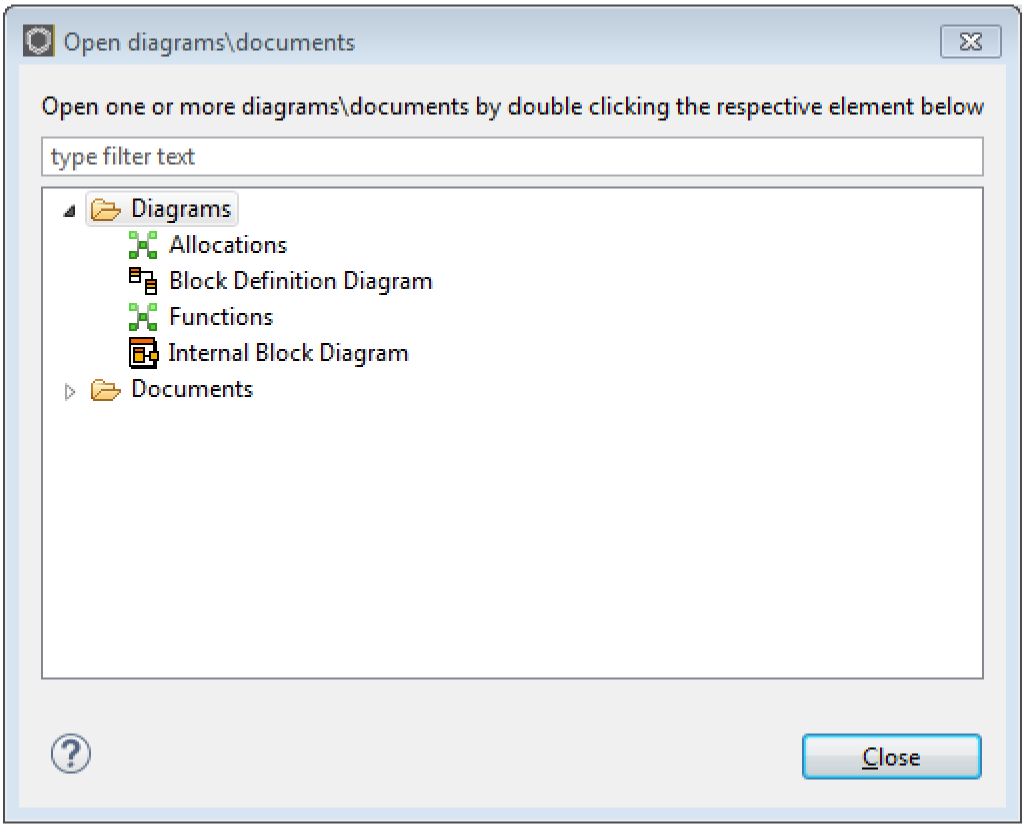


fig. Model Explorer view with active filter "Show diagram"s.

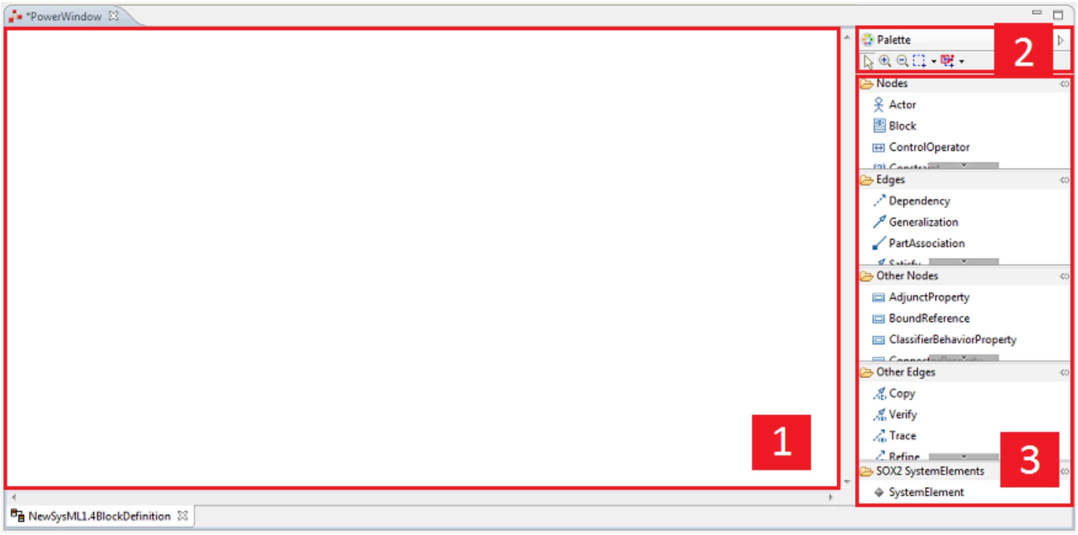
Created diagrams can also be opened in the "Open diagrams\documents" dialog which can be found by clicking on the open diagrams\documents icon at the toolbar.


Open diagrams\documents

Open one or more diagrams\documents by double clicking the respective element below

fig. Open diagrams\documents dialog.

The Diagram Editor



[1] In this area the diagram can be created and edited.

[2] Tool-Palette that contains:

↖	Select single objects or more by holding down the mouse button.
⊕	Left-click to zoom in.
⊖	Left-click to zoom out.
⬚ ▾	Select the objects completely including into the rectangle area.
⬚	Standard marquee selection.
⊟	Nodes only.
T	Labels only.
⬚	Connections only.
⧉ ▾	Select the objects intersecting and including the marquee rectangle
⧉	Intersection selection
⧉	Nodes only (intersection)
T	Labels only (intersection)
⧉	Connections only (intersection)

[3] In this explorer all objects are listed that can be used for the diagram.

Exemplary Method for Designing the System Structure with SysML 1.4

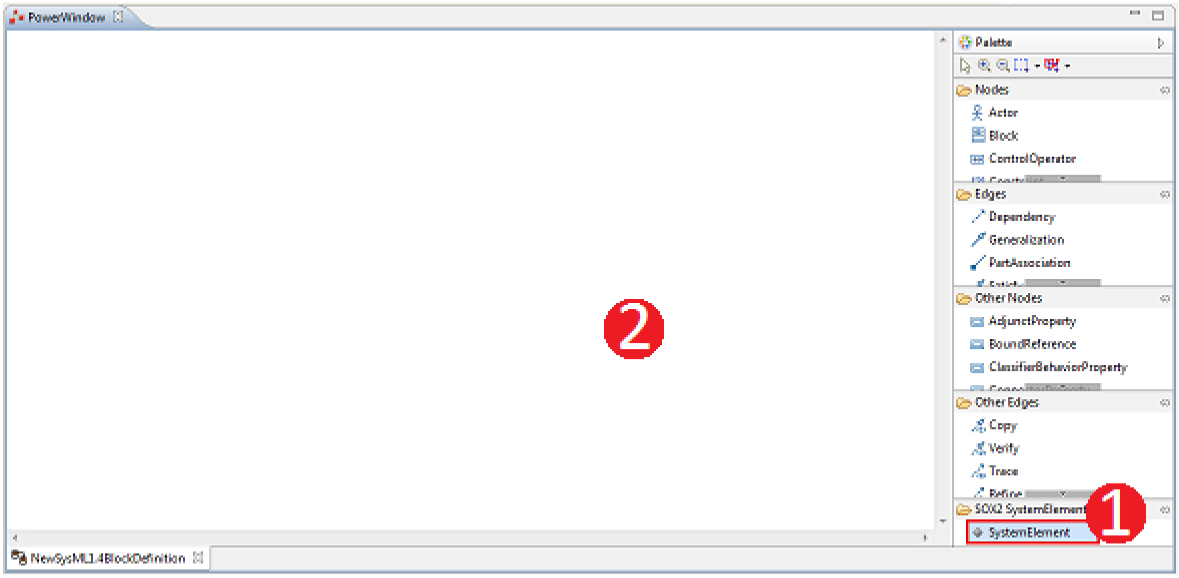
Precondition: A SOX Project was created and opened.

1. **Right-click** on **SysML 1.4 model** in the Model Explorer view.
2. Choose **New Diagram > SysML 1.4 Block Definition.**

   ► A name dialog window opens.

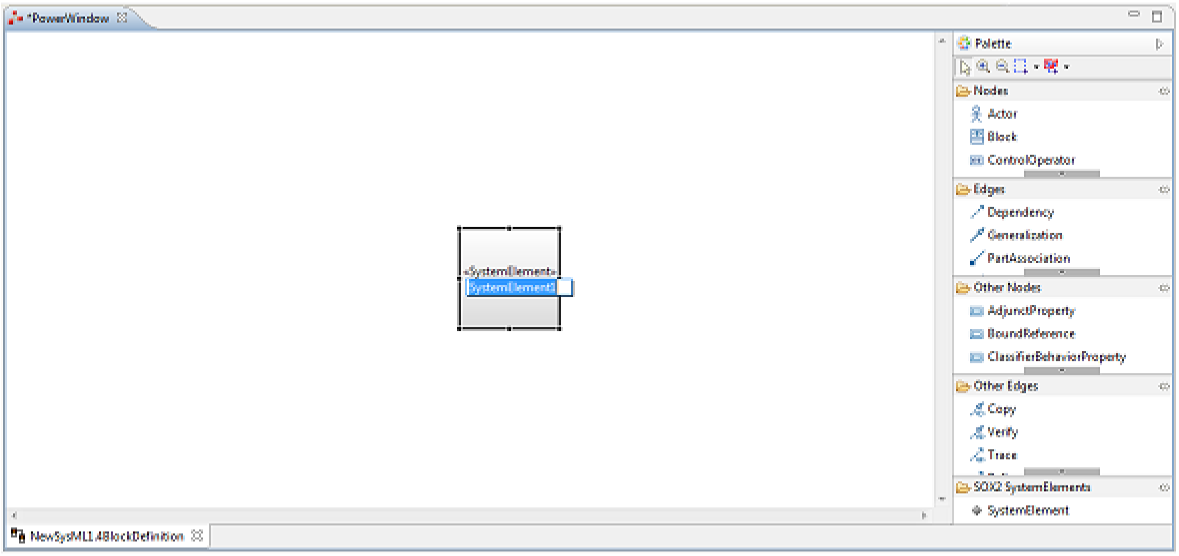
3. Choose a name for the diagram.
4. **Click OK.**

   ► The Diagram Editor opens.



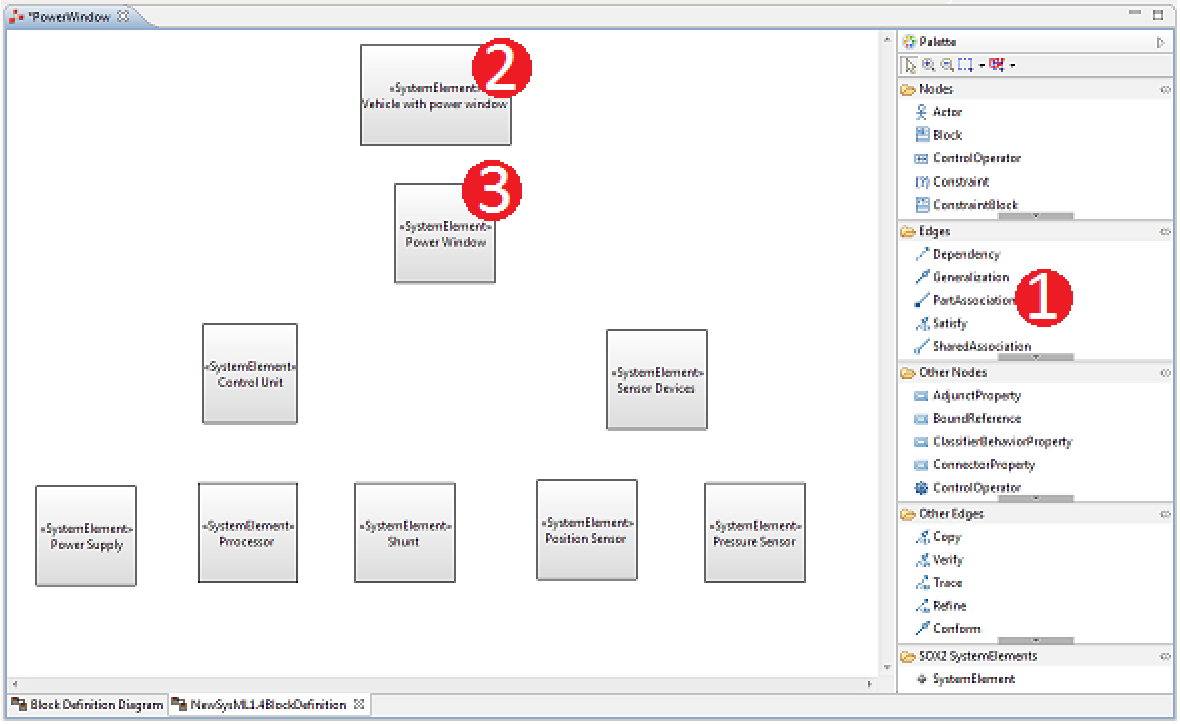
1. **Left-click** on **SystemElement.**
2. **Left-click** in the **editor**.

   ► A system element was created.



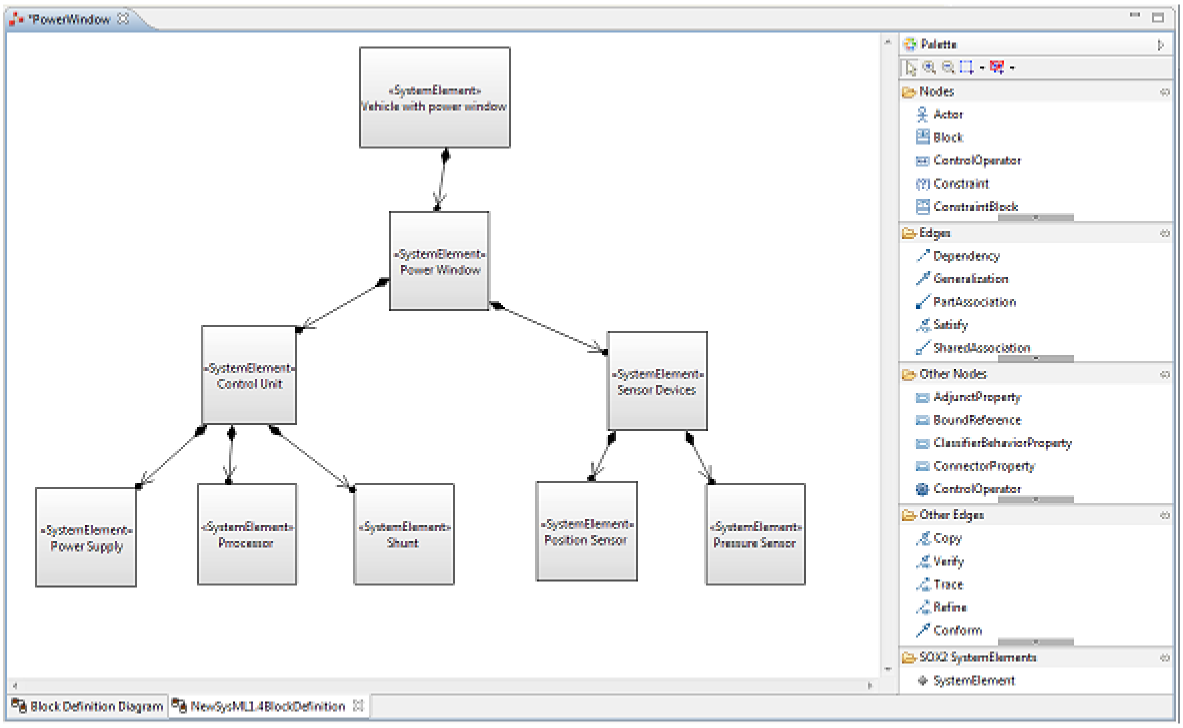
Note: The name of the objects can be edited directly after they have been created, in the properties view or using the short cut function F2.

3. Define the system structure



Note: Use the "PartAssociaton" connectors to define the system structure hierarchy.

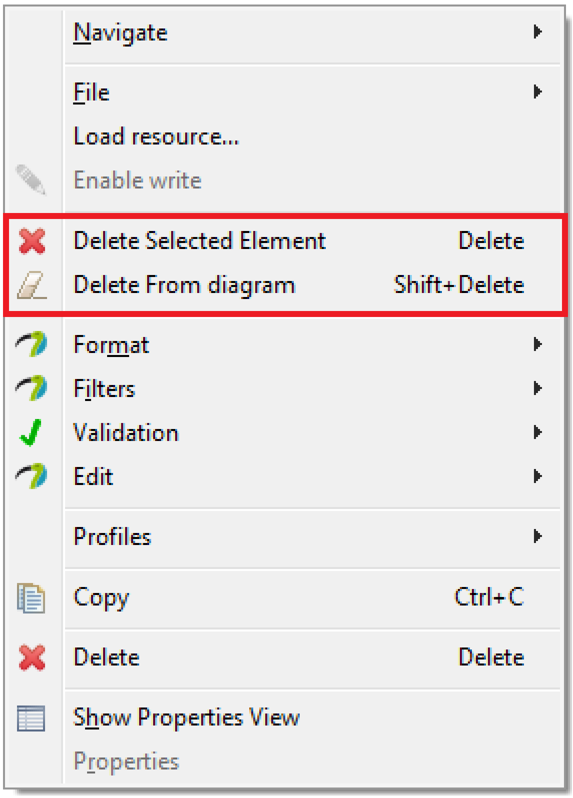
1. **Select a connector** with a **left-click**. (PartAssociation)
2. **Select a parent SystemElemen**t with a **left-click.**
3. **Select the child SystemElement** with a **left-click.**



Note: The diagram can be modeled for your desire. Click here for more information.

Deleting In Diagrams

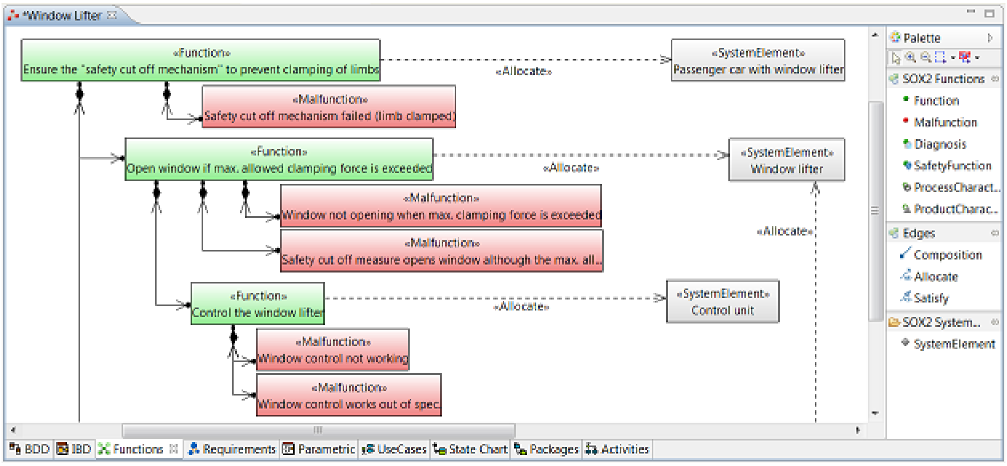
Do a right-click on an element in the diagram editor to:



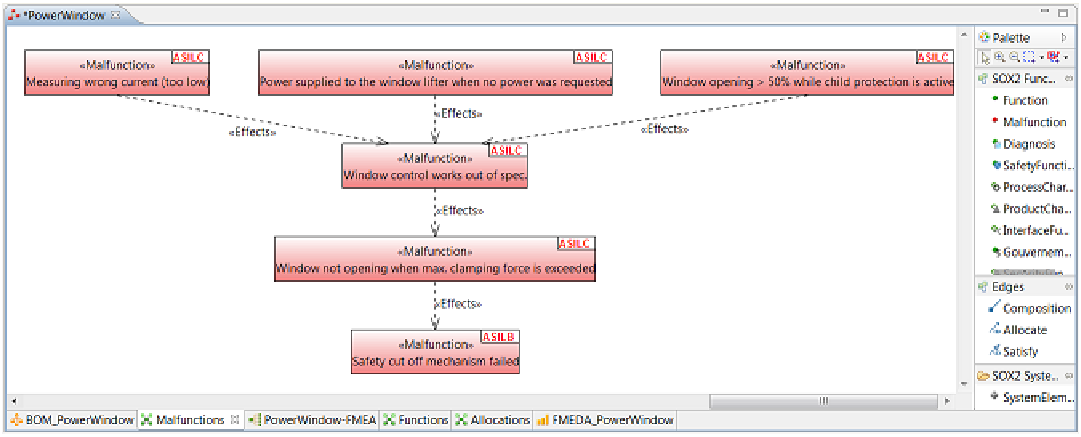
- **Delete Selected Element** will delete the element from the entire model and also from all diagrams where it was present.
- **Delete From Diagram** will hide the element just in this diagram.

SOX Functions

Create a SOX Function diagram to specify a Functions net, their hierarchy, associated malfunctions, and allocations of functions to system elements. Malfunctions are assigned to functions via a Composition relationship from the function to the malfunction. Functions are assigned to system elements via an Allocate relationship.



Connections between malfunctions defined in failure nets (cause-effect-relationships) are added to the system design as well. They are represented in SysML by dependencies with a SOX-specific stereotype Effects applied. Hence, the failure net connections can be represented by, e.g., a Function diagram



The SOX Functions diagram has been extended with the following Stereotypes:

- Function (stereotyped SysML Block)
- Malfunction (stereotyped SysML Block)
- Diagnoses (stereotyped SysML Block)
- Safetyfunction (typo)
- ProcessCharacteristics (stereotyped SysML Block)
- ProductCharacteristics (stereotyped SysML Block)
- InterfaceFunction (stereotyped SysML Block)
- GovernmentFunction (stereotyped SysML Block)
- SecurityFunciton (typo)
- SystemElement (stereotyped SysML Block)

SOX Requirements

The SOX Requirements diagram has been extended with the following stereotypes:

- SafetyGoal (stereotyped SysML Requirement)
- SystemElement (stereotyped SysML Block)

Note: You have to create a Requirement document in the RM Module, before creating a SOX Requirement diagram. This is necessary to select a parent module and type of a requirement in the diagram editor.

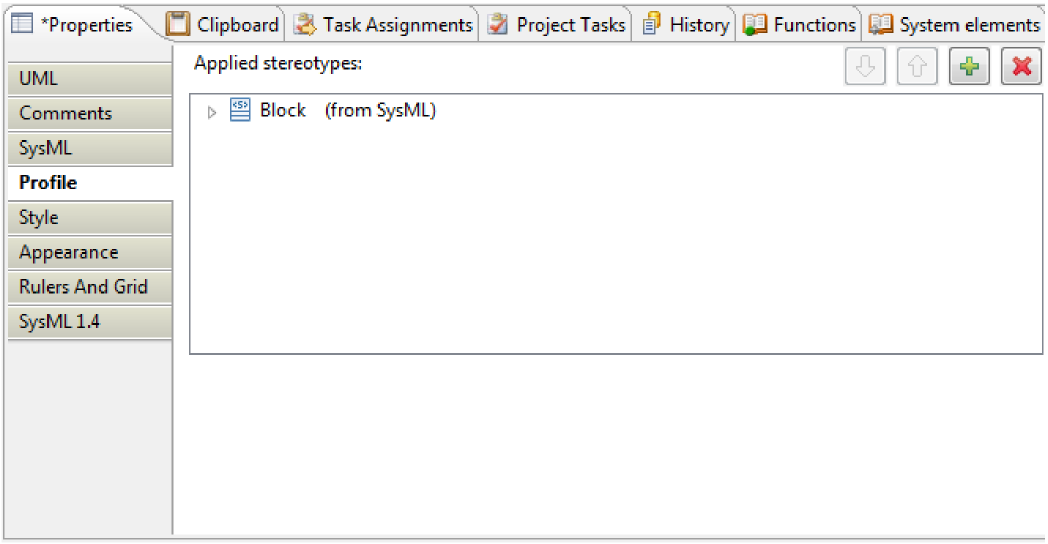
Requirements can be created or imported (ReqIF format) in the RM (Requirements) module. All added/imported requirements are automatically available in the system design and can be dragged there into diagrams to link them with system design elements (Satisfy relationship in SysML). Linking requirement with system design elements in other modules (e.g., FMEA editor) can be performed by just dragging a requirement on the desired element. This causes automated creation of a corresponding Satisfy relationship in the system design.

Apply Stereotypes

Warning

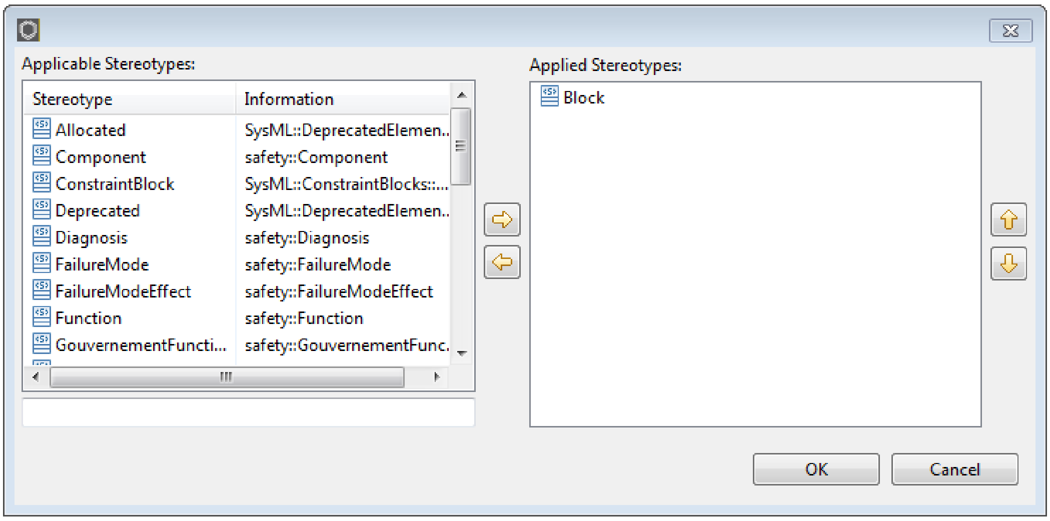
Manually applying/removing **SOX Stereotypes** changes the meaning of an element in SOX which can have unintended consequences, e.g., if the element is already used in other documents.

1. **Create an element** in the diagram editor.
2. **Select** the element.
3. Open the **Properties view**.
4. Choose **Profile**.



5. Click on the Apply stereotype symbol ✚.

   ► The Stereotype window opens.



Stereotype	Information
Allocated	SysML::DeprecatedElemen...
Component	safety::Component
ConstraintBlock	SysML::ConstraintBlocks::...
Deprecated	SysML::DeprecatedElemen...
Diagnosis	safety::Diagnosis
FailureMode	safety::FailureMode
FailureModeEffect	safety::FailureModeEffect
Function	safety::Function
GouvernementFuncti...	safety::GouvernementFunc...

6. **Select** the desired stereotypes.
7. Use the arrows ⇨ ⇦ ⇧ ⇩ to move the chosen stereotypes.

8. **Click OK** to finish the process.

   → The chosen stereotypes have been applied to the object.

With the Remove stereotype icon ✖ you can delete stereotypes from the selected object.

Import System Design (UML/SysML)

You can import systems designed with UML/SysML 1.4 (Supported input format: Enterprise Architect XMI 2.1.).

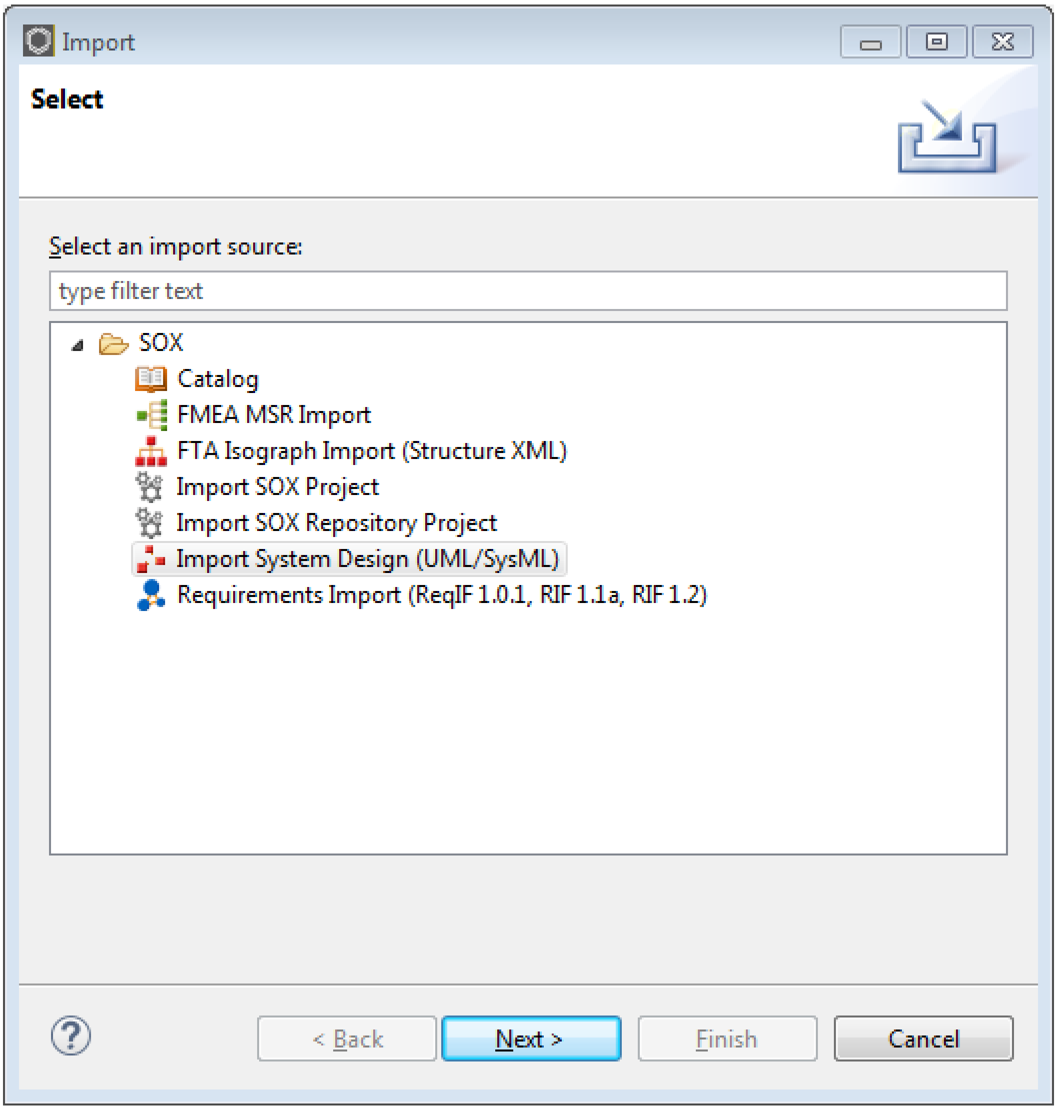
Note

Individual Profiles can not be imported.

Precondition: A SOX project was created/imported and the target project selected.

1. Right-click in the Repository view and choose **Import...**

   ► The "Import" wizard opens.



Import

Select

Select an import source:

type filter text

- SOX
  - Catalog
  - FMEA MSR Import
  - FTA Isograph Import (Structure XML)
  - Import SOX Project
  - Import SOX Repository Project
  - Import System Design (UML/SysML)
  - Requirements Import (ReqIF 1.0.1, RIF 1.1a, RIF 1.2)

fig. "Impor"t wizard.

2. Choose **Import System Design (UML/SysML).**
3. Click **Next.**

   ► The "System Design (UML/SysML) Import" opens.

4. Select the desired source file.
5. The target location has to be a SysML 1.4 model or a sub folder of this package.
6. Click **Next.**

   ► The "Import Model" dialog opens.

7. The drill down menu shows all model elements that will be imported.
8. Click **Next.**

   ► The "Diagnosis" dialog opens.

   ### Note

   Individual SysML profiles can not be imported. You can review in the "Diagnosis" dialog all objects that can not be imported. If you want to create diagrams with this objects you have to create them later.

9. Click **Next.**

   ► The "Apply Stereotype" wizard opens.

   Select the desired objects from the imported model and apply SOX stereotypes to them. The following list shows a standard combination of UML objects and SOX stereotypes (other combinations are also possible)

UML Object	SOX Stereotype
Blocks	System Element
Blocks, Activities	Function
Classes	Malfunction

10. Click **Finish.**

→ The system design will be imported and added to the SOX project (Design) and SysML 1.4 model.

Export Diagrams as Pictures

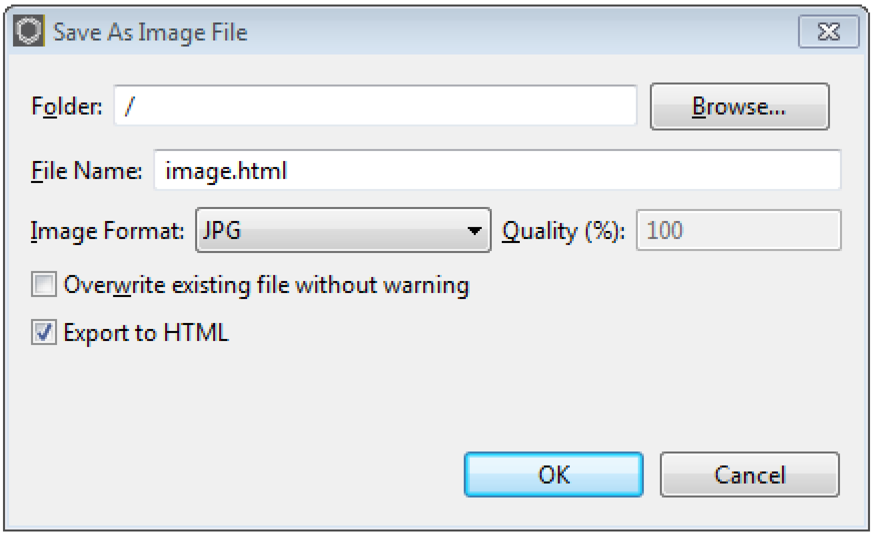
With SOX you can export diagrams as pictures in different formats: GIF, BMP, JPEG, JPG, SVG, PNG, PDF.

Recommendation: SVG, the size for the elements of this vector image format can be scaled for your desires without degradation.

Export a Single Diagram

1. Open the diagram in the editor.
2. **Right-click** in the editor on an empty area.
3. Choose **File > Save As Image File**.

   ►Save As Image File window opens.



Folder: /

File Name: image.html

Image Format: JPG

Quality (%): 100

☐ Overwrite existing file without warning

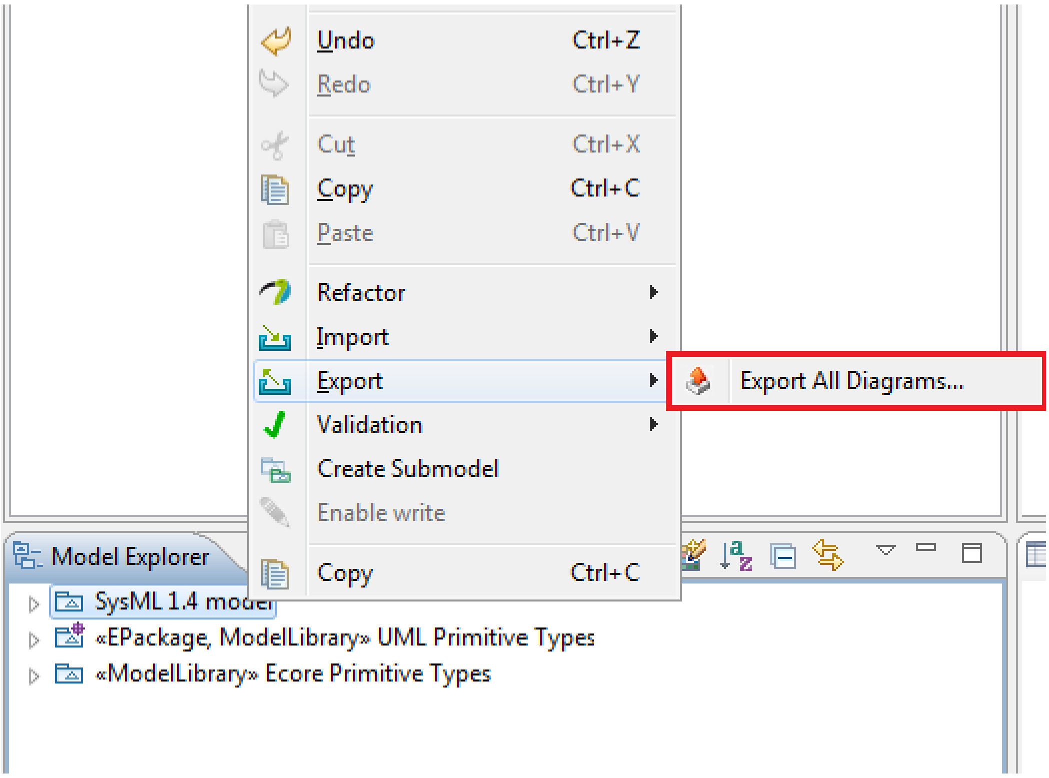
☑ Export to HTML

1. Select the output directory.
2. Choose a File Name.
3. Choose an output Image Format.

   NOTE: The quality can be changed if you choose JPEG as Image Format.
4. Do a mark for overwriting an existing file without warning.
5. Do a mark for exporting the diagram as HTML so you can display the diagram in your browser.
6. Click **OK** to export the diagram.

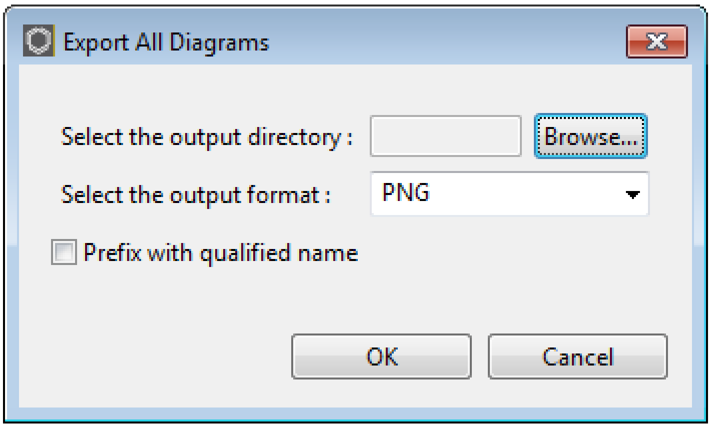
   →The diagram was exported and saved to your chosen file path.

Export all Diagrams



1. **Right-click** in the Model Explorer on SysML 1.4 model

   ► The Export All diagrams window opens.



Select the output directory :

Select the output format : PNG

☐ Prefix with qualified name

1. Select the output directory.

2. Choose an output Image Format.

   NOTE: The quality can be changed if you choose JPEG as Image Format.

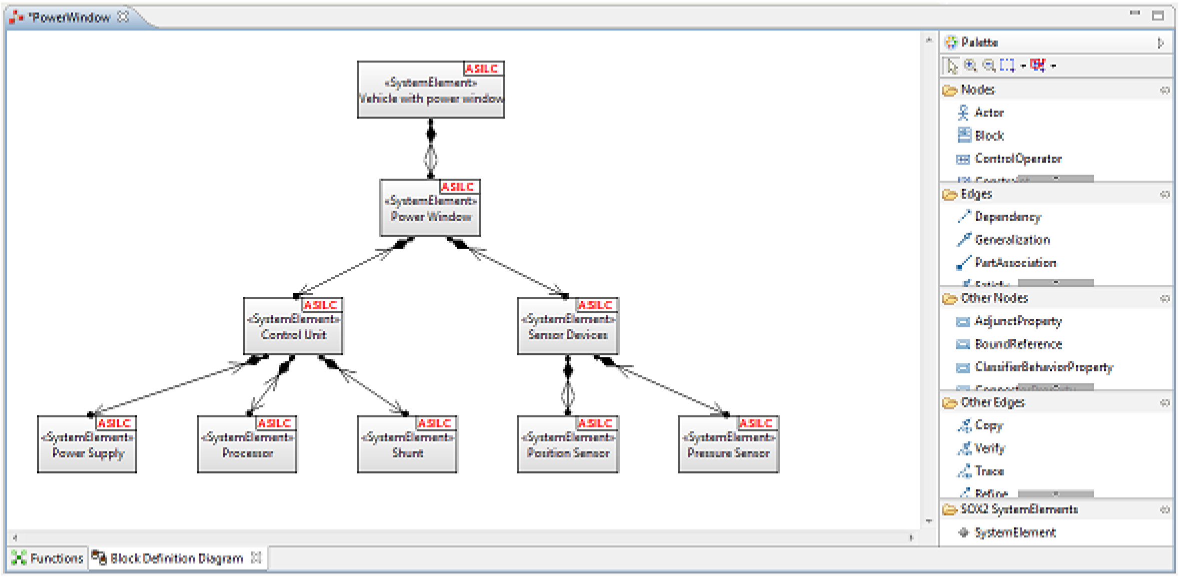
3. **Click OK** to export all diagrams.

   Note: If "Prefix with qualified name" is marked, the diagram name will be provided with the prefix e.g. SysML 1.4 model.

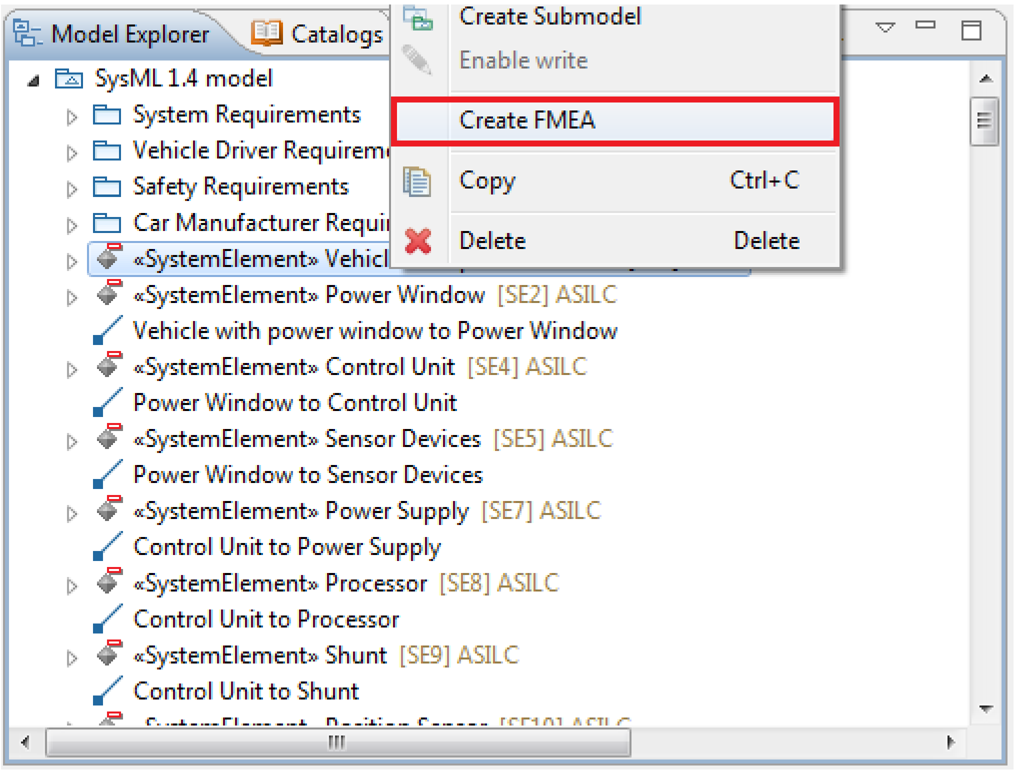
   → The diagrams were exported and saved to your chosen file path.

Derive a FMEA from System Design

It is possible to automatically initialize a new FMEA document with the structure from the system design starting from a chosen root system element.



Precondition: The system design has been defined.


Model Explorer
Catalogs
SysML 1.4 model
System Requirements
Vehicle Driver Requirem
Safety Requirements
Car Manufacturer Requi
«SystemElement» Vehicl
«SystemElement» Power Window [SE2] ASILC
Vehicle with power window to Power Window
«SystemElement» Control Unit [SE4] ASILC
Power Window to Control Unit
«SystemElement» Sensor Devices [SE5] ASILC
Power Window to Sensor Devices
«SystemElement» Power Supply [SE7] ASILC
Control Unit to Power Supply
«SystemElement» Processor [SE8] ASILC
Control Unit to Processor
«SystemElement» Shunt [SE9] ASILC
Control Unit to Shunt
Create Submodel
Enable write
Create FMEA
Copy Ctrl+C
Delete Delete

1. **Right-click** in the Model Explorer on the desired root element.

2. Choose **Create FMEA**.

   ► The File import window opens.

3. Select a target folder where the FMEA should be saved. (FMEA Folder)

4. Choose a filename.

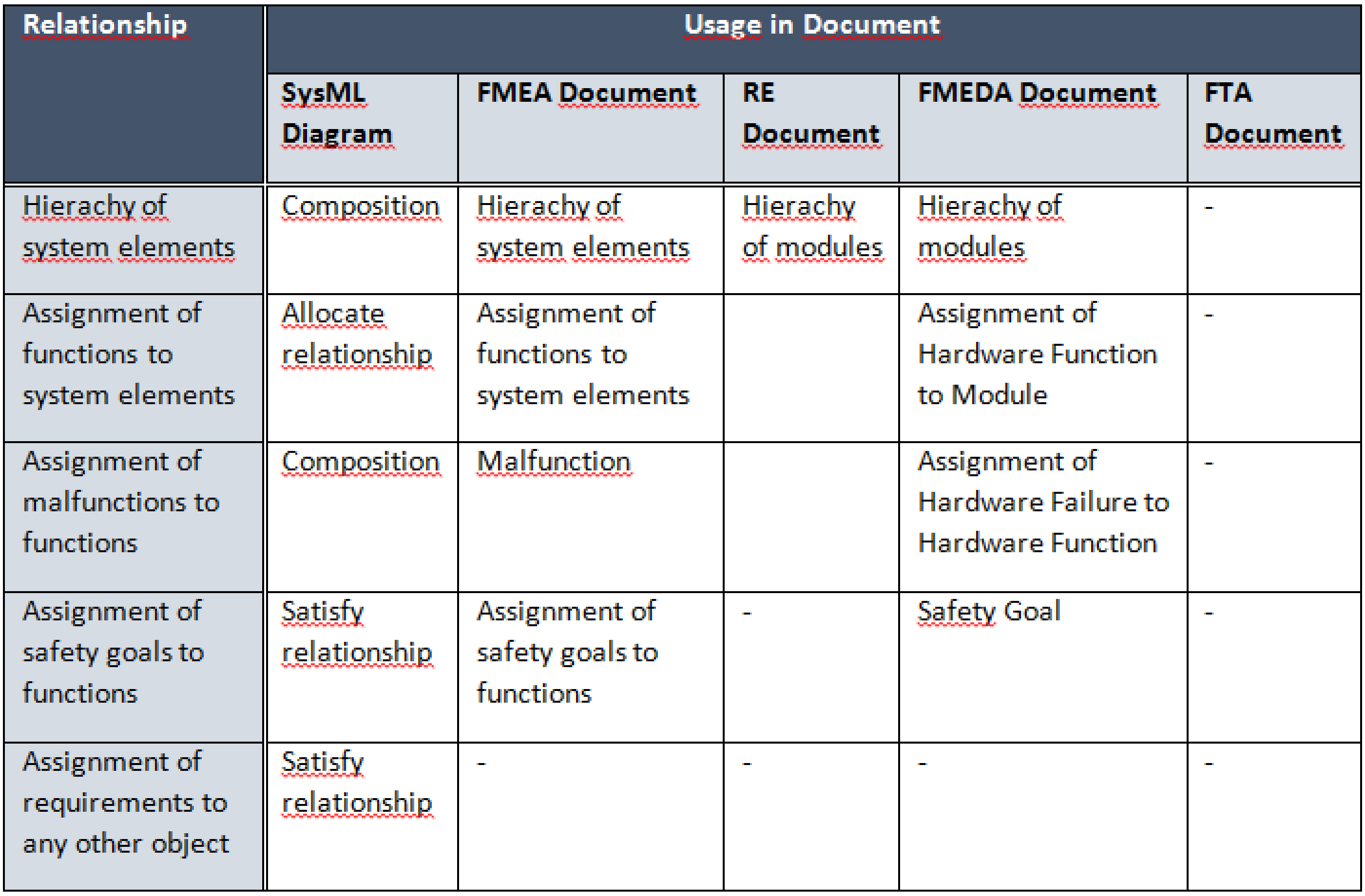
5. Click **Finish.**

   → The FMEA with all relations that were defined in the Model Explorer was created.

Semantics of SysML Relationships in SOX

The main relationships between elements are stored in the system design as well and, hence, kept consistent across all documents: Hierarchy of system elements, hierarchy of functions, assignment of functions to system elements, assignment of malfunction to functions, cause-effect relationships between malfunctions, assignment of safety goals to functions, and assignment of requirements to system design elements. Again, adding such a relationship in one document automatically creates a corresponding relationship in the system design (but not vice versa) and deleting such a relationship in the system design can result in appearance of a “Refactoring” dialogue that informs about the consequences.

The following table lists the relationships that are relevant in multiple types of documents/diagrams and their meaning within a certain document/diagram type:



Relationship	Usage in Document				
	SysML Diagram	FMEA Document	RE Document	FMEDA Document	FTA Document
Hierachy of system elements	Composition	Hierachy of system elements	Hierachy of modules	Hierachy of modules	-
Assignment of functions to system elements	Allocate relationship	Assignment of functions to system elements		Assignment of Hardware Function to Module	-
Assignment of malfunctions to functions	Composition	Malfunction		Assignment of Hardware Failure to Hardware Function	-
Assignment of safety goals to functions	Satisfy relationship	Assignment of safety goals to functions	-	Safety Goal	-
Assignment of requirements to any other object	Satisfy relationship	-	-	-	-

- Association

  specifies peer-to-peer relationships between model elements, e.g. if a Class-x has an attribute of type Class-y, it can be viewed in a class diagram as a Association between Class-x and Class-y.

- Aggregation

  is used to model a whole/part relationship between model elements. The part element can exist without the whole. Aggregation causes the generated code to contain the aggregate either by reference or by value, depending on the details of the relationship. E.g. to model an aggregation, the aggregate (Department) has an aggregation association to its constituent parts (Employee). A hollow diamond is attached to the end of an association path on the side of the aggregate (the whole) to indicate aggregation.

- Composition

  is an aggregation with strong ownership, i.e. when the container is deleted, all of its composite objects are deleted as well.

- Dependency

  is a relationship in which one model element uses another. Dependency may exist between classes if a message is sent from one class to the other or if one class mentions the other as a parameter to an operation. Dependency may exist between packages if one package is dependent on another.

- Generalization

  relationship causes a class to be generated as a subclass of another class.

- Realizes

relationship specifies that, e.g. an implementation realizes a specification. The Realizes relationship does not affect the code.

To create a relationship between two modeling elements, use the tool palette in the diagram editor, e.g. to create an Association between two classes, select the Association tool in the tool palette, click on the source element and then click on the destination element.

Diagram Modeling Tools

Select

For selecting all elements,shapes and connectors in the diagram editor, do a right-click on an empty area and choose select. You can also use the select icon from the toolbar .

To select more items manually use ctrl + left-click.

Arrange

With this function you can arrange the diagram automatically.

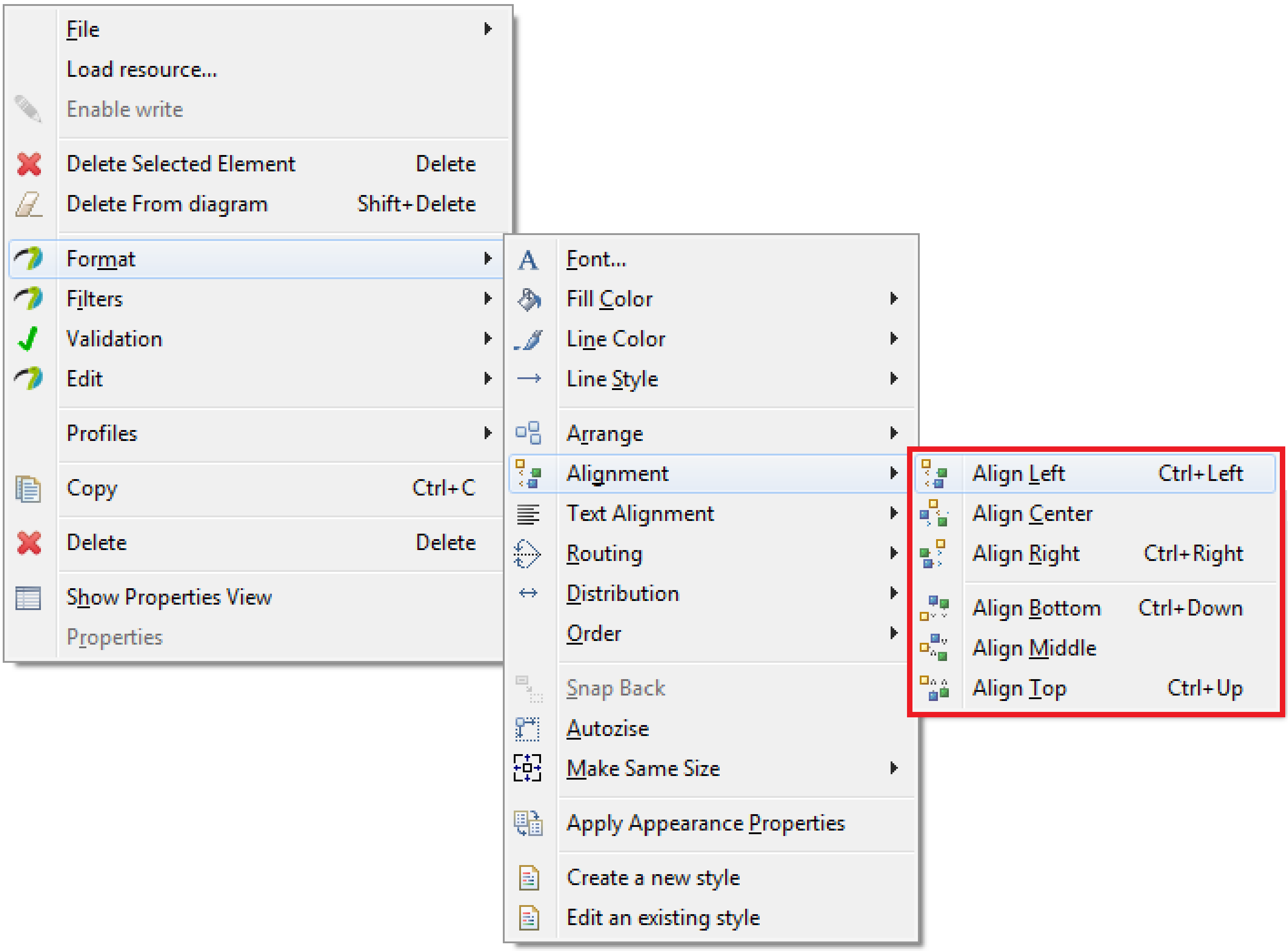
Note: The structure will be arranged by considering the connectors/relations.

Shape Align

1. Select all desired elements.

   Note: The last selected element will define the position for all elements.

2. Right-click on one selected element.



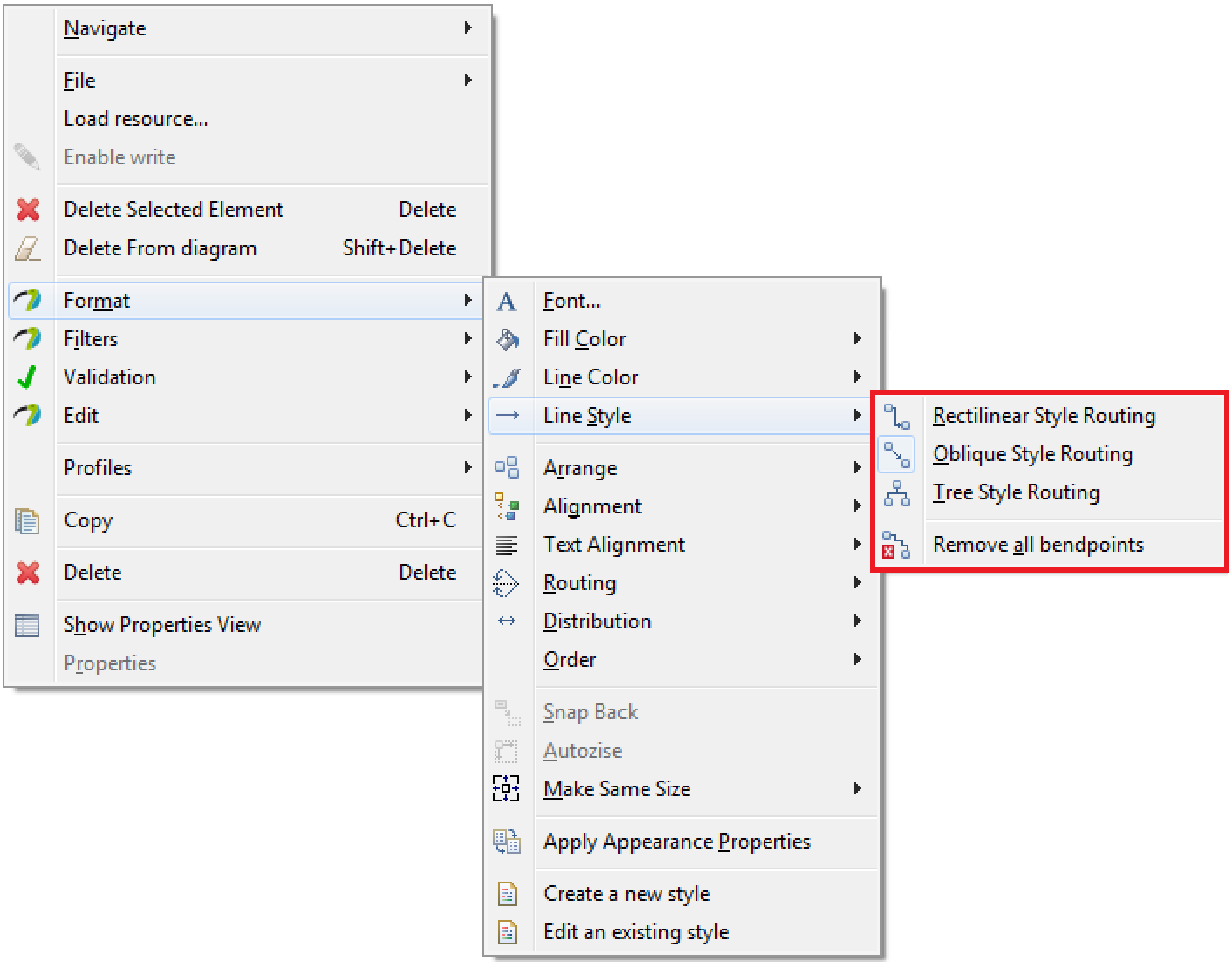
3. Choose Format > Alignment.

   → The selected elements will be aligned with your chosen method.

Connectors/Relations

You can model the connectors/relations with the Line Style function.

1. **Select** all desired connectors.
2. **Right-click** on one selected element.



3. Choose **Format** > **Line Style**.

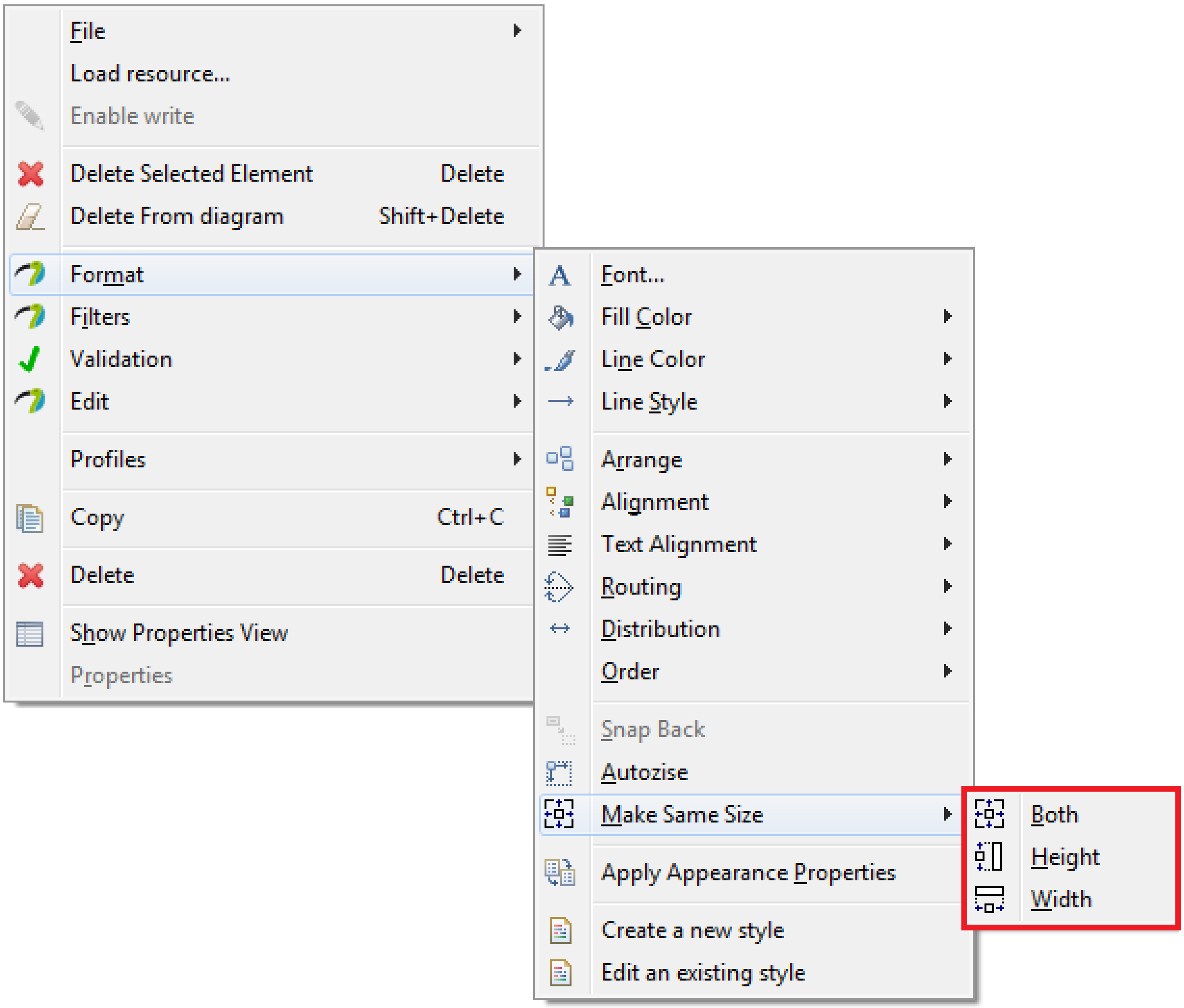
   → The selected lines will be routed in your chosen style.

Shape Size

1. **Select** all desired elements.

   Note: The last selected element will define the size for all elements.

2. **Right-click** on one selected element.

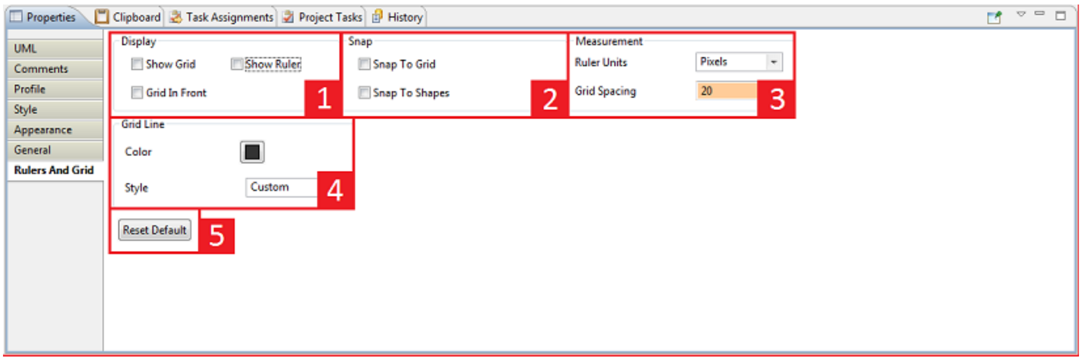


3. Choose Format > Make Same Size.

→ The selected elements will have the same size after your selection.

Rulers and Grid

The Rulers and Grid function supports you to create diagrams organized and descriptive. It is a helping tool and will not be displayed in the printed/exported diagrams.



☐ Show Grid ☐ Show Ruler
☐ Grid In Front
☐ Snap To Grid
☐ Snap To Shapes
Ruler Units: Pixels
Grid Spacing: 20
Style: Custom

[1] **Display**

- Show Grid

Put a mark to show/hide the grid.

- Grid In Front

  Put a mark to set the grid in front or behind the diagram objects.

- Show ruler

  Put a mark to show/hide the ruler which can be scaled in different units and spacing.

[2] **Snap**

- Snap To Grid

  Put a mark to snap the diagram objects to the grid automatically.

- Snap To Shapes

  Put a mark to snap the diagram objects to the shapes.

[3] **Measurement**

- Ruler Units

  You can choose between *Inches, Pixels, Centimeters.*

- Grid Spacing

  Set the spacing of the grid lines.

[4] **Grid Line**

- Color

  Choose a desired color for the grid lines.

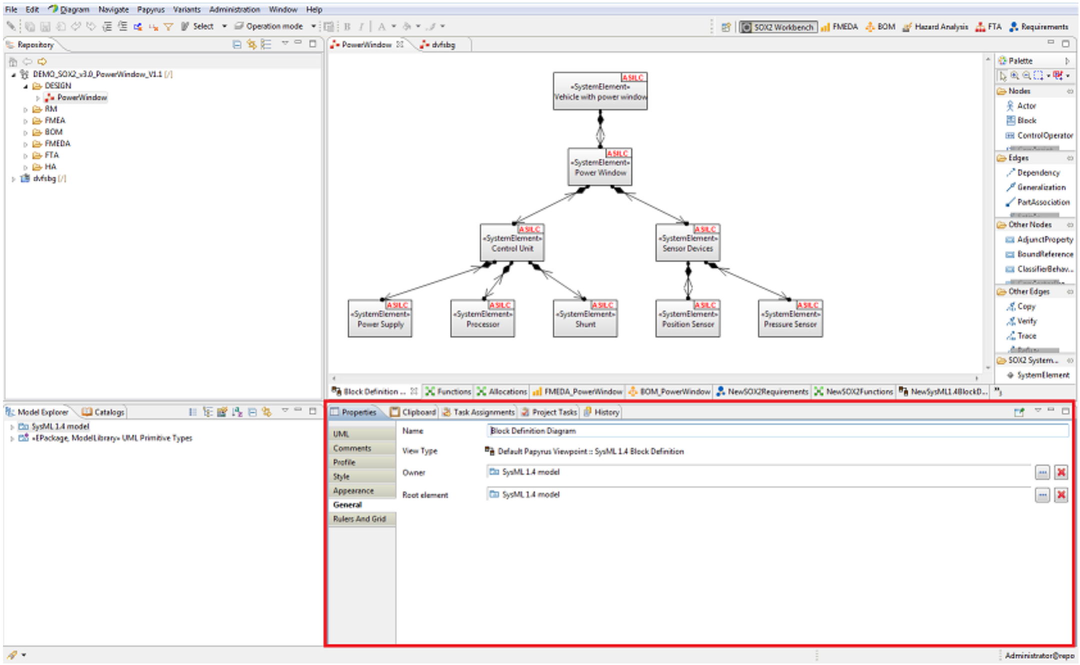
- Style

  You can choose between *Dash, Dash Dot, Dash Dot Dot, Dot, Solid, Custom.*

[5] **Reset Default**

Use this button to set the ruler and grid settings to its default.

Properties view



Name: Block Definition Diagram

View Type: Default Papyrus Viewpoint :: SysML 1.4 Block Definition

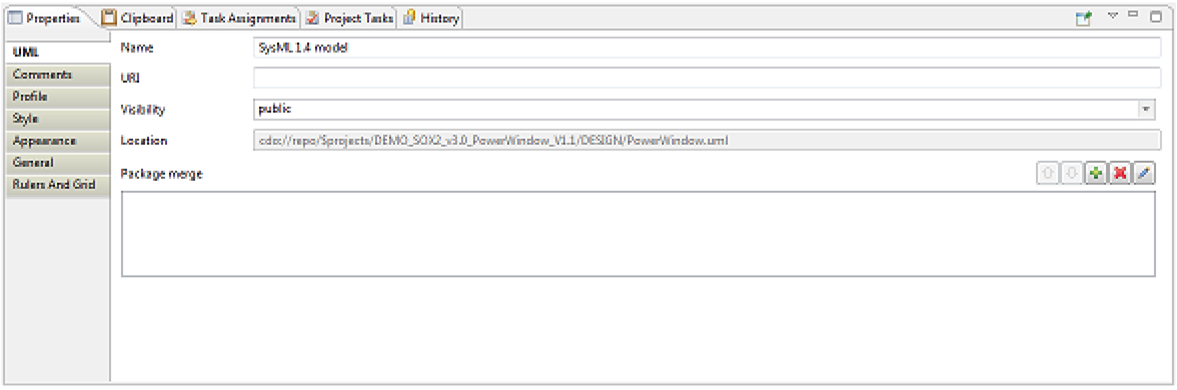
Owner: SysML 1.4 model

Root element: SysML 1.4 model

This is the default place of the properties view.

For the different types of selection *nodes, edges* there are different register.

Empty Area



Name: SysML 1.4 model

URI:

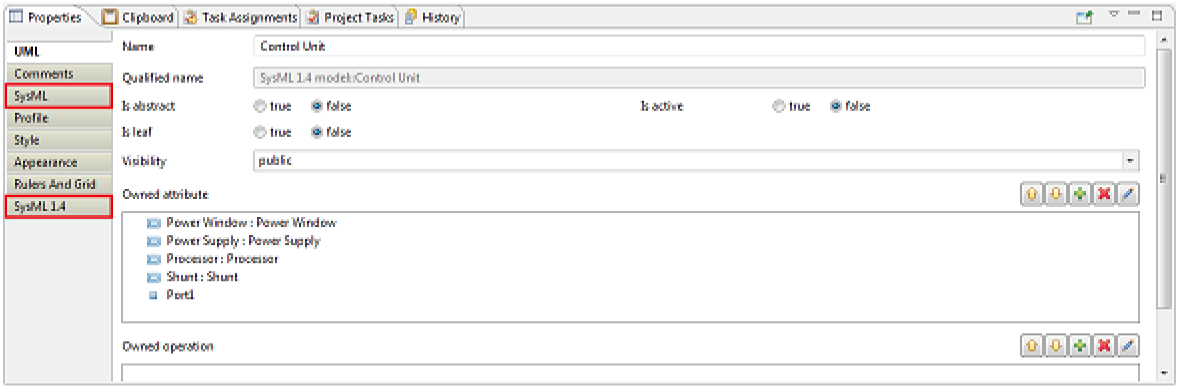
Visibility: public

Location: cdo://repo/$projects/DEMO_SOX2_v3.0_PowerWindow_V1.1/DESIGN/PowerWindow.uml

Package merge

General informations of an opened diagram are shown and can be edited if no object is selected.

Nodes



Name: Control Unit

Qualified name: SysML 1.4 model::Control Unit

Is abstract ○ true ● false

Is active ○ true ● false

Is leaf ○ true ● false

Visibility: public

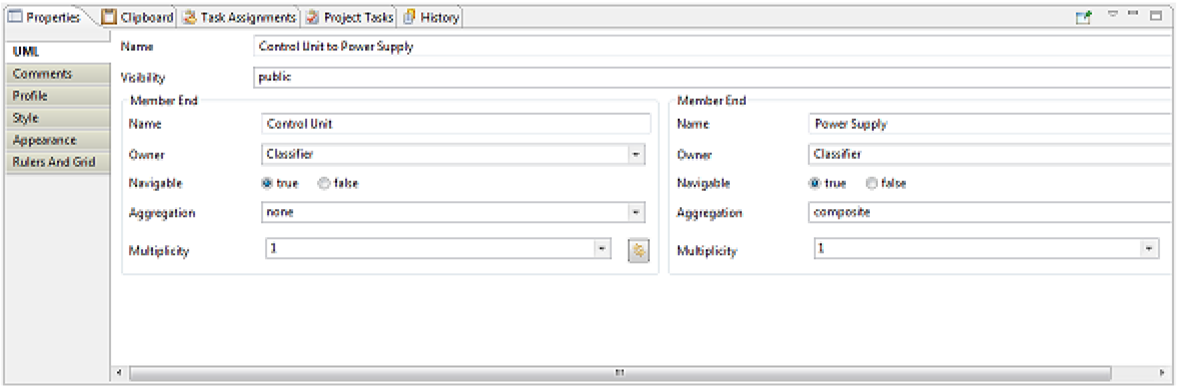
Owned attribute

- Power Window : Power Window
- Power Supply : Power Supply
- Processor : Processor
- Shunt : Shunt
- Port1

Owned operation

Informations of nodes are shown and can be edited if a node is selected. Also stereotypes can be applied.

Edges



Name: Control Unit to Power Supply

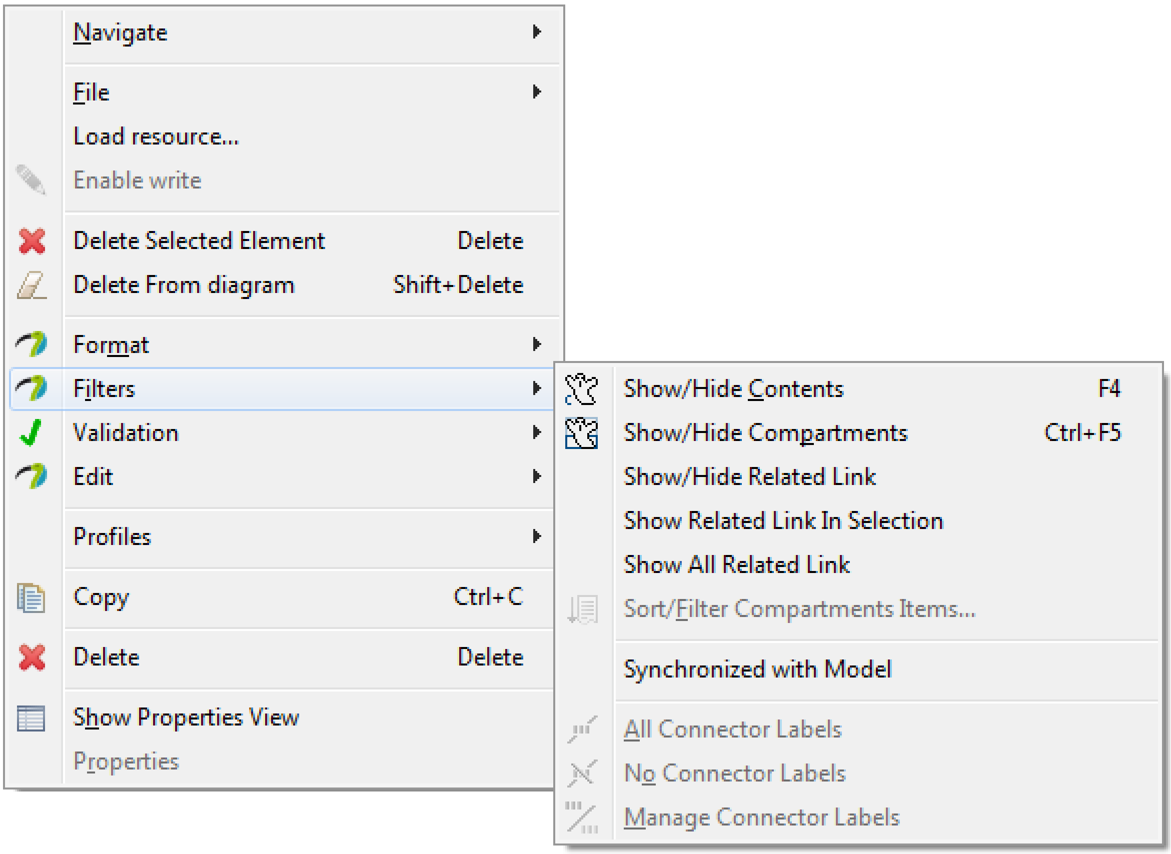
Visibility: public

Member End		Member End	
Name	Control Unit	Name	Power Supply
Owner	Classifier	Owner	Classifier
Navigable	● true ○ false	Navigable	● true ○ false
Aggregation	none	Aggregation	composite
Multiplicity	1	Multiplicity	1

Informations of edges are shown and can be edited if a edge (connector, relation) is selected. You can also specifies the kind of aggregation that applies to the properties.

Filter

You can find all filter with a right-click on a element in your diagram editor or in the toolbar.



- Show/Hide Compartments

  Use this function to select the compartments of an element that are should displayed in the editor.

- Show/Hide Content

  Use this function to select the content of an element that are should displayed in the editor. This is primary necessary in the internal block diagram (IBD). You can also use the drag & drop function for ports and properties.

- Show/Hide Related Link

  Use this function to select the connectors/relations between elements that are should displayed.

Model Explorer

All existing system design elements of a project are listed in the “Model Explorer” view and can be reused from there, e.g., by dragging and dropping them into other documents. Alternatively, it is possible to open one or more “Object list" views to show lists of all existing elements of a specific type.

Symbol definition:

↓az	Sort elements alphabetically.
✎	Customize the Model Explorer.
☰	Toggle advanced Model Explorer.
⇆	Link with editor. A handy feature to select objects: If this is active, every object you select in the

	editor will also be immediately selected in the model explorer and vice versa.
☰	Show diagrams. This shows all diagrams in the model and filters out everything else.

Create Elements Directly in the Model Explorer View.

1. **Right-click** on a **parent element** where the new element should be saved.
2. **Choose** your desired **type** from the topics *New SysML Child, SysML 1.4, New Child, New Relationship, New Diagram, New Table.*
3. **Edit** the element in the respective **properties** view.

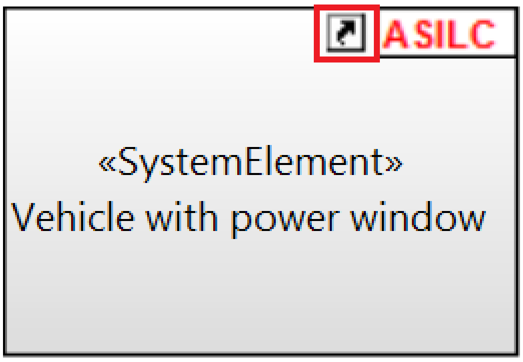
   Note: Elements that are not valid for respective parent elements are not displayed or shown grayed.

Create Child Models

Tip: Child models can be useful for sub-systems e.g.

1. **Right-click** on a parent model.
2. Choose **new child > model**.

All objects from a parent model can be used in the child model. Already created objects can be imported by drag & drop or with the copy function. Imported objects that are used in a diagram of the child model will be marked with a hyper-link symbol.



FMEDA

FMEDA

The SOX FMEDA supports the generation of FMEDAs in accordance with ISO 26262. With the SOX module FMEDA you can calculate safety specific metrics per component group and follow the progress of your analysis via Status and Tasks.

The SOX module FMEDA offers not only the ability to build variants, but import hardware and system effects from the FMEA module and easily create a network using the Drag & Drop feature.

Causes and effects of risks are systematically identified and eliminated through the appropriate measures (e.g. diagnosis). The SOX FMEDA module possesses a variety of analysis options and via the Reliability module the generation of failure rates in accordance with e.g. SN 29500.

Step-by-Step-Guide

Creating an FMEDA File

Precondition: A SOX Project was created and SOX Workbench perspective is active.

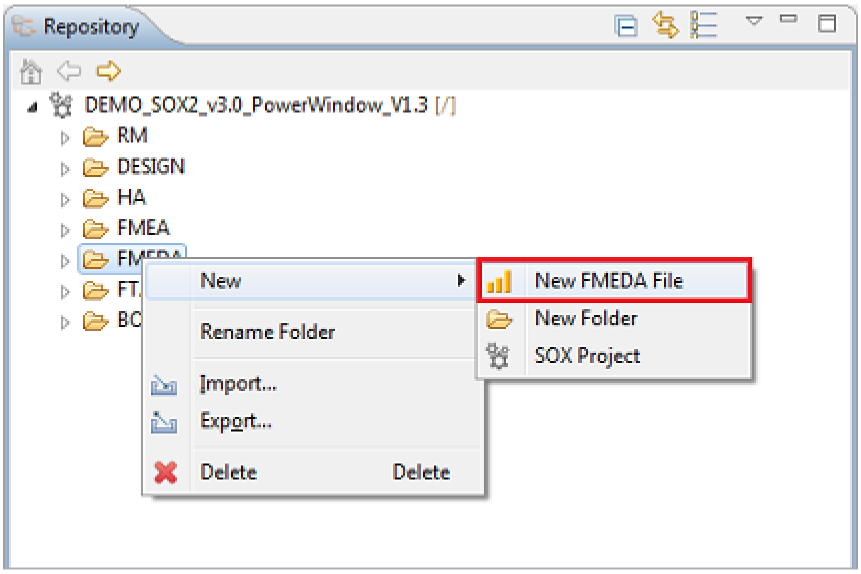


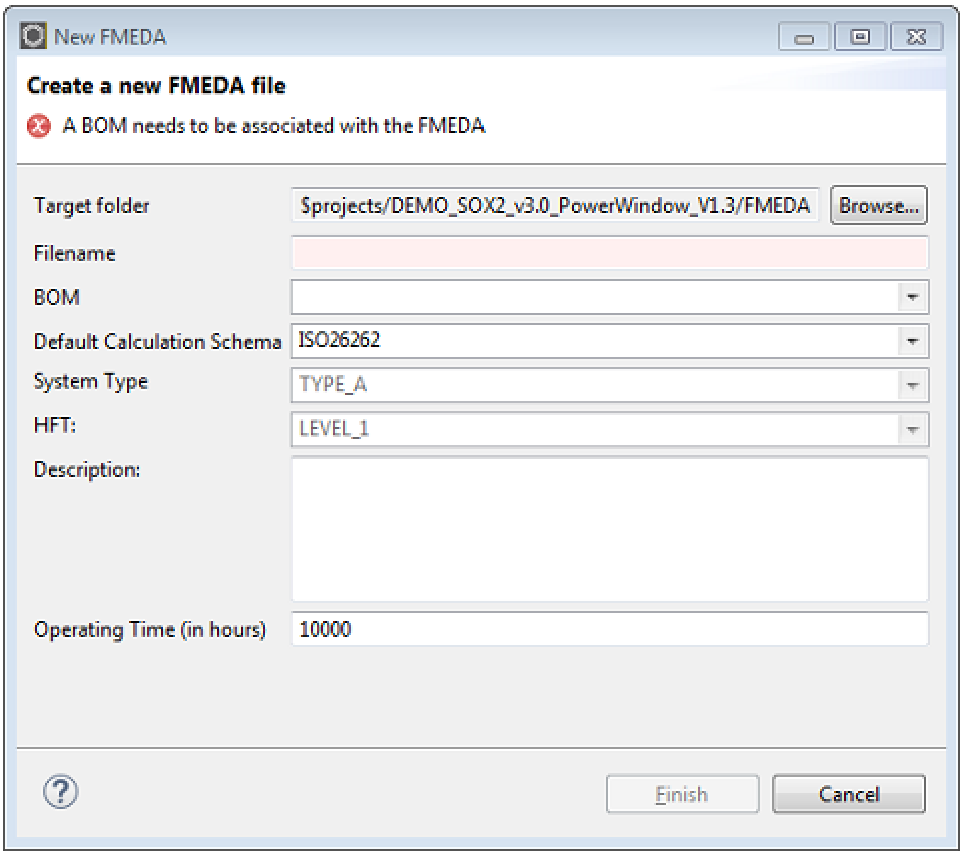
fig. New FMEDA file.

1. Right-click in the Repository view on the FMEDA folder.

   ► The context menu opens.

2. Choose **New > New FMEDA File.**

   ► The dialog "New FMEDA" opens.



New FMEDA

Create a new FMEDA file

A BOM needs to be associated with the FMEDA

Target folder: $projects/DEMO_SOX2_v3.0_PowerWindow_V1.3/FMEDA

Filename:

BOM:

Default Calculation Schema: ISO26262

System Type: TYPE_A

HFT: LEVEL_1

Description:

Operating Time (in hours): 10000

fig. "New FMED"A dialog.

3. Click on **Browse...** to specify the file location.
4. Enter a name for the FMEDA.
5. Choose a BOM which forms the base of the FMEDA.
6. Choose your default calculation scheme. (ISO 26262, IEC 61508)
7. If IEC 61508 is chosen, select a system type of your calculation scheme and set the HFT level.
8. Enter the Operation Time (in hours) if the default calculation scheme is **ISO 26262.**
9. Click on **Finish**.

→ An FMEDA file was created and added to the repository.

Assigning Failure Modes to Components

Hardware function/failure and system function/failure can be assigned from the FMEA, but also with the Functions view.

Precondition: Functions and malfunctions were created, the FMEDA document is opened and the Functions view is active.

1. Drag the desired malfunction and drop it to the according column in the editor.

   ► The "Add or replace" alert opens.

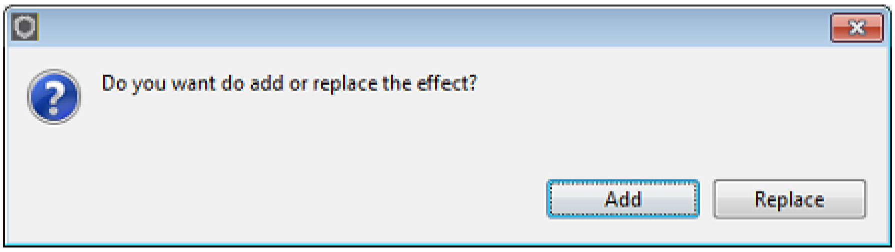
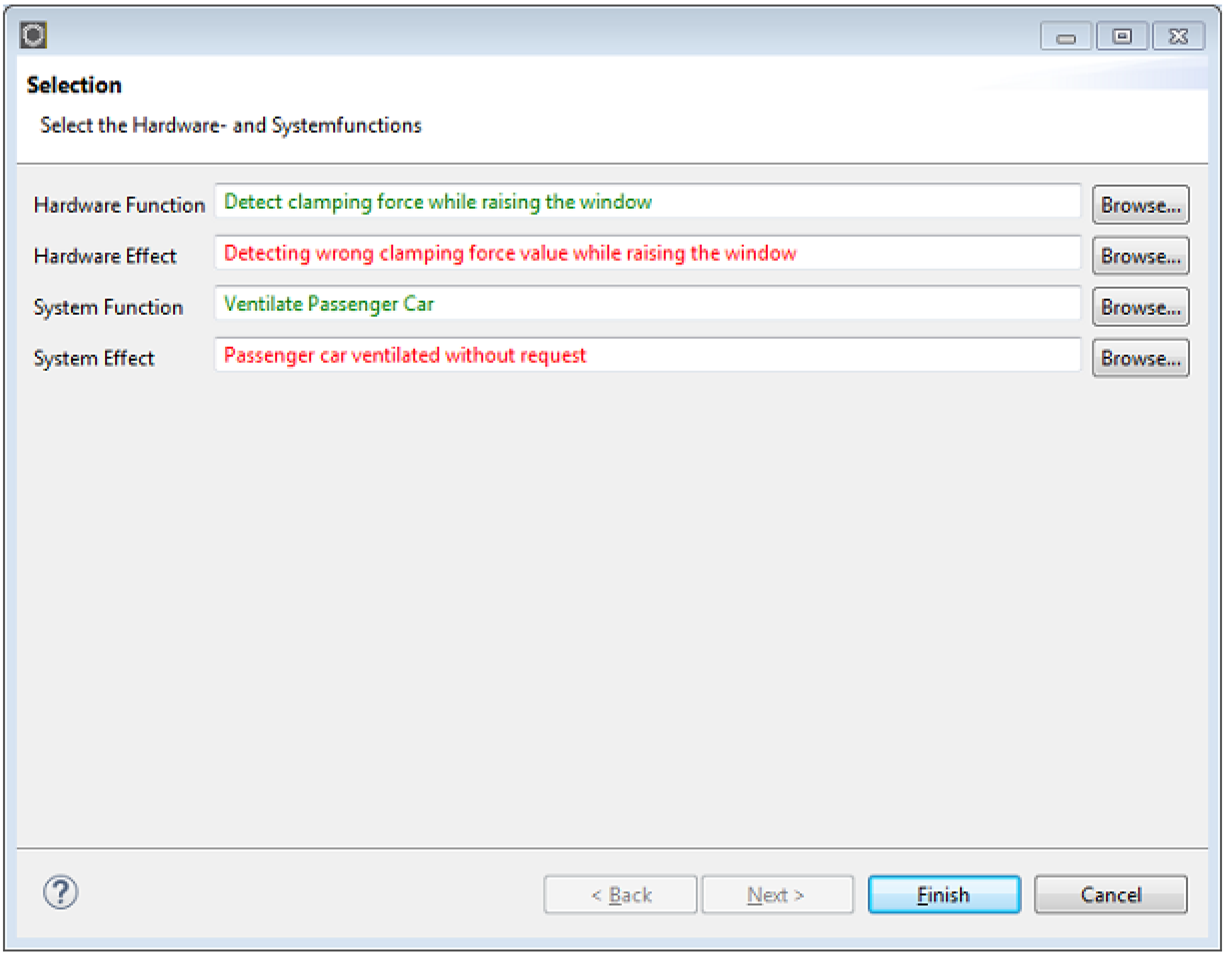

Do you want do add or replace the effect?

fig. Add or replace alert.

2. Click on **Add** or **Replace**.

3. ► The Hardware- and System functions dialog opens.


Selection

Select the Hardware- and Systemfunctions

Hardware Function: Detect clamping force while raising the window

Hardware Effect: Detecting wrong clamping force value while raising the window

System Function: Ventilate Passenger Car

System Effect: Passenger car ventilated without request

fig. Hardware- and System functions dialog.

→ The according hardware function/failure and system function/failure will be set automatically. But they can also changed by clicking the according **Browse...** button.

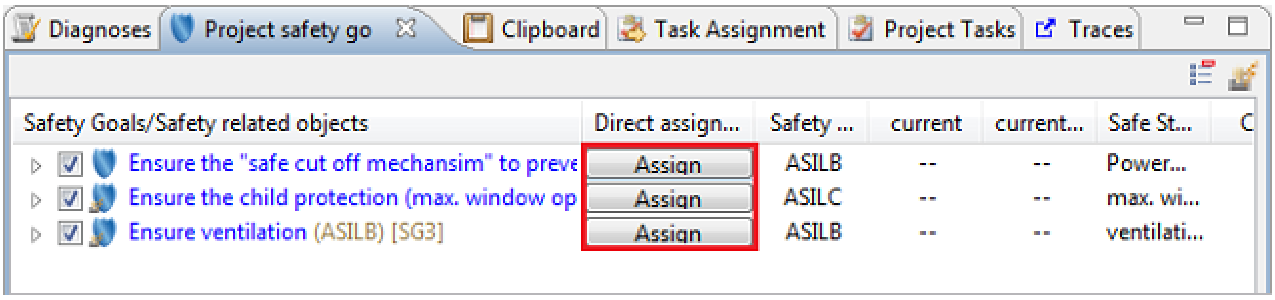
Note

The functionality to add or replace hardware function/failure and system function/failure is identical.

Assigning Safety Goals

Precondition: The FMEDA Editor and the Project safety goals view is active. A Project safety goal was created.

1. Left-click on the **Assign** button of the desired safety goal.



Safety Goals/Safety related objects	Direct assign...	Safety ...	current	current...	Safe St...	C
☑ Ensure the "safe cut off mechansim" to preve	Assign	ASILB	--	--	Power...	
☑ Ensure the child protection (max. window op	Assign	ASILC	--	--	max. wi...	
☑ Ensure ventilation (ASILB) [SG3]	Assign	ASILB	--	--	ventilati...	

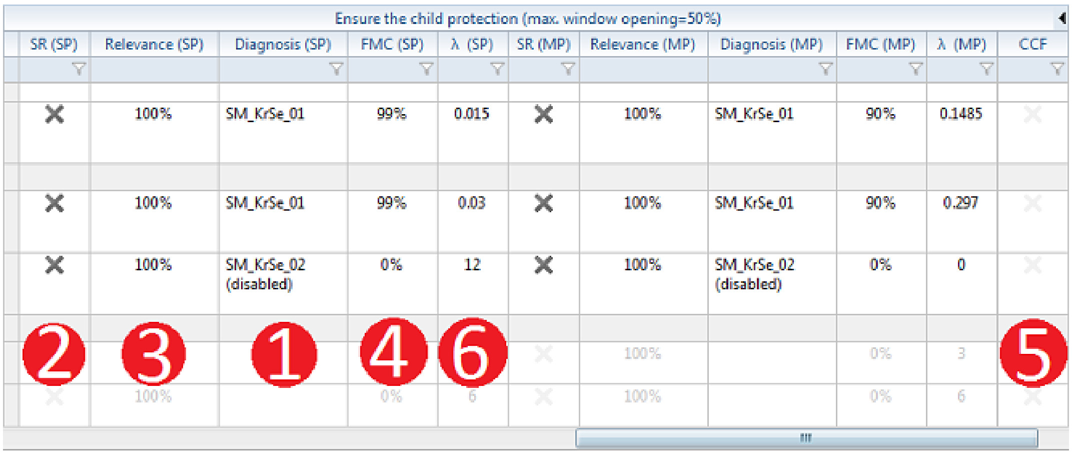
fig. Assigning safety goals.

→ SOX automatically extends the FMEDA table with additional columns for metric calculation per safety goal.

Calculating FMEDA according to ISO 26262

The safety engineer edits an FMEDA, assigns calculation parameter values and diagnoses to a FMEDA document with the calculation scheme ISO 26262. SOX then performs the calculations accordingly and displays the results.

Precondition: An FMEDA document with calculation scheme ISO 26262 is open. Diagnoses were created. Safety goals were assigned.



Ensure the child protection (max. window opening=50%)

SR (SP)	Relevance (SP)	Diagnosis (SP)	FMC (SP)	λ (SP)	SR (MP)	Relevance (MP)	Diagnosis (MP)	FMC (MP)	λ (MP)	CCF
✗	100%	SM_KrSe_01	99%	0.015	✗	100%	SM_KrSe_01	90%	0.1485	✗
✗	100%	SM_KrSe_01	99%	0.03	✗	100%	SM_KrSe_01	90%	0.297	✗
✗	100%	SM_KrSe_02 (disabled)	0%	12	✗	100%	SM_KrSe_02 (disabled)	0%	0	✗
					✗	100%		0%	3	
✗	100%		0%	6	✗	100%		0%	6	✗

fig. Calculation parameters per failure mode and safety goal.

1. Double-click to set the diagnosis.

2. Double-click to set the safety relevance SR (SP).

3. Enter the relevance (optional).

4. Enter FMC (SP).

   Do the same steps for MP.

5. Set CCF.

6. SOX calculates the resulting metrics λ and displays them.

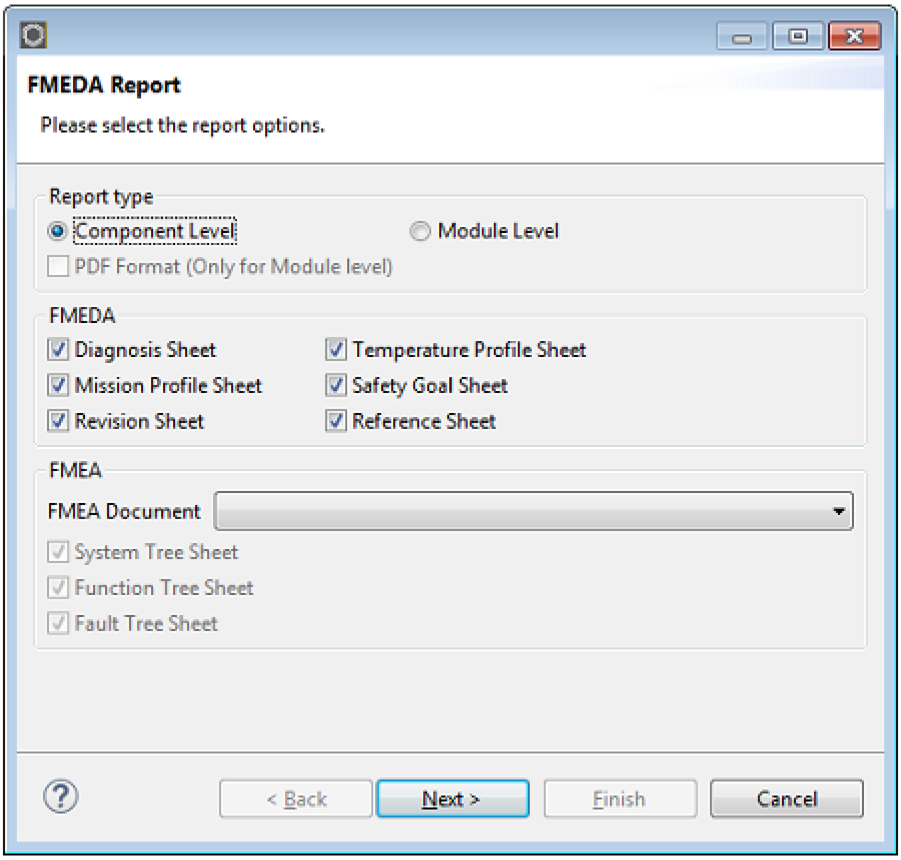
Creating an FMEDA Report

Precondition: An FMEDA document is open.

1. In the menu bar, click on **File**.

2. Choose **Print**.

   ► The "FMEDA Report" wizard opens.



FMEDA Report

Please select the report options.

Report type

● Component Level ○ Module Level

☐ PDF Format (Only for Module level)

FMEDA

☑ Diagnosis Sheet ☑ Temperature Profile Sheet

☑ Mission Profile Sheet ☑ Safety Goal Sheet

☑ Revision Sheet ☑ Reference Sheet

FMEA

FMEA Document

☑ System Tree Sheet

☑ Function Tree Sheet

☑ Fault Tree Sheet

fig. "FMEDA Repor"t wizard.

3. Set report type.

4. Select Excel report or PDF report (PDF only for module report).

5. Set sheets (sections) to be added to the report.

6. Set FMEA data to be added to the report.

7. Click **Next**.

   ► The output dialog opens.

8. Click on **Browse** to specify the file location.

9. The output file will open automatically if "Open" is marked.

10.Click on **Finish**.

→ An FMEDA report was created.

The User Interface

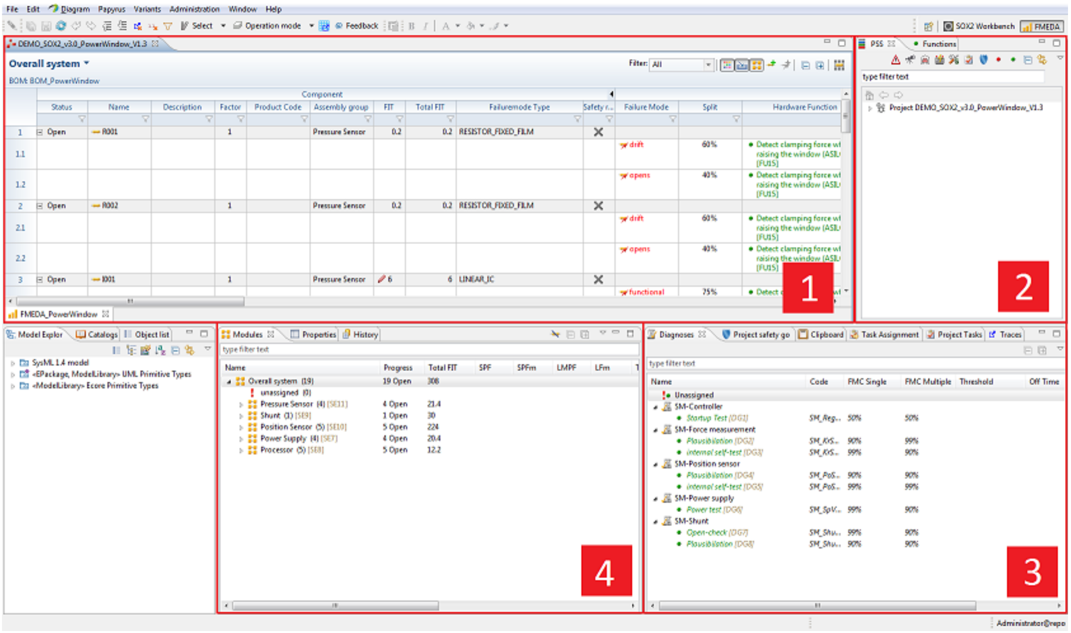


fig. User Interface FMEDA perspective.

[1] FMEDA Editor

[2] PSS view, Functions view

[3] Diagnoses view, Project safety goals view, Clipboard, Task Assignment, Project Tasks, Traces

[4] Modules view, Properties view, History view

FMEDA Editor

Functions View

The Functions view gives you an overview of all functions and their malfunctions. Moreover, you may create or delete functions and malfunctions. The functions are listed in a tree diagram and are sorted by corresponding modules.

Furthermore the system design is displayed and the safety goal assignments can be edited.

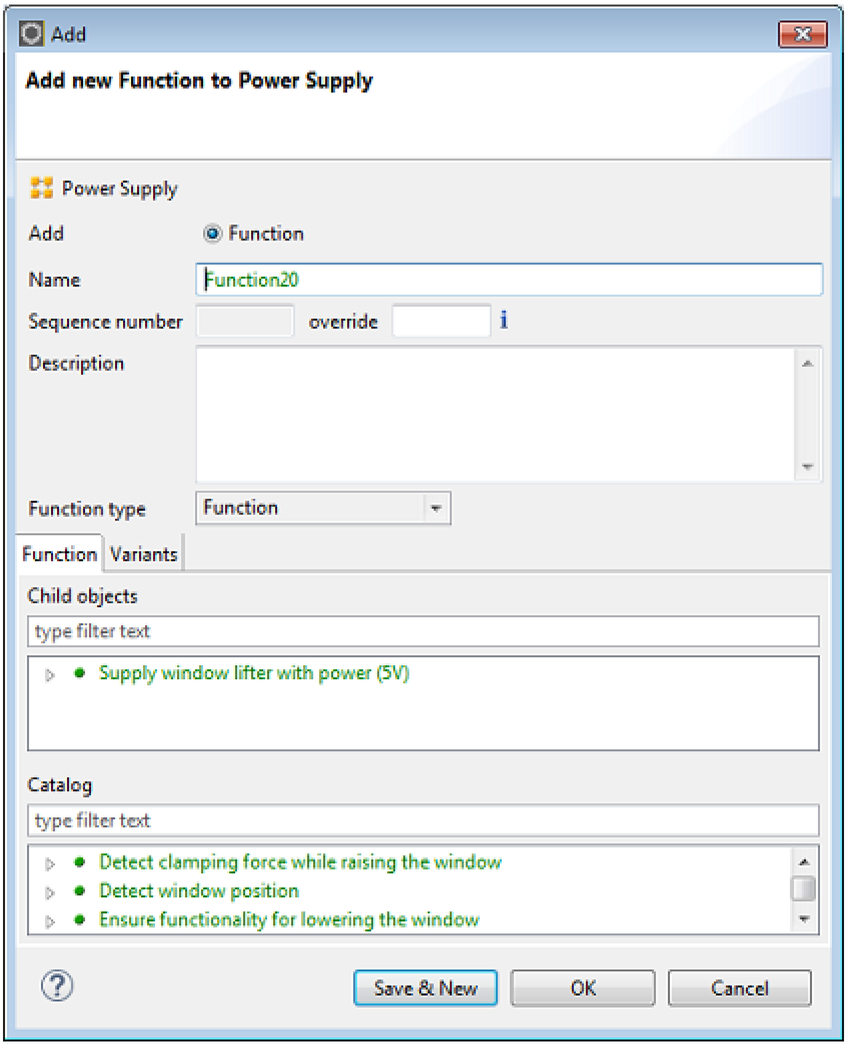
Creating a new Function

Precondition: The functions view is active.

1. Select the desired module or "Unassigned".

2. Choose **New** > **New Function**.

   ► The "Add new Function" dialog opens.



Add

Add new Function to Power Supply

Power Supply

Add ● Function

Name: Function20

Function type: Function

Child objects

- Supply window lifter with power (5V)

Catalog

- Detect clamping force while raising the window
- Detect window position
- Ensure functionality for lowering the window

fig. "Add new Functio"n dialog.

3. Enter a name for the function.

4. Optionally, enter a description.

   To create more functions, click on **Save & New**, then you can directly enter a new name for a new function. With **OK** you save your function and finish the process. With **Cancel** the process will be canceled.

→ A new function was added to the project.

Assigning Functions to Modules

To assign a function to a module, choose the desired function and drag & drop it on a module.

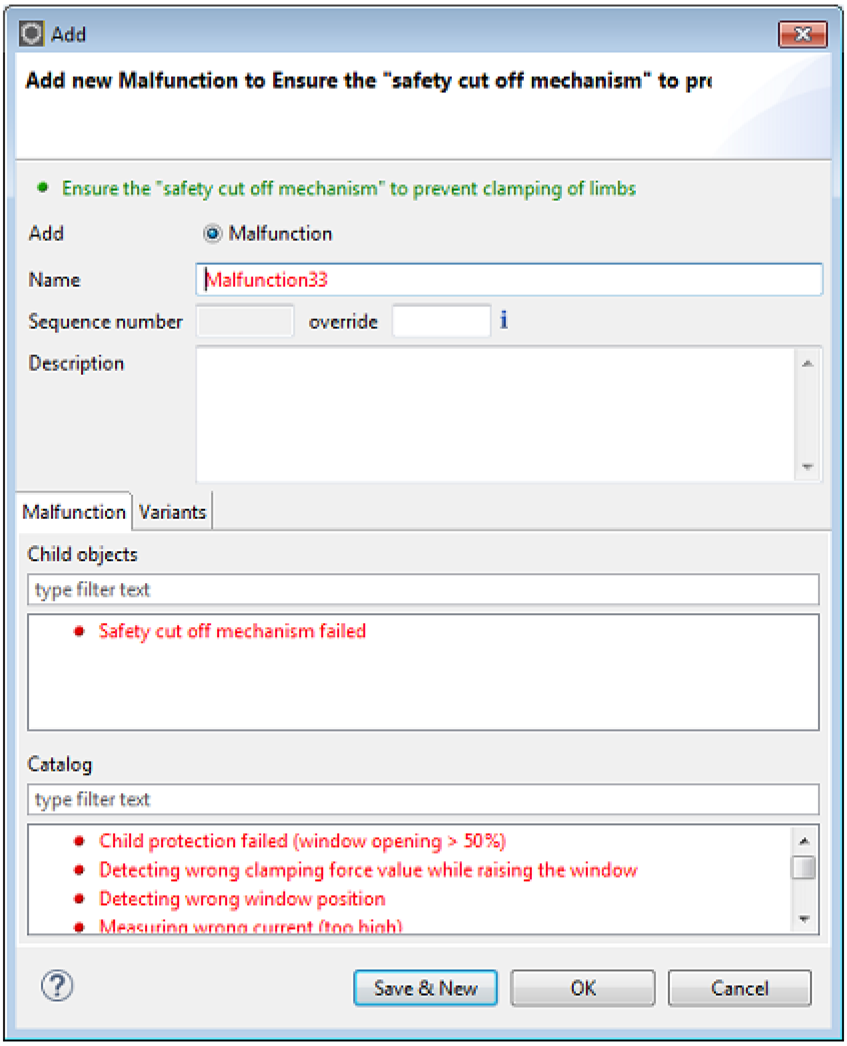
Create Malfunctions

Precondition: A function was created and the function view is active.

1. Right-click on a function.

2. Choose **New** > **New malfunction**.

   ► The "Add malfunction" dialog opens.



Add

Add new Malfunction to Ensure the "safety cut off mechanism" to pr

- Ensure the "safety cut off mechanism" to prevent clamping of limbs

Add: ● Malfunction

Name: Malfunction33

Sequence number: override:

Description:

- Safety cut off mechanism failed

- Child protection failed (window opening > 50%)
- Detecting wrong clamping force value while raising the window
- Detecting wrong window position
- Measuring wrong current (too high)

fig. "Add malfunctio"n dialog.

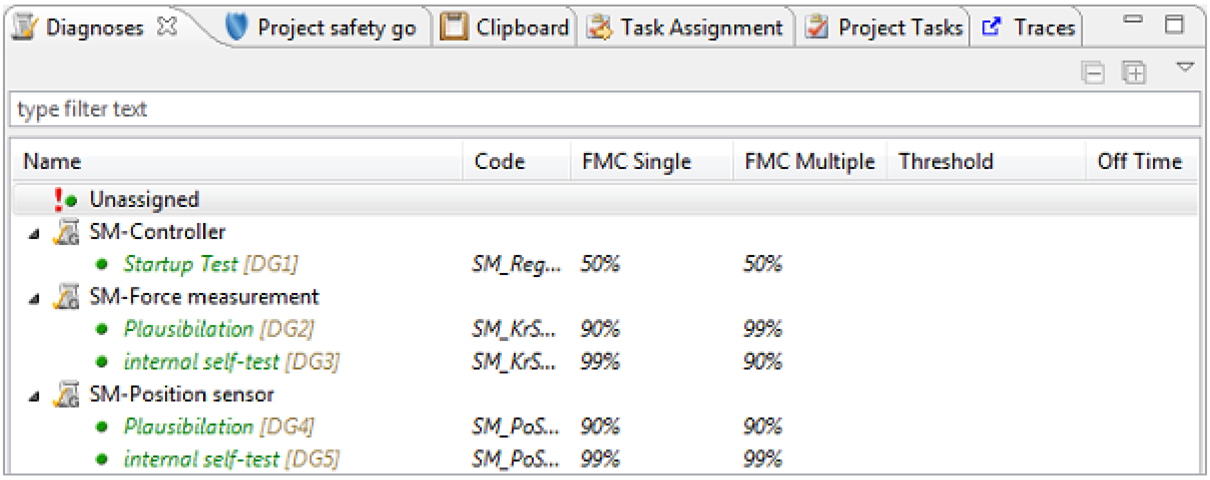
3. Enter a name for the new malfunction.

4. Optionally, enter a description.

   To create more malfunctions, click on **Save & New**, then you can directly enter a new name for a new malfunction. With **OK** you save your malfunction and finish the process. With **Cancel** the process will be canceled.

→ A malfunction was added to the project.

Diagnoses View



Name	Code	FMC Single	FMC Multiple	Threshold	Off Time
Unassigned					
SM-Controller					
Startup Test [DG1]	*SM_Reg...*	*50%*	*50%*		
SM-Force measurement					
Plausibilation [DG2]	*SM_KrS...*	*90%*	*99%*		
internal self-test [DG3]	*SM_KrS...*	*99%*	*90%*		
SM-Position sensor					
Plausibilation [DG4]	*SM_PoS...*	*90%*	*90%*		
internal self-test [DG5]	*SM_PoS...*	*99%*	*99%*		

fig. Diagnoses view.

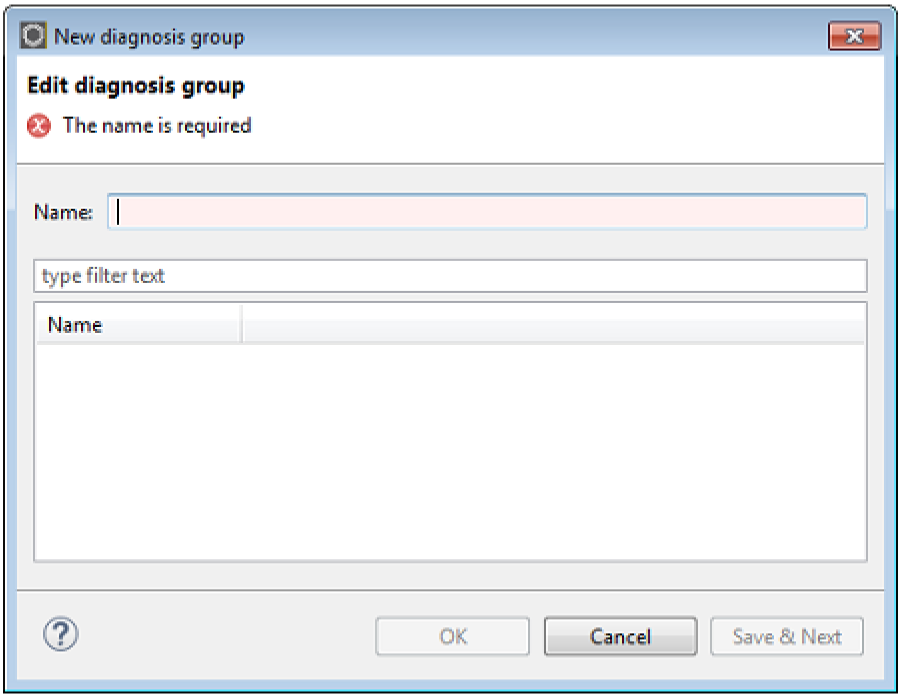
The Diagnoses view displays all diagnoses and their functions. Furthermore in this view diagnoses can be created, edited and deleted.

Creating Diagnosis Groups

Precondition: The diagnoses view is active.

1. Right-click somewhere in the diagnosis view.
2. Choose **New > New Diagnosis Group**

► The "New diagnosis group" dialog opens.



Edit diagnosis group

The name is required

Name:

fig. "New diagnosis grou"p dialog.

To create more diagnosis groups, click on **Save & New**, then you can directly enter a new name for a new diagnosis group. With **OK** you save your diagnosis groups and finish the process. With **Cancel** the process will be canceled.

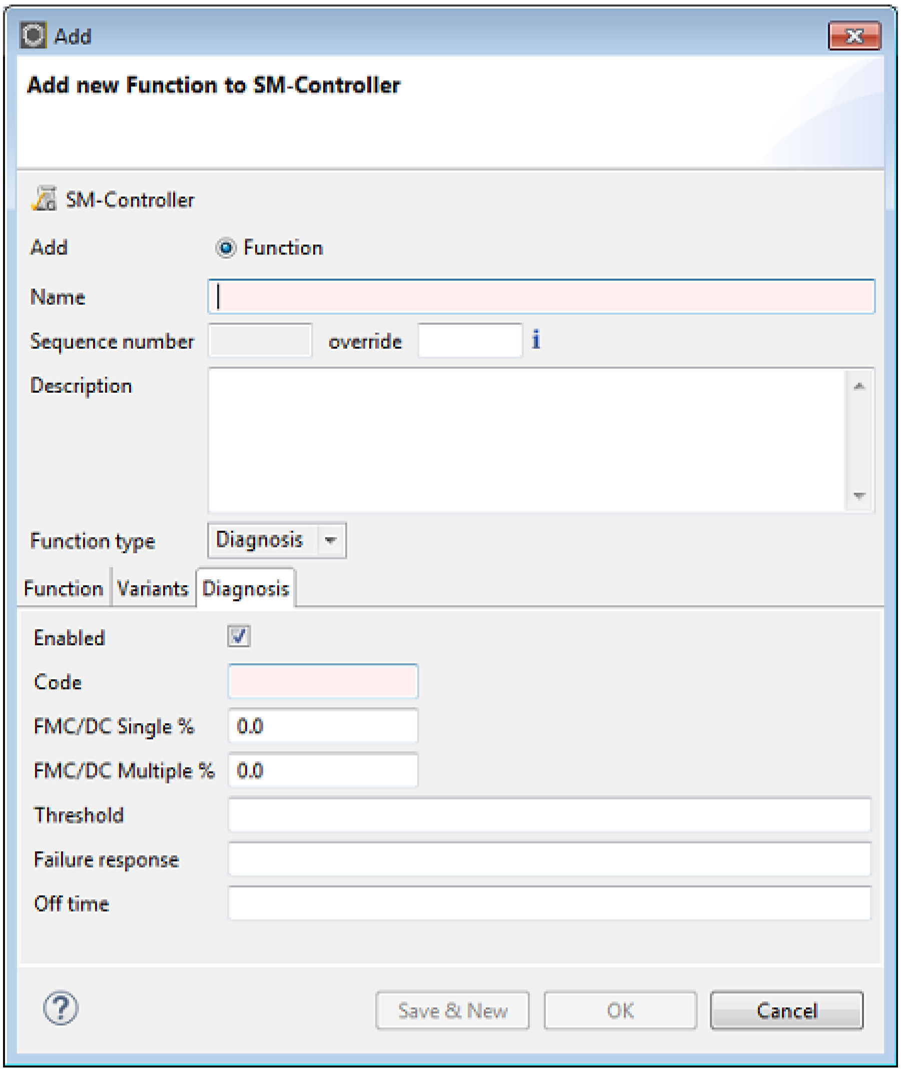
→ A new diagnosis group was created and added to the diagnosis view.

Creating Diagnoses

Precondition: A diagnosis group was created.

1. Select an existing diagnosis group.
2. Right-click on it.
3. Choose **New > New Diagnosis**

► The Add diagnosis dialog opens.



Add

Add new Function to SM-Controller

SM-Controller

Add ● Function

Name

Sequence number override

Description

Function type: Diagnosis

Enabled: ☑

Code

FMC/DC Single %: 0.0

FMC/DC Multiple %: 0.0

Threshold

Failure response

Off time

fig. Add diagnosis dialog.

1. Enter a name for the diagnosis.

2. Optionally, enter a description.

3. Set enabled/disabled.

Note

- IEC: Only DC Single is required.

- ISO: FMC Single/Multiple is required.

4. Enter threshold (optional).

5. Enter failure response (optional).

6. Enter off time (optional).

To create more diagnoses, click on **Save & New**, then you can directly enter a new name for a new diagnosis. With **OK** you save your diagnosis and finish the process. With **Cancel** the process will be canceled.

→ A new diagnosis was added to the selected diagnoses group.

Editing Diagnoses and Diagnosis Groups

To edit diagnoses and diagnosis groups, select the desired one. Right-click on the diagnosis and choose **Edit**. After that, the "Edit diagnoses" dialog opens.

Setting the Diagnosis State

To set a diagnosis state, select your diagnosis and right-click on the desired one. Choose **Set diagnosis state** and you get the options "enable" and "disable".

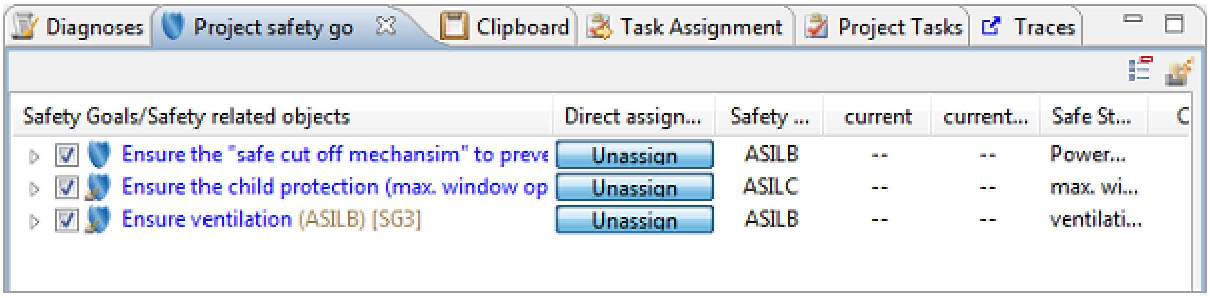
If you disable your diagnosis state,you will set the FMC in the overview to 0% and consequently modify the metric calculation.

Deleting Diagnoses and Diagnosis Groups

To delete a diagnosis or a diagnosis group, right-click on the desired one and choose **Delete**.

The Refactoring dialog opens. To finally delete the diagnosis or diagnosis group, click on **Finish**.

Project Safety Goals View



Safety Goals/Safety related objects	Direct assign...	Safety ...	current	current...	Safe St...	C
☑ Ensure the "safe cut off mechansim" to preve	Unassign	ASILB	--	--	Power...	
☑ Ensure the child protection (max. window op	Unassign	ASILC	--	--	max. wi...	
☑ Ensure ventilation (ASILB) [SG3]	Unassign	ASILB	--	--	ventilati...	

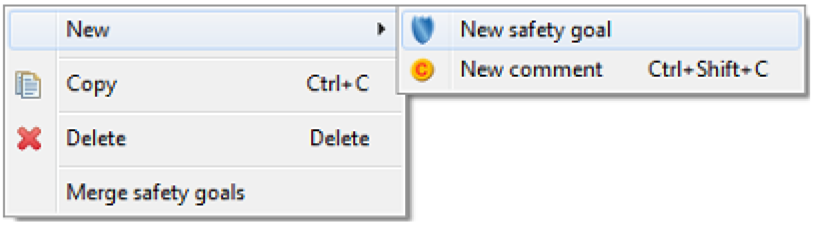
fig. Project safety goals view.

The Project safety goals view displays all Project safety goals. Furthermore in this view Project safety goals can be created, edited, deleted and assigned.

Creating Project Safety Goals

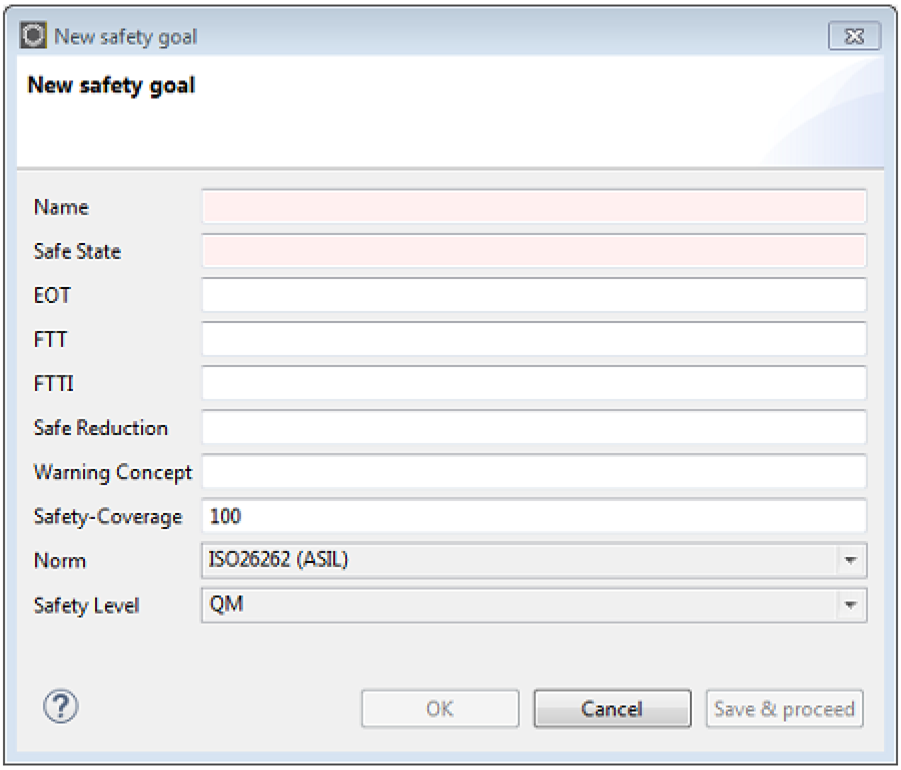
Precondition: The Project safety goals view is active.

1. Right-click in the Project safety goals view.



2. Choose **New** > **New safety goal**.

► The" New safety goal" dialog opens.



Name

Safe State

EOT

FTT

FTTI

Safe Reduction

Warning Concept

Safety-Coverage 100

Norm ISO26262 (ASIL)

Safety Level QM

fig. New safety goal dialog.

3. Enter a name for the safety goal.

4. Enter a Safe State.

Optional:

- Enter a EOT, FTT, FTTI.
- Enter a Safe Reduction
- Enter a Warning Concept
- Enter a Safety-coverage.

5. Choose the norm according to the desired safety calculation ASIL, SIL, PL, MSIL.

6. Choose the Safety Level according to the chosen norm.

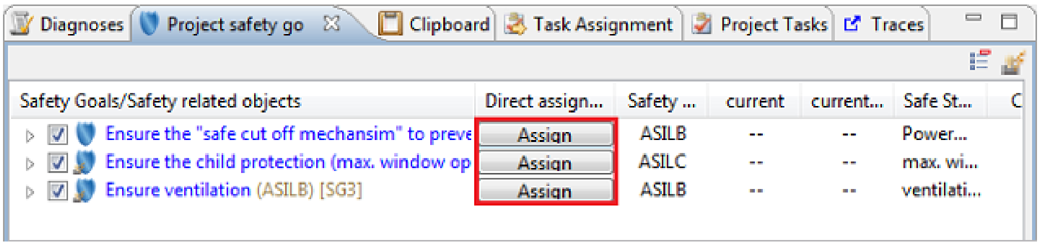
To create more safety goals, click on **Save & New**, then you can directly enter a new name for a new diagnosis. With **OK** you save your diagnosis and finish the process. With **Cancel** the process will be canceled.

→ A new Safety goal was created.

Assigning Project Safety Goals

Precondition: The FMEDA Editor and the Project safety goals view is active. A Project safety goal was created.

1. Left-click on the **Assign** button of the desired safety goal.



Safety Goals/Safety related objects	Direct assign...	Safety ...	current	current...	Safe St...	C
☑ Ensure the "safe cut off mechansim" to preve	Assign	ASILB	--	--	Power...	
☑ Ensure the child protection (max. window op	Assign	ASILC	--	--	max. wi...	
☑ Ensure ventilation (ASILB) [SG3]	Assign	ASILB	--	--	ventilati...	

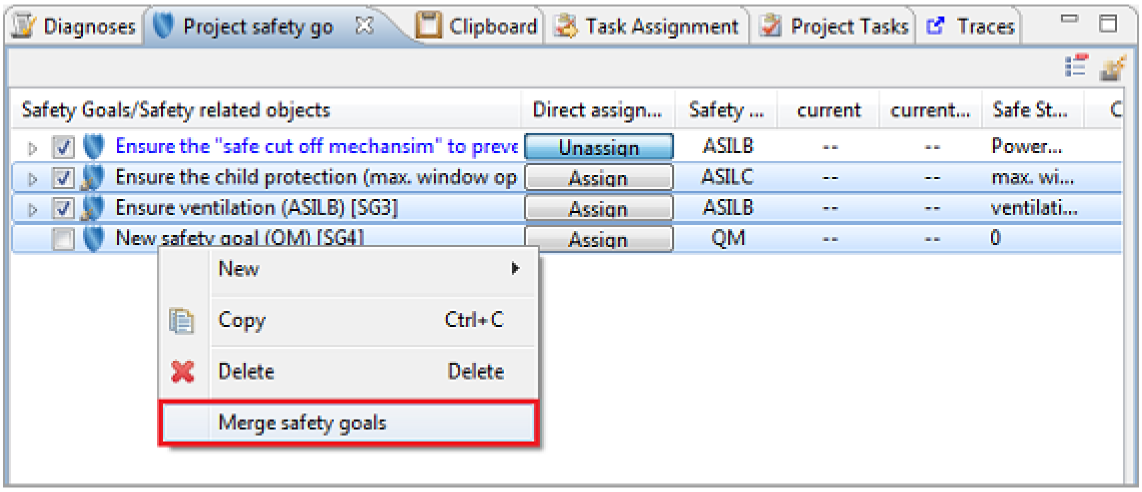
fig. Assign safety goals.

→ SOX automatically extends the FMEDA table with additional columns for metric calculation per safety goal.

Merging Project Safety Goals

Precondition: Safety goals were created and the Project safety gaols view is active. The safety goals have no safety relevance and are in the same safety norm calculation.

1. Select the desired safety goals (hold CTRL + Left-click).

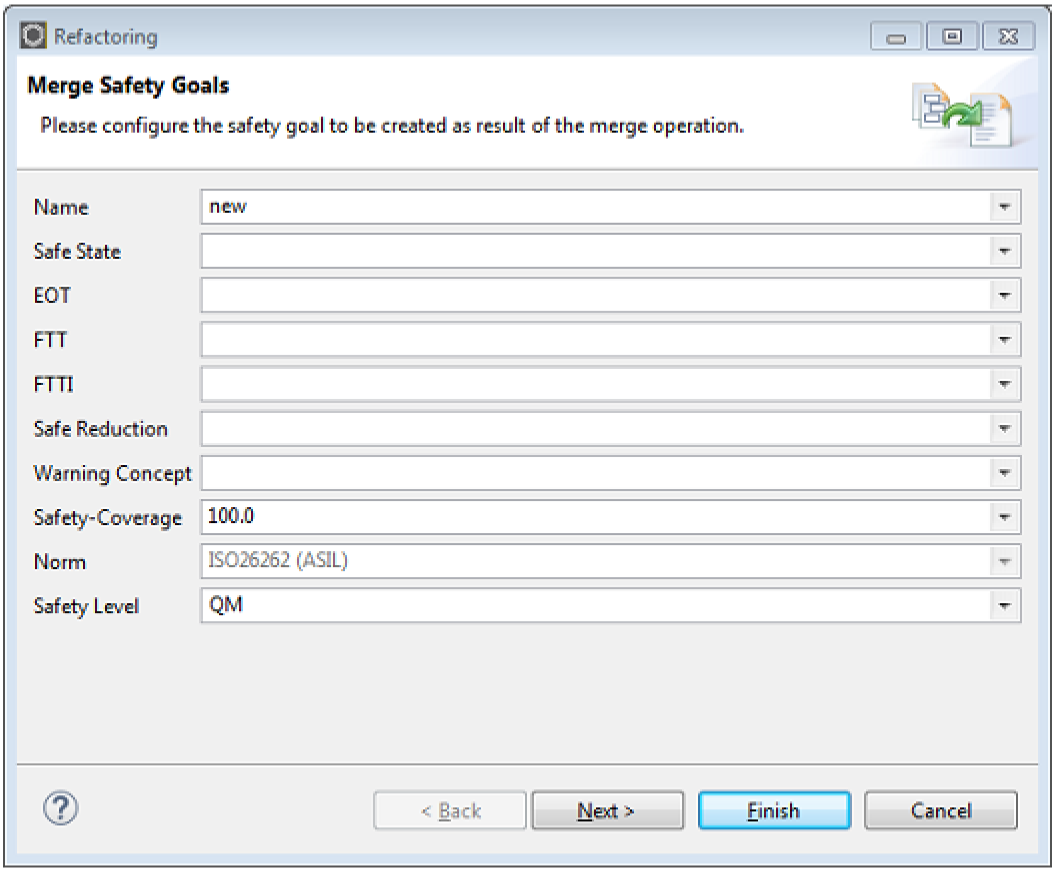


Safety Goals/Safety related objects	Direct assign...	Safety ...	current	current...	Safe St...	C
☑ Ensure the "safe cut off mechansim" to preve	Unassign	ASILB	--	--	Power...	
☑ Ensure the child protection (max. window op	Assign	ASILC	--	--	max. wi...	
☑ Ensure ventilation (ASILB) [SG3]	Assign	ASILB	--	--	ventilati...	
☐ New safety goal (QM) [SG4]	Assign	QM	--	--	0	

2. Right-click on one selected safety goal.

3. Choose **Merge safety goals**.

►The "Merge Safety Goals" dialog opens.



Merge Safety Goals

Please configure the safety goal to be created as result of the merge operation.

Name	new
Safe State	
EOT	
FTT	
FTTI	
Safe Reduction	
Warning Concept	
Safety-Coverage	100.0
Norm	ISO26262 (ASIL)
Safety Level	QM

fig. "Merge Safety Goal"s dialog.

4. Enter a name for the new safety goal.

5. Enter the remaining parameters for the new generated safety goal.

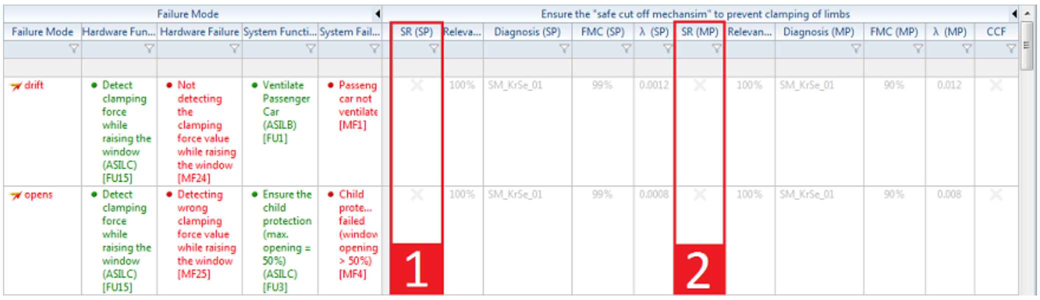
6. Click on **Finish**.

→ The safety goals were merged and the newly generated safety goal will be added to your project.

Assigning Safety Relevance

Precondition: The Project safety goal has to be assigned and the FMEDA document is opened.

1. Double-click in the SR (SP) [1]/SR (MP) [2] column of the desired Failure Mode row.



Failure Mode					Ensure the "safe cut off mechansim" to prevent clamping of limbs										
Failure Mode	Hardware Fun...	Hardware Failure	System Functi...	System Fail...	SR (SP)	Releva...	Diagnosis (SP)	FMC (SP)	λ (SP)	SR (MP)	Relevan...	Diagnosis (MP)	FMC (MP)	λ (MP)	CCF
drift	● Detect clamping force while raising the window (ASILC) [FU15]	● Not detecting the clamping force value while raising the window [MF24]	● Ventilate Passenger Car (ASILB) [FU1]	● Passeng car not ventilate [MF1]	✕	100%	SM_KrSe_01	99%	0.0012	✕	100%	SM_KrSe_01	90%	0.012	✕
opens	● Detect clamping force while raising the window (ASILC) [FU15]	● Detecting wrong clamping force value while raising the window [MF25]	● Ensure the child protection (max. opening = 50%) (ASILC) [FU3]	● Child prote... failed (window opening > 50%) [MF4]	✕	100%	SM_KrSe_01	99%	0.0008	✕	100%	SM_KrSe_01	90%	0.008	✕

fig. FMEDA Editor.

→ The failure mode is now safety related which is displayed by a X symbol.

Tip

- Several relevance can be assigned with multiple selection.
  1. Hold CTRL and click on the desired rows.
  2. Press F2.
- All relevance can be assigned
  1. Double-click on the column title SR (SP)/SR (MP)

     ► All rows are marked.
  2. Press F2.

Note

The relevance of each safety goal can be scaled in percent in the Relevance (SP)/(MP) column. This has an effect on the safety calculation.

Edit Project Safety Goals

To edit Project safety goals, select the desired one. Right-click on it and choose **Edit**. After that, the "Edit Project safety goals" dialog opens.

Deleting Project Safety Goals

To delete a Project safety goal, right-click on the desired one and choose **Delete**.

The Refactoring dialog opens. To finally delete the project safety goal, click on **Finish**.

Additional Functionality

Linking FMEA and FMEDA

The functions and malfunctions from the FMEA analysis can be used for the FMEDA document.

Precondition: A FMEA was created, a FMEDA document is opened and the PSS view is active.

1. Open the FMEA in the PSS view.

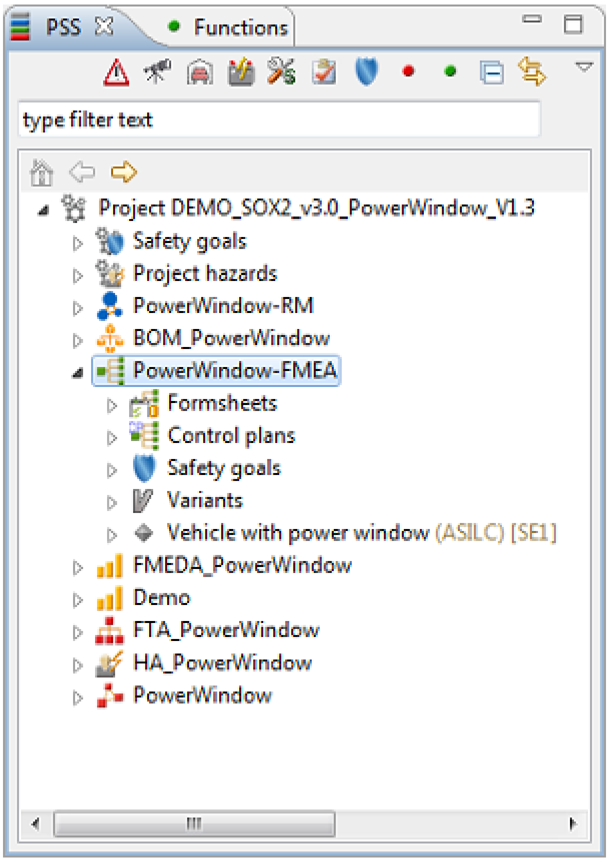
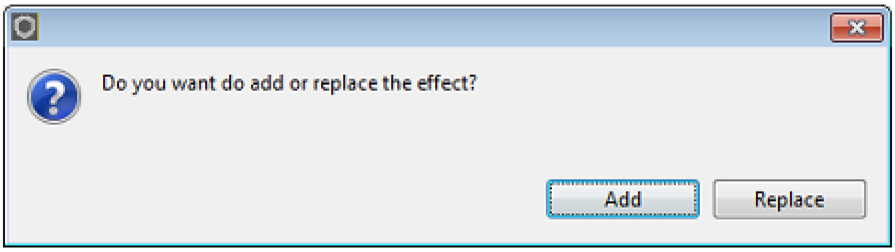


fig. Opened FMEA in the PSS view.

2. Drag the malfunction desired as hardware/system failure.

3. Drop it to the according column in the FMEDA editor.

► The "Add or replace" alert opens.

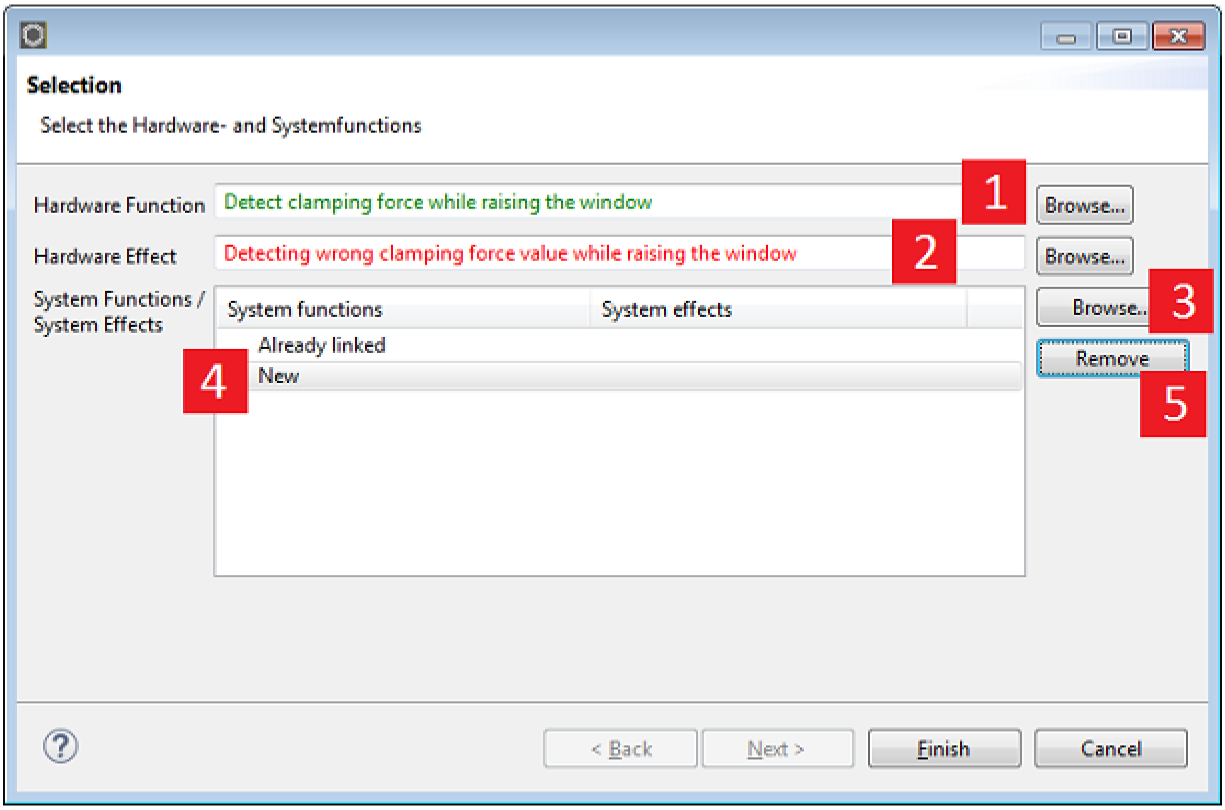


Do you want do add or replace the effect?

fig. Add or replace alert.

Add/Replace

► The add Hardware- and System functions dialog opens.



Selection

Select the Hardware- and Systemfunctions

Hardware Function: Detect clamping force while raising the window

Hardware Effect: Detecting wrong clamping force value while raising the window

System Functions / System Effects

System functions	System effects
Already linked	
New	

fig. Add Hardware- and System functions dialog.

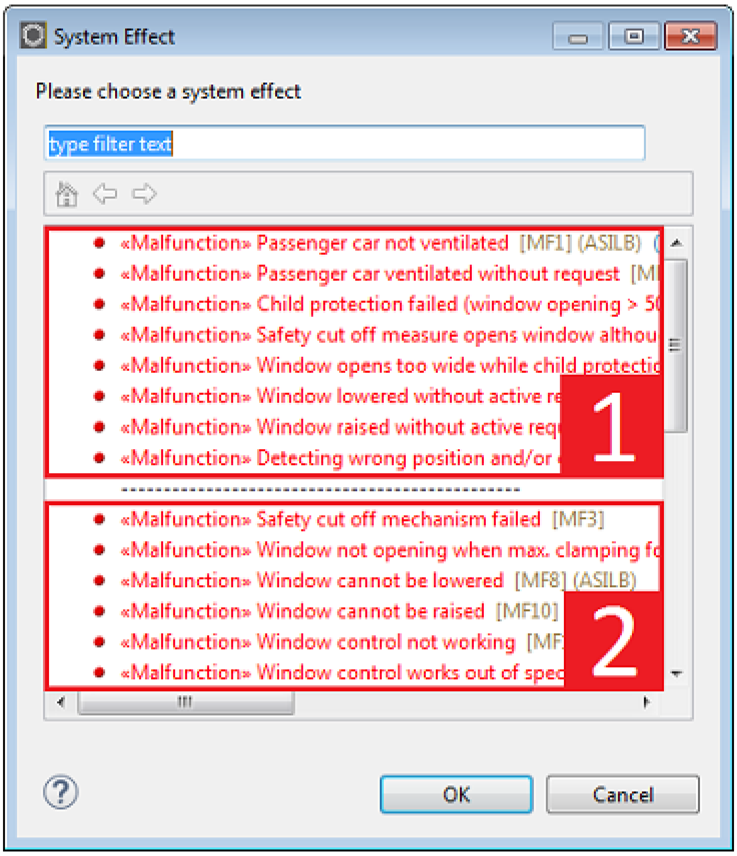
[1] According hardware function of the chosen hardware failure

[2] Chosen hardware failure

[3] Selection of system failure

[4] System functions and system failure.

To remove the system functions and system failure, select the desired one [4] and press the button **Remove** [5].



- «Malfunction» Passenger car not ventilated [MF1] (ASILB)
- «Malfunction» Passenger car ventilated without request [M
- «Malfunction» Child protection failed (window opening > 5
- «Malfunction» Safety cut off measure opens window althou
- «Malfunction» Window opens too wide while child protecti
- «Malfunction» Window lowered without active re
- «Malfunction» Window raised without active req
- «Malfunction» Detecting wrong position and/or

- «Malfunction» Safety cut off mechanism failed [MF3]
- «Malfunction» Window not opening when max. clamping f
- «Malfunction» Window cannot be lowered [MF8] (ASILB)
- «Malfunction» Window cannot be raised [MF10]
- «Malfunction» Window control not working [MF
- «Malfunction» Window control works out of spe

fig. [3] Selection of system failure.

[1] Linked malfunctions from the failure net and level info (blue).

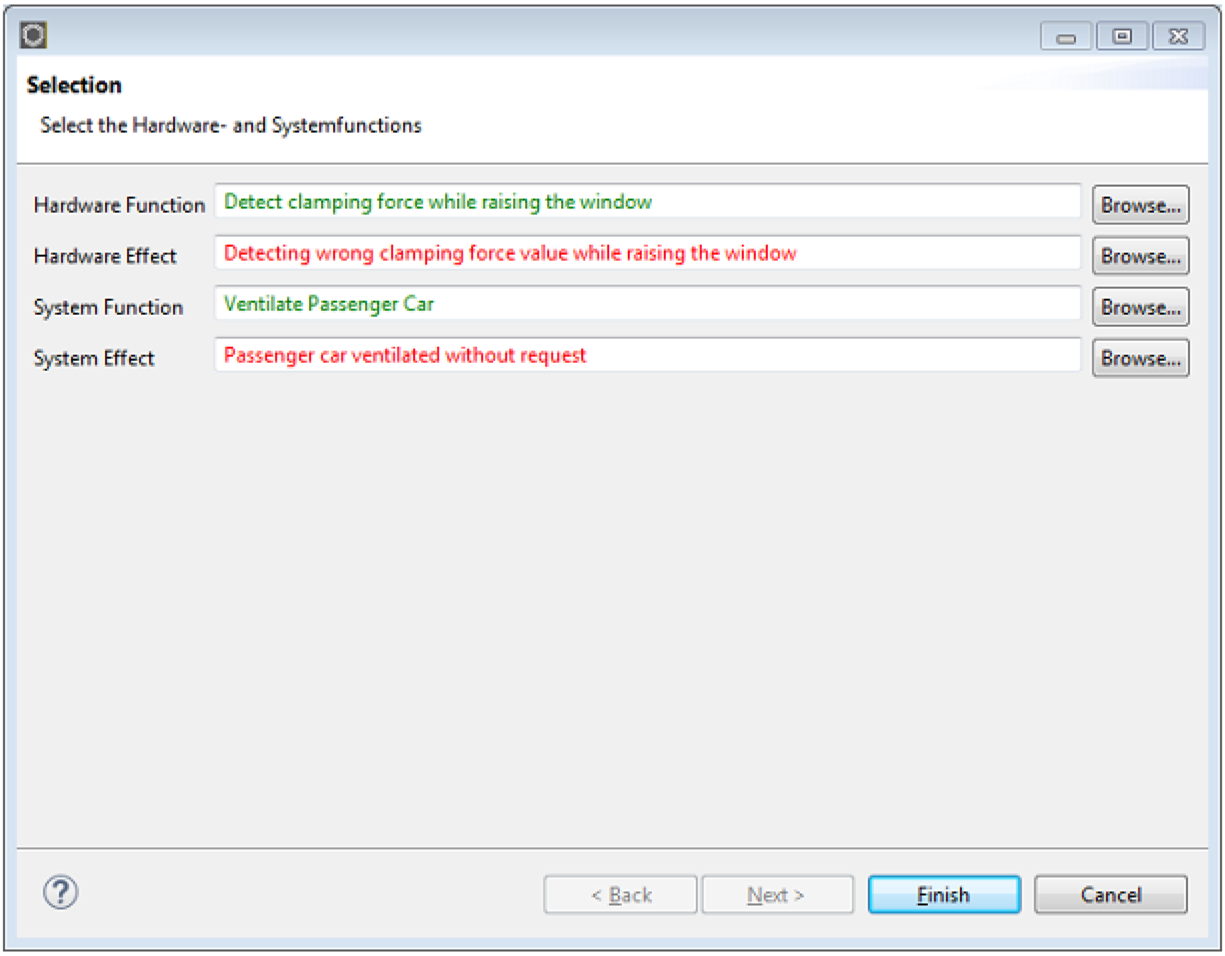
[2] Remaining malfunctions from the project.

Click on **Finish**.

→ A hardware function/failure and system function/failure will be added and the safety goal assignment will be adopted and displayed in the column SE SG.

Replace

► The " Hardware- and System functions" dialog opens.



Selection

Select the Hardware- and Systemfunctions

Hardware Function: Detect clamping force while raising the window

Hardware Effect: Detecting wrong clamping force value while raising the window

System Function: Ventilate Passenger Car

System Effect: Passenger car ventilated without request

fig. "Hardware- and System function"s dialog.

The according hardware function/failure and system function/failure will be set automatically. But they can also be changed by clicking the according **Browse...** button.

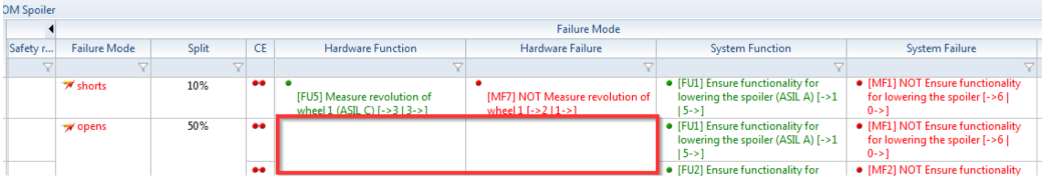
Note

The functionality to add or replace hardware function/failure and system function/failure is identical.

Synchronize with FMEA

This function is a semi-automatic support for synchronization of FMEDA system effects and hardware failures with FMEA. After activate the Sync function, the following analyses will be executed by SOX.

- Empty hardware effect

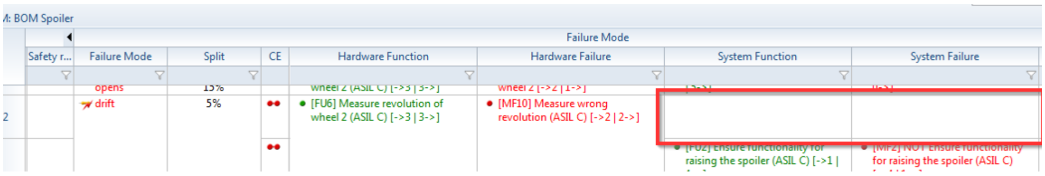


OM Spoiler

				Failure Mode			
Safety r...	Failure Mode	Split	CE	Hardware Function	Hardware Failure	System Function	System Failure
	shorts	10%	●●	● [FU5] Measure revolution of wheel 1 (ASIL C) [->3 | 3->]	● [MF7] NOT Measure revolution of wheel 1 [->2 | 1->]	● [FU1] Ensure functionality for lowering the spoiler (ASIL A) [->1 | 5->]	● [MF1] NOT Ensure functionality for lowering the spoiler [->6 | 0->]
	opens	50%	●●			● [FU1] Ensure functionality for lowering the spoiler (ASIL A) [->1 | 5->]	● [MF1] NOT Ensure functionality for lowering the spoiler [->6 | 0->]
			●●			● [FU2] Ensure functionality for	● [MF2] NOT Ensure functionality

fig. Empty hardware effect at a FMEDA.

- Empty system effect

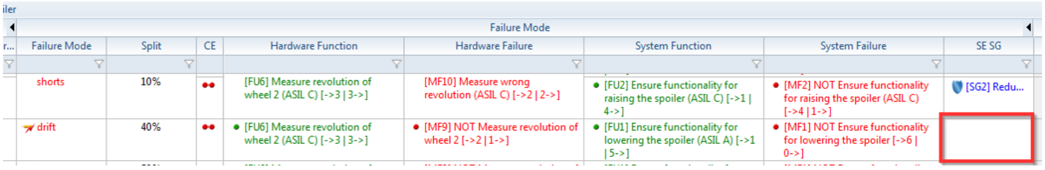


/: BOM Spoiler

	Failure Mode							
	Safety r...	Failure Mode	Split	CE	Hardware Function	Hardware Failure	System Function	System Failure
		opens	15%		wheel 2 (ASIL C) [->3 | 3->]	wheel 2 [->2 | 1->]		
2		drift	5%	●●	● [FU6] Measure revolution of wheel 2 (ASIL C) [->3 | 3->]	● [MF10] Measure wrong revolution (ASIL C) [->2 | 2->]		
				●●			● [FU2] Ensure functionality for raising the spoiler (ASIL C) [->1 |	● [MF2] NOT Ensure functionality for raising the spoiler (ASIL C)

fig. Empty system effect at a FMEDA.

- Not safety-related system effect

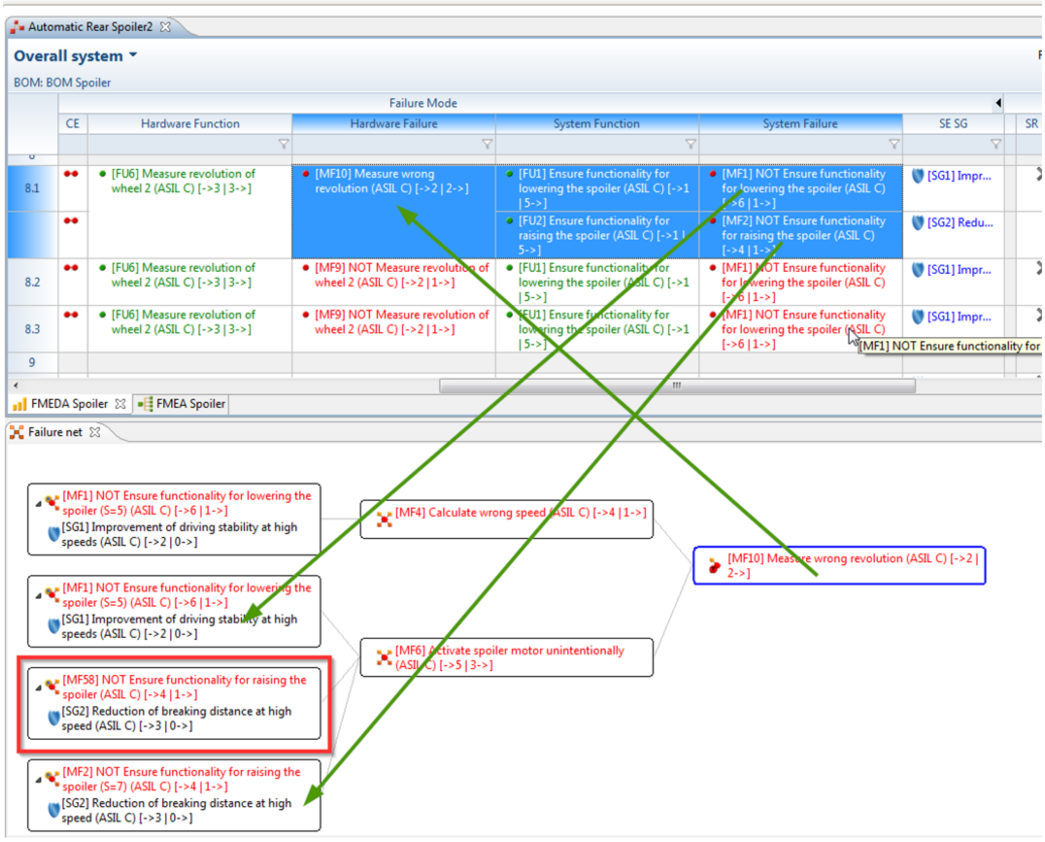


iler

	Failure Mode							
r...	Failure Mode	Split	CE	Hardware Function	Hardware Failure	System Function	System Failure	SE SG
	shorts	10%	●●	[FU6] Measure revolution of wheel 2 (ASIL C) [->3 | 3->]	[MF10] Measure wrong revolution (ASIL C) [->2 | 2->]	● [FU2] Ensure functionality for raising the spoiler (ASIL C) [->1 | 4->]	● [MF2] NOT Ensure functionality for raising the spoiler (ASIL C) [->4 | 1->]	[SG2] Redu...
	drift	40%	●●	● [FU6] Measure revolution of wheel 2 (ASIL C) [->3 | 3->]	● [MF9] NOT Measure revolution of wheel 2 [->2 | 1->]	● [FU1] Ensure functionality for lowering the spoiler (ASIL A) [->1 | 5->]	● [MF1] NOT Ensure functionality for lowering the spoiler [->6 | 0->]	

fig. Not safety-related system effect at a FMEDA.

- Missing system effect



Overall system

BOM: BOM Spoiler

	Failure Mode						
	CE	Hardware Function	Hardware Failure	System Function	System Failure	SE SG	SR
8.1	●●	● [FU6] Measure revolution of wheel 2 (ASIL C) [->3 | 3->]	● [MF10] Measure wrong revolution (ASIL C) [->2 | 2->]	● [FU1] Ensure functionality for lowering the spoiler (ASIL C) [->1 | 5->]	● [MF1] NOT Ensure functionality for lowering the spoiler (ASIL C) [->6 | 1->]	[SG1] Impr...	
	●●			● [FU2] Ensure functionality for raising the spoiler (ASIL C) [->1 | 5->]	● [MF2] NOT Ensure functionality for raising the spoiler (ASIL C) [->4 | 1->]	[SG2] Redu...	
8.2	●●	● [FU6] Measure revolution of wheel 2 (ASIL C) [->3 | 3->]	● [MF9] NOT Measure revolution of wheel 2 (ASIL C) [->2 | 1->]	● [FU1] Ensure functionality for lowering the spoiler (ASIL C) [->1 | 5->]	● [MF1] NOT Ensure functionality for lowering the spoiler (ASIL C) [->6 | 1->]	[SG1] Impr...	
8.3	●●	● [FU6] Measure revolution of wheel 2 (ASIL C) [->3 | 3->]	● [MF9] NOT Measure revolution of wheel 2 (ASIL C) [->2 | 1->]	● [FU1] Ensure functionality for lowering the spoiler (ASIL C) [->1 | 5->]	● [MF1] NOT Ensure functionality for lowering the spoiler (ASIL C) [->6 | 1->]	[SG1] Impr...	
9							

[MF1] NOT Ensure functionality for

[MF1] NOT Ensure functionality for lowering the spoiler (S=5) (ASIL C) [->6 | 1->]
[SG1] Improvement of driving stability at high speeds (ASIL C) [->2 | 0->]

[MF1] NOT Ensure functionality for lowering the spoiler (S=5) (ASIL C) [->6 | 1->]
[SG1] Improvement of driving stability at high speeds (ASIL C) [->2 | 0->]

[MF58] NOT Ensure functionality for raising the spoiler (ASIL C) [->4 | 1->]
[SG2] Reduction of breaking distance at high speed (ASIL C) [->3 | 0->]

[MF2] NOT Ensure functionality for raising the spoiler (S=7) (ASIL C) [->4 | 1->]
[SG2] Reduction of breaking distance at high speed (ASIL C) [->3 | 0->]

[MF4] Calculate wrong speed (ASIL C) [->4 | 1->]

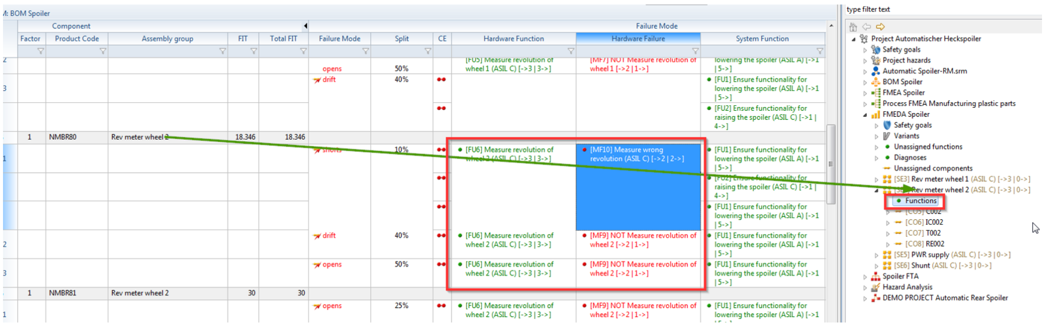
[MF6] Activate spoiler motor unintentionally (ASIL C) [->5 | 3->]

[MF10] Measure wrong revolution (ASIL C) [->2 | 2->]

fig. Missing system effect.

In this case, the system failure (MF10) is provided with three hardware failures (MF1, MF58, MF2) at the FMEA failure net and MF58 is missing at the FMEDA. This will be recognized by the synchronize with FMEA function.

- Hardware effect not assigned to modul



BOM Spoiler

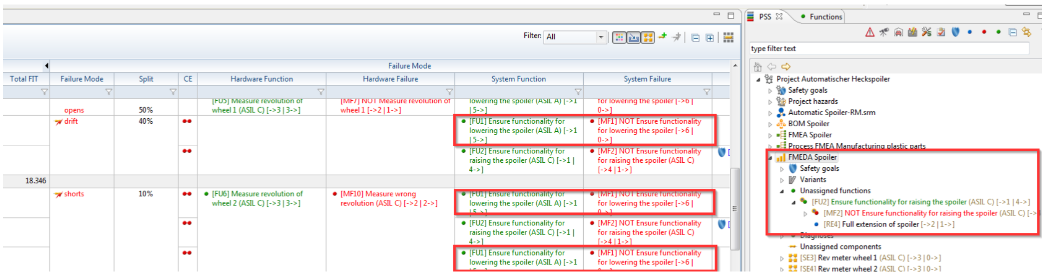
Component						Failure Mode					
	Factor	Product Code	Assembly group	FIT	Total FIT	Failure Mode	Split	CE	Hardware Function	Hardware Failure	System Function
2						opens	50%		[FU5] Measure revolution of wheel 1 (ASIL C) [->3 | 3->]	[MF7] NOT Measure revolution of wheel 1 [->2 | 1->]	lowering the spoiler (ASIL A) [->1 | 5->]
3						drift	40%	●●			● [FU1] Ensure functionality for lowering the spoiler (ASIL A) [->1 | 5->]
								●●			● [FU2] Ensure functionality for raising the spoiler (ASIL C) [->1 | 4->]
	1	NMBR80	Rev meter wheel 2	18.346	18.346						
1						shorts	10%	●●	● [FU6] Measure revolution of wheel 2 (ASIL C) [->3 | 3->]	● [MF10] Measure wrong revolution (ASIL C) [->2 | 2->]	● [FU1] Ensure functionality for lowering the spoiler (ASIL A) [->1 | 5->]
								●●			[FU2] Ensure functionality for raising the spoiler (ASIL C) [->1 | 4->]
								●●			● [FU1] Ensure functionality for lowering the spoiler (ASIL A) [->1 | 5->]
2						drift	40%	●●	● [FU6] Measure revolution of wheel 2 (ASIL C) [->3 | 3->]	● [MF9] NOT Measure revolution of wheel 2 [->2 | 1->]	● [FU1] Ensure functionality for lowering the spoiler (ASIL A) [->1 | 5->]
3						opens	50%	●●	● [FU6] Measure revolution of wheel 2 (ASIL C) [->3 | 3->]	● [MF9] NOT Measure revolution of wheel 2 [->2 | 1->]	● [FU1] Ensure functionality for lowering the spoiler (ASIL A) [->1 | 5->]
	1	NMBR81	Rev meter wheel 2	30	30						
1						opens	25%	●●	● [FU6] Measure revolution of wheel 2 (ASIL C) [->3 | 3->]	● [MF9] NOT Measure revolution of wheel 2 [->2 | 1->]	● [FU1] Ensure functionality for lowering the spoiler (ASIL A) [->1

type filter text

- Project Automatischer Heckspoiler
  - Safety goals
  - Project hazards
  - Automatic Spoiler-RM.srm
  - BOM Spoiler
  - FMEA Spoiler
  - Process FMEA Manufacturing plastic parts
  - FMEDA Spoiler
    - Safety goals
    - Variants
    - ● Unassigned functions
    - ● Diagnoses
    - Unassigned components
    - [SE3] Rev meter wheel 1 (ASIL C) [->3 | 0->]
    - Rev meter wheel 2 (ASIL C) [->3 | 0->]
      - ● Functions
      - C002
      - [CO6] IC002
      - [CO7] T002
      - [CO8] RE002
    - [SE5] PWR supply (ASIL C) [->3 | 0->]
    - [SE6] Shunt (ASIL C) [->3 | 0->]
  - Spoiler FTA
  - Hazard Analysis
  - DEMO PROJECT Automatic Rear Spoiler

fig. Hardware effect is not assigned to modul at the FMEDA.

- Missing hardware effect



Filter: All

Failure Mode							
Total FIT	Failure Mode	Split	CE	Hardware Function	Hardware Failure	System Function	System Failure
	opens	50%		[FU5] Measure revolution of wheel 1 (ASIL C) [->3 | 3->]	[MF7] NOT Measure revolution of wheel 1 [->2 | 1->]	lowering the spoiler (ASIL A) [->1 | 5->]	for lowering the spoiler [->6 | 0->]
	drift	40%	●●			● [FU1] Ensure functionality for lowering the spoiler (ASIL A) [->1 | 5->]	● [MF1] NOT Ensure functionality for lowering the spoiler [->6 | 0->]
			●●			● [FU2] Ensure functionality for raising the spoiler (ASIL C) [->1 | 4->]	● [MF2] NOT Ensure functionality for raising the spoiler (ASIL C) [->4 | 1->]
18.346							
	shorts	10%	●●	● [FU6] Measure revolution of wheel 2 (ASIL C) [->3 | 3->]	● [MF10] Measure wrong revolution (ASIL C) [->2 | 2->]	● [FU1] Ensure functionality for lowering the spoiler (ASIL A) [->1 | 5->]	● [MF1] NOT Ensure functionality for lowering the spoiler [->6 | 0->]
			●●			● [FU2] Ensure functionality for raising the spoiler (ASIL C) [->1 | 4->]	● [MF2] NOT Ensure functionality for raising the spoiler (ASIL C) [->4 | 1->]
			●●			● [FU1] Ensure functionality for lowering the spoiler (ASIL A) [->1	● [MF1] NOT Ensure functionality for lowering the spoiler [->6 |

PSS ● Functions

type filter text

- Project Automatischer Heckspoiler
  - Safety goals
  - Project hazards
  - Automatic Spoiler-RM.srm
  - BOM Spoiler
  - FMEA Spoiler
  - Process FMEA Manufacturing plastic parts
  - FMEDA Spoiler
    - Safety goals
    - Variants
    - ● Unassigned functions
      - [FU2] Ensure functionality for raising the spoiler (ASIL C) [->1 | 4->]
        - [MF2] NOT Ensure functionality for raising the spoiler (ASIL C) [->
        - ● [RE4] Full extension of spoiler [->2 | 1->]
    - Diagnoses
    - Unassigned components
    - [SE3] Rev meter wheel 1 (ASIL C) [->3 | 0->]
    - [SE4] Rev meter wheel 2 (ASIL C) [->3 | 0->]

fig. Missing hardware effect.

Precondition: A FMEDA and FMEA were created.

1. Go to the Repository view and right-click on the desired FMEDA.

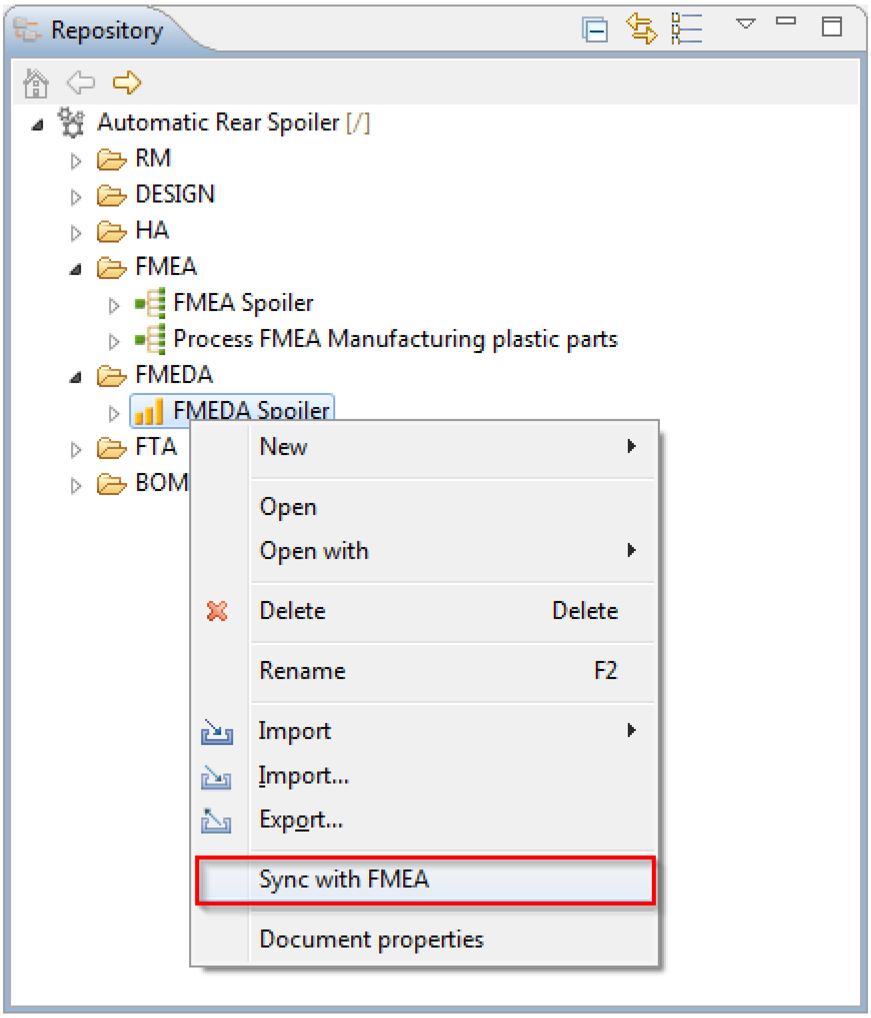


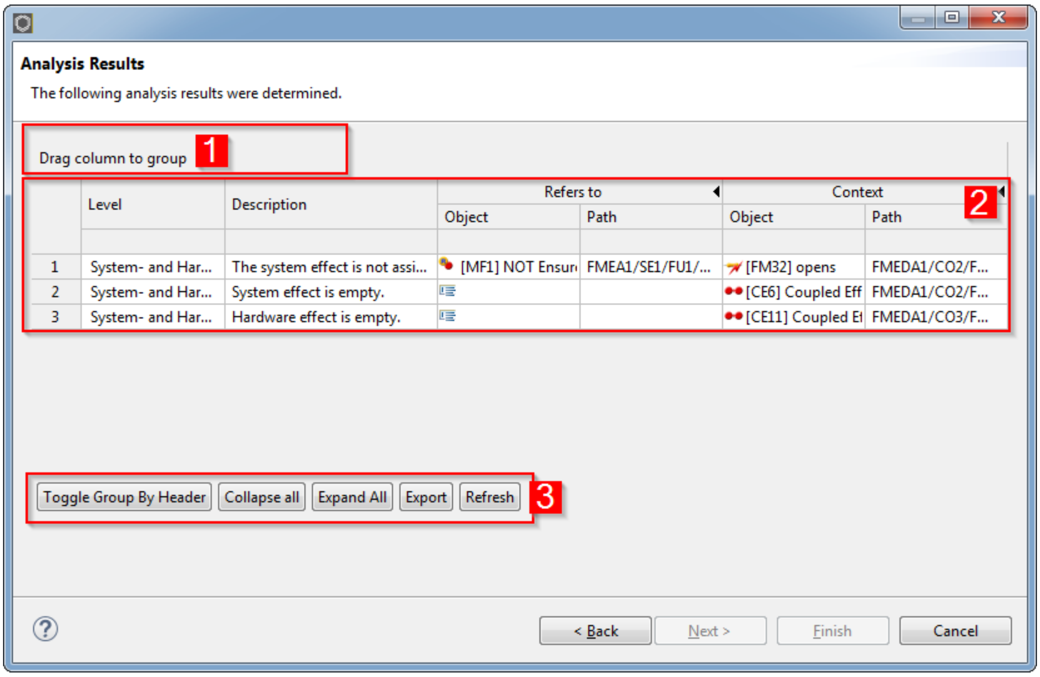
fig. Context menu entry Sync with FMEA.

2. Choose **Sync with FMEA.**

   ►The FMEA Selection dialog opens.

3. Select your desired FMEA and click on **Next.**

   ► The Analysis Results dialog opens.



	Level	Description	Refers to		Context	
			Object	Path	Object	Path
1	System- and Har...	The system effect is not assi...	[MF1] NOT Ensur	FMEA1/SE1/FU1/...	[FM32] opens	FMEDA1/CO2/F...
2	System- and Har...	System effect is empty.			[CE6] Coupled Eff	FMEDA1/CO2/F...
3	System- and Har...	Hardware effect is empty.			[CE11] Coupled Ef	FMEDA1/CO3/F...

fig. Analysis Results dialog.

[1] In this area you can drag columns. Same messages of the dragged column will be grouped. With a right click on a dragged column you can ungroup the messages.

[2] In this area the results of the analyses are displayed.

[3]

- Toggle Group By Header

  Shows or hides the area [1] for dragging columns to group.

- Collapse All

  Collapse all expanded groups.

- Expand All

  Expand all collapsed groups.

- Export

  Export the analysis results as an Excel Workbook (.xls).

- Refresh

  Refresh the analysis results. This can be necessary by editing the FMEDA while this dialog is active.

4. Select your desired results, make a **right-click** and choose **Quick Fix**.

   Note: The selection in dialog triggers selection in the editor or PSS.

   ► The Quick Fix dialog opens.

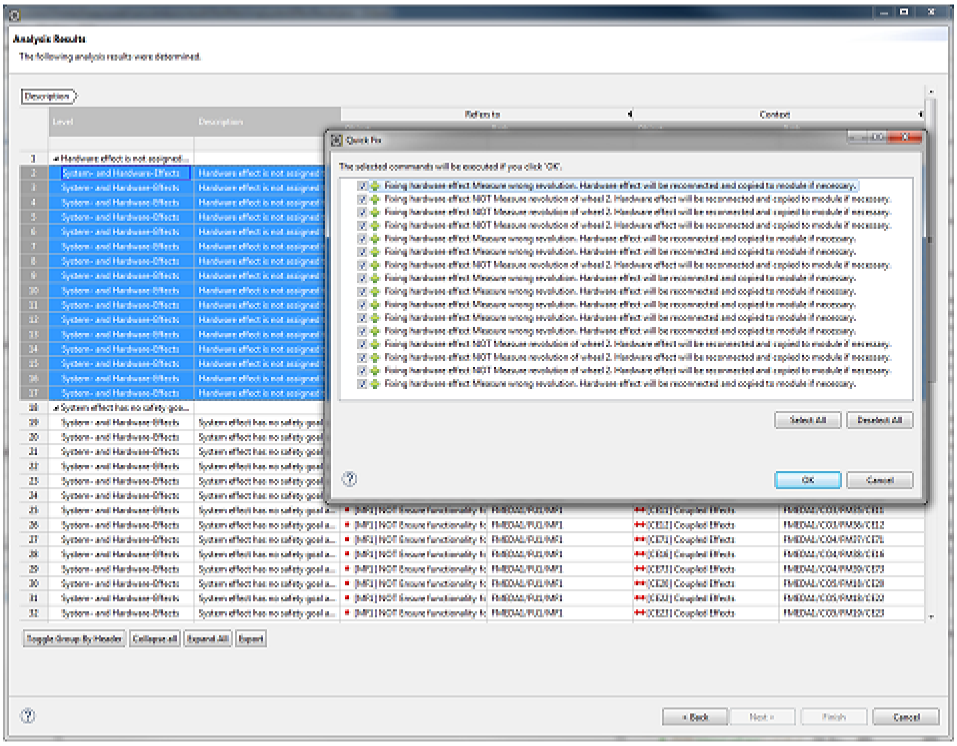


fig. Quick Fix dialog.

5. Select the desired changes and click **OK**.

→ The selected changes will be added to the FMEDA.

Requirements

Introduction

The SOX Requirements module offers a complete solution for creating , tracking and analyzing requirements. Import your product requirements specifications from Excel, Word, ReqIF or Rif and create the functional specification document in SOX . For this, you can reuse data from former projects from the server-based catalog, compare different concepts and make status alignments via the SOX Traceability Matrix.

Step-by-Step-Guide

Creating an RM File

Precondition: A SOX project was created and the Repository view is active.

1. Right-click on the **RM** folder in the repository.
2. Choose **New** > **New RM File**.

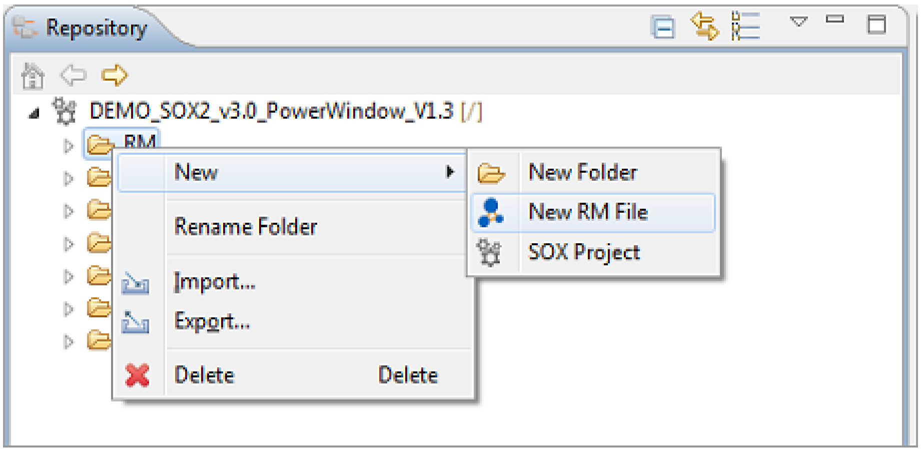
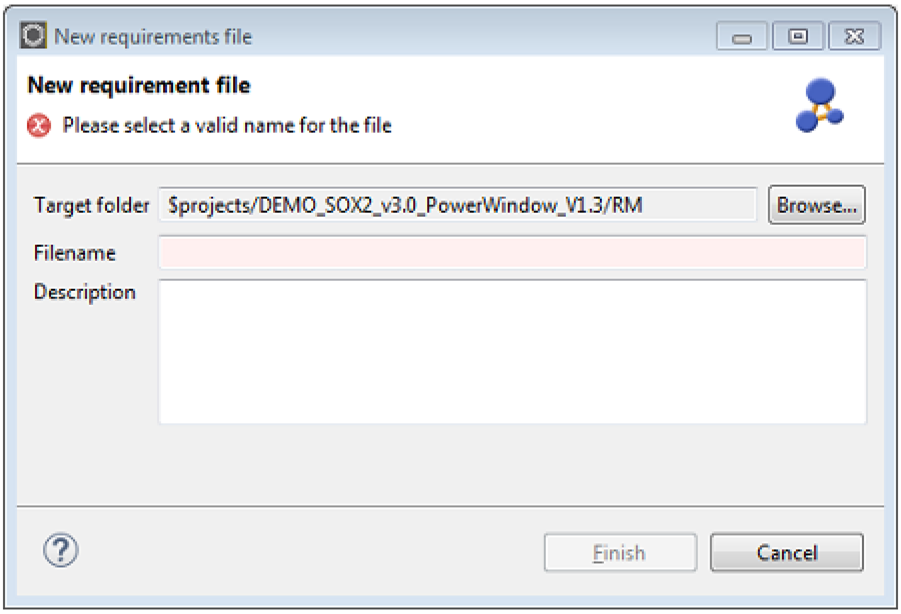


fig. New RM file from the Repository.

► The dialog "New requirements file" opens.



New requirements file

New requirement file

Please select a valid name for the file

Target folder: $projects/DEMO_SOX2_v3.0_PowerWindow_V1.3/RM

Filename:

Description:

fig. "New requirements fil"e dialog.

3. Click on **Browse** to specify the file location.

4. Enter a filename.

5. Optionally, enter a description.

6. Click on **Finish.**

→ A new RM file with the RM module specification document and the according type definition was added to the repository.

Creating new Requirement Types

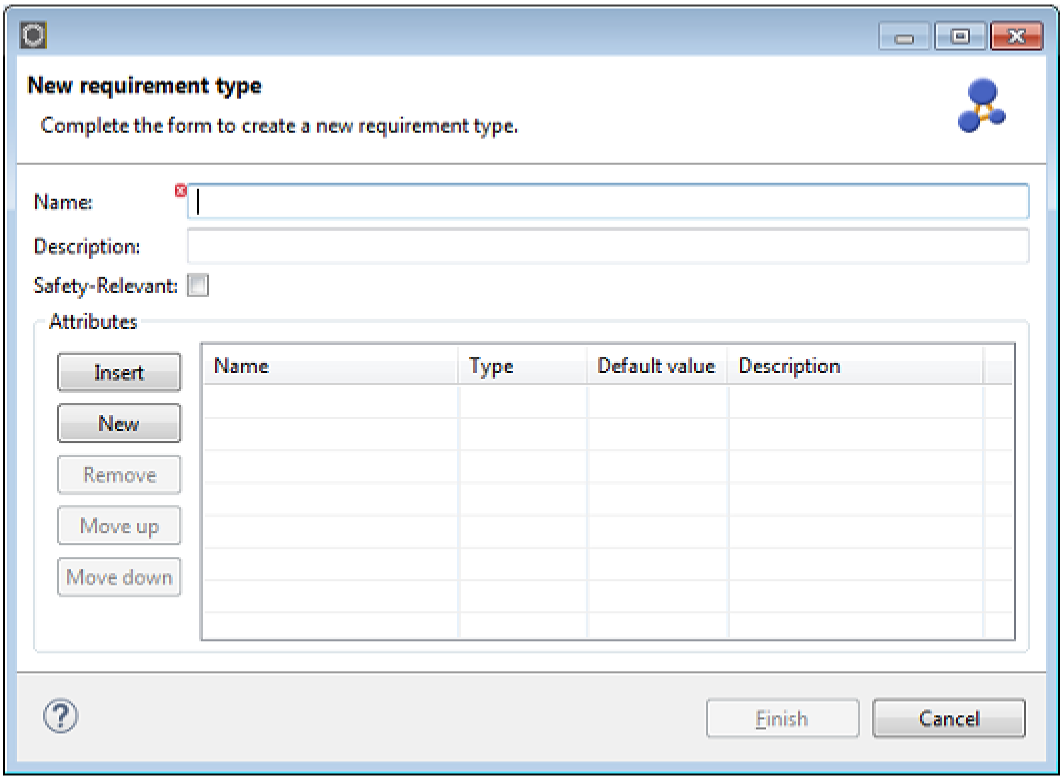
A requirement type is needed to define the number and kind of the characteristics of a requirement. I.e. a requirement type consists of a collection of attributes. Also the table head will be designed by these types.

Precondition: The view "Type Definitio"n is open.

1. Right-click in the "Type Definition" view.

2. Choose **New** > **New Requirement Type.**

   ► The dialog "New requirement type" opens.



New requirement type

Complete the form to create a new requirement type.

fig. "New requirement typ"e dialog.

3. Enter a name for the requirement type.

4. Optionally, enter a description.

5. Set the safety relevance for the requirement type.

   Insert Attributes

   Create New Attributes

6. Click on **Finish.**

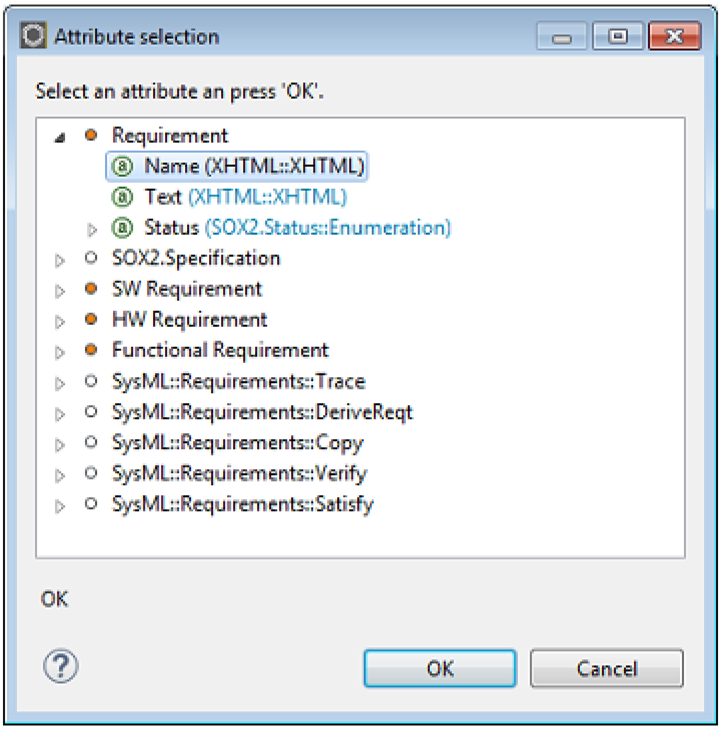
→ A requirement type was created and added to the view "Type Definition".

Inserting Attributes

Already existing attributes can be used for the requirement type.

1. Click on **Insert**.

   ► The dialog "Attribute selection" opens.



Select an attribute an press 'OK'.

- Requirement
  - Name (XHTML::XHTML)
  - Text (XHTML::XHTML)
  - Status (SOX2.Status::Enumeration)
- SOX2.Specification
- SW Requirement
- HW Requirement
- Functional Requirement
- SysML::Requirements::Trace
- SysML::Requirements::DeriveReqt
- SysML::Requirements::Copy
- SysML::Requirements::Verify
- SysML::Requirements::Satisfy

OK

fig. "Attribute selectio"n dialog.

2. Select the desired attribute.

3. Click on **OK.**

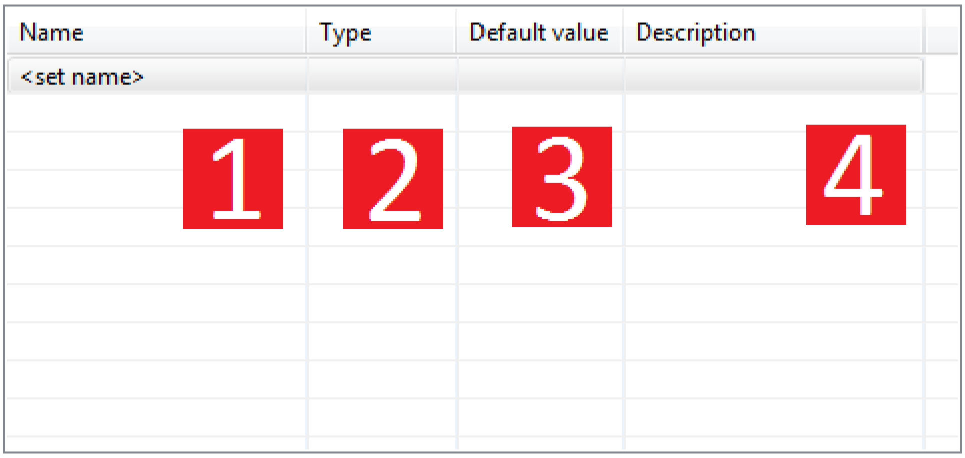
→ The selected attribute was added to the requirement type.

Creating new Attributes

1. Click on **New**.

Note

Name and Status attributes must be applied specifically if you want to import an Excel file. A name attribute has to be named with ReqIF.Name. A status attribute has to be provided with the SOX.Status type.



Name	Type	Default value	Description
<set name>			

fig. Attribute settings.

[1] Name for the attribute

[2] String, Boolean, Integer, Real, Date, Enumeration (can be customized), XHTML, SOX.Status

[3] Default value

[4] Optionally, enter a description

→ An attribute was created.

Creating Requirement Modules

A module represents a collection of requirements. However, as a requirement needs to be assigned to a module, the creation of module is mandatory.

Precondition: The Hierarchy view is active.

1. Right-click in the hierarchy view.
2. Choose **New** > **New Module**.

   ► The dialog "New module" opens.

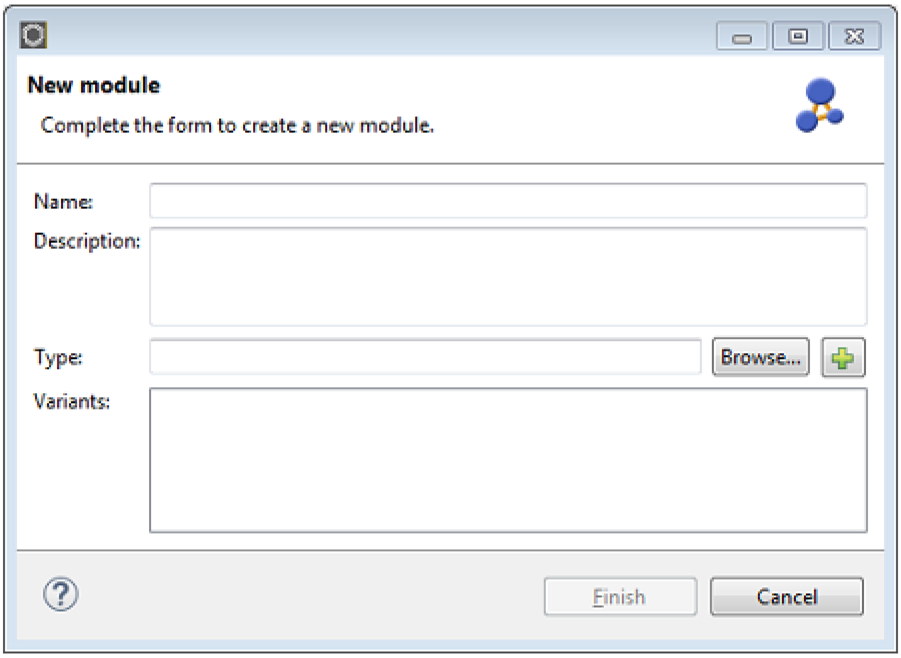


fig. "New Modul"e dialog.

3. Enter a name for the module.
4. Optionally, enter a description.
5. Click on **Browse** to choose a module type or create a new one by clicking on the plus symbol.
6. Click on **Finish.**

→ A module was created and added to the Hierarchy view.

Creating new Requirements

It is possible to create an arbitrary amount of requirements. Requirements consist of a defined amount and kind of attributes. These attributes can be combined to an attribute type.

Every requirement needs to have an attribute type which defines kind and amount of attributes.

Requirements themselves have to be assigned to a module.

Precondition: A Module was created and the Hierarchy view is active.

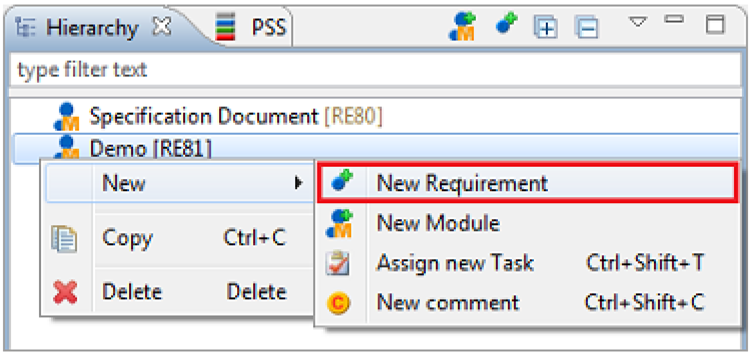
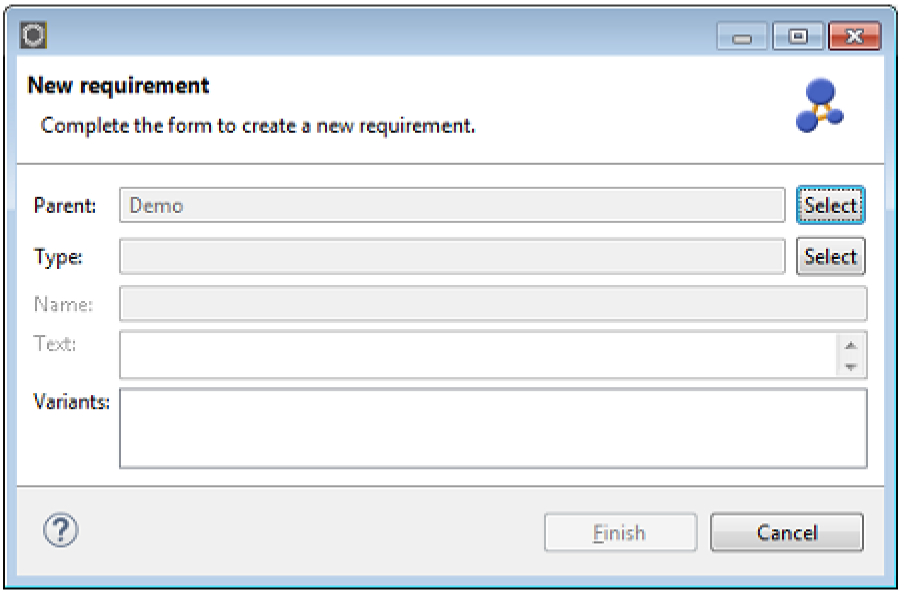


fig. Context menu for new requirement.

1. Right-click on the parent module.
2. Choose **New** > **New Requirement.**

► The dialog "New requirement" opens.


New requirement

Complete the form to create a new requirement.

Parent: Demo

fig. "New requiremen"t dialog.

3. Click on **Select** to choose the parent module.
4. Click on **Select** to choose the requirement type.
5. Enter a name.
6. Enter a text. It will be displayed in the text column.
7. Click on **Finish**.

→ A requirement was created and added to the module. It also will be displayed in the RM editor.

Assigning Safety Goals

Precondition: Requirements and Safety Goals were created. The RM Editor and the Project Safety goal view is active.

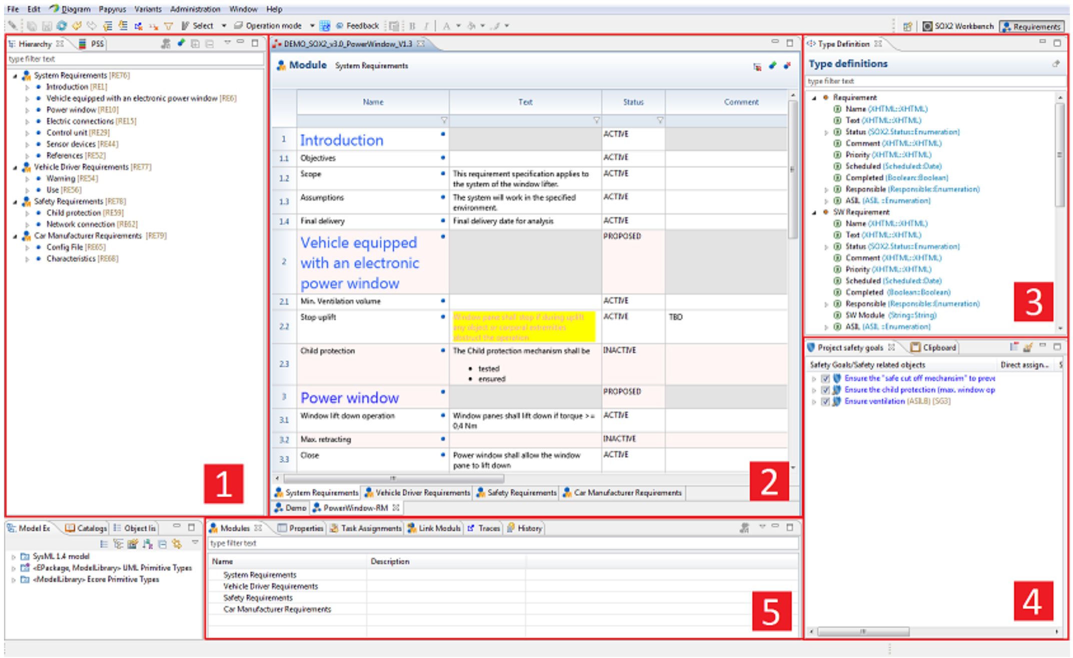
1. Select the desired safety goal.

2. Drag & drop it into the desired requirement row and safety goals column.

   ► The safety goal level will be adopted and the assigned requirement will be marked.

→ A requirement was assigned to a safety goal.

The User Interface



type filter text

- System Requirements [RE76]
  - Introduction [RE1]
  - Vehicle equipped with an electronic power window [RE6]
  - Power window [RE10]
  - Electric connections [RE15]
  - Control unit [RE29]
  - Sensor devices [RE44]
  - References [RE52]
- Vehicle Driver Requirements [RE77]
  - Warning [RE54]
  - Use [RE56]
- Safety Requirements [RE78]
  - Child protection [RE59]
  - Network connection [RE62]
- Car Manufacturer Requirements [RE79]
  - Config File [RE65]
  - Characteristics [RE68]

Module System Requirements

	Name	Text	Status	Comment
1	Introduction		ACTIVE	
1.1	Objectives		ACTIVE	
1.2	Scope	This requirement specification applies to the system of the window lifter.	ACTIVE	
1.3	Assumptions	The system will work in the specified environment.	ACTIVE	
1.4	Final delivery	Final delivery date for analysis	ACTIVE	
2	Vehicle equipped with an electronic power window		PROPOSED	
2.1	Min. Ventilation volume		ACTIVE	
2.2	Stop uplift	Window pane shall stop if during uplift any object or corporal extremities obstruct the operation	ACTIVE	TBD
2.3	Child protection	The Child protection mechanism shall be • tested • ensured	INACTIVE	
3	Power window		PROPOSED	
3.1	Window lift down operation	Window panes shall lift down if torque >= 0,4 Nm	ACTIVE	
3.2	Max. retracting		INACTIVE	
3.3	Close	Power window shall allow the window pane to lift down	ACTIVE	

Type definitions

type filter text

- Requirement
  - Name (XHTML::XHTML)
  - Text (XHTML::XHTML)
  - Status (SOX2.Status::Enumeration)
  - Comment (XHTML::XHTML)
  - Priority (XHTML::XHTML)
  - Scheduled (Scheduled::Date)
  - Completed (Boolean::Boolean)
  - Responsible (Responsible::Enumeration)
  - ASIL (ASIL ::Enumeration)
- SW Requirement
  - Name (XHTML::XHTML)
  - Text (XHTML::XHTML)
  - Status (SOX2.Status::Enumeration)
  - Comment (XHTML::XHTML)
  - Priority (XHTML::XHTML)
  - Scheduled (Scheduled::Date)
  - Completed (Boolean::Boolean)
  - Responsible (Responsible::Enumeration)
  - SW Module (String::String)
  - ASIL (ASIL ::Enumeration)

Safety Goals/Safety related objects	Direct assign...
☑ Ensure the "safe cut off mechansim" to preve	
☑ Ensure the child protection (max. window op	
☑ Ensure ventilation (ASILB) [SG3]	

- SysML 1.4 model
- <EPackage, ModelLibrary> UML Primitive Types
- <ModelLibrary> Ecore Primitive Types

type filter text

Name	Description
System Requirements	
Vehicle Driver Requirements	
Safety Requirements	
Car Manufacturer Requirements	

fig. The User Interface

[1] Hierarchy, PSS

[2] RM Editor

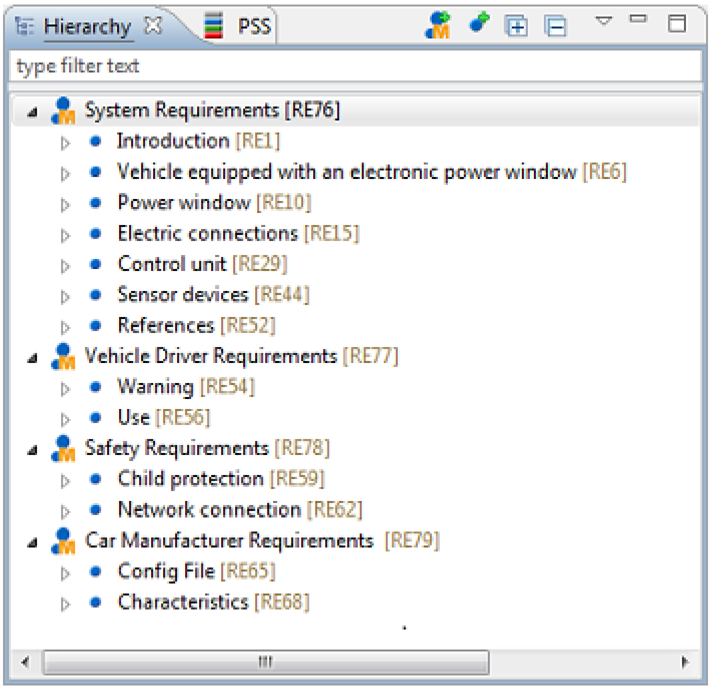
[3] Type Definition

[4] Project safety goals, Clipboard

[5] Modules, Properties, Task Assignment, Link Modules, Traces, History

The Hierarchy View

The Hierarchy view displays the requirement modules and their related requirements. Furthermore requirements and modules can be created and organized here.



- System Requirements [RE76]
  - Introduction [RE1]
  - Vehicle equipped with an electronic power window [RE6]
  - Power window [RE10]
  - Electric connections [RE15]
  - Control unit [RE29]
  - Sensor devices [RE44]
  - References [RE52]
- Vehicle Driver Requirements [RE77]
  - Warning [RE54]
  - Use [RE56]
- Safety Requirements [RE78]
  - Child protection [RE59]
  - Network connection [RE62]
- Car Manufacturer Requirements [RE79]
  - Config File [RE65]
  - Characteristics [RE68]

fig. "Hierarch"y view.

- **New module**

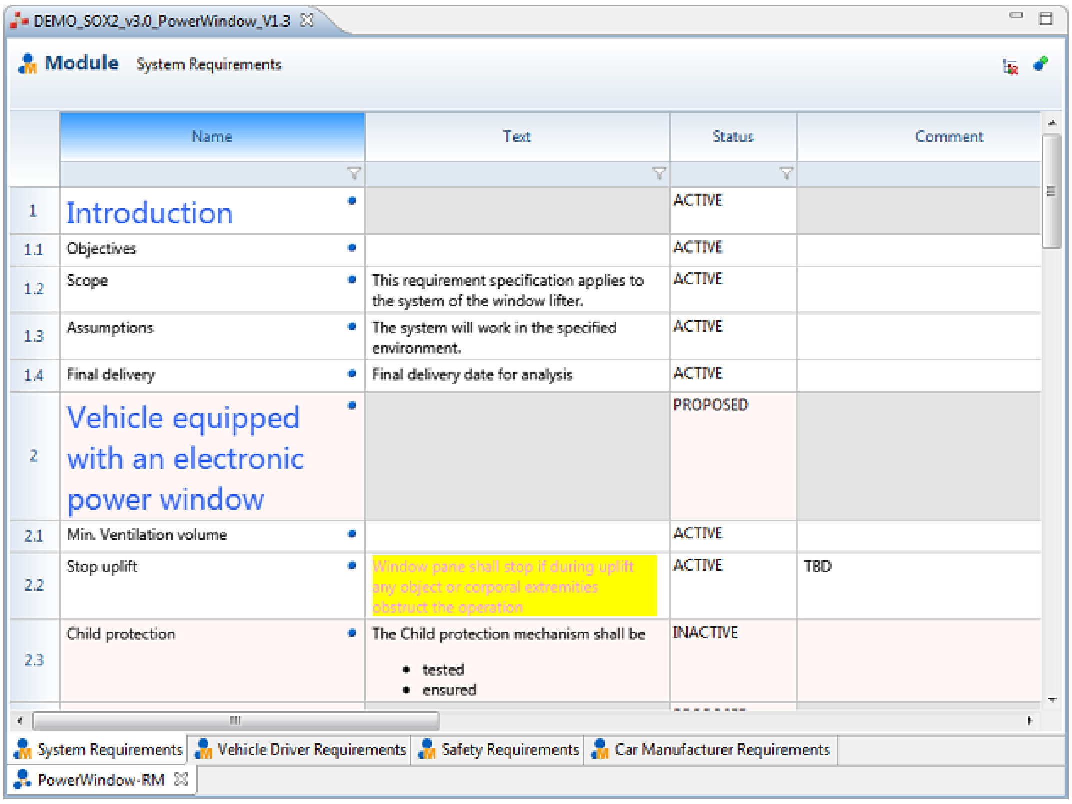
  Triggers the new module dialog to create a new module.

- **New requirement**

  Triggers the new requirement dialog to create a new requirement.

The RM Editor

The RM editor shows all requirements of a project in table form. Every module is a separate table. The table head is given by the requirement types and can be customized in this way. The table rows are numbered. There are also columns for assigning safety goals.


DEMO_SOX2_v3.0_PowerWindow_V1.3
Module
System Requirements
System Requirements
Vehicle Driver Requirements
Safety Requirements
Car Manufacturer Requirements
PowerWindow-RM

	Name	Text	Status	Comment
1	Introduction		ACTIVE	
1.1	Objectives		ACTIVE	
1.2	Scope	This requirement specification applies to the system of the window lifter.	ACTIVE	
1.3	Assumptions	The system will work in the specified environment.	ACTIVE	
1.4	Final delivery	Final delivery date for analysis	ACTIVE	
2	Vehicle equipped with an electronic power window		PROPOSED	
2.1	Min. Ventilation volume		ACTIVE	
2.2	Stop uplift	Window pane shall stop if during uplift any object or corporal extremities obstruct the operation	ACTIVE	TBD
2.3	Child protection	The Child protection mechanism shall be • tested • ensured	INACTIVE	

fig. RM Editor.

- **Import status**

  Show/Hide the import status.

- **New requirement**

  Opens the dialog "New requirement", to create a new requirement.

- **Delete requirement**

  Deletes the selected requirement.

Customizing the Tables

The table can be customized by the requirement types or using the table modeling functions. Do a right-click on the table head to open the context menu.

- **Hide column**

  Hides the selected column.

- **Show all columns**

  Shows all columns

- **Group selected columns**

  Groups the selected columns. To select several columns at once, hold down the CTRL key and left-click the columns.

- **Ungroup selected columns**

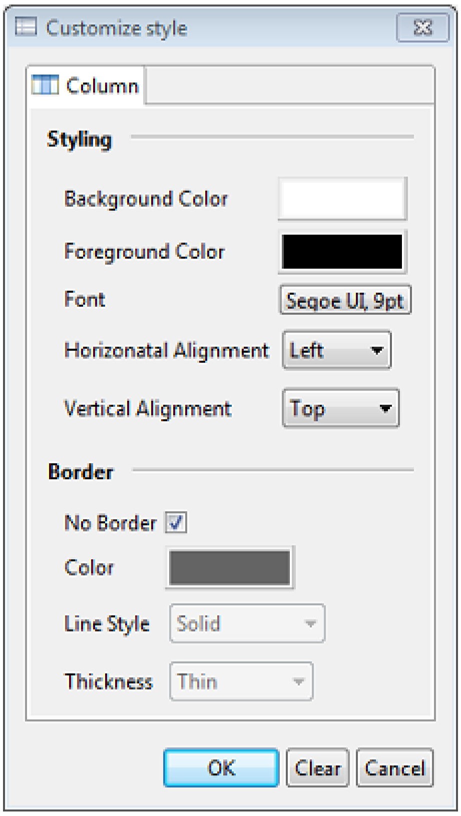
  Ungroups the selected columns. To select several columns at once, hold down the CTRL key and left-click the columns.

- **Auto resize column**

  Resizes the column to the minimal size

- **Edit styles**

  Opens the dialog "Customize style".



Styling

Background Color

Foreground Color

Font: Segoe UI, 9pt

Horizonatal Alignment: Left

Vertical Alignment: Top

Border

No Border ☑

Color

Line Style: Solid

Thickness: Thin

fig. "Customize styl"e dialog.

- **Rename column**

  Renames the column. (Not the attribute!)

- **Clear all filters**

  Clears all filters.

- **Choose columns**

  Opens the dialog "Column Chooser".

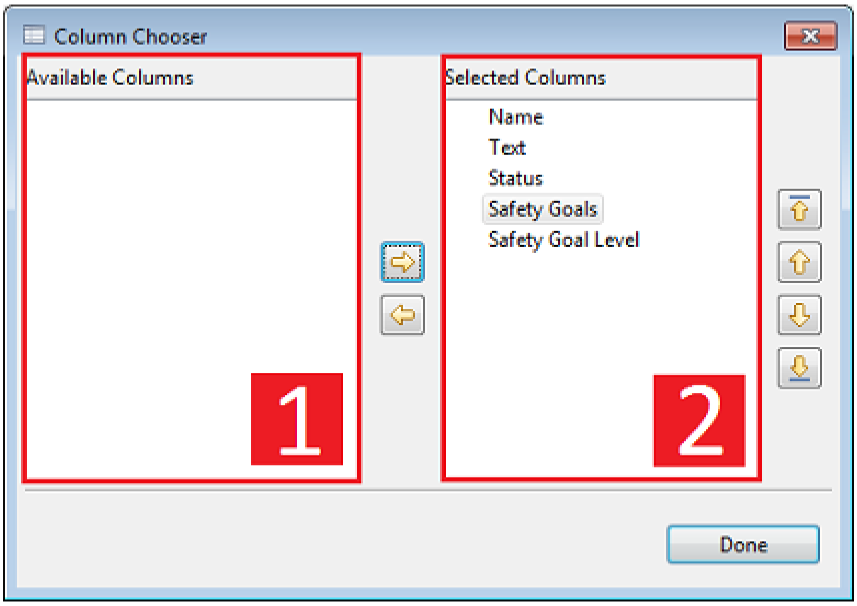


fig. "Column Choose"r dialog.

[1] Available Columns (not active in the editor).

[2] Selected Columns (active in the editor). The order from top to down defines the order of the table head form left to right.

Use the arrow symbols to move the columns.

Sorting and Filtering

Click on the desired table head to sort the according column alphabetically. An arrow shows the direction.

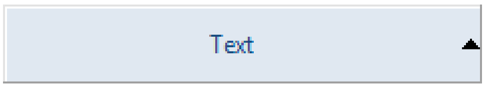


fig. Sorted column from a-z (▲).

Use the filter cell to filter a column.

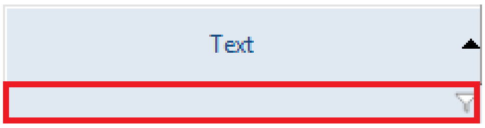


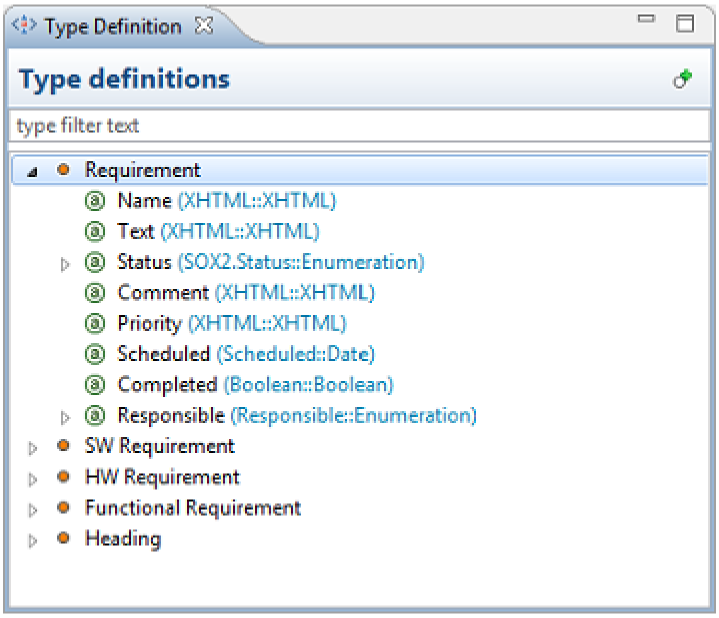
fig. Filter cell.

Dragging & Dropping Pictures into the Editor

Pictures and screen shots can be used in the RM Editor per drag & drop from your system into the requirement editor. Possible image files are: svg, gif, jpeg, png.

The Type Definition View

The "Type Definition" view shows the requirement types and the according attributes. Furthermore, requirement types and attributes can be created and deleted.



- Requirement
  - Name (XHTML::XHTML)
  - Text (XHTML::XHTML)
  - Status (SOX2.Status::Enumeration)
  - Comment (XHTML::XHTML)
  - Priority (XHTML::XHTML)
  - Scheduled (Scheduled::Date)
  - Completed (Boolean::Boolean)
  - Responsible (Responsible::Enumeration)
- SW Requirement
- HW Requirement
- Functional Requirement
- Heading

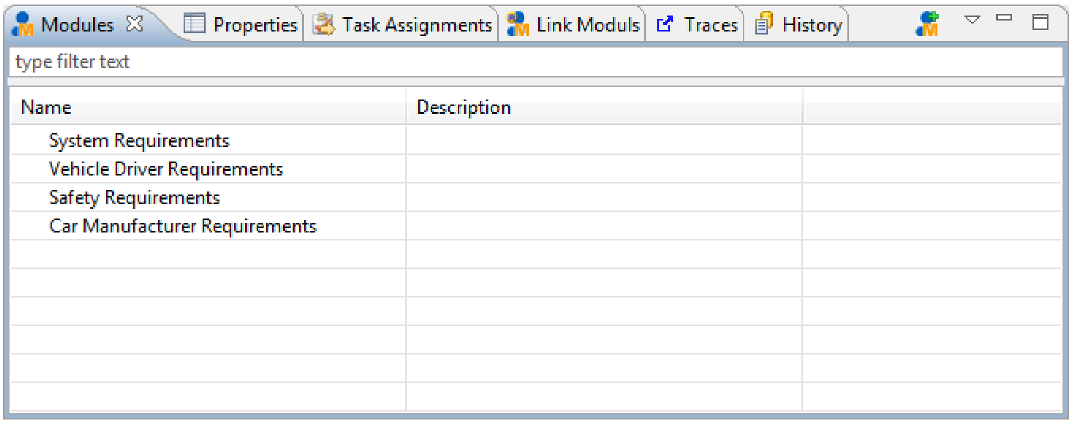
fig. "Type Definitio"n view.

- **New Requirement Type**

  Opens the dialog "New requirement" dialog to create a new requirement type.

The Modules View

The "Modules" view shows all requirement modules of the active project. Furthermore, modules and requirements can be created, deleted and copied. Also tasks can be assigned and comments created.



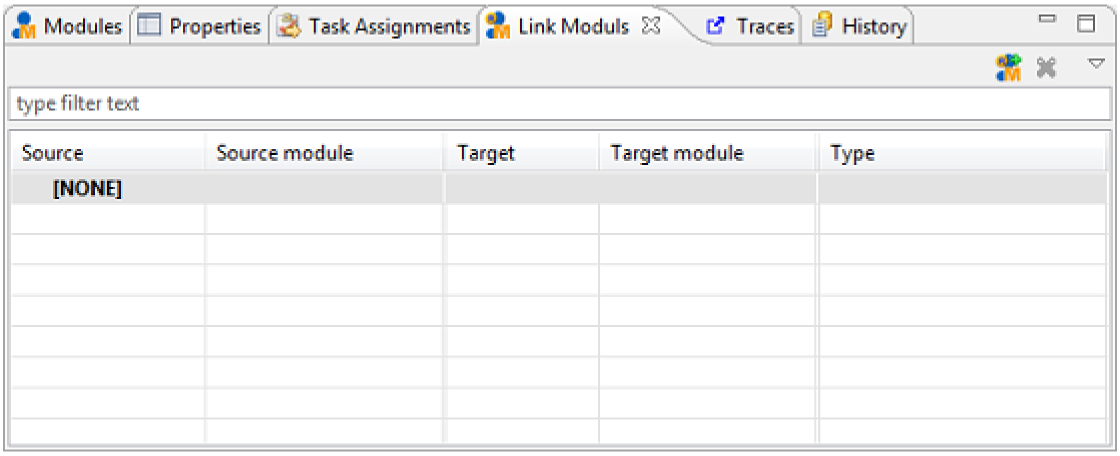
Name	Description	
System Requirements		
Vehicle Driver Requirements		
Safety Requirements		
Car Manufacturer Requirements		

fig. "Module"s view.

- **New Module**

  Opens the dialog "New module" to create a new module.

The Link Modules View



Source	Source module	Target	Target module	Type
[NONE]				

fig. "Link Module"s view.

Additional Functionality

Linking Requirements

Requirements can be linked with other SOX elements. For example, a requirement can be assigned to a system element:

Precondition: A requirement and a system element have been created. The RM editor and the PSS view are active.

1. Select the desired requirement.
2. Drag & drop it from the RM editor onto the desired element in the PSS view.

   ► The linked element will be marked with a requirement symbol and the requirement will be added to the element in the PSS view.

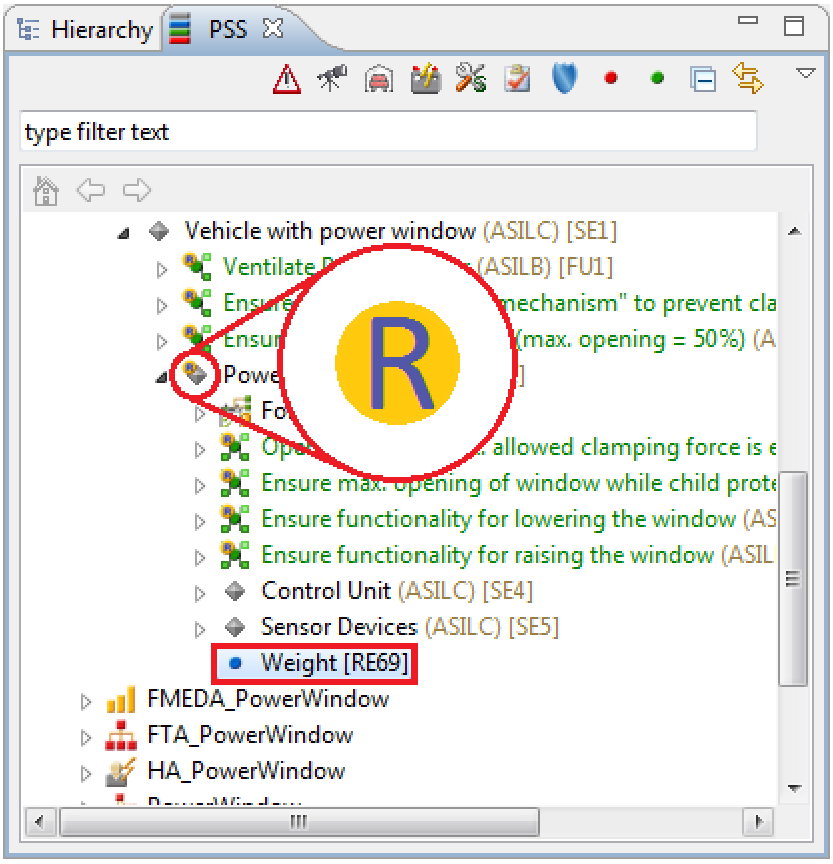

Hierarchy
PSS
type filter text
Vehicle with power window (ASILC) [SE1]
Ventilate
(ASILB) [FU1]
Ensure
mechanism" to prevent cla
Ensur
(max. opening = 50%) (A
Powe
]
Fo
Op
allowed clamping force is e
Ensure max. opening of window while child prote
Ensure functionality for lowering the window (AS
Ensure functionality for raising the window (ASIL
Control Unit (ASILC) [SE4]
Sensor Devices (ASILC) [SE5]
Weight [RE69]
FMEDA_PowerWindow
FTA_PowerWindow
HA_PowerWindow
R

fig. Decorator for linked requirement .

→ A requirement was linked with an element.

Note

The safety level will be adopted, if the element is assigned with a safety goal.

The following elements can be linked with requirements:

- BOM modules
- System elements
- Functions/malfunctions
- Safety goals

Safety Classification

Adding a Safety Classification

Safety classifications can be added in the model explorer, in the RM Hierarchy view, PSS view and in the diagram.

Precondition: A requirement was created.

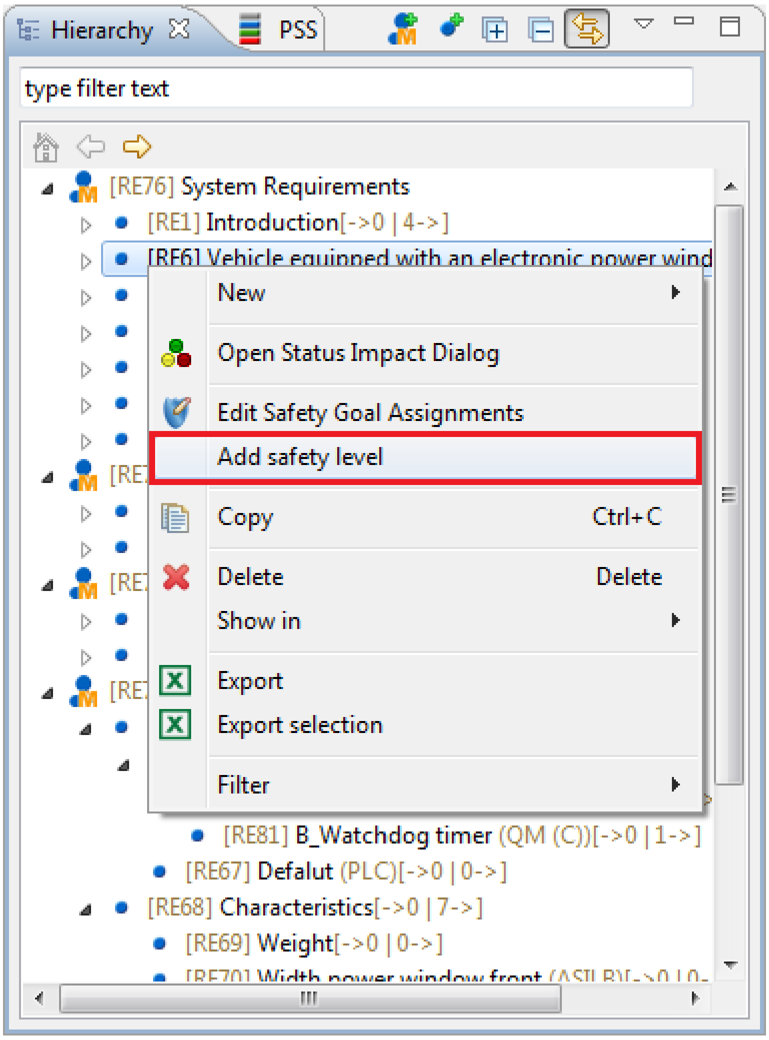
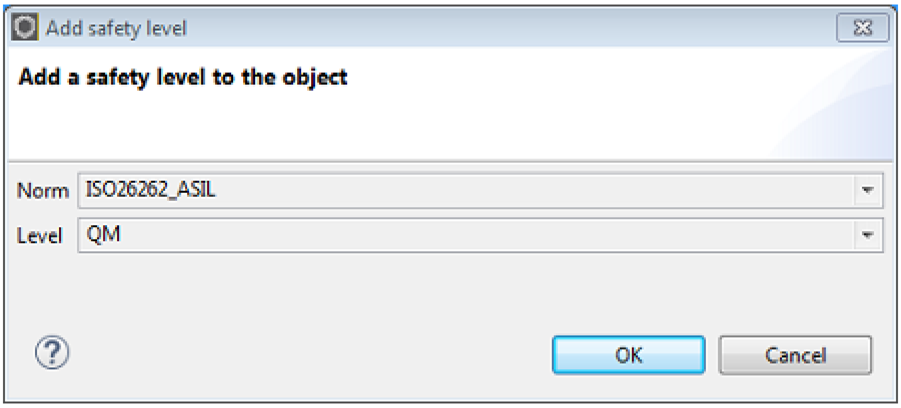

Hierarchy
PSS
type filter text
[RE76] System Requirements
[RE1] Introduction[->0 | 4->]
[RE6] Vehicle equipped with an electronic power wind
New
Open Status Impact Dialog
Edit Safety Goal Assignments
Add safety level
Copy Ctrl+C
Delete Delete
Show in
Export
Export selection
Filter
[RE81] B_Watchdog timer (QM (C))[->0 | 1->]
[RE67] Defalut (PLC)[->0 | 0->]
[RE68] Characteristics[->0 | 7->]
[RE69] Weight[->0 | 0->]
[RE70] Width power window front (ASIL B)[->0 | 0-

fig. Context menu for adding a safety level in the Hierarchy view.

1. Right-click on the respective requirement.

2. Choose **Add safety level**.

► The dialog "Add safety level" opens.



Norm ISO26262_ASIL

Level QM

fig. "Add safety leve"l dialog.

3. Choose the safety level.

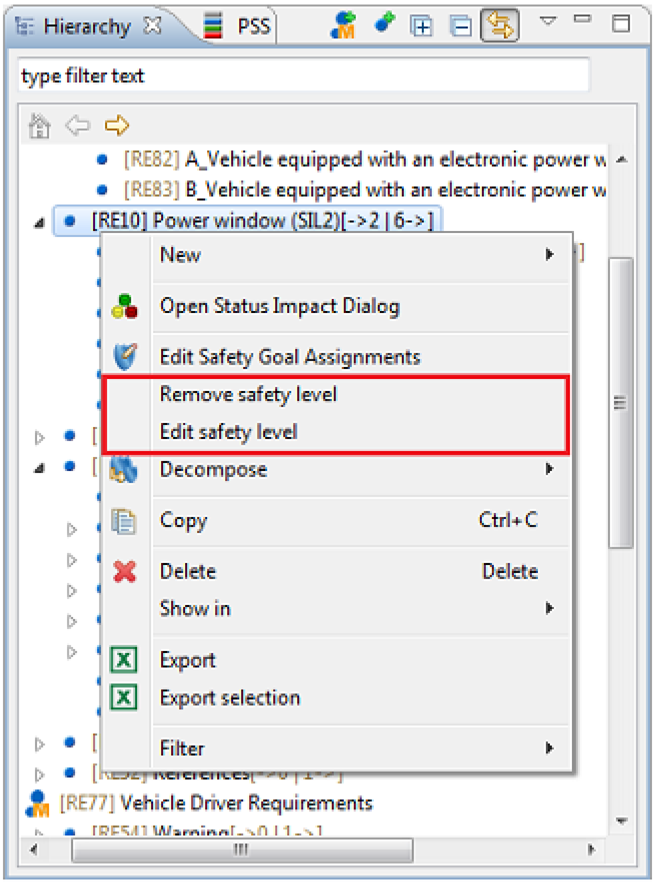
4. Click on **OK**.

→ A safety level was added to the requirement.

Editing/Deleting a Safety Classification

1. Right-click on a safety classified requirement.

2. Choose **Edit/Remove safety level**.


Hierarchy
PSS
type filter text
[RE82] A_Vehicle equipped with an electronic power w
[RE83] B_Vehicle equipped with an electronic power w
[RE10] Power window (SIL2)[->2 | 6->]
New
Open Status Impact Dialog
Edit Safety Goal Assignments
Remove safety level
Edit safety level
Decompose
Copy Ctrl+C
Delete Delete
Show in
Export
Export selection
Filter
[RE77] Vehicle Driver Requirements

→ The safety level was edited or removed.

ASIL Decomposition

SOX supports ASIL decomposition according to ISO26262. An ASIL decomposition can be performed on safety goals and requirements with safety classification.

Safety Goals

The ASIL decomposition of safety goals can be performed in the views "Project Safety Goal", "PSS", "Model Explorer (Diagrams)" and " Object list".

Precondition: The safety level of the safety goal must be defined in the ISO26262 (ASIL).

1. Right-click on a safety goal.

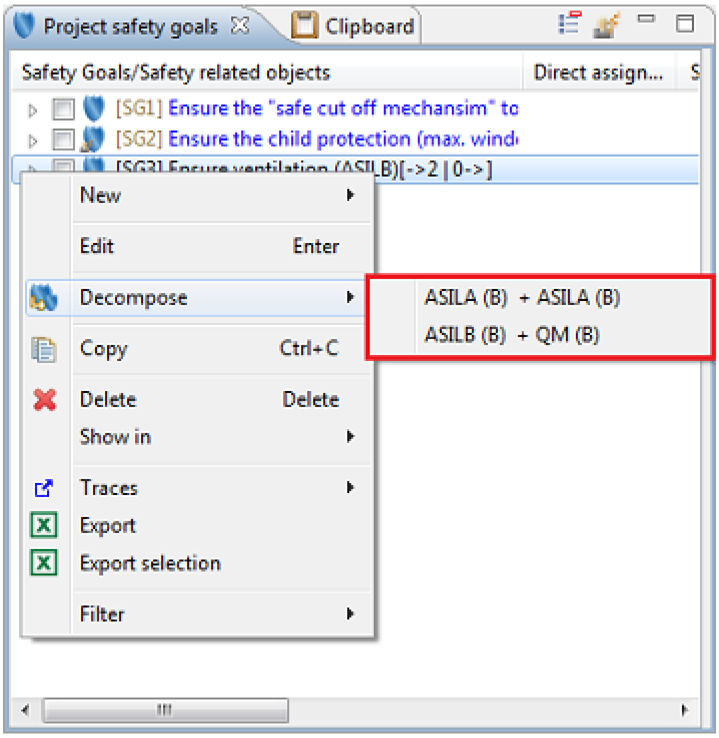


fig. Context menu for decomposing a safety goal.

2. Choose **Decompose** > and your desired decomposing level.

   The context menu shows all possible decompositions. If you are not at the lowest level you can do further compositions.

→ The new created safety goals will be named with "A_", "B_" and provided with the new and parent safety level.

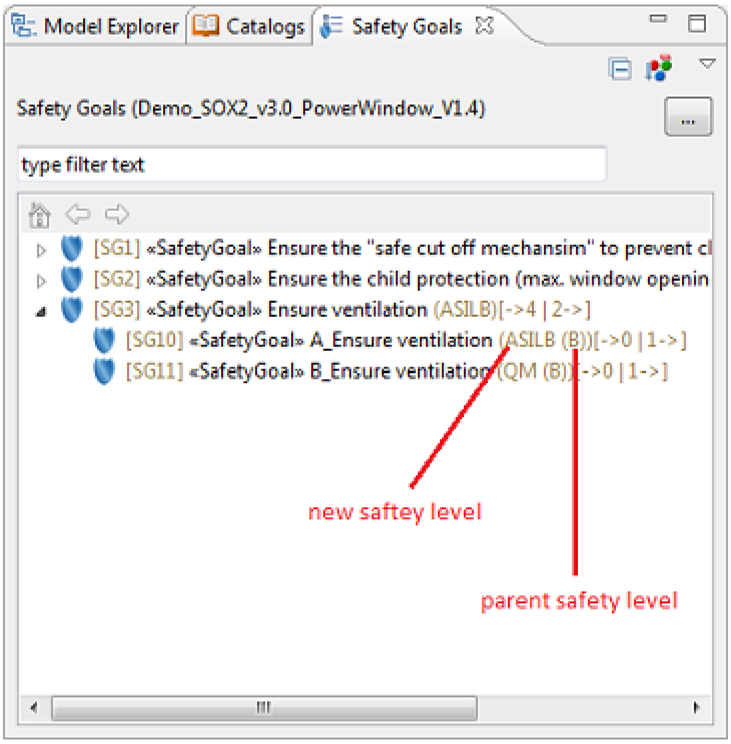

Model Explorer
Catalogs
Safety Goals
Safety Goals (Demo_SOX2_v3.0_PowerWindow_V1.4)
...
type filter text
[SG1] «SafetyGoal» Ensure the "safe cut off mechansim" to prevent cl
[SG2] «SafetyGoal» Ensure the child protection (max. window openin
[SG3] «SafetyGoal» Ensure ventilation (ASILB)[->4 | 2->]
[SG10] «SafetyGoal» A_Ensure ventilation (ASILB (B))[->0 | 1->]
[SG11] «SafetyGoal» B_Ensure ventilation (QM (B))[->0 | 1->]
new saftey level
parent safety level

fig. Safety goal decomposition.

Safety Classified Requirements

The ASIL decomposition of requirements can be performed in the views "Hierarchy", "PSS", "Model Explorer- (Diagrams)" and "Object list".

Precondition: The requirement must be safety classified.

1. Right-click on a requirement.

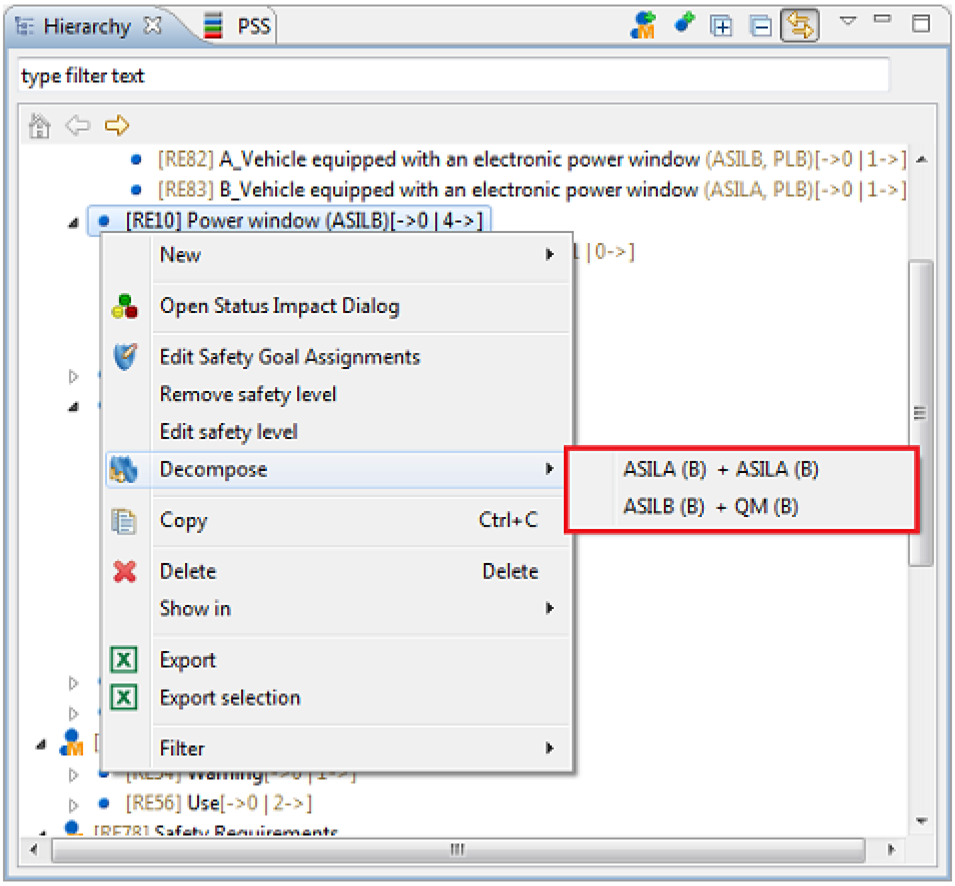
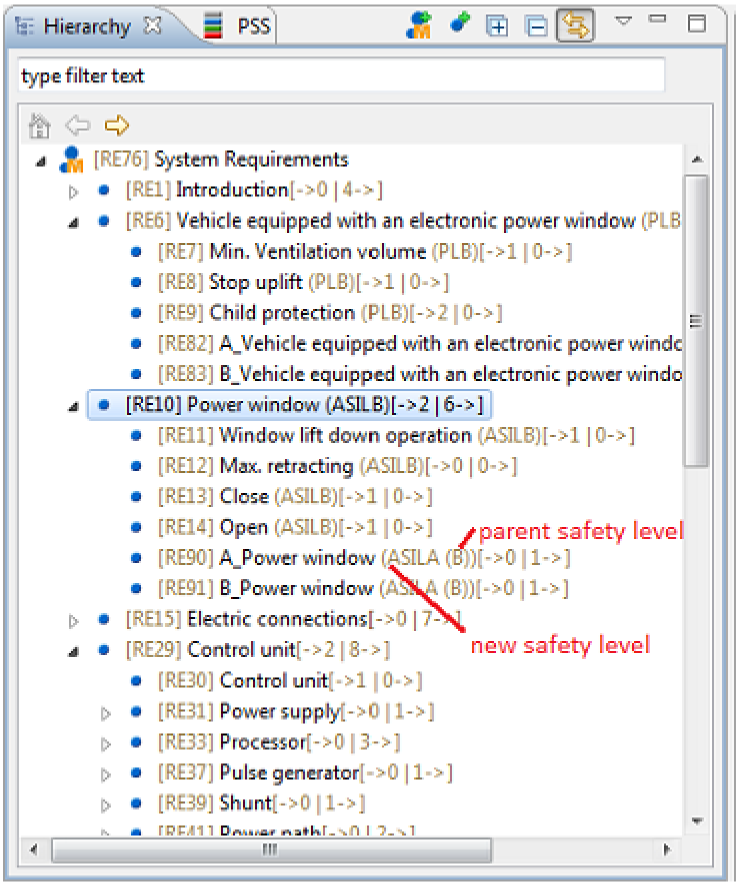

Hierarchy
PSS
type filter text
[RE82] A_Vehicle equipped with an electronic power window (ASILB, PLB)[->0 | 1->]
[RE83] B_Vehicle equipped with an electronic power window (ASILA, PLB)[->0 | 1->]
[RE10] Power window (ASILB)[->0 | 4->]
New
Open Status Impact Dialog
Edit Safety Goal Assignments
Remove safety level
Edit safety level
Decompose
ASILA (B) + ASILA (B)
ASILB (B) + QM (B)
Copy Ctrl+C
Delete Delete
Show in
Export
Export selection
Filter
[RE56] Use[->0 | 2->]
[RE78] Safety Requirements

fig. Decomposing a requirement.

2. Choose **Decompose** > and your desired decomposition level.

   The context menu shows all possible decompositions. If you are not at the lowest level you can do further compositions.

→ The new requirements will be named with "A_", "B_" and provided with the new and parent safety level.



- [RE76] System Requirements
  - [RE1] Introduction[->0 | 4->]
  - [RE6] Vehicle equipped with an electronic power window (PLB
    - [RE7] Min. Ventilation volume (PLB)[->1 | 0->]
    - [RE8] Stop uplift (PLB)[->1 | 0->]
    - [RE9] Child protection (PLB)[->2 | 0->]
    - [RE82] A_Vehicle equipped with an electronic power windc
    - [RE83] B_Vehicle equipped with an electronic power windo
  - [RE10] Power window (ASILB)[->2 | 6->]
    - [RE11] Window lift down operation (ASILB)[->1 | 0->]
    - [RE12] Max. retracting (ASILB)[->0 | 0->]
    - [RE13] Close (ASILB)[->1 | 0->]
    - [RE14] Open (ASILB)[->1 | 0->]
    - [RE90] A_Power window (ASILA (B))[->0 | 1->]
    - [RE91] B_Power window (ASILA (B))[->0 | 1->]
  - [RE15] Electric connections[->0 | 7->]
  - [RE29] Control unit[->2 | 8->]
    - [RE30] Control unit[->1 | 0->]
    - [RE31] Power supply[->0 | 1->]
    - [RE33] Processor[->0 | 3->]
    - [RE37] Pulse generator[->0 | 1->]
    - [RE39] Shunt[->0 | 1->]
    - [RE41] Power path[->0 | 2->]

fig. Requirement decomposition.

SysML Example

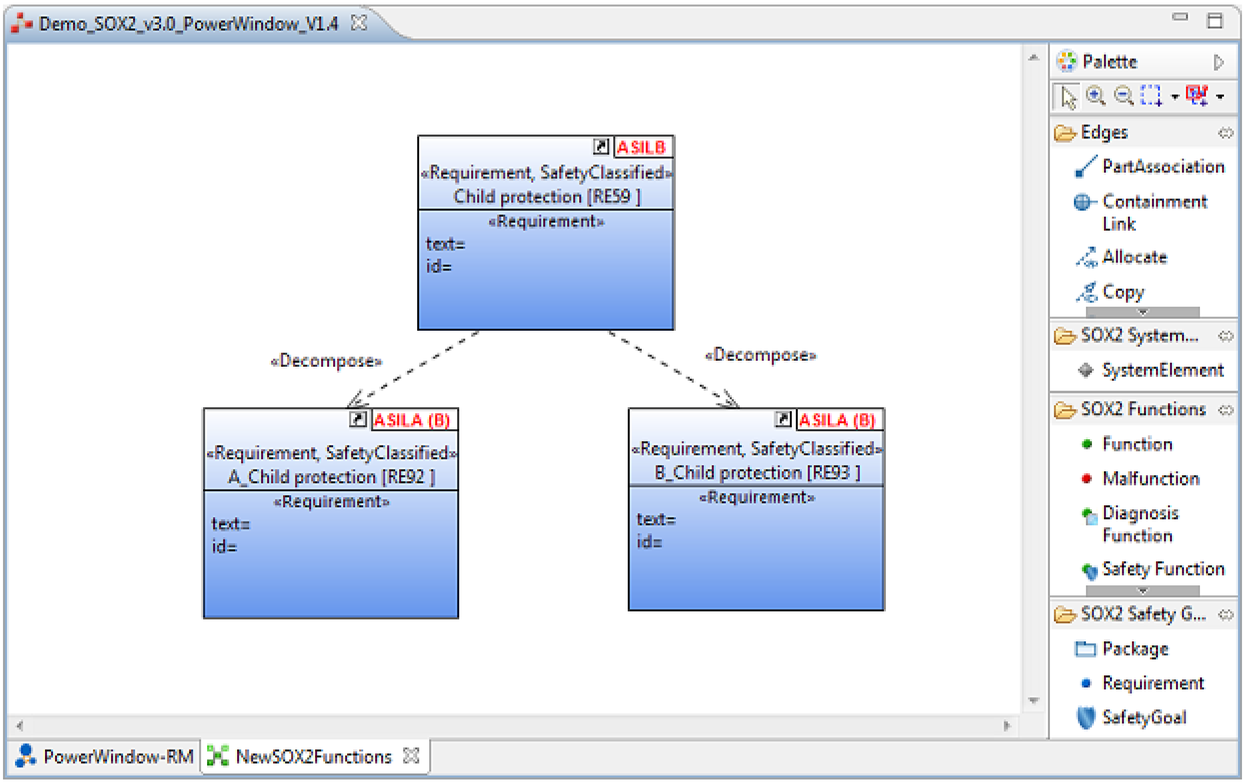


fig. Decomposition of a requirement in a diagram.

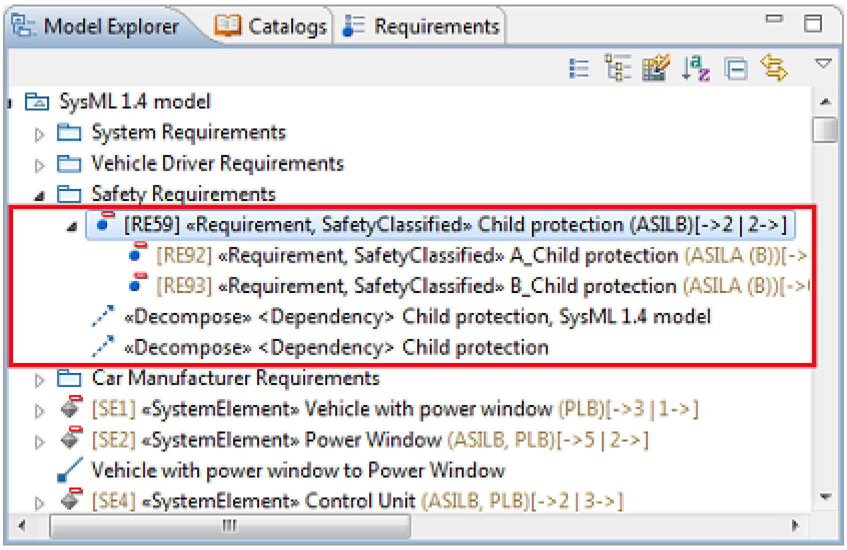

Model Explorer
Catalogs
Requirements
SysML 1.4 model
System Requirements
Vehicle Driver Requirements
Safety Requirements
[RE59] «Requirement, SafetyClassified» Child protection (ASILB)[->2 | 2->]
[RE92] «Requirement, SafetyClassified» A_Child protection (ASILA (B))[->
[RE93] «Requirement, SafetyClassified» B_Child protection (ASILA (B))[->
«Decompose» <Dependency> Child protection, SysML 1.4 model
«Decompose» <Dependency> Child protection
Car Manufacturer Requirements
[SE1] «SystemElement» Vehicle with power window (PLB)[->3 | 1->]
[SE2] «SystemElement» Power Window (ASILB, PLB)[->5 | 2->]
Vehicle with power window to Power Window
[SE4] «SystemElement» Control Unit (ASILB, PLB)[->2 | 3->]

fig. Decomposition of a requirement in the model explorer.

Deleting a Decomposition

1. Right-click on a decomposed requirement or safety goal.
2. Choose **Decompose** > **Delete decomposition**.

   ► A dialog opens, asking if you confirm deleting the child elements.
3. Click on **Yes**.

   ► The "Refactoring" dialog opens.
4. Click on **Finish**.

→ The decomposition has been deleted.

Importing Files

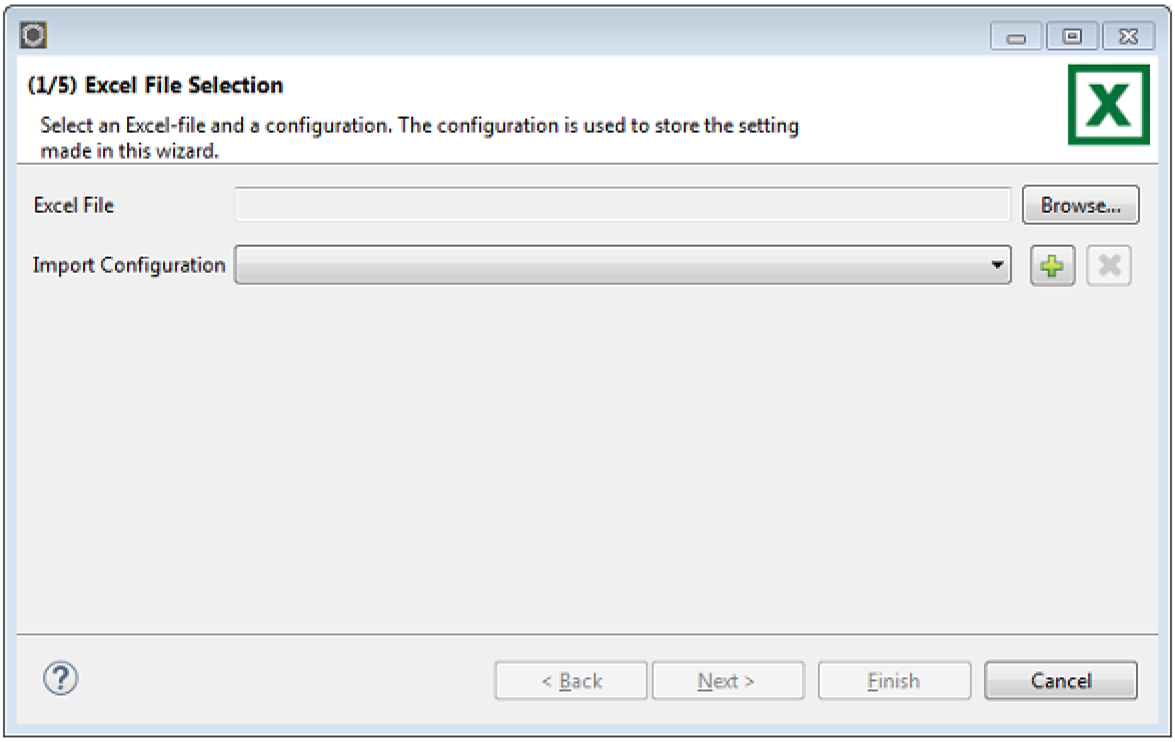
You can import requirements from an Excel file or ReqIF formats. Furthermore ReqIF documents can be merged.

Importing an Excel File

Precondition: A requirement document was created and is active. The Excel file has a requirement identifiers column (Id's) for mapping the sheet with SOX.

1. In the menu bar, open **File.**
2. Choose **Import** > **Import Excel.**

   ► The Excel import wizard opens.



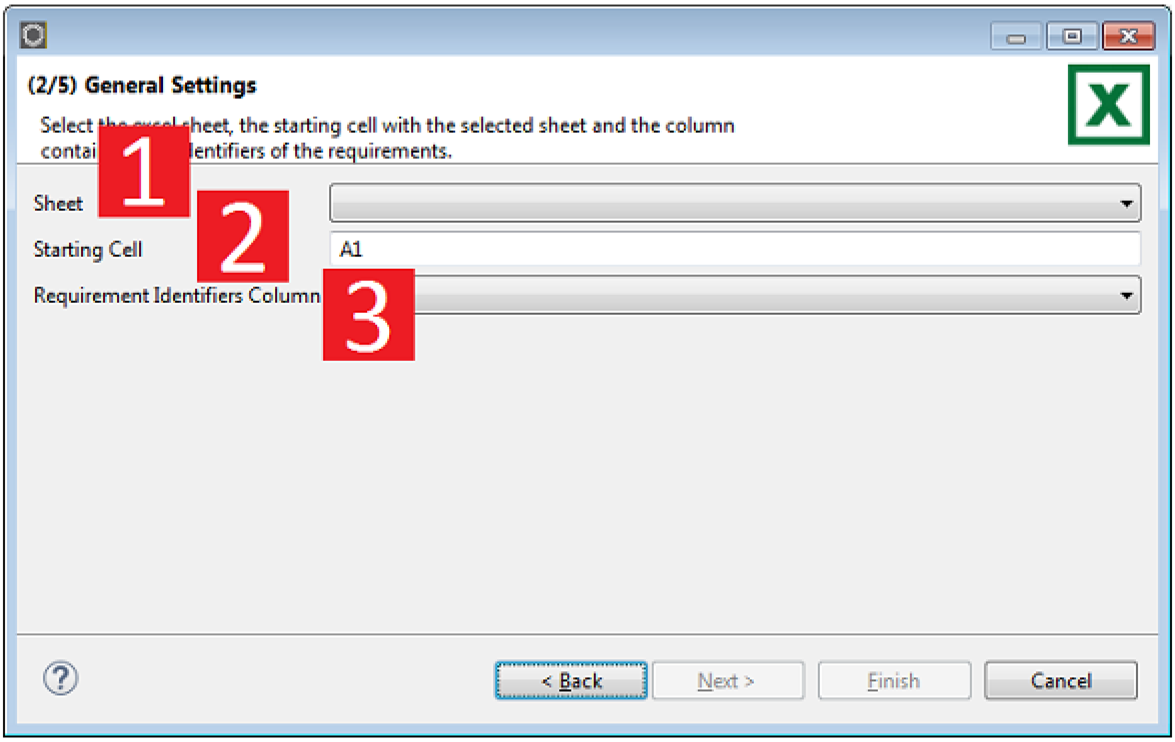
(1/5) Excel File Selection

Select an Excel-file and a configuration. The configuration is used to store the setting made in this wizard.

fig. Excel File Selection.

3. Click on **Browse...** to choose the desired file.
4. Click on the **plus symbol** (✚)to create a new import configuration or select an existing one.

   This configuration will be saved an can be used for further imports.
5. Click on **Next.**



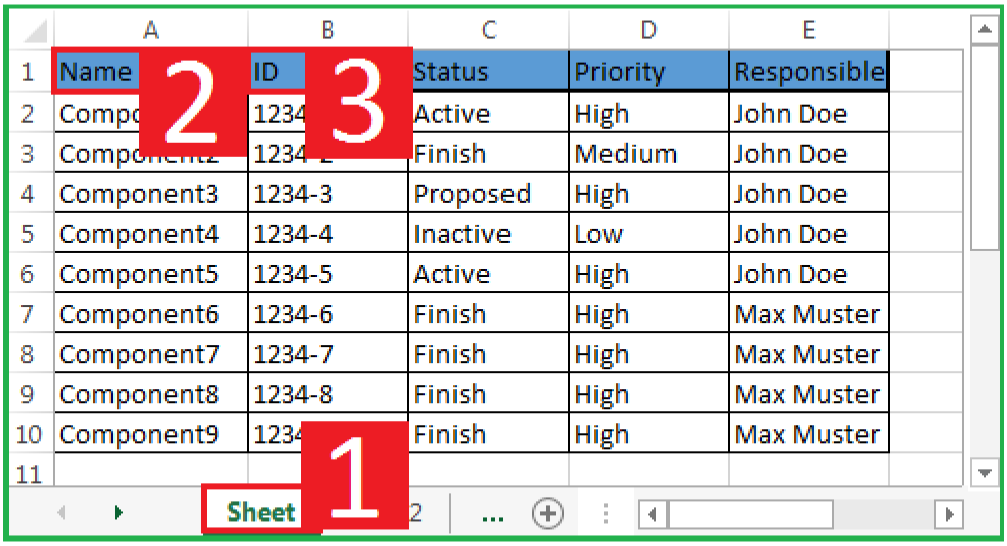
(2/5) General Settings

Select th heet, the starting cell with the selected sheet and the column contai lentifiers of the requirements.

Starting Cell: A1

fig. General Settings.

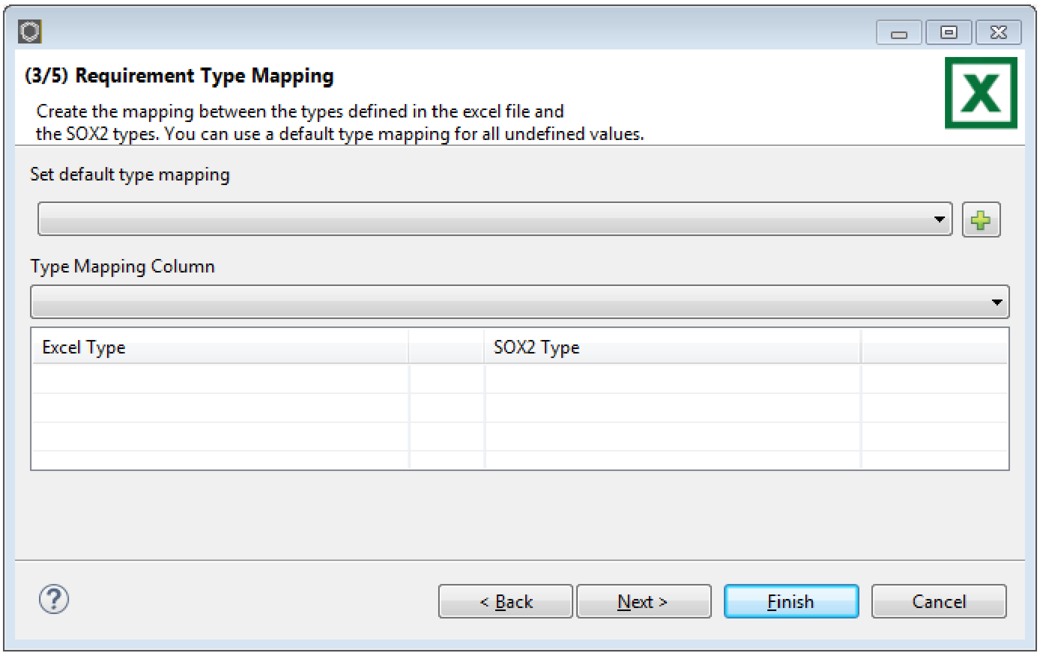
6. Choose the sheet [1] of the Excel file that should be imported.
7. Choose the starting cell [2] which declares the beginning of the requirement table.
8. Choose the requirement identifiers column which declares the ID of each requirement.



	A	B	C	D	E
1	Name	ID	Status	Priority	Responsible
2	Compo	1234	Active	High	John Doe
3	Compo	1234	Finish	Medium	John Doe
4	Component3	1234-3	Proposed	High	John Doe
5	Component4	1234-4	Inactive	Low	John Doe
6	Component5	1234-5	Active	High	John Doe
7	Component6	1234-6	Finish	High	Max Muster
8	Component7	1234-7	Finish	High	Max Muster
9	Component8	1234-8	Finish	High	Max Muster
10	Component9	1234	Finish	High	Max Muster
11					

fig. Excel sheet example.

9. Click on **Next.**



(3/5) Requirement Type Mapping

Create the mapping between the types defined in the excel file and the SOX2 types. You can use a default type mapping for all undefined values.

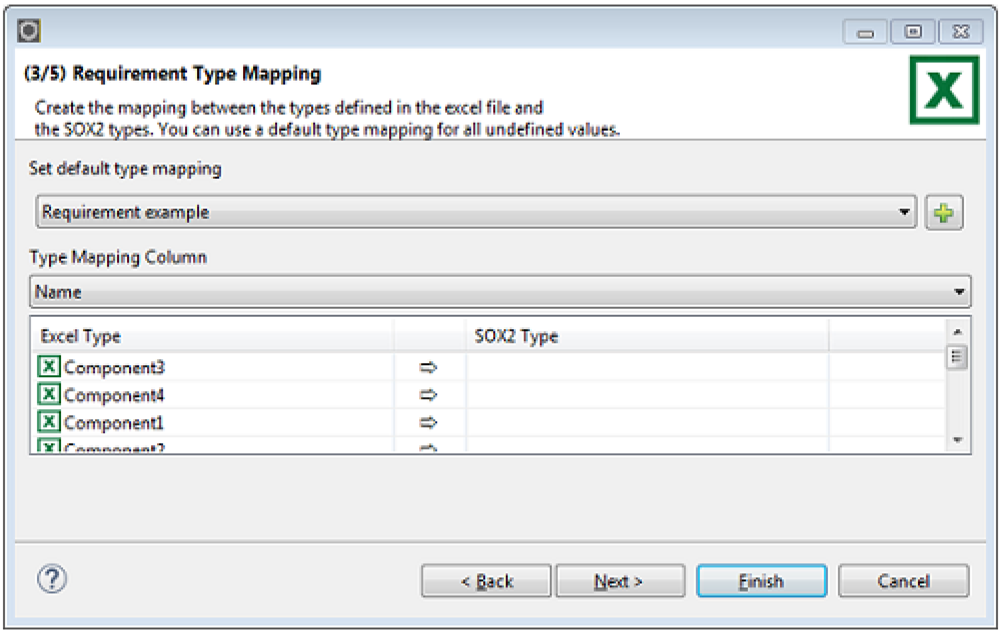
Set default type mapping

Type Mapping Column

Excel Type	SOX2 Type

fig. Requirement Type Mapping.

10. If all attributes are defined in one requirement type, set a default requirement type. With the plus symbol (✚)you can create a new requirement type.
11. Create for each column the mapping between the Excel Type and the SOX type if there is no default type.



(3/5) Requirement Type Mapping

Create the mapping between the types defined in the excel file and the SOX2 types. You can use a default type mapping for all undefined values.

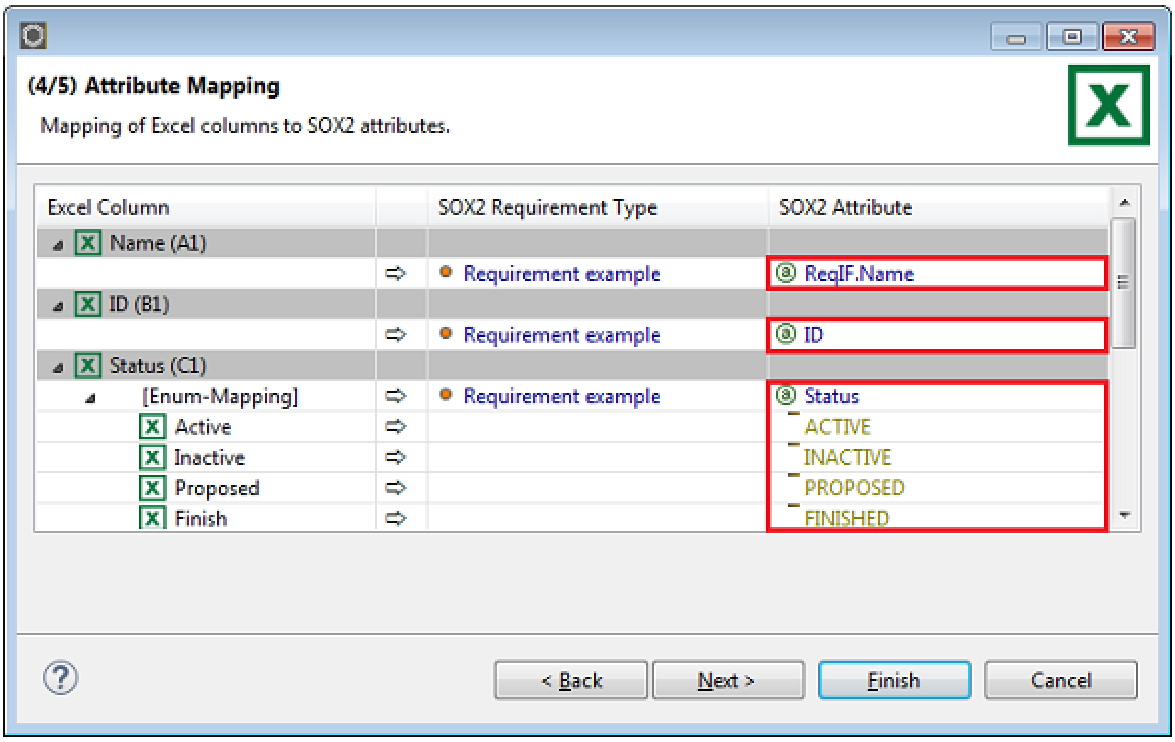
Set default type mapping: Requirement example

Type Mapping Column: Name

Excel Type		SOX2 Type
Component3	⇨	
Component4	⇨	
Component1	⇨	

fig. Requirement Type Mapping Example.

12.Click on **Next.**



(4/5) Attribute Mapping

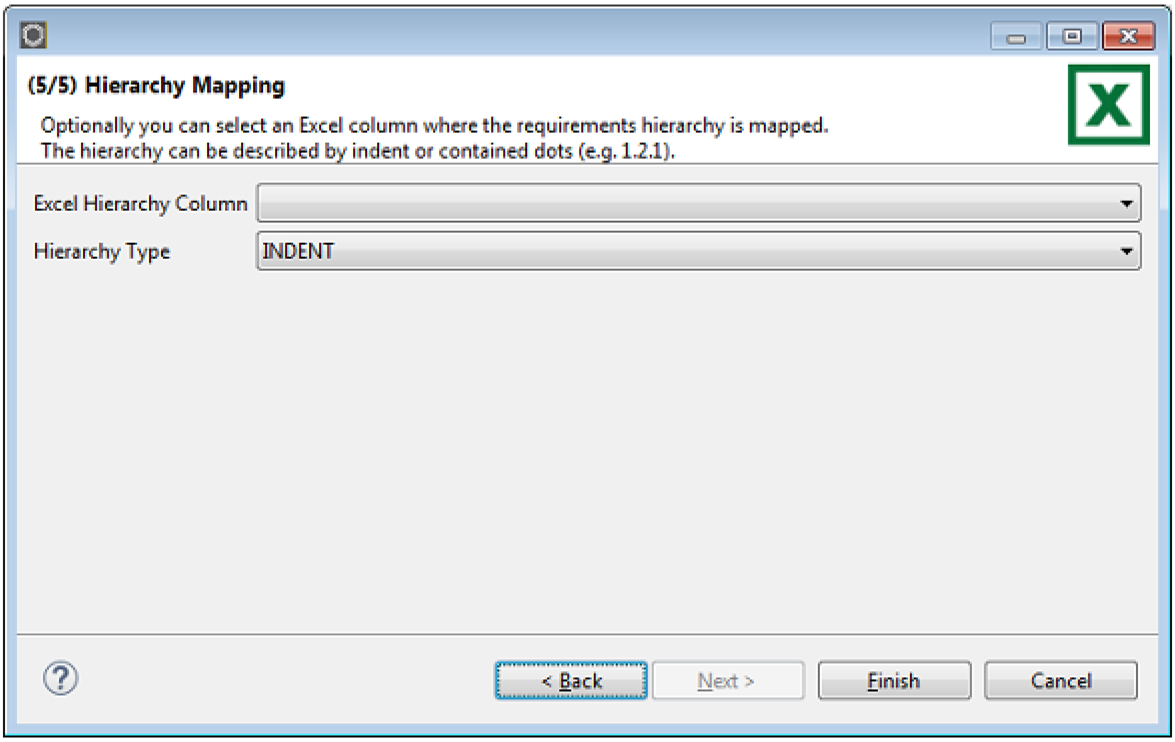
Mapping of Excel columns to SOX2 attributes.

Excel Column		SOX2 Requirement Type	SOX2 Attribute
Name (A1)			
	⇨	Requirement example	ReqIF.Name
ID (B1)			
	⇨	Requirement example	ID
Status (C1)			
[Enum-Mapping]	⇨	Requirement example	Status
Active	⇨		ACTIVE
Inactive	⇨		INACTIVE
Proposed	⇨		PROPOSED
Finish	⇨		FINISHED

fig. Attribute Mapping.

13.Double-click into the "SOX Attribute" column and the according row to set the desired SOX attribute. Also the enumeration of an attribute hast to be mapped.

14.Click on **Next.**



(5/5) Hierarchy Mapping

Optionally you can select an Excel column where the requirements hierarchy is mapped.
The hierarchy can be described by indent or contained dots (e.g. 1.2.1).

Excel Hierarchy Column:

Hierarchy Type: INDENT

fig. Hierarchy Mapping.

15.Optionally you can select an Excel column where the requirements hierarchy is mapped. The hierarchy can be described by indent or contained dots (e.g. 1.2.1).

16.Click on **Finish.**

→ An Excel file was imported and will be added as a requirement module.

Importing a Requirement Document

Precondition: A SOX project was created and the Repository view is active.

1. Right-click in the Repository view on the **RM** folder.

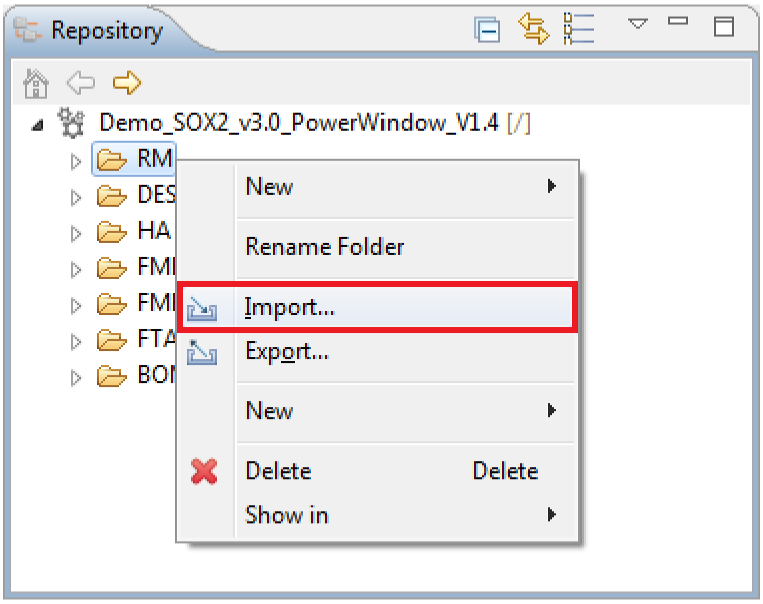


fig. Import RM from the Repository View.

2. Choose **Import**.

► The Import wizard opens.

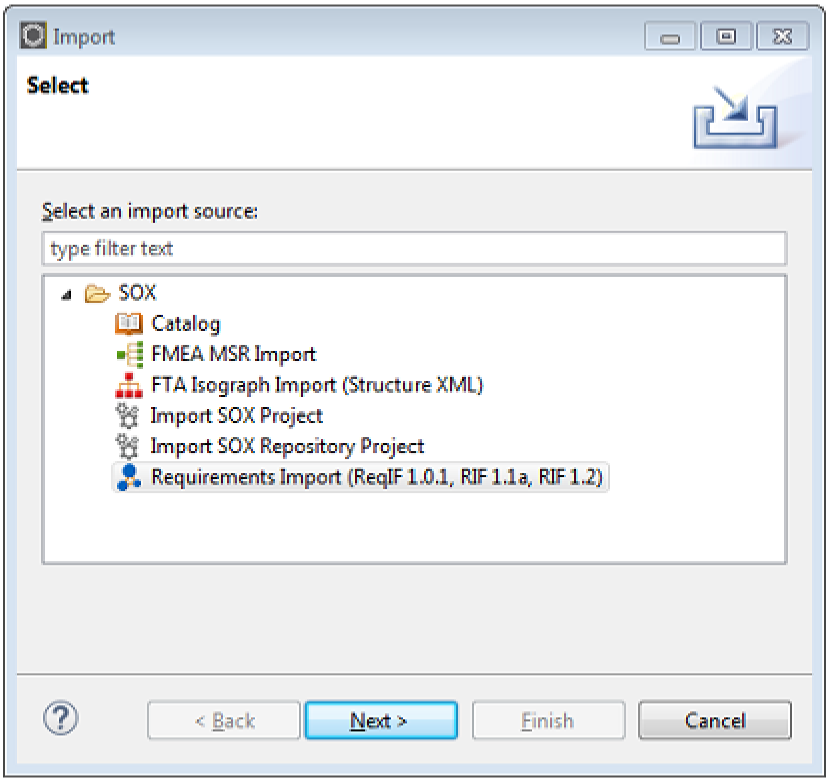
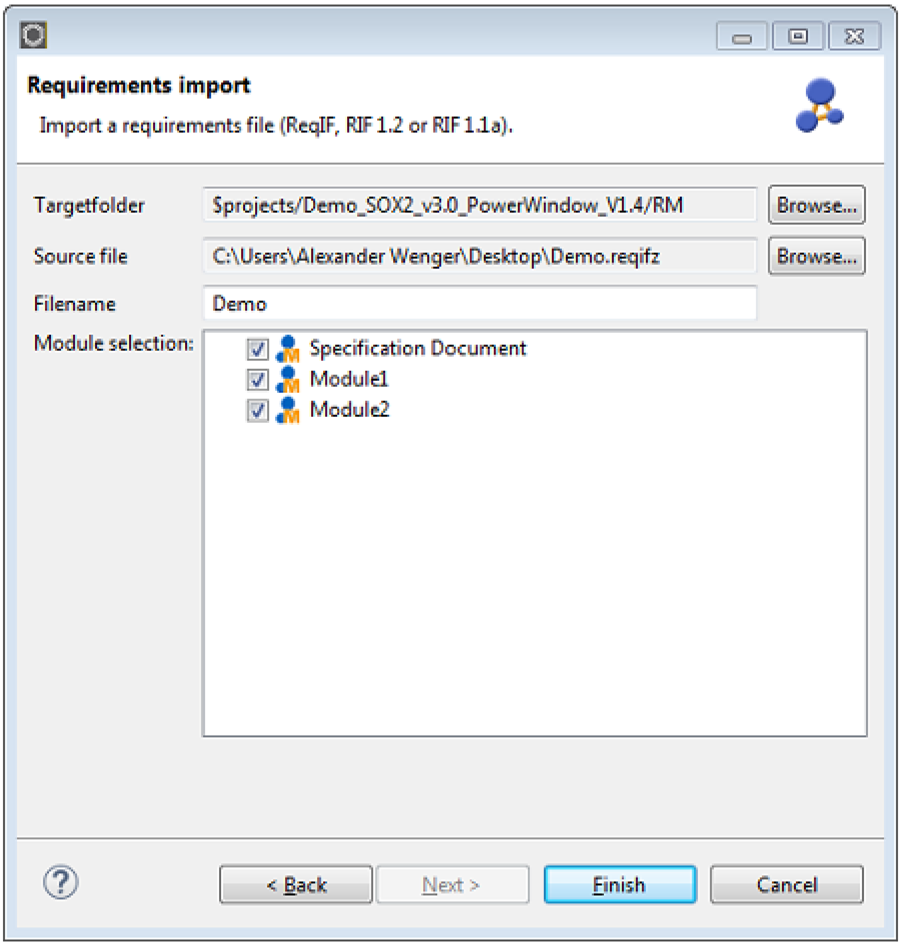


fig. Import wizard.

3. Select **Requirements Import.** Possible versions are: (ReqIF 1.0.1, RIF 1.1a, RIF 1.2).

4. Click on **Next.**



Requirements import

Import a requirements file (ReqIF, RIF 1.2 or RIF 1.1a).

Targetfolder: $projects/Demo_SOX2_v3.0_PowerWindow_V1.4/RM

Source file: C:\Users\Alexander Wenger\Desktop\Demo.reqifz

Filename: Demo

Module selection:

- ☑ Specification Document
- ☑ Module1
- ☑ Module2

fig. Requirements Import.

5. Click on **Browse** to choose **RM** as the target folder.

6. Click on **Browse** to select the desired file.

7. Enter a filename.

8. Select the desired modules.

9. Click on **Finish.**

→ A requirement document was imported.

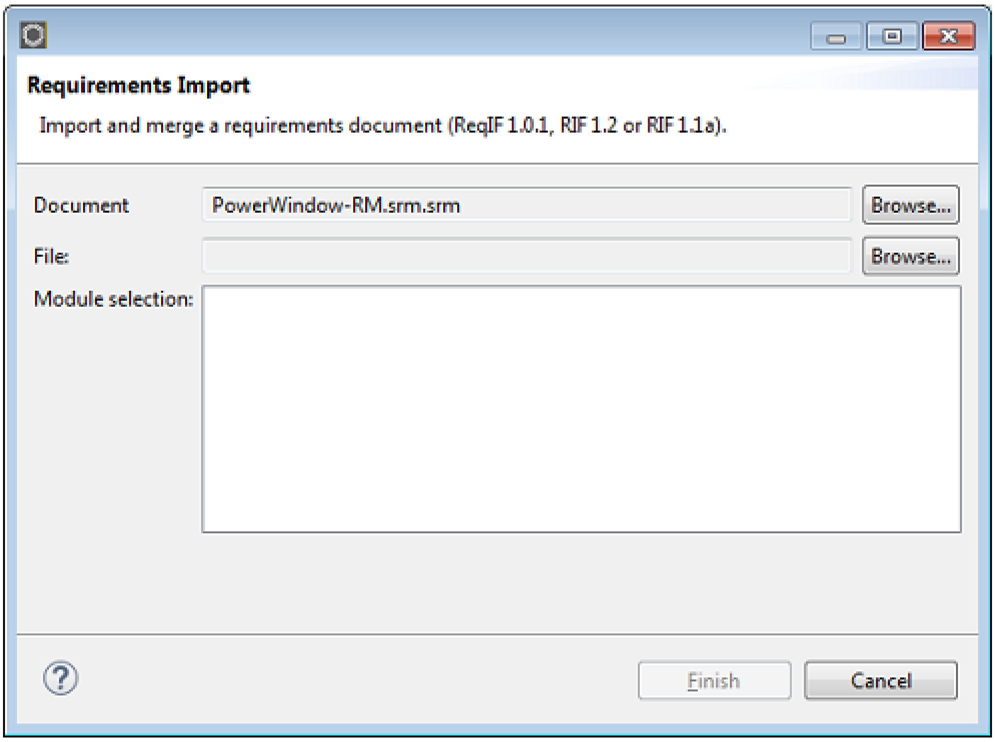
Merging Requirement Documents

Precondition: A requirement document was created and is opened.

1. Open the menu bar point **File.**

2. Choose **Import** > **ReqIF format.**

► The dialog "Requirements Import" opens.



Requirements Import

Import and merge a requirements document (ReqIF 1.0.1, RIF 1.2 or RIF 1.1a).

Document: PowerWindow-RM.srm.srm

File:

Module selection:

fig. "Requirements Impor"t dialog.

3. Click on **Browse** to choose the requirement document from SOX.
4. Click on **Browse** to choose the file that should be merged.
5. Select the desired modules.
6. Click on **Finish.**

→ The requirement file was merged into the chosen document.