Quick Tour



VERSION 2025

ReliaSoft

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Quick Tour of BlockSim

BlockSim supports a wide variety of system reliability, availability and related analyses using **reliability block diagrams (RBDs)**, **fault trees (FTA)** and/or **Markov analysis**. It's also packed with tools for related analyses, such as reliability allocation, optimum replacement and inspection, reliability importance measures and throughput analysis. In addition, BlockSim's **event analysis flowcharts** use Monte Carlo simulation to model and analyze even the most complex probabilistic or deterministic scenarios.

You can use this application to answer a wide variety of questions, such as:

- What is the expected reliability of the system? What are the most critical components? What component reliabilities are required to meet the system reliability goal?
- What is the expected availability (uptime) or throughput? Where are the critical components or bottlenecks? What changes are needed to meet the operational goals?
- What is the optimum maintenance strategy? When is the best time for scheduled maintenance? How many spares should we keep on hand? Is crew capacity sufficient?
- How much will it cost to operate the system? How will a change in the design or operating conditions affect costs? Which components are the most costly?
- What is the risk of catastrophic failure? Which components or failure modes pose the greatest risk? How will a change in the design or operating conditions affect safety?
- How does the system perform across different operational phases?
- What is the effect of variability on performance? How will the outcome be affected by changes in specific inputs? What are the probabilities of different possible outcomes?



Using Databases and Projects

File Menu

Use commands on the File menu (New, Recent or Open Database) to create or open a database.

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

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



Project List

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

If you have a lot of projects:

- Use the **project filter** to limit what's displayed.
- Use the project category to group projects within the list.



Current Project Explorer

Use the current project explorer to create or open analyses and reports.

You can open the same project in any ReliaSoft desktop application. Analyses and reports are visible only in the application(s) that can edit them:

- Life data folios are visible only in Weibull++
- Fault trees are visible only in BlockSim
- FMEAs are visible only in XFMEA/RCM++
- Etc.

Common features such as **resources** and **project attachments** are visible in all ReliaSoft desktop applications.

Using Fault Trees

BlockSim's fault trees can be configured as analytical diagrams (which use the exact mathematical solution for the system model but impose limitations on what can be modeled and what results can be obtained) or simulation diagrams (which provide more modeling options and results but must be analyzed with discrete event simulation).

Fault trees and reliability block diagrams (RBDs) can be used together in the same analysis (e.g., a subdiagram block in a fault tree can point to an RBD and vice versa).

The basic steps for using an analytical fault tree are:

1. Add fault tree diagram

Right-click the Fault Trees folder in the current project explorer and choose Add Analytical Fault Tree.



2. Add gates

Right-click inside the diagram and choose the type of gate to add.



3. Add events

Right-click a gate and choose **Fault Tree > Add Event > [Type of Event]**. When a gate is selected, the event will be added below the gate, already connected.



4. Connect blocks (if applicable)

If you need to create a new connection, hold down the **ALT** key, click the source block and drag a line to the destination block.



5. Set block properties

To edit a block's properties, right-click it and choose **Block Properties**. For gate blocks, you can change the name and identifiers. For event blocks, specify any operational and cost properties and use *universal reliability definitions* (URDs) to specify the reliability properties.

- To select an existing URD, click inside the URD field.
- To create a new URD, click inside the **Model Reliability** field and follow the wizard. You can create a new model (left) or select an existing model (right). Existing models may have been manually created, or may have been published from other analyses in BlockSim, Weibull++ or Lambda Predict.

Universal Reliability Defi	nition (URD)		Universal Reliability Defi	nition (URD)
🖃 🚮 URD	Default		🖃 🚮 URD	Default
Model - Failure	Default - Cannot Fail	-	🗛 Model - Failure	Default - Cannot Fail 🗸
	Model 🛃 🄁 🏷			Model
	Model Name: [Default]			Filter 🛃
	2P-Weibull 👻 🚬	1		🔛 Weibull_ComponentA_Data1 [WB2 (2.53, 5
	Data 15			🔛 Weibull_ComponentB_Data1 [WB2 (3.37, 5
	Beta			🔛 Weibull_ComponentC_Data1 [WB2 (2.53, 4
	Eta 1000			🔛 Weibull_ComponentD_Data1 [WB2 (2.1, 59
				🔛 Weibull_ComponentE_Data1 [WB2 (2.38, 6
				🔛 Weibull_ComponentF_Data1 [WB2 (1.7, 52)
	Unit Hour (hr) -			< >>
┖┯┙	OK Cancel	}	└──	OK Cancel
		: Ll		

6. Analyze the diagram

Click the Analyze icon on the control panel.

To view the calculated reliability or unreliability at a specific time for each block, select **Show Results** on the control panel and specify the time. To view the algebraic equations for the system reliability, *pdf* and failure rate, click the **Results valid as of** field on the control panel. Note that starting in Version 2022, you have a choice of analysis methods for analytical fault trees; algebraic equations are available only for the Equation analysis type, not for the new Binary Decision Diagram analysis types.

βη σμ

Analytical		
Results valid as of		
9/8/2021 1:05:58 PM (Equation)		— View system equations
Not Fitted		
Show Results	1]
Reliability		
Unreliability		- View block results
Time (Hour)		within diagram
1	G	
		4

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Cut	Сору	Paste	Print Preview	Print	Add Equation to Attachments	Refresh			
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QCP ↓ □

7. Calculate metrics

Click the **QCP** icon on the control panel to open the Quick Calculation Pad.

D QCP		P ×
R(t=100) hr)	0.790717
Reliability	hr Units -	No Bounds Captions On Bounds Options
Calculate		Input
Probability	Reliability = Prob. of Failure	Mission End Time (hr) 100
	Cond. Reliability Cond. Prob. of Failure	
Life	Reliable Life	
	Mean Life	
Rate	Failure Rate	
		Calculate
		Close

8. View plots

Click the **Plot** icon on the control panel to open the plot sheet.



Using Simulation RBDs

A reliability block diagram (RBD) is a graphical representation of how the components of a system are reliability-wise connected. BlockSim's RBDs can be configured as analytical diagrams (which use the exact algebraic equation for the system model but impose limitations on what can be modeled and what results can be obtained) or simulation diagrams (which provide more modeling options and results but must be analyzed with discrete event simulation).

The basic steps for using a simulation RBD are:

1. Add diagram

Right-click the RBDs folder in the current project explorer and choose Add Simulation RBD.



2. Add blocks

Right-click inside the diagram and choose the type of block to add.



3. Connect blocks

Hold down the ALT key, click the source block and drag a line to the destination block.



4. Set block properties

To edit a block's properties, right-click it and choose **Block Properties**. Use a *universal reliability definition* (URD) to specify the reliability properties.

- To select an existing URD, click inside the URD field.
- To create a new URD, click inside the **Model Reliability** field and follow the wizard. You can create a new model (left) or select an existing model (right). Existing models may have been manually created, or may have been published from other analyses in BlockSim, Weibull++ or Lambda Predict.



5. Simulate the diagram

Click the **Simulate** icon on the control panel.

Specify the simulation settings and click Simulate.

(Maintainability/Availability Simulation	?	×
A = 92.812705%		
Seed Value 1 Current Sep 03 - 03:46:41 ETC Sep 03 - 03:46:43 Convergence 0.00775162084644776 Resolution 0.01000	of 1000	
Comparative Options Advanced Options Display Options	tions	•
Point Results Every 10 Hour (hr)	•
Number of Simulations		
Number of Simulations 1000		
Analysis Settings Simulate Details	Close	

6. View the simulation results

From within the Maintainability/Availability Simulation window, click **Details**. If you have closed the window, click the **Results valid as of** field on the control panel.

	Simulation	>
	RBD - Simulation	
S	Simulation	
1	Results valid as of	
QCP	9/3/2019 3:46:41 PM	
	Distribution fit	
=24	Not Fitted	

๎฿						Simulation Resu	ults E	xplorer				×	¢
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Paste	📄 Paste Special	Q	Show Expa Block Na	inded me	i IIII Fre	eeze Heading Rows		f_{z}^{h} Full Report	🚡 Send R	GA Results to RGA		Unit	
	Clipboard				Vie	w			Sheet				
	General Summary							A		В		С	
= 📻 :	System			1				System Overview					٠
	System Overview			2	General								
	System Point Resu	lts		3				Mean Availability (A	Il Events):	0.9281			
	System Costs			4			S	td Deviation (Mean Av	/ailability):	0.0778			
-7	a System Costs			5		Mean Av	ailab	ility (w/o PM, OC & In	spection):	0.9281			
± 🔛	Blocks			6		Poir	nt Ava	ailability (All Events) a	t 1000 hr:	0.899			
🗎 🗉	Crews			7				Reliability a	it 1000 hr:	0.161			
🕀 🎬 🗄	Spare Part Pools			8				Up	time (hr):	928.1271			
• 🕋	Simulation			9				Total Dowr	ntime (hr):	71.8729			
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				10	4 6 641	Evotom Ovorview			: A	57.2020		•	1
L				144		System Overview	+		: 4				
Diagran	11												

7. Calculate metrics

Click the **QCP** icon on the control panel to open the Quick Calculation Pad.



QCP Diagram1			e ×
Am(t=1	000)	0	.928127
Mean Availability	hr	No Bounds	Captions On
	Units -	Bounds -	Options -
Calculate		Input	
	Point Availability	Mission End Time (hr) 1000
	Point Unavailability		
Probability	Point Reliability		
Probability	Point Prob. of Failure		
	Mean Availability 💻		
	Mean Unavailability		
	Time For Availability		
Time	Time For Reliability		Report
Life	MTTFF	Calculate	Details

8. View plots

Click the **Plot** icon on the control panel to open the plot sheet.





Using Event Analysis Flowcharts

Event analysis flowcharts (formerly RENO flowcharts) are used to build models of probabilistic or deterministic problems, processes or scenarios in order to help you understand and/or quantify them. The flowchart is a graphical representation of the mathematical process of predicting an outcome.

The example that follows demonstrates some of the basic techniques used in working with event analysis flowcharts. This simple flowchart generates failure times for 10 items.

1. Add diagram

Right-click the Event Analysis Flowcharts folder in the current project explorer and choose Add Event Analysis Flowchart.



- 2. Define resources
 - a. Create a variable

This resource will control the number of items to generate failure times for.

Choose Home > ReliaSoft > Resource Manager.



🐵 🕒		Ŧ		Resource M	anager (Pr	oject: Project 1)				×
Home	Administ	ration								^
Show All	Show Only Unused	Show Only Duplicates Display		Show Local Show Global Show Reference	Add	Batch Add	Delete	Trace Usage	Make G	obal
Show All									- +	×Ν
📑 Res	ources			Variable Name	Value	When to Reset	Comm	ents	Catego	y
P Variat	bles		٣	RBC	RBC	ROC	RBC		RBC	
Mode	ls									
📑 Corre	ctive Tasks									
🚼 Scheo	duled Tasks	*								
📑 Reso	ources									
Sele	ct Columns									
Variables	Show Loca	Resources	All							:

In the Resource Manager, choose **Variables** and then choose **Home > Edit > Add**.

Define the variable properties.

🤒 Variable		?	×
Variable Name			
Number_of_Items			
Initial Value			
0			
Event Analysis Flowchart Simulation Only			
When to Reset			
Reset After Analysis			•
Category			
No Category			•
Comments			
			*
C	ж	Cance	2
(Creating	new varia	ble

b. Create a model

This resource will define the model used to generate the failure times.

In the Resource Manager, choose **Models** and then choose **Home > Edit > Add**. Define the model properties.

🕸 Model	P	×
Model Name		
Item_Failure_Distribution		
Model Properties		^
🖃 💽 Model Category		
- Category	Reliability	•
🖃 🝂 Model Type		
_ Туре	Distribution	•
🗆 🛕 Distribution	[?	2
Distribution	2P-Weibull	Ŧ
Parameters and Input State	puts	
— Beta	2.3	
— Eta	1750	
Units	Day (day)	▼ ,
	OK Can	cel
	Creating new m	odel

3. Add blocks

a. Add a standard block (to increment the variable)

This block will increment the value of the Number_of_Items variable.

Right-click inside the diagram and choose to add a standard block.



To edit the block's properties, right-click it and choose **Block Properties**.

Properties		
Block (Standard Block)		
Block Name	Item_Count	
🖃 🍡 Block Properties		
— Equation	Number_of_Items+1	
Storage Variable	(Not Set)	
🗉 🧱 Identifiers		
	Shile OK	

Click inside the **Equation** field and type **Number_of_Items + 1**.

Block Properties			×
Properties			^
Block (Standard Block)			
Block Name	Item_Count		
Block Properties			
— Equation	Number_of_Items+1		
🖃 Storage Variable	Number_of_Items	/ -	1
When to Reset	Variable		X
🖃 🧱 Identifiers	Filter		2
Comments Active Block Standard Block - St	Number_of_Items		
	ОК	Cancel	

Click inside the **Storage Variable** field and select the **Number_of_Items** variable.

b. Add a conditional block (i.e., create an IF statement)

This block will determine the simulation path based on whether the item count has reached 10.

Right-click inside the diagram and choose to add a conditional block.

In the block's properties window, specify that if the incoming value is less than or equal to 10, a value of 0 will be passed on the "true" path. Otherwise, a value of 0 will be passed on the "false" path.

If_Item_Count_LE_10		
<=		
10		
0		
0		
aths		
	If_Item_Count_LE_10 <=	If_Item_Count_LE_10 <=

c. Add a standard block (to generate the failure times)

This block will generate a failure time by returning a random value based on the Item_ Failure Distribution model.

In the block's properties window, right-click inside the **Equation** field, choose **Show Function Selector** then choose **Event Analysis Internal Functions** from the drop-down list. Double-click the **rvm** function.

Block Properties		×	
Properties]
Block (Standard Block)			
Block Name G	Generate_Failure_Time		
Block Properties			
- Equation	rvm		rvm
Storage Variable (i	🔍 analyze_markov		Returns a random
🗆 🇱 Identifiers	虱 in		specified model.
Comments	model_fr model_pdf model_prob model_prob		Parameters Model
Active Block Standard Block - Style	runs_cur runs_total		
	S rvm	•	Help on This Function
	Event Analysis Internal Functions	•	→

In the Enter Parameters window that appears, right-click in the **Model** field and open the Function Selector. Double-click the **Item_Failure_Distribution** model.

(B) Enter Paramete	ers	?	×	
rvm Returns a random va	lue based on the specif	ied model	I.	
Model				
_	Item_Failure_Distribu	tion tribution		Item_Failure_Distribution Model
				WB2 (2.3, 1750)
				Help on This Function
	Models		Ŧ	

d. Add a result storage block

This block will store an array of the failure times generated by the standard block.

Right-click inside the diagram and choose to add a result storage block.

In the block's properties window, specify that it will store an array of results.

Block Properties			×
Properties			
🖃 📕 Block (Result Storage)			
Block Name	Array_of_Failure_Times		
Block Properties			
— Store	Array of Results		-
Required Number of Executed Incoming Paths	Average of Results		
Storage Variable	Sum of Results		
Identifiers Ident	Array of Results Minimum of Results Maximum of Results Last Value Normalized Sum of Results		
Active Block Result Storage -	Style OK	Cancel	Ξ.

e. Create a FOR loop

These blocks will form a loop that will cycle through the flowchart until the variable value reaches 10.

Add a flag marker block, a go-to-flag block and a stop flag.

Define the properties.

๎₿>	Block Properties				×
P	operties				
	Block (Flag Marker)				
	Block Name	Loop_Start			
	Block Properties				
	- Execute on Call Only				
	Storage Variable	(Not Set)			
÷	🔚 Identifiers				
Act	ive Block Flag Marker 👻	Style	ОК	Cancel	

Block Properties	C	×
Properties		
🖃 📕 Block (GoTo Flag)		
Block Name	Loop_End	
Block Properties		
- Flag Marker	Loop_Start	-
🗆 🧱 Identifiers	Loop_Start	
Comments		
Active Block GoTo Flag - St	yle OK C	ancel

	Block Properties			×
[Properties			
	🗉 📕 Block (Stop Flag)			
	Block Name	Loop_Exit		
	Block Properties			
	What to Abort	AbortAnalysis		▼
	🛨 🧱 Identifiers			
l	active Block Stop Flag	de OK	Cancel	

4. Connect blocks

Connect the blocks as shown below. To create each connection, hold down the **ALT** key, click the source block and drag a line to the destination block.



The first connector you create from the conditional block will be marked as the "true" path and the second as the "false" path. If necessary, you can switch these designations by rightclicking the connector and choosing **Set to Failure** or **Set to Success** on the shortcut menu.



5. Simulate the flowchart

Click the **Simulate** icon on the control panel.

Specify to run a single simulation with a seed of 1 and click **Simulate**.

Flowchart Simulation	?	×
Idle		
General Settings Sensitivity Analysis Multiple Analyses		
Single Run Simulation Settings Number of Simulations 1 ✓ Use a Seed 1 Advanced Simulation Settings Sensitivity Analysis - Disabled Multiple Analyses - Disabled		
Display Options		
Full Display Minimal Display		
Update Increments 10		_
Y-Axis Auto -100 100		
Display Result Storage Block (Not Set)		•
Close this window when done Simulate Details	Close	

S

6. View the simulation results

From within the Flowchart Simulation Window, click **Details**. If you have closed the window, click the **Results valid as of** field on the diagram control panel.

	Flowchart					
S	Simulation					
12	Results valid as of					
	9/4/2019 9:30:33 AM					
	Show Block Values					
	Show Block Functions					
	Show Connector Priorities					

To view the failure times generated during the simulation, click the result storage block in the navigation panel.

8	🛞 🛅 🕅 - Simulation Results Explorer 🗆 X					×		
Home								•
Paste	☆ Cut ♪ Copy Paste Special	🗐 Quick Print 🕞 Print 😡 Print Preview		Show Expanded Block Name Freeze Block Name Column Freeze Heading Rows	Set Co	Irransfer Rep Fill Report	oort - on to Weib	ull++
Cli	ipboard	Print		View		Sheet		
📄 Gen	neral Summary		-	A		B		
🖃 🚞 Res	ult Storage Blocks	;	1	Block Name: A	Array_	of_Failure_Times		*
- <u>= </u> /	Array_of_Failure_1	Times	2	Flowchart(s) Locatio	on: -	->Event Analysis Fic	wcnarti	_
			2	Buns Stor	pe.	Aildy 1		-
			5	Kuns Stor	eu.	1		_
			6	Result #		Array of Failure	Times	
			7	1		1930.926050	5	
			8	2		2008.575072	2	
			9	3		2546.727662	7	
			10	4		1291.008805	5	
			11	5		647.42902		
			12	6		2164.346878	3	_
			13	7		1562.131953	3	_
			14	8		525.730922		_
			15	9		2397.02994		_
			16	10		1653.12614		
			144	Result Storage Block	Summar	y : ◀		•
Event Anal	lysis Flowchart1							:

7. View plots

Click the **Plot** icon on the diagram control panel to open the plot sheet.



On the plot sheet control panel, choose the plot type, then select the result storage block(s) to show in the plot.

,	Plot >
	Flowchart
, /	Plot Type 🚺 🗖
1	Probability Plot 🔹
?	Units N/A ~
,	✓ Auto Refresh
	✓ Keep Aspect Ratio
Sca	aling
Y	100 🗸
x	70000
Set	ttings
Scale	e e linear e e e e e e e e e e e e e e e e e e
	Available Blocks
	Array_of_Failure_Times (Array)



More Analyses and Tools

Phase Diagrams

Reliability phase diagrams represent scenarios in which a system may undergo changes over time.



Markov Diagrams

Markov diagrams model the behavior of systems based on memoryless transitions between states, allowing you to look at partial or degraded working states, and to start analysis in varying states.



Process Flow Simulation Diagrams

A process flow simulation diagram is used to model a continuous process flow, typically a fluid flow, using a diagram in which the components are connected in flow-wise configuration. The simulation can be used to estimate the amount of raw material consumed by the process, as well as the amount of finished product and waste generated by the process in a given time frame.



Reliability Allocation

The allocation analysis tool helps determine the reliability requirements for individual components/assemblies that would be needed to achieve an overall reliability goal.

0	Allocati	on Ana	alysis1								- 0	×]
	✓ Block Name		Reliability Importance	Current Reliability	Maximum Achievable Reliability	Feasibility	Target Reliability	Equivalent Parallel Units	Comments	Calcul	ations ocation Analysi	> S	
	Subsys		0.980968	0.952914	1	Easy (1)	0.968431	1.130834		Alloc	ation Type	0 -	
	Subsys		0.952914	0.980968	1	Hard (9.9)	0.980968	1.000000		Cost C	Optimized		
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			Block Name	Reliability Importance	Current Reliability	Maximum Achievable Reliability	Feasibility	Target Reliability	Equivalent Parallel Units	Comments	Calculations	n Anal	→ vsis
			Asmbly A	0.998807	0.954052	1	Moderate (5) 0.969342	1.131355		B Allegation Th		<u> </u>
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		<								>	Subsystem A		
		Syst	em Subsyst	tem A Asmb	ly A								

FRED Reports

FRED reports provide a graphical demonstration of the reliability and maintainability/availability characteristics of the components in a system and help to identify the components that may require improvement.



Optimum Replacement

The Optimum Replacement tool helps to determine the best time to inspect and/or replace components, based on the costs for planned and unplanned maintenance.

🐵 🗢	Optimum Replacement												
Cut Delete Edit	Display Diagram Na	me refe	Show Inspection Columns rences	4 Simul	Auto Fill ation Costs Costs	Clear Values	βη σμ Calcula	te Cost vs. Time Plot	Creat 1 pols				
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								800		10920.363780		0.009673	
	F	Rep	placement Cost Per	' Unit 1	fime (hr)).117246							

Simulation Worksheets

Simulation worksheets can vary values that are used when simulating an RBD or a flowchart, allowing you to investigate the effect of various factors on the simulation results (e.g., how the restocking interval and initial quantity in a spare part pool affect the cost of maintaining a system). The values can be entered manually, or can be transferred from an experiment design folio in Weibull++. After simulation, you can transfer the results into the design folio in Weibull++ for analysis and/or optimization.



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