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FORWARD THINKING

## Task Sequences *Supercharging the Server*

"How are you at multitasking?"

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## Introduction to Tasks

- ▶ The Server models a limited capacity resource that performs processing.
- ▶ The Process Type property on Server:
  - Specific Time: Processing Time expression.
  - Task Sequence: Repeating list of Tasks to be executed.

- ▶ Tasks can require secondary resources and materials.

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## Introduction to Tasks

- ▶ Task sequencing is controlled by Task Precedence Method
  - Sequence number – Best with simple sequences
  - Immediate Successor
  - Immediate Predecessor

Other Task Sequence Options	
Task Precedence Method	Sequence Number Method
Task Resources Referenced Table Name	
Task Materials Referenced Table Name	

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## Task Precedence Methods

```

graph LR
  Task1((Task1)) --> Task2((Task2))
  Task1 --> Task3((Task3))
  Task2 --> Task4((Task4))
  Task3 --> Task5((Task5))
  Task4 --> Task6((Task6))
  Task5 --> Task6
  
```

Using Seq Numbers		Using Predecessors			Using Successors		
Sequence Number	Task Name	ID Number	Task Name	Immediate Predecessors	ID Number	Task Name	Immediate Successors
10	Task1	1	Task1		1	Task1	2,3
20.1	Task2	2	Task2	1	2	Task2	4
20.2	Task3	3	Task3	1	3	Task3	5
30.1	Task4	4	Task4	2	4	Task4	6
30.2	Task5	5	Task5	3	5	Task5	6
40	Task6	6	Task6	4,5	6	Task6	

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## Task Process Type



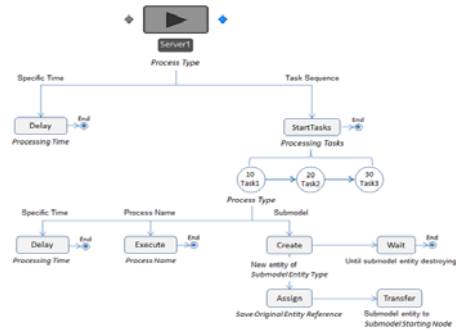
- ▶ The method used to model the processing of a task.
- ▶ Four **Process Types** available:
  - **Specific Time** – delay by a specified expression.
  - **Process Name** – execute a process and wait for it to complete.
  - **Submodel** – send an entity clone to a submodel and wait for it to complete.
  - **Sequence Dependent Setup** – Automatically calculate processing time based on data specified in a Changeover Logic element.

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## Task Processing Logic



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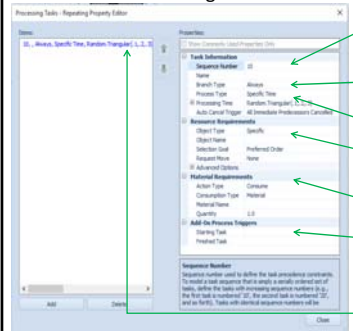
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## Task Sequence



### ▶ Server Processing Tasks



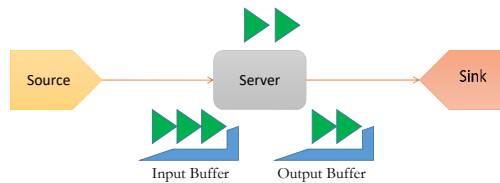
- ▶ **Task Number** determines if execution is sequential or in parallel. Simple sequence is 10, 20, 30, 40.
- ▶ **Branch Type** allows selective task execution.
- ▶ **Process Type** determines where the logic is specified.
- ▶ **Object Type** defines any resource required to perform this task.
- ▶ **Material Requirements** defines any required materials for this task.
- ▶ **Add-on Processes** can be directly executed right before or after each task is performed.
- ▶ **Items Repeat** group provides set of serial and parallel tasks.

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## Source Server Sink with Tasks



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## Task Branch Type



- ▶ Determines if the Task should be executed.
- ▶ Four **Branch Types**
  - **Always**
  - **Conditional** – if expression is TRUE.
  - **Probabilistic** – mutually exclusive alternatives.
  - **Independent Probabilistic** – independent possibilities.
- ▶ By default a Task is not executed if it's predecessors are not executed.

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## Task Numbering: XX.YY.YY...



- ▶ Task sequence numbers are used to control the order in which tasks are performed. They can be in parallel or sequential.
- ▶ XX is an integer referred to as the root sequence number.
- ▶ YY is optional integer suffixes separated by dots. Think of these as sub-paths.
- ▶ The precedence rules are as follows:
  - If no suffixes, all tasks with lower root numbers (ignoring suffixes) must precede that task. (10.1 < 20)
  - If suffixes, all tasks with lower root numbers must precede if:
    - No suffixes. (10 < 20.1)
    - Shared suffixes match. (10.1 < 20.1.3)
  - If suffixes, all tasks with the same root number and no suffixes must precede that task (10 < 10.1)

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## Straight-line Tasks



Sequence Number	Task Name
10	Task1
20	Task2
30	Task3



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## Conditional Task



Sequence Number	Task Name	Branch Type	Condition Or Probability
10	Task1	Always	
20.1	Task2	Conditional	Entity.Is.Red
30.1	Task3	Always	
20.2	Task4	Conditional	!Entity.Is.Red
30.2	Task5	Always	
40	Task6	Always	



Sub-path .1 does not interact with Sub-path .2

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## Probabilistic Task



### ► Probabilistic Options:

- **Probabilistic:** Will always pick exactly one branch
  - 60% of time Task2 will be selected, 40% Task4
- **Independent Probabilistic:** Will select zero or more branches

Sequence Number	Task Name	Branch Type	Condition Or Probability
10	Task1	Always	
20.1	Task2	Probabilistic	.6
30.1	Task3	Always	
20.2	Task4	Probabilistic	.4
30.2	Task5	Always	
40	Task6	Always	

If this example used Independent Probabilistic :

- 60% of time Task2 will be selected
- 40% Task4 will be selected
- 24% chance neither is selected
- 24% chance both will be selected.



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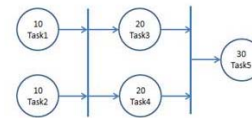
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## Parallel Tasks – Sequential



Sequence Number	Task Name
10	Task1
10	Task2
20	Task3
20	Task4
30	Task5

Both 10's must complete before either 20 can start. Both 20's must complete before 30 can start.



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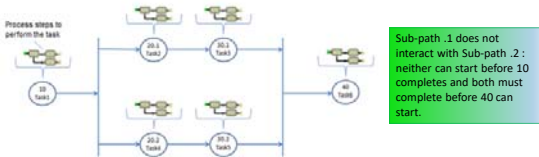
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## Parallel Tasks – Sub Processes



Sequence Number	Task Name
10	Task1
20.1	Task2
30.1	Task3
20.2	Task4
30.2	Task5
40	Task6



Sub-path .1 does not interact with Sub-path .2 : neither can start before 10 completes and both must complete before 40 can start.

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## Resources and Materials



- Resource Requirements provide options to require and select a resource constraint
- Material Requirements provide options to consume or produce materials or BOM

<b>Resource Requirements</b>	
Object Type	Specific
Object Name	Mary
Selection Goal	Preferred Order
Request Move	None
Advanced Options	
<b>Material Requirements</b>	
Action Type	Consume
Consumption Type	Material
Material Name	Subassembly23
Quantity	5
<b>Add-On Process Triggers</b>	

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## Task SimBit Solutions



### ► ServerUsingTaskSequenceWithWorkers

- Four serial tasks

### ► TaskSequenceAndWorker

- Task moves worker to a new location and then back
- Define Tasks in Server
- Define Tasks in Table

Task Sequence Number	Task Name	Process Type	Processing Time (Minutes)	Process Name	Object Name	Request Move	Destination Node
1	ReserveRoom	Process	0	GetRoom	Name		
2	SendNurseToRoomAndClean	Specific Time	Random.Triangular(5,15,5)		Nurse	ToRoom	Input@Exam1
3	BringBackNurse	Specific Time	0		Nurse	ToRoom	Output@WaitingArea

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## Task Sequences Advanced Concepts

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## Tasks Reusing Same Resource



### ► Resource Requirements

Advanced Options

The screenshot shows the 'Properties' window for a task. The 'Resource Requirements' section is expanded, showing 'Number Of Objects' set to 1 and 'Reservation Timeout' set to 'Math.Expression'. A green arrow points from the 'Keep Reserved If' text to the 'Reservation Timeout' field.

**Keep Reserved If:** Optional condition indicating whether to keep the released resource capacity reserved for possible later reuse by the same owner object. Other objects will be unable to seize the reserved capacity unless the reservation is cancelled.

**Reservation Timeout:** If the released resource capacity is being kept reserved, an optional wait time before automatically cancelling the reservation.

With default options entity will always momentarily keep reserved the resource(s) that were seized to perform the task.

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## Use with Data Tables



- Option 1: A data-driven model can specify a data table field for any property values

The screenshot shows the 'Task Information' window with 'Condition Or Prob.' set to 'PatientData.Priority == 4'. A green arrow points from this field to a data table. The data table has columns for 'Patients' and 'Priority' with rows for 'Asymptomatic', 'Moderate', 'Severe', and 'Urgent'. The 'Urgent' row has a value of 40 in the 'Patients' column.

In this specific case only "Urgent" patients are going to perform task "40".

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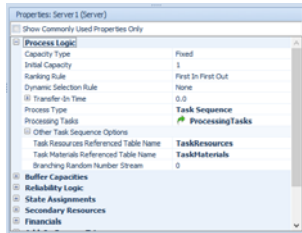
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## Use with Data Tables



- ▶ Option 2: You can create relational tables and directly reference those tables.



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## Tasks Defined in Server



- ▶ Best approach if Tasks are fixed at a specific Server – e.g. a complex assembly area in a production line.
- ▶ Tasks descriptions are entered in the repeat group for the Server.
- ▶ Limited to one resource per Task.
- ▶ Limited to one material consumption per Task.

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## Tasks Defined in Tables



- ▶ Best approach if tasks for the Server vary by Entity – e.g. Exam room in a health clinic.
- ▶ Tasks descriptions are entered in relational data tables.
- ▶ No limit on number of task resources.
- ▶ No limit on number of task materials consumed/produced.

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## More Task SimBit Solutions



- ▶ **ServerUsingTaskSequenceAlternativeMethodsForDefiningTaskPrecedence**
  - Sequence Number
  - Immediate Predecessor
  - Immediate Successor
- ▶ **ServersUsingTaskSequenceWithDataTablesJobShop**
  - Entities being processed have different routings based on type.
  - Multiple tasks are performed at each location and are job dependent.
  - Multiple resources and materials for each task.
  - Data driven model.
- ▶ **Example: HealthCareClinic**
  - All Task data specified in relational data tables

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## Auto Cancel Trigger



- Determines how a task is effected by the cancelling or bypassing of a predecessor task.

Example:

10 (if Entity.Is.RedBall)  
20 (AutoCancelTrigger = AllImmediatePredecessorsCancelled)  
30 (AutoCancelTrigger = None)  
40 (AutoCancelTrigger = None)

Results in:

Red => 10, 20, 30, 40  
NotRed => 30, 40

- If the entity is a 'RedBall', task 10 is first executed, then task 20, then task 30, then task 40.
- If NOT a 'RedBall', task 10 would be cancelled, then task 20 automatically cancelled because all its immediate predecessors (i.e., task 10) were cancelled. Task 30 then task 40 would still be executed.

