webMethods BPM Process Simulation Help

Version 10.7

October 2020

WEBMETHODS

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Table of Contents

About this Guide

Process Simulation is deprecated without replacement from release 10.7.

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 service names and locations in the format *folder.subfolder.service*, APIs, Java classes, methods, properties.
Italic	Identifies: Variables for which you must supply values specific to your own situation or environment. New terms the first time they occur in the text. References to other documentation sources.
`Monospace font`	Identifies: Text you must type in. Messages displayed by the system. Program code.
{ }	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 (...).

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1 About Process Simulation

Simulating a Process

Process Simulation is deprecated without replacement from release 10.7.

The webMethods Process 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 misspent 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 webMethods Process Development, which has its own help set. For general information about working with processes, see the *webMethods BPM Process Development Help* .

Process simulation is covered in the following main topics:

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 "Running 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. Simulations 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 13 describes simulation scenarios and their contents.
- "About Resources" on page 14 describes the various kinds of simulation resources and their definition.
- "About Costs" on page 14 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 16.

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 by a particular process step. When a consumable resource is acquired by a step, the resource is removed from the set of allocated resources. When a non-consumable resource, such as an office clerk, is acquired by a step, it is no longer available to other steps until the processing of that step is completed. This means that if you have only one office clerk and a 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 fixed cost for any use that 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.

Configuring 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 requires processing power you may want to use elsewhere. Running the simulation in the background and sending the results to a report enables 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 Process Simulation preferences as described in the following table:

Preference	Description
Enable animation recording	Check this box to enable Designer to record simulation sessions for playback. Enabled by default.
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.
Switch to the Process Simulation perspective when opening a simulation file	Choose **Always**, **Never**, or **Prompt**. Default is **Prompt**.

Preference	Description
Activity gauge type	Choose **Image Gauge** or **Bar Chart Gauge**. Default is **Image Gauge**. See "Step Gauges and Statistics" on page 87.

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 enables 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

The Process Simulation perspective provides several views that enable 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 Statistics view provides information about the number of completed, created, and active instances, as well as time and cost averages.
- The Optimize Statistics view provides information about progress toward objectives, as well as summary information.

For more information about these views, see "About Process Simulation Views" on page 17.

Additional step configuration is supported in the Properties view for various step types. The **Schedule**, **Scenario**, **Metrics**, and **Transition Distribution** pages enable you to finely tune your simulations. See "Configuring a Step Simulation" on page 59.

About Process Simulation Views

The Process Simulation perspective includes functionality that enables 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 tabs with settings for Run Settings and Statistics; and the Advanced Run Settings view contains tabs 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 "Configuring Process Simulation Preferences" on page 15. 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 enables 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 13.

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.

Note:
If a simulation is not open in the editor, the view displays the message, "Resource view is not available." Open a simulation to view its resources.

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

The following tool bar buttons are available in the Resource view:

- **Add resource to simulation**
- **Import resources from other simulations**
- **Remove resource from simulation**

After you have defined the resources for a simulation, you then configure the steps in the simulation to use them. For more information, see "Configuring a Step Simulation" on page 59.

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

The following table describes the **Resource** page fields in the Properties view:

Field	Description
Name	Unique resource name. Default is Resource1, Resource2, and so on.
Description	Optional description of the resource.
Available Units	How many units of the resource are available overall. Do one of the following: - Enter a static numeric value. - Click the browse button ... to open the Available Units dialog box for the selected resource. You can enter a constant or a variable, or select a distribution:

Field	Description
	■ 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** tab in the Advanced Run Settings view. ■ Click **Distribution** to select a distribution. You can select from the list and modify the available parameters. After you define your configuration, click **Finish**. **Note:** Descriptions of available distributions are provided in the selection dialog box and in "Distribution Reference" on page 22.

The following table describes the **Cost** page fields in the Properties view:

Field	Description
Consumable Resource	Select this check box if the resource is consumable. A consumable resource loses a portion of its available units when it is allocated to a step. For example, fuel is a consumable resource. An example of a resource that is not consumable is an employee. When you indicate that a resource is consumable, the **Fixed Cost** option is removed. You can set **Usage Cost** and **Variable Cost** without a **per period** value. **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.
Usage Cost	Usage costs include "fixed fee" 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: ■ Enter a static numeric value. ■ Click the browse button ... to open the Usage Cost dialog box for the selected resource. You can enter a constant or a variable, or select a distribution:

Field	Description
	■ 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. ■ 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** tab in the Advanced Run Settings view. ■ Click **Distribution** to select a distribution. You can select from the list and modify the available parameters. Descriptive text for each distribution type is shown on the Usage Cost dialog box and in "Distribution Reference" on page 22. After you define your configuration, click **Finish**.
Variable Cost	Variable cost is based only on the amount of the resource's capacity. Do one of the following: ■ 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: ■ 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** tab in the Advanced Run Settings view. ■ Click **Distribution** to select a distribution. You can select from the list and modify the available parameters. Descriptions of available distributions are provided in the selection window and in "Distribution Reference" on page 22 After you define your configuration, click **Finish**.
per Period	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. **Note:** The **per Period** option is not available for consumable resources.

Field	Description

Fixed Cost	This option is available only for non-consumable resources.
	
	A fixed cost is neither variable nor usage-based. Do one of the following:
	
	■ Enter a static numeric value.
	
	■ Click the browse button ... to open the Fixed Cost dialog box for the selected resource. 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 **Fixed 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** tab in the Advanced Run Settings view.
	
	  ■ Click **Distribution** to select a distribution. You can select from the list and modify the available parameters. Descriptions of available distributions are provided in the selection window and in "Distribution Reference" on page 22.
	
	When you have defined the configuration you want:
	
	■ 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	Select the profile that best describes the hours during which the activities in your simulation will take place: ■ **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).

Distribution Reference

Designer enables you to select from a list of distribution types when you configure a simulation resource distribution in the Properties view, and when you configure a simulation step scenario in the Properties view. The following distribution types are available:

Note:
The descriptions below are also available in the Usage, Variable, and Fixed Cost dialog boxes when you configure a resource in Designer:

The following table describes the distribution types.

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.
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 *Simulation Modeling and Analysis (Third Edition)* by Law and Kelton (2000) for details. Furthermore,

Distribution	Description
	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 >= 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 >= 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].
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 < 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 < 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

Distribution	Description
	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 - 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 <= probability1 <= 1.0.
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 the 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 sth 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.

Distribution	Description
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.
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 shape1 > 0, shape1 = 0, or shape1 < 0, respectively. The Johnson SB distribution is closely related to the classical normal distribution - see the book *Simulation Modeling and Analysis (Third Edition)* by Law and Kelton (2000) for details. Parameter restrictions are shape2 > 0.0 and maximum > 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 shape1 > 0, shape1 = 0, or shape1 < 0, respectively. The Johnson SU distribution is closely related to the classical normal distribution - see the book *Simulation Modeling and Analysis (Third Edition)* by Law and Kelton (2000) for details. Parameter restrictions are scale > 0.0 and 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 shape > 2. Parameter restrictions are scale > 0.0 and 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 shape > 2. Parameter restrictions are scale > 0.0 and 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 shape > 2. The Pearson type V distribution is closely related to the gamma distribution. See the book *Simulation Modeling and Analysis (Third Edition)* by Law and Kelton (2000) for details. Parameter restrictions are scale > 0.0 and 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 shape2 > 2.The Pearson type VI distribution is closely related to the beta distribution. See the book *Simulation Modeling and Analysis (Third Edition)* by Law and

Distribution	Description
	Kelton (2000) for details. Parameter restrictions are scale > 0.0 and shape1 > 0.0.
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.

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

You can configure the following fields:

On the **Run Settings** tab, as described in the table below:

Field	Description
Period	Select a **Date Range** or **Duration** in which to run your simulation. **Tip:** Date and time formatting are 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.
Start	Click the calendar button and select a date, or type a start date, and then (optionally) a start time. The default date value is the creation date of the simulation, and the default time value is 12:00:00 AM.
End	Available only for the **Date Range** period. Click the calendar button and select a date, or type an end date, and then (optionally) an end time. The default date value is the creation date of the simulation, and the default time value is 12:00:00 AM.
Duration	Available only for the **Duration** period. Enter the amount of time you want your simulation to run in months, days, hours, minutes, and seconds. The default is 3 months.
Update Frequency	Select the update frequency for the simulation run. Select **Milliseconds**, **Seconds**, **Minutes**, **Hours**, **Days**, **Weeks**, **Months**, or **Years**. The default value is **Hours**.

Field	Description
	This setting specifies how often to refresh the animation and write information to the simulation recording file. You are advised to use the same value that is configured for the **Time Interval** property on the **Schedule** page of the process start step. **Tip:** If you encounter performance issues while running a simulation with animation, it may help to increase the **Update Frequency** value or unit of measure. For example, if it is set to **Hours**, try increasing the number of hours, or changing the unit of measure to **Days** or **Weeks**. See "Configuring a Step Simulation" on page 59 and " Process Simulation Recording and Playback" on page 89.

On the **Statistics** tab, as described in the table below:

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	Select the cost period frequency of the simulation. Options are **Weekly**, **Monthly**, **Quarterly**, **Half-Yearly**, and **Yearly**. The default is Quarterly. This setting controls how often resource costs are updated in the Statistics view, and is used in aggregating resource costs in the Simulation report. For more information, see "About the Statistics View" on page 36 and " Process Simulation Reporting" on page 69.
Simulation Time Unit	Select the default time unit for the simulation clock: **Milliseconds**, **Seconds**, **Minutes**, **Hours**, **Days**, **Weeks**, **Months**, or **Years**. The default value is **Hours**. Adjust this unit of measure to be larger or smaller, depending on the length of execution time you expect for the steps in the simulation (for example, weeks or milliseconds). **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 the same

Field	Description
	time unit of measure that is configured for the step **Processing Time** property on the **Scenario** page in the Properties view. For more information, see "Configuring a Step Simulation" on page 59.

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.

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

The Advanced Run Settings view contains three tabs:

- The **Variables** tab. For more information, see "About the Variables Tab" on page 29.

  When you use a variable data source, you must specify its default value. No further configuration is necessary. 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.

- The **Historical Data** tab. For more information, see "About the Historical Data Tab" on page 32.

  A historical data source 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 "Configuring Your System to Use Historical Data" on page 53.

- The **Optimization** tab. For more information, see "About the Optimization Tab" on page 33.

  An optimized data source 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 benefit in doing this.

About the Variables Tab

The table on the **Variables** tab 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 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** tab 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.

The following table provides information for each **Variable Name** on the **Variables** tab:

Field	Description
Referenced Component	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. This value is not editable. 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`.
Data Source	The **Data Source** of the variable: ■ **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.
Value	The **Value** column is populated after you specify the **Data Source** information. **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. The column values are not editable. **Important:** You cannot undo the Clear Values action described below! To clear data values, click one of the following buttons: ■ **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. The following table lists those fields:

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, as described in the following table:

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 listed in the following table 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

Note:

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 Tab

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.

The following table describes data ranges on the **Historical Data** tab:

Data Range	Description
Start	Click the calendar button and select a date, and then (optionally) a start time, or type a start date. The default date and time value is the creation date and time of the simulation. For any other date, the default time value is 12:00:00 AM.
End	Click the calendar button and select a date, and then (optionally) an end time, or type an end date. The default date value is one month after the creation date and time of the simulation.
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** tab in the Advanced Run Settings view contains a list of all variables defined on the **Variables** tab for which a Historical Data Source is selected. The information it contains about each **Variable Name** is listed in the following table:

Field	Description
Process Name	The name of the process where the variable is defined. This value is not editable.
Referenced Component	The name of the component (that is, the step label) referenced by the variable. This value is not editable.
Source	The **Source** from which the variable should be loaded: ■ **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. You can choose to load historical data from either source, but not both, in a single simulation.

An **Extract to BPMS** button becomes available when a **Source** is specified. For more information, see "Loading Historical Data from BPMS to Create a Fit Distribution" on page 54

webMethods Monitor 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 Tab

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

- The **Objective** tab. For more information, see "About the Objective Tab" on page 33
- The **Decision Variable Limits** tab. For more information, see "About the Decision Variable Limits Tab" on page 34
- The **Constraints** tab. For more information, see "About the Constraints Tab" on page 35
- The **Run Options** tab. For more information, see "About the Run Options Tab" on page 35

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

About the Objective Tab

The **Objective** tab 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 tab. For example, you might want to minimize (***Target***) the average (***Optimization Statistic***) queue wait time (***Target Value***). The following table lists the object values you can select from:

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 Tab

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** tab are the variables for which an Optimized Data Source is selected on the **Variables** tab in the Advanced Run Settings view.

Each listed **Decision Variable** has the settings described in the following table:

Field	Description
Start Value	The starting value for the variable. The variable's default value is used if you do not set this.
Lower Bound	The lowest acceptable value for the variable.
Upper Bound	The highest acceptable value for the variable.
Increments	The increment by which the variable value is increased. 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 as it could potentially result in 20,000 tests. An increment of 100 would enable your optimization to run in a more reasonable amount of time.

Note:

After you have configured the settings on the **Objective** and **Decision Variable Limits** tabs, you can run the optimization. However, you can configure additional settings on the **Constraints** and **Run Options** tabs.

About the Constraints Tab

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, as described in the following table:

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

The **Add Expression** button opens the Constraint Expression Builder window, where you can use logical expressions to define a complex constraint expression. For more information, see "Building a Constraint Expression" on page 57.

About the Run Options Tab

Run options enable you to fine-tune your simulation optimization runs. A simulation run is the entire run of the simulation defined by the simulation period defined in the Run Settings view.

You can set the following, as described in the table below:

Field	Description
Number of simulation runs per iteration	Specifies how many times you want to repeat the simulation for each simulation optimization during a single iteration. The default is 1. For example, suppose you configure your Run Settings to run the simulation for a month. If you 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. **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.
Maximum number of iterations	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.
Automatic stop	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.
Precision	Specifies how precise, or how close to your defined objective, you want your optimization value to be. The default is 0.001.
Run Optimization	Click **Run Optimization** when you are ready to run your optimization. The button name changes to **Terminate Optimization** while an optimization is running.

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.

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 87.

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

Statistics displayed for the overall simulation include the following fields, as described in the table below:

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** tab in the Run Settings view.

Statistics displayed for a selected activity (step) include the following fields, as described in the table below:

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

Field	Description
	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	
Resource Name	Resource Used Average Usage / Instance Maximum Usage / Instance Minimum Usage / Instance Period Cost Total Resource Cost **Note:** The **Cost Period Frequency** on the **Statistics** tab 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. **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

Field	Description
	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.
TOTAL ACTIVTY COST	
	Total cost of all resources used on the step, expressed in value set for **Currency Name** on the **Statistics** tab in the Run Settings view.
ACTIVITY THRESHOLDS	
	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 determine a process time. 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.

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 by clicking the Run Optimization button in the view toolbar.

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

The Optimize Statistics view provides the information listed in the following table:

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

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

2 Working with Process Simulations

Working 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 actions listed in the following table:

To do this	See this information
1. Create a process	"Creating Processes" in *webMethods BPM Process Development Help*
2. Create a simulation file	"Creating a Process Simulation from an Open Process" on page 45 "Creating a Process Simulation File" on page 46
3. Configure the simulation	"Configuring Process Simulation Preferences" on page 15 "Configuring a Process Simulation" on page 51 "Configuring Process Simulation Properties" on page 58 "About the Resources View" on page 19 "About the Run Settings View" on page 27 "About the Advanced Run Settings View" on page 29
4. Configure step scenarios	"Configuring a Step Simulation" on page 59
5. Run the simulation	"Running a Process Simulation " on page 68

To do this	See this information
6. Interpret the results	"About the Statistics View" on page 36 "About the Optimize Statistics View" on page 39 " Process Simulation Reporting" on page 69
7. Repeat steps 3-6	"Updating a Simulation from a Process" on page 48

Creating 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 "Creating 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 "Configuring 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 "Configuring Process Simulation Preferences" on page 15.

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

Creating 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 "Creating 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 "Configuring 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 "Configuring Process Simulation Preferences" on page 15.

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

Adding 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 "Configuring Process Simulation Preferences" on page 15.

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.

Removing 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**.

Updating 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 "Updating 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.

Updating 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.

Importing 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 > > 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**.

Exporting 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 > > 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**.

Working with a Process Simulation in the Solutions View

Using the Solutions view, you can perform the actions listed in the following table 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.

To	Take this action in the Solutions view
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*.

Configuring 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.

The following table explains how to configure the settings of a process simulation.

To configure	Follow these procedures
Processes in a simulation	To add processes to simulations, see "Adding a Process to a Simulation" on page 47. To remove processes from simulations, see "Removing a Process from a Simulation" on page 48. To update processes in simulations, see "Updating a Simulation from a Process" on page 48.
Process simulation default settings	Process simulation default settings are configured in Process Simulation preferences, and control enabling animation recording for playback, automatic perspective switching, and step gauge type. See "Configuring Process Simulation Preferences" on page 15 and "Step Gauges and Statistics" on page 87.

To configure	Follow these procedures
Process simulation resources	Process simulation resources include the **Resource** and **Cost** pages in the Properties view for each resource configured in the Resources view. See "About the Resources View" on page 19.
Process simulation run settings	Process simulation run settings include the **Run Settings** and **Statistics** tabs in the Run Settings view and the **Variables**, **Historical Data**, and **Optimization** tabs in the Advanced Run Settings view. The Optimization tab has four tabs of its own: **Objective**, **Decision Variable Limits**, **Constraints**, and **Run Options**. **Tip:** If you are not using variables in your simulation, you do not need to use the **Variables** tab. If you are not using historical data in your simulation, you do not need to use the **Historical Data** tab. If you are not using optimizing your simulation, you do not need to use the **Optimization** tab. 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.
Process simulation properties	Process simulation properties include the **General** and **Metrics** pages in the Properties view. See "Configuring Process Simulation Properties" on page 58.
Step schedules	Step schedules for receive tasks, start events, and intermediate events include the **General**, **Schedule**, and **Transition Distribution** pages in the Properties view. In simulation reports, these are grouped as Start Step Schedules and Intermediate Step Schedules. **Note:** End events have neither schedules nor scenarios. Likewise send tasks. These are all throwing events. See "Configuring a Step Schedule" on page 60.
Step scenarios	Step scenarios for most activities (tasks other than send and receive, call activities (including referenced processes), and subprocesses) include the **General**, **Schedule**, and **Transition Distribution** pages in the Properties view. See "Configuring a Step Simulation" on page 59.
Transition Distribution	Transition distributions for simulated transitions govern the behavior of the simulation.

To configure	Follow these procedures
	See "Configuring a Transition Distribution" on page 62.
Gateways	Gateways are specialty transitions, and are configured on the **Transition Distribution** page like other transitions. See "Configuring a Gateway" on page 63.

Working with Historical Data

Configuring 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 Software AG 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 Software AG 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 (pushSimInstAcccum, 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*.

Loading 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** tab, 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** tab. 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.

Loading 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** tab, 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 Server s**).

   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.

Working with Optimized Data

Defining 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 tab. 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.

Configuring 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.

Adding 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.

Modifying 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.

Deleting 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.

Building a Constraint Expression

Important:
Constraints can be defined only for Optimized variables, as specified in the **Data Source** column on the **Variables** tab. If the **Add Expression** button is disabled, check to make sure you have an Optimized variable defined.

To build a constraint expression

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

2. Click **Add Expression**.

3. In the Constraint Expression Builder dialog box, type a **Constraint Name**.

4. Create a constraint expression as follows doing the following:
   - Select a variable from the **Decision Variables** list to add it to the expression string. This list displays all of the available Optimized variables.
   - Click the operator and function buttons to add them to the expression string.
   - Type numeric values on your keyboard. Optionally, you can type the variable, operation, and function terms into the expression field as well.
5. Use the **Validate** button to check expression you create.
6. Click **OK** to save your expression and close the Constraint Expression Builder window.

   To modify or delete a condition expression, see "Modifying or Deleting a Constraint Expression" on page 58.

Modifying or Deleting a Constraint Expression

To modify or delete a constraint expression

1. In Designer, open the Advanced Run Settings view and click the **Optimization** tab, then click the **Constraints** tab.
2. For the constraint expression you want to work with:
   - Click **Edit** to modify the expression.
   - Click **Delete** to delete the expression.
3. Save the simulation to apply your changes.

Configuring 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 fields as described in the table below:

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** tab in the Run Settings view. See "About the Run Settings View" on page 27.

Configuring 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:

- "Configuring a Step Schedule" on page 60
- "Configuring a Step Scenario" on page 62
- "Configuring a Transition Distribution" on page 62
- "Configuring a Gateway" on page 63

Configuring 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 fields in the Step Schedule section as described in the following two tables:

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** tab 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.**

Field	Description
	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	Specifies the time period at which the receive step runs (that is, the amount of time between the **Quantity** of processes started). 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: ■ 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** tab 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.
Hours	Specifies the unit of time used to measure the **Time Interval** Default is **Hours**. You can also select **Milliseconds**, **Seconds**, **Minutes**, **Days**, **Weeks**, **Months**, and **Years**.

5. On the **Schedule** page in the Properties view of intermediate steps, configure the fields in the Step Schedule section as described in the following table:

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

Configuring 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.

Configuring 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 fields described in the table below:

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.

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.

Configuring 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.

Tip:

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 fields described in the table below:

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 Running Process Simulations

Running a Process Simulation

After you create and configure a process simulation, you can run it to determine the results of your configuration. If you run it with animation, you can watch its progress in the simulation editor and generate a report when the simulation has completed. Alternatively, 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 animate** on the simulation editor 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 simulation editor toolbar displays the elapsed run time of the process you are simulating.

Designer displays a **Threshold Exceeded** warning on a 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.

Rearranging 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.

Important:
In a process simulation, do not move steps from one swimlane to another.

If you update a simulation with the original process model, the steps in the simulation will be returned to the order shown in the process model. For more information, see:

- "Updating a Simulation from a Process" on page 48
- "Updating a Simulation from the Outline View" on page 49

For purposes of consistency, you are advised to always rearrange steps in the original process and then update the simulation. This method ensures your process model and your simulation are always synchronized.

About Animation Slider Controls

The process simulation editor provides two slider control in the tool bar area:

Note:
You can use these slider controls only when playing back a recorded process simulation file. For more information, see " Process Simulation Recording and Playback" on page 89.

- A Slow-Fast slider. This slider is used only to control the animation speed during playback.
- A Start-End slider. This slider indicates the percentage of the simulation progress for a running simulation, 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. You cannot move the slider while a simulation is running.

Process Simulation Reporting

Designer offers real-time reporting in the form of step gauges and statistics in the simulation editor. These components are displayed 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 **Simulate and report (without animation)** in the main toolbar 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 70
- "Simulation Results - Activity 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 84
- "Simulation Results - Optimization Results" on page 86

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

The following table describes the fields in Process Level worksheet:

Field	Description
Simulation Results - Activity Level	
Times, Costs, Counts	All time values use the unit configured for **Simulation Time Unit** on the **Statistics** tab in the Run Settings view. All cost values use the unit configured for **Currency Name** on the **Statistics** tab 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** tab 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.
Avg	The average units consumed of each resource for each process.
Max	The maximum units consumed of each resource for each process.

Field	Description
Min	The minimum units consumed of this resource for each process.
Total	The total number of units consumed of this resource for each process.
Cost in <*Currency Name*>	The **Currency Name** is configured on the **Statistics** tab 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 for each process.
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 for each process.
Busy %	The percentage of time the resource was in use (actively doing something) for each process.
Unavailable %	The percentage of time the resource was being requested for each process but was unavailable as it was being used elsewhere.

Simulation Results - Activity Level

If there is more than one process in the simulation, the following information is provided for each of those processes. The Activity Level worksheet provides results for each BPMN activity step in the simulation, as follows in the table below:

Field	Description
Simulation Results - Activity Level	
Times, Costs, Counts	
Activities	A row is created for each BPMN activity step in the process.
Cycle Time	The total amount of time that the activity step waited and processed (**Processing Time** + **Wait Time**).
Avg	The average amount of time that the activity step waited and processed.
Max	The maximum amount of time that the activity step waited and processed.

Field	Description
Min	The minimum amount of time that the activity step waited and processed.
Processing Time	The amount of time the activity 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 activity step was processing something.
Max	The maximum amount of time the activity step was processing something.
Min	The minimum amount of time the activity step was processing something.
Wait Time	The amount of time the activity step waited for a resource before starting.
Avg	The average amount of time the activity step waited for a resource before starting.
Max	The maximum amount of time the activity step waited for a resource before starting.
Min	The minimum amount of time the activity step waited for a resource before starting.
Completed Instances	
Completed	The number of completed instances of the activity step during the entire simulation.
Cost in <*Currency Name*>	The **Currency Name** is configured on the **Statistics** tab in the Run Settings view.
Avg	The average cost required by the activity step during the entire simulation.
Resource Utilization	The resources used at this activity step during the entire simulation.
Activity / Resource	A row is created for each activity step and resource in the process.
Consumption	The amount of resources consumed at this activity step during the entire simulation.
Avg	The average amount of a resource consumed at this activity step during the entire simulation.
Avg not TW	The average amount of a resource consumed at this activity step during the entire simulation, without Time Weighting (TW).

Field	Description
	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.
Max	The maximum amount of a resource consumed at this activity step during the entire simulation.
Min	The minimum amount of a resource consumed at this activity step during the entire simulation.
Total	The total amount of a resource consumed at this activity step during the entire simulation. If more than one type of resource is acquired by an activity step, the report displays another row.
Cost in <Currency Name>	The **Currency Name** is configured on the **Statistics** tab in the Run Settings view.
Cost Per Unit	The total cost per resource unit for the activity step during the entire simulation.
Total	The total cost for the activity step during the entire simulation.
Utilization	The percentage of time each resource was in use by the activity 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 activity step.
Busy %	The percentage of time the resource was in use by the activity step (actively doing something).
Unavailable %	The percentage of time the resource was being requested by the activity step but was unavailable as it was being used elsewhere.

Simulation Results - Swimlane Level

This worksheet is present only if swimlanes are used in the simulation. If more than one process in the simulation contains swimlanes, the following information is provided for the swimlanes in each of those processes.

The following table describes the fields in Swimlane Level worksheet:

Field	Description
Simulation Results - Swimlane Level	

Field	Description
Times, Cost, Counts	
Swimlanes	A row is created for each swimlane in the process.
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.
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.

Field	Description
Resource Utilization	The resources used by steps in the swimlane during the entire simulation.
Swimlane / Resource	A row is created for each resource used in each swimlane.
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.
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

If there is more than one process in the simulation, the following information is provided for each of those processes.

The following table describes the fields in Potential Bottlenecks worksheet:

Field	Description
Simulation Results - Potential Bottlenecks	
Processes	Provides information for each process in the simulation. The information on this page is filtered by enabled process thresholds.
Processing Time in <*Simulation Time Unit*>	The amount of time it took for the entire process to process. The **Simulation Time Unit** is configured on the **Statistics** tab 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 <*Currency Name*>	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.
Activities	To be displayed here, an activity 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 <*Simulation Time Unit*>	The amount of time the activity 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 activity step.
Avg	The average **Processing Time** for the activity step.
Queue Wait Time (in <*Simulation Time Unit*>)	The amount of time each activity step instance waited to be processed. The **Simulation Time Unit** is configured on the **Statistics** tab in the Run Settings view

Field	Description
Threshold	The **Queue Wait Time Threshold** for the activity step.
Avg	The average **Queue Wait Time** for the activity step.
Queue	The number of activity step instances waiting to be processed.
Threshold	The **Queue Threshold** for the activity step.
Avg	The average **Queue** for the activity step.
Cost in <*Currency Name*>	The cost incurred by the activity step. The **Currency Name** is configured on the **Statistics** tab in the Run Settings view.
Threshold	The **Cost Threshold** for the activity step.
Avg	The average **Cost** for the activity step.

Simulation Results - Simulation Settings

If there is more than one process in the simulation, the following information is provided for each of those processes.

The following table describes the fields in 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** tab 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** tab 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** tab in

Field	Description
	the Run Settings view. Options are **Hours**, **Days**, **Weeks**, **Months**, and **Years**.
Simulation Resources	
Resource / Description/ Available Units	A row is created for each resource in the simulation.
Default Value	The default value set for the resource in the *<Resource Name>*: 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.
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.
Consumable	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.
Downtime Profile	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**.
Cost in *<Currency Name>*	
Fixed Cost per Time Unit	
Default Value	The default value set for the resource in the *<Resource Name>*: Fixed Cost window, accessed from the **Fixed Cost** field on the Cost page in the Properties view of the resource.

Field	Description
	The **Default Value** displays the **Variable** name if a variable name is configured as the default.
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.
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	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. The **Default Value** displays the **Variable** name if a variable name is configured as the default.
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.
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**.

Field	Description
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.
Usage Cost	
Default Value	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. The **Default Value** displays the **Variable** name if a variable name is configured as the default.
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.
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. Options are: **Milliseconds**, **Seconds**, **Minutes**, **Hours**, **Days**, **Weeks**, **Months**, and **Years**.
Cost Threshold	Specifies an average cost; when this value is exceeded, a notification appears in the simulation report. Configured in the **Cost Threshold** field on the Metrics page in the Properties view of the process.
Schedules	

Field	Description
Start Step Schedules	Contains an entry for each starting event in the process.
Event	The name of the event step.
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.
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.
Time Unit	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**.
Quantity/Default Value	The default value set for the input to the step in the <*Start Step Name*>: Quantity window, accessed from the **Quantity** field on the **Schedule** page in the Properties view.
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.
Transitions Taken	The transition(s) taken from this step, or, the destination of the transition, or, notice that this is an end step with no transitions.

Field	Description
Probability Percentage	The percentage of probability that the **Step Transitions Taken** would occur. Configured on the **Transition Distribution** page in the Properties view of the step.
Distribution Type	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.
Intermediate Step Schedules	This section provides the same information as the Start Step Schedules portion of the worksheet, except that intermediate-type steps are listed.
Step Scenarios	Contains an entry for each activity step in the process.
Activity	The name of each activity step in the process.
Processing Time in <*Time Unit*>	
Default Value	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.
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.
Time Unit	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**.

Field	Description
Processing Time Threshold	Configured in the **Processing Time Threshold** field on the **Metrics** page in the Properties view of the step.
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	The number of process instances that can be waiting to be processed at the step; if this value is exceeded, it indicates a bottleneck and generates a notification in the simulation report. Configured in the **Queue Threshold** field on the **Metrics** page in the Properties view of the step.
Queue Wait Time Threshold	The average wait time for process instances at the step; if this value is exceeded, a notification appears in the simulation report. 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	The average cost; when this value is exceeded, a notification appears in the simulation report.Configured in the **Cost Threshold** field on the Metrics page in the Properties view of the step.

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.

The following table describes the fields in Optimization Settings worksheet:

Field	Description
Simulation Results - Optimization Settings	

Field	Description
Objective Settings	These values are displayed on the Objective tab of the Optimization page in the Advanced Run Settings view. See "Defining 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 "Configuring Decision Variables" on page 56.
Variable Name	Selected **Variable Name**.
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 "Configuring 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. "Configuring 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 "Configuring Decision Variables" on page 56.

Field	Description
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 "Configuring Decision Variables" on page 56.
Performance Measure	Selected **Performance Measure**.
Optimization Statistic	Selected **Optimization Statistic**.
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.

The following table describes the fields in 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 "Configuring Decision Variables" on page 56.
Variable Name	Defined **Variable Name**.

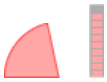
Field	Description
Referenced Component	Selected **Referenced Component**.
Data Source	**File** or **BPMS**.
Best Value	The best value based on the variable input.
Performance Constraints	These values are displayed on the Constraints tab on the Optimization page in the Advanced Run Settings view. See "Configuring Decision Variables" on page 56.
Performance Measure	
Optimization Statistic	
Best Value	The best value based on the performance constraints.
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 "Configuring 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, as explained in the following table.

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 "Configuring Process Simulation Preferences" on page 15.

Designer displays the step gauges to the left of each step. The gauges are composites of graphics representing the ratios listed in the table below:

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

The following table lists the statistics that Designer displays to the right of each step:

	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, as listed in the following table:

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 buttons listed in the following table:

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, both described in the following table:

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 90
- "Initial Values" on page 91
- "Decision Variable Bounds" on page 91
- "Complexity of the Objective" on page 92
- "Constraints" on page 92
- "Feasibility" on page 92
- "Number of Replications and Simulations" on page 93
- "Simulation Accuracy" on page 93
- "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 listed in the following table:

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 <= X <= 100

0 <= Y <= 100

0 <= Z <= 100

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

10*X + 12*Y + 20*Z <= 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 <= X <= 20

0 <= Y <= 16.667

0 <= Z <= 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 <= 4

drills + grinders >= 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 <= saws <= 5

And a constraint is:

saws <= 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.