



WebSphere Education



Setting up and running simulations

Unit 18



Unit objectives

After completing this unit, you should be able to:

- Describe element behavior in simulation
- Create a snapshot
- Define simulation attributes
- Define simulation preferences

The diagram illustrates the WebSphere Business Modeler (WBM) architecture and its integration with other IBM Rational and WebSphere components. The central component is the **WebSphere Business Modeler** (highlighted with a thick orange border). It is connected to several other components:

- WebSphere Publishing Server**: Connected via a bidirectional arrow.
- WebSphere Business Monitor**: Connected via a bidirectional arrow.
- WebSphere Process Server**: Connected via a bidirectional arrow.
- WebSphere Integration Developer**: Connected via a bidirectional arrow.
- Rational RequisitePro**: Connected via a bidirectional arrow.
- Rational Data Architect**: Connected via a bidirectional arrow.
- Rational Software Architect**: Connected via a bidirectional arrow.
- External Data**: Connected via a bidirectional arrow.
- Rational ClearCase or CVS**: Connected via a bidirectional arrow.
- Rational Application Developer**: Connected via a bidirectional arrow.

The **WebSphere Business Modeler** also interacts with a **DB2** database, which is connected to the **WebSphere Business Monitor** and the **WebSphere Process Server**.

Element behavior in simulation

- Process time and cost
 - Accumulated from the attributes of all the included element attributes
 - Process attributes are used if there are no elements inside
- Service time and cost
 - Attributes determine how it performs work
- Task and map
 - Attributes determine the time and cost of its work
 - Escalations in human tasks are not evaluated
 - Business rules tasks are treated like generic tasks (business rules not evaluated)
- Timer, broadcaster, receiver, repository, timetable
 - Attributes affect the behavior of the process
- Decisions, merges, forks and joins
 - Use attributes to affect the flow of the process through probabilities or expressions
- Roles and resources
 - Determine time and cost based on specified allocations
 - Resource attributes take precedence over role attributes
 - In human task, primary owner is treated as a normal resource or role requirement

Role and resource behavior in simulations

- Costs for resources and roles
 - If you define costs for both resources and roles, the resource cost takes priority.
 - Role cost is used only if no other cost is associated with the resource.
 - For a process containing an activity that has a requirement for a role.
 - The resource cost of the activity is based on the cost of the qualified resource that is allocated to the activity.
- Resource and role allocations
 - There are no rules to govern the role or resource allocation for simulations.
 - If a process instance ends before an activity role or resource allocation time is complete, the roles or resources are de-allocated from the activity and can be allocated to another activity.
 - A role or resource allocation may be split into multiple intervals, if the allocated role or resource is not continuously available for the entire duration of the resource requirement.

Task duration and resource requirements

- Duration is used to determine cycle time.
- Resource time required is used to determine cost.

General Cost and Revenue **Duration** Inputs Outputs Resources

▼ Processing time

The length of time required to finish this task.

Specific value ▼

Days Hours Minutes

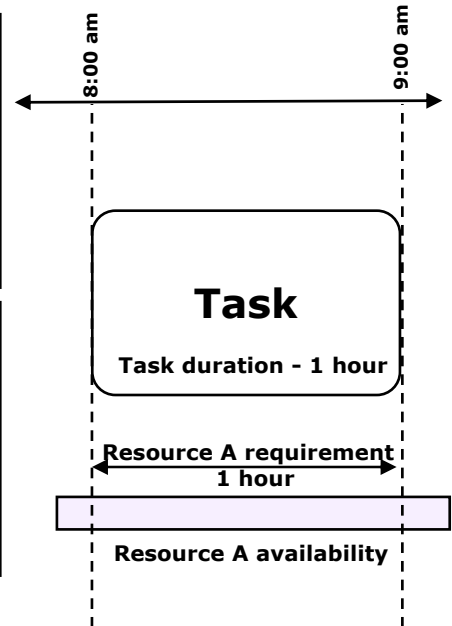
General Cost and Revenue Duration **Inputs** Outputs Resources

► Role requirements

▼ Individual resource requirements

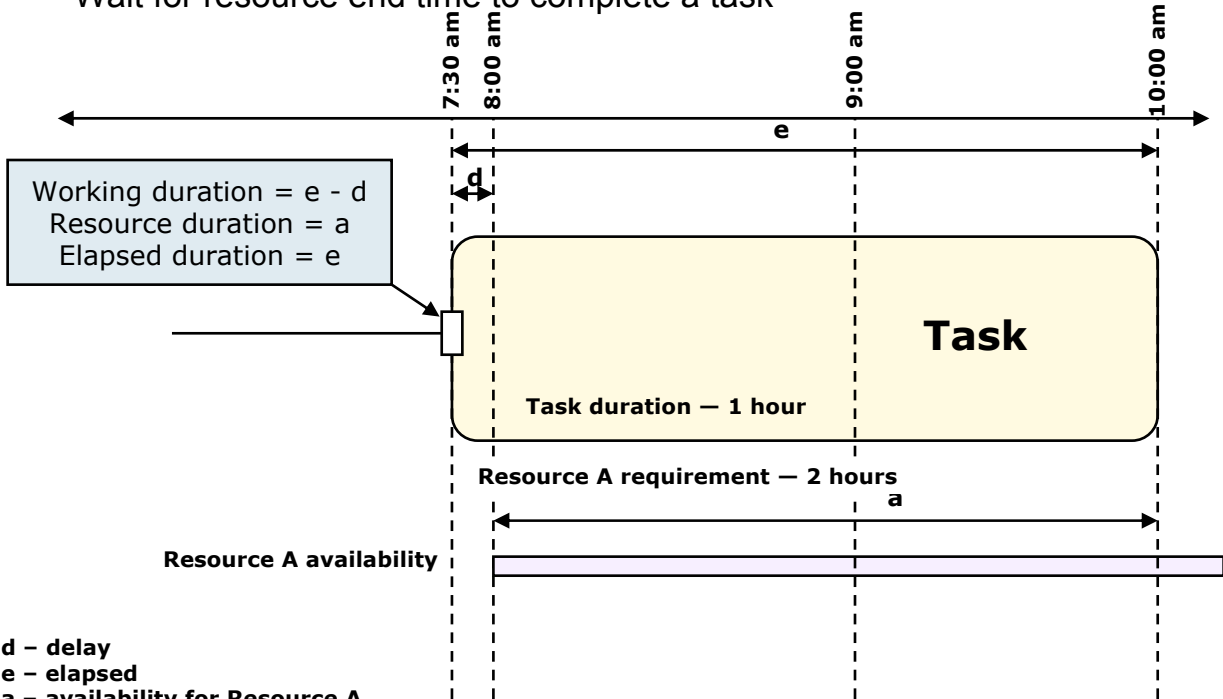
This section displays the list of individual resource requirements.

Name	Individual resource	Time required
Individual requirement: 1	Resource A	1 hour



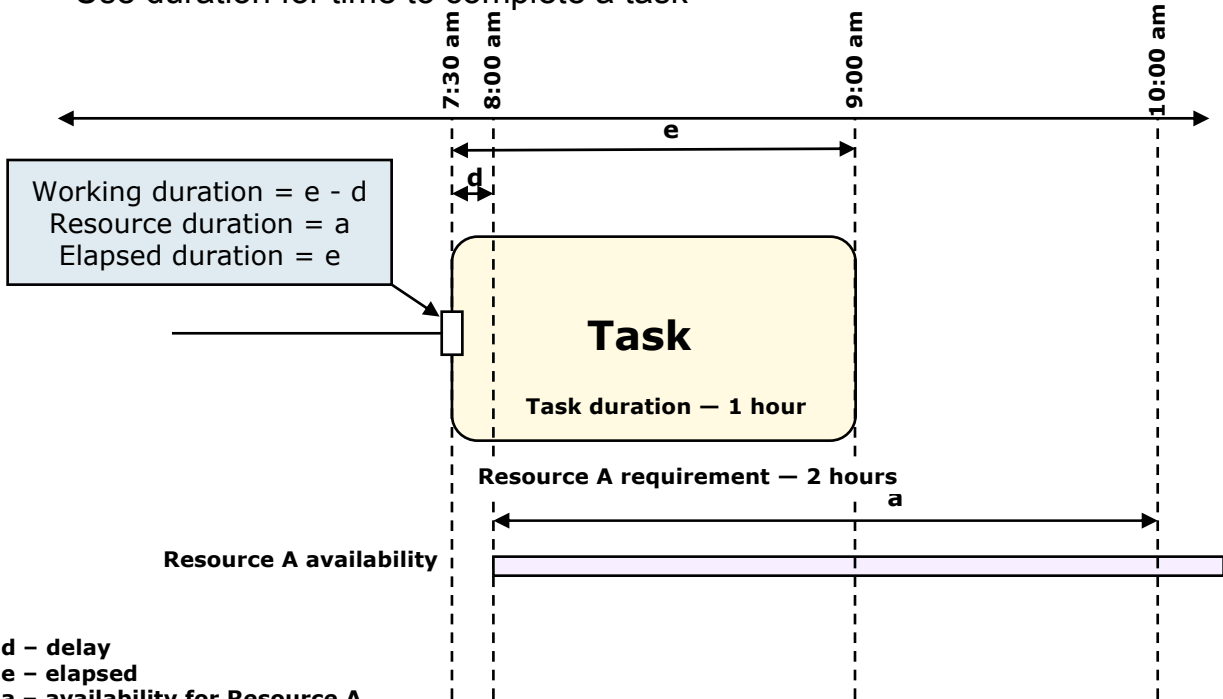
Single resource – task time equals resource time

- Use resources' time required as a task processing time
 - Set to “Yes”
 - Wait for resource end time to complete a task



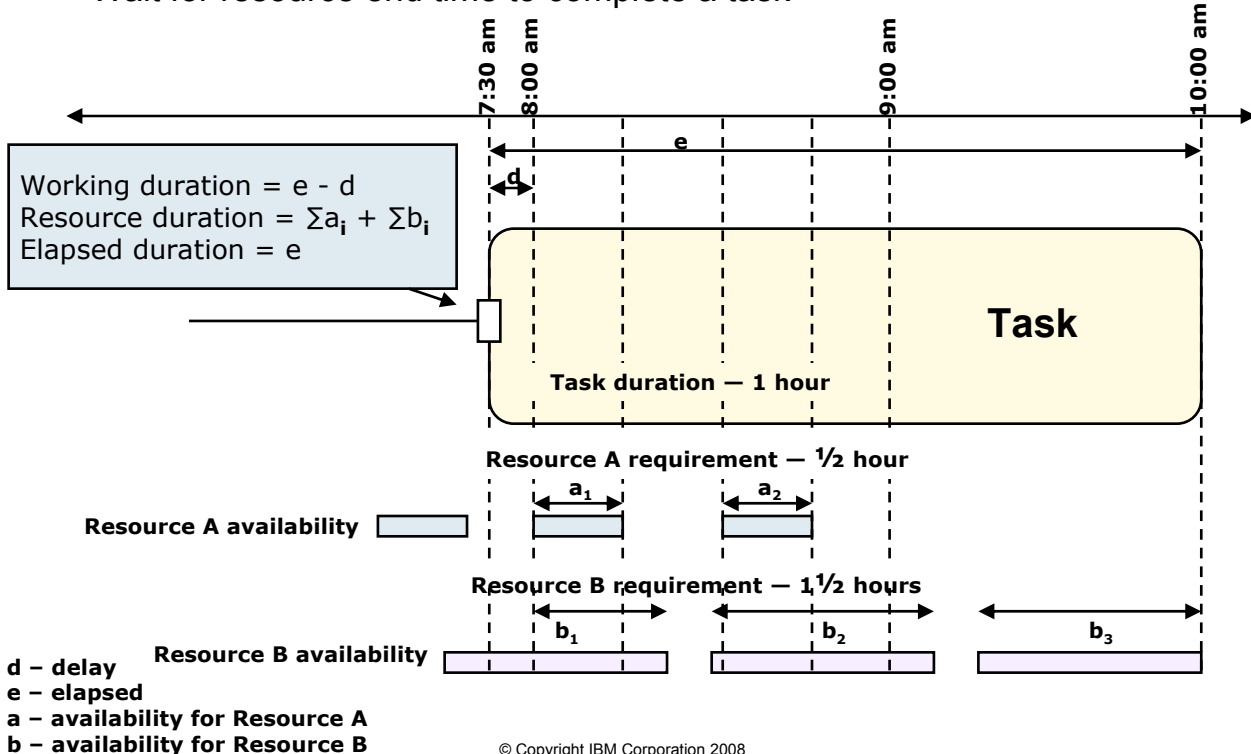
Single resource – task time equals set duration

- Use resources' time required as a task processing time
 - Set to “No”
 - Use duration for time to complete a task



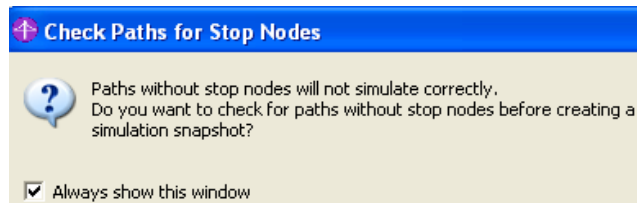
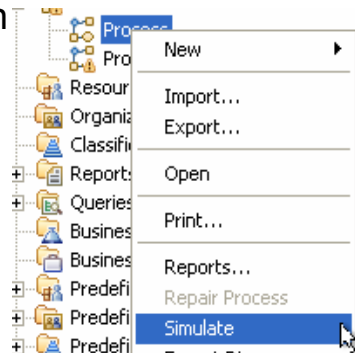
Multiple resources

- Task behavior with simulation preference set to “Yes”
 - Wait for resource end time to complete a task



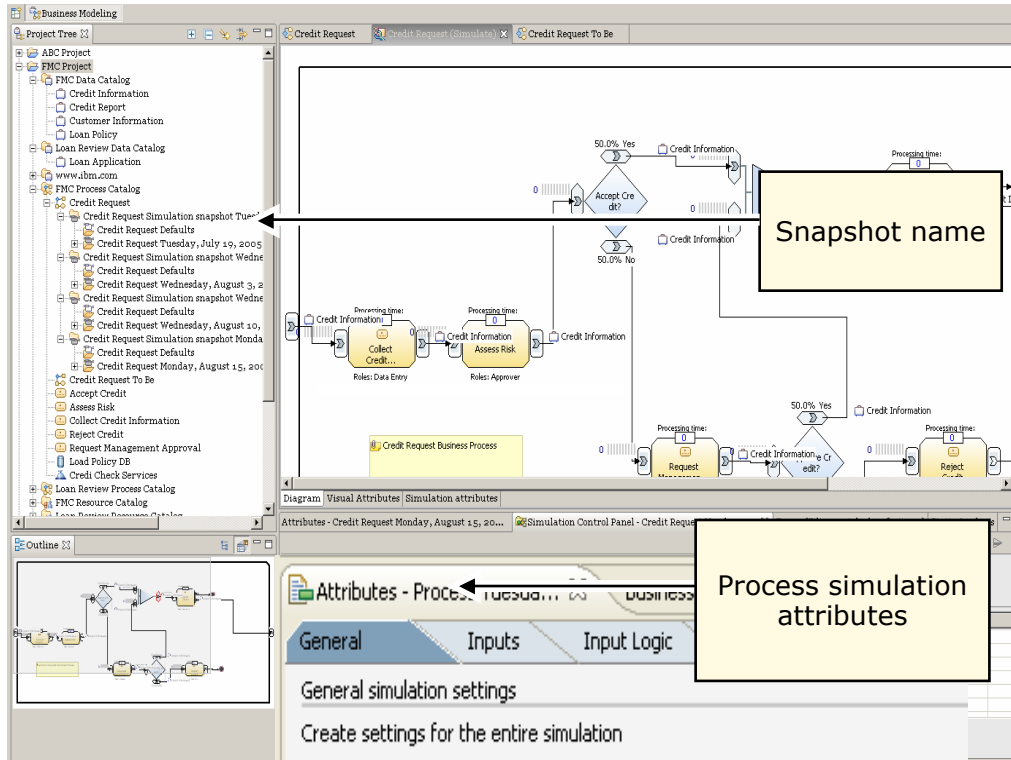
Creating a simulation snapshot

- To simulate a process, you must create a simulation snapshot.
 - Creating a simulation snapshot creates an initial simulation profile.
- The snapshot generator asks to check the stop nodes.
 - Every process must end with a stop node.
- A new simulation snapshot appears in the Project Tree.
 - Its name is made up of:
 - The name of the originating process
 - The words “simulation snapshot”
 - A timestamp
 - The simulation snapshot contains the simulation snapshot settings and an initial simulation profile.
- Fix critical errors before creating a snapshot.



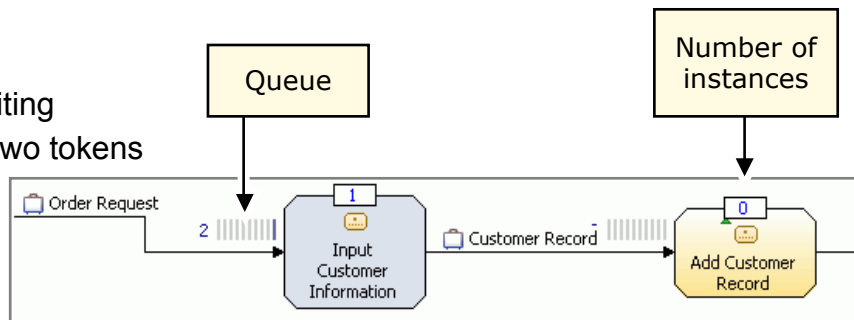
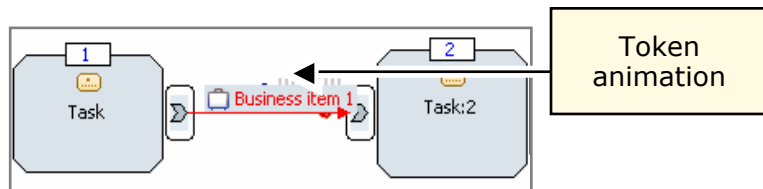
Simulation snapshot (1 of 2)

- The simulation snapshot opens in a tab over the process editor.
- Snapshot name
 - Rename to document settings
- Simulation attributes
 - Define the simulation behavior



Simulation snapshot (2 of 2)

- Token animation
 - Watch the movement of tokens
 - Look for bottlenecks
- Activity color
 - Changes color when active
- Instances
 - Displays number of instances
- Queue
 - Number of tokens waiting
 - Each bar represents two tokens
- Animation is not necessary
 - Turning off shortens execution time



Simulation attributes: General (1 of 2)

- Process availability begins and Process availability ends
- Evaluate subprocesses
- Maximum simulation duration
 - Real time in which the simulation occurs
- Maximum number of process invocations
 - Per simulation run

The screenshot shows a software interface for configuring simulation settings. It features a tabbed menu at the top with 'General' selected. Below the tabs, the title 'General simulation settings' is followed by the instruction 'Create settings for the entire simulation'. The settings include: 'Process availability begins' and 'Process availability ends' with date-time pickers and 'Edit...' buttons; 'Evaluate all subprocesses' with 'Yes' (selected) and 'No' radio buttons; 'Maximum simulation duration' with five spinners for Days (365), Hours (0), Minutes (0), Seconds (0), and Milliseconds (0); and 'Maximum number of process invocations' with a spinner set to 0.

General	Inputs	Input Logic	Business Item Creation	Resource Pool	Interrupts
General simulation settings					
Create settings for the entire simulation					
Process availability begins		Tuesday, January 30, 2007 6:23:39 PM GMT-5		Edit...	
Process availability ends		Wednesday, January 30, 2008 6:23:39 PM GMT-5		Edit...	
Evaluate all subprocesses		<input checked="" type="radio"/> Yes <input type="radio"/> No			
Maximum simulation duration					
Days	Hours	Minutes	Seconds	Milliseconds	
365	0	0	0	0	
Maximum number of process invocations		0			

Simulation attributes: General (2 of 2)

- Random number seed
- Delay for steady state simulation
 - Virtual wait time before collecting statistics
 - Skip data collection during startup
- Method of selecting output path
- Use resources' time required as task process time

Random number seed

Delay for steady state simulation

Days	Hours	Minutes	Seconds	Milliseconds
<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>

Method of selecting an output path:

Use resources' time required as a task processing time ☒ Yes ☐ No

Randomly to a single path
Randomly to a single path
Based on probabilities to a single path
Based on an expression

Simulation attributes: Inputs (1 of 2)

- Associate a token with a business item
 - The business item will arrive with the token
- Number of tokens per bundle
 - Number of tokens that arrive at the same time
- Total number of tokens
 - Number of tokens generated per run
 - Total tokens are grouped by bundle
- One-time cost per token

Attributes - Advanced Simulation X Simulation Control Panel Business Measures Errors (Filter matched 0 of 0 items)

General Inputs Input Logic Business Item Creation Resource Pool Interrupts

Token creation settings

Change the settings for creating tokens associated with inputs.

Name	Associated data	Minimum	Maximum	Input source
Input	Credit Information	1	1	Flow

Remove Token Creation Settings

Number of tokens per bundle
1 Edit...

Total number of tokens
100 Edit...

One-time cost per token
0 Edit... USD ▼

Simulation attributes: Inputs (2 of 2)

- Time trigger
 - Fixed interval with a start time
- Random time trigger
 - Select a statistical distribution for token generation
- Timetable trigger
 - Use a timetable to generate tokens

The screenshot shows a configuration window for simulation triggers. It contains three radio buttons for selecting a trigger type: 'Time trigger' (unselected), 'Random time trigger' (selected), and 'Timetable trigger' (unselected). Below the 'Time trigger' option are fields for 'Start time' and 'Recurring time interval for bundle creation', each with an 'Edit...' button. The 'Random time trigger' section has a 'Random time value' field with a dropdown menu currently set to 'Minutes', and an 'Edit...' button. The 'Timetable trigger' section has a text prompt 'Click Browse and select a timetable' above a text field and a 'Browse...' button. At the bottom, there are three fields: 'Number of times to repeat', 'Repetition period', and 'Beginning on'. Below these fields are two tabs: 'Recurring time intervals' (active) and 'Exemption period'.

☐ **Time trigger**

Start time

Recurring time interval for bundle creation

☒ **Random time trigger**

Random time value

☐ **Timetable trigger**

Click Browse and select a timetable

Number of times to repeat

Repetition period

Beginning on

Simulation attributes: Input logic

- Input criteria simulation settings:
 - For one process input: The probability of the input is 100%.
 - For multiple process inputs: Specify the probability of receiving each of the different inputs or combination of inputs.

General Inputs **Input Logic** Business Item Creation Resource Pool Interrupts

Input criteria simulation settings

The values found in this section define the probability that an input will take a particular path.

	Name	Criterion	Probability (%)
	Input Criterion	Input	100

General Inputs **Input Logic** Business Item Creation Resource Pool Interrupts

Input criteria simulation settings

The values found in this section define the probability that an input will take a particular path.

	Name	Criterion	Probability (%)
	Input Criterion	Input	50
OR	Input Criterion:2	Input:2	50

Detail

Output criteria associations
Specify the association between the inputs of the process and the outputs of the process

Output Criteria Associations

Input set name: Input Criterion

Name	Probability (%)
Output Criterion	100

Simulation attributes: Business item creation

- Business item creation
 - Specifies the business items to be created by the process
- Create simulation values
 - Specifies the rule used to create business items

General	Inputs	Input Logic	Business Item Creation	Resource Pool	Interrupts																														
Business item creation																																			
Define how values are set on business items leaving this data input.																																			
<table border="1"><thead><tr><th>Name</th><th>Associated data</th><th>Minimum</th><th>Maximum</th><th>Output target</th></tr></thead><tbody><tr><td>Input</td><td>Business item 1</td><td>1</td><td>1</td><td>Flow</td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr></tbody></table>						Name	Associated data	Minimum	Maximum	Output target	Input	Business item 1	1	1	Flow																				
Name	Associated data	Minimum	Maximum	Output target																															
Input	Business item 1	1	1	Flow																															
					Create Simulation Values																														

Simulation value creation

Select a rule type for business item creation in simulation.

Value creation rule

No Rule

No Rule

Random List

Weighted List

Define custom rules

Simulation attributes: Resource pool (1 of 2)

- Resource usage
 - Run simulation without resource requirements.
 - Ignore the resource requirements.
 - Use to test the model without resources.

The screenshot shows a software interface for simulation attributes. The main window is titled 'Attributes - Advanced Simulation' with a close button. It has several tabs: 'Simulation Control Panel', 'Business Measures', 'Errors (Filter matched 0 of 0 items)', 'General', 'Inputs', 'Input Logic', 'Business Item Creation', 'Resource Pool' (which is the active tab), and 'Interrupts'. Under the 'Resource Pool' tab, there is a section titled 'Resource usage' with a downward arrow. Below this, it says 'Specify how simulation will use resources.' and there is a checkbox labeled 'Run simulation without resource requirements'.

Attributes - Advanced Simulation	Simulation Control Panel	Business Measures	Errors (Filter matched 0 of 0 items)		
General	Inputs	Input Logic	Business Item Creation	Resource Pool	Interrupts

▼ Resource usage

Specify how simulation will use resources.

☐ **Run simulation without resource requirements**

Simulation attributes: Resource pool (2 of 2)

- Resource pool
 - Select resources to be made available to the simulation.
 - By default, all resources defined in your project are available.
 - If the roles are checked, the simulation will supply as many roles as needed.
 - The number of roles can be limited.

▼ Resource pool

Select the resources that are available to the simulation.

☒ Bulk resource

- ☒ Customer Svc Clerk - Bulk
- ☒ Loan Officer - Bulk

☒ Individual resource

- ☒ Marion
- ☒ Mitch
- ☒ Sylvain

☒ Role

Quantity to generate for the selected role

0 ☒ Unlimited

Simulation attributes: Interrupts

- Interrupts allow the monitoring of specific conditions.
 - Cost overruns, excessive times spent waiting for resources.
 - The simulation run is automatically suspended when a condition occurs.

General	Inputs	Input Logic	Business Item Creation	Resource Pool	Interrupts														
Simulation interrupt settings																			
Define the conditions that pause the simulation.																			
Available interrupt types			Available settings for selected interrupt type																
<input type="checkbox"/> Queue overflow <input type="checkbox"/> Total idle time <input type="checkbox"/> Total processing time <input type="checkbox"/> Total cost <input type="checkbox"/> Total deficit			<table border="1"><thead><tr><th>Interrupt setting</th><th>Value</th></tr></thead><tbody><tr><td>Number of interrupt activations to ignore</td><td></td></tr><tr><td>Check interrupt ratios</td><td></td></tr><tr><td>Threshold (%)</td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr></tbody></table>			Interrupt setting	Value	Number of interrupt activations to ignore		Check interrupt ratios		Threshold (%)							
Interrupt setting	Value																		
Number of interrupt activations to ignore																			
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<table border="1"><thead><tr><th>Interrupt type</th><th>Condition</th></tr></thead><tbody><tr><td>Queue overflow</td><td>Total number of activities scheduled for completion at any given moment</td></tr><tr><td>Total idle time</td><td>Total time spent waiting for resources by all activities in the process</td></tr><tr><td>Total processing time</td><td>Total processing time of all activities in the process</td></tr><tr><td>Total cost</td><td>Total cost of performing all activities within a process</td></tr><tr><td></td><td>Note: This does not consider revenue generated by activities</td></tr><tr><td>Total deficit</td><td>Total cost minus revenue of all activities performed within a process</td></tr></tbody></table>						Interrupt type	Condition	Queue overflow	Total number of activities scheduled for completion at any given moment	Total idle time	Total time spent waiting for resources by all activities in the process	Total processing time	Total processing time of all activities in the process	Total cost	Total cost of performing all activities within a process		Note: This does not consider revenue generated by activities	Total deficit	Total cost minus revenue of all activities performed within a process
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Total cost	Total cost of performing all activities within a process																		
	Note: This does not consider revenue generated by activities																		
Total deficit	Total cost minus revenue of all activities performed within a process																		

Simulation control panel

- The simulation control panel
 - Controls simulation settings and allows you to pause, stop, step, run a simulation
 - Shows time the simulation has been running
 - Shows data updated as model is running

The screenshot displays the 'Simulation Control Panel' window. The top bar includes tabs for 'Attributes - Process 1 Tues...', 'Business Measures', 'Errors (Filter matched 0 of ...)', and 'Technical Attributes View'. The main area shows the simulation status. A message states 'Simulation ready to run, based on saved simulation settings.' Below this, it indicates 'Time that simulation has been running: 00:00:00'. A progress bar is shown with the label 'Simulation running' and 'Time that simulation has been running: 00:00:19'. The progress bar is filled with blue segments. On the right side, there is a control menu with buttons for 'Setting', 'Pause', 'Stop', 'Step', and 'Run'. The bottom section shows a table with columns for 'Process start time', 'Process end time', and 'Total revenue'. The table contains one row of data.

Process start time	Process end time	Total revenue
Process Wednesday, January 31, 2007 12:5...	January 30, 2007 6:23:...	0 USD

Simulation settings

- Simulation settings
 - Step settings
 - Animation settings
 - Display animation
 - Speed
 - Statistic settings
 - Specify what is displayed in statistics
 - Replication settings
 - Result settings

The screenshot shows a 'Simulation Settings' dialog box with a blue title bar. It contains several sections: 'Step settings' with a dropdown for 'Number of tasks per step' set to 1; 'Animation settings' with a checked checkbox for 'Display animation during simulation' and a speed slider between 'Slow' and 'Fast'; 'Statistic settings' with checked checkboxes for 'Display statistics during simulation', 'Collect statistics for each process instance', 'Show process statistics', 'Show task statistics', and 'Show connection statistics', plus a text field for 'Maximum process instances to display' set to 50 and a checked checkbox for 'Collect and average statistics across process instances'; 'Replication settings' with an unchecked checkbox for 'Replicate simulations consecutively' and a text field for 'Consecutive replications per simulation' set to 5; and 'Result settings' with a checked checkbox for 'Store simulation result'.

Simulation Settings

Step settings
Number of tasks per step: 1

Animation settings
☒ Display animation during simulation
Speed: Slow ————— Fast

Statistic settings
☒ Display statistics during simulation
☒ Collect statistics for each process instance
☒ Show process statistics
☒ Show task statistics
☒ Show connection statistics
Maximum process instances to display: 50
☒ Collect and average statistics across process instances

Replication settings
☐ Replicate simulations consecutively
Consecutive replications per simulation: 5

Result settings
☒ Store simulation result

Simulation statistics

- Displayed in a tab over the attributes
 - Processes, tasks and connections
 - Check box — collect and display statistics across process instances

The screenshot displays the 'Simulation Control Panel - Process ...' window. The 'Simulation complete' message is shown, along with the running time '00:00:34'. The 'Processes' tab is active, showing a table with columns: Process start time, Process end time, Total rev..., and Total cost. The table contains one row for 'Process Wednesday, January 31, 2007 12:5...'. Below this, a detailed view of the 'Process Wednesday, January 31, 2007 12:5...' is shown, including a table of 'Active instances' and a table of 'Tokens transferred'.

Simulation complete

Time that simulation has been running: 00:00:34

Processes | Tasks | Connections

	Process start time	Process end time	Total rev...	Total cost
Process Wednesday, January 31, 2007 12:5...	January 30, 2007 6:23:...	January 30, 2007 6:43:...	0 USD	16 USD

Processes | Tasks | Connections

	Active instances
Process Wednesday, January 31, 2007 12:5...	0
Task	0
Task:2	0

Processes | Tasks | Connections

	Tokens transferred
Process Wednesday, January 31, 2007 12:5...	
Process --> Task	1
Task --> Task:2	1
Task:2 --> Stop Node	1
Task:2 --> Process	1

Simulation errors

- Simulation finished but not all tasks were completed successfully (includes details).

The screenshot shows the 'Simulation Control Panel' window. The top tabs include 'Attributes - Process 1 Tu...', 'Business Measures', 'Errors (Filter matched 0 o...', and 'Technical Attributes View'. The main area displays the message: 'Simulation finished but not all tasks were completed successfully. (details)'. Below this, it states 'Time that simulation has been running: 00:00:40'. There are three tabs: 'Processes', 'Tasks', and 'Connections'. A table below these tabs shows simulation data for 'Process 1 Tuesday, January 30, 2007 10:33:...' with columns for 'Process start time', 'Process end time', 'Total revenue', and 'Total cc'. A 'Simulation Failure Details' dialog box is open in the foreground, showing a table of failed tasks.

Simulation finished but not all tasks were completed successfully. [\(details\)](#)

Time that simulation has been running: 00:00:40

Processes Tasks Connections

	Process start time	Process end time	Total revenue	Total cc
Process 1 Tuesday, January 30, 2007 10:33:...	January 30, 2007 10:00:...	March 4, 2007 10:00:46...	0 USD	3 USD

Simulation Failure Details

The following tasks or processes failed to execute successfully during the previous simulation

Task or Process Name	Description of Failure	Simulation
Task:3	The process containing this element was termin...	March 4,
Task:3	The process containing this element was termin...	March 4,

Simulation results

Results are posted in the Project Tree and accessed through dynamic analysis

Case Name	Distribution	Success Status	Process Instance Name	Cost	Start Time	Finish Time	Elapsed Duration	Working Duration	Resource
+ Case 1	100.00%	Succeeded		U...			20 minutes	20 minutes	
All Cases	100.00%			U...			20 minutes	20 minutes	

Changing model attributes in the simulation model

- Cost and revenue

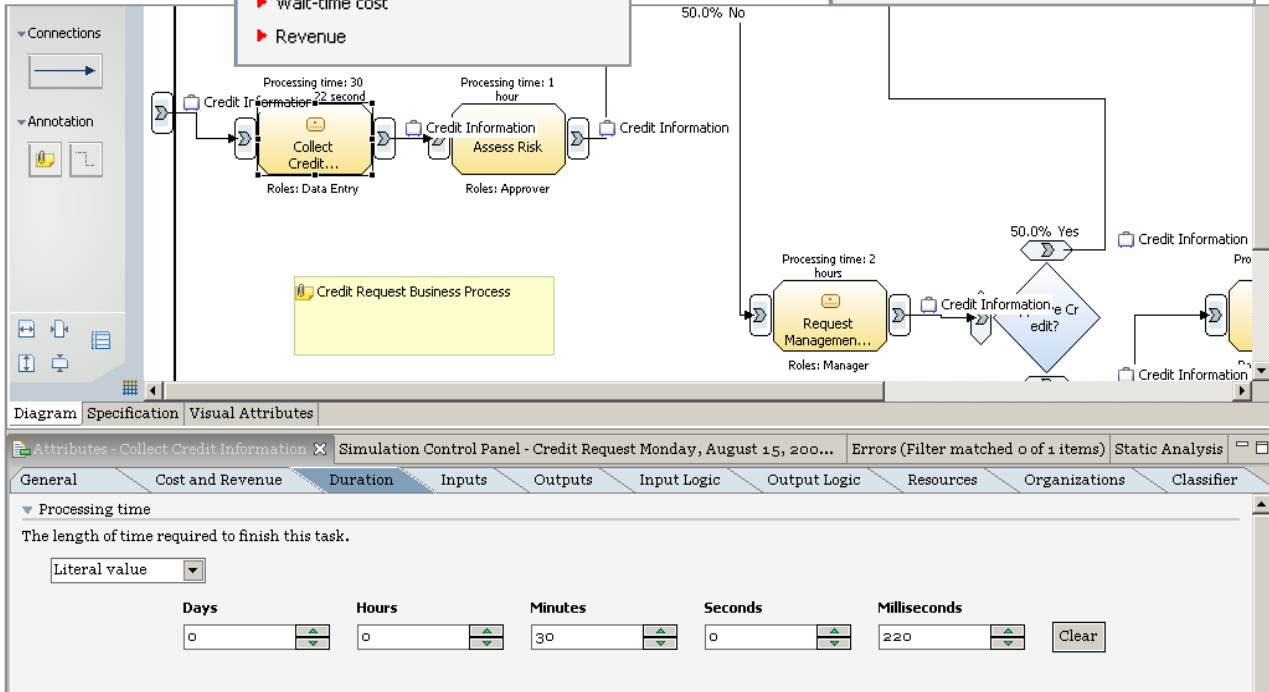
Cost and Revenue

- ▶ Processing cost
- ▶ Startup cost
- ▶ Wait-time cost
- ▶ Revenue

- Duration

Cost and Revenue

- ▶ Processing time
- ▶ Resource wait time

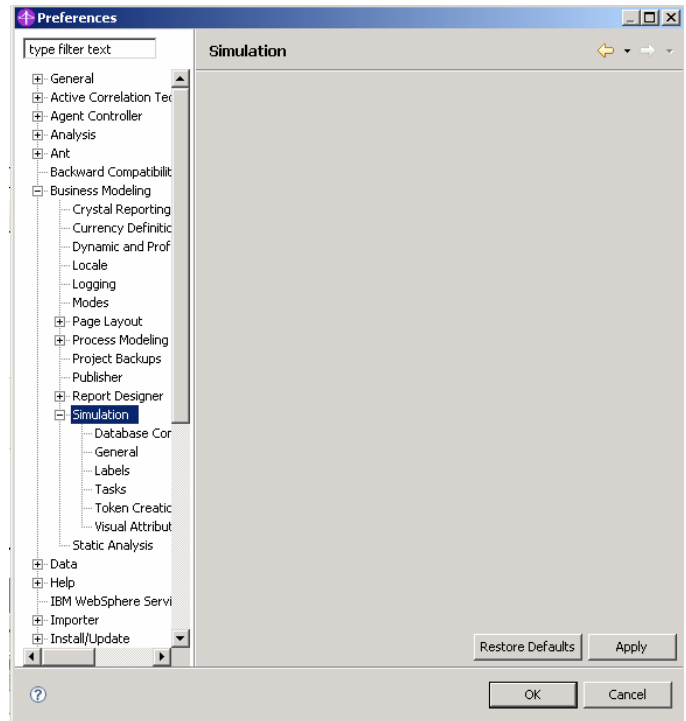
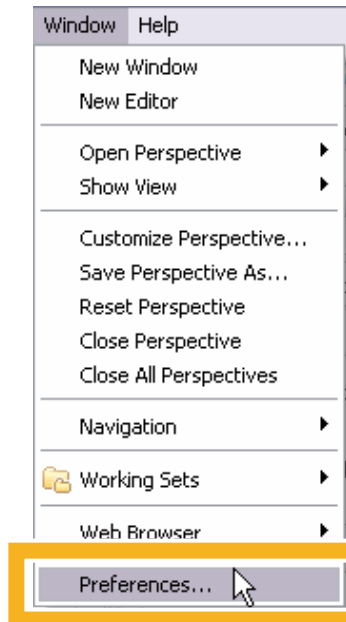


Setting simulation preferences

- Simulation attributes control the behavior of your simulation runs so that simulation snapshots and results reflect real-world behavior.
- Simulation attributes can be set at multiple levels.
 - At the highest level are the simulation preferences.
 - At the next level are the simulation snapshot settings.
 - At the lowest level are those in a particular simulation profile.

Simulation preferences

- At the highest level are the simulation preferences.
 - From the tool bar



Simulation preferences: Database Connection, General, Labels

Preferences

Simulation

Select the database to store the simulation results

Derby 10.3

Test Connection Clear Simulation Results...

General

Method of selecting an output path:

Based on probabilities to a single path

Evaluate all subprocesses

☒ Yes ☐ No

Random number seed

10

Maximum simulation duration

365 days Edit...

Delay for steady state simulation

0 seconds Edit...

Run simulation without resource requirements

☐ Yes ☒ No

Use resources' time required as a task processing time

☒ Yes ☐ No

Wait for resources' end time to complete a task

☐ Yes ☒ No

Show check paths confirmation dialog

☒ Yes ☐ No

Labels

☒ Display labels on the diagram

Process element	Top label	Bottom label
Local task	<hide label>	<hide label>
Global task	<hide label>	<hide label>
Global service	<hide label>	<hide label>
Local process	<hide label>	<hide label>

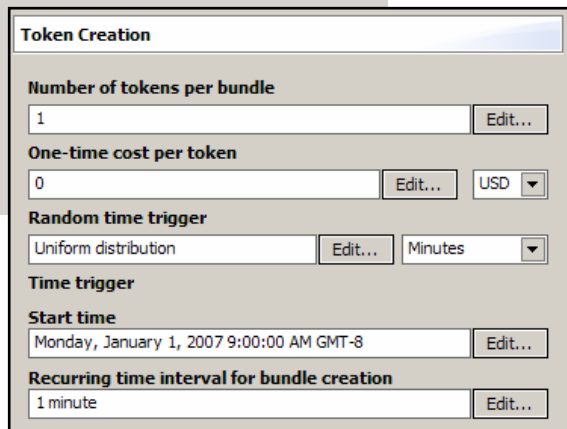
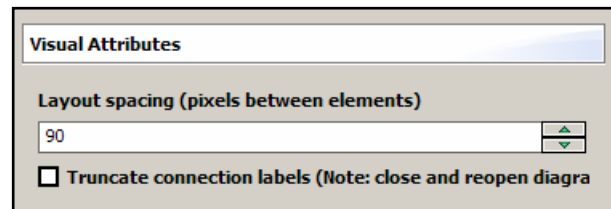
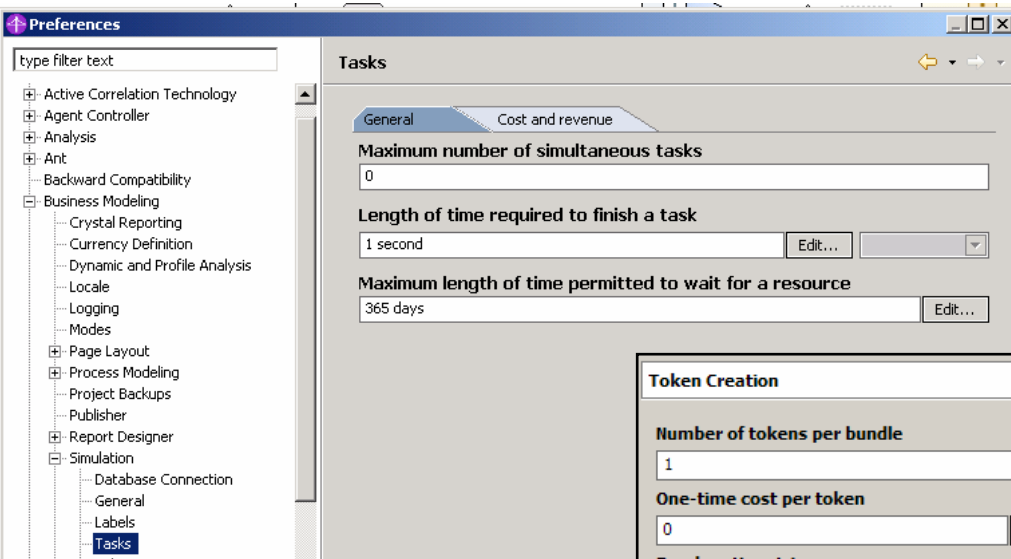
On profile creation

☒ Use process labels

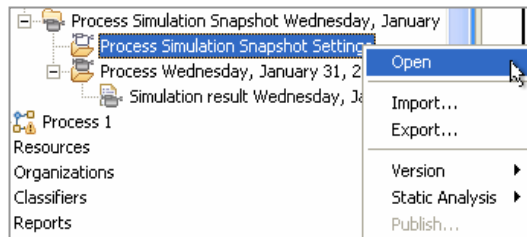
☐ Use simulation label settings

☐ Hide decision percentage labels

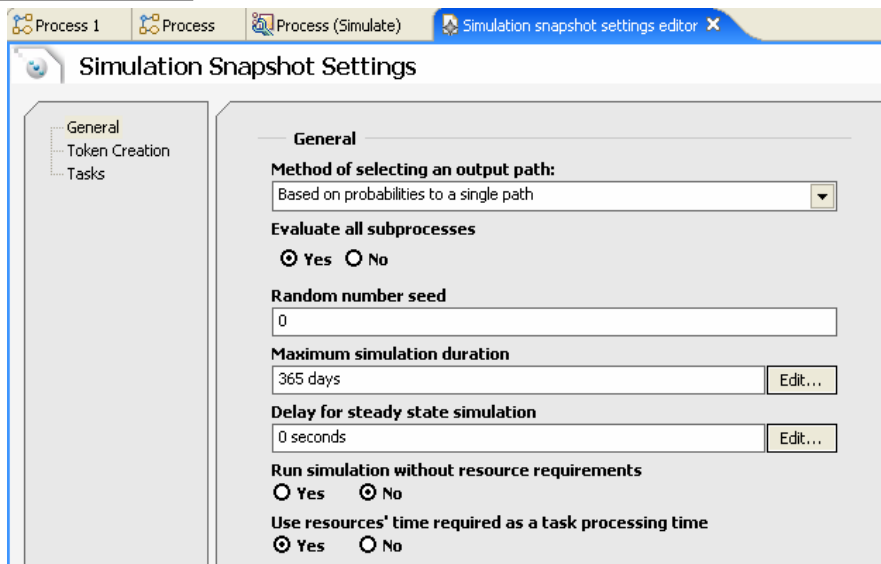
Simulation preferences: Tasks, Token Creation, Visual Attributes



Simulation snapshot settings (1 of 2)



- Next level from the Project Tree
- Includes general settings, token creation settings and tasks settings



Simulation snapshot settings (2 of 2)

Simulation Snapshot Settings

General

Token Creation

Tasks

Token Creation

Number of tokens per bundle

1

Edit...

One-time cost per token

0

Edit...

USD

Random time trigger

Uniform distribution

Edit...

Minutes

Time trigger

Start time

Tuesday, January 30, 2007 6:23:40 PM GMT-5

Edit...

Recurring time interval for bundle creation

1 minute

Edit...

- Token creation and tasks settings



Simulation Snapshot Settings

General

Token Creation

Tasks

Tasks

General

Cost and revenue

Maximum number of simultaneous tasks

0

Length of time required to finish a task

1 second

Edit...

Maximum length of time permitted to wait for a resource

1 year

Edit...

Checkpoint: Running simulations

Your instructor will review these questions with you as a group. If time permits, the instructor may provide you time to answer the questions on your own before the group discussion.

1. What is the difference between task duration and resource time requirements?
2. What is the function of a resource pool during simulation?
3. When is the purpose of an interrupt?
4. How do you turn off the animation during a simulation so that it runs more quickly?

Checkpoint solutions: Running simulations

1. Task duration is used to determine cycle time.
Resource time requirements are used to calculate cost.
2. The resource pool allows the selected resources to be made available to the simulation.
3. Interrupts allow the monitoring of specific conditions such as cost overruns or excessive time spent waiting for resources.
The simulation run is automatically suspended when a condition occurs.
4. In Simulation Settings, clear the “Display Animation during simulation” check box.

Unit summary

Having completed this unit, you should be able to:

- Describe element behavior in simulation
- Create a snapshot
- Define simulation attributes
- Define simulation preferences

Exercise overview

In this exercise, you will:

- Run a process simulation
- Use global simulation settings
- Run a simulation with global simulation attributes
- Use local simulation attributes
- Run a simulation with local simulation attributes