Timeline chart

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Unlike a Time Series chart, a Timeline chart allows you to see the active States of an object or a property during simulation or the Activities simulated in an object. The Timeline plot allows you to see the animation of all active States while a model simulation is running, as well as which objects are active in each State or when a State starts and ends.

Similar to the Time series chart, the Timeline chart also shows the x-axis and y-axis. The x-axis represents time while the y-axis represents object State names in different values. The Timeline chart identifies the changes in the object states and plots them along a timeline. The States are grouped by region. Cameo Simulation Toolkit records changes in the active States and allows you to export them to a CSV or TSV file. You can then import the CSV file into an Excel file to analyze the exported Timeline chart, such as calculating the simulation duration, what object is in a particular State, and how long it was busy or idle.

We use the sample project FlashingLight.mdzip throughout this section to demonstrate how to use the Timeline chart in your model.

Properties of the Timeline chart

The Cameo Simulation Toolkit's Timeline chart can also serve as a predefined subtype of a UI Config. You can use it as a UI mockup of the SimulationConfig element just like an ImageSwitcher. The Specification window of the Timeline chart will be as follows:

Specification of TimelineChart TC_FlashLight × Specification of TimelineChart properties Specify properties of the selected TimelineChart in the properties specification table. Choose the Expert or All options from the Properties drop-down list to see more properties. 🖬 🔁 🔂 💋 TC_FlashLight TC_FlashLight abc Properties: All ⊡<u>r</u>⊂o<u>x</u> 🗈 Usage In Annotate Failures 🗸 true Instances Context Plot false ⊡ Documentation Navigation/Hyperlinks Dynamic false 🗈 Usage in Diagrams Fixed Time Length 20000 Attributes Fixed Time Location Ports Ignored Elements · 🗈 Operations Keep Open After Termination false - 🗈 Signal Receptions Linear Interpolation 🗸 true · 🗈 Behaviors TC_FlashLight Name · 🗈 Template Parameters #BC334E Inner Elements Plot Color · 🗈 Relations Tags Record Plot Data As CSV Constraints Represents System [system] · 🗈 Traceability **Result File** --- 🛅 Language Properties Timeline Mode state Title +button : system::Button [system::Syste Value Hight : system::Light [system::System] +timer : system::timer::Timer [system::Sy Represents Specify the classifier represented by the configuration. Q Type here to filter properties Close Back Forward Help

The properties of Timeline chart in the Specification window.

You can change the Timeline chart's display by modifying its properties, as shown in the following table.

Property	Function
Annotate Failures	To annotate a Requirement and constraint failures as the chart plot area in red (true by default).
Context Plot	To show or hide a context plot.
Dynamic	If true, the chart shows only States or Actions actually used and sorted by occurrence. Otherwise, the list of static Behaviors is shown, and the chart contains information when open.

Title	To specify the title of a Timeline Chart.						
Timeline Mode	To select whether to show the Timeline of a State or an Activity.						
Result File	To specify the file name to be saved from the results in the selected file format specified in the Record Plot Data As property. Otherwise, the results will be saved into model elements.						
Record Plot Data As	To specify the selected format of the file to be saved if Result File is specified.						
Plot Color	To specify a plot color.						
Linear Interpolati on	If true, the plot will connect 2 dots in a non-rectangular line at a time.						
Keep Open After Terminati on	To keep the Timeline chart open after the termination of the simulation.						
Ignored Elements	A list of elements (States, Actions, and Activities) which will be ignored and not displayed in the Timeline chart. This list takes priority over the Value list.						
Fixed Tim e Location	To specify the start time of the time axis in a Timeline chart. If you specify a value for the Fixed Time Length but leave the Fixed Time Location value empty, the Timeline chart will work like an oscilloscope. The plot(s) will move to the left. A fixed time location unit is specified by a time unit tag definition of the Simulation Config. If you do not specify the time unit, Cameo Simulation Toolkit uses the millisecond as the default unit.						
Fixed Time Leng th	To specify a fixed range of the time axis in a Timeline chart in milliseconds. If you specify a value, the time axis range will be fixed to that particular value. If you do not specify the value of the Fixed Time Location, the plot(s) will move to the left if the time range is greater than the maximum value of the time axis. A fixed time length unit is specified by a time unit tag definition of the Simulation Config. If you do not specify the time unit, Cameo Simulation Toolkit uses 20,000 milliseconds as the default unit.						

Using a Timeline chart

To display a Timeline chart

Open the shortcut menu of the Variables pane in the Simulation window.
 Right-click the row of a runtime value you want to show on the Timeline chart and select Show in Timeline Chart > State or Activity. This example uses State.

③ Simulation								
Simulation			a x					
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🖰 Variables 🗙 🛞 See	ssions	\times >>_ Console \times $^{\circ}_{\circ}$ Breakpoints \times						
🕻 🗃 🖀 🛱			Ø -					
Name		Value						
■• 🔜 System [on]		system : System@2e63b7d3						
🔷 button : Button [Release		Expand Recursively						
		Export Value To						
i 🔿 light : Light [off]		Save To Default Value(s)						
		Show in Timeline Chart	State					
		Go To K	Activity					
	æ	Select in Containment Tree Alt+B						
		Create Sequence Diagram						

To use a Timeline chart

- Create a Timeline chart element to represent a Classifier.
 Open its Specification window and click next to the Value property to select the elements/values to be monitored in the Timeline Chart. The Select Nested Properties dialog opens.

X	Select Property		>
	ents tree views. To find an element type text or wildca their qualified names or use camel case when sea		
Q- La Tree Ellist □\$ □\$ □\$ □\$ Ex	14 matches found with filter applied		Selected elements: 3 button : Button [system::Syst timer : Timer [system::System] light : Light [system::System]
Association[light:system]	:Button	+ 2	
☑ Apply Filter (Ctrl+Space) 7	Creation Mode		< >
		OK	Cancel Help

OK 3. Select the values and click The selected values of the Timeline chart appear in the Value tag property of the Specification window.

	S	Specification of Time	elineChart Timeline ×			
	electe		erties specification table. Choose the ee more properties.			
🖬 🔁 🔁 💋	Ti	imeline				
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	E	TimelineChart				
		Name	Timeline			
		Context Plot	🗌 false			
		Timeline Mode	state			
		Fixed Time Length 20000				
		Fixed Time Location	0			
		Title				
			button : Button [system::System]			
		Value	timer : Timer [system::System]			
			light : Light [system::System]			
		Represents				
		Plot Color #BC334	#BC334E			
		'alue tructural feature which is re	presented in timeline chart.			
		C	lose Back Forward Help			

- Double-click Simulation Config Flashlight on the diagram pane to open its Specification window.
 Click I next to the UI property field. The Select UI dialog opens.
- 6. Select the Timeline component and click

to add it to the UI of the Simulation Config.

Select, search for, or create elements Search for an element by using list or tree views. To find an element type I Name" input field. Search elements by their qualified names or use camel ca mode is enabled.	
	Selected elements: 2 LampBulb [simulation::config] PowerButton [simulation::config]

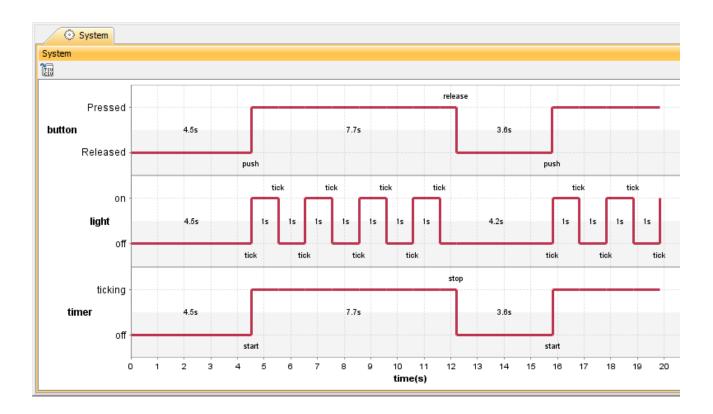
OK

Specification of Simulation Co	onfiguration FlashLight	×
	figuration properties Simulation Configuration in the properties drop-down list to see more properties.	specification table. Choose the Expert
🗉 🗟 🖸 💋	FlashLight	
FlashLight Web Server Properties		Properties: Standard 🗸
🛄 Timing Properties	Simulation Configuration	
	Name	FlashLight
	Execution Target	system : system::System [simulation::instances]
	Auto Start	✓ true
	Silent	false
	Number Of Runs	
	Result Location	
	Animation Speed	
		LampBulb [simulation::config]
	IU	PowerButton [simulation::config]
		Timeline [simulation::config]
	Execution Listeners	
	(Name) (Description)	
		Close Back Forward Help

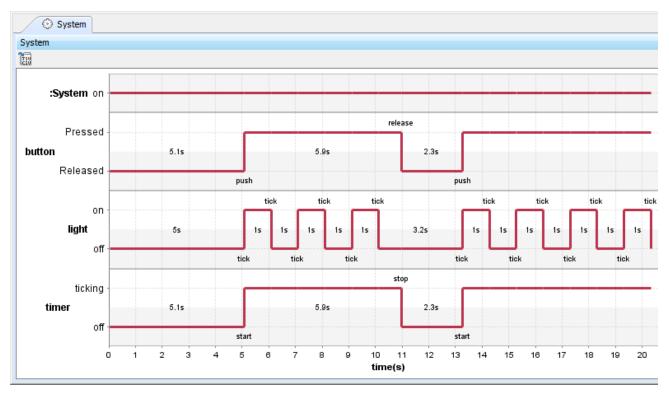
8. Once you specify all of the values, the Simulation Config in the diagram pane shows the Timeline chart along with the values that represent systems.

«SimulationConfig» 🛠	:	«TimelineChart»					
FlashLight		Timeline			:	:	
«Simulation Config»		«TimelineChart»	 	• · · · ·		* • • •	• •
UI =	1	contextPlot = true			:	1	
🔁 LampBulb		fixedTimeLength = 20000	 				
PowerButton		fixedTimeLocation = 0					
Timeline	L	plotColor = "#BC334E"					
autoStart = false		timelineMode = state	 	• • • • •		• • • •	•
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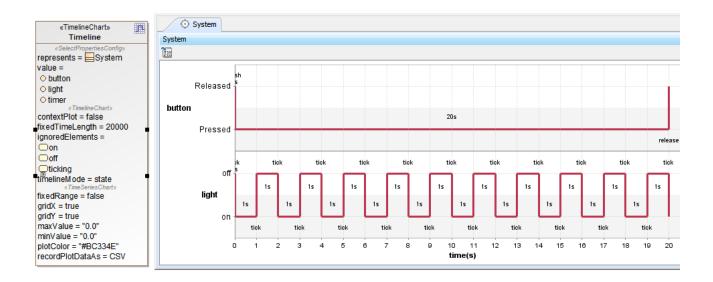
9. Run the Timeline Chart. You can see the animation of the active States in the Timeline Chart when the **Context Plot** option is set to **False** an d **True**. The following figure shows the Timeline chart output when the **Context Plot** option in the Specification window is set to **False**.



The following figure shows the Timeline chart output when the Context Plot option in the Specification window is set to True



10. Optionally, you can specify in the **Ignored Elements** property what State will be ignored and not be recorded in the Timeline chart if the user does not want to see them. The following figure shows the Timeline chart output when the Ignored Elements property is set to ignore the ticking State and the off State of timer, and the on State of system



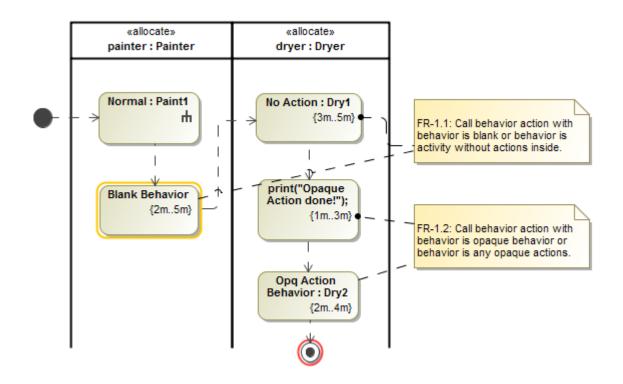
The Ignored Elements property set to ignore the ticking State and the off State of timer, and the on State of system.

Dimetion chart shows only States and Actions which are actually used, e.g., Actions with duration constraints and signaled States. The used elements will be displayed in the chart and sorted in time order.

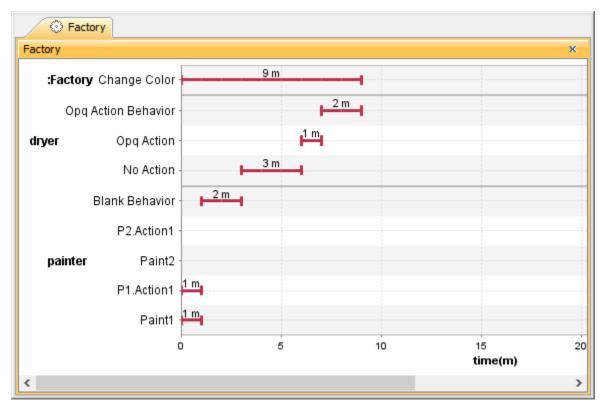
Showing the duration of empty/dummy Actions as duration constraints

To show the duration of empty/dummy Actions as duration constraints

[•] The Timeline Chart can show empty or dummy actions with duration constraints. The dummy action can be either an empty call Behavior Action with no behavior assigned or an Opaque Action with duration constraints, shown in the following example.



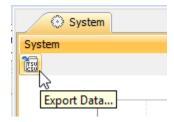
The Timeline Chart shows the Action names on the left-hand side and the duration simulation performed on the Actions (not the Activities) on the righthand side. The same thing applies to an Action that has Behaviors assigned, but it is empty and has no diagram. The following figure shows the Timeline chart of the empty/dummy actions from the above example.



The Timeline chart of the empty/dummy actions.

Exporting a Timeline chart

1. On the Timeline chart pane, e.g., System, click the Export Data button on the Timeline Chart dialog.



2. The Timeline chart will be exported as a CSV format file. The exported Timeline chart in an Excel file is in the figure as follows.

		A	В	С	D
Name,Start time,End time,Duration(s)	1	Name	Start time	End time	Duration(s)
button.Released,0,0,0	2	button.Released	0	0	0
timer.off,0,0,0	3	timer.off	0	0	0
light.off,0,0,0	4	light.off	0	0	0
button.Pressed,0,2,2	5	button.Pressed	0	2	2
timer.ticking,0,2,2	6	timer.ticking	0	2	2
light.on,0,1,1	7	light.on	0	1	1
light.off,1,1,0	8	light.off	1	1	0
light.on,1,2,1	9	light.on	1	2	1
light.off,2,2,0 timer.off,2,2,0	10	light.off	2	2	0
button.Released,2,2,0	11	timer.off	2	2	0
button.Pressed,2,,	12	button.Released	2	2	0
timer.ticking,2,,	13	button.Pressed	2		
light.on,2,2,0		timer.ticking	2		
light.off,2,3,1	15	light.on	2	2	0
light.on,3,4,1	16	light.off	2		1
5 777	17	light.on	3	4	1
	C				
eline chart exported as a CSV format file	Time	line chart export	ed as an E	xcel file	

Representing Time series charts in a Timeline chart

To represent value properties as separated Time series charts in a Timeline chart

1. Open the Specification window of a Timeline chart and click the **Value** tag. Boolean, Enumeration, and Numeric primitive value types, e.g., Number, Real, or Integer, are supported as shown in the following figure.

Specification of TimelineChart Change Color X	Select Nested Properties ×
Specification of TimelineChart properties Specify properties of the selected TimelineChart in the properties specification table. Choose the Expert or All options from the Properties drop-down list to see more properties.	Select Nested Properties Select nested properties in a root dassifier
🗉 🔁 🖉 Change Color	8
Change Color Navigation/Hype	Factory [2.Many Workers] G : 2.Many Workers::time [2.Many Workers::Factory G dryer : 2.Many Workers::Worker [1] [2.Many Work V jobsDoneIn : Integer [2.Many Workers::Factory] U numOfDryers : Integer [2.Many Workers::Factory] U numOfDobs : Integer [2.Many Workers::Factory] D numOfDanters : Integer [2.Many Workers::Factory] D numOfPanters : Integer [2.Many Workers::Worker [1] [2.Many Workers::Factory] D numOfPanters : Integer [2.Many Workers::Worker [1] [2.Many Workers::Factory] D numOfPanters : Integer [2.Many Workers::Worker [1] [2.Many Workers::Worker [1] [2.Many Workers::Worker [1] [2.Many Workers] D numOfPanters : Integer [2.Many Workers::Worker [1] [2.Many Workers] D numOfPanters : Integer [2.Many Workers::Worker [1] [2.Many Workers] D numOfPanters : Integer [2.Many Workers] D numOfPanters : Integer [2.Many Workers] D numOfPanters : Integer [2.Many Workers] D numOfP
C Type here to filter properties	Clear All Select All
Close Back Forward Help	OK Cancel

Selecting numeric primitive value types in Value of a Timeline chart.

2. Run the simulation with the Timeline chart. The selected value properties will be included in the Timeline chart and represented as the Time series chart with fixed height, as separate bars for individual properties as shown in the figure below.

«TimelineChart»	«SimulationConfig»	*				
Change Color	Many Workers	© Factory				
«SelectPropertiesConfig»	« Simulation Config»	Factory	×			
represents = Factory	UI = Change Color autoStart = true	1actory	^			
value = JobsDoneln	autostartActiveObjects = true	183				
contextPlot = true	constraintFailureAsBreakpoin		Allocations			
dynamic = false	decimalPlaces = 4					
fixedTimeLength = 20000	durationSimulationMode = rar	init	in			
timelineMode = activity «TimeSeriesChart»	endTime = 50					
fixedRange = false	executionTarget = 📼 system		m			
gridX = true	fireValueChangeEvent = true initializeReferences = false	main				
gridY = true keepOpenAfterTermination = false	silent = true					
linearInterpolation = true	startTime = 0	> Change Color-1	21.6 min			
		Change Color-1				
Simulation		act	29.8 min			
Simulation	e x	Change Color-2	250100			
🕧 🕤 🗇 🗇 🕲 🕲	8 8 🖬 🖬 🕨 🐧					
		Change Color-3	19.6 min			
😫 Variables 🗙		Change Color-3				
C 2 2	Time: 00 : 29 : 48 , 000 🔅 -		25.8 min			
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	Value					
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jobsDoneIn : Integer 2	19	5 20				
···⊇ numOfDryers : Integer 3	•	6				
······································	+	ula 20 00 00 00 00				
··· V numOfPainters : Integer 4	•	×.				
⊕- 🕑 dryer : Worker [*] [\	Worker@1afae721, Worker					
P painter : Worker [*]	Worker@5edd7c27, Worker		time(min)			
L		L				

The selected jobsDoneIn value property is represented as the Time series chart in form of separated bars in the Timeline chart.

Glossary

Context plot

A Context plot is a Timeline chart property that enables the plot of the context. It appears on top of the chart as a horizontal line.

CSV

A CSV is a comma-separated values file that stores tabular data (text and number) in plain text. Each line in the file is a record and each record consists of one or more fields, separated by commas.

Oscilloscope

A piece of equipment showing oscillations in an electric current as waves on the screen.

• Timeline chart

A Timeline chart is used to describe the Behaviors of both individual Classifiers and Interactions of the Classifiers, focusing attention on the time of events triggering a State change.

TSV

A TSV is a tab-separated values file that stores data in a tabular structure (e.g. database or spreadsheet data). Each line in the file is a record and each record consists of one or more fields, separated by tabs.

Sample model

The models used in the figures on this page are the **FlashingLight** and **OntologicalBehaviorModeling** sample models that come with your modeling tool.

To open the sample, do either of the following

- Download *FlashingLight.mdzip* or *OntologicalBehaviorModeling.mdzip*.
 Find it in the modeling tool *<modeling tool installation directory>*\samples\simulation\.