# Frestimate System Reliability Model Module
Tutorial

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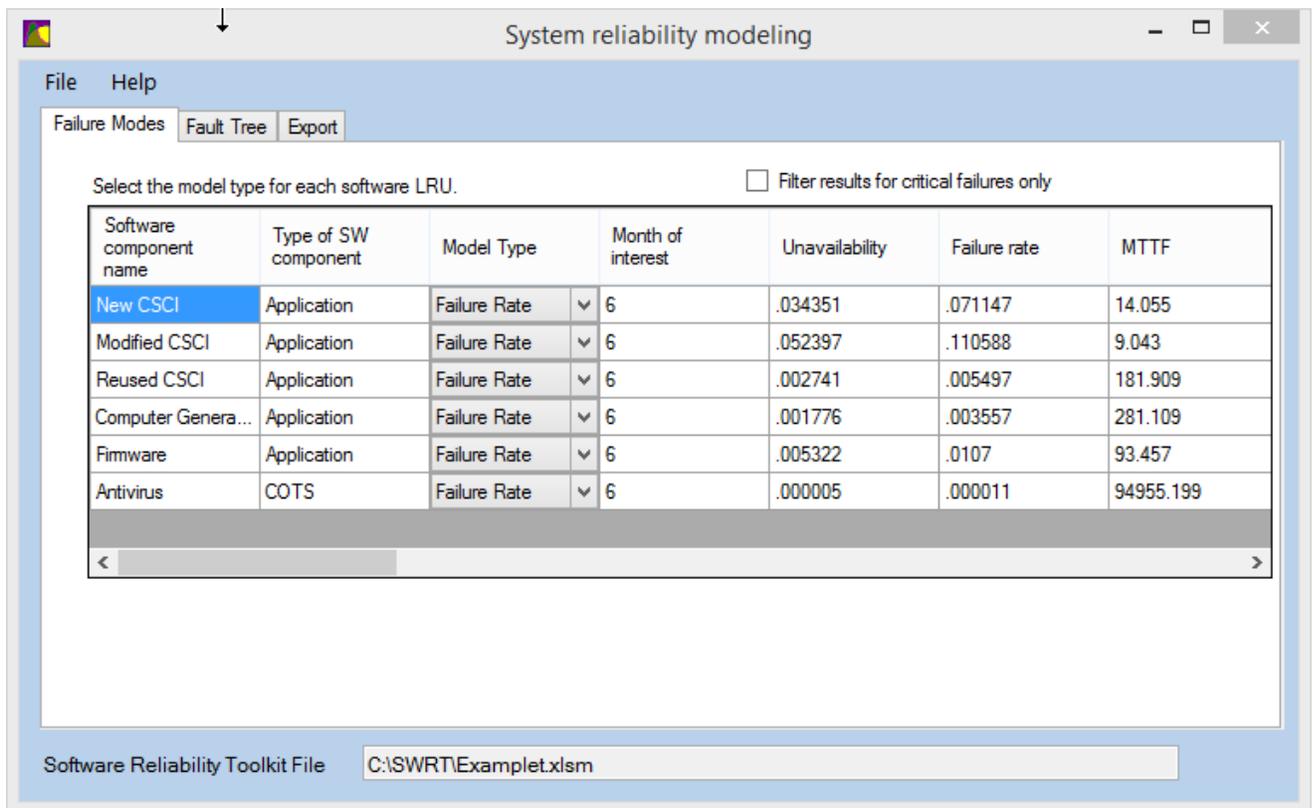
Operating the System Reliability Model Module

1. The Frestimate System Reliability Model Module is used with either the Software Reliability Toolkit or the Frestimate software. The user must have one of these products purchased prior to using this module.
2. Using one of the above tools create a prediction for each software LRU in the system. Make sure to include all in-house developed software, Commercial Off the Shelf (COTS), Government Furnished Software (GFS), Free Open Source Software (FOSS), and firmware. Ideally the software should be designed so that each software LRU (typically called a Computer Software Configuration Item) is associated cohesively with a particular target hardware. So, if the system is an automobile the software components might include the transmissions software, GPS software, Camera software, security software, convertible top control software, entertainment software, temperature control software, etc. Unless the software in the system is very small, there should be more than one software LRU. The LRU for software is the Dynamic Link Library (DLL) file or the Executable (EXE) file or the application file.
3. Once the predictions are defined for each software LRU, launch the System Reliability Model Module.
4. Select the File->Open menu option. Select the Frestimate or Software Reliability Toolkit file that you just created. It will usually be in the c:\SWRT folder.
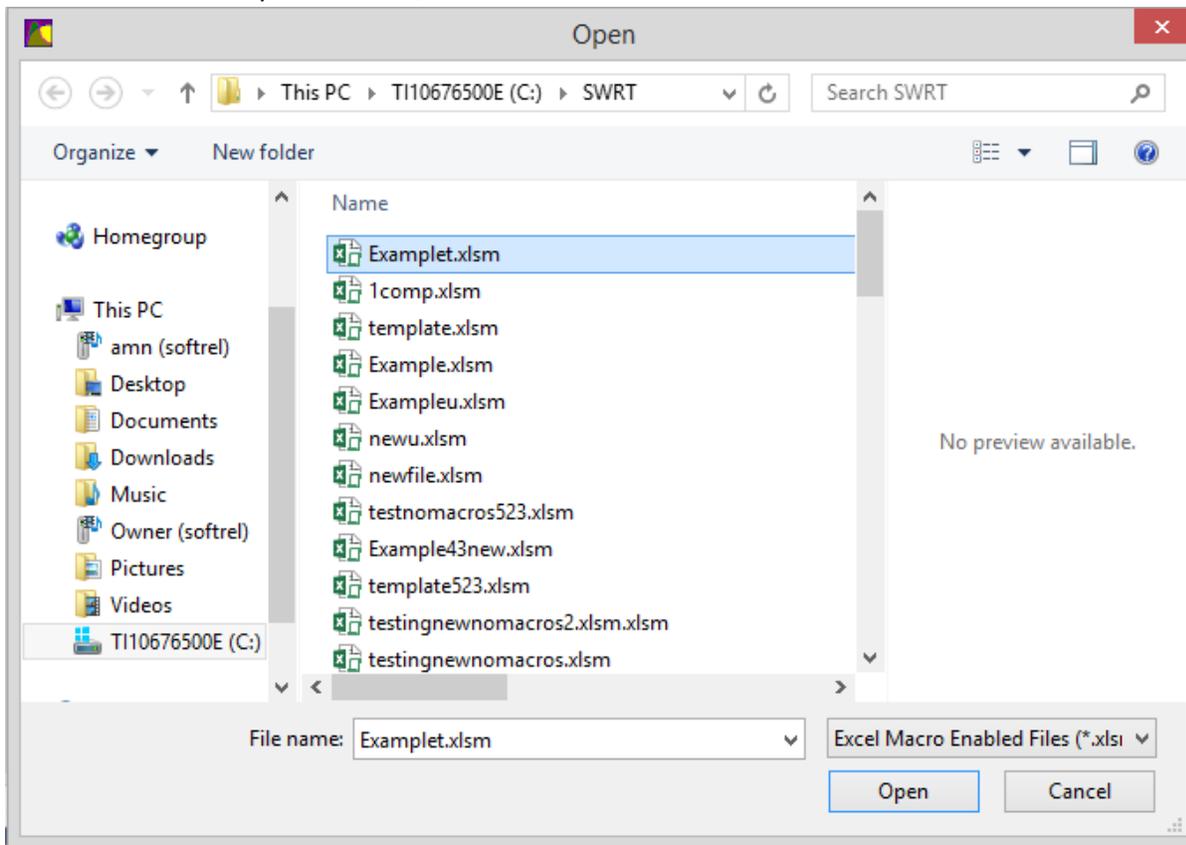
5. View the Failure Mode Tab. It shows each software LRU and its predicted values. All of the columns are read only except for the Model Type column. See the below figure and table.

Filter results for critical failures only checkbox

Checked	Uses the predicted number of failures that are expected to affect availability. On average this can be about 2-8% of all software failures.
Unchecked	Uses all types of failure severities which are serious enough to be noticeable.

Column Header	Description
Software component name	The name of the software LRU that you defined in the In-house and COTS worksheets of the software reliability toolkit or Frestimate software
Type of software component	This is either Application (developed by your organization) or COTS (commercially developed by another organization. The in-house software components may exhibit different failure modes than the COTS components. For example, COTS components are generally more likely to have interface or update problems.
Model type	Select either "Failure Rate" or "MTBF". Both results are actually exported. This field is used to show which results are shown on the Reliability Blocks.
Month of Interest	You defined this in the Frestimate or Software Reliability Toolkit. It is how many months of operational growth will transpire prior to the milestone of interest. This is hardly ever more than 12 months due to the fact that most software systems undergo new feature releases at least yearly.
Unavailability, Failure rate and MTBF.	These are all computed at the "Month of Interest". If you wish to change the month of interest, you will need to do so in the Software Reliability Toolkit or Frestimate software.
Restore time	There is no "MTTR" for software because software does not wear out. There is a Mean Time To Software Restore which is a weighted average of restart time, reboot time, workaround time. In some cases, some operational failures can only be fixed via a change to the software product code. So, the administrator time to get a new release of software or downgrade to a previous version of software is also considered.
Unavailability, Failure rate and MTBF for the first 10 months of operational usage.	Isograph Reliability Workbench allows for 10 different milestones for these predictions. We associate the 10 milestones with the first 10 months of operational growth that is predicted to occur.

6. View the Fault Tree Tab. This tab shows 28 different failure mode/root cause pairs associated with software. Edit each of the columns for each software LRU so that the failure modes most related to a particular LRU are given a higher weighting than those that are least likely.
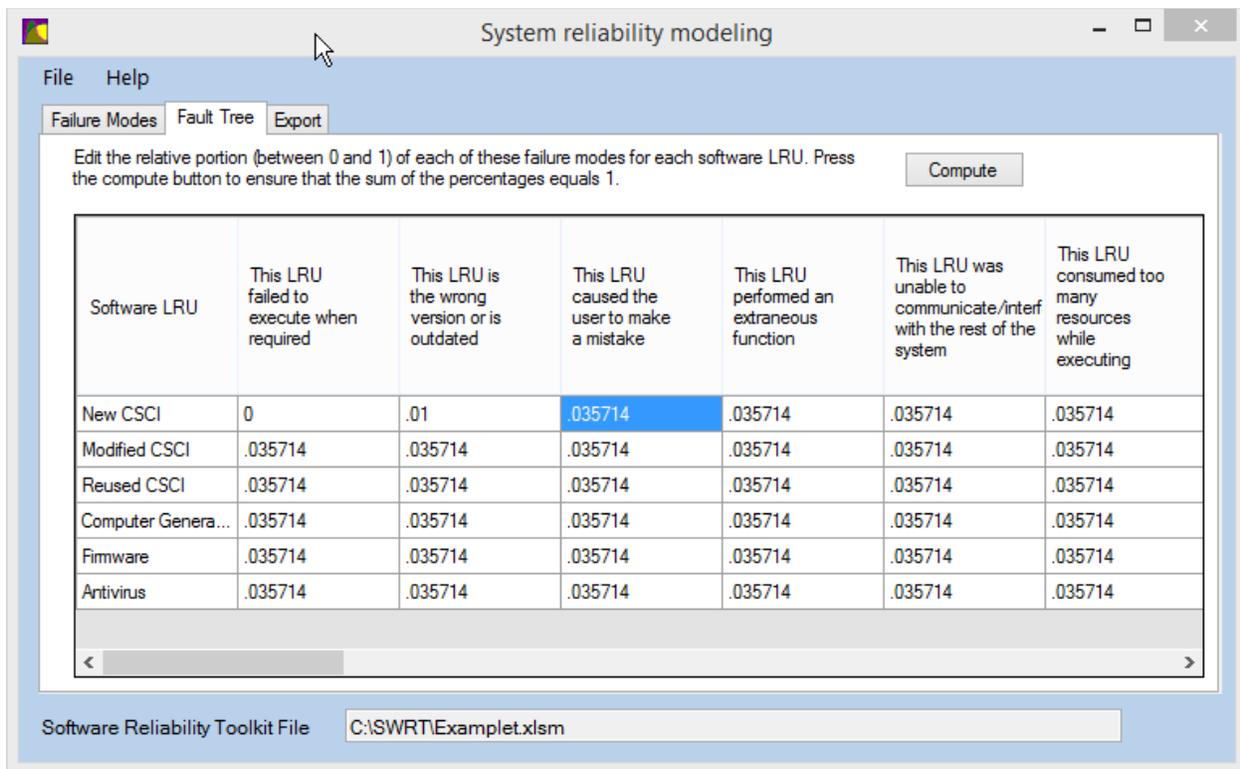
The below is a listing of the 28 failure mode/root cause pairs. The fault tree will display the below events and assign a failure rate for each event that is the product of its relative weighting which you input on the above tab and the failure rate prediction for that software LRU. So, for example if the software LRU is predicted to have a failure rate of .001 and you assign equal relative portions of the below failure mode/root causes then each even will have a resulting failure rate of .001/28. Edit the cells under each failure mode/root cause heading to assign more or less weighting to each of the below failure mode/root cause pairs. For more information about these failure mode/root cause pairs see "Effective Application of Software Failure Modes Effects Analysis" http://softrel.com/Publications.html.

The "compute" button ensures that the relative portions for each of the 28 failure mode/root cause pairs equal 1. It is possible to assign a relative portion of 0 to a failure mode/root cause column if you have no past or current evidence that the failure mode is likely. For example, if the software is installed exclusively in a factory or by a qualified service technician the likelihood of a serviceability failure mode is relatively small.

Note that all of the below failure modes and root causes can and do occur as a single point failure. Three of the faulty error handling root causes happen when there is a failure in the system (i.e. hardware or other software) that the software fails to detect or handle. You can supply a failure rate for the system event which is not necessarily related to the software itself. For example, if the software LRU is a transmission software system and the transmission hardware encounters a failure and the software fails to detect it or fails to recover from it that is both a hardware failure and a software failure.

Generic failure mode	Specific root cause	
Faulty functionality	This LRU performed an extraneous function	
	This LRU failed to execute when required	
	This LRU is missing a function	
	This LRU performed a function but not as required	
Faulty sequencing	This LRU executed while in the wrong state	
	This LRU executed out of order	
	This LRU failed to terminate when required	
	This LRU terminated prematurely	
Faulty timing	This LRU executed too early	
	This LRU executed too late	
Faulty data	This LRU manipulating data in the wrong unit of measure or scale	
	This LRU can 't handle blank or missing data	
	This LRU can 't handle corrupt data	
	This LRU data/results are too big	
	This LRU data or results are too small	
Faulty error handling	This LRU generated a false alarm	
	This LRU A failure in the hardware, system or software has occurred	
	This LRU detected a system failure but provided an incorrect recovery	A failure in the hardware, system or software has occurred
	This LRU failed to detect errors in the incoming data, hardware, software, user or system	
Faulty processing	This LRU consumed too many resources while executing	
	This LRU was unable to communicate/interface with the rest of the system	
Faulty usability	This LRU caused the user to make a mistake	
	This LRU User made mistake because of user manual	
	This LRU failed to prevent common human mistakes	
	This LRU allowed user to perform functions that they should not perform	
	This LRU prevented user from performing functions that they should be allowed to perform	
Faulty serviceability	This LRU installed improperly	
	This LRU updated improperly	
	This LRU is the wrong version or is outdated	

7. Export Tab. On this tab, press the Export button to Export the failure modes, reliability blocks and fault tree information so that it can be imported by Isograph Reliability Workbench. Refer to the next section for how to import the exported file into the Isograph software.

Importing Software Reliability Predictions into Isograph Reliability Workbench.

1. Export the software reliability predictions using the Export button on the Export Tab of the Frestimate System Reliability Model tool.
2. Launch Isograph Reliability Workbench.

3. Select the File menu option. Select the New Project file option.
4. Select the File Import option.
5. Select "Excel" from the Type field. Select the Browse button and select the file that you just created in step 1. Make sure that the "Column names in first row" box is checked.
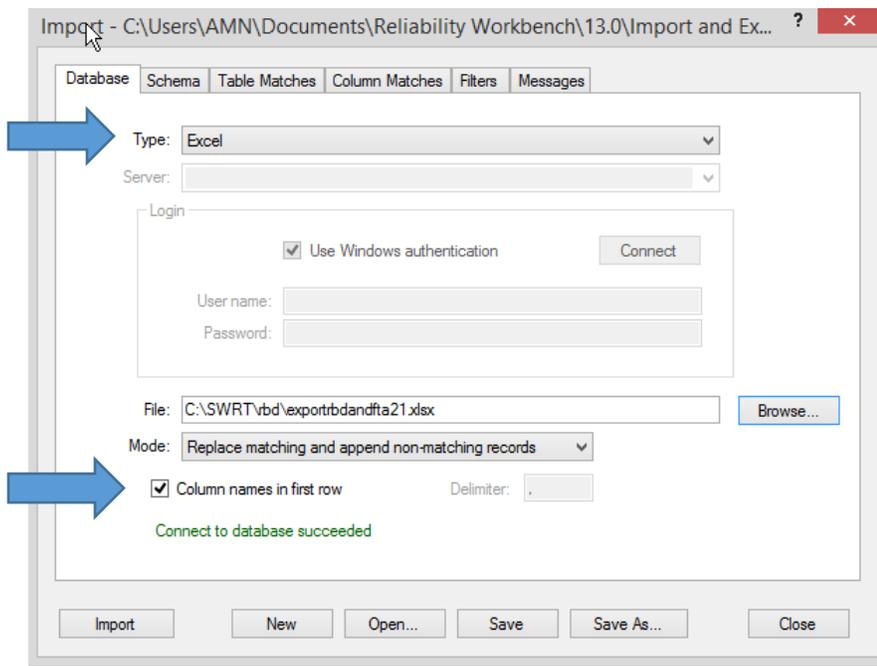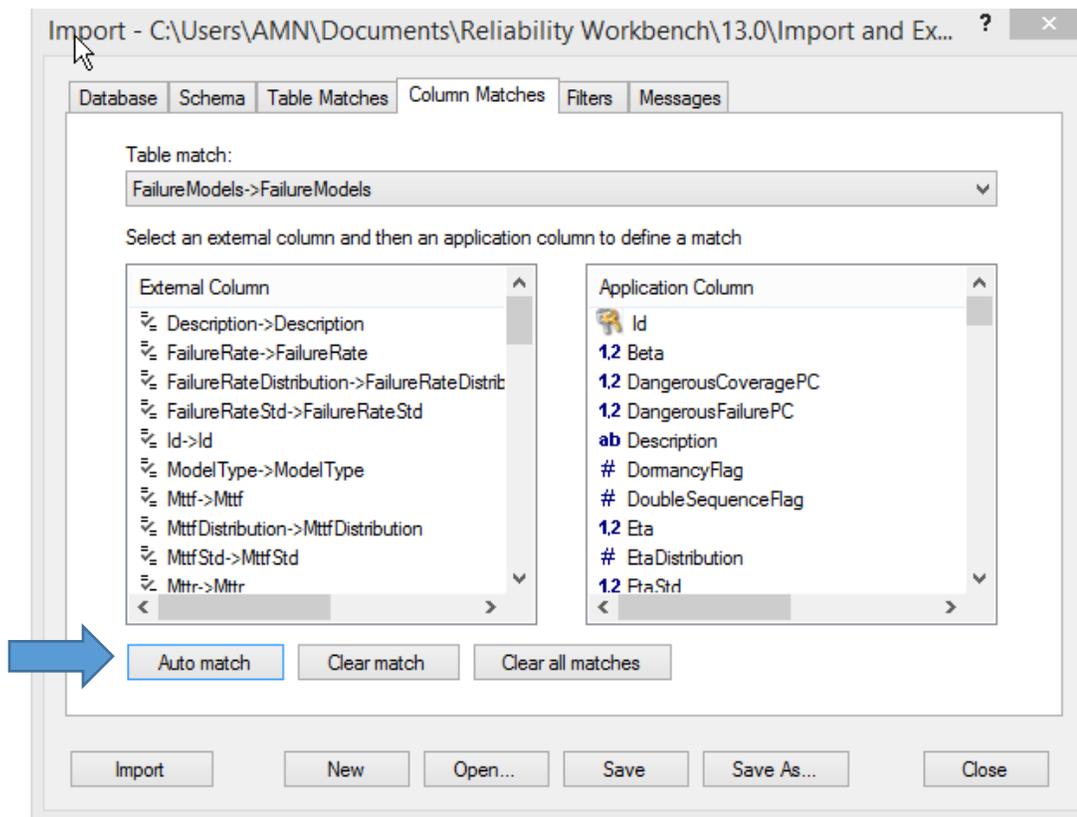

6. Select the Table Matches tab. Select the Auto Match button.
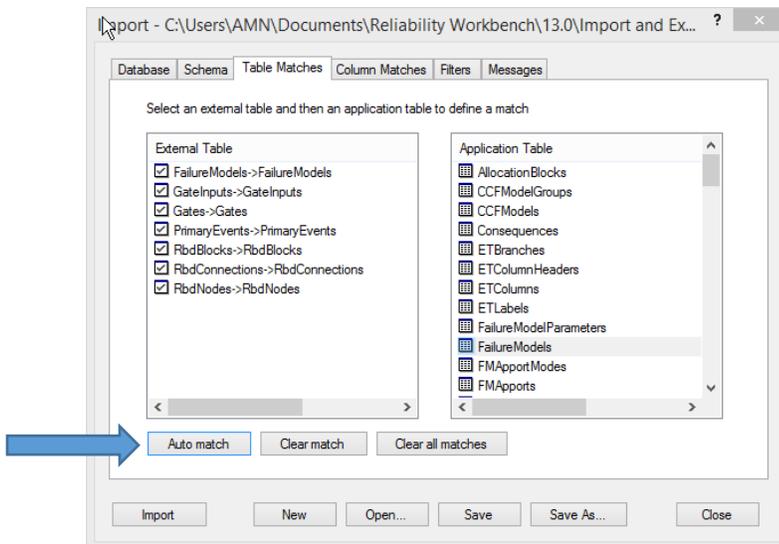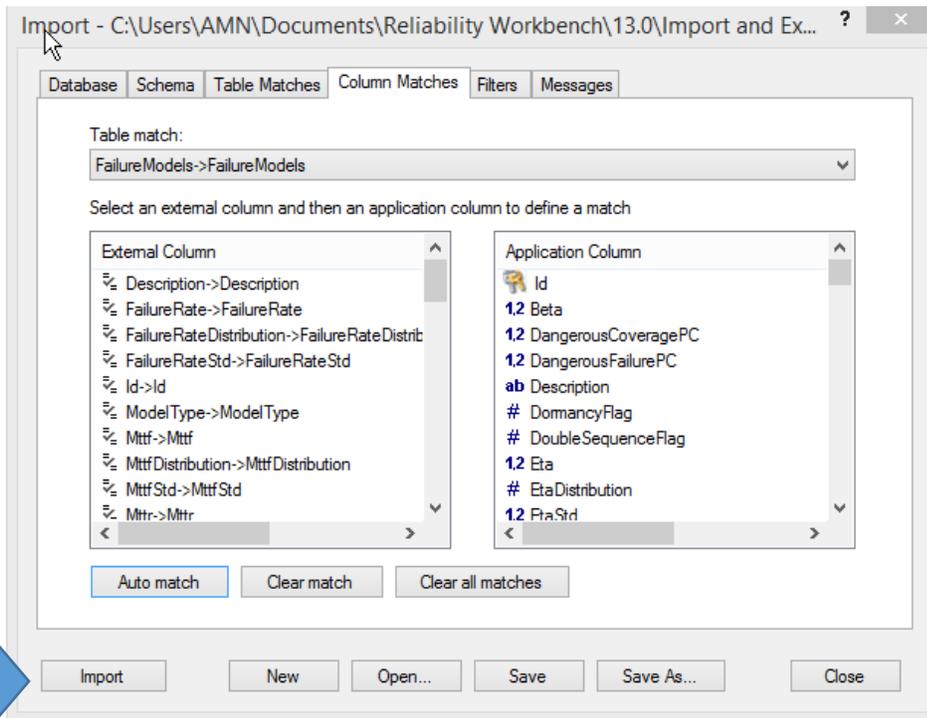

7. Select the Column Matches tab. Notice that there are 7 items in the Table Match selection list.
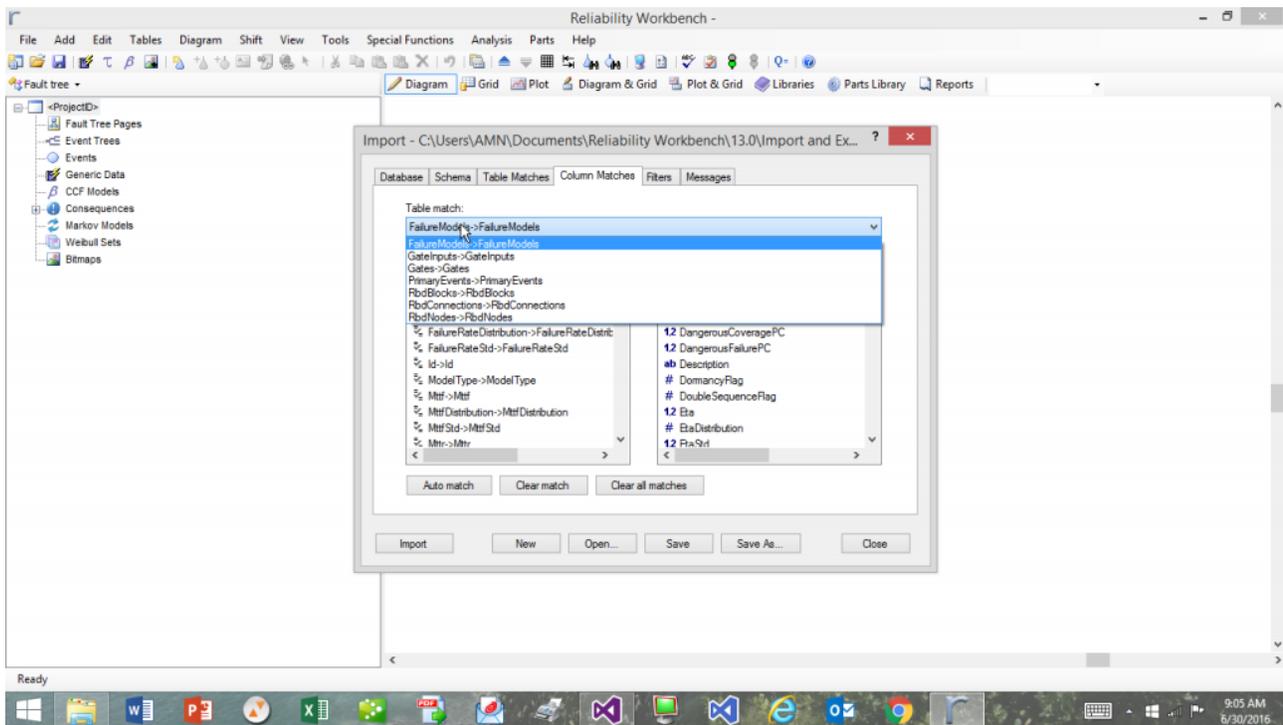
8. Select the Auto Match button for each of the 7 items in the Table Match list.

9. When **all** 7 tables have been "auto matched" then press the Import button.

10. When the import is complete select the RBD option. The software LRUs are placed into the SY1 RBD page. All of the software LRUs are placed in series with each other. Each software LRU should be placed in series with the hardware that it supports. For example, if the system is an automobile the transmissions control software should be in series with the transmissions control hardware. If the software LRUs don't align with the hardware LRUs a discussion with the software and firmware engineers should be initiated.
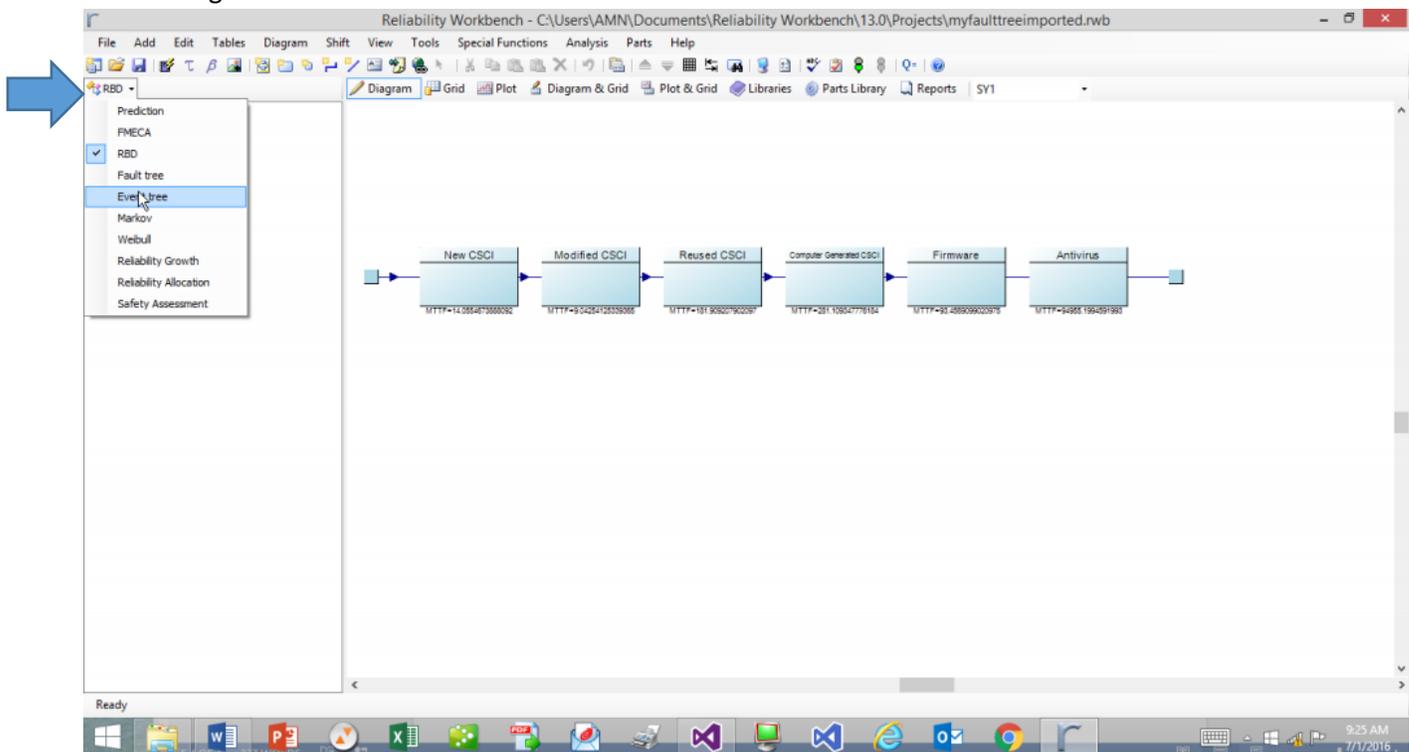
11. Select the Fault Tree option. For each software LRU, a fault tree has been created. The top level failure rate for each software LRU is apportioned to each of the 28 failure modes based on your inputs to the

Fault Tree Options tab in the Frestimate System Reliability Model tool. These fault trees can be merged into the system level fault trees.
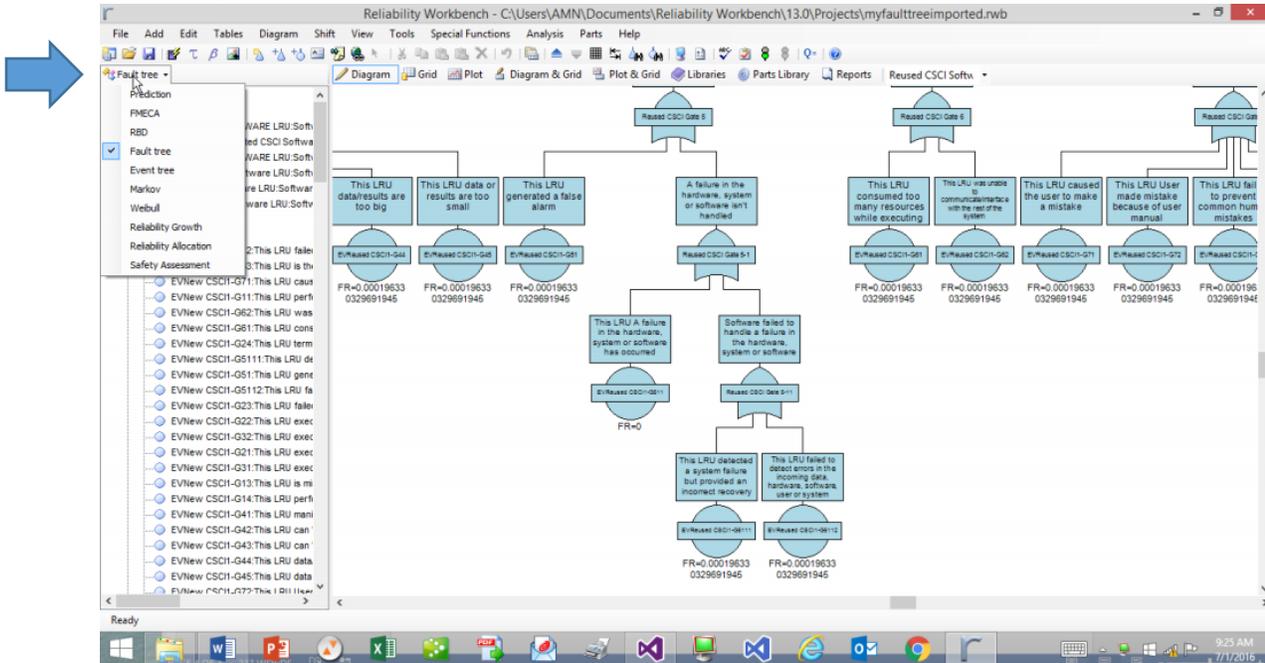
12. All of the failure models are imported as per the Failure Model tab. All of the events have been imported as per the Fault tree options tab.