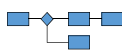


## Processes Beyond the Basics

## Outline

- ▶ Quick Overview of Processes
- ▶ Advanced Process Options
- ▶ Event-based Decision Logic
- ▶ Scan and Search Steps

## Processes




- ▶ A **process** is sequence of actions (e.g. assign state, delay by time, seize a resource, etc.) that may span time and change the state of the model.
- ▶ Most Simio models are built using objects in the Facility window, supplemented with processes.
- ▶ Processes are flexible and execute extremely fast.
- ▶ Processes are comprised of **tokens** that execute **steps** (actions) that change the state of **elements**.
- ▶ Simio provides an auto-layout function creating process flows.


## Process Triggering Types

- ▶ **Add-on processes**
  - Allow customized process to add additional functionality to an object.
  - Process trigger (entry point) is defined inside object
- ▶ **Standard processes**
  - Process logic is defined inside object
  - Automatically run at specific points in the logic.
- ▶ **Decision processes**
  - 0-time standard processes that compute a return value used for making a decision.
- ▶ **Event-triggered processes**
  - Executed whenever a user-specified event occurs.

## Steps




- ▶ Steps perform an action such as seize, delay, decide, wait, etc.
- ▶ Steps are stateless, but often change the state of an element/token/entity/object.
- ▶ Use of **Name** (F2 key) is very important for model clarity, documentation, trace, and debugging.
- ▶ Color coding steps particularly in large or overridden process can add clarity.

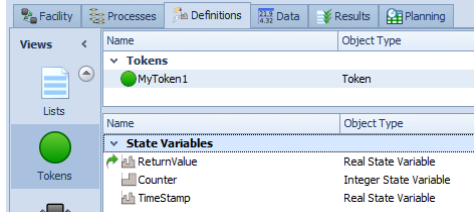


7/18/2017 Copyright 2016 Simio LLC 5

## Tokens




- ▶ Tokens move from step to step in a process.
- ▶ Tokens are “delegates” from entities or other objects to execute processes.
- ▶ Custom Tokens may carry user-defined states that change at a step.

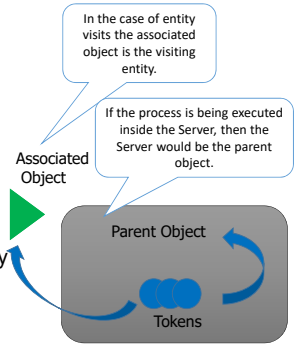


7/18/2017 Copyright 2016 Simio LLC 6

## Token Data Referencing


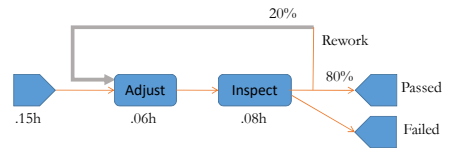


- ▶ A token carries a reference to both its **parent object** and **associated object**.
- ▶ The attributes of the associated object may be referenced using the class name; e.g. *ModelEntity.TimeCreated*
- ▶ The attributes of the parent object may be referenced by name; e.g. *ProcessTime*



7/18/2017 Copyright 2016 Simio LLC 7

## TV Adjustment Example

7/18/2017 Copyright 2016 Simio LLC 8

## Adjust with Processes

7/18/2017 Copyright 2016 Simio LLC 9

## Advanced Process Options 1

Multiple tokens can be active in a single process

- Many steps allow different exit paths
  - Decide, Find, Transfer
  - Mutually exclusive
- Some steps allow multiple exits
  - Create, Search
  - Each "extra" token may have a different associated object or table row

7/18/2017 Copyright 2016 Simio LLC 10

## Advanced Process Options 2

Token Actions relate to changes in associated object.

- What happens when token's associated object is destroyed?
- What happens when token's associated object is transferred out of the parent object?

7/18/2017 Copyright 2016 Simio LLC 11

## Advanced Process Options 3

Input Arguments and Return Values facilitate sharing processes between multiple "calling" locations.

- Used along with custom tokens and states.

7/18/2017 Copyright 2016 Simio LLC 12

## Advanced Process Options 4

### ▶ Suspend and Resume Processes



### ▶ Inactive Processes, *ProcessName.Enabled*

Initially Enabled	True
Allow Step Trace	True

**Initially Enabled**  
Specifies whether this process is enabled when the system is initialized. Any attempt to execute a disabled process will be ignored by the simulation engine.

### ▶ Allow Step Trace to suppress trace on a process

7/18/2017

Copyright 2016 Simio LLC

13

## Event-based Decision Logic

- ▶ Events are messages that can be fired to communicate between objects.
- ▶ Events are useful for informing other objects that something important has happened and for incorporating custom logic.
- ▶ Events can be fired through model logic or can be automatically generated.

7/18/2017

Copyright 2016 Simio LLC

14

## Automatic events

- ▶ When an entity enters or leaves a node, begins or ends a transfer, or is destroyed.
- ▶ When a resource is allocated or released, changes capacity, or is failed or repaired.
- ▶ When a server changes capacity, or is failed or repaired.
- ▶ When a worker or vehicle enters or leaves a node, begins or ends a transfer, is allocated or released, changes capacity, or is failed or repaired.

7/18/2017

Copyright 2016 Simio LLC

15

## Actions triggered by events

- ▶ Source can trigger entity creation.
- ▶ Source can stop creating entities.
- ▶ Server, resource, conveyor, or vehicle can start a failure.
- ▶ Vehicle or worker can stop a dwell time.

7/18/2017

Copyright 2016 Simio LLC

16

## Common event triggers



- ▶ **Station element** - used to define a capacity constrained location for holding entities representing discrete items.
  - Generates Entered, Exited, and CapacityChanged events.
- ▶ **Timer element** - fires a stream of events according to a specified IntervalType.
  - Generates event named Event each time the timer matures.
  - Timer can also respond to external events to trigger future timer events or reset the timer.
- ▶ **Monitor element** - detects a discrete value change or threshold crossing of a state variable or group of state variables.
  - Generates event named Event each time the monitor detects a monitored state change.
- ▶ **Fire step** - used to fire a user-defined event.

7/18/2017

Copyright 2016 Simio LLC

17

## Event Triggered Processes



Properties: Source1\_CreatedEntity (Process Element)

Show Commonly Used Properties Only

**Basic Logic**

Triggering Event Name	
Triggering Event Condition	

7/18/2017

Copyright 2016 Simio LLC

18

## User Events



Properties: Wait1 (Wait Step Instance)

Show Commonly Used Properties Only

**Basic Logic**

Event Name	
Event Condition	
Events (More)	0 Rows

**Advanced Options**

Token Wait Action: WaitUntilAnyEvent

Exclusion Expression: WaitUntilAnyEvent

**General**

WaitUntilAllEvents

**Token Wait Action**

The wait action to be taken by the token arriving at the Wait step. If 'WaitUntilAnyEvent', then the token will wait until any one of the specified events occurs. If 'WaitUntilAllEvents', then the token will wait until all of the specified events occur.

7/18/2017

Copyright 2016 Simio LLC

19

## Scan Step



- ▶ When a token arrives at a Scan step, a scan condition is evaluated.
  - If the condition is true, then the token is permitted to exit the step without delay.
  - Otherwise, the token is held at the Scan step until the condition is detected to be true.
- ▶ This offers considerable flexibility, but comes with two caveats.
  - The condition is only checked at time advances, so momentary (zero time) conditions can be missed and the condition will not be recognized until a time advance.
  - Monitoring an expression is slower than an event-based approach. In most models this will not be noticeable, but in some models it could cause a slower execution speed.

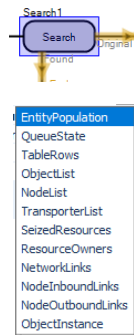
7/18/2017

Copyright 2016 Simio LLC

20

## Search Step

- ▶ Used to search a collection of objects or table rows
- ▶ If *Collection Type* is for objects like 'EntityPopulation', 'QueueState' or 'SeizedResources' the 'Found' token is associated with that found object.
- ▶ If the *Collection Type* is 'TableRows', then 'Found' token has a pointer to the associated row in the table (and not to any particular object).
- ▶ Original token always continues out of the 'Original', regardless of whether or not the Search Step finds anything. A new token will be created in the Found exit for each item found.



7/18/2017

Copyright 2016 Simio LLC

21



7/18/2017

Copyright 2016 Simio LLC

22