

webMethods BPM Process Simulation Help

Version 9.6

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This document applies to webMethods Process Simulation Version 9.6 and to all subsequent releases.

Specifications contained herein are subject to change and these changes will be reported in subsequent release notes or new editions.

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About this Guide

This guide contains the *webMethods BPM Process Simulation Help* in PDF book format. The information in this guide is the same information that you can view via the Software AG Designer online help.

Document Conventions

Convention	Description
Bold	Identifies elements on a screen.
Narrowfont	Identifies storage locations for services on webMethods Integration Server, using the convention <i>folder.subfolder:service</i> .
UPPERCASE	Identifies keyboard keys. Keys you must press simultaneously are joined with a plus sign (+).
<i>Italic</i>	Identifies variables for which you must supply values specific to your own situation or environment. Identifies new terms the first time they occur in the text.
Monospace font	Identifies text you must type or messages displayed by the system.
{ }	Indicates a set of choices from which you must choose one. Type only the information inside the curly braces. Do not type the { } symbols.
	Separates two mutually exclusive choices in a syntax line. Type one of these choices. Do not type the symbol.
[]	Indicates one or more options. Type only the information inside the square brackets. Do not type the [] symbols.
...	Indicates that you can type multiple options of the same type. Type only the information. Do not type the ellipsis (...).

Documentation Installation

You can download the product documentation using the Software AG Installer. The documentation is downloaded to a central directory named `_documentation` in the main installation directory (SoftwareAG by default).

Online Information

You can find additional information about Software AG products at the locations listed below.

If you want to...	Go to...
Access the latest version of product documentation.	Software AG Documentation website http://documentation.softwareag.com
Find information about product releases and tools that you can use to resolve problems. See the Knowledge Center to:	Empower Product Support website https://empower.softwareag.com
<ul style="list-style-type: none">■ Read technical articles and papers.■ Download fixes and service packs (9.0 SP1 and earlier).■ Learn about critical alerts. See the Products area to:	
<ul style="list-style-type: none">■ Download products.■ Download certified samples.■ Get information about product availability.■ Access older versions of product documentation.■ Submit feature/enhancement requests.	

If you want to...	Go to...
<ul style="list-style-type: none">■ Access additional articles, demos, and tutorials.■ Obtain technical information, useful resources, and online discussion forums, moderated by Software AG professionals, to help you do more with Software AG technology.■ Use the online discussion forums to exchange best practices and chat with other experts.■ Expand your knowledge about product documentation, code samples, articles, online seminars, and tutorials.■ Link to external websites that discuss open standards and many web technology topics.■ See how other customers are streamlining their operations with technology from Software AG.	<p>Software AG Developer Community for webMethods</p> <p>http://communities.softwareag.com/</p>

1 About Process Simulations

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Simulate a Process

The webMethodsProcess Simulation feature for Software AG Designer provides a mechanism to simulate processes and observe how they run. By simulating a process, or multiple processes, you can save time, energy, and resources that might otherwise be missed on deploying solutions that do not fit your business needs. Simulation provides the opportunity for testing and fine-tuning processes in the design phase, before they ever reach production, or even a test environment.

Simulation enables you to:

- Discover process bottlenecks
- Predict process behavior in multiple scenarios
- Learn about total process cost
- Understand process resource utilization, including consumables and non-consumables
- Compare the behavior (performance, utilization, cost, etc.) of two or more different processes, or of two or more versions of the same process
- Optimize processes
- Determine how processes actually work under real-world conditions

With a greater depth of process knowledge and behavior, you can make informed iterative changes until you reach the desired simulated result, and ultimately deploy the final version of the process to a production environment.

Process simulation requires webMethodsProcess Development, which has its own help file. For general information about working with processes, see "Process Development Help" in *webMethods BPM Process Development Help*.

Process simulation is covered in the following main topics:

- ["About Simulation Information" on page 11](#)
- ["Configure Process Simulation Preferences" on page 13](#)
- ["About Process Simulation Views" on page 15](#)
- ["Work with a Process Simulation" on page 44](#)
- ["Configure a Process Simulation" on page 51](#)
- ["Run a Process Simulation" on page 68](#)
- ["Process Simulation Reporting" on page 69](#)
- ["Process Simulation Recording and Playback" on page 89](#)
- ["Process Simulation Performance Settings" on page 90](#)

About Simulation Information

To successfully simulate a process, you must specify various kinds of information that represent the data and conditions that the process would normally work with when it is implemented in the run-time environment. The more accurately you define this information, the more accurate your simulations will be. You can configure your simulations to use historical data from real processes (where available), and you can also set various preferences that define the behavior of a simulation as it runs.

You can create a simulation directly from an open process, or you can create a new simulation file and then add one or more processes to it.

You can also create a simulation from an imported XPDL process, and you can create a simulation while importing if the XPDL file contains simulation information. For more information, see "Importing XPDL Processes" in *webMethods BPM Process Development Help*, and ["Run a Process Simulation" on page 68](#).

After you have run a simulation, you can generate a simulation report that captures detailed information about the scenario simulated, and whose data allows you to create charts, graphs, and other materials based on the results of the simulation. For more information, see ["Process Simulation Reporting" on page 69](#).

Note: Designer does not extract metadata for simulations. They do not have references or dependencies. You cannot publish or retract simulation metadata.

The simulation information you define is described in the following topics:

- ["About Scenarios" on page 11](#)—describes simulation scenarios and their contents.
- ["About Resources" on page 12](#)—describes the various kinds of simulation resources and their definition.
- ["About Costs" on page 12](#)—describes the various kinds of costs associated with a resources and their definition.

For a general description of the Process Simulation perspective and the views it contains, see ["About the Process Simulation Perspective" on page 14](#).

About Scenarios

To transform your business process to a simulation you must first define a *scenario* of attributes for the process. Setting up your scenario for the process model enables you to create a test case for how a process or set of processes will function with particular constraints.

A scenario is defined by:

- The frequency and the interval of business process instances.
- The length of time each step may be actively processing.
- Any resources that your process may use to execute its steps.

By creating scenarios from existing criteria within your business, you can closely model the behavior, efficiency and results of your process models. Analyzing output from simulations enables you to:

- Increase service level
- Reduce total process cycle time
- Increase throughput
- Reduce waiting time
- Reduce process cost
- Reduce inventory costs

About Resources

A resource can be consumable or non-consumable. Examples of consumable resources are equipment or supplies such as trucks and gasoline. Examples of non-consumable resources would be a salaried employee or a hired consultant.

Resources are defined on a per simulation basis and are available for all processes within a simulation — meaning that a single resource pool is shared by all the processes. This enables a more sophisticated comprehension of resource contention across a set of processes in an enterprise.

Resources are defined by the units allocated for the resource and the units acquired at a particular process step. A consumable resource acquired at a step is used and removed from the set of allocated resources. A non-consumable resource, such as an office clerk, when acquired is not available by other steps until the processing of that step is completed. This means that if you have only one office clerk and the step that requires the clerk is started, the next process instance that arrives at that step will be queued for processing until the first instance requiring the clerk is completed.

About Costs

Resources can also have cost attributes:

- A flat usage cost for any access which is not based on time.
OR
- A fixed cost per time period.
OR
- A variable cost per time period which is associated with non-consumable resources or a variable cost without a time period which is associated with consumable resources.

Some examples of cost types:

- Consumable resource with variable cost

Fuel is an example of a consumable resource with a variable cost. If fuel costs \$3 a gallon, \$3 is its variable cost. Every time a unit (gallon) of fuel is used, a cost of \$3 is applied.

- **Non-consumable resource with variable cost per period**

An employee paid hourly is an example of a non-consumable resource with a variable cost per period. The employee's hourly pay may be defined as a variable cost of \$30 per hour.

- **Non-consumable resource with fixed cost**

A salaried employee is an example of a non-consumable resource with a fixed cost. The employee's annual salary may be defined as fixed cost of \$30,000 yearly.

Configure Process Simulation Preferences

In Designer's Process Simulation Preferences, you can set options for recording animation, automatic switching to the Process Simulation perspective, and the types of gauges displayed during an animated simulation. The Process Simulation control panel provides additional options for viewing a running simulation, in real time or playback mode.

Tip! You can run a simulation with animation and watch, record, and play back the simulation, or you can run the simulation silently and send the results to a report. Some simulations run for a long time, and live animation takes processing power you may want to use elsewhere. Running the simulation in the background and sending the results to a report allows you to continue your work in Designer.

To configure Process Simulation preferences



- 1 In Designer: **Window > Preferences > Software AG > Process Development > Process Simulation**
- 2 You can configure the following Process Simulation preferences:

Preference	Description
Enable animation recording	Check this box to enable Designer to record simulation sessions for playback.
Temp directory	This option is only available when Enable animation recording is enabled. Type or browse to select the temp directory you want Designer to use to store animation recording files. The default path is the parent folder of the currently selected workspace.

Preference	Description
Switch to the Process Simulation Perspective when opening a simulation file	Choose <i>Always</i> , <i>Never</i> , or <i>Prompt</i> . Default is <i>Prompt</i> .
Step Gauge Type	Choose <i>Image Gauge</i> or <i>Bar Chart Gauge</i> . Default is <i>Image Gauge</i> . See “Step Gauges and Statistics” on page 88 .

Note: Whether or not you set Designer to prompt you, automatic perspective switching happens only when you *open* a process or process simulation file. When you switch back and forth between a process and a process simulation file after they have been opened, Designer does not change perspective. This allows you to view a file in a different perspective than its default.

- 3 To apply default preferences on a page, click **Restore Defaults**.
- 4 Do one of the following:
 - Click **Apply** to save your changes and keep the Preferences window open.
 - Click **OK** to save your changes and close the Preferences window.
 - Click **Cancel** to close the Preferences window without saving your changes.

Tip! You can use the  **Forward** and  **Back** buttons in the Preferences window to navigate through Preferences pages you have visited.

About the Process Simulation Perspective


In support of process simulation, Designer provides the Process Simulation perspective, which includes several views that allow you to configure your simulations and interpret their behavior:

- The **Resources** view—contains Resource and Cost information; these are displayed in the Properties view for a selected resource.
- The **Run Settings** view—contains Run Settings and Statistics information.
- The **Advanced Run Settings** view—contains information about Variables, Historical Data, and Optimization. The Optimization page contains additional pages to configure Objective, Decision Variable Limits, Constraints, and Run Options.

For more information about these views, see [“About Process Simulation Views” on page 15](#).

Additional step configuration is supported in the Properties view for various step types. The Schedule, Scenario, Metrics, and Transition Distribution pages allow you the opportunity to finely tune your simulations. See [“Configure a Step Simulation” on page 58](#).

About Process Simulation Views

The  Process Simulation perspective includes functionality that allows simulation of processes, including advanced resource configuration and run settings, animation, statistics, and reporting. It includes the simulation-related Resources view, Run Settings view, Advanced Run Settings view, Statistics view, and Optimize Statistics view. The Run Settings view contains additional pages with settings for Run Settings and Statistics; and the Advanced Run Settings view contains additional pages with settings for Variables, Historical Data, and Optimization.

The Process Simulation perspective and its views are made available when you install the Process Simulation feature.

You can configure Designer preferences to automatically switch to the Process Simulation perspective when you open a simulation file. See [“Configure Process Simulation Preferences” on page 13](#). You can also configure automatic switching to the Process Development perspective when you open a process file. See "Appearance Preferences" in *webMethods BPM Process Development Help*.

Note: Whether or not you set Designer to prompt you, automatic perspective switching happens only when you *open* a process or process simulation file. When you switch back and forth between a process and a simulation file after they have been opened, Designer does not change perspective. This allows you to view a file in a different perspective than its default. The Process Simulation feature is required to view simulation files. See [“About Simulation Information” on page 11](#).


The Process Simulation perspective also contains some views also displayed in the Process Development perspective.

Properties View

The Properties view displays information about the currently selected asset in Designer, including processes, steps, pools, transitions, annotations (notes), and simulation resources. Based on the type of asset selected, the Properties view is organized into pages that allow you to see and configure specific aspects of the asset.

Basic and advanced information pages in the Properties view is included in the Process Debug and Process Simulation perspectives; the Process Development perspective displays advanced properties information only when the Advanced Process Development capability is enabled.




Note: By default, the Advanced Process Development capability is enabled. Designer displays advanced properties in the Properties view, advanced preferences in the Preferences window, and advanced functions on the main toolbar. To see only basic properties, preferences, and functions, you must disable the Advanced Process Development capability preference in **Window > Preferences > General > Capabilities**. See "Capabilities Preferences" in *webMethods BPM Process Development Help*.

If you close the Properties view and want to reopen it, select **Window > Show View >  Properties**.

Outline View


The Outline view is a standard Eclipse view. In Designer, it provides a tree view of the elements in the currently open simulation editor. Use it to locate elements on the canvas. This is especially helpful when the canvas contains many elements. When you select an element in the Outline view, it becomes the selected element on the canvas. As a result, other views that are specific to the selected element, such the Properties view, also display information for the selected element.

If you close the Outline view and want to reopen it, select **Window > Show View >  Outline**.

Use the  Add Process,  Remove Process, and  Refresh Processes buttons to manage the processes in a currently open simulation file.

Navigator View

The Navigator view is a standard Eclipse view that provides a tree view of all the assets in your workspace. You can use the Navigator view to open files for editing or select assets for operations such as exporting. If you are using Team Development, use the Navigator view to share assets in your workspace with other team members. For more information about using the Navigator view or Team Development, see the Eclipse *Workbench User Guide* documentation.





If you close the Navigator view and want to reopen it, select **Window > Show View >  Navigator**.


Note: An alternative to viewing your workspace using the Navigator view is to use the webMethods-provided Solutions view. In the Navigator view, the tree structure lists files that are in your workspace. The Solutions view provides a simpler view that shows only your webMethods assets. In the Solutions view, the tree structure lists only the assets (for example, processes, simulations, tasks, and user interfaces) and not the individual files that make up those assets.

Solutions View

The Solutions view shows webMethods assets in your workspace; that is, it shows processes, simulations, webMethods rules, user tasks, and user interfaces. Assets are grouped by solution, which is a logical grouping you can form to relate the processes,


simulations, webMethods rules, user tasks, and user interfaces that you use for a solution. This allows you to visually comprehend all the assets that make up one of your solutions.

You can adjust and update the Solutions view tree using the  Collapse All and  Refresh buttons on its toolbar. You can also  Import and  Export files in the Solutions view.

If you close the Solutions view and want to reopen it, select **Window > Show View >  Solutions**.


Problems View



The Problems view is a default Eclipse view that displays system-generated errors, warnings, or information associated with a resource. For example, if a receive task in your process does not have a subscription document specified, the error is automatically logged in this view. The Problems view also displays errors and warnings generated by Simulation.

If you close the Problems view and want to reopen it, or if you want to open it in another perspective, go to **Window > Show View >  Problems**.

For more information on Process Development views and perspectives, see “Process Development Help” in *webMethods BPM Process Development Help*.

About the Resources View

The  Resources view is displayed in the Process Simulation perspective. You use the Resources view to configure the resources (consumable and non-consumable) used in simulations.


Select  Add resource to simulation,  Import resources from other simulations, and  Remove resource from simulation to perform these actions.

After you have defined the resources for a simulation, you then configure the steps in the simulation to use them. For more information, see “[Configure a Step Simulation](#)” on [page 58](#).

The Resources view contains a list of all the resources defined for a simulation. By default, resources are named Resource1, Resource2, and so on. You can change the name of a resource by viewing its Properties. You can configure the following properties for a selected resource:

On the Resource page in the Properties view:


Field	Description
Name	Unique resource name. Default is Resource1, Resource2, and so on.
Description	Optional description of the resource.


Field	Description
Available Units	<p>How many units of the resource are available overall. Do one of the following:</p> <ul style="list-style-type: none"> ■ Enter a static numeric value. ■ Click  the browse button to open the Available Units window for the selected resource. You can enter a constant or a variable, or select a distribution: <ul style="list-style-type: none"> ■ Click Constant to enter a static numeric value in the Constant field. This is the same as entering the value in the Available Units field on the Resource page of the Properties view. ■ Click Variable to use historical data or an optimized variable. Enter a Variable Name and a Default Value. Further configuration of variables is available on the Variables page in the Advanced Run Settings view. ■ Click Distribution to select a distribution. You can select from the list and modify the available parameters. <p>After you define your configuration, click Finish.</p>


Note: Extensive descriptions of available distributions are provided in the selection window and in [“Distribution Reference” on page 22](#).

On the Cost page in the Properties view:

Field	Description
Consumable Resource	<p>A consumable resource loses a portion of its units when it is allocated to a step. Select the check box to indicate the resource is consumable. For example, fuel is a consumable resource. An example of a resource that is not consumable is an employee.</p> <p>When you indicate that a resource is consumable, the Fixed Cost option is removed.</p> <hr/> <p>Note: For non-consumable resources, you can set Usage Cost, Fixed Cost, and either Variable Cost per period or Variable Cost without a per period value. For consumable resources, you can set Usage Cost and Variable Cost without a per period value.</p> <hr/>

Field	Description
Usage Cost	<p data-bbox="605 300 1414 436">Usage costs include "flat fee" type charging schemes such as administrative or service call charges. The same cost is applied regardless of the amount of the resource's capacity or the step's processing time. Do one of the following:</p> <ul data-bbox="605 457 1414 1024" style="list-style-type: none"><li data-bbox="605 457 1019 489">■ Enter a static numeric value.<li data-bbox="605 520 1414 636">■ Click  the browse button to open the Usage Cost window for the selected resource. You can enter a constant or a variable, or select a distribution:<ul data-bbox="654 646 1414 1024" style="list-style-type: none"><li data-bbox="654 646 1414 783">■ Click Constant to enter a static numeric value in the Constant field. This is the same as entering the value in the Usage Cost field on the Cost page of the Properties view.<li data-bbox="654 804 1414 940">■ Click Variable to use historical data or an optimized variable. Enter a Variable Name and a Default Value. Further configuration of variables is available on the Variables page in the Advanced Run Settings view.<li data-bbox="654 961 1414 1024">■ Click Distribution to select a distribution. You can select from the list and modify the available parameters. <p data-bbox="605 1045 1230 1077">After you define your configuration, click Finish.</p> <hr/> <p data-bbox="605 1119 1414 1213">Note: Extensive descriptions of available distributions are provided in the selection window and in “Distribution Reference” on page 22.</p> <hr/>

Field	Description
Variable Cost	<p>Variable cost is based only on the amount of the resource's capacity. Do one of the following:</p> <ul style="list-style-type: none"> ■ Enter a static numeric value. ■ Click  the browse button to open the Variable Cost window for the selected resource. You can enter a constant or a variable, or select a distribution: <ul style="list-style-type: none"> ■ Click Constant to enter a static numeric value in the Constant field. This is the same as entering the value in the Variable Cost field on the Cost page of the Properties view. ■ Click Variable to use historical data or an optimized variable. Enter a Variable Name and a Default Value. Further configuration of variables is available on the Variables page in the Advanced Run Settings view. ■ Click Distribution to select a distribution. You can select from the list and modify the available parameters. <p>After you define your configuration, click Finish.</p> <hr/> <p>Note: Extensive descriptions of available distributions are provided in the selection window and in "Distribution Reference" on page 22.</p>
per Period	<p>Optional. When set, variable cost calculation takes into account the amount of the resource's capacity and the time used. Select Milliseconds, Seconds, Minutes, Hours, Days, Weeks, Months, or Years. No default value is set.</p> <hr/> <p>Note: When you indicate that a resource is consumable, the per Period option is removed.</p>

Field	Description
Fixed Cost	<p>A fixed cost is neither variable nor usage-based. Do one of the following:</p> <ul style="list-style-type: none"> ■ Enter a static numeric value. ■ Click  the browse button to open the Fixed Cost window for the selected resource. You can enter a constant or a variable, or select a distribution: <ul style="list-style-type: none"> ■ Click Constant to enter a static numeric value in the Constant field. This is the same as entering the value in the Fixed Cost field on the Cost page of the Properties view. <hr/> <p>Note: When you indicate that a resource is consumable, the Fixed Cost option is removed.</p> <hr/> ■ Click Variable to use historical data or an optimized variable. Enter a Variable Name and a Default Value. Further configuration of variables is available on the Variables page in the Advanced Run Settings view. ■ Click Distribution to select a distribution. You can select from the list and edit the available parameters if you wish. <hr/> <p>Note: Extensive descriptions of available distributions are provided in the selection window and in “Distribution Reference” on page 22.</p> <hr/> <p>When you have defined the configuration you want:</p> <ul style="list-style-type: none"> ■ Click Finish. ■ Select the time basis or cost period frequency of the fixed cost. Options are Weekly, Monthly, Quarterly, Half-Yearly, and Yearly. Default is Quarterly.
Downtime Profile	<p>Select the profile that best describes the hours during which the activities in your simulation will take place:</p> <ul style="list-style-type: none"> ■ No downtime (selected by default). ■ Standard shift (includes a downtime schedule that causes a resource to be available only from 8am-12 noon and 1-5pm, Monday-Friday) ■ Night shift (includes a downtime schedule that causes a resource to be available only from 11pm-3am and 4-8am, Monday-Friday).

If you close the Resources view and want to reopen it, select **Window > Show View >**

 **Resources.**

Distribution Reference

When you specify simulation resource distributions in the Properties view of a resource in the Resource view, and when you configure simulation step scenarios in the Properties view, you are presented with a list of distribution types. The following distribution types are available:

Note: The descriptions below are also displayed in Designer.

Distribution	Description
Constant	A static numeric value.
Poisson	The Poisson distribution (discrete) with mean = m is the distribution of the number of customers that arrive to some system in any time interval of length 1 when the interarrival times have an exponential distribution (continuous) with mean = $1/m$. Mean must be greater than 0.0.
Exponential	The exponential distribution (continuous) is commonly used to model interarrival times of customers to some system when the arrival rate is approximately constant over the time period of interest. It is also sometimes used to model the time to failure of a piece of equipment. The mean of an exponential distribution is a scale parameter and must be greater than 0.0. An exponential distribution with mean = m is a gamma distribution with mean = m and shape = 1. An exponential distribution with mean = m is a Weibull distribution with shape = 1 and scale = m . If interarrival times of customers have an exponential distribution with mean = m , then the number of arrivals in any time interval of length t has a Poisson distribution (discrete) with mean = t/m .
Normal (non-negative)	This distribution is similar to the classical normal distribution, but if a negative value is generated, it is rejected and new values are generated until a non-negative value is generated. In general, this distribution will not be a good model for the time required to perform some task, since task-time distributions are almost always skewed to the right.

Distribution	Description
Normal (unbounded)	This is the classical normal distribution, which is found in most statistics books. It takes on real values between minus infinity and plus infinity. The density function is the familiar "bell-shaped" curve, which is symmetric about the mean. The probability that a value is between the mean minus 2 standard deviations and the mean plus two standard deviations is approximately 0.95. This distribution should not be used to model the time required to perform some task, since the normal distribution can take on negative values. Furthermore, as stated above, the distribution of the time to perform some task is almost always skewed to the right, rather than being symmetric.
Lognormal	The lognormal distribution could be used to model the time required to perform some task when "large" values sometimes occur. It is always skewed to the right and it has a longer right tail than the gamma or Weibull distributions. The lognormal distribution is closely related to the classical normal distribution - see the book <i>Simulation Modeling and Analysis (Third Edition)</i> by Law and Kelton (2000) for details. Furthermore, the parameters of the lognormal distribution, namely, mean and standard deviation, correspond to the lognormal distribution and are not the mean and standard deviation of the corresponding normal distribution. Parameter restrictions are mean > 0.0 and standard deviation > 0.0.
Triangular	The triangular distribution (continuous) is typically used as a rough model for the time required to perform some task when no real-world data are available. A triangular distribution takes on values in the finite interval [minimum, maximum] (minimum \geq 0.0, mode > minimum, and maximum > mode), with values near the mode being most likely to occur. Subjective estimates of the three parameters are obtained from subject-matter experts. The mean of a triangular distribution is only equal to the mode when the distribution is symmetric.
Uniform	The uniform distribution (continuous) is equally likely to take on any real number in the finite interval [minimum, maximum] (minimum \geq 0.0 and maximum > minimum). The real numbers produced by a random-number generator (appear to) have a uniform distribution on the interval [0, 1].

Distribution	Description
Gamma	The gamma distribution (continuous) could be used to model the time required to perform some task. If a gamma distribution has parameters mean = m and shape = a , then $b = m/a$ is a scale parameter. A gamma distribution with mean = m and shape = 1 is an exponential distribution with mean = m . When shape is a positive integer, the gamma distribution is an Erlang distribution. Parameter restrictions are mean ≥ 0.0 and $0.0 < \text{shape} < 100.0$.
Beta	The beta distribution (continuous) could be used to model the time required to perform some task when the possible values are restricted to the finite interval [minimum, maximum] (minimum ≥ 0.0 , maximum ≤ 1.0 , and maximum $>$ minimum). Parameter restrictions for shape1 and shape2 are shape1 ≥ 0.0 and shape2 > 0.0 . The density function is skewed to the left, symmetric, or skewed to the right if shape1 $>$ shape2, shape1 = shape2, or shape1 $<$ shape2, respectively. A beta distribution with shape1 = shape2 = 1 is a uniform distribution with the interval [0, 1].
Erlang	The Erlang distribution (continuous) could be used to model the time required to perform some task. If an Erlang distribution has parameters mean = m and shape = a , then $b = m/a$ is a scale parameter. An Erlang distribution is just a gamma distribution whose shape parameter is a positive integer. The sum of k exponential random variables with mean = m is an Erlang distribution with mean = km and shape = k . Parameter restrictions are mean ≥ 0.0 and $0.0 < \text{shape} < 100.0$.
Weibull	The Weibull distribution (continuous) could be used to model the time required to perform some task. It is also sometimes used to model the time to failure of a piece of equipment. A Weibull distribution with parameters shape = 1 and scale = b is an exponential distribution with mean = b . The Weibull distribution is skewed to the left when shape > 3.6 . Parameter restrictions are shape ≥ 0.0 and scale > 0.0 .
Hyper Exponential	The hyper exponential distribution (continuous) is a mixture of two exponential distributions. Specifically, a hyper exponential distribution with parameters mean1, mean2, and probability1 takes on values from an exponential distribution with parameter mean1 with a probability of probability1 and takes on values from an exponential distribution with parameter mean2 with a probability of $1 - \text{probability1}$. A hyper exponential distribution with probability1 = 1 is an exponential distribution with parameter mean1. Parameter restrictions are mean1 ≥ 0.0 , mean2 > 0.0 , and $0.0 \leq \text{probability1} \leq 1.0$.

Distribution	Description
Uniform Integer	A uniform integer distribution (discrete) is equally likely to take on any integer in the finite interval [minimum, maximum], where minimum and maximum are integers with minimum ≥ 0 and minimum $<$ maximum.
Geometric	The geometric distribution (discrete) with probability = p can be thought of as the distribution of the number of failures before the first success in a sequence of independent Bernoulli trials, where success occurs on each trial with a probability of p and failure occurs on each trial with a probability of $1 - p$.
Pareto	The Pareto distribution (continuous) could be used to model interarrival times of customers (for example, messages) when the traffic has burst-like behavior. The mean and variance are finite only if shape > 2 . Parameter restrictions are location ≥ 0.0 and shape > 0.0 .
Binomial	The binomial distribution (discrete) with parameters trials = t (a positive integer) and probability = p can be thought of as the distribution of the number of successes in t independent Bernoulli trials, where success occurs on each trial with a probability of p and failure occurs on each trial with a probability of $1 - p$. A binomial distribution with trials = 1 is called a Bernoulli distribution with probability = p .
Negative Binomial	The negative binomial distribution (discrete) with parameters s (> 0.0) and probability = p can be thought of as the distribution of the number of failures before the s th success in a sequence of independent Bernoulli trials, where success occurs on each trial with a probability of p and failure occurs on each trial with a probability of $1 - p$. A negative binomial distribution with parameters $s = 1$ and probability = p is a geometric distribution with probability = p .
Inverse Gaussian	The inverse Gaussian distribution (continuous) could be used to model the time required to perform some task. Parameter restrictions are scale > 0.0 and shape > 0.0 .
Inverted Weibull	The inverted Weibull distribution (continuous) could be used to model the time required to perform some task. The mean and variance are finite only if shape > 2 . If the random variable X has an inverted Weibull distribution with location = 0, scale = b , and shape = a , then $Y = 1/X$ has a Weibull distribution with scale = $1/b$ and shape = a . (The location parameter is 0.) Parameter restrictions are scale > 0.0 and shape > 0.0 .



Distribution	Description
Johnson SB	The Johnson SB distribution (continuous) could be used to model the time required to perform some task when the possible values are restricted to the finite interval [minimum, maximum]. The density function is skewed to the left, symmetric, or skewed to the right if $\text{shape1} > 0$, $\text{shape1} = 0$, or $\text{shape1} < 0$, respectively. The Johnson SB distribution is closely related to the classical normal distribution - see the book <i>Simulation Modeling and Analysis (Third Edition)</i> by Law and Kelton (2000) for details. Parameter restrictions are $\text{shape2} > 0.0$ and $\text{maximum} > \text{minimum}$.
Johnson SU	The Johnson SU distribution (continuous) could be used to model a random variable that can take on any value between minus infinity and plus infinity. The density function is skewed to the left, symmetric, or skewed to the right if $\text{shape1} > 0$, $\text{shape1} = 0$, or $\text{shape1} < 0$, respectively. The Johnson SU distribution is closely related to the classical normal distribution - see the book <i>Simulation Modeling and Analysis (Third Edition)</i> by Law and Kelton (2000) for details. Parameter restrictions are $\text{scale} > 0.0$ and $\text{shape2} > 0.0$.
Log-Logistic	The log-logistic distribution (continuous) could be used to model the time required to perform some task. The mean and variance are finite only if $\text{shape} > 2$. Parameter restrictions are $\text{scale} > 0.0$ and $\text{shape} > 0.0$.
Log-Laplace	The log-Laplace distribution (continuous) could be used to model the time required to perform some task. The mean and variance are finite only if $\text{shape} > 2$. Parameter restrictions are $\text{scale} > 0.0$ and $\text{shape} > 0.0$.
Pearson Type V	The Pearson type V distribution (continuous) could be used to model the time required to perform some task. The mean and variance are finite only if $\text{shape} > 2$. The Pearson type V distribution is closely related to the gamma distribution - see the book <i>Simulation Modeling and Analysis (Third Edition)</i> by Law and Kelton (2000) for details. Parameter restrictions are $\text{scale} > 0.0$ and $\text{shape} > 0.0$.
Pearson Type VI	The Pearson type VI distribution (continuous) could be used to model the time required to perform some task. The density function can take on a wide variety of shapes because it has two shape parameters shape1 and shape2 . The mean and variance are finite only if $\text{shape2} > 2$. The Pearson type VI distribution is closely related to the beta distribution - see the book <i>Simulation Modeling and Analysis (Third Edition)</i> by Law and Kelton (2000) for details. Parameter restrictions are $\text{scale} > 0.0$ and $\text{shape1} > 0.0$.

Distribution	Description
Random Walk	The random walk distribution (continuous) could be used to model the time required to perform some task. Parameter restrictions are scale > 0.0 and shape > 0.0.

About the Run Settings View

The  Run Settings view appears in the Process Simulation perspective. Use the Run Settings view to configure the overall settings of a simulation. You can configure the following fields:

On the Run Settings page:

Field	Description
Period	<p>Select a Date Range or Duration in which to run your simulation.</p> <hr/> <p>Tip! Date and time formatting is governed by your operating system settings; examples are provided. If you want to run Designer using a different locale, set your system to the new locale, then restart the machine and run Designer.</p>
Start	<p>Do one of the following:</p> <ul style="list-style-type: none"> ■ Enter a start date and (optionally) a start time. The default date value is the creation date of the simulation, and the default time value is 00:00:00. ■ Click  the scheduler button to select a date and time.
End	<p>Available only for a date range. Do one of the following:</p> <ul style="list-style-type: none"> ■ Enter a start date and (optionally) a start time. The default date value is the creation date of the simulation, and the default time value is 00:00:00. ■ Click  the scheduler button to select a date and time.
Duration	<p>Available only for a duration. Enter the amount of time you want your simulation to run in months, days, hours, minutes, and seconds.</p>


Field	Description
Update Frequency	<p>Select the update frequency for the simulation run. Select Milliseconds, Seconds, Minutes, Hours, Days, Weeks, Months, or Years. The default value is Hours.</p> <p>This setting specifies how often to refresh the animation and write information to the simulation recording file. You are advised to use the same frequency that is configured for the Time Interval property on the Schedule page of the process start step.</p> <hr/> <p>Tip! If you encounter performance issues while running a simulation with animation, it may help to increase the Update Frequency. For example, if it is set to Hours, try increasing it to Days or Weeks.</p> <hr/>

See [“Configure a Step Simulation” on page 58](#) and [“Process Simulation Recording and Playback” on page 89](#).


On the **Statistics** page:

Field	Description
Currency Name	Type the name of the form of currency to be used in the simulation. This value is used for reporting purposes only, and is included in the simulation report and Statistics view.
Cost Period Frequency	<p>Select the cost period frequency of the simulation. Options are Weekly, Monthly, Quarterly, Half-Yearly, and Yearly. Default is Quarterly.</p> <p>This setting controls how often resource costs are updated in the Statistics view, and is used in aggregating resource costs in the Simulation report.</p> <p>For more information, see “About the Statistics View” on page 37 and “Process Simulation Reporting” on page 69.</p> <hr/>

Field	Description
Simulation Time Unit	<p>Select the default time unit for the simulation clock. Select Milliseconds, Seconds, Minutes, Hours, Days, Weeks, Months, or Years.</p> <p>The default value is Hours. This should be adjusted larger or smaller if the time units of step Processing Time in the simulation are much larger (for example, years) or much smaller (for example, milliseconds) than hours.</p> <hr/> <p>Tip! The Simulation Time Unit controls the time period used by the Process Simulation Engine when reporting cycle time for steps, processes, and availability. Statistics are collected at the specified unit of time. If you have a process that starts a given number of times per week and you set the Simulation Time Unit at one hour, Designer collects data every hour. In the case of a long-running simulation, this could be a waste of processing power. For this reason, you are advised to use a similar time unit as that configured for the step Processing Time on the Scenario page in the Properties view.</p> <hr/> <p>For more information, see “Configure a Step Simulation” on page 58.</p>

If you close the Run Settings view and want to reopen it, select **Window > Show View >  Run Settings**.

About the Advanced Run Settings View


The  Advanced Run Settings view appears in the Simulation perspective. Use the Advanced Run Settings view to configure variables, historical data, and optimization settings. If you do not use variables, historical data, or optimization, you do not need to use this view. It contains three pages:

- [“About the Variables Page” on page 30](#)
- [“About the Historical Data Page” on page 32](#)
- [“About the Optimization Page” on page 33](#)

When you use a variable data source, you must select its default value. This requires no further configuration. The simulation replaces the variable with its default value. A default value is useful if you want to quickly change the constant value of a component property without navigating to the component and editing it there.

An optimized data source must be configured on the Optimization page and requires running an optimization to obtain an optimal value. Though it is possible to run an optimization with the default 0.0 value (if you do not have optimization data), there is no value in doing this.

A historical data source must be configured on the Historical Data page and requires BPMS data extraction to calculate the value. Simulation cannot run without the historical data from a historical data fit distribution, because the variable has no value. For more information, see [“Configure Your System to Use Historical Data” on page 53](#).

If you close the Advanced Run Settings view and want to reopen it, select **Window > Show View >  Advanced Run Settings**.

About the Variables Page

The table on the Variables page in the Advanced Run Settings view contains a list of all variables defined on the simulation resource and step properties. You can add and remove variables by editing the component property (such as a resource's fixed cost or a step processing time).

The table on the Variables page is updated automatically whenever you add, change, or remove a variable by editing the component property. If you edit a component property that uses a variable to use a constant instead, the table on the Variables page no longer displays the variable as it is no longer used.

Each variable can be used by only one component property; thus, each variable can have only one referenced component.


Though you cannot directly modify the variables using the table, you can control a variable's data source, which essentially sets the value of the variable to be used in simulation of the process. When you configure a simulation scenario, you have the option of defining the fixed cost of a resource to a variable (such as r1cost), where the r1cost value is obtained through optimization (data source) and has a result of 200 (value). If historical data is available, you can use that data source.

For each **Variable Name** on the Variables page:

Field	Description
Referenced Component	<p>The Referenced Component of a variable is a combination of the name of the component where the variable is and the attribute type the variable has. Not editable.</p> <p>For example, you might have a receive task called Receive Task and set a variable for its Quantity on the Schedule page in the Properties view. The Referenced Component name would be Receive Task quantity.</p>
Data Source	<p>The Data Source of the variable:</p> <ul style="list-style-type: none"> ■ Default—The default value set for the variable. ■ Historical—Historical data: select where to get the value (file or BPMS). The value is <Not Yet Retrieved> until you select the source. ■ Optimized—An optimized value: run an optimization to populate the value. The value is 0.0 until you run the optimization.

Field	Description
Value	<p>The Value column is populated after you select the Data Source information.</p> <hr/> <p>Important! This means that if you select a Historical Data Source, you must retrieve the data before you see a value here. If you select an Optimized Data Source, you must run an optimization before you see a value here.</p> <hr/> <p>The column values are not editable. If you want to clear values, you can use the provided buttons.</p> <hr/> <p>Important! You cannot undo the Clear Values action described below!</p> <hr/> <p>To clear data values, click one of the following buttons:</p> <ul style="list-style-type: none"> ■ Clear Optimized Values ■ Clear Historical Data Values ■ Clear All Values

About Variables

Any field that has a  browse button can be set as a variable. This includes:

Field	Located
Available Units	... on the Resource page in the Properties view of a resource.
Variable Cost	... on the Cost page in the Properties view of a resource.
Fixed Cost	... on the Cost page in the Properties view of a resource.
Processing Time	... on the Scenario page in the Properties view of a step.

Tip! Spaces are not permitted in variable names.

Variable values can be populated three ways:

Field	Description
Default	A default value set by the user.
Optimized	A value calculated by running an optimization.
Historical	A value calculated by gathering historical data.

Historical data values can be used for the following types of values:

Field	Located
Quantity	... on the Schedule page in the Properties view of a start step. The Quantity describes the number of instances to run at the given Time Interval .
Time Interval	... on the Schedule page in the Properties view of a start step. The Time Interval is the frequency at which the start step runs.
Processing Time	... on the Scenario page in the Properties view of a step. The Processing Time is the amount of time it takes the step to process.
Distribution	... on the Transition Distribution page in the Properties view of a step. The Distribution describes which transitions are taken in which combinations from the step

Historical data values can be used for any variable, but only the above listed types of values are available from process audit and reporting data. If you want to set variables on other types of attributes in the simulation (resources, available units, costs, etc.), you must supply a tab-delimited data file from which to create a distribution function.

Optimized values can be calculated for any variable other than transition distributions for steps.

Important! If you are using Optimized or Historical Data variables, you must retrieve the values you will use by running the optimization or historical data fit distribution before you run your simulation. Default values are used if no values have been retrieved.

For more information about using variables, see [“Distribution Reference” on page 22](#).

About the Historical Data Page

You can use historical data to create simulations based on real values from previous process executions; this is done by finding a distribution function that fits a sample of these values. Simulations that utilize historical data are often referred to as *fit distributions*.

Historical data for a resource can be loaded from a tab-delimited file of values. Process initiation frequency and volume, step duration, and transition path distributions can either be imported from a tab-delimited file, or directly from data from the webMethods BPMS reporting database.

Tip! Date and time formatting is governed by your operating system settings; examples are provided. If you want to run Designer using a different locale, set your system to the new locale, then restart the machine and run Designer.

On the Historical Data page:

Data Range Field	Description
Start	The start date of the BPMS historical data you want to extract. The default is today's date.
End	The end date of the BPMS historical data you want to extract. The default is one month from today's date.
Sample Size	The number of samples to retrieve from the BPMS database for each distribution calculation. The number must be between 100 and 50,000. The default value is 10,000.

The table on the Historical Data page in the Advanced Run Settings view contains a list of all variables defined on the Variables page for which an Historical Data Source is selected. It contains the following information about each Variable Name:

Field	Description
Process Name	The name of the process where the variable is defined. Not editable.
Referenced Component	The name of the component (step Label) referenced by the variable. Not editable.
Source	The Source from which the variable should be loaded: <ul style="list-style-type: none"> ■ BPMS— A historical BPMS database. Selected by default unless the variable is on a resource, in which case the only option is File.... ■ File...— A tab-delimited file. The only available option if the variable is on a resource.

Important! You can choose to load historical data from either source, but not both, in a single simulation.

webMethods Monitor reporting data gathers the required information about frequency, volume, processing time, and transition distribution. Simulation uses manageable sample records from this data to compute distributions. The sample data is copied from the Reporting database to the Simulation database.

About the Optimization Page

There are many customizations you can apply to optimization simulations; to accommodate this, the Optimization page in the Advanced Run Settings view has four pages:

- [“About the Objective Page” on page 34](#)
- [“About the Decision Variable Limits Page” on page 34](#)

- [“About the Constraints Page” on page 35](#)
- [“About the Run Options Page” on page 36](#)

If you are not running an optimization to calculate optimal data for use in simulation, you do not need to set anything on these pages.

About the Objective Page

The Objective page is where you define the goal, or objective, of your optimization. It is expressed in the following form:

To *<Target>* the *<Optimization Statistic>* *<Target Value>*

where each variable is defined by the fields on the page. For example, you might want to minimize (*Target*) the average (*Optimization Statistic*) queue wait time (*Target Value*). Select the object values from the following:

Field	Description
Target	The action you want to take on the Optimization Statistic of the Target Value . You can choose Maximize (default) or Minimize .
Optimization Statistic	The operator to apply to the Target . You can choose Average (default), Maximum , Minimum , or Standard Deviation .
Target Value	The specific value you want to optimize. Expand the list and select from Resources , Decision Variables , and Processes . Then select a type and specific target value. For example, your selection might be Processes > Loan Process > Queue Wait Time .

About the Decision Variable Limits Page

Decision variables restrict the attempted values that the simulation engine will use for your variable inputs. This helps to make the optimization run more efficiently, and ensure that undesired values are not attempted.

The items in the list on the Decision Variable Limits page are the variables for which an Optimized Data Source is selected on the Variables page in the Advanced Run Settings view.

Each Decision Variable listed has the following settings:

Field	Description
Lower Bound	The lowest acceptable value for the variable.
Upper Bound	The highest acceptable value for the variable.
Start Value	The starting value for the variable. The variable's default value is used if you do not set this.

Field	Description
Increments	The increments in which to try variable values. The default value of 1 is used if you do not set this.
	Tip! Set your search increment to larger values for larger sets. For example, if your Lower Bound is 1 and your Upper Bound is 20000, you would probably not want to use an increment of 1. An increment of 100 seems a more prudent choice, unless you want your optimization to run for a really long time.

Note: After you have configured the settings on the Objective and Decision Variable Limits pages, you can run the optimization; however, you can continue with additional configuration on the Constraints and Run Options pages.

About the Constraints Page

A constraint defines restrictions on the overall behavior of the process that the optimization should not violate. These restrictions can include process- and step-level characteristics, as well as resource restrictions. Use constraints to make sure your simulation does not make unrealistic assumptions about the process while attempting to find the proper variable values to achieve your set objective.

A constraint adds detail to the objective. For example, your objective might be to minimize queue wait time. You can set a constraint to never let the step wait time to be longer than a given value.

Use the **Add** and **Delete** buttons to add and delete constraints in the table. Each row in the table represents a single constraint, and includes the following information:

Field	Description
Performance Measure	The name of the performance measure to constrain while optimizing decision variables.
Optimization Statistic	The operator to apply to the Performance Measure. You can choose Average (default), Maximum , Minimum , or Standard Deviation .
Lower Bound	The lowest acceptable value for the variable.
Upper Bound	The highest acceptable value for the variable.

Note: The Performance Measure list includes the same options as the Target Value list on the Objective page.


The **Add Expression** button opens the Constraint Expression Builder window, where you can use logical expressions to define a constraint.

About the Run Options Page


Run options provide fine-tuning of your simulation optimization run. You can set the following:

Field	Description
Number of simulation runs per iteration	<p>A simulation run is the entire run of the simulation based on the Run Settings. Specifies how many times you want to repeat the simulation for each simulation optimization (as it is configured on the Run Settings page in the Run Settings view) during a single iteration. The default is 1.</p> <p>For example, if you configure your Run Settings to run the simulation for a month, set the Number of simulations per iteration to 10, and set the Maximum number of iterations to 10, you would run that simulation 100 times (10 multiplied by 10 individual month periods).</p> <p>Note: Each simulation run may produce slightly different results, particularly when a process contains transition splits and a distribution function is used to determine the processing path. When there are different results, Designer averages the results of the simulation runs.</p>
Maximum number of iterations	<p>Specifies the maximum number of optimization iterations you want to run. The default is 100. You can see this information in real time in the progress bar of the Optimization Statistics view.</p> <p>Note: If you configure your Run Settings to run the simulation for a month, set the Number of simulations per iteration to 10, and set the Maximum number of iterations to 10, you would run that simulation 100 times (10 multiplied by 10 individual month periods).</p>
Automatic stop	<p>Specifies if you want your optimization to stop automatically when all values have been tried or when a value is found that is within the set precision. The check box is selected by default (meaning yes).</p>
Precision	<p>Specifies how precise, or how close to your defined objective, you want your optimization value to be. The default is 0.0010.</p>
Run Optimization	<p>Click Run Optimization when you are ready to run your optimization. The button name toggles to Terminate Optimization while an optimization is running.</p>

The larger the **Number of simulation runs per iteration** and the **Maximum number of iterations** values are, the more opportunity the engine has to find the best possible values for the variables based on the target objective you set. However, the larger these numbers are, the longer your optimization takes to run.

If you close the Advanced Run Settings view and want to reopen it, select **Window > Show View >**  **Advanced Run Settings**.

About the Statistics View

The  Statistics view appears in the Process Simulation perspective. You use the Statistics view to observe the performance of a simulation in progress. Select a step in the simulation to see statistics on it, or click the canvas to see statistics on the overall simulation.

Designer also displays statistics in the simulation editor when you run a simulation with animation. See [“Step Gauges and Statistics” on page 88](#).

Statistics displayed for the overall simulation include:

Field	Description
TOTAL PROCESS INSTANCES	
Completed Instances	Instances of the process that are completed.
Created Instances	Instances of the process that are created.
Active Instances	Instances of the process that are active.
TIME (AVERAGE)	
Processing Time	Processing time of steps per process instance.
Wait Time	Wait time of steps per process instance.
Process Cycle Time	Process instance duration.
COSTS (AVERAGE)	
	Cost of steps per process instance.
	Note: Costs are expressed in the value set for Currency Name on the Statistics page in the Run Settings view.

Statistics displayed for a selected step include:


Field	Description
<Step Label> STEP	
Completed	Instances of this step that are completed.
Active	instances of this step that are active.
Queued	Instances of this step that are queued.

Field	Description
STEP TIME	
Processing Time	Average Processing Time / Instance. Maximum Processing Time / Instance. Minimum Processing Time / Instance. Processing time is the time it takes for a step to act upon a document.
Wait Time	Average Wait Time / Instance Maximum Wait Time / Instance Minimum Wait Time / Instance Wait time is the time a document waits to be acted upon and processed.
Cycle Time	Average Cycle Time / Instance Maximum Cycle Time / Instance Minimum Cycle Time / Instance Cycle time is the time it takes for the step to run, including wait time and processing time.
RESOURCE UTILIZATION	

Field	Description
Resource Name	<p data-bbox="873 300 1068 331">Resource Used</p> <p data-bbox="873 352 1198 384">Average Usage / Instance</p> <p data-bbox="873 405 1230 436">Maximum Usage / Instance</p> <p data-bbox="873 457 1230 489">Minimum Usage / Instance</p> <p data-bbox="873 510 1027 541">Period Cost</p> <p data-bbox="873 562 1133 594">Total Resource Cost</p> <hr/> <p data-bbox="873 636 1401 909">Note: The Cost Period Frequency on the Statistics page in the Run Settings view determines the Period Cost, and informs the Total Resource Cost. For example, if you set a Cost Period Frequency of 1 week, and run a simulation for 1 month, Designer displays 4 Period Costs before the Total Resource Cost.</p> <hr/> <p data-bbox="873 961 1417 1518">Tip! The Total Resource Cost may show zero (0) if the Simulation Period is not at least as long as the Cost Period Frequency, or if you stop the simulation before it reaches the Cost Period Frequency. For example, if you set a simulation to run for a month with a weekly cost period frequency, but stop it after 5 days, no cost period elapses, and the total resource cost is shown as zero. The Total Resource Cost has not had enough time to aggregate, so the value is shown as zero (0). Similarly, if you set a simulation to run for 5 days with a weekly cost period frequency, no cost period will elapse even if you run the simulation all the way to the end.</p>
TOTAL STEP COST	<p data-bbox="873 1602 1385 1749">Total cost of all resources used on the step, expressed in value set for Currency Name on the Statistics page in the Run Settings view.</p>
STEP THRESHOLDS	


Field	Description
	Processing Time Threshold
	Queue Threshold
	Queue Wait Time Threshold
	Cost Threshold

Note: Step times reflect the average time a step took from start to finish (cycle), the time it spent on execution (processing), and the time it spent in waiting for resources (queued). These step times have no relation to process instances and, depending on the model, steps could be running concurrently (in splits); repeated (in loops); or skipped (in branch). Therefore, you should not expect to add up step times to equal process times. Process average times account for all instances created, including active instances. Average process cycle time - average process processing time = average process wait time. Process cycle time is simulation time over created instances, while processing time is an aggregate of all step processing time over created instances.

If you close the Statistics view and want to reopen it, select **Window > Show View >  Statistics**.

About the Optimize Statistics View


The Optimize Statistics view displays statistics that are relevant specifically to optimizations. It presents information in real time during your simulation run about the progress being made toward your set objective.

You can run an optimization directly from the Optimize Statistics view using the  **Run Optimization** button in the view toolbar.

Field	Description
Progress of Objective	
Progress	Iterations of the of the simulation that are completed.
(Number of Iterations)	The total number of iterations is set with Maximum number of iterations in Advanced Run Settings > Optimization > Run Options).
Current	

Field	Description
Status	The current status of the simulation. It could be running, aborted (the Optimize engine encountered an error and stopped it automatically), infeasible, stopped (manually stopped by selecting Terminate Optimization), or completed (the optimization ran all of the iterations as configured and stopped automatically). In the case of infeasible simulations, it could abort (aborted infeasible); stop (stopped infeasible); or complete (completed infeasible) as a result.
Iteration	The number of the current iteration.
Objective Value	The current result of the set optimization objective. For example, if the objective is to minimize total resource cost, then the objective value is the calculated minimum total resource cost for the current optimization.
Objective	Statement of the objective as configured (set in Advanced Run Settings > Optimization > Objective).
Termination Reason	The reason the simulation stopped.
Best Objective	
Iteration	The iteration run number that produced the best objective.
Feasible	Is the objective feasible? True or False.
Objective Value	The most optimal optimization objective value as determined by the optimization. The result is entirely dependent on the optimization configuration. The best value may be zero (0) if that is what the engine determines. The Objective Value field is empty when a simulation is not running, as there is no iteration value to report.
Decision Variable	
Name	The name of each variable with an Optimized data source.
Best	The best value of those that have been tried so far.
Current	The current value being tried.
Constraint Variable	
Name	The name of each constraint variable.
Best	The best value of those that have been tried so far.
Current	The current value being tried.
Expression	
Name	The name of each expression constraint.

Field	Description
Best	<p>The best value of those that have been tried so far.</p> <p>You can expand the expression constraint to display the expression string and additional details about it. The best value is displayed for each line.</p>
Current	<p>The current value being tried.</p> <p>You can expand the expression constraint to display the expression string and additional details about it. The current value is displayed for each line.</p>

If you close the Optimize Statistics view and want to reopen it, select **Window > Show View >  Optimize Statistics**.

2 Work with Process Simulations

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Work with a Process Simulation

You can create a simulation:

- Directly from an existing process that is open in the process editor.
- By creating a process simulation file.

In both cases, you can modify the simulation in these ways:

- Add more processes
- Remove processes
- Update the existing processes
- Change resource availability and usage
- Change run settings (including variables, historical data, and optimized data)
- Change step scenarios

Note: You do not need to create separate simulations exclusively for extracting historical data or performing optimization; when configured, any simulation can utilize the historical data or optimization features.

Simulating a process involves the following actions:

To do this...	See this information...
1. Create a process	"Creating Processes" in <i>webMethods BPM Process Development Help</i>
2. Create a simulation file	"Create a Process Simulation from an Open Process" on page 45 "Create a Process Simulation File" on page 46
3. Configure the simulation	"Configure Process Simulation Preferences" on page 13 "Configure a Process Simulation" on page 51 "Configure Process Simulation Properties" on page 57 "About the Resources View" on page 17 "About the Run Settings View" on page 27 "About the Advanced Run Settings View" on page 29
4. Configure step scenarios	"Configure a Step Simulation" on page 58
5. Run the simulation	"Run a Process Simulation" on page 68


To do this...	See this information...
6. Interpret the results	“About the Statistics View” on page 37 “About the Optimize Statistics View” on page 40 “Process Simulation Reporting” on page 69
7. Repeat steps 3-6	“Update a Simulation from a Process” on page 48

Create a Process Simulation from an Open Process

You can create a process simulation directly from an existing process that is open in the process editor, and optionally add additional processes to it.

Note: You can also create a process simulation file without having a process open in the editor. For more information, see [“Create a Process Simulation File” on page 46](#).

To create a process simulation from an open process

- 1 In Designer, ensure that the process you want to work with is open in the process editor, and that the editor has focus.
- 2 Click the  **Simulate Process** button on the main toolbar.

Tip! You can use the following keyboard shortcut: ALT+S.

Note: If it is not possible to create a simulation from the process, Designer displays the Not Applicable for Simulation dialog box, which describes the reason or reasons the process cannot be simulated. You can modify the process according to the instructions, and then try again until Designer can create a simulation. There are two cases in particular that cannot be simulated: processes with no start step (that can start a new process instance), and processes that contain cyclical graphs (that is, a transition to a previously executed step). In the latter case, use a subprocess loop instead.

- 3 If it is possible to create a simulation from the process, the Create a Simulation wizard appears. The default selection is Create a new simulation and add process *<your process name>*.
- 4 Click Next to select Create a new simulation and add process *<your process name>*.
- 5 Enter, modify, or select the information in the following fields:
 - Simulation Name (pre-populated with the current process name)
 - Description (not pre-populated; optional)
 - Select Project (pre-populated with the current project name)

- 6 If you want to add additional existing processes to the simulation, click **Next**; the **Add Processes** panel appears. Select the check boxes corresponding to the processes you want to add. A process can be included in a given simulation file only once; if you want to create different scenarios for a process, you must create multiple simulation files.

Note: Designer will not allow you to add processes that it cannot simulate.

- 7 Click **Finish** to create the simulation file; the **New Simulation Created** dialog box appears. This dialog box also includes reminders that you must configure the resources, step scenarios, and run settings of the simulation. For more information, see [“Configure a Process Simulation” on page 51](#).
- 8 Click **OK** to open the simulation file.

Note: When you open a simulation file, Designer can automatically switch to the **Simulation** perspective, or prompt you to do so. See [“Configure Process Simulation Preferences” on page 13](#).




For more information about working with processes, see *“Process Development Help”* in *webMethods BPM Process Development Help*.

Create a Process Simulation File

You can create a process simulation file directly, without having an open process.

Note: You can create a process simulation from a process that is open in the process editor, and optionally add additional processes to it. For more information, see [“Create a Process Simulation from an Open Process” on page 45](#).

To create a process simulation file and add processes to it

- 1 In Designer, in any perspective (including **Process Simulation**), do one of the following:
 - Click **File > New >  Simulation**
 - Right-click  **Simulations** in the **Solutions** view and click  **New Simulation**.
- 2 In the **Create a Simulation** wizard, enter or select the information in the following fields:
 - **Simulation Name**
 - **Description** (optional)
 - **Select Project**
- 3 Click **Next**.

- 4 In the Add Processes panel, select the check boxes that correspond to the processes you want to add to the simulation. A process can be included in a given simulation file only once; if you want to create different scenarios for a process, you must create multiple simulation files.

Note: Designer will not allow you to add processes that it cannot simulate.

- 5 Click **Finish** to create the simulation file. Designer displays the New Simulation Created dialog box. This dialog box also includes reminders that you must configure the resources, step scenarios, and run settings of the simulation. See [“Configure a Process Simulation” on page 51](#).
- 6 Click **OK** to open the simulation file.

Note: When you open a simulation file, Designer can automatically switch to the Simulation perspective, or prompt you to do so. See [“Configure Process Simulation Preferences” on page 13](#).

For more information about working with processes, see “Process Development Help” in *webMethods BPM Process Development Help*.

Add a Process to a Simulation

After you create a simulation file, you can add one or more processes to it.

To add a process to a simulation file

- 1 In Designer, ensure that the simulation you want to work with is open in the simulation editor, and that the editor has focus.

Note: When you open a simulation file, Designer can automatically switch to the Simulation perspective, or prompt you to do so. See [“Configure Process Simulation Preferences” on page 13](#).

- 2 Open or switch to the Outline view.
- 3 Click **+ Add Process**.
- 4 In the Add Processes dialog box, select the check boxes that correspond to the processes you want to add to the simulation. A process can be included in a given simulation file only once; if you want to create different scenarios for a process, you must create multiple simulation files.

Note: Designer will not allow you to add processes that it cannot simulate.

- 5 Click **Finish** to add the process.


Remove a Process from a Simulation

You can remove one or more processes from a simulation.

Note: You cannot undo the removal of a process from a simulation.

Note: Designer does not prevent you from removing all processes from a simulation, but you cannot run a simulation that contains no processes.


To remove a process from a simulation file

- 1 In Designer, ensure that the simulation you want to work with is open in the simulation editor, and that the editor has focus.
- 2 Expand the top-level simulation node to view the processes included in the simulation.
- 3 Select the process you want to remove (hold down the CTRL key to select multiple processes).
- 4 Click  **Remove Process**. Designer prompts you to confirm the action, displaying the name of the process to remove.
- 5 Click Yes.

Update a Simulation from a Process

Use this procedure when you want to update a simulation by adding a process, or by applying changes you have made to a single process that already exists in a simulation. You can also update all of the processes in a simulation at the same time; for more information, see [“Update a Simulation from the Outline View” on page 49](#).

To update an process simulation from a process

- 1 In Designer, ensure that the process you want to work with is open in the process editor, and that the editor has focus.
- 2 Click the  **Simulate Process** button on the main toolbar.

Tip! You can use the following keyboard shortcut: ALT+S.

Note: If you are adding the process, and it is not possible to create a simulation from the process, Designer displays the Not Applicable for Simulation dialog box, which describes the reason or reasons the process cannot be simulated. You can modify the process according to the instructions, and then try again until Designer can create a simulation. There are two cases in particular that cannot be simulated: processes with no start step (that can start a new process instance), and processes that contain cyclical graphs (that is, a transition to a previously executed step). In the latter case, use a subprocess loop instead.


- 3 If it is possible to create a simulation from the process, Designer displays the Create a Simulation wizard.
- 4 Click **Update an existing simulation with the process <your process name>**.
- 5 Click **Next** to select the simulation that you want to update, either by adding the process or by applying any changes you have made to an existing process.
- 6 Click **Finish**. Designer displays the Simulation successfully updated dialog box.
- 7 Click **OK**. Designer displays the updated simulation.


Update a Simulation from the Outline View

Use this procedure when you want to update all of the processes in a simulation at the same time; this applies any changes you have made to the processes in the simulation.

To update an process simulation from the Outline view

- 1 In Designer, ensure that the simulation you want to work with is open in the simulation editor, and that the editor has focus.


Tip! You can also update one or more processes in an existing simulation using the Outline view. Open the simulation file you want to update in the simulation editor, open the Outline view, and then click  **Refresh Processes**.

- 2 Open or switch to the Outline view.
- 3 Click  **Refresh Processes**. Designer prompts you to confirm the action, displaying the name of the processes to update.
- 4 Click **OK**. The processes in the simulation are updated to match the current state of the process models in Designer.

Import a Process Simulation File

You can import an existing Designer process simulation file into an existing process project.


To import a Designer process simulation file

- 1 In Designer: File > Import > Software AG >  Simulation File.
- 2 Click Next.
- 3 In the Process File Import Wizard, click **Browse** to select a `.simulation` file to import.
- 4 Select the target Process Project from the list.
- 5 Click Finish.

Export a Process Simulation File







You can export a process simulation file and save it as a `.simulation` file.

To import a Designer process simulation file

- 1 In Designer: File > Import > Software AG >  Simulation File.
- 2 Click Next.
- 3 In the Process File Import Wizard, click **Browse** to select a `.simulation` file to import.
- 4 Select the target Process Project from the list.
- 5 Click Finish.

Work with a Process Simulation in the Solutions View

Using the Solutions view, you can perform the following actions for process simulations:

To...	Take this action in the Solutions view...
Open a process simulation in the simulation editor	Right-click a  simulation and click Open , or double-click the simulation.
View the file in your workspace that correspond to a process simulation	Right-click a  simulation and click  Show Files . Designer displays the  Navigator view and highlights the file associated with the simulation.
Refresh the contents of a process simulation	Right-click a  simulation and click  Refresh .

Note: Process simulations do not have references or dependencies.

For more information about working with processes, see “Process Development Help” in *webMethods BPM Process Development Help*.

Configure a Process Simulation

Before you can run a process simulation, you must configure a number of settings, including the resources used by the process as well as the behavior of different steps in the process. With the exception of Process Simulation preferences, all of the configuration work must be done with the simulation file open in the simulation editor.

Note: You do not need to create separate simulations exclusively for extracting historical data or performing optimization; when configured, any simulation can utilize the historical data or optimization features.

To configure...	Follow these procedures...
Processes in a simulation	<p>To add processes to simulations, see “Add a Process to a Simulation” on page 47.</p> <p>To remove processes from simulations, see “Remove a Process from a Simulation” on page 48.</p> <p>To update processes in simulations, see “Update a Simulation from a Process” on page 48.</p>
Process simulation default settings	<p>Process simulation default settings are configured in Process Simulation preferences, and control enabling animation recording for playback, automatic perspective switching, and step gauge type.</p> <p>See “Configure Process Simulation Preferences” on page 13 and “Step Gauges and Statistics” on page 88.</p>
Process simulation resources	<p>Process simulation resources include the Resource and Cost pages in the Properties view for each resource configured in the Resources view.</p> <p>See “About the Resources View” on page 17.</p>

To configure...	Follow these procedures...
Process simulation run settings	<p>Process simulation run settings include the Run Settings and Statistics pages in the Run Settings view and the Variables, Historical Data, and Optimization pages in the Advanced Run Settings view. The Optimization page has four pages of its own: Objective, Decision Variable Limits, Constraints, and Run Options.</p> <hr/> <p>Tip! If you are not using variables in your simulation, you do not need to use the Variables page. If you are not using historical data in your simulation, you do not need to use the Historical Data page. If you are not using optimizing your simulation, you do not need to use the Optimization page.</p> <hr/> <p>See “About the Run Settings View” on page 27, “About the Advanced Run Settings View” on page 29, and “Process Simulation Performance Settings” on page 90.</p>
Process simulation properties	<p>Process simulation properties include the General and Metrics pages in the Properties view.</p> <p>See “Configure Process Simulation Properties” on page 57.</p>
Step schedules	<p>Step schedules for receive tasks, start events, and intermediate events include the General, Schedule, and Transition Distribution pages in the Properties view.</p> <p>In simulation reports, these are grouped as Start Step Schedules and Intermediate Step Schedules.</p> <hr/> <p>Note: End events have neither schedules nor scenarios. Likewise send tasks. These are all throwing events.</p> <hr/> <p>See “Configure a Step Schedule” on page 59.</p>
Step scenarios	<p>Step scenarios for most activities (tasks other than send and receive, call activities (including referenced processes), and subprocesses) include the General, Scenario, Metrics, and Transition Distribution pages in the Properties view.</p> <p>See “Configure a Step Simulation” on page 58.</p>
Transition Distribution	<p>Transition distributions for simulated transitions govern the behavior of the simulation.</p> <p>See “Configure a Transition Distribution” on page 62.</p>
Gateways	<p>Gateways are specialty transitions, and are configured on the Transition Distribution page like other transitions.</p> <p>See “Configure a Gateway” on page 63.</p>

Work with Historical Data

Configure Your System to Use Historical Data

To configure your system to use historical data

Use the following general procedure to configure a historical data fit distribution:

- 1 Make sure all required database components exist, including the Process Audit, Staging, and Reporting database components, and configure the Simulation function to work with the Reporting database component. For complete information and instructions about database components, see the PDF publication *Installing webMethods and Intelligent Business Operations Products*.
- 2 Configure the process models to log the process and all events, activities, and looped activities. For instructions, see the PDF publication *webMethods Monitor User's Guide*.
- 3 Install the Simulation database components, and then connect an Integration Server to them. For instructions, see the PDF publication *Installing webMethods and Intelligent Business Operations Products*.
- 4 Populate the Simulation database components by running the `wm_designer_sim_fitDistribution_pushSimTables` service in the `WmDesigner` package on your Integration Server to retrieve process audit data that has been aggregated into the reporting database. The service does not have input parameters.

This service calls three other services (`pushSimInstAccum`, `pushSimStepAccum`, and `pushSimTransAccum`) that sample representative data from the Reporting tables and copy it to the Simulation tables in the Reporting database component. This data allows you to create distribution functions that you can apply to properties that are configured as "Variables" in your simulations.

Note: To acquire a meaningful sample of historical data, you must obtain run-time data over a period of time, not just from a few minutes of running a process. Software AG recommends that you schedule the service to run automatically, at specific times or intervals. Doing so minimizes the time required to process the data. For more information on scheduling services on Integration Server, see the PDF publication *webMethods Integration Server Administrator's Guide*.

Important! Make sure you have a **Minimum Logging Level** set at **5-Process** and **all events, activities, and looped activities (default)** for processes whose data you want to use in historical data fit distributions. For more information about process logging, including detailed descriptions of logging levels, see the PDF publication *webMethods Monitor User's Guide*.

Load Historical Data from a Tab-Delimited File to Create a Fit Distribution

To load historical data from a tab-delimited file to create a fit distribution

- 1 In Designer, open the Advanced Run Settings view and click the **Historical Data** tab.

Tip! You do not need to do anything in the Date Range section if you are loading historical data from a file.

- 2 For each **Variable Name** that has a designation of **Historical** on the Run Settings page, Designer displays the **Process Name** and the **Referenced Component**.
- 3 Select **File...** as your **Source** for each **Variable Name** for which you want to retrieve historical data.
- 4 After you select a specific tab-delimited file, Designer displays an informational message that the file was successfully read and a distribution function was created. This value is used to populate the distribution value for the variable on the Variables page. For example: Uni(0.0,999.979,12).

If Designer cannot successfully read your file and create a distribution function, it displays the **Fit Distribution Failed** dialog box, informing you that there was an error running the fit distribution for the file.

Note: The value loaded is saved, but not the location of the file itself. If you need to change the file, you must re-select it the same way.

Load Historical Data from BPMS to Create a Fit Distribution

To load historical data from BPMS to create a fit distribution

- 1 In Designer, open the Advanced Run Settings view and click the **Historical Data** tab.
- 2 Enter the **Start** and **End** dates of the BPMS historical data you want to extract.

You can type a date in your system's date format, or you can click the



calendar button to select a date.

- 3 Enter a number between 100 and 50,000 to represent the **Sample Size** of the BPMS historical data you want to extract.
- 4 For each **Variable Name** that has a designation of **Historical** on the Run Settings page, Designer displays the **Process Name** and the **Referenced Component**.
- 5 Select **BPMS** as your **Source** for each **Variable Name** for which you want to retrieve historical data from the database.

- 6 Click **Extract BPMS Data** to retrieve historical data for all of the variable names in the sample that match those in your list.

Important! Extracting BPMS data requires a connection to Integration Server. If you are not connected, Designer displays a connection error message and prompts you to connect in Preferences (**Window > Preferences > Software AG > Integration Servers**).

Important! When extracting BPMS data, the back end Integration Server service looks for all versions of the process that have been run during the selected time frame. If more than one version has been run, a window appears asking you to select which version's data to load. Designer allows historical data for only one version at a time. If the prior version contains different steps and/or different transitions, Designer loads information only for items that still exist in the current version. For example, step instance data for steps no longer in the process model is not loaded.

Work with Optimized Data

Define Optimization Objectives

Each optimization has a stated objective. It is expressed in the following form:

To *<Target>* the *<Optimization Statistic>* *<Target Value>*

where each variable is defined by the fields on the page. For example, you might want to minimize (*Target*) the average (*Optimization Statistic*) queue wait time (*Target Value*).

To define the objective of your optimization

- 1 In Designer, open the Advanced Run Settings view and click the **Optimization** tab, then click the **Objective** tab.
- 2 Select a **Target**.
- 3 Select an **Optimization Statistic**.
- 4 Select a **Target Value**:
 - The Resources node contains all of your resources and possible target values.
 - The Decision Variables node contains a set of possible process-level targets nested under their simulation names. It also contains all the steps in each process, with each step having its own set of configurable target values.
- 5 Save the simulation to apply your settings.

Configure Decision Variables

To configure a decision variable

- 1 In Designer, open the Advanced Run Settings view and click the **Optimization** tab, then click the **Decision Variable Limits** tab.
- 2 In the same row as the **Name** of the decision variable you want to configure, enter a value for **Lower Bound** and a value for **Upper Bound**.
- 3 Optionally, enter a value for **Start Value** and a value for **Increments**.
- 4 Save the simulation to apply your settings.

Add a Constraint

To add a constraint

- 1 In Designer, open the Advanced Run Settings view and click the **Optimization** tab, then click the **Constraints** tab.
- 2 Click **Add**.
- 3 Select a **Performance Measure** from the list.
- 4 Select an **Optimization Statistic** from the list.
- 5 Enter a **Lower Bound** value and an **Upper Bound** value.
- 6 Save the simulation to apply your settings.

Modify a Constraint

To modify a constraint

- 1 In Designer, open the Advanced Run Settings view and click the **Optimization** tab, then click the **Constraints** tab.
- 2 Select the constraint you want to modify.
- 3 Select a **Performance Measure** from the list.
- 4 Select an **Optimization Statistic** from the list.
- 5 Enter a **Lower Bound** and an **Upper Bound**.

Note: You can modify any or all of the existing fields.

- 6 Save the simulation to apply your settings.

Delete a Constraint

To delete a constraint

- 1 In Designer, open the Advanced Run Settings view and click the **Optimization** tab, then click the **Constraints** tab.
- 2 Select the constraint you want to delete.
- 3 Click **Delete**.
- 4 Save the simulation to apply your settings.

Build a Constraint Expression

To build a constraint expression

Important! You must define an **Optimized** variable (on the Variables page) before you can set a constraint for it. If the **Add Expression** button is disabled, check to make sure you have an **Optimized** variable defined.

- 1 In Designer, open the Advanced Run Settings view and click the **Optimization** tab, then click the **Constraints** tab.

Important! You must define an **Optimized** variable (on the Variables page) before you can set a constraint for it. If the **Add Expression** button is disabled, check to make sure you have an **Optimized** variable defined.

- 2 Click **Add Expression**.
- 3 In the Constraint Expression Builder window, provide a **Constraint Name**.
- 4 Build an **Expression** by selecting decision variables and using the operator and function buttons in the Decision Variables section.
- 5 Use the **Validate** button to check expressions you build.
- 6 Click **OK** to save your expression and close the Constraint Expression Builder window. Click **Cancel** to close the window without saving.

Configure Process Simulation Properties

Process simulation properties govern the simulation as a whole.

To configure process simulation properties

- 1 With the process simulation open in the simulation editor, click the canvas to give the entire simulation focus.
- 2 Open or switch to the Properties view.
- 3 The General page in the Properties view displays the **Process Name**, **Process ID**, **Version**, **Created By**, and **Description** fields from the process on which the simulation is based. There is nothing to configure on this page; it is for reference purposes only.
- 4 On the Metrics page in the Properties view, configure the following:

Field	Description
Enable Threshold	Select this check box to enable threshold violation warnings during simulation animation and in the Simulation report (Potential Bottlenecks). Not selected by default. Important! Only enabled thresholds (for a process or a step) are examined. You must set the threshold and enable it.
Processing Time Threshold	Specifies an average processing time; when this value is exceeded, a notification appears in the simulation report.
Hours	Specifies the unit of time used to measure the Processing Time Threshold Default is Hours. You can also select Milliseconds, Seconds, Minutes, Days, Weeks, Months, and Years.
Cost Threshold	Specifies an average cost; when this value is exceeded, a notification appears in the simulation report. The Currency Name is set on the Statistics page in the Run Settings view. See “About the Run Settings View” on page 27.

Configure a Step Simulation

Step scenarios, schedules, and transition distributions govern each step in a process simulation. You can configure them to behave differently in order to find your most efficient distribution, or to reach a different goal with your process. There are differences in configuring different step types:

- Activities (tasks with the exceptions of send and receive tasks, call activities (including referenced processes), and subprocesses) have step scenario configuration pages in the Properties view.

- Receive tasks and start events (start message, start signal, start none), send tasks, and end events do not require step scenario configuration other than for outbound transitions.
- Step schedules dictate when start and intermediate events occur and when start and intermediate (join) receive tasks receive.
- Transition distribution allows you to specify just what portion of the pipeline goes where at a split or a join.
- Gateways are made of splits and joins. Like other splits and joins, their behavior is configured on the Transition Distribution page in the Properties view of the step.

For more information, see these topics:

- [“Configure a Step Schedule” on page 59](#)
- [“Configure a Step Scenario” on page 62](#)
- [“Configure a Transition Distribution” on page 62](#)
- [“Configure a Gateway” on page 63](#)


Configure a Step Schedule

To configure a step schedule

- 1 With the process simulation open in the simulation editor, select the start receive task, intermediate receive task, start event, intermediate message event, or intermediate signal event you want to configure.
- 2 Open or switch to the Properties view.
- 3 The General page in the Properties view displays the **Label**, **Step ID**, and **Description** fields from the process on which the simulation is based. There is nothing to configure on this page; it is for reference purposes only.

- 4 On the Schedule page in the Properties view of start steps, configure the following in the Step Schedule section:

Field	Description
Quantity	Specifies the number of instances to run at the given time interval (the number of processes will start one right after another).


You can type a value or click  the browse button to open the Quantity window. You can enter a constant or a variable, or select a distribution:

- Click **Constant** to enter a static numeric value in the **Constant** field. This is the same as entering the value in the **Quantity** field on the Schedule page of the Properties view.
- Click **Variable** to use historical data or an optimized variable. Enter a **Variable Name** and a **Default Value**. Further configuration of variables is available on the Variables page in the Advanced Run Settings view.
- Click **Distribution** to select a distribution. You can select from the list and edit the available parameters if you wish.

When you have defined the configuration you want, click **Finish**.

For example: you set **Quantity** to 2 and **Time Interval** to 30 minutes. When the simulation starts, 2 instances will be started immediately. After 30 minutes, 2 more instances will be started. After another 30 minutes, 2 more instances will be started, and so on.

Note: Extensive descriptions of available distributions are provided in the selection window and in [“Distribution Reference” on page 22](#).

Field	Description
Time Interval	<p>Specifies the time period at which the receive step runs (that is, the amount of time between the Quantity of processes started).</p> <p>You can type a value or click  the browse button to open the Time Interval window. You can enter a constant or a variable, or select a distribution:</p> <ul style="list-style-type: none"> ■ Click Constant to enter a static numeric value in the Constant field. This is the same as entering the value in the Quantity field on the Schedule page of the Properties view. ■ Click Variable to use historical data or an optimized variable. Enter a Variable Name and a Default Value. Further configuration of variables is available on the Variables page in the Advanced Run Settings view. ■ Click Distribution to select a distribution. You can select from the list and edit the available parameters if you wish. <p>When you have defined the configuration you want, click Finish.</p> <p>For example: you set Quantity to 2 and Time Interval to 30 minutes. When the simulation starts, 2 instances will be started immediately. After 30 minutes, 2 more instances will be started. After another 30 minutes, 2 more instances will be started, and so on.</p> <hr/> <p>Note: Extensive descriptions of available distributions are provided in the selection window and in “Distribution Reference” on page 22.</p>
Hours	<p>Specifies the unit of time used to measure the Time Interval</p> <p>Default is Hours. You can also select Milliseconds, Seconds, Minutes, Days, Weeks, Months, and Years.</p>

- 5 On the Schedule page in the Properties view of intermediate steps, configure the following in the Step Schedule section:

Field	Description
Delay Time	Specifies the amount of time the step waits to run
Hours	<p>Specifies the unit of time used to measure the Delay Time</p> <p>Default is Hours. You can also select Milliseconds, Seconds, Minutes, Days, Weeks, Months, and Years.</p>
Start Delay Timer	Start the Delay Time countdown when the specified condition is met

Configure a Step Scenario

You configure step scenarios for most all activity steps. Send and receive tasks are the exceptions. Besides those, all tasks, call activities (including referenced processes), and subprocesses have configurable step scenarios.

To configure a step scenario

- 1 With the process simulation open in the simulation editor, select the step you want to configure.
- 2 Open or switch to the Properties view.
- 3 The General page in the Properties view displays the **Label**, **Step ID**, and **Description** fields from the process on which the simulation is based. There is nothing to configure on this page; it is for reference purposes only.
- 4 On the Scenario page in the Properties view of the subprocess step, specify the number of times you want the subprocess to execute in the **Loop Count** field.

Configure a Transition Distribution

To configure a transition distribution

- 1 With the process simulation open in the simulation editor, select the step an outbound transition you want to configure.
- 2 Open or switch to the Properties view.
- 3 The General page in the Properties view displays the **Label**, **Step ID**, and **Description** fields from the process on which the simulation is based. There is nothing to configure on this page; it is for reference purposes only.
- 4 On the Transition Distribution page in the Properties view of steps with outbound transitions, configure the following:
 - Click the **Transition Distribution** page. This defines the **Probability Percentage** that transitions from this step make to target steps. Select from the following:

Field	Description
All Transitions	The transition to each target step is made each time (100% probability). This is the default selection.
Even Probability	The transition to each target step is made an equal percentage of the time. For example: if there are 2 target steps, each one has a 50% probability; if there are 4 target steps, each one has a 25% probability.

Field	Description
Custom	<p>You can define the transition probability percentages to the target steps in any way you like.</p> <p>To modify the table, you can click Add Row and Remove Row, and select percentages to modify them. To change a Yes or No, click it to toggle to the value.</p>
Variable	<p>You can select a variable probability from historical data.</p> <hr/> <p>Note: Transition distribution cannot be optimized, and has no default value. If you try to select an optimized data source for a transition distribution, you will get an error informing you that an optimized data source is invalid.</p>

For each row in the table, your selections appear in a **Probability Percentage** column, and subsequent columns with the target step label as the column name. If the target step labels are identical, the step ID is applied.

Configure a Gateway

Gateways are made of splits and joins. In a process simulation, you configure gateway behavior in the Process Simulation perspective. Configuring a gateway involves the Transition Distribution page in the Properties view.

Process Simulation supports AND and OR joins only.

For AND gateways, a converging AND join on the gateway itself requires both transitions to pass through the gateway.

For OR gateways (Inclusive, Exclusive, and Complex), you must configure the Transition Distribution for both the upstream step and the gateway itself in order to get expected results.

Though Process Simulation does not offer an XOR (Unsynchronized OR) join option, you can create XOR behavior by configuring the transition distribution as a 70-30 split. In a converging gateway, 70% come from upstream Path A, and 30% come from upstream Path B. It works the same way in a diverging gateway, except the 70-30 split is going out of the gateway, downstream, to new targets.

To configure a gateway for simulation

On the Transition Distribution page in the Properties view of steps with outbound transitions, including the gateway itself configure the following:

Click the Transition Distribution page. This defines the **Probability Percentage** that transitions make from this step to target steps. Select from the following:

Field	Description
All Transitions	The transition to each target step is made each time (100% probability). This is the default selection.
Even Probability	The transition to each target step is made an equal percentage of the time. For example: if there are 2 target steps, each one has a 50% probability; if there are 4 target steps, each one has a 25% probability.
Custom	You can define the transition probability percentages to the target steps in any way you like. To modify the table, you can click Add Row and Remove Row , and select percentages to modify them. To change a Yes or No , click it to toggle to the value.
Variable	You can select a variable probability from historical data. Note: Transition distribution cannot be optimized, and has no default value. If you try to select an optimized data source for a transition distribution, you will get an error informing you that an optimized data source is invalid.

Diverging inclusive or exclusive gateway:

- Set All Transitions on the gateway step. All transitions must complete for the process simulation to complete.
- Set an exclusive distribution (50% to one target step and 50% to another target step) on the gateway step. Either transition completing completes the process simulation.

Converging inclusive or exclusive gateway:

- Set All Transitions on the upstream step. All transitions must pass through the gateway and reach the target step for the process simulation to complete.
- Set an exclusive distribution (50% to one target step and 50% to another target step) on the upstream step. Either transition passing through the gateway and reaching the target step completes the simulation.

Converging parallel gateway:

- Set All Transitions on the upstream step. All transitions must reach the gateway for the AND join to be satisfied.

Important! If you set the transition distribution from the upstream step to anything other than All Transitions, the AND join at the gateway will never be satisfied. The process simulation will be marked completed because it has gone as far as it can go. No counts will show for the gateway step or any steps downstream from the gateway, because they will never be reached.

Diverging parallel gateway:



- Set All Transitions on the gateway step. All transitions must pass through the gateway and reach the target step for the process simulation to complete.
- Set an exclusive distribution (50% to one target step and 50% to another target step) on the upstream step. Either transition passing through the gateway and reaching the target step completes the simulation.



3 Run Process Simulations

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Run a Process Simulation


After you create and configure a process simulation, you can run it. You can run it with animation and watch its progress on step gauges and statistics, and generate a report when the simulation has completed, or you can run it without animation and go directly to the report.

- To run the simulation file currently open in the simulation editor without animation and generate a report, click  **Simulate and report (without animation)** on the main Designer toolbar.
- To run the simulation file currently open in the simulation editor without animation and generate a report, click  **Simulate and report (without animation)** on the main Designer toolbar.

When you click  **Simulate and animate** and start a simulation, the button changes to  **Stop simulation**. Click it if you want to stop the simulation before it stops on its own.


Note: If you stop a process simulation before it completes on its own, and then run a report, the report will contain only the results for the time processed before the stop.

The Simulation duration clock on the Process Simulation toolbar displays the elapsed run time of the process you are simulating.

Designer displays a  **Threshold Exceeded** warning on the gauge when a configured threshold is exceeded during a simulation. A tooltip provides details on the specific threshold(s) that have been violated.

When an optimization cannot find a feasible solution, Designer displays a message that contains details about the specific nature of the limitations encountered.

After you have run a process simulation with animation, Designer keeps the simulation results as long as the simulation file remains open. The results are displayed in the simulation editor, in the step gauges and statistics, and in the Statistics view. They are also available for playback, if you have enabled that preference, and for generating reports.

Running a new process simulation with animation clears the previous simulation results. If you want to clear the simulation results and start fresh, or just clear the simulation results without running a new process simulation, click  **Clear simulation** on the Process Simulation toolbar. The button is only available after you have run a process simulation with animation.

Rearrange Steps in a Simulation

You can move steps in a process simulation; however, the original process model is unaffected and retains the initial step order. If you update the simulation with the original process file, the steps in the simulation will be returned to their original order.

For purposes of consistency, you are advised to always rearrange steps in the original process and then update the simulation so you can run the new step arrangement. This way, your process model and your simulation will always be synchronized. For more information, see:

- [“Update a Simulation from a Process” on page 48](#)
- [“Update a Simulation from the Outline View” on page 49](#)

Important! Do not move process simulation steps into other swimlanes.


About Animation Slider Controls


The Slow-Fast slider is not adjustable during simulation with animation. It is used only to control the animation speed during playback.


While a process simulation is running, the Start-End slider indicates the percentage of its progress, based on the **Period** specified in the Run Settings view. If you stop the simulation before the specified **Period** has elapsed, the slider stops at that point in the percentage completed. You cannot move the slider while a simulation is running.

You can use the slider controls only when you play back a recorded process simulation file. See [“Process Simulation Recording and Playback” on page 89](#).

Process Simulation Reporting

Designer offers real-time reporting, in the form of step gauges and statistics in the simulation editor, when you run a process simulation with animation. When the simulation is complete, you can generate a report with the  **Save simulation report** button.

Note: The  **Save simulation report** button is not available until you run a simulation.

You can also run process simulations without animation and generate the report. Click the  **Simulate and report (without animation)** to run the simulation file currently open in the simulation editor, without animation, and generate a report.

When you generate a simulation report, Designer prompts you to specify the **Report Format**, **Report Name**, and **Report Location**. You can also specify the option **Designer should Overwrite if file exists**. When the report has been generated, Designer displays a confirmation message.

You can generate as many reports as you want on a given process simulation — perhaps reconfiguring, rerunning, and saving generated reports with different names for later comparison. Designer can generate simulation reports in .CSV or .XLS format, the latter supporting the creation of charts, graphs, and HTML export to aid you in interpreting your results.

Process Simulation Reports

Designer can generate simulation reports in .CSV or .XLS format, the latter supporting the creation of charts, graphs, and HTML export to aid you in interpreting your results. The reports are organized into worksheets that comprise a workbook called Simulation Results.

The worksheets are organized as follows:

- [“Simulation Results - Process Level” on page 71](#)
- [“Simulation Results - Step Level” on page 72](#)
- [“Simulation Results - Swimlane Level” on page 74](#)
- [“Simulation Results - Potential Bottlenecks” on page 76](#)
- [“Simulation Results - Simulation Settings” on page 78](#)
- [“Simulation Results - Optimization Settings” on page 85](#)
- [“Simulation Results - Optimization Results” on page 87](#)

The top of each worksheet displays the names of the processes included in the simulation, the Run Settings, and the actual running time. These settings and data sources are described below.

Field	Description
Simulation Report for <Simulation Name>	
Actual Start Time	The value configured on the Run Settings page in the Run Settings view.
Actual End Time	The value configured on the Run Settings page in the Run Settings view.
Actual Duration	The value configured on the Run Settings page in the Run Settings view.
Simulation Start Time	The actual time you ran the simulation and generated the report.
Simulation End Time	The actual time the simulation ended.
Simulation Duration	The actual duration of the simulation.
Simulation Processes	The processes included in the report.

Simulation Results - Process Level

The first page of the report is devoted to process level statistics. If there is more than one process in a simulation, then each process is listed in the Times, Costs, Counts section. There are no steps or swimlane breakdowns on this page. Resources are reported on across all processes in the simulation.

On the Process Level worksheet:

Field	Description
Simulation Results - Process Level	
Times, Costs, Counts	All time values use the unit configured for Simulation Time Unit on the Statistics page in the Run Settings view. All cost values use the unit configured for Currency Name on the Statistics page in the Run Settings view.
Processes	Each process in the report has its own data.
Cycle Time Avg	The average time to run a process all the way through, including wait time and processing time. Important! If a process model contains parallel processing due to a split, or if some steps take significantly longer than others to complete, the Cycle Time can be less than the Processing Time. This can result in a negative Cycle Time Avg value, which the Simulation report displays as "Not Available."
Processing Time Avg	The average amount of time for actual processing activity.
Wait Time Avg	The average amount of time each process was running but not actively working on something.
Completed Instances Total	The number of instances completed.
Cost in <Currency Name> Avg	The average cost. The Currency Name is configured on the Statistics page in the Run Settings view.
Resource Utilization	The usage of each resource for the entire simulation. Remember that a simulation can have multiple processes in it. Resource information for a resource used in multiple processes represents the entire simulation.
Consumption	The usage (consumption) of each resource during the entire simulation.

Field	Description
Avg	The average units consumed of each resource.
Max	The maximum units consumed of each resource.
Min	The minimum units consumed of this resource.
Total	The total number of units consumed of this resource.
Cost in <Currency Name>	The Currency Name is configured on the Statistics page in the Run Settings view.
Cost Per Unit	Determined by the various cost settings that are applied to a resource (variable, fixed, usage, etc.) and divided by the number of resources accessed during any processes that have started (active state) or completed (started then finished).
Total	The total cost for every resource accessed for the entire simulation (all processes).
Utilization	The percentage of time each resource was in use (busy), not in use (idle), or being used in one place while being needed in another (unavailable).
Idle %	The percentage of time the resource was not in use.
Busy %	The percentage of time the resource was in use (actively doing something).
Unavailable %	The percentage of time the resource was being requested but was unavailable as it was being used elsewhere.

Simulation Results - Step Level

On the Step Level worksheet:

Field	Description
Simulation Results - Step Level	
Steps	
Times, Costs, Counts	
Cycle Time	The total amount of time that the step waited and processed (Processing Time + Wait Time).
Avg	The average amount of time that the step waited and processed.
Max	The maximum amount of time that the step waited and processed.
Min	The minimum amount of time that the step waited and processed.

Field	Description
Processing Time	The amount of time the step was processing something. Configured as the Processing Time on the Scenario page in the Properties view of the step.
Avg	The average amount of time the step was processing something.
Max	The maximum amount of time the step was processing something.
Min	The minimum amount of time the step was processing something.
Wait Time	The amount of time the step waited for a resource before starting.
Avg	The average amount of time the step waited for a resource before starting.
Max	The maximum amount of time the step waited for a resource before starting.
Min	The minimum amount of time the step waited for a resource before starting.
Completed Instances	
Completed	The number of completed instances of the step during the entire simulation.
Cost in <Currency Name>	The Currency Name is configured on the Statistics page in the Run Settings view.
Avg	The average cost required by the step during the entire simulation.
Step / Resource	
Resource Utilization	The resources used at this step during the entire simulation.
Consumption	The amount of resources consumed at this step during the entire simulation.
Avg	The average amount of a resource consumed at this step during the entire simulation.
Avg not TW	The average amount of a resource consumed at this step during the entire simulation, without time weighting.
	Note: Resources have time-weighted statistics for the most part; other statistics, such as those that are step- or process-related, are observation-based, meaning their statistics are based on the number of instances that occurred during the simulation run.

Field	Description
Max	The maximum amount of a resource consumed at this step during the entire simulation.
Min	The minimum amount of a resource consumed at this step during the entire simulation.
Total	The total amount of a resource consumed at this step during the entire simulation. If more than one type of resource is acquired by a step, the report displays another row.
Cost in <Currency Name>	The Currency Name is configured on the Statistics page in the Run Settings view.
Cost Per Unit	The total cost per resource unit for the step during the entire simulation.
Total	The total cost for the step during the entire simulation.
Utilization	The percentage of time each resource was in use by the step (busy), not in use by the step (idle), or being used elsewhere while being requested by the step (unavailable).
Idle %	The percentage of time the resource was not in use by the step.
Busy %	The percentage of time the resource was in use by the step (actively doing something).
Unavailable %	The percentage of time the resource was being requested by the step but was unavailable as it was being used elsewhere.

Simulation Results - Swimlane Level

On the Swimlane Level worksheet:

Field	Description
Simulation Results - Swimlane Level	
Swimlanes	
Times, Cost, Counts	
Cycle Time	The total amount of time that steps in the swimlane waited and processed (Processing Time + Wait Time).
Avg	The average amount of time that steps in the swimlane waited and processed.
Max	The maximum amount of time that steps in the swimlane waited and processed.

Field	Description
Min	The minimum amount of time that steps in the swimlane waited and processed.
Processing Time	The amount of time steps in the swimlane did something. Configured as the Processing Time on the Scenario page in the Properties view of each step.
Avg	The average amount of time steps in the swimlane did something.
Max	The maximum amount of time steps in the swimlane did something.
Min	The minimum amount of time steps in the swimlane did something.
Wait Time	The amount of time steps in the swimlane waited for a resource before starting.
Avg	The average amount of time steps in the swimlane waited for a resource before starting.
Max	The maximum amount of time steps in the swimlane waited for a resource before starting.
Min	The minimum amount of time steps in the swimlane waited for a resource before starting.
Completed Instances	
Completed	The number of completed instances of steps in the swimlane during the entire simulation.
Costs	
Avg	The average cost required by steps in the swimlane during the entire simulation.
Swimlane / Resource	
Resource Utilization	The resources used by steps in the swimlane during the entire simulation.
Consumption	The amount of resources consumed by steps in the swimlane during the entire simulation.
Avg	The average amount of a resource consumed by steps in the swimlane during the entire simulation.
Max	The maximum amount of a resource consumed by steps in the swimlane during the entire simulation.

Field	Description
Min	The minimum amount of a resource consumed by steps in the swimlane during the entire simulation.
Total	The total amount of a resource consumed by steps in the swimlane during the entire simulation. If more than one type of resource is acquired by steps in the swimlane, the report displays another row.
Cost in <Currency Name>	The Currency Name is configured on the Statistics page in the Run Settings view.
Cost Per Unit	The total cost per resource unit for steps in the swimlane during the entire simulation.
Total	The total cost for steps in the swimlane during the entire simulation.
Utilization	The percentage of time each resource was in use by steps in the swimlane (busy), not in use by steps in the swimlane (idle), or being used elsewhere while being requested by steps in the swimlane (unavailable).
Idle %	The percentage of time the resource was not in use by steps in the swimlane.
Busy %	The percentage of time the resource was in use by steps in the swimlane (actively doing something).
Unavailable %	The percentage of time the resource was being requested by steps in the swimlane but was unavailable as it was being used elsewhere.

Simulation Results - Potential Bottlenecks

On the Potential Bottlenecks worksheet:

Field	Description
Simulation Results - Potential Bottlenecks	
Processes	If there is more than one process, there may be more than one row. The information on this page is filtered by enabled process thresholds.

Field	Description
Processing Time in < <i>Simulation Time Unit</i> >	The amount of time it took for the entire process to process. The Simulation Time Unit is configured on the Statistics page in the Run Settings view.
Threshold	The Processing Time Threshold for the entire process.
Avg	The average Processing Time for the entire process.
Cost in < <i>Currency Name</i> >	The cost incurred by the entire process. The Currency Name is configured on the Statistics page in the Run Settings view.
Threshold	The Cost Threshold for the entire process.
Avg	The average Cost for the entire process.
Steps	In order to be displayed here, a step must have the Enable Thresholds setting enabled on the Metrics page in the Properties view, and at least one of those thresholds must have been crossed in the simulation.
Processing Time in < <i>Simulation Time Unit</i> >	The amount of time the step took to process. The Simulation Time Unit is configured on the Statistics page in the Run Settings view.
Threshold	The Processing Time Threshold for the step.
Avg	The average Processing Time for the step.
Queue Wait Time (in < <i>Simulation Time Unit</i> >)	The amount of time each instance waited to be processed. The Simulation Time Unit is configured on the Statistics page in the Run Settings view.
Threshold	The Queue Wait Time Threshold for the step.
Avg	The average Queue Wait Time for the step.
Queue	The number of instances waiting to be processed.
Threshold	The Queue Threshold for the step.
Avg	The average Queue for the step.
Cost in < <i>Currency Name</i> >	The cost incurred by the step. The Currency Name is configured on the Statistics page in the Run Settings view.
Threshold	The Cost Threshold for the step.

Field	Description
Avg	The average Cost for the step.

Simulation Results - Simulation Settings

On the Simulation Settings worksheet:

Field	Description
Simulation Results - Simulation Settings	
Run Settings	
Simulation Time Unit	The frequency at which the simulation engine sends new update events. Configured on the Statistics page in the Run Settings view. Options are Hours , Days , Weeks , Months , and Years .
Cost Period Frequency	The frequency at which costs are aggregated. Configured on the Statistics page in the Run Settings view. Options are Weekly , Monthly , Quarterly , Half-Yearly , and Yearly .
Currency Name	The name of the currency used (for example, dollars or euros).
Update Frequency	The frequency at which the simulation animation updates. Configured on the Run Settings page in the Run Settings view. Options are Hours , Days , Weeks , Months , and Years .
Simulation Resources	
Resource / Description	
Available Units	
Default Value	The default value set for the resource in the <i><Resource Name></i> : Available Units window, accessed from the Available Units field on the Resource page in the Properties view of the resource. The Default Value displays the Variable name if a variable name is configured as the default.

Field	Description
Calculated Value	<p>The actual value used if the Default Value is a Variable.</p> <p>If the source of the variable is optimized, the optimized value obtained by running an optimization is displayed. If the source of the variable is historical, a distribution function value created from a specified tab-delimited file or a value from historical data is displayed. If the source of the variable is default, the default value configured for the variable is displayed.</p>
Consumable	<p>Whether or not the resource is consumable. Configured in the Consumable Resource check box on the Cost page in the Properties view of the resource.</p>
Downtime Profile	<p>The Downtime Profile configured in the Downtime Profile field on the Cost page in the Properties view. Options are No downtime, Standard shift, and Night shift.</p>
Cost	
Fixed Cost Default Value	<p>The default value set for the resource in the <i><Resource Name></i>: Fixed Cost window, accessed from the Fixed Cost field on the Cost page in the Properties view of the resource.</p> <p>The Default Value displays the Variable name if a variable name is configured as the default.</p>
Calculated Value	<p>The actual value used if the Default Value is a Variable.</p> <p>If the source of the variable is optimized, the optimized value obtained by running an optimization is displayed. If the source of the variable is historical, a distribution function value created from a specified tab-delimited file or a value from historical data is displayed. If the source of the variable is default, the default value configured for the variable is displayed.</p>

Field	Description
Fixed Cost Time Unit	The time unit used to measure the Fixed Cost . Configured on the Cost page in the Properties view of the resource.
Variable Cost Per Time Unit Default Value	<p>The default value set for the (non-consumable) resource in the <Resource Name>: Variable Cost window, accessed from the Variable Cost field on the Cost page in the Properties view of the resource. A non-consumable resource cost is based on a time unit.</p> <p>The Default Value displays the Variable name if a variable name is configured as the default.</p>
Calculated Value	<p>The actual value used if the Default Value is a Variable.</p> <p>If the source of the variable is optimized, the optimized value obtained by running an optimization is displayed. If the source of the variable is historical, a distribution function value created from a specified tab-delimited file or a value from historical data is displayed. If the source of the variable is default, the default value configured for the variable is displayed.</p>
Variable Cost Time Unit	Time unit by which the Variable Cost is measured. Configured in the per Period field on the Cost page in the Properties view of the resource. Options are: Milliseconds, Seconds, Minutes, Hours, Days, Weeks, Months, and Years .
Variable Cost Per Unit (If Consumable Resource)	The value configured for the (consumable) resource in the <Resource Name>: Variable Cost window, accessed from the Variable Cost field on the Cost page in the Properties view of the resource. A consumable resource cost can be a variable.

Field	Description
Usage Cost Default Value	<p>The default value set for the resource in the <Resource Name>: Usage Cost window, accessed from the Usage Cost field on the Cost page in the Properties view of the resource.</p> <p>The Default Value displays the Variable name if a variable name is configured as the default.</p>
Calculated Value	<p>The actual value used if the Default Value is a Variable.</p> <p>If the source of the variable is optimized, the optimized value obtained by running an optimization is displayed. If the source of the variable is historical, a distribution function value created from a specified tab-delimited file or a value from historical data is displayed. If the source of the variable is default, the default value configured for the variable is displayed.</p>
Process Thresholds	
Processing Time Threshold	Configured in the Processing Time Threshold field on the Metrics page in the Properties view of the process.
Unit	Time unit by which the Processing Time Threshold is measured. Configured on the Metrics page in the Properties view of the process. Options are: Milliseconds, Seconds, Minutes, Hours, Days, Weeks, Months, and Years.
Cost Threshold	Configured in the Cost Threshold field on the Metrics page in the Properties view of the process.
Schedules	
Start Step Schedules	
Steps	
Time Interval Default Value	The default value set for the frequency of input to the step in the <Start Step Name>: Time Interval window, accessed from the Time Interval field on the Schedule page in the Properties view.

Field	Description
Calculated Value	<p>The actual value used if the Default Value is a Variable.</p> <p>If the source of the variable is optimized, the optimized value obtained by running an optimization is displayed. If the source of the variable is historical, a distribution function value created from a specified tab-delimited file or a value from historical data is displayed. If the source of the variable is default, the default value configured for the variable is displayed.</p>
Time Unit	<p>The time unit by which the Time Interval is measured. Configured on the Schedule page in the Properties view of a start step. Options are: Milliseconds, Seconds, Minutes, Hours, Days, Weeks, Months, and Years.</p>
Quantity Default Value	<p>The default value set for the input to the step in the <<i>Start Step Name</i>>: Quantity window, accessed from the Quantity field on the Schedule page in the Properties view.</p>
Calculated Value	<p>The actual value used if the Default Value is a Variable.</p> <p>If the source of the variable is optimized, the optimized value obtained by running an optimization is displayed. If the source of the variable is historical, a distribution function value created from a specified tab-delimited file or a value from historical data is displayed. If the source of the variable is default, the default value configured for the variable is displayed.</p>
Step Transitions Taken	<p>The transition(s) taken from this step.</p>

Field	Description
Probability Percentage	<p>The percentage of probability that the Step Transitions Taken would occur. Configured on the Transition Distribution page in the Properties view of the step.</p> <p>If a step has multiple transitions, there are several options: All Transitions, Even Probability, Custom, or Variable. A Variable Probability Percentage could be a distribution function or set from historical data.</p>
Step Scenarios	
Step	
Processing Time in <Time Unit>	
Default Value	<p>The default value set for the processing time of the step in the <Step Name>: Processing Time window, accessed from the Processing Time field on the Scenario page in the Properties view of the step.</p>
Calculated Value	<p>The actual value used if the Default Value is a Variable.</p> <p>If the source of the variable is optimized, the optimized value obtained by running an optimization is displayed. If the source of the variable is historical, a distribution function value created from a specified tab-delimited file or a value from historical data is displayed. If the source of the variable is default, the default value configured for the variable is displayed.</p>
Time Unit	<p>The time unit by which the Processing Time is measured. Configured on the Scenario page in the Properties view of a step. Options are: Milliseconds, Seconds, Minutes, Hours, Days, Weeks, Months, and Years.</p>
Processing Time Threshold	<p>Configured in the Processing Time Threshold field on the Metrics page in the Properties view of the step.</p>

Field	Description
Unit	Time unit by which the Processing Time Threshold is measured. Configured on the Metrics page in the Properties view of the step. Options are: Milliseconds, Seconds, Minutes, Hours, Days, Weeks, Months, and Years.
Queue Threshold	Configured in the Queue Threshold field on the Metrics page in the Properties view of the step.
Queue Wait Time Threshold	Configured in the Queue Wait Time Threshold field on the Metrics page in the Properties view of the step.
Unit	Time unit by which the Queue Wait Time Threshold is measured. Configured on the Metrics page in the Properties view of the step. Options are: Milliseconds, Seconds, Minutes, Hours, Days, Weeks, Months, and Years.
Cost Threshold	Configured in the Cost Threshold field on the Metrics page in the Properties view of the step.
Resource	
Available Units	
Default Value	The default value set for the Available Units of a resource in the <i><Resource Name></i> : Available Units window, accessed from the Available Units field on the Resource page in the Properties view of the resource.
Calculated Value	The actual value used if the Default Value is a Variable . If the source of the variable is optimized, the optimized value obtained by running an optimization is displayed. If the source of the variable is historical, a distribution function value created from a specified tab-delimited file or a value from historical data is displayed. If the source of the variable is default, the default value configured for the variable is displayed.
Units to Acquire	

Field	Description
Default Value	The default value set for the Units to Acquire of a resource for the step in the <i><Step Name></i> : Units to Acquire for <i><Resource Name></i> window, accessed from the Units to Acquire field on the Scenario page in the Properties view of the step.
Calculated Value	The actual value used if the Default Value is a Variable . If the source of the variable is optimized, the optimized value obtained by running an optimization is displayed. If the source of the variable is historical, a distribution function value created from a specified tab-delimited file or a value from historical data is displayed. If the source of the variable is default, the default value configured for the variable is displayed.

Simulation Results - Optimization Settings

Tip! Date and time formats are governed by your operating system settings. If you want to run Designer using a different locale, set your system to the new locale, then restart the machine and run Designer.

On the Optimization Settings worksheet:

Field	Description
Simulation Results - Optimization Settings	
Objective Settings	These values are displayed on the Objective tab of the Optimization page in the Advanced Run Settings view. See “Define Optimization Objectives” on page 55.
Objective Target	Selected Target.
Optimization	Selected Optimization.
Target Value	Selected Target Value.
Variables	These values are displayed on the Variables page in the Advanced Run Settings view. See “Configure Decision Variables” on page 56.
Variable Name	Selected Variable Name.

Field	Description
Referenced Component	Selected Referenced Component.
Data Source	File or BPMS.
Value	Defined Target Value.
Fit Distribution Settings	These values are displayed on the Historical Data page in the Advanced Run Settings view. See “Configure Your System to Use Historical Data” on page 53.
Start Date	Selected Start Date.
End Date	Selected End Date.
Sample Size	Selected Sample Size.
Fit Distribution Variables	These values are displayed on the Historical Data page in the Advanced Run Settings view. “Configure Your System to Use Historical Data” on page 53.
Name	Variable Name.
Process Name	Selected Process Name.
Type	Selected distribution Type.
Source	File or BPMS.
Decision Variable Limits	These values are displayed on the Decision Variables tab on the Optimization page in the Advanced Run Settings view. See “Configure Decision Variables” on page 56.
Name	Defined decision variable Name.
Start Value	Optional Start Value.
Lower Bound	Defined Lower Bound value.
Upper Bound	Defined Upper Bound value.
Increments	Optional Increments.
Performance Constraints	These values are displayed on the Constraints tab on the Optimization page in the Advanced Run Settings view. See “Configure Decision Variables” on page 56.
Performance Measure	Selected Performance Measure.
Optimization Statistic	Selected Optimization Statistic.

Field	Description
Lower Bound	Defined Lower Bound value.
Upper Bound	Defined Upper Bound value.

Simulation Results - Optimization Results

The Optimization Results worksheet contains information displayed in the Optimization Statistics view during an optimization, including the best values returned during the simulation.

On the Optimization Results worksheet:

Field	Description
Simulation Results - Optimization Results	
Best Objective	
Iteration	The iteration with the best objective value.
Feasible	True or false: the configured values and constraints can create a feasible solution for the input values to the variables.
Best Value	The best objective value.
Variables	The decision variables from the Decision Variables tab on the Optimization page in the Advanced Run Settings view. See “Configure Decision Variables” on page 56.
Variable Name	Defined Variable Name .
Referenced Component	Selected Referenced Component .
Data Source	File or BPMS .
Best Value	The best value based on the variable input.
Performance Constraints	These values are displayed on the Constraints tab on the Optimization page in the Advanced Run Settings view. See “Configure Decision Variables” on page 56.
Performance Measure	
Optimization Statistic	
Best Value	The best value based on the performance constraints.

Field	Description
Lower Bound	Performance constraints have bounds; expression constraints do not.
Upper Bound	Performance constraints have bounds; expression constraints do not.
Expression Constraints	These values are displayed on the Constraints tab of the Optimization page in the Advanced Run Settings view. See “Configure Decision Variables” on page 56.
Name	Defined expression Name.
Expression	Defined Expression.
Best LHS	Performance constraints have bounds; expression constraints do not. The best left hand side (LHS) and right hand side (RHS) based on the expression constraints are displayed.
Best RHS	Performance constraints have bounds; expression constraints do not. The best left hand side (LHS) and right hand side (RHS) based on the expression constraints are displayed.


Step Gauges and Statistics



When you run a process simulation with animation, real-time statistics are available with step gauges.



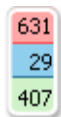
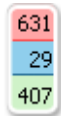

Designer displays information about the state of each step as the simulation proceeds. You can configure Process Simulation preferences to use image gauges or bar chart gauges. See [“Configure Process Simulation Preferences” on page 13.](#)

Designer displays the step gauges to the left of each step. The gauges are composites of graphics representing the following ratios:

Ratio	Description
 Bottleneck ratio	<p>The number of process instances waiting at the step compared to the number of process instances waiting AND processing at the step.</p> <p>On the image gauge: red arc</p> <p>On the bar chart: red bar</p>

Ratio	Description
Relative efficiency 	The number of process instances waiting OR processing at the step compared to the number of process instances processing. On the image gauge: blue arc On the bar chart: blue bar
Completed / status 	The percentage the step has completed compared to the number of processes created. On the image gauge: green bar with black squares On the bar chart: green bar

To the right of each step, Designer displays statistics corresponding to the following:

	Color	Description
	Red	The number of processes waiting at the step.
	Blue	The number of process instances that are active (processing or waiting) at the step.
	Green	The number of times the step has completed for all process instances that are running now or have run already.





At the top right of the design canvas, there are three more statistics:

Statistic	Description
Completed Instances	The number of process instances that have completed.
Created Instances	The number of process instances that have been created.
Active Instances	The number of process instances that are active (processing at steps) OR waiting at steps.

Process Simulation Recording and Playback

If you configure Process Simulation preferences to enable animation recording, Designer automatically records your simulation when you run it with animation.

When you play back a process simulation, you can use the following buttons:

Button	Description
	Search backwards
	Playback simulation
	Stop simulation
	Search forwards

There is no pause function; if you stop a simulation during playback, the simulation resets to the beginning.

There are two slider controls:

Slider Control	Description
Start - End	When you play back a process simulation file, the Start-End slider indicates the percentage of its progress, based on the length of the simulation file. You can move the slider forward and backward in the simulation file while you are playing a simulation recording.
Slow - Fast	When you play back a process simulation file, you can control the speed at which it runs using the Slow-Fast slider on the Process Simulation toolbar. Move the slider to the right to speed up, and to the left to slow down.

Note: Process simulation recordings are available for playback only during the Designer session in which they are recorded. You must run the simulations again in another session if you want to play them back again.

Process Simulation Performance Settings

The following topics contain important information about how you can optimize the performance of Process Simulation.

Any heuristic method for solving problems cannot guarantee that it will find the optimal solution. It might find a solution that is only close to the optimal solution, usually referred to as the *best solution*; this is why maximizing performance is critical.

Refer to the following topics for relevant factors that directly affect performance:

- [“Number of Decision Variables” on page 91](#)
- [“Initial Values” on page 92](#)
- [“Decision Variable Bounds” on page 92](#)
- [“Complexity of the Objective” on page 92](#)

- [“Constraints” on page 93](#)
- [“Feasibility” on page 93](#)
- [“Number of Replications and Simulations” on page 94](#)
- [“Simulation Accuracy” on page 94](#)
- [“Simulation Speed” on page 94](#)

Number of Decision Variables

The number of decision variables greatly affects Process Simulation performance. Process Simulation has no physical limit on the number of decision variables that can be used in any given problem. However, the performance might deteriorate if more than 100 decision variables are used.

Also, as the number of decision variables increases, more simulations are needed to find high-quality solutions. General guidelines for the minimum number of simulations required for a given number of decision variables in a problem are:

Number of Variables	Minimum Number of Simulations
Less than 10	100
10 - 20	500
20 - 50	2,000
50 - 100	5,000

You can also take the following actions:

- Increase the number of replications to increase accuracy
- Rerun the optimization

Another option is to de-select certain decision variables and optimize the remaining ones. If an optimization has already been run, there might be information available about which decision variables have the least effect on the objective function. When one or more decision variables is de-selected and the optimization is rerun, the search focuses on the remaining (more important) decision variables.

For very large numbers of decision variables, try this procedure:

- 1 Decrease the number of replication per simulation, at least initially.
- 2 Run the optimization to get an approximate solution.
- 3 Set the suggested values to the approximate solution.
- 4 Further restrict the bounds on the decision variables.

Initial Values

The initial values are the values listed as the **Starting Values** on the **Decision Variables** tab. Initial values are important because the closer they are to the optimal value, the faster Process Simulation can find an optimal solution. If the initial values are constraint-infeasible, they are ignored.

For potentially large models with many decision variables, it might be helpful to first run a simplified version of the optimization to find initial values for the full-scale model. For example, expected values could be used for some of the random variables in the model.

Decision Variable Bounds

Process Simulation performance can be significantly improved by selecting meaningful bounds for the decision variables. Suppose, for example, that the bounds for three decision variables (X, Y, and Z) are:

$$0 \leq X \leq 100$$

$$0 \leq Y \leq 100$$

$$0 \leq Z \leq 100$$

And in addition to the bounds, the following constraint applies:

$$10*X + 12*Y + 20*Z \leq 200$$

Although the optimization model is correct, the decision variables bounds are not meaningful. A better set of bounds for these decision variables would be:

$$0 \leq X \leq 20$$

$$0 \leq Y \leq 16.667$$

$$0 \leq Z \leq 10$$

These bounds take into consideration the values of the coefficients and the constraint limit to determine the maximum value for each decision variable. The new, tighter bounds result in a more efficient search for the optimal values of the decision variables. However, this efficiency comes at the expense of missing the optimal solution if it lies outside the specified bounds.

Complexity of the Objective

A complex objective has a highly nonlinear surface with many local minimum and maximum points. Process Simulation is designed to find global solutions for all types of objectives, especially complex objectives. However, for more complex objectives, generally it is required to run more simulations to find high quality global solutions.

Because only one value can be optimized, complex objectives must be defined within the model expressions.

Constraints

Constraints can be used to restrict the values of decision variables (model parameters) by defining relationships among the decision variables; constraints can also restrict the value of output variables (performance measures).

If a constraint is defined using only decision variables, Process Simulation can eliminate sets of decision variables values that are constraint-infeasible before it runs the simulation. Limiting the optimization by defining constraints on decision variables is extremely time-effective.

If a constraint contains a performance measure, a simulation must be run to determine whether the suggested solution satisfies the constraint. The search process benefits from the use of constraints on decision variables and tight bounds on decision variables. However, performance generally suffers when performance measure constraints are included in the optimization model for two reasons:

- Performance measure constraints are very time-consuming to evaluate, since Process Simulation must run an entire simulation before determining whether the results are constraint-infeasible.
- To avoid running constraint-infeasible simulations, Process Simulation must identify the characteristics of solutions likely to be constraint-feasible; this makes the search more complex and requires more time.

Even though performance measure constraints can greatly decrease the number of feasible simulations performed during an optimization, performance measure constraints can focus the search to effectively rule out undesirable solutions. If there are lots of performance measure constraints that Process Simulation can't easily satisfy, consider combining the output constraints into one multi-objective function.

Feasibility

Process Simulation considers finding a feasible solution the highest priority. After it finds a feasible solution, it then concentrates on finding better solutions. The fact that a particular solution may be infeasible does not imply that the problem itself is infeasible.

However, infeasible problems do exist. For example, suppose that in a Job Shop problem a foreman insists on finding an optimal configuration with the following constraints:

drills + grinders \leq 4

drills + grinders \geq 5

Clearly, there is no combination that will satisfy both of these constraints.

Or, for this same example, suppose the bounds for a decision variable are:

$3 \leq$ saws \leq 5

And a constraint is:

saws \leq 2

This also results in an infeasible problem. Process Simulation displays an error message and terminates infeasible optimizations.

Infeasible problems can be made feasible by fixing the inconsistencies of the relationships modeled by the constraints. Process Simulation detects optimization models that are constraint-infeasible and reports them.

If a model is constraint-feasible, Process Simulation will always find a feasible solution and search for the optimal solution (that is, the best solution that satisfies all constraints).

Number of Replications and Simulations

When Process Simulation runs an optimization, it runs a simulation to evaluate each set of decision variable (model parameter) values. Therefore, the quality of the optimization results depends on the number of simulations (iterations) and the number of replications per simulation.

For a set period of time, the number of replications per simulation is inversely related to the number of simulations; as one increases, the other decreases. Decreasing the number of replications can help increase the number of simulations.

The more simulations Process Simulation can run, the more sets of values it can evaluate, and the more likely Process Simulation is to find a solution close to the optimal solution.

Simulation Accuracy

There are two factors that affect simulation accuracy:

- Number of replications per simulation—for sufficient accuracy, the number of replications per simulation must be set to the minimum number necessary to obtain a reliable estimate of the objective function being optimized; this minimum number is typically found with empirical testing.
- Noisiness of the objective—this factor is caused by the probability distributions used to model the problem's uncertainty. In some cases, Process Simulation might have trouble discerning the minimum or maximum value. Noisy functions can be detected by watching for best solutions that seem to "bounce around" from one set of values to completely different sets of values. To help solve this problem, increase the number of replications per simulation.

Simulation Speed

Some suggestions for increasing speed include:

- Reduce the size of the model (or the duration of the simulation).
- Increase the system's RAM.
- Reduce the number of uncertain elements in the simulation.
- Close other applications.

