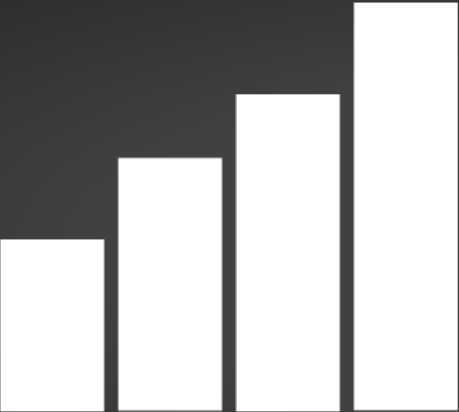
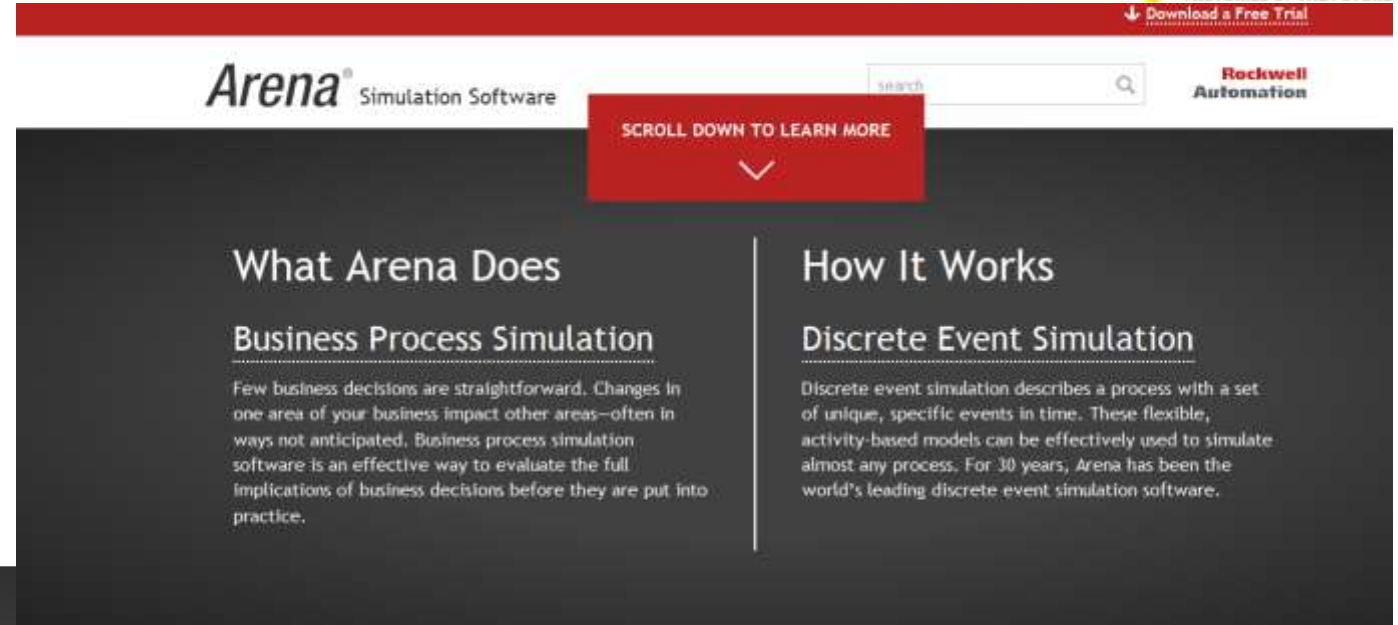


Business Process Modeling and Reengineering

Module 2 Arena tutorial

Prof. Fabiana Pirola
Prof. Giuditta Pezzotta

What is Arena?



A bar chart with four white bars of increasing height from left to right, set against a dark grey background. The bars represent growth over four periods.

Arena

World's Leading Discrete Event Simulation Software for 30 Years!

- Arena is utilized by a majority of Fortune 100 companies.
- Arena is taught in more global universities than any other discrete event simulator.
- More than 25,000 students graduate yearly with Arena training.

<https://www.arenasimulation.com/>

Arena workspace



The screenshot shows the Arena software interface with several components highlighted:

- Toolbars:** Located at the top, containing various icons for file operations, editing, and simulation control.
- Project Bar:** A vertical panel on the left containing icons for different process types such as Create, Dispose, Process, Decide, Batch, Separate, Assign, Record, Attribute, Entity, Queue, Resource, Variable, Schedule, and Set.
- Model Window Flowchart view:** The central workspace displaying a flowchart with three main components: 'Create 1', 'Process 1', and 'Dispose 1' connected by arrows.
- Model Window spreadsheet view:** A table at the bottom showing details for 'Process 1'.

Name	Type	Action	Delay Type	Units	Allocation	Minimum	Value	Maximum	Report Statistics
Process 1	Standard	Delay	Triangular	Hours	Value Added	5	1	1.5	<input checked="" type="checkbox"/>

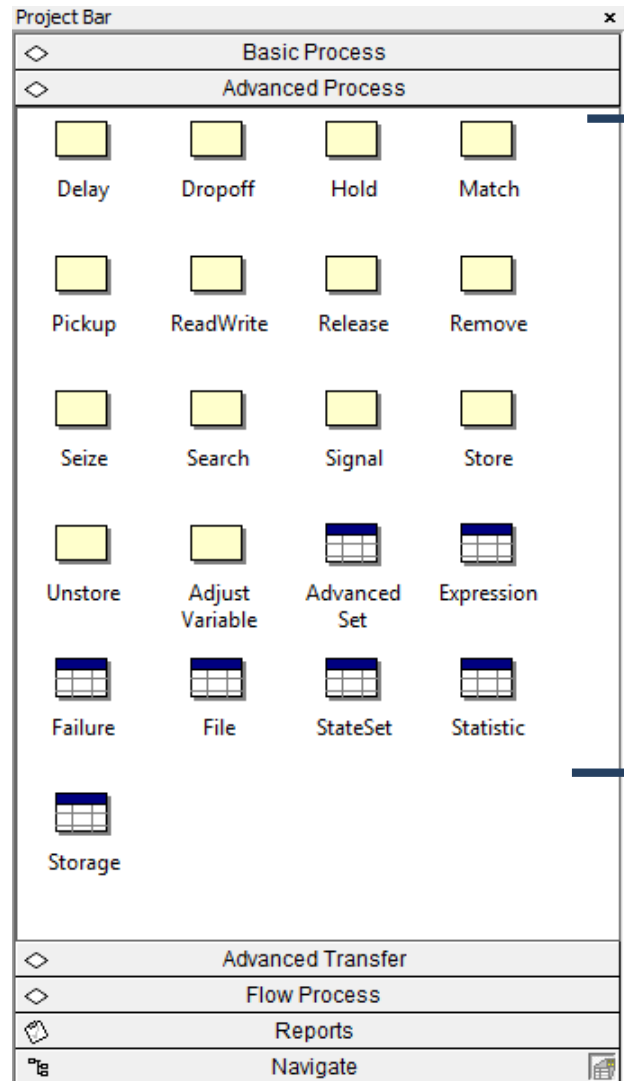
Toolbars



The image shows a screenshot of a software interface with two rows of toolbars. The toolbars are categorized into five groups, each highlighted with a colored box:

- File management (orange box):** Includes icons for file operations such as Open, Save, Print, Copy, Paste, and Undo.
- View (yellow box):** Includes icons for zooming (58%), panning, and other view-related functions.
- Simulation controls (blue box):** Includes play, pause, and stop buttons, along with a progress slider.
- Draw, text, colours... (green box):** Includes drawing tools like lines, rectangles, and text tools, along with color selection options.
- Animation (pink box):** Includes various animation and simulation control icons.

Project bar



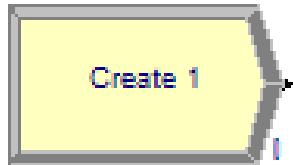
Flowchart module:

The flowchart view is a canvas to draw the process flow of entities using modules from the project bar. It can also have the animation and other drawing elements

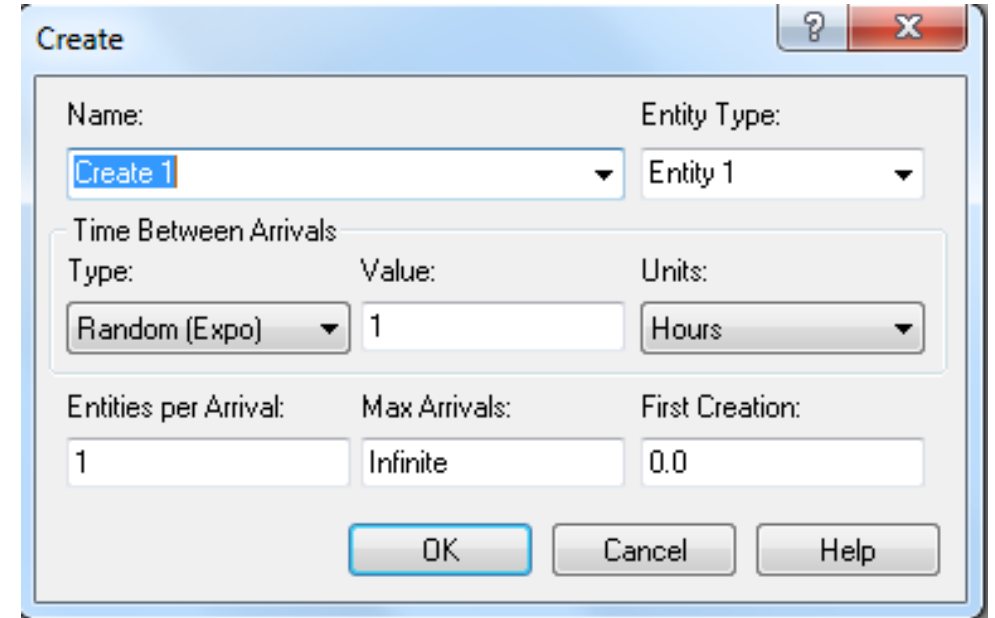
Data module:

The spreadsheet view displays the properties of selected module in the flowchart view or the project bar.

Some Arena modules



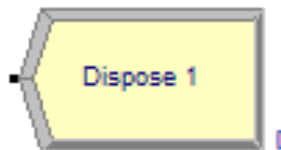
Create:
Entities enter the simulation here.



The screenshot shows the 'Create' dialog box in Arena. It has a title bar with a question mark and a close button. The dialog contains the following fields and controls:

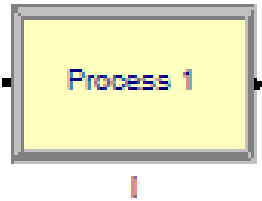
- Name:** A text box containing 'Create 1'.
- Entity Type:** A dropdown menu showing 'Entity 1'.
- Time Between Arrivals:** A section containing:
 - Type:** A dropdown menu showing 'Random (Expo)'.
 - Value:** A text box containing '1'.
 - Units:** A dropdown menu showing 'Hours'.
- Entities per Arrival:** A text box containing '1'.
- Max Arrivals:** A text box containing 'Infinite'.
- First Creation:** A text box containing '0.0'.

At the bottom of the dialog are three buttons: 'OK', 'Cancel', and 'Help'.



Dispose:
Entities are removed from the simulation here

Some Arena modules



Process:

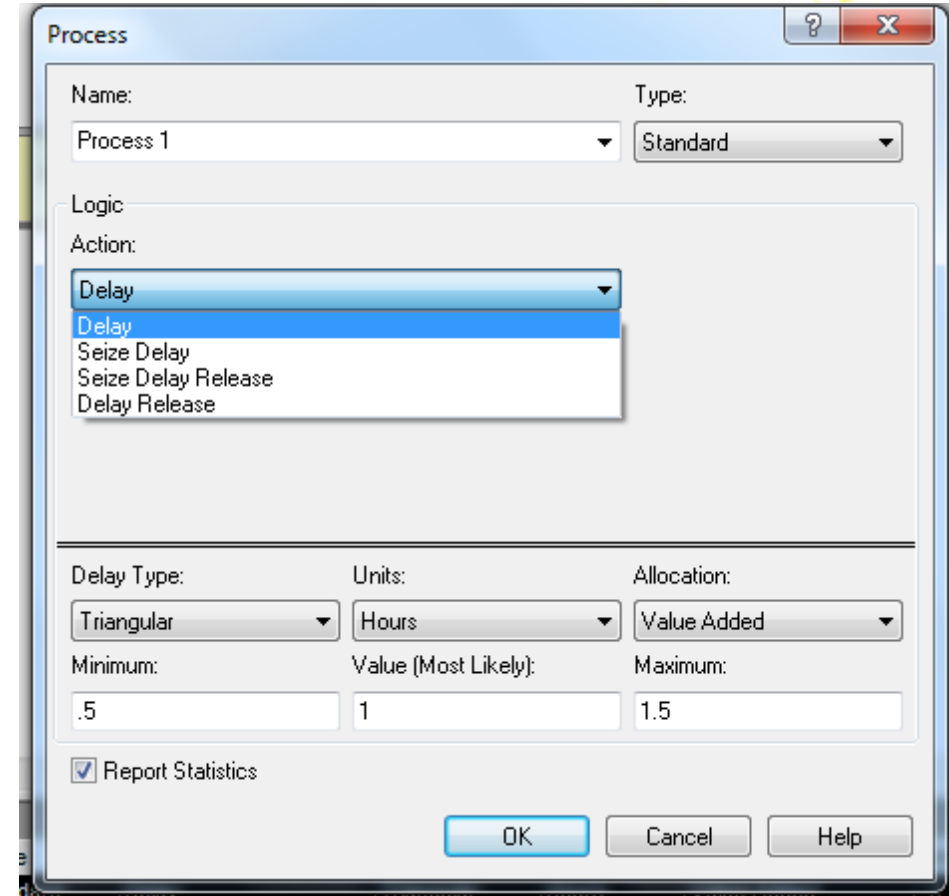
An activity, usually performed by one or more resources and requiring some time to complete

Seize Delay Release: the arriving entity seizes some number of units of a resource, then is delayed for a time, and then releases the resource

Delay: the arriving entity is simply delayed for some time and no resource is required

Seize Delay: seizes the resource and then is delayed, but does not release the resource

Delay Release: assuming that the resource is seized previously, the entity is delayed and then the resource is released



Process

Name: Process 1 Type: Standard

Logic

Action:

- Delay
- Seize Delay
- Seize Delay Release
- Delay Release

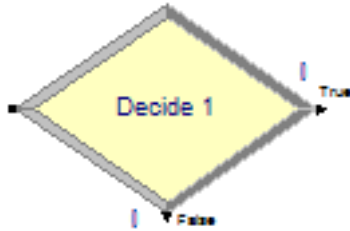
Delay Type: Triangular Units: Hours Allocation: Value Added

Minimum: .5 Value (Most Likely): 1 Maximum: 1.5

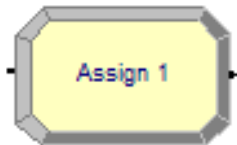
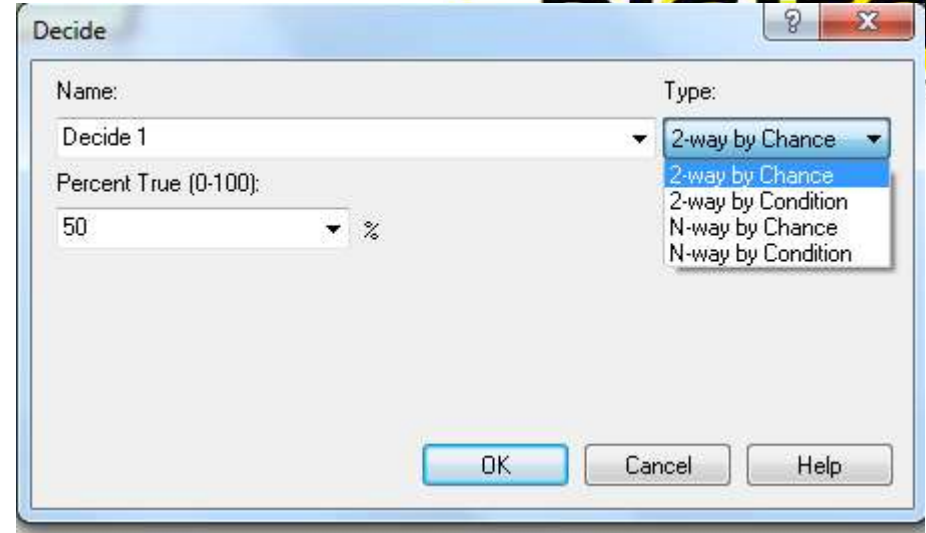
Report Statistics

OK Cancel Help

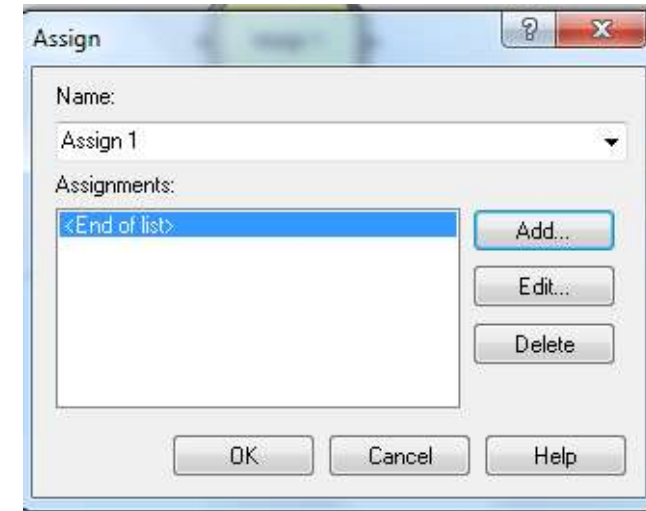
Some Arena modules



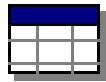
Decide:
A branch in entity flow. Only one branch is taken.



Assign:
Change the value of some parameter (during the simulation), such as the entity's type or model variable



Some Arena modules



Entity

Entity - Basic Process									
	Entity Type	Initial Picture	Holding Cost / Hour	Initial VA Cost	Initial NVA Cost	Initial Waiting Cost	Initial Tran Cost	Initial Other Cost	Report Statistics
1 ▶	Entity 1	Picture.Report	0.0	0.0	0.0	0.0	0.0	0.0	<input checked="" type="checkbox"/>

Double-click here to add a new row.

Entity/Resource:

Shows the tables through which it is possible to modify resources properties



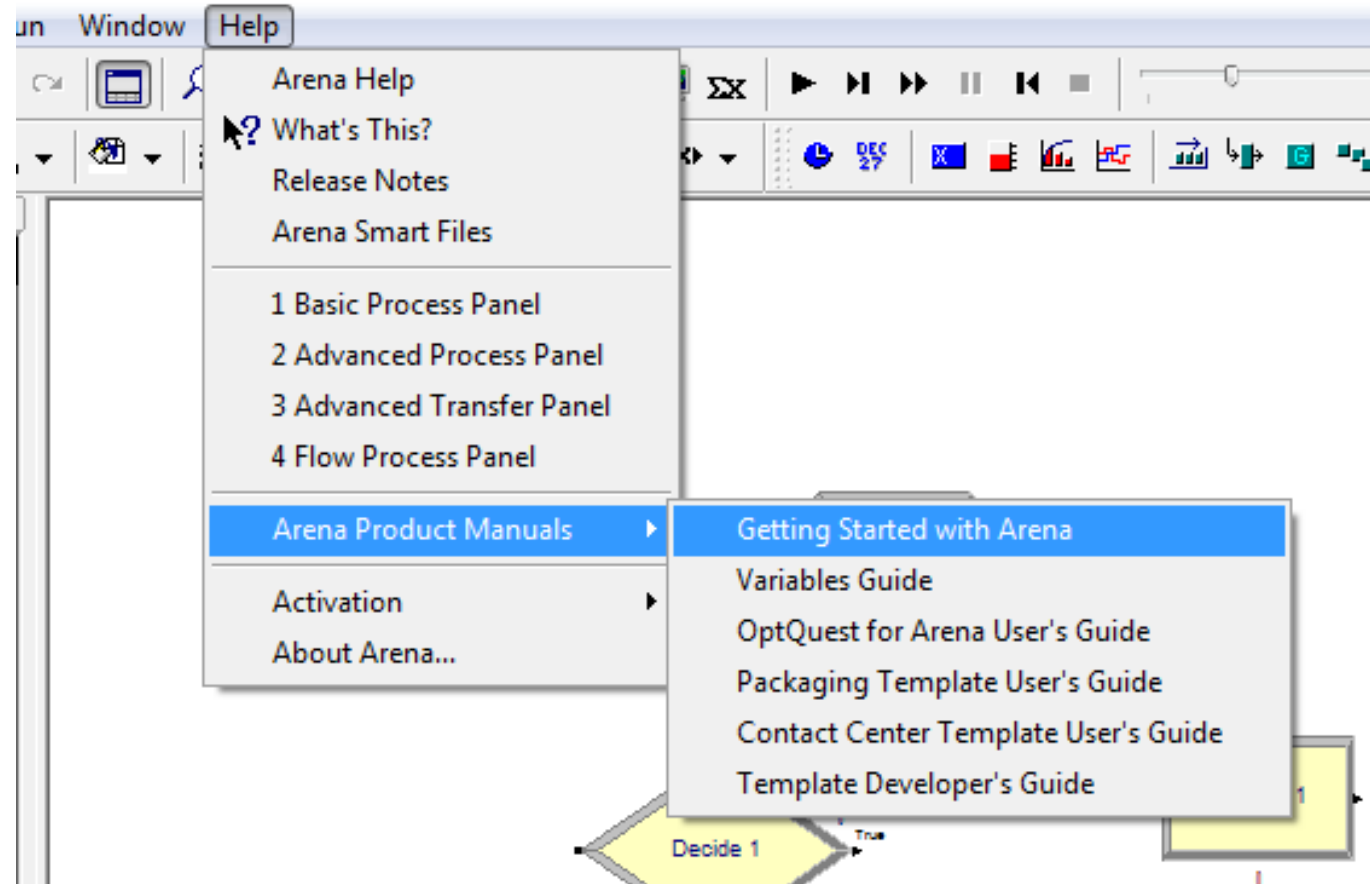
Resource

Resource - Basic Process									
	Name	Type	Capacity	Busy / Hour	Idle / Hour	Per Use	StateSet Name	Failures	Report Statistics
1 ▶	Resource 1	Fixed Capacity	1	0.0	0.0	0.0		0 rows	<input checked="" type="checkbox"/>

Double-click here

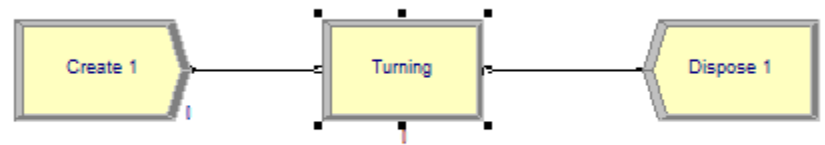
- Fixed Capacity
- Based on Schedule

For further information



Example

- Model a machining process

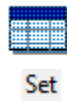


Common problems – Resources working in parallel



- Define each resource (machine1, machine2)
- Group the resources into a set (set machines)

- In the process assign a «set».



The screenshot displays three overlapping windows from a simulation software:

- Process Window:** Shows a process named "Turning" with a "Standard" type. The "Resources" field is set to "Resource_Resource 1".
- Resources Window:** A dialog box for defining a resource set. The "Type" is "Set", the "Set Name" is "Set machines", and "Units to Seize/Release" is set to 1.
- Members Window:** A table listing the members of the "Set machines" resource set.

Members	
	Resource Name
1	Machine 1
2	Machine 2

	Name	Type	Members
1	Set machines	Resource	2 rows

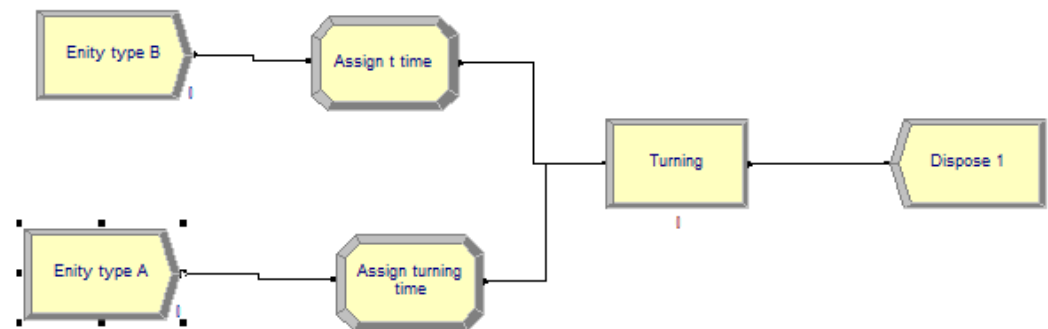
Example



- **Simulation of a production process:**
- Assembly: usual duration 1,2 hours, max 1,5 hours, min 0,5 hours. Performed by assemblers
- Test: usual duration 0,5 hours, max 1 hours, min 0,2 hours. . Performed by tester
- Final preparation: usual duration 15 min, max 18 min, min 10 min. Performed by assemblers
- **Resources:**
- 2 assemblers working from 8.00 to 12.00 and from 13.00 to 17.00
- 1 tester working from 9.00 to 13.00 and from 14.00 to 18.00
- **Demand:**
- Random every 45 minutes 1 arrival
- In the 95% of cases the assembled product passes the test. In it does not pass the test, a new test is done. The probability to pass this new test is 50%. If the assembled product does not pass the second test is it discarded.

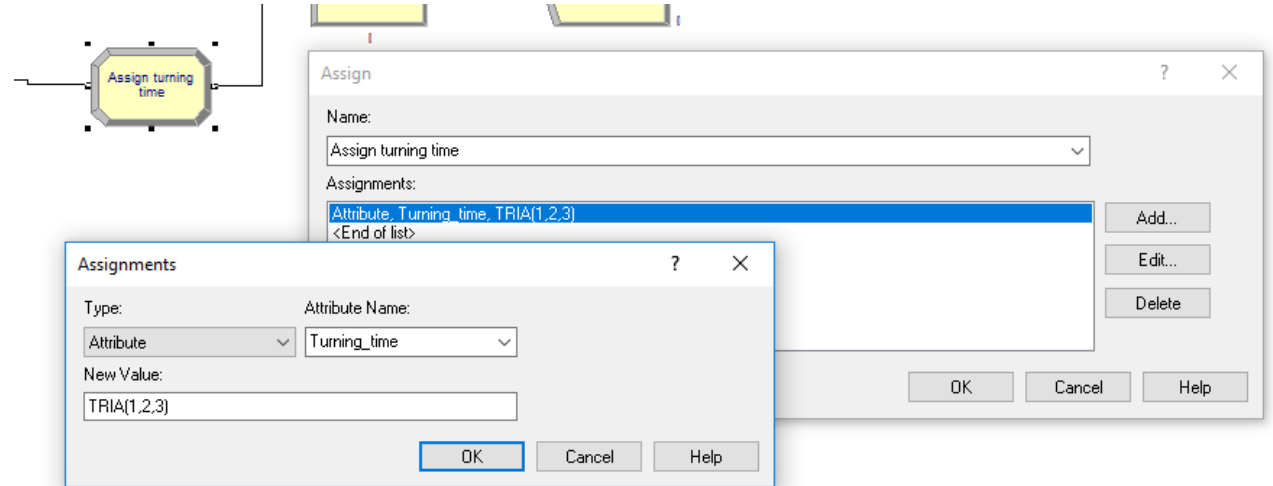
Common problems – different processing time

- Model the machining process of two pieces A and B.
- Both of them have to move through the «turning» activity but the time they spend in the process is different
- Entity type A: turning process (1h, 2h, 3h)
- Entity type B: turning process (0.5 h, 1h, 1.5h)

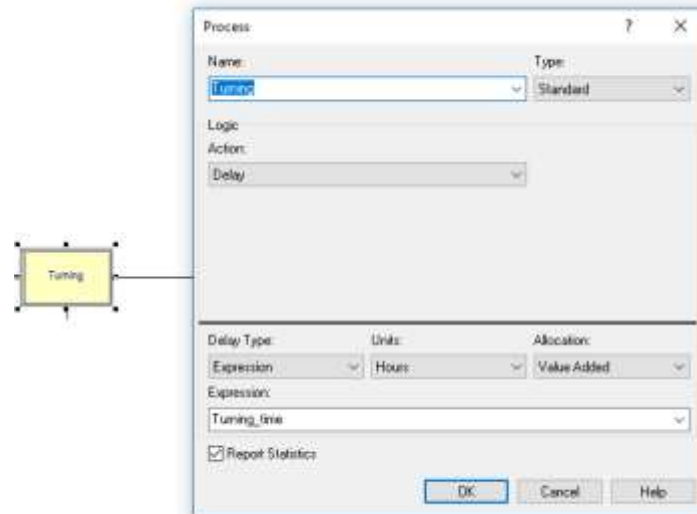


Common problems – different processing time

- «Assign module» is used to set an attribute that defines the process duration for each type of entity

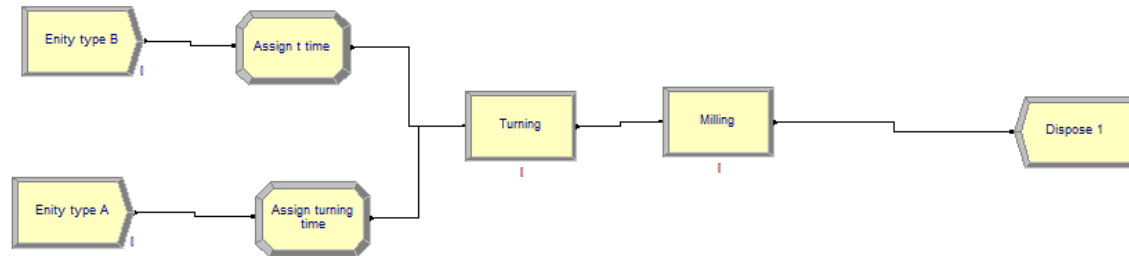


- The activity duration inside the process module is defined as the name of the attribute previously defined

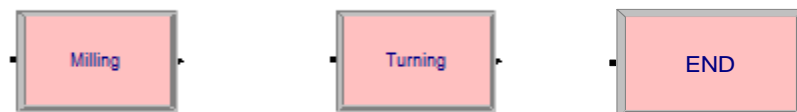


Common problems– Different sequence of activities for different type of entities

- This is how the process works in case both entity type A and B follow the same process

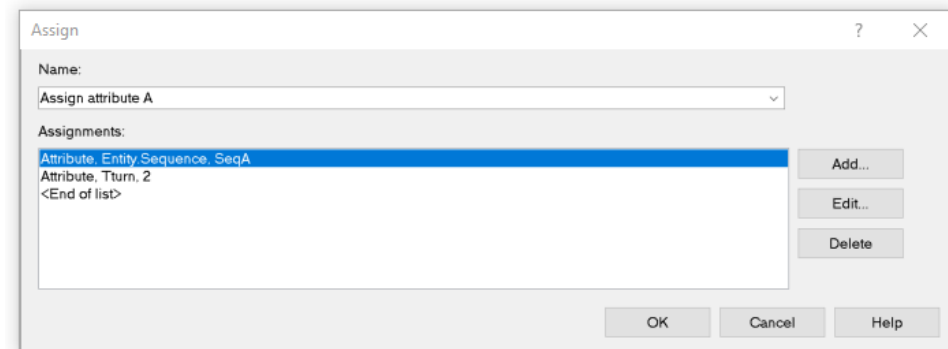
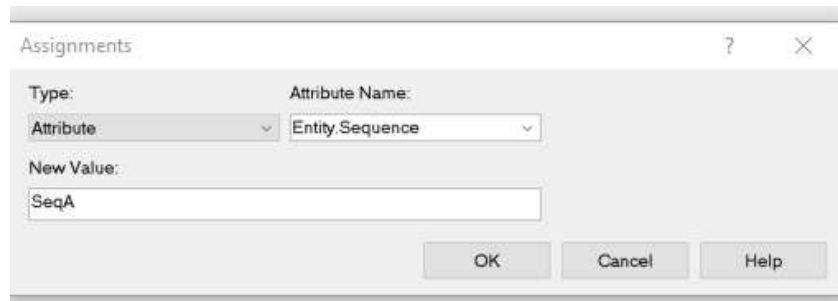


- In case entity type A and B follow different sequence of activities the «process» module must be substituted by «station» module



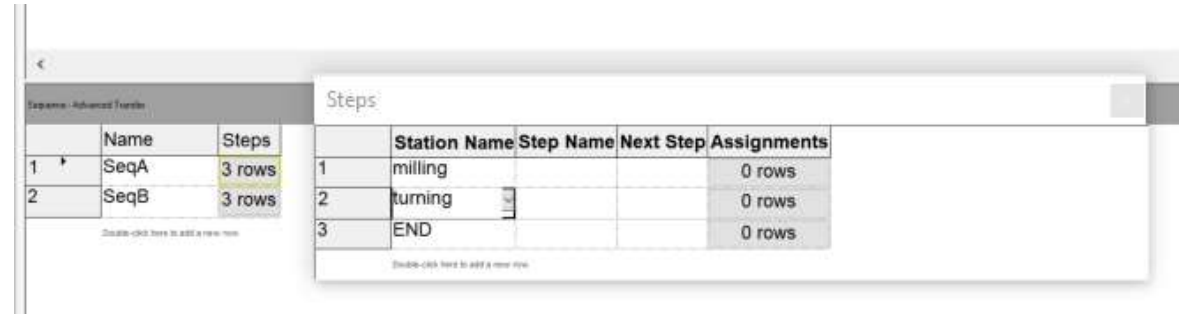
How to use the «station» module

- Define all the possible «stations» of the model (milling, turning, end)
- Add «processes» or «dispose» modules after «stations» modules
- Assign the attributes to entity A and B (turning time, SeqA, SeqB). For the sequence, assign an attribute name called «Entity.Sequence»



How to use the «station» module

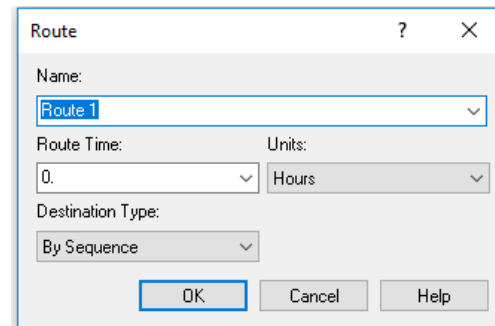
Define the sequence of activities for each single entity type in the data module «sequence» (Advance transfer template)



	Name	Steps
1	SeqA	3 rows
2	SeqB	3 rows

	Station Name	Step Name	Next Step	Assignments
1	milling			0 rows
2	turning			0 rows
3	END			0 rows

Use the «route» modules to guide the entity process. Set «destination type» «by sequence».



Route

Name:

Route Time: Units:

Destination Type:

OK Cancel Help

How to use the «station» module

- The model works as following:

