Mercury Tool

A tool for dependability evaluation adopting RBD and SPN models

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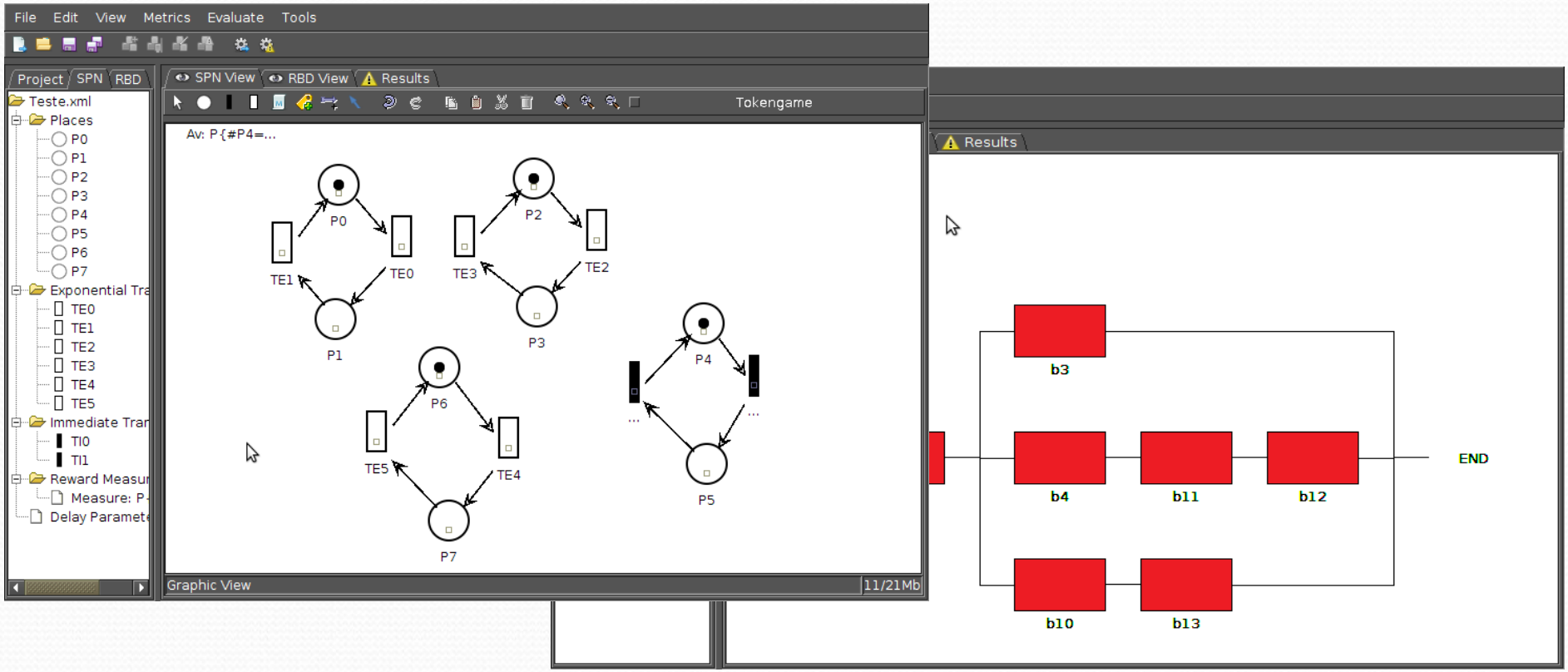


MERCURY TOOL - FEATURES

- SPN Editor
  - Stationary Simulation
    - Standard Simulation (Availability)
    - Experimentation (evaluate different scenarios with same model)
  - Transient Simulation
    - Standard Simulation (Reliability)
  - Token Game

MERCURY TOOL - FEATURES

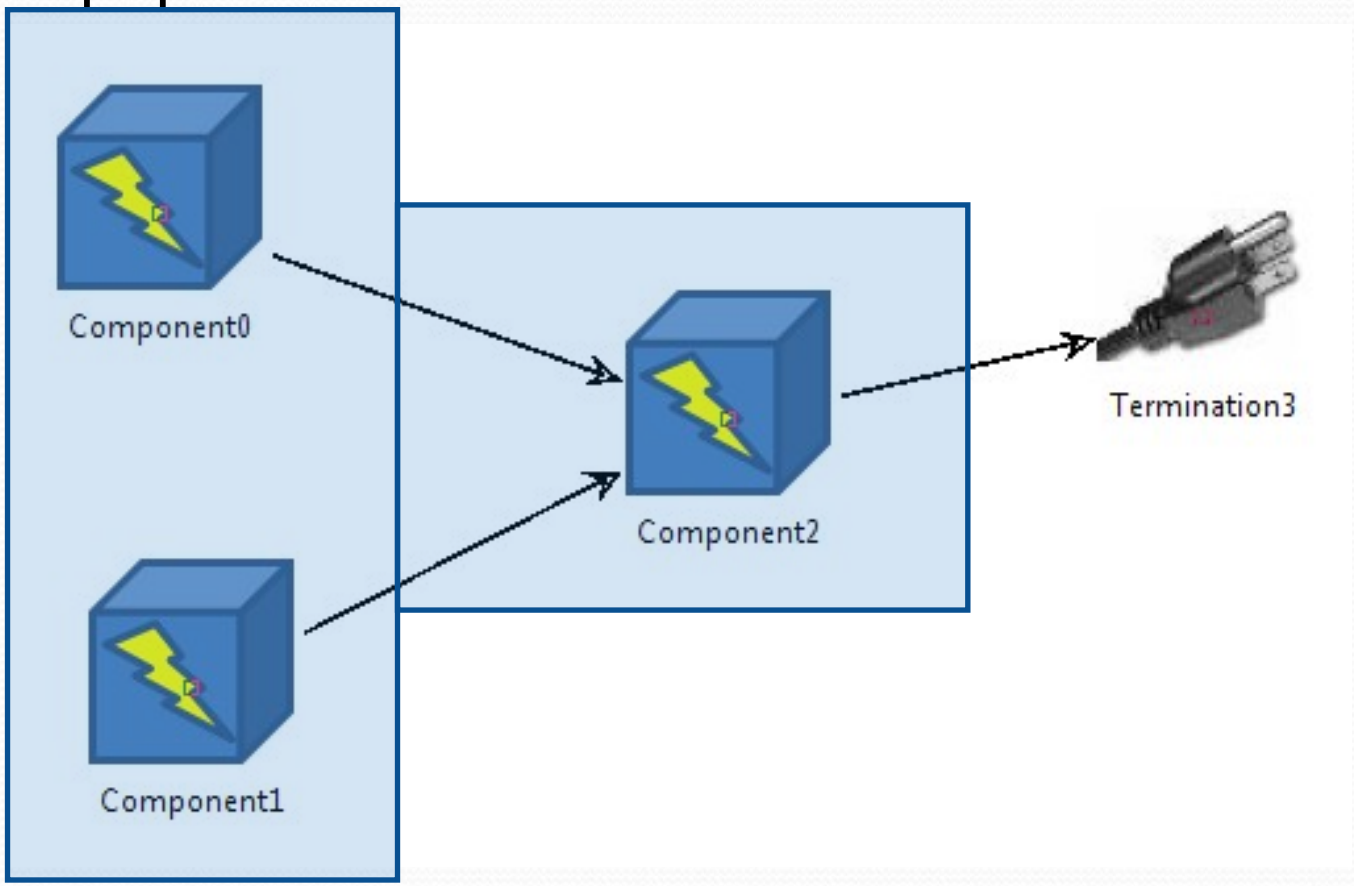
- RBD Editor
  - Standard Evaluation
    - Availability and Reliability
  - Reliability Importance
  - Experimentation
  - Bounds Evaluation
  - Logical & Structural functions

MERCURY TOOL - FEATURES

- Stationary Simulation
  - Simulate the model in order to evaluate the availability of the System.
  - Different scenarios in the same model can be evaluated adopting experiment feature.

Example:

- Suppose a power infrastructure with two components in parallel and one in series, that provides energy to one given equipment.



Example

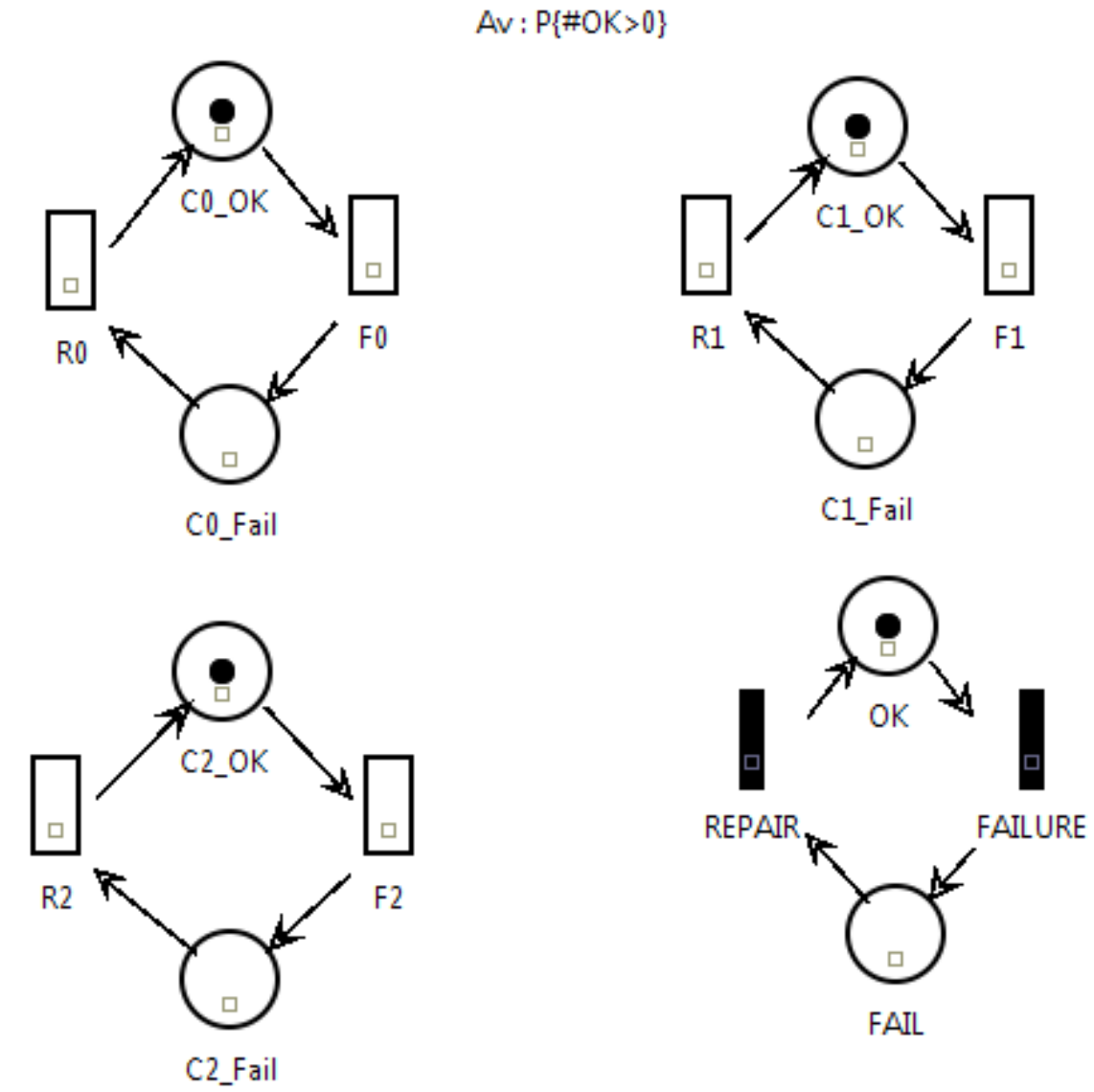
- Dependability Parameters:

Component	MTTF (Hours)	MTTR (Hours)
Component0	1000	1
Component1	1000	1
Component2	1000	1

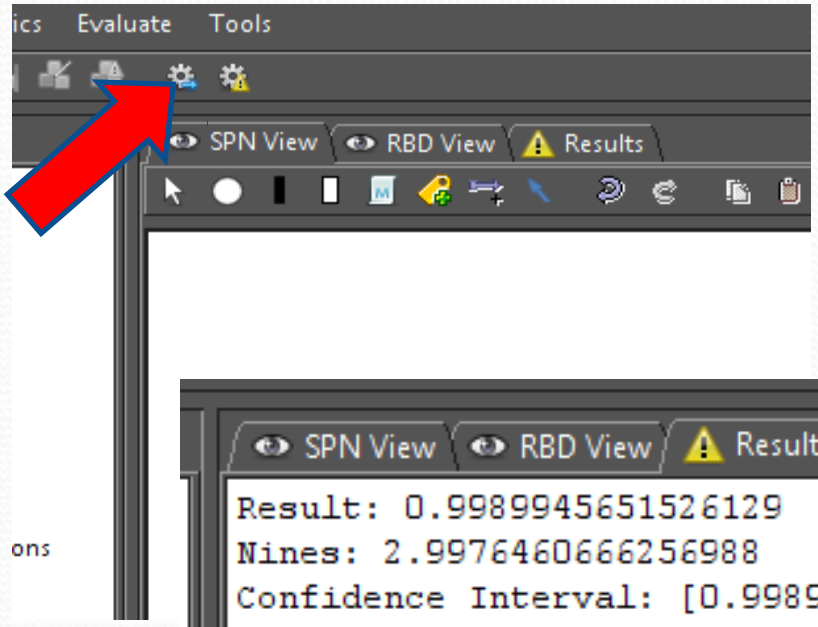
- Fail Condition
  - If(Component0 Fails and Component1 Fail) or if(Component2 Fail) then the **system fails**

Example

- SPN model



Stationary Simulation



SPN View | RBD View | Results

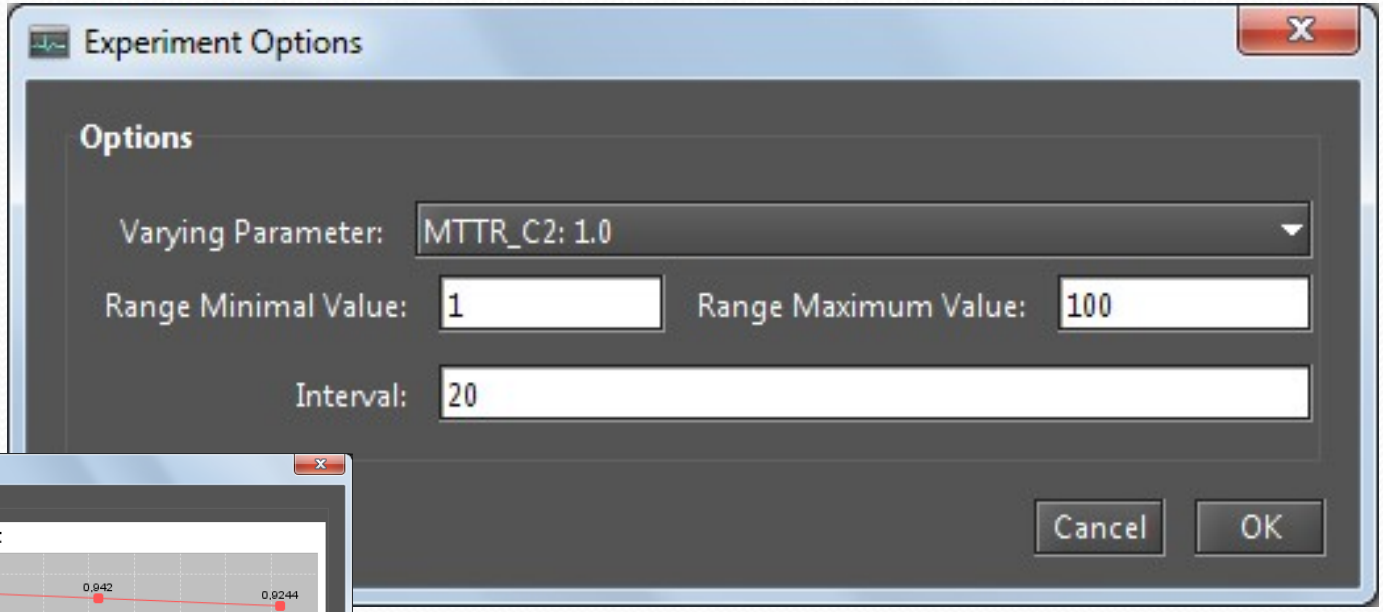
```
Result: 0.9989945651526129
Nines: 2.9976460666256988
Confidence Interval: [0.9989647476609412,0.9990243826442845]
Error %: 0.002984750138963997
Run size: 1000
Numer of Runs 50
Total Runs 50000
```

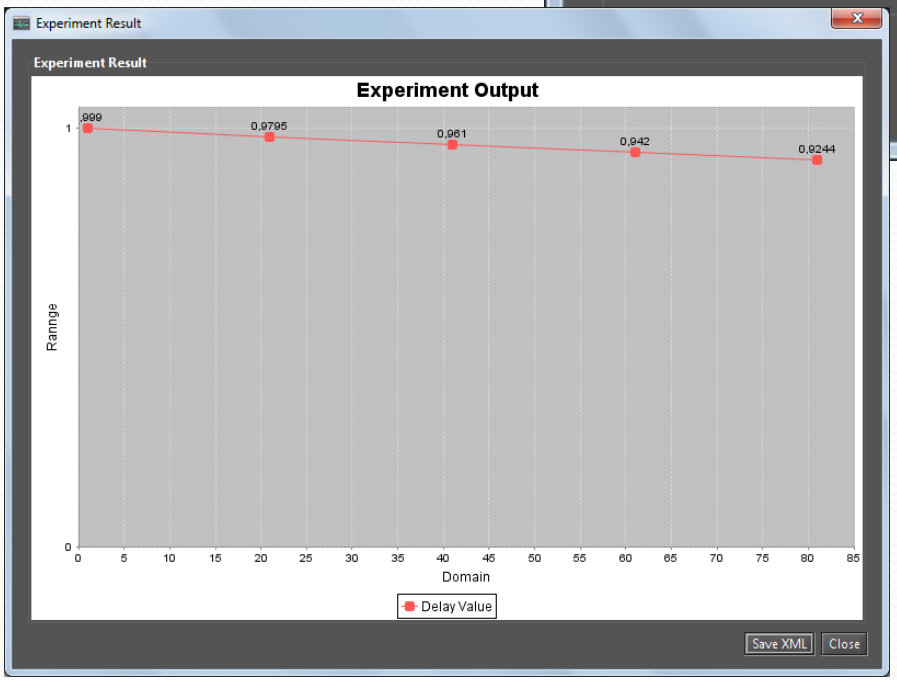
Experiment different scenarios

- Different values of MTTF and MTTR can be associated to components and the user can change these values.

- For instance, the user can evaluate the availability considering different values of MTTF related to Component2

Experiment different scenarios

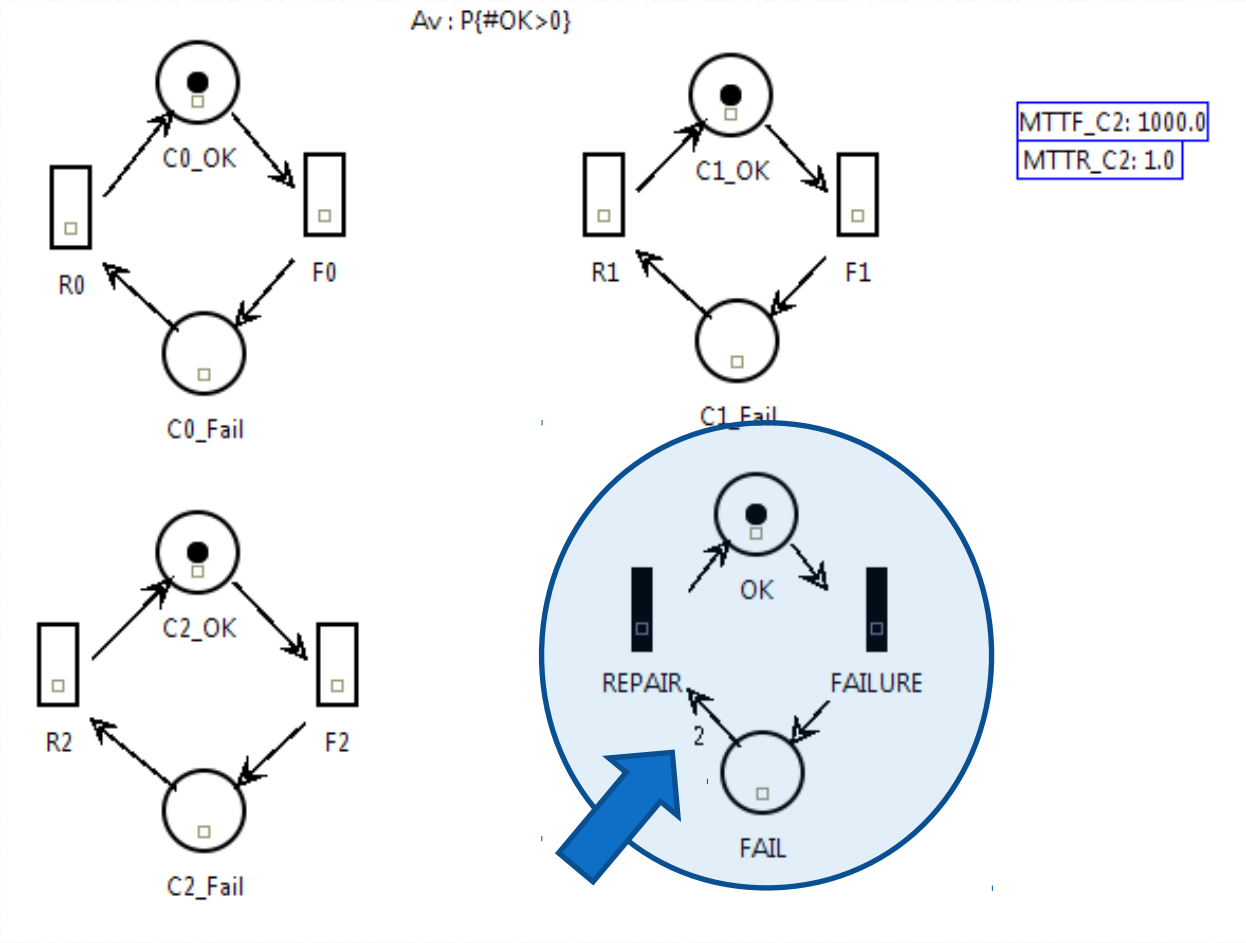




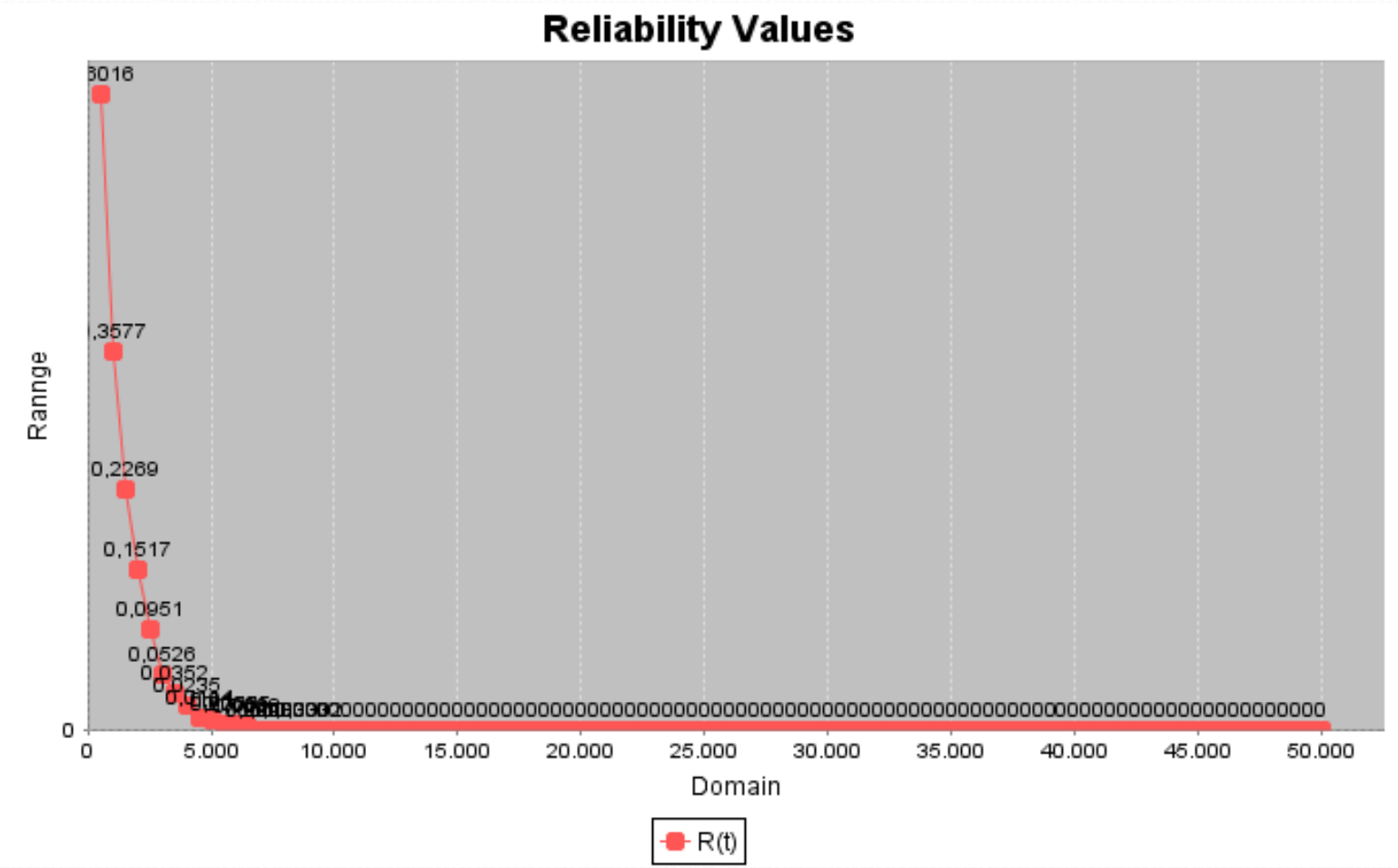
Transient Simulation

- Calculate reliability adopting SPN simulation.
- To calculate reliability, repair activities are not allowed.
- A different SPN model must be considered to adopt Transient Simulation.

Transient Simulation



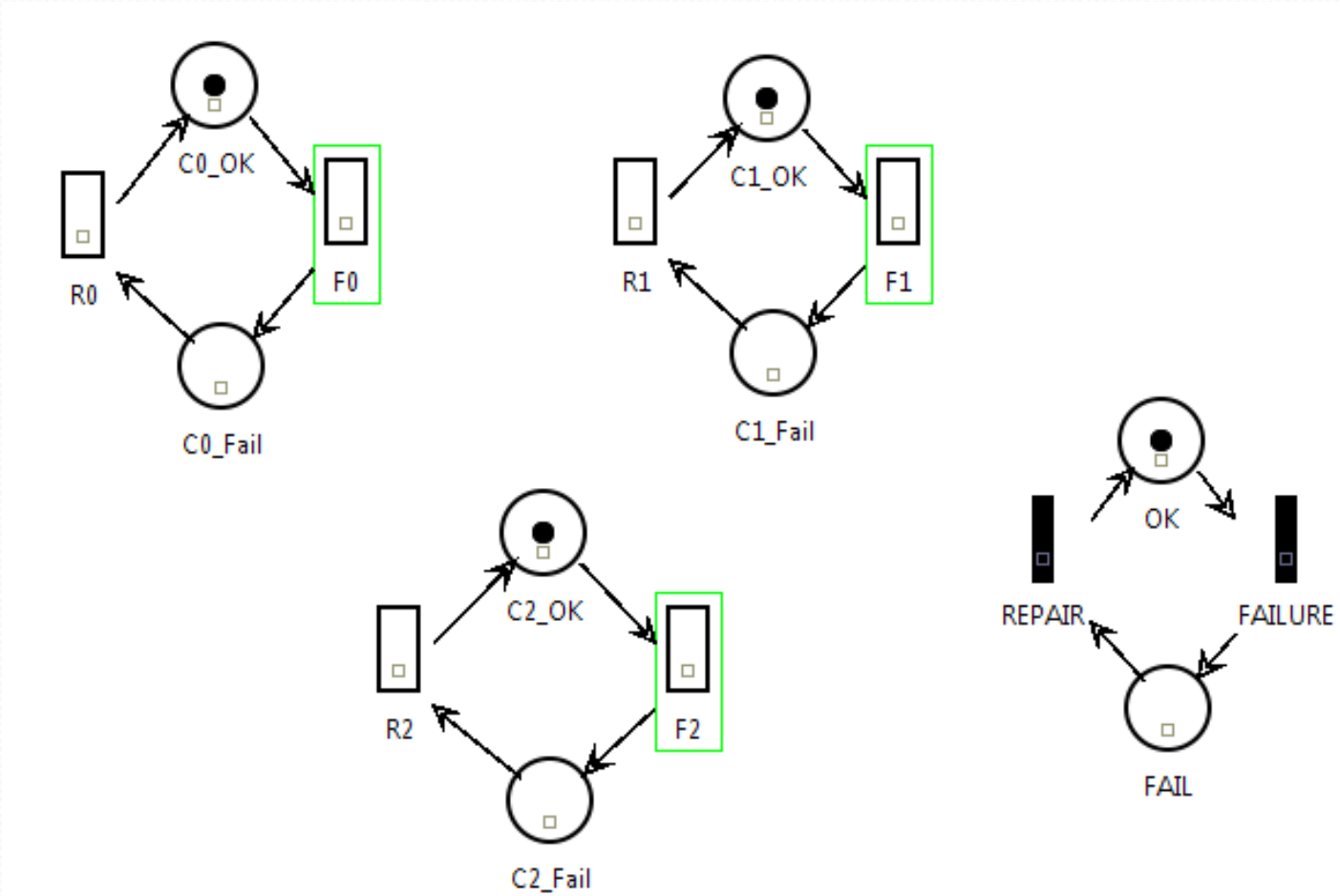
Transient Results



Token Game

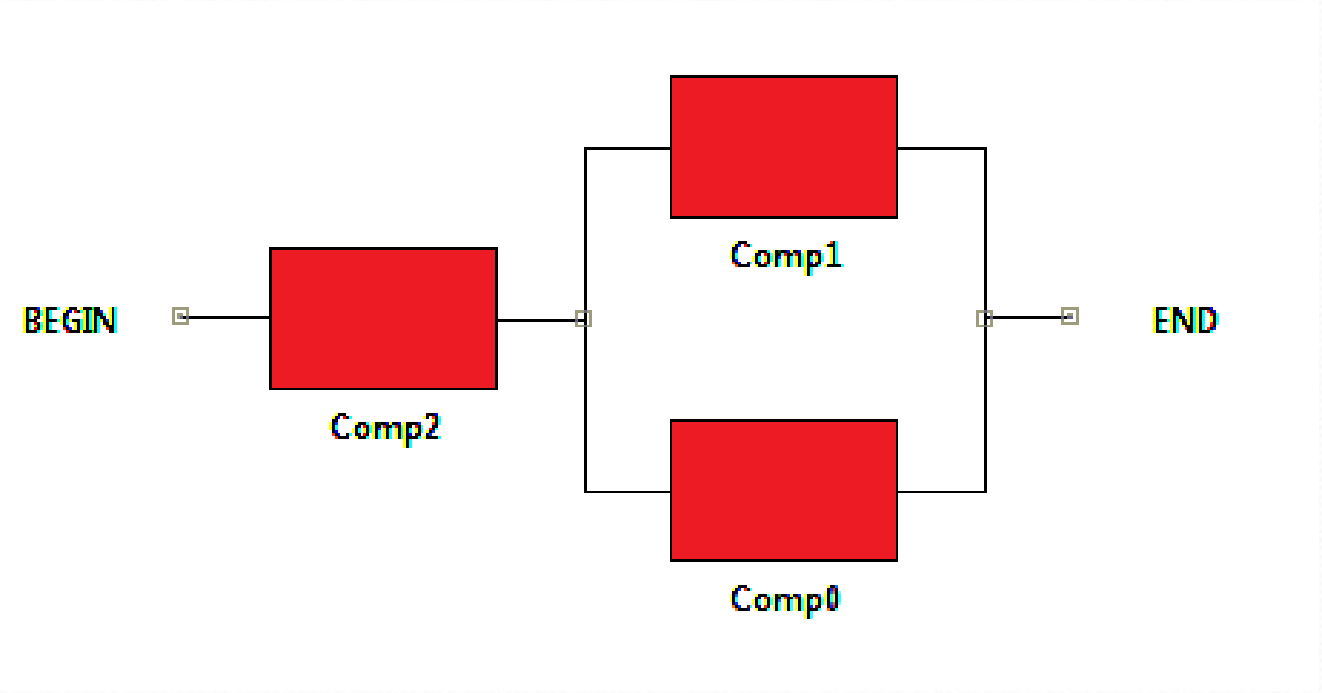
- Feature that allows users simulate/debug the behavior of Petri net model.
- The user runs the model according to the firing rules of SPN.
- Allows the user to analyze different situations, and assess their consequences.

Token Game


C0_OK
R0
F0
C0_Fail
C1_OK
R1
F1
C1_Fail
C2_OK
R2
F2
C2_Fail
OK
REPAIR
FAILURE
FAIL

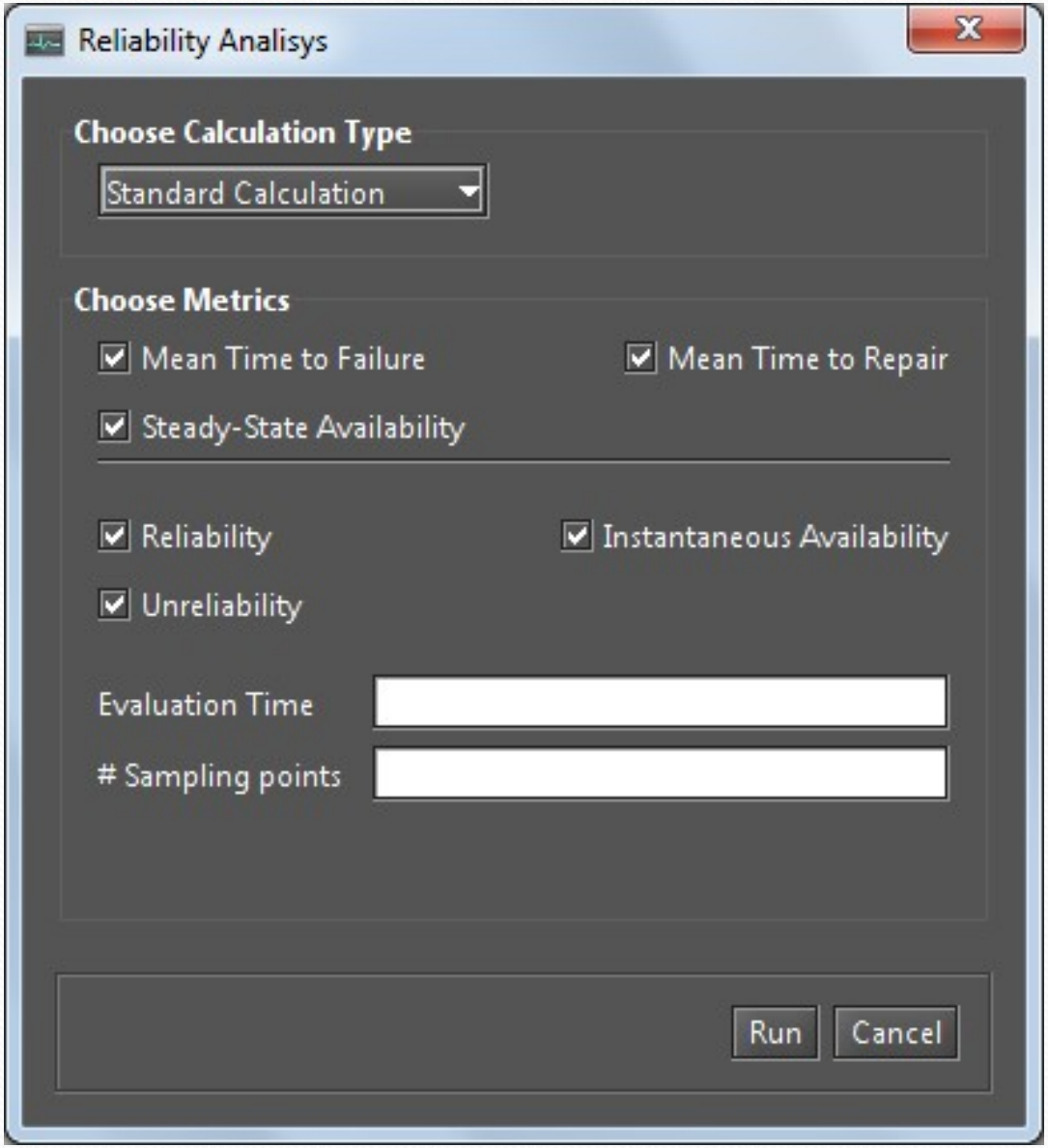
RBD Editor

- Evaluate the model adopting Reliability Block diagram.



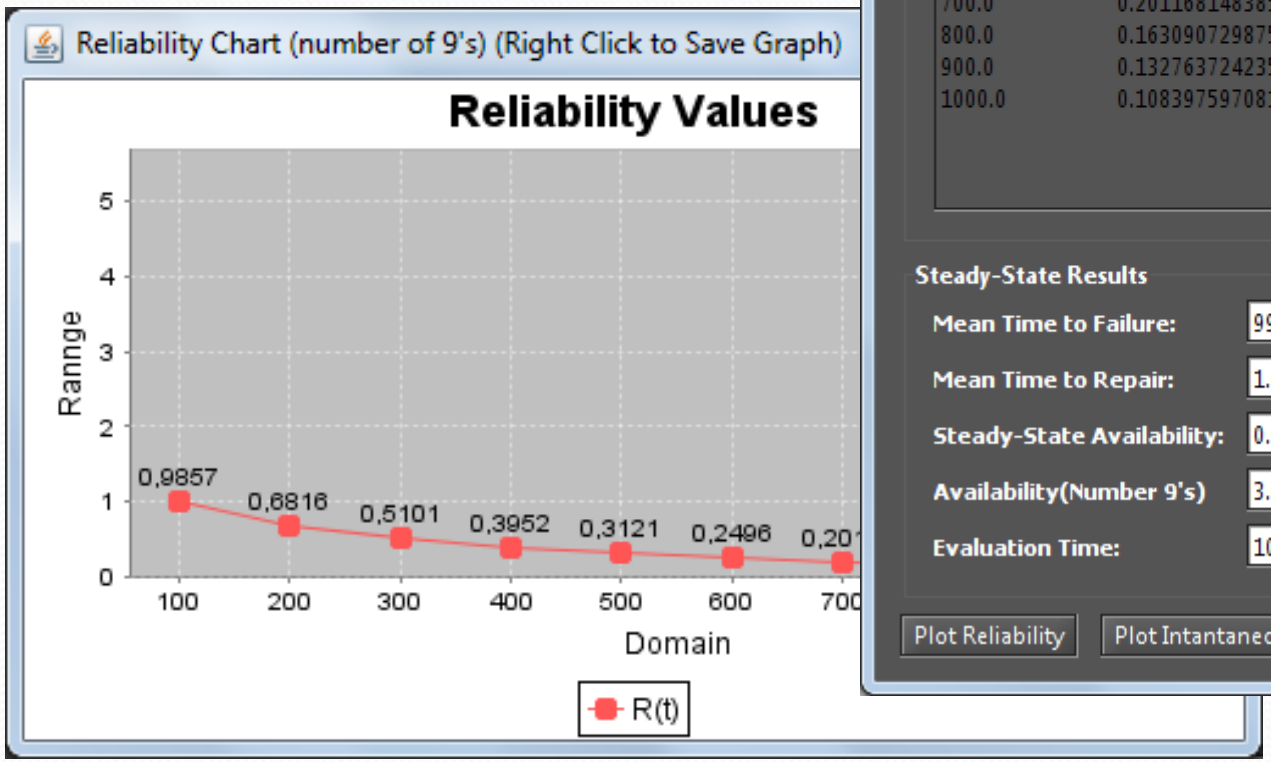
RBD Editor

- Evaluate Model



RBD Editor

- Results



Textual Result

```
********** RBD Results **********
MTTF:          999.0009990009991
MTTR:          1.0
Availability:  0.9990000019950092
Nines:         3.000000866422302

TIME          Reliability(9's)              Availability(9's)
100.0         0.9856613043607321            3.000000866422302
200.0         0.6815786365858836            3.000000866422302
300.0         0.5101168785370143            3.000000866422302
400.0         0.39519496724436887           3.000000866422302
500.0         0.31214006862300936           3.000000866422302
600.0         0.24956067781393076           3.000000866422302
700.0         0.2011681483855754            3.000000866422302
800.0         0.16309072987532214           3.000000866422302
900.0         0.13276372423583016           3.000000866422302
1000.0        0.10839759708103647           3.000000866422302
```

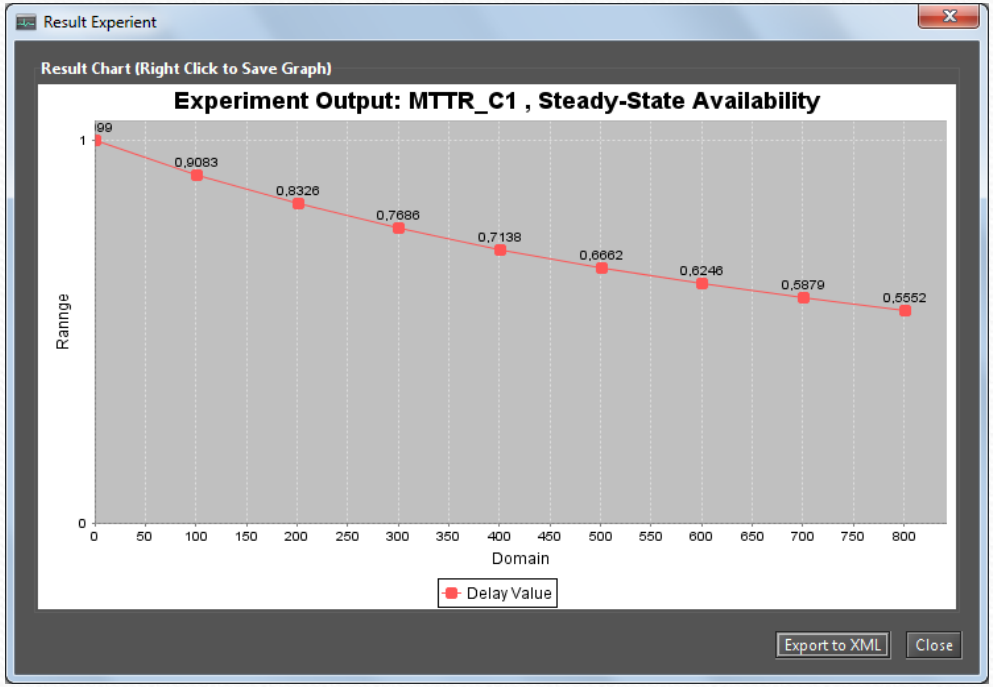
Steady-State Results

Mean Time to Failure:	999.0009990009991
Mean Time to Repair:	1.0
Steady-State Availability:	0.9990000019950092
Availability(Number 9's)	3.000000866422302
Evaluation Time:	1000.0

Plot Reliability | Plot Intantaneous Availability | Export to XML | Close

RBD Editor – Expirement

- Experiment different scenarios also is included in the RBD editor.
- The user associate a label to MTTF/R and experiment the model.

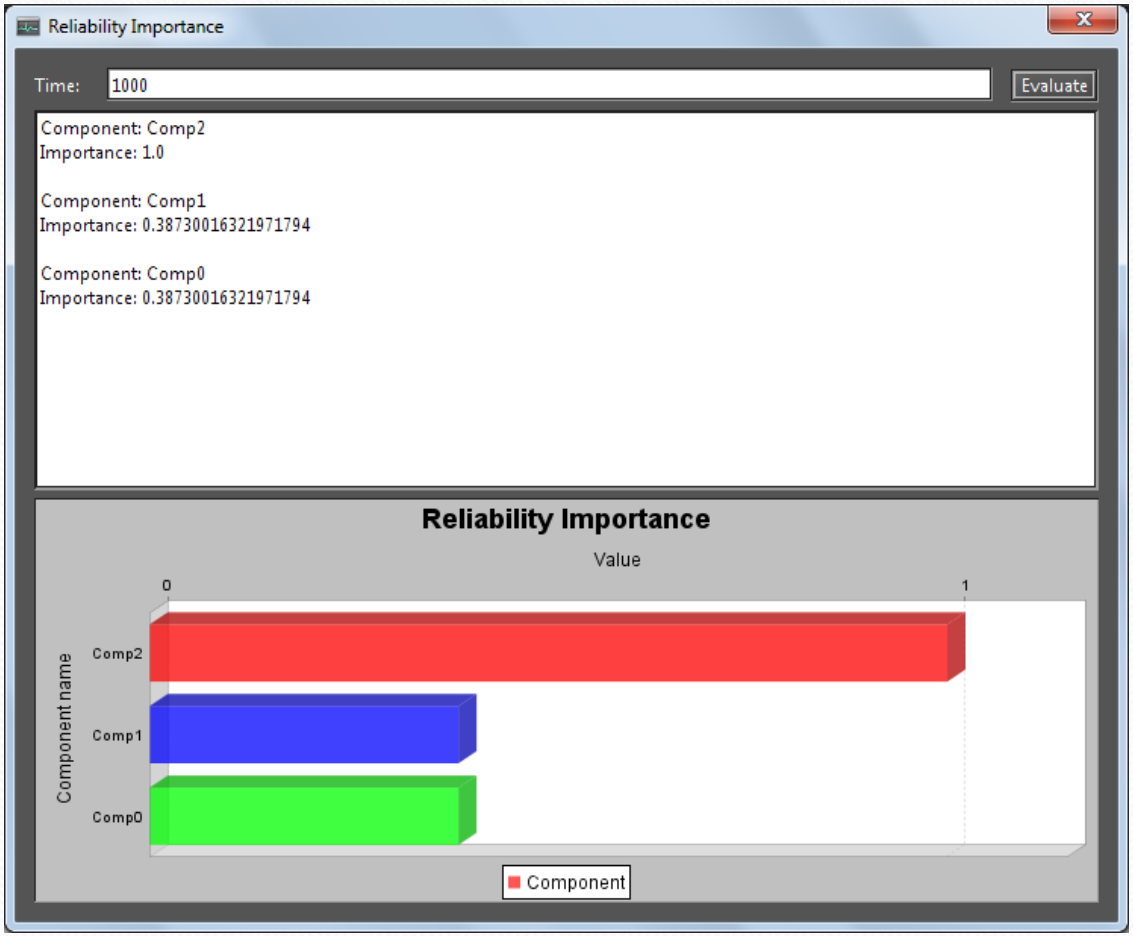


RBD – Reliability Importance

- Reliability importance measures is one method of identifying the relative importance of each component in a system.
- One graph is presented to show the most importants components in terms of reliability.
- Depends
  - Time
  - Structure
  - MTTF/R

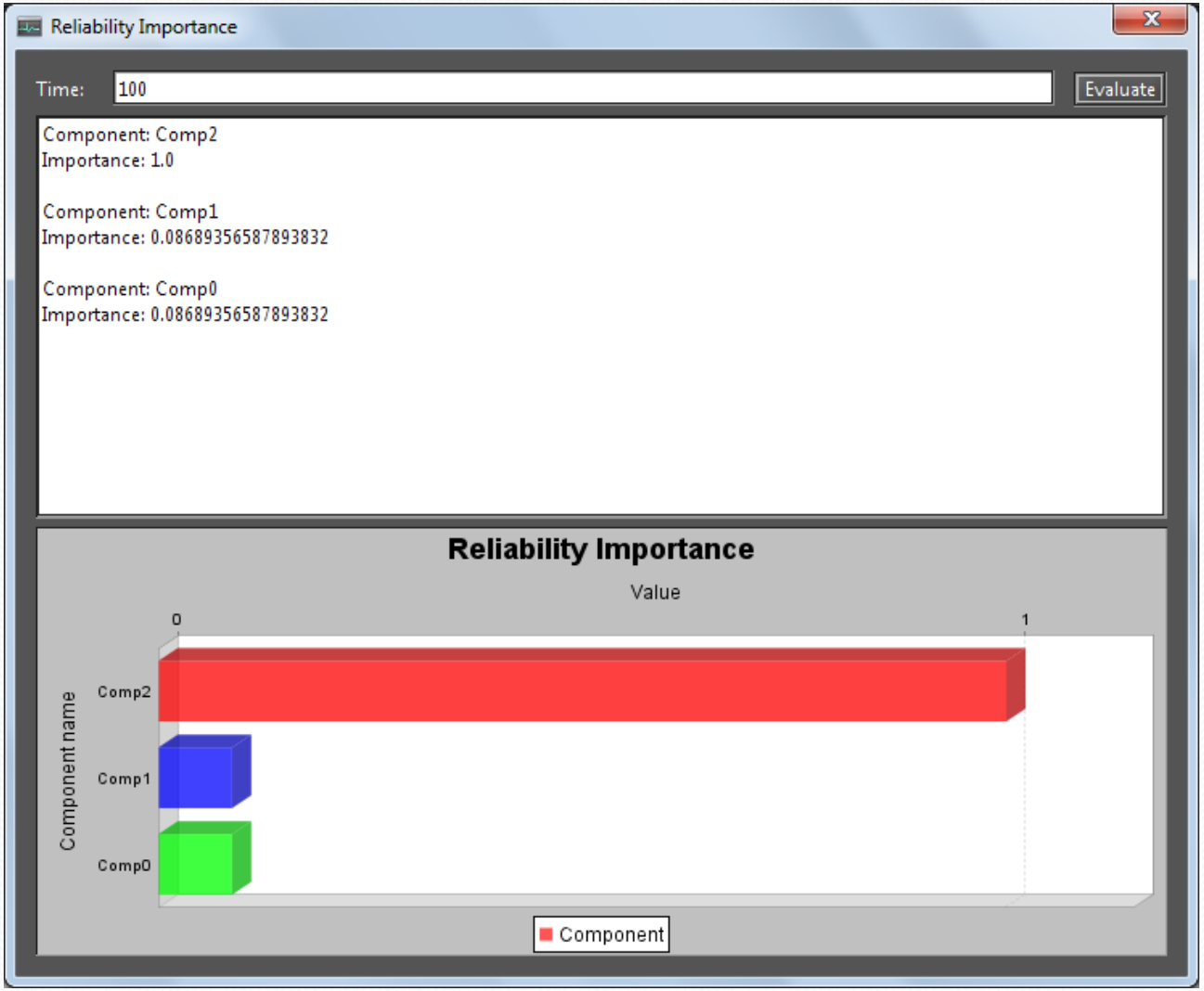
RBD – Reliability Importance

- 1000 hours



RBD – Reliability Importance

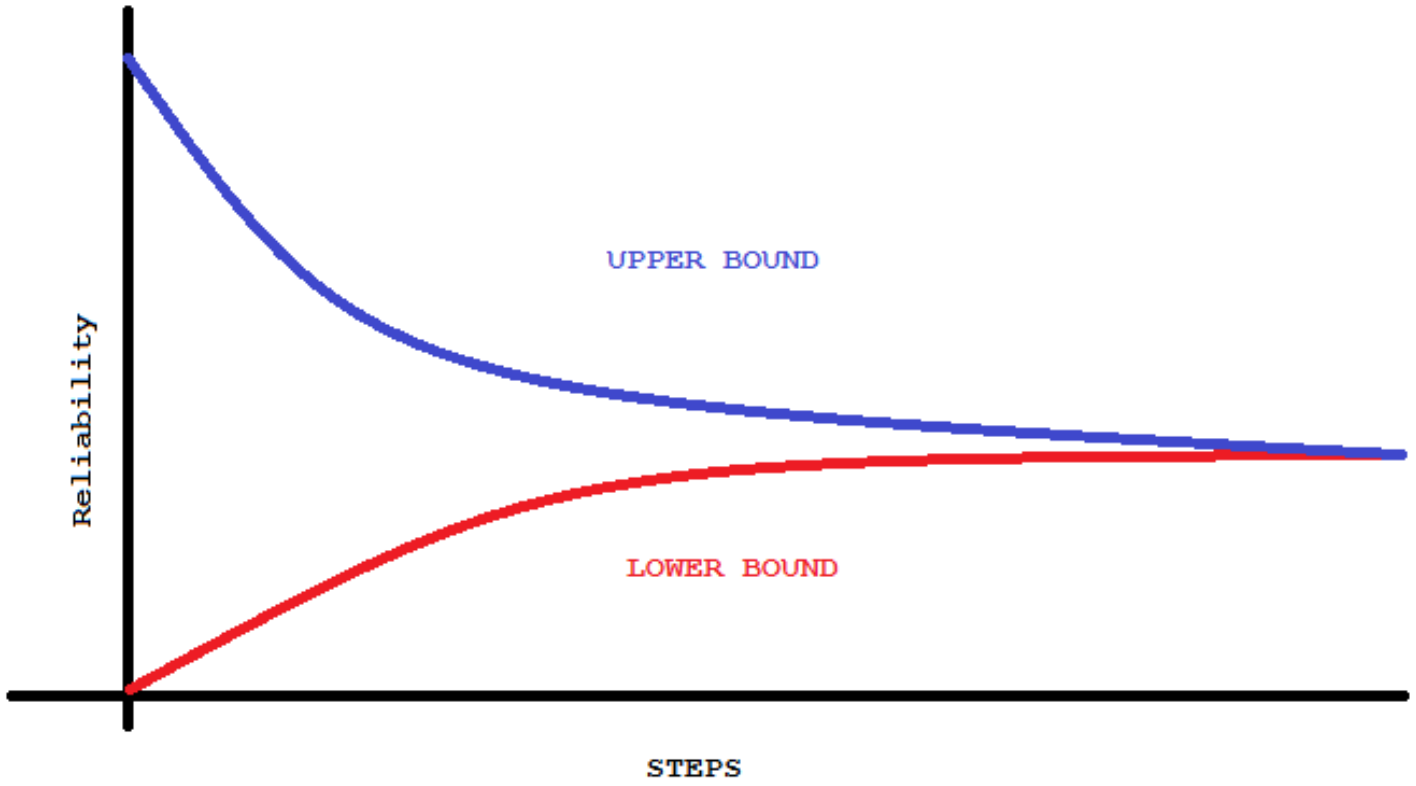
- 100 hours



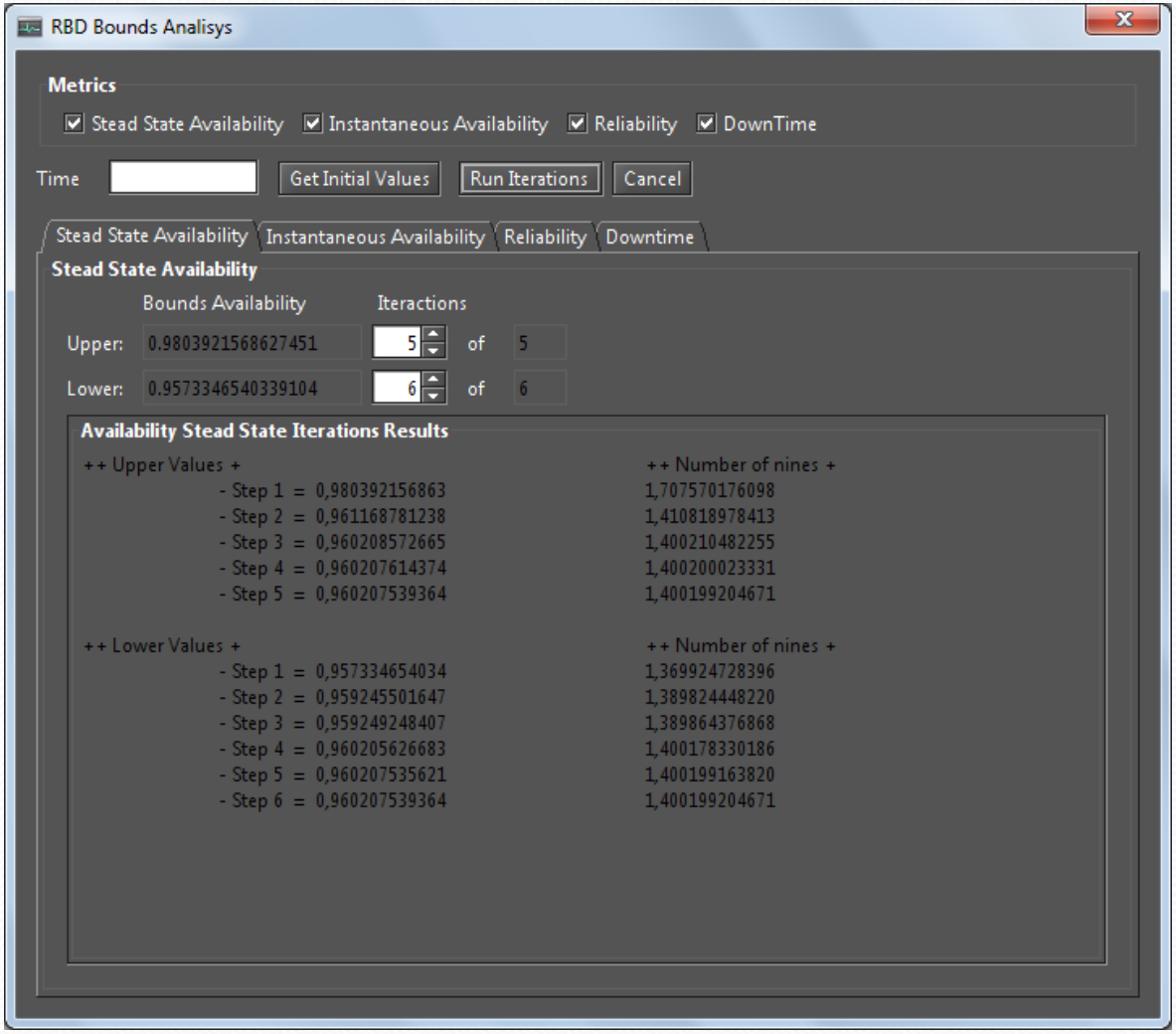
RBD Bounds Evaluation

- Adopted to evaluate large systems.
- Calculate the Upper and Lower bounds of RBD model
- The accuracy is selectable by the user.

RBD Bounds Evaluation



RBD Bounds Evaluation



MERCURY

- High Level Editors can be included in Mercury and these models can be translated to SPN/RBD.