iGrafx® 2007

# Simulation Quick Reference Guide

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# Modeling and Simulation

The methodology for analyzing a process with simulation includes these basic steps:

1 Identify goals, objectives, and scope of the project.
2 Gather data on the existing process through interviews and measurements.
3 Build a model of the current process that approximates process performance when simulated.
4 Perform simulation what-if analysis by making changes to the model and running simulations.
5 Present your results and recommendations for potential changes to the current process.

In the above methodology, building a model involves these basic activities:

1 Create the process diagram using departments, shapes, and connector lines. (See Creating a Process Diagram (Map or Flowchart).)
2 Describe the behavior of each activity.
3 Describe the simulation environment the process lives in through the Scenario.
4 Execute a simulation and analyze the results in the Report.

## Creating a Process Diagram (Map or Flowchart)

The Process diagram type supports all the features and functionality discussed in this guide. From the *File* menu, point to New and choose Process.

For a quick reminder on how to diagram with iGrafx, see the FlowCharter Quick Reference Guide at **www.igrafx.com/resources/UserGuides**.

 Selector cursor: Click the left mouse button to select an object.

###  Departments

1 Click the Departments icon in the Toolbox toolbar (the vertical toolbar on the left side of the window).
2 Choose Insert Department.

3 In the Insert Department dialog box, name the departmentand click OK, or click the Apply button to add more departments.

## Add a Shape or Symbol

1 Click a shape icon in the Toolbox toolbar.

2 Move the cursor into the process window. The selector cursor changes to the placement cursor

3 Click-and-drag the left mouse button to precisely place the shape on the diagram.

4 Start typing to enter text in the selected shape.

## Connect Shapes/Symbols

Click and drag the selector tool from inside the source shape to the destination shape. The selector cursor changes to  . When you release the mouse button, the line is automatically routed.

## Enter or Modify Text in a Shape or on the Process Diagram

Select the shape and start typing, then press the Esc key to finish.

## Display Shape or Activity Numbers

When you place a shape in a diagram, a number is automatically assigned to it.

- To display shape numbers, click on the Shape Numbering tool in the Toolbox toolbar and choose Show All Shape Numbers.
- To automatically renumber the shapes, click on the Shape Numbering tool in the Toolbox toolbar and choose Auto Renumber.

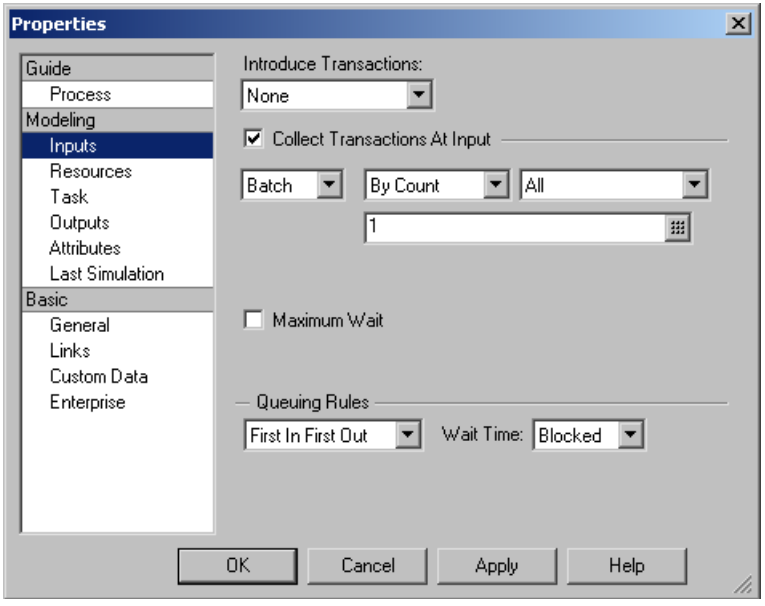
## Describing Activity Behavior

Most shapes represent activities and contain behavioral information. As a general rule, during simulation a transaction enters the activity and visits each page of the Modeling category in the Properties dialog box starting with Inputs and proceeding through the Last Simulation page.

The Process Guide (the Process page in the Guide category) provides quick entry of the most frequently modeled data. Modeling category pages most commonly used are Inputs, Resources, Task, and Outputs.

To display the Properties dialog box, double-click the left mouse button on a shape, or click the right-mouse button and choose Properties.

### Inputs Page: Describe how transactions are collected



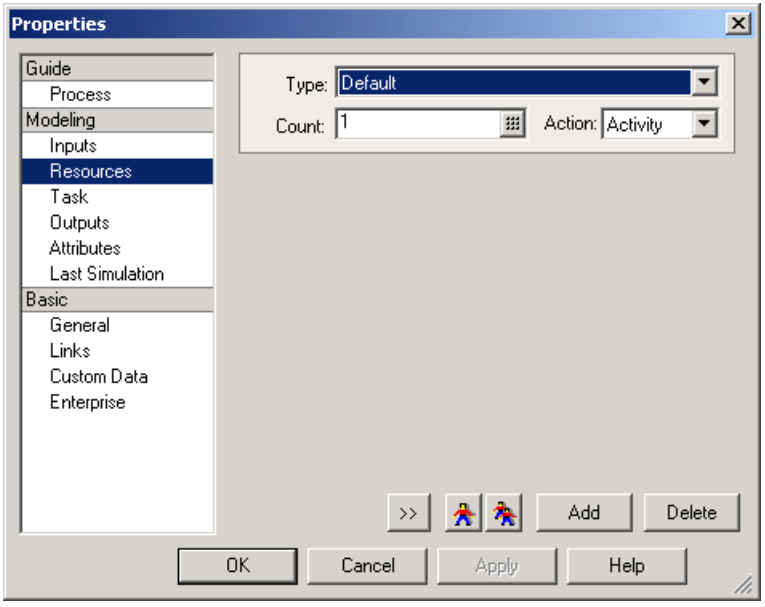
The default is no collection. The most common forms of collection used in modeling are:

| Collection Type | Behavior |
|---|---|
| Batch | Collect multiple transactions in a basket and carry them through the process. The On Completion tab of the Task page contains a command to Unbatch the transactions and empty the basket. |
| Join | Merge multiple transactions together into a single transaction. Some data is merged, including attributes. |
| Gate | Hold transactions at the gate until a condition is met and the gate is opened. |
| Group | Transactions can enter an activity individually, and they are tagged with a group name. |

**Introduce Transactions** defines a point in the process where transactions are introduced.

- **None** specifies that no transactions are generated here.
- **Using a Start Point** names the start point where generators introduce transactions into the activity.
- **Generate Here** tells the simulator to generate a transaction when a condition occurs, such as when an event happens or a period of time elapses.

## Resources page: Identify resources required to do work



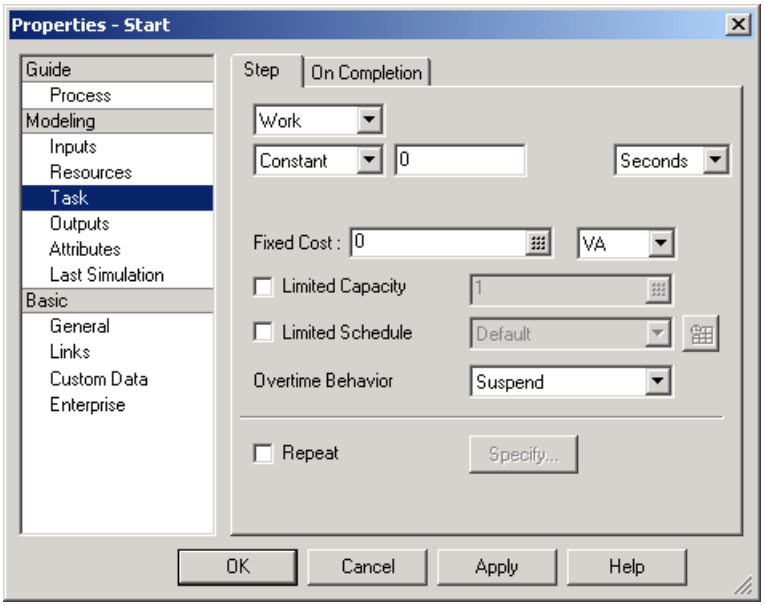

By default, iGrafx automatically creates and allocates a built-in resource named Worker to any newly created department as soon as you add activities that acquire a resource. The default resource type for a department is the first type allocated to it (first allocation listed on the Organizations tab). You can create other non-worker resource types such as Labor or Equipment in the Scenario.

The most important resource options are shown by default:

- Worker or other named resource (Default worker is the default resource type).
- How the resource is acquired. Usually the resource works for the activity.
- Number of resources required to work on each transaction processed.

Click the  button for more dialog box options, and click the Add button to specify that more than one type of resource is required for an activity. The Delete button removes a specified resource from an activity.

## Task page: Define the type of task the activity performs




Click the Step tab to set behaviors such as type of task, duration, and special handling used by most activities.

| Task Type | Behavior |
|---|---|
| Work | Uses a resource to work on a transaction for the duration of the Task. Reported as Work. |
| Process | Linked to a subprocess. During simulation, the transaction moves from this activity to a start activity on another diagram (subprocess). The transaction returns to this activity when it completes the subprocess. |
| Delay | Blocks the transaction for the duration of the Task. Delay tasks do not usually use a resource. |

To create a subprocess:

1 On the Task page, choose Process from the drop-down menu for task type.

2 Click the New Process button.

3 Enter a name for the process and click OK.

To view a subprocess, hold the Shift key and double-click the parent shape.

If the activity is Work or Delay, the task has duration. Default duration is zero (0).

| Duration Type | Behavior |
|---|---|
| Constant | The same (constant) duration value for all transactions. |
| Distributed | The duration value is a range with a minimum and maximum value. The duration may be uniformly or normally distributed between the two numbers:<br>• Uniform specifies every number between the two numbers has an equal probability of being used.<br>• Normal specifies a bell curve distribution, which is centered between the two numbers. |
| Expression | Equations can describe the duration of the activity. See Expressions in the iGrafx Help system. |

Value Class identifies the activity as value added, no value added, or business value added.

| Value Class | Definition |
|---|---|
| VA | Value Added–The resource is contributing to the creation or delivery of a product or service. The customer is willing to pay for this work. |
| BVA | Business Value Added–The resource is useful to the business but does not contribute directly to the product or service. This work does not add value for the customer. |
| NVA | No Value Added–This work adds no value. Lean methodology refers to this as muda. |

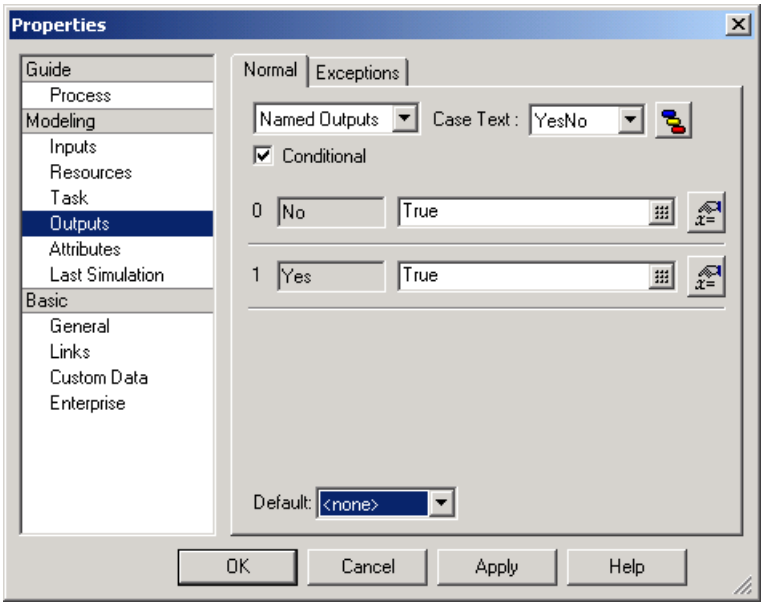
Task Capacity, Schedule, and Overtime Behavior define limits to the number of transactions processed and the processing time frame. These settings also describe activity behavior with regard to the defined schedule.

| Transaction Limit | Behavior |
|---|---|
| Limited Capacity | Limits the number of transactions that can be processed at one time. |
| Limited Schedule | Specifies whether the time frame of the activity is limited to a schedule. Resource schedules still apply for any resources required for the activity. |
| Overtime Behavior | Specifies how the activity behaves if resources go out of schedule. |

Use the On Completion tab to specify how transactions are handled when an activity completes. Some common choices are:

| Transaction Handling | Behavior |
|---|---|
| None | No output behavior is defined. |
| Duplicate | Copies a transaction into multiple (Count) identical transactions. |
| Discard | Terminates the transaction. The transaction is not counted as complete in the simulation report. |
| Unbatch | Undoes the Batch collection of transactions and removes each transaction from the collection. |

## Outputs page: Describe how transactions leave the activity




A transaction follows a directed connector line or lines out of an activity to the inputs of the next activity. The Normal tab, used on most activities, defines how transactions follow lines. The Exceptions tab specifies any special outputs.

These common choices on the Normal tab specify which paths a transaction follows to an activity:

| Output Type | Behavior |
|---|---|
| All | Sends the transaction down all paths that leave the activity. If more than one path exists, an implicit duplication occurs (iGrafx creates identical transactions and sends them down each path). |
| Decision | Sends transactions down one of the paths specified, based on percentages or expressions. |

These common choices on the Exceptions tab define conditions where the activity terminates early and the path to take:

| Exception Type | Behavior |
|---|---|
| None | No special exception occurs. This is the default. |
| Timer | Sets a time limit on performing the activity. Transactions follow the exception path if the limit is reached. The Timer may be disabled at various points in the execution of the activity. |

### Attributes page: Access to Transaction (local) and Scenario (global) location attributes

Provides access to attributes similar to programming variables that are used to communicate information and manage the flow of transactions through a process. For information, see various topics on attributes and expressions in the iGrafx Help system.

### Last Simulation page: View summary results for the activity from the last simulation

Summarizes statistics for the activity from the last simulation. See Properties dialog box - Last Simulation page in the iGrafx Help system.

## Describing the Simulation Environment Through Scenarios

A scenario describes the simulation environment for a process. A simulation uses a single scenario with one or more process diagrams. You can have several scenarios in one file for running what-if simulations or variations of a process.

To view scenarios, click the View Scenario button on the Modeling toolbar.
or
On the *File* menu, choose *Components* and double-click the scenario or right-click and choose *View*.

The most important sections in the Scenario are Run Setup, Generators, Resources, and the Schedules subsection under Calendars.

### Run Setup Section: Set simulation timing and how the results of simulation are placed in a report

Double-click the Run Setup section in the Scenario to display the run Setup dialog box. The most important options are the Simulation Time tab and Initialization/Reports tab.

On the Simulation Time tab:

| Control | Behavior |
|---|---|
| Simulation Start | Specifies when the simulation starts (default Weekday rather than a specific date). |
| Simulation End | Specifies when simulation stops (default Transactions Complete). Most often you'll want to set a specific duration for simulation (Custom). To set a custom end for simulation:<br>1 Choose Custom from the drop-down list.<br>2 Choose a duration time unit (for example, Hours).<br>3 Enter a duration (simulation end) value. |

On the Initialization/Reports tab, specify how the simulation results are saved to the report (default Create so results are replaced each time a simulation runs).

### Generators Section: Set up introduction of transactions into the process

During simulation, generators introduce transactions into the process. The most important option is Generator Type, which determines other data to specify. Common types are:

| Generator Type | Behavior |
|---|---|
| Completion | Introduces one or more transactions into the process when the previous transaction or transactions have completed processing. If you specify a maximum, places one transaction or a group of transactions at a time in the process until transactions reach the maximum count (default Max Transactions: 1). |
| Demand | Introduces a transaction whenever the named resource (for example, Worker) is available or not acquired in the department that has the Start activity for this generator. |

| Generator Type | Behavior |
|---|---|
| Interarrival | Specifies the duration of time between transactions arriving in the process. You may start with a simple Constant or Distributed interarrival time.<br><br>**Constant**: The same (constant) time between transactions entering the process.<br><br>**Distributed**: The time between transactions entering the process is a range between two values.<br><br>**Expression**: The expression can use math functions such as ExponDist() for exponential arrivals. |
| Timetable | Introduces transactions at specified intervals over a span of time. The table may be repeated.<br><br>Click the Modify Timetable button to modify the timetable generator. On the bar chart, the X-axis shows the time intervals and the overall time span, and the Y-axis shows the number of transactions introduced during each interval. Values of interest are:<br><br>**Total Span**: The total span of time covered by the timetable pattern given. For example, 1d (1 day) indicates that every day the given pattern should repeat.<br><br>**Time Resolution**: The smallest interval of time unit of time in the bar chart. |

## Resources: Create, modify, and manage resources used by the process

1 Double-click the Resources section in the Scenario to display the Define Resources dialog box.

2 Choose a task below and follow the procedure.

| Task | Procedure |
|---|---|
| Add a resource type | 1 On the Resource Types tab, click the Add button and choose Resource Type.<br>2 Enter the name of the new resource type. (Do not use special characters or spaces. The "_" character is allowed.)<br>3 Choose Labor or Equipment for the Classification. Other has limited use and is not recommended. |

| Task | Procedure |
|---|---|
| Modify a resource | 1 On the Resource Types tab, select the resource.<br>2 Click the Properties tab. If the resource use is Pool, specify the Count (number of that resource available to the process). On this tab, set the Schedule (when resources are available and inactive), and Cost (the hourly rate and/or hourly overtime rate for the resource), Overtime and Availability for the resource. |

### Schedules: Specify spans of active or inactive time

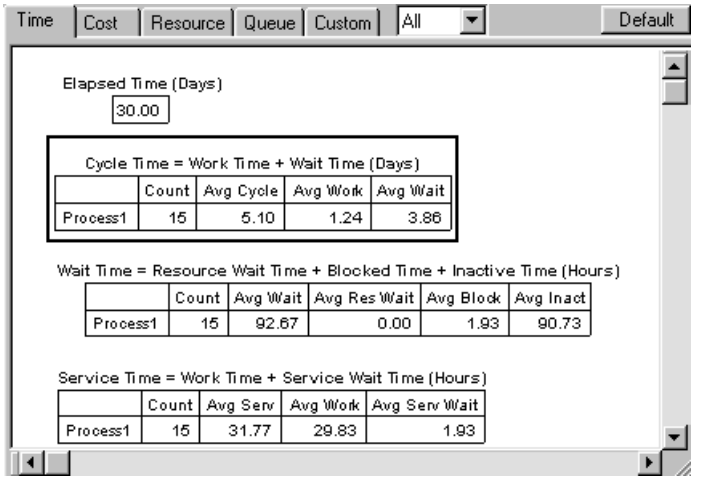
iGrafx provides several built-in schedules. See Calendars in the iGrafx Help system.

## Executing a Simulation and Analyzing Results

- **Run mode** runs the simulation for a specified amount of time or until all transactions are processed.
- **Trace mode** graphically shows the flow of transactions through a process diagram with changing activity colors.

| Task | Procedure |
|---|---|
| Run a simulation in Run mode | On the Model toolbar, click the ▸ tool<br>or<br>On the *Model* menu, point to *Run* and choose *Start*. |
| Run a simulation in Trace mode | On the Model toolbar, click the tool, and then click the ▸ tool on the Trace toolbar<br>or<br>On the *Model* menu, point to *Run* and choose *Trace*, then click the ▸ tool on the Trace toolbar.<br><br>On the *Control* menu, choose commands to change trace colors and set or remove pause points.<br><br>To leave Trace mode, on the Model toolbar, click the tool<br>or<br>On the *Model* menu, point to *Run* and choose *Trace*. |

## Viewing Simulation Results




*The Report Window*

Four of the Report tabs (Time, Cost, Resource, and Queue) contain sets of commonly used statistics captured during simulation. You can copy and paste an existing report element or create a new report element from the *Report* menu to appear on the blank Custom tab.

### Report Results

iGrafx gathers basic statistics about process times, costs, resources, and waiting lines or queues. You can create your own custom statistics. The basic statistics are categorized depending on whether they apply to transactions, resources, or activities (see the table below).

| Transaction | Resource | Activity |
|---|---|---|
| Completion Count | Number of Workers (Count) | Cycle Time (Avg, Tot) |
| Cycle Time (Avg, Tot) | Utilization (Util. %) | Work Time (Avg, Tot) |
| Work Time (Avg, Tot) | Busy Time (Avg., Tot.) | Wait Time (Avg, Tot) |
| Wait Time (Avg, Tot) | Idle Time (Avg., Tot.) | Costs (VA, NVA, BVA) |

| Transaction | Resource | Activity |
|---|---|---|
| Resource Wait Time (Avg, Tot) | Out Of Service Time (OOS) | # Trans.Wait (Tavg, Tot, Max) |
| Blocked Time (Avg, Tot) | Inactive Time (Avg, Tot) | # Trans. at Activity (Tavg, Max) |
| Inactive Time (Avg, Tot) | Overtime (OT) | # Transactions |
| Service Time (Avg, Tot) | Costs (Tot, Stdev, OT, Busy) | |
| Costs (VA, NVA, Labor, Equip) | | |

Place the cursor over a statistic heading in the report to view ToolTips that explain statistics in more detail. ToolTips do not explain summarizations like Min, Max, Average, and Total.

## Common Default Report Statistics

The following tables describe the most common default report statistics.

| Basic Transaction and Activity Time Statistics | |
|---|---|
| Work Time | Time accumulated doing work (Task page duration) |
| Resource Wait Time | Time accumulated waiting to obtain a resource (Resources page) |
| Blocked Time | Time accumulated waiting in collection (Inputs page) and in delay (Task page) |
| Inactive Time | Time accumulated waiting for a resource that is inactive or out of schedule |

| Composite Transaction and Activity Time Statistics | |
|---|---|
| Cycle Time | Blocked Time + Resource Wait Time + Inactive Time + Work Time |
| Service Time | Blocked Time + Resource Wait Time + Work Time |

| Composite Transaction and Activity Time Statistics | |
|---|---|
| Wait Time | Blocked Time + Resource Wait Time + Inactive Time |
| Service Wait Time | Blocked Time + Resource Wait Time |

| Basic Resource Time Statistics | |
|---|---|
| Busy Time | Paid time the resource is acquired, such as Active and Working (Task page Duration) |
| Idle Time | Paid time the resource is active and in schedule, but not busy |
| Out of Service | Paid or unpaid time the resource is scheduled to be active and also unavailable |
| Inactive Time | Remaining time when the resource is not schedule to be available or Out of Service |

## Naming a Simulation Run

1 From the  menu, choose Simulation Data.

2 Double-click the simulation run and type and new name.

## Copying (Exporting) Report Data to Other Applications

1 Click the report element or hold the Shift key and click to select multiple report elements.

2 Press Ctrl+C to copy, make the other application active, and press Ctrl+V to paste the report data. You may also right-click and choose Copy and Paste or Paste Special if available.