



Andhra Pradesh State Skill Development Corporation



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DIGITAL MANUFACTURING WITH DELMIA

FACTORY FLOW SIMULATION

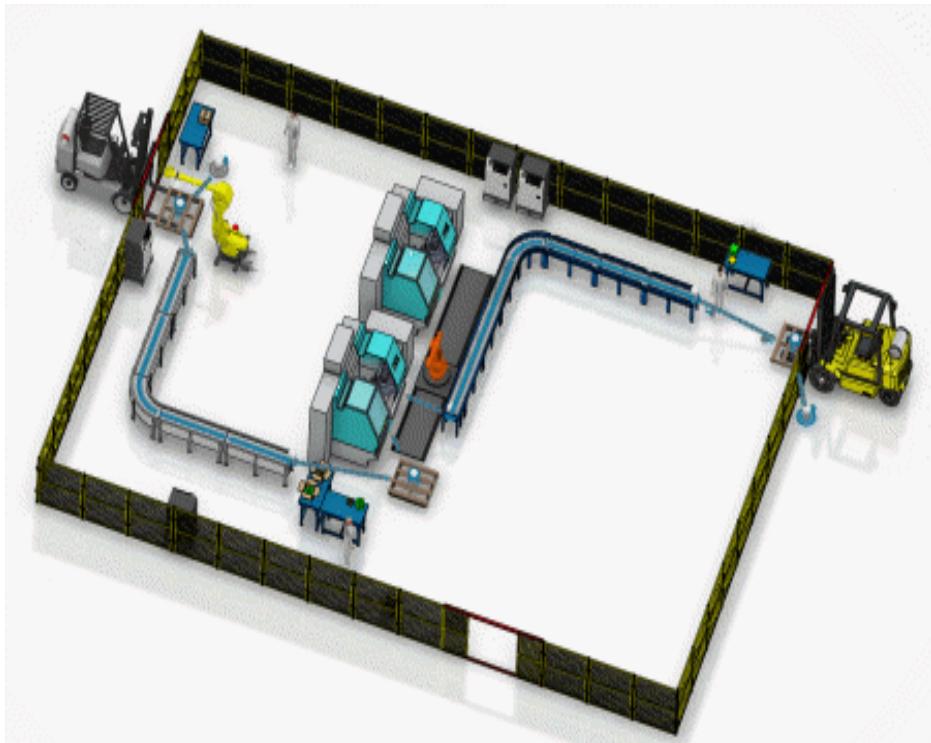


Factory Flow Simulation

Factory Flow Simulation enables you to create, define, and simulate production system behavior to optimize production performance.

For industrial engineers, Factory Flow Simulation provides the following key capabilities:

- Create from scratch a production system that includes products, resources, and product flows.
- Generate a production system from process planning content and reuse existing resource behavior.
- Customize a production system by defining specific resource behavior.
- Simulate realistically a production system at different levels of detail.
- Analyze a production system by displaying simulation statistics and resource reports during simulation.
- Edit a production system and its components to optimize its performance.



Factory Flow Simulation supports design range management. Factory Flow Simulation supports design range management.

When you create new content, you must specify the associated design range. Normal range is the default option and is sufficient in the majority of cases. For more information, see 3DEXPERIENCE Native Apps: Introducing Design Range Management.

Module-4. A: Factory Flow Simulation Basics

A. Factory Flow Simulation Basics

Before you begin using this app, you need to know the key concepts and capabilities described in related guides and the user interface specific to this app.

In this section:

- Related Guides and Resources
- Access to Content
- Predefined Queries
- User Interface



B. Getting Started

This section shows basic tasks you can carry out using Factory Flow Simulation.

In this section:

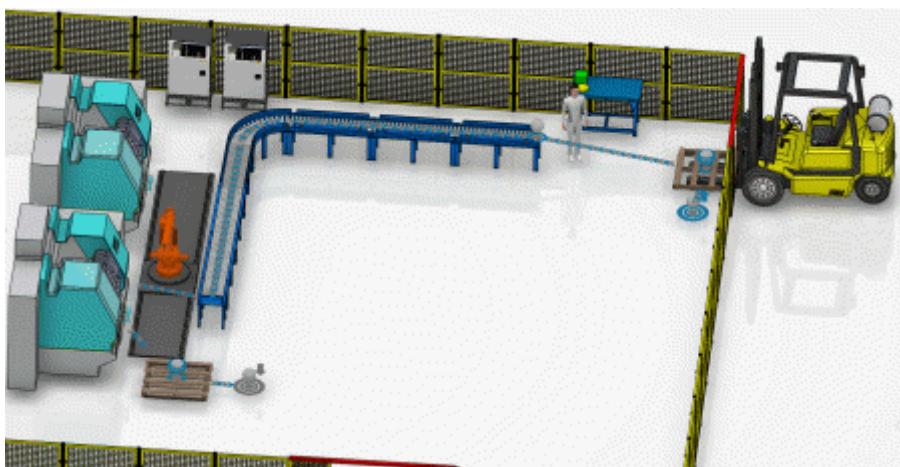
- Creating a Factory Flow
- Defining a Resource Zone
- Associating a Resource with a Product Flow
- Simulating the Factory Flow
- Editing the Activity of a Resource
- Adding a Product to the Factory Flow

C. Creating a Factory Flow

In this step, you will create a Factory flow.

Note: The resource structure used in this scenario contains the following resources: two storage resources (pallets), a worker, a conveyor, a robot, an NC machine, and products to manufacture. These resources are organized in a specific order as shown in the picture below. To reproduce this scenario, open a resource structure similar to the one used here.

1. From the Programming section of the action bar, click Define Factory Flow and select a point where the Factory flow is to start.
2. Click Add Products to define a Create Activity and select a product to manufacture in the tree or work area.
3. Select the following resources one after the other:
 - a. The first pallet
 - b. The conveyor
 - c. The NC machine. Click Add Product to define the Output for the Transform Activity and select a manufactured product in the tree or work area.
 - d. The second pallet
4. Select a point where the Factory flow is to end.

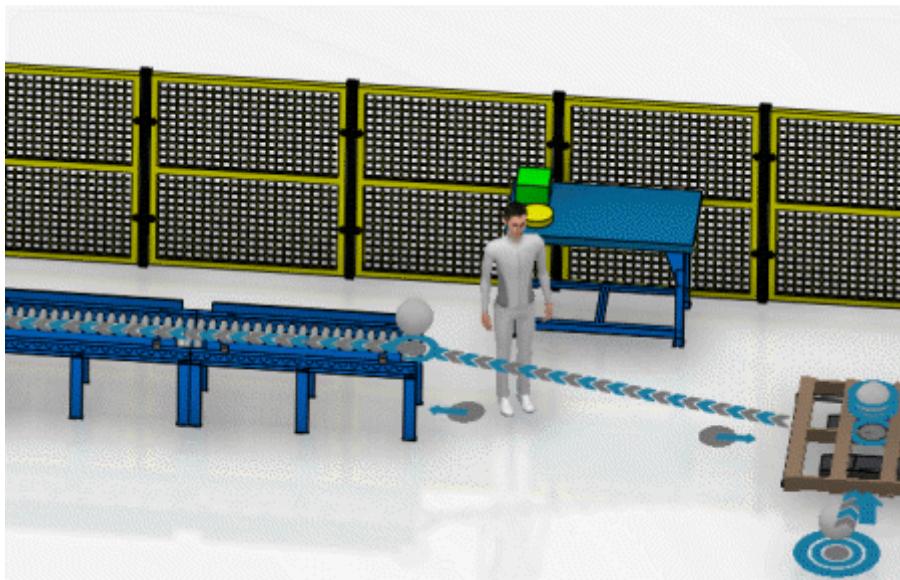


Next step: Defining a Resource Zone

D. Defining a Resource Zone

In this step, you will define two Resource zones between the conveyor and first pallet.

1. From the Programming section of the action bar, click Add Resource Zone and select the conveyor.
2. Click a point near the conveyor where the Resource zone is to be located.
3. Use the Robot to define the worker position and direction.
4. In the same way, create the second Resource zone near the pallet.
5. To finish, press Esc.

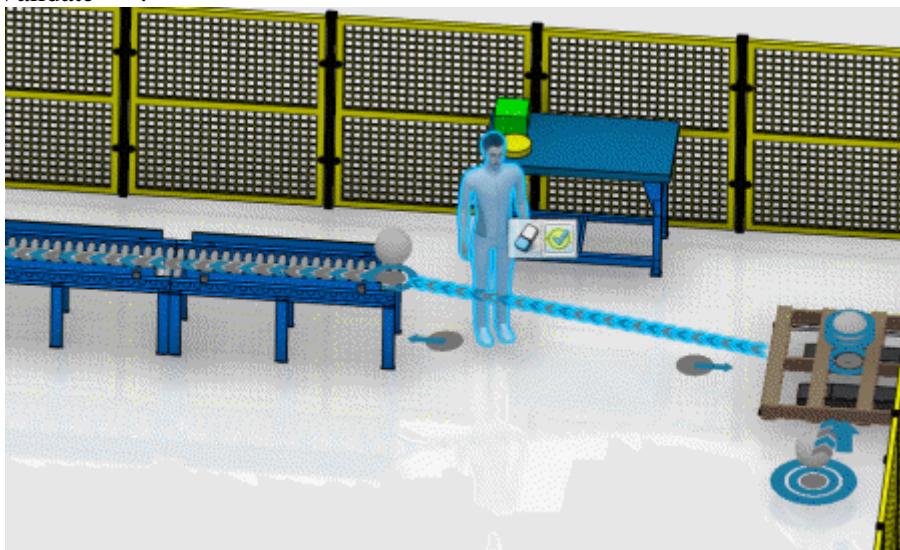


Next step: Associating a Resource with a Product Flow

E. Associating a Resource with a Product Flow

In this step, you will associate the worker with the first Product flow.

1. Select the Product flow between the pallet and conveyor.
2. In the context toolbar, click Assign Resource Pool and select the worker.
3. Click Validate .



Next step: Simulating the Factory Flow

F. Simulating the Factory Flow

In this step, you will simulate the Factory flow.

1. Click the Play button of the Compass.
The following simulations appear in My Play Experiences:

- Discrete Event Simulation
- Dynamic Level1
- Dynamic Level2

2. Select Discrete Event Simulation.

The Player appears.

3. Optional: In the Player, click Play forward .
4. During simulation, click the conveyor.

The simulation statistics panel appear.



The Factory flow is simulated.



Next step: Editing the Activity of a Resource

G. Editing the Activity of a Resource

In this step, you will edit the activity name and duration parameters of the NC machine.

1. Select the NC machine and click Edit the SLA resource behavior and activities in the context toolbar.

The Edition dialog box opens.

2. In the Transform area, do the following:
 - a. In the Name box, type Drilling
 - b. In the Duration box, enter 4.0
3. Click OK.

The activity name and duration parameters of the NC machine are edited.

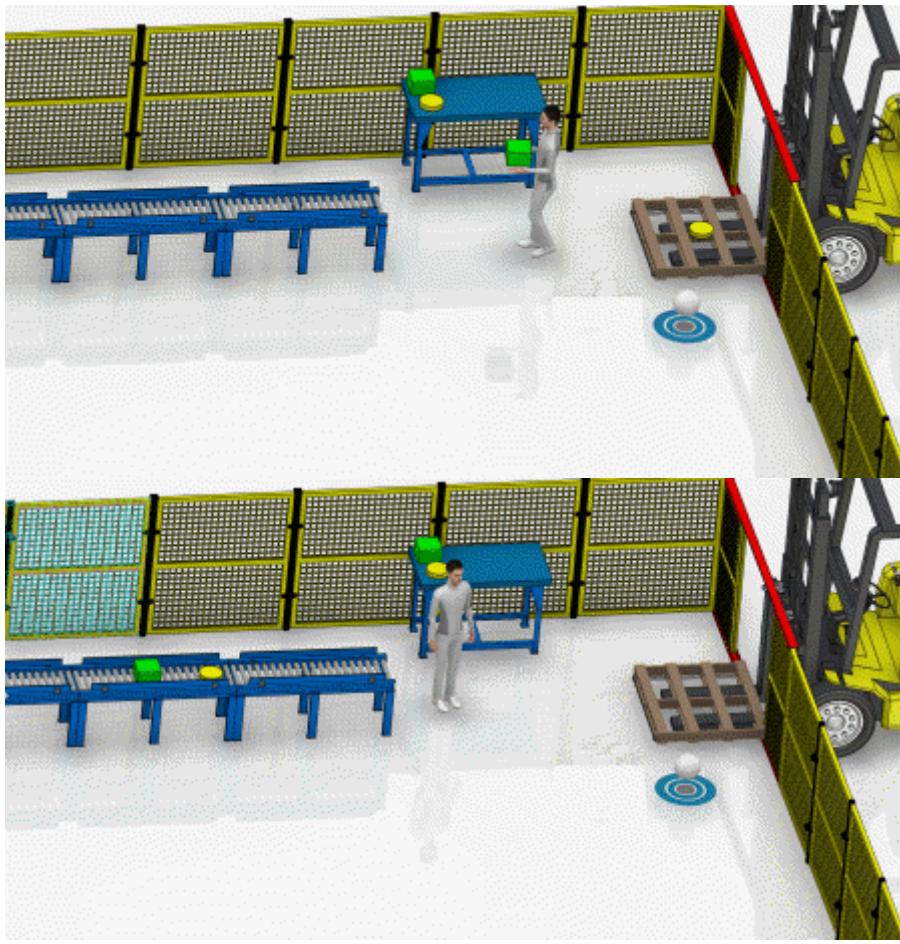
Next step: Adding a Product to the Factory Flow

H. Adding a Product to the Factory Flow

In this step, you will add another product to the Factory flow.

1. Select the In zone of the Factory flow.
2. In the context toolbar, click Add Create Activity .
3. Click Add Product(s) to define a Create Activity and select a product.
4. To finish, press Esc.

A second product is now part of the Factory flow and appears in the Factory flow during simulation.



Module-4. B: Defining Flows

This section shows you how to define factory and product flows.

In this section:

- About Flows
- Creating and Modifying a Factory Flow
- Creating and Modifying a Product Flow
- Creating a Factory Flow from Process Planning

A. About Flows

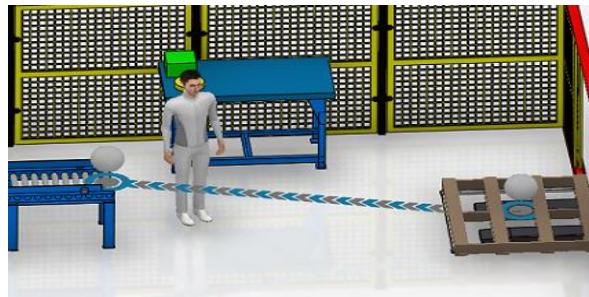
Flows create links between resources, allowing a product to be handled by one or more resources.

- Product Flow
- Factory Flow

Product Flow

A product flow creates a link between two resources, allowing one or more products to move from one resource to another.

It is symbolized by a chevron line with a product zone located at each extremity.

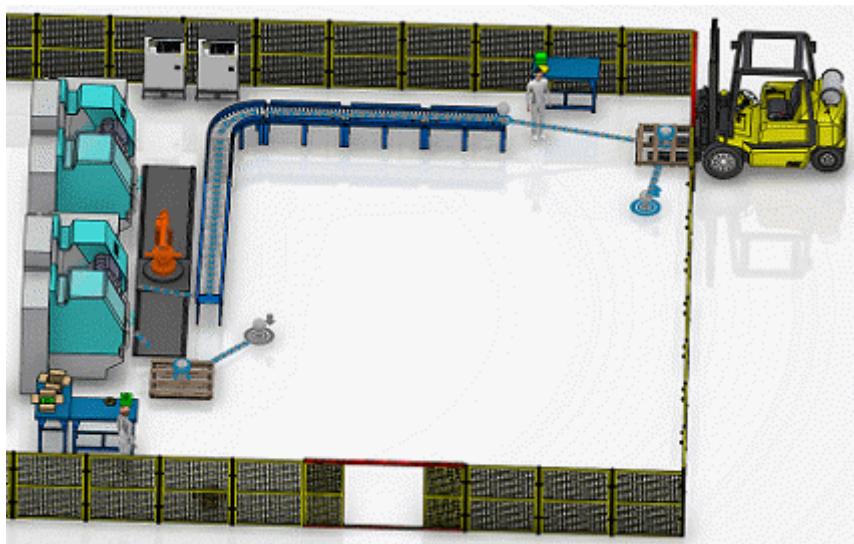




Factory Flow

A factory flow is a series of product flows and activities, allowing one or more products to go through several resources.

The factory flow starts with an in zone associated with a create activity and ends with an out zone associated with a dispatch activity.



You can customize the color of flows. See Customizing Preferences.

B. Creating and Modifying a Factory Flow

You can create a factory flow for several resources. You can also modify the factory flow after creating it, to include more resources or to redirect the flow to a new branch of the production system.

This task shows you how to:

- Create a Factory Flow
- Modify a Factory Flow

Create a Factory Flow

You can create a factory flow for several resources such as conveyor, NC machines, and storage resources.

1. From the Programming section of the action bar, click Define Factory Flow .
2. Select a point in the work area where the factory flow is to start.

The Robot and Add Products to define a Create Activity appear. A product zone and create activity are automatically created.

3. Click Add Products to define a Create Activity and select a product in the tree or work area.
4. Select one of the following resources in your resource structure:
 1. Conveyor
 2. Industrial Computer
 3. NC Machine

Note: When selecting an NC Machine, click Add Products to define the output for the Transform

Activity and select a product in the tree or work area.

4. Storage
5. Tool Device

A product flow symbolized by a chevron line appears between the start point of the factory flow and the resource. A product zone is automatically created. Depending on the resource you select, different activities are also created and a default task is associated with the activity.

5. In the same way, select other resources to include in the factory flow.
6. Select a point in the work area where the factory flow is to end.

A product zone and dispatch activity are automatically created.

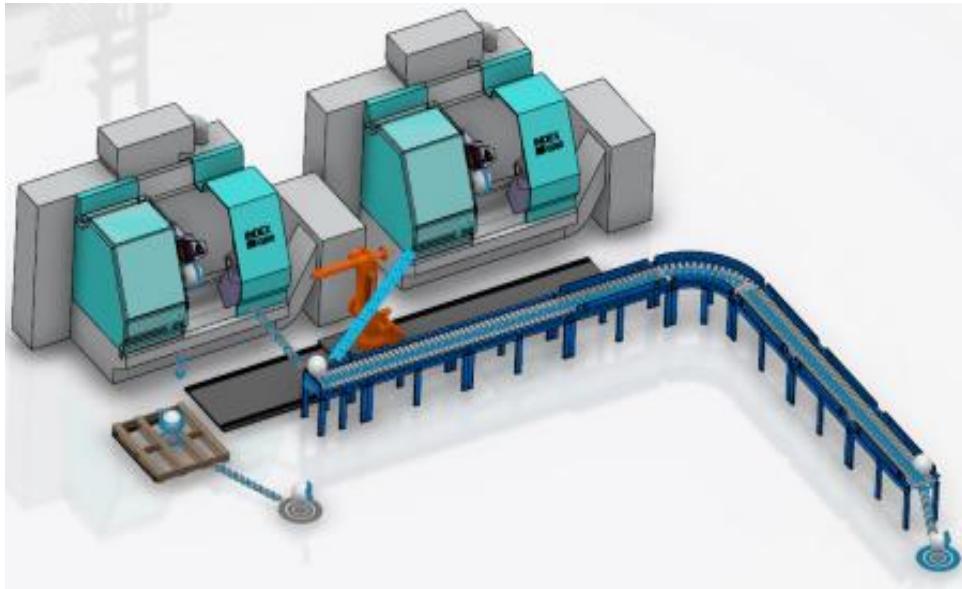


Modify a Factory Flow

You can modify a factory flow using Define Factory Flow. This is useful when you want to include new resources to the flow, or when you want to redirect the flow to another branch of the production system. This task illustrates how to include new resources to a factory flow.

1. Select a resource of the factory flow.
2. From the Programming section of the action bar, click Define Factory Flow .
3. Select a new resource to include in the flow.

A product flow is created, linking the new resource with the factory flow.



C. Creating and Modifying a Product Flow

You can add or modify a product flow between two resources.

This task shows you how to:

- Creating a Product Flow
- Modifying a Product Flow

Creating a Product Flow

You can add a product flow between two resources.

Before you begin: Open a resource structure on which to add a product flow.

1. From the Programming section of the action bar, click Add Product Flow .
2. Select the resource where the product flow is to start.
3. Select the resource where the product flow is to end.
4. Click  and select a product to add to the product flow.
5. To finish, press Esc.
6. Optional: To delete a product flow, right-click the product flow and select Delete.

Modifying a Product Flow

You can modify a product flow between two resources.

1. Do one of the following:
 - Click Resource Configuration  from the Programming section of the action bar. In the Resource Configuration table that appears, right-click a product flow and select Edit product flow  from the context menu.
 - Select the product flow in the work area and click Edit .
2. In the Edit Product Flow dialog box that appears, click:
 - Add Product to Flow .



Note: You can also add a new product when you select the product flow in the work area then click Add Product to Flow . From there, select the product from the work area, tree, or Suggested Products panel and click OK.

- Specify the details such as a name, proportion, priority, and output product.
- Assign a resource pool and edit the pool's Quantity to mention the number of resources required from each pool during simulation. Also edit the Start Position and End Position to set the home position of the resource.

3. Click OK.

You have modified the product flow.

D. Creating a Factory Flow from Process Planning

You can generate a factory flow from process planning.

Before you begin:

- Create a system in the Process Planning app. Resources must be associated with the system.
- Do you know if the process planning will be updated in the future? Modifications to the process planning do not propagate to the factory flow. Make sure the process planning is complete before generating a factory flow from it.

1. From the Setup section of the action bar, click Synchronize with Planning Data .
2. In the dialog box that appears, click OK.

A manufacturing product appears in the tree. The manufacturing product contains all the products defined in the process planning.

3. From the Programming section of the action bar, click Generate data model from process planning .
4. In the tree, select the created manufacturing product.

The factory flow is generated from the process planning as follows:

- Operations from the process planning become activities.
- Source operations become in zones with a create activity assigned.
- Sink operations become out zones with a dispatch activity assigned.

Notes:

- Alternatively, you can manually create a manufacturing product with all the products defined in the process planning.
- If no source operation is defined in the process planning, an in zone with a create activity is created by default. If no sink operation is defined in the process planning, an out zone with a dispatch activity is created by default.

Module-4. C: Creating Zones

This section shows you how to create Product, Resource, and In and Out zones.

In this section:

- About Zones
- Adding Zones

A. About Zones

Zones are specific points you can define on a resource for a product to be handled (product zones, decision zones), and near a resource to specify the position of a worker (resource zones).

The following topics are discussed:

- Types
- Product Zones
- Resource Zones



Types

The following zones are available:

Icons	Zones	Description
	In-zone	Start point of a factory flow
	Out-zone	End point of a factory flow
	Product zone	Point set on resources where the product is handled by a resource.
	Resource zone	Point near a resource where a worker is located to handle a product.
	Decision zone	Point set on a conveyor where a resource executes an activity on a product when that product reaches the zone.
	PnF Decision zone	Point set on a Power and Free conveyor to load, unload, and route products. You can also specify a number of carriers that can claim this decision zone at the same time.

Product Zones

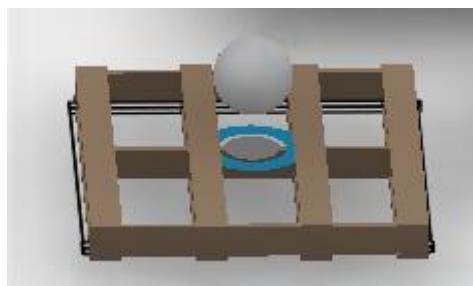
Product zones are specific points set on resources where the product is handled by a resource.

When using Define Factory Flow and selecting resources, product zones are automatically created and set on specific parts of the resources, for example:

- Conveyors: product zones are created at the start and end of the conveyor.
- NC machine: a product zone is created on its mounting port.
- Storage: a product zone is created on its top face.

Blue and gray rings and a sphere identify a product zone.

In the image below, a product zone is created on a storage resource:



You can add a product zone manually using Add Product Zone and then associate an activity with it.

Resource Zones

Resource zones are specific points near a resource where a worker is located to handle a product.

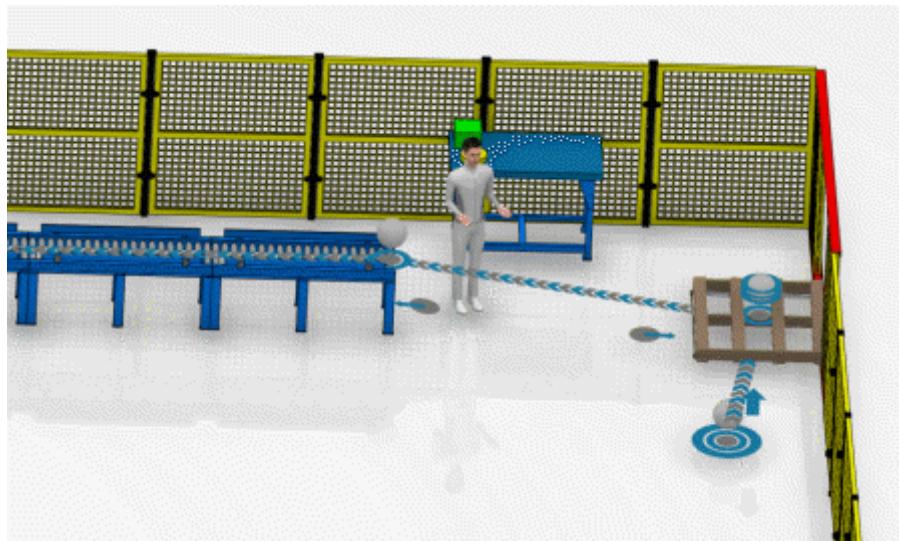
You can define resource zones using Add Resource Zone . When using this command, a gray circle



and a blue arrow appear to identify the resource zone:

The blue arrow specifies the position of the worker with respect to the resource next to which the resource zone is created.

In the example below, two resource zones are created: one near a pallet, the other near a conveyor. The arrows of the resource zones point towards the resource next to which they are created so that the worker faces the resource when approaching it.



B. Adding Zones

You can add several types of zones to a flow.

This task shows you how to:

- Add an In Zone
- Add an Out Zone
- Add a Product Zone
- Add a Resource Zone
- Define a Decision Zone on a Conveyor
- Create an AGV Decision Zone
- Define Groups and Mobile Objects for AGV Decision Zone
- Define Route Group on a Decision Zone
- Define Request Group for a Decision Zone
- Define Claim Group for a Decision Zone

Add an In Zone

You can add an in zone to a product flow.

1. From the Programming section of the action bar, click Add In Zone .
2. Click a point in the work area to specify the location of the in zone.

The in zone appears in the work area.

3. Optional: Use the Robot to define the position of the zone.
4. To finish, press Esc.
5. To edit the zone, double-click it in the Resource Configuration table.
6. Optional: In the Edit dialog box that appears, you can set the Operation mode to Schedule.
7. Optional: Define the schedule using the Edit option in the dialog box to specify the part name, lot size, and time of arrival of the part.

During simulation, machines produce parts on the in zone according to the schedule you defined.



Add an Out Zone

You can add an out zone to a product flow.

- From the Programming section of the action bar, click Add Out Zone
- Click a point in the work area to specify the location of the out zone.

The out zone appears in the work area.

- Optional: Use the Robot to define the position of the zone.
- To finish, press Esc.

Add a Product Zone

You can add a product zone to define a point in the product flow where a resource handles the product.

- From the Programming section of the action bar, click Add Product Zone
- Select a resource.
 - The product zone appears on the selected resource.
 - If the resource is a carrier on a Power and Free conveyor with a mount port defined on it, then a dialog box appears. You can select a mount port from the list displayed in the dialog box.

Apply to all instances option lets you create a product zone on all the instances of the selected carrier.

- Optional: Use the Robot to define the position of the zone.
- In the context toolbar, click Add the Product that flows and select a product in the tree or work area.
- To finish, press Esc.

Add a Resource Zone

You can add a resource zone to specify a point in the product flow where a worker waits for a product.

- From the Programming section of the action bar, click Add Resource Zone
- Select the closest resource to specify the location of the resource zone.
- Click a point in the work area to specify the location of the resource zone.

The resource zone and the Robot appear.

- Optional: Use the Robot to define the worker position and direction.
- Specify the Quantity of workers required.

Note: You can have more than one worker in a resource zone.

During simulation, each worker occupies the closest possible resource zone or the closest least occupied zone assigned to the operation.

- To finish, press Esc.

The resource zone appears on the selected zone.

Define a Decision Zone on a Conveyor

You can define a zone on a conveyor where you want a resource to execute an activity on a product. You can define one decision zone per conveyor only.

- From the Programming section of the action bar, click Add Decision Zone
- Select a point on the conveyor.
- Click the selected point again to confirm your selection.

The decision zone appears on the conveyor.

- Optional: Use the Robot to define the position of the zone.
- Press Esc.
- Create an activity to handle the product:
 - Select the decision zone.
 - In the context toolbar, click Add Transform Activity
 - Click Add products to define the requirements for the Transform activity and select an input product.
 - Click Add Products to define the output for the Transform activity and select an output product.



e. Press Esc.

7. To edit the activity parameters, select the zone and click Edit SLA Resource
 8. In the Edit dialog box that appears, specify the Claim Capacity under Decision Zone Behavior. You have defined the maximum number of parts that occupy the decision zone. For example, if the claim capacity is 1, then only one part occupies the decision zone. If the claim capacity is 2, then one part will occupy the decision zone and the other part accumulates behind the part occupying the decision zone.
 9. Enable the Unclaim When Trail Ends option beside Claim Capacity. This unclaims the decision zone as soon as the part starts traveling away from the zone or when the trail end of the part reaches the zone.
- The transform activity appears on the decision zone.

Create an AGV Decision Zone

You can create an AGV decision zone and add it to a pathway.

1. From the Programming section of the action bar, click Add AGV Decision Zone

Note: You can also add an AGV decision zone to a pathway in the Resource Configuration table.

2. Click a pathway from the tree then click Resource Configuration
3. In the Resource Configuration table that appears, right-click the AGV decision zone and use the context menu to add activities, product flows, and resource zones to the AGV decision zone.

Note: You can also add activities, flows, and zones to the AGV decision zone with the action bar commands.

You have created an AGV decision zone.

If you assigned a product flow to the AGV decision zone, then product transfer occurs. In this case, if the AGV decision zone has parts inside the pallet, then the assigned product flow routes the parts.

4. To edit the AGV decision zone, right-click the zone and select Edit AGV decision zone from the context menu.
5. Set the Route Type to Fixed, then click OK and close the Resource Configuration table.

You have edited the AGV decision zone.

Define Groups and Mobile Objects for AGV Decision Zone

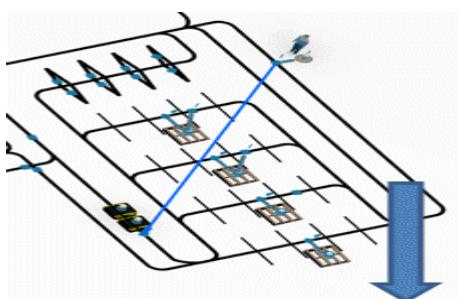
You can define a parking group and manage mobile objects for an AGV decision zone.

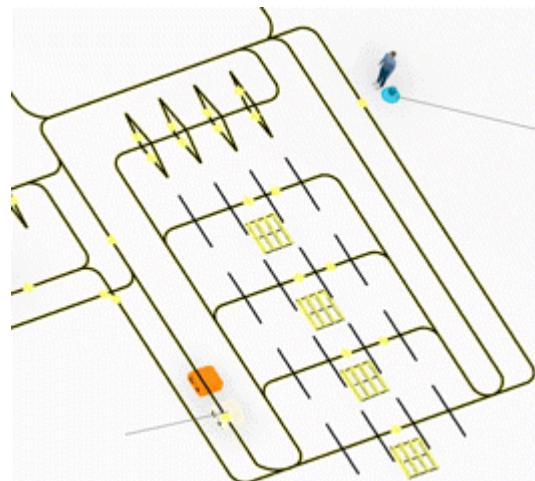
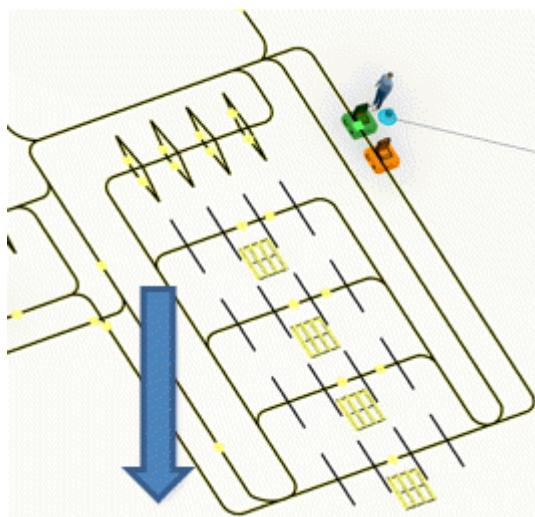
1. Click Parking Group Definition from the Programming section of the action bar to define a parking group for an AGV decision zone.
2. In the Create or Edit AGV Parking Group dialog box that appears, click Add Group , then select the AGV decision zone.
3. Click the start and target decision zones then add or remove decision zones from the group in the Select Decision Zone(s) dialog box that appears.

Note: The target decision zones signify the place where the AGV decision zones park after completing the task at the start zone. This behavior is available by default.

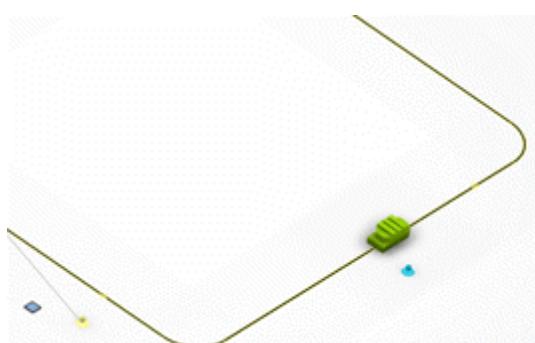
4. Click Edit Group to edit a parking group and Remove Group(s) to delete a parking group.
5. Click Assign Pool to assign a resource pool and Unassign Pool to unassign a resource pool.
6. Click OK to validate.

After completing the operation on the target decision zone, based on parking group definition, AGV routes to the parking decision zone if there are no other pending tasks.





7. Click Define mobile pre-emption from the Programming section of the action bar to preempt the AGV moving to a parking task to perform a different task.
 8. Click Assign to choose preempting resources or Unassign to unassign them.
 9. Set the preempting condition Activity Threshold value measured by percentage, then click OK.
- You have preempted the AGV moving to a parking task to perform a different task.



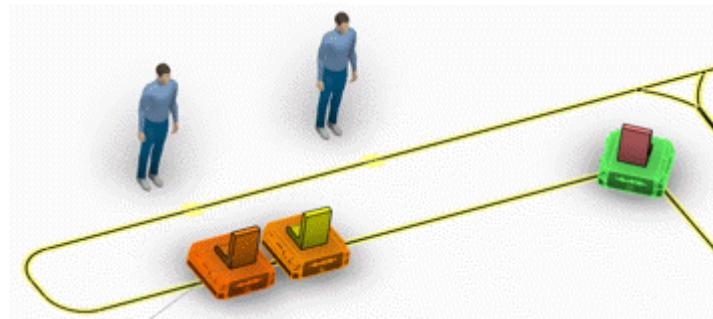
10. To define the depart requirement at the AGV decision zone, click Define Mobile Depart Requirement from the Programming section of the action bar.

Note: AGVs must spend time at a decision zone even if the AGV does not have any operation defined at that decision zone. This occurs through the depart requirement for an AGV decision zone.

11. In the Edit Resource Depart Requirement dialog box that appears, double-click an AGV decision zone to define or edit the depart requirement.
12. Set the depart requirement to Immediate or Wait Specified Delay.



Note: If you choose Wait Specified Delay, you must specify the Delay value measured in seconds. Once you define depart requirement, all of the AGVs of the same pool that are passing through that decision zone stop for the defined time and start to travel again. During simulation, AGV is in Depart Blocked state when stopped at a decision zone due to the depart requirement defined on the decision zone.



Define Route Group on a Decision Zone

You can route group definition to a decision zone.

1. From the Programming section of the action bar, click Route Group Definition , then select a decision zone.

Note: You can also route group definition to a pathway. In this case, the route groups already defined on the pathway are on the list.

2. In the Create or Edit AGV Route Group dialog box that appears, click Add Group .
3. In the Select Decision Zone(s) dialog box that appears, click Add Decision Zone to add decision zones to the group or Remove Decision Zone to remove them from the group.
4. Click OK to validate.

The Select Decision Zone(s) dialog box closes and the Create or Edit AGV Route Group dialog box appears.

5. Specify the Starting Zone for the route group.
6. Specify the Route type from the listed options.

Once you update the route type for any group, the same is updated for Route type on the start decision zone only and not on the target decision zones.

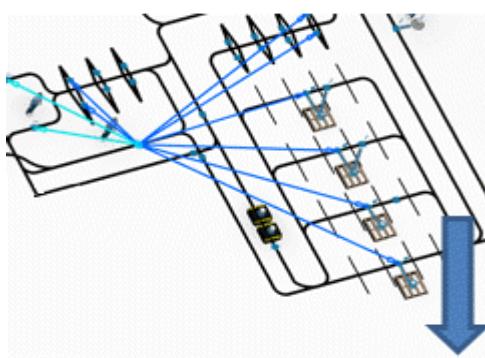
7. Specify the Group Name of the route group.
8. Choose the Priority of the group, which is used to manage multiple route groups that you defined on a given decision zone.

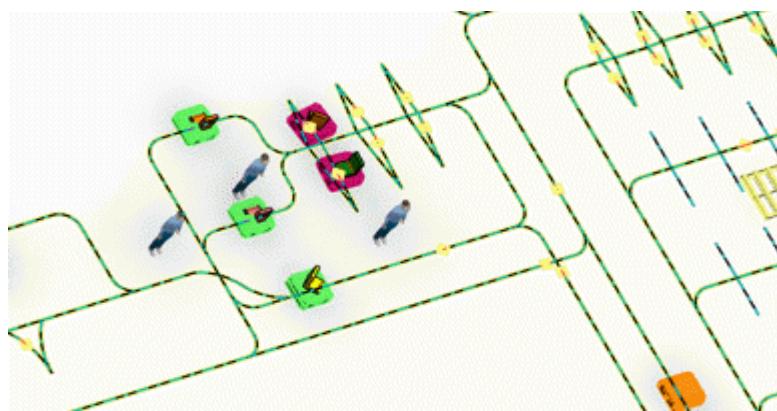
If a decision zone has multiple groups, then the zone considers the route group with priority one first. If it is full, then the zone uses another route group with the next priority for routing. If all the decision zones in the first group are busy, AGV routes to the second route group.

9. Specify the route group's Product Status type to specify if the group can be used for Light Rework or Good parts.

Note: This does not support Heavy Rework.

During simulation, AGV travels to the relevant destination based on the route group's product type. If the part is rework, the AGV is routes based on the route group defined for rework part. If the parts are good, then the part routes using the route group with the product type good.





10. Specify the Executing Pool for the route group.

11. Specify the Target Zones for the route group.

If there are multiple target zones, the target zone selection is based on what you defined as the Closest Free AGV in Route type. In this case, the AGV routes to the closest free AGV Decision Zone.

Similarly, Farthest Free AGV is routed to the farthest free AGV Decision Zone and Cyclic AGV routes to each AGV decision zone in a cyclic manner.



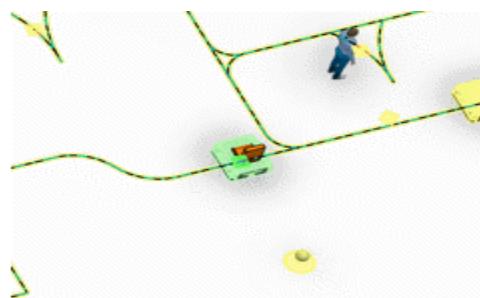
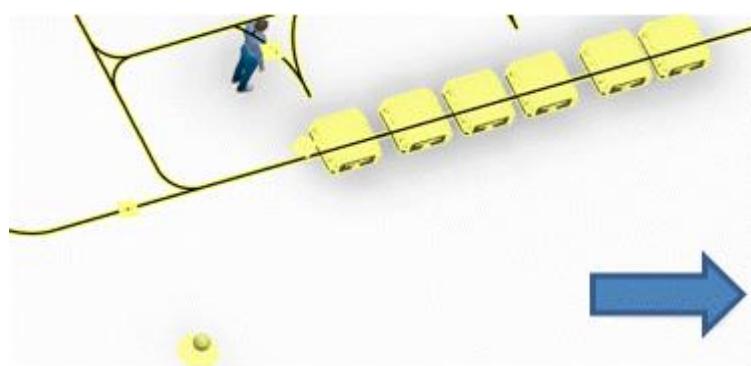
12. Click Edit Group to edit a route group and Remove Group(s) to delete a route group.

13. Click Assign Pool to assign a resource pool and Unassign Pool to unassign a resource pool.

14. Click OK.

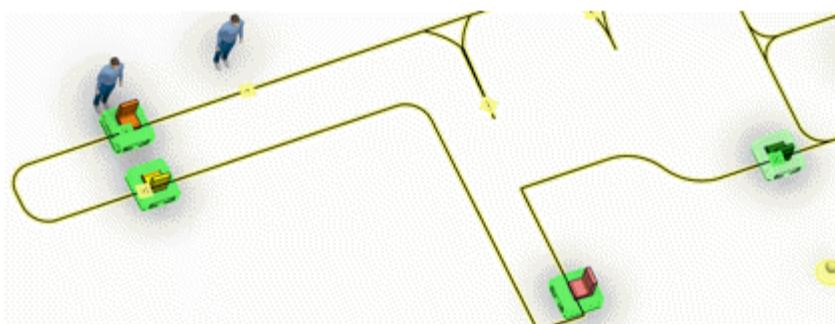
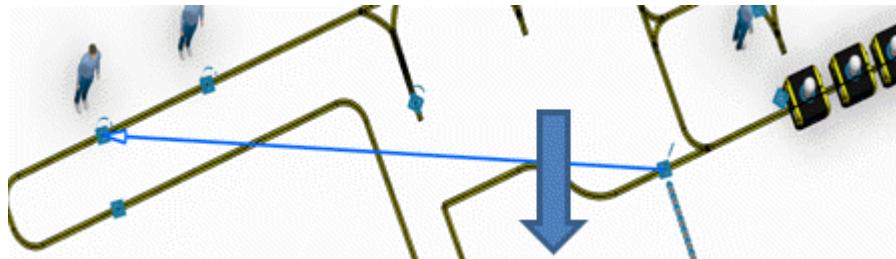
You have routed group definition to a decision zone.

Note: During simulation, when a group supplies a part to an AGV decision zone with a defined load activity, it selects an AGV to perform the task.

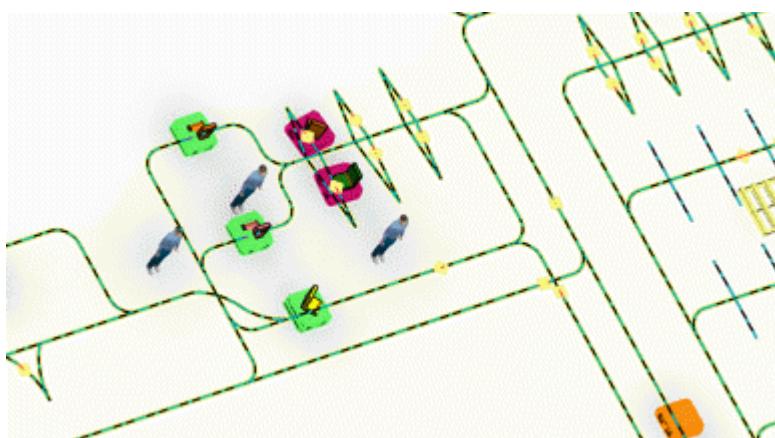
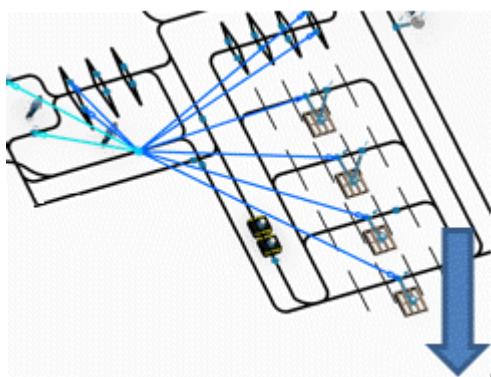




Once the load activity occurs, based on route definition for given decision zone, AGV goes to the next decision zone.



If you defined a rejection rate on the decision zone, then inspection carries out on the part during simulation and the part is good or rework.





Define Request Group for a Decision Zone

You can define a request group when you must pull a part from decision zone.

- From the Programming section of the action bar, click Request Group Definition , then select a decision zone with the Operation mode set to Pull.

Note: You can also request group definition for a pathway. In this case, the request groups already defined on the pathway are on the list.

- In the Create or Edit AGV Request Group dialog box that appears, select the pathway then click Add Group .

When you select a pathway, the list of all the request groups you defined appears.

- Click Add Decision Zone to add decision zones to the group or Remove Decision Zone to remove them from the group in the Select Decision Zone(s) dialog box that appears.
- Click OK to validate.

The Select Decision Zone(s) dialog box closes and the Create or Edit AGV Request Group dialog box appears.

- Specify the Starting Zone, Target Zones, Source Zones, and other options in the dialog box.

Note: The options in this dialog box are similar to those in the Create or Edit AGV Route Group dialog box.

The target decision zones in the request group signify the decision zones to pull parts from to satisfy a request in the start zone.

- Click Edit Group to edit a request group and Remove Group(s) to delete a request group.
- Click Assign Pool to assign a resource pool and Unassign Pool to unassign a resource pool.
- Click OK.

You have requested group definition and pulled a part from the decision zone. Whenever you create a request on the resource connected to a decision zone operating on Pull mode, the request group fulfills the part request on the connected resource during simulation.

Define Claim Group for a Decision Zone

You can define a claim group for a decision zone.

- From the Programming section of the action bar, click Claim Group definition , then select a decision zone.

Note: You can also claim group definition for a pathway. In this case, the claim groups already defined on the pathway are on the list.

- In the Create or Edit AGV Claim Group dialog box that appears, click Add Group .
- In the Edit Claim Group dialog box that appears, click Add Decision Zone.
- In the Select Decision Zone(s) dialog box that appears, add decision zones from the group, then click OK.
- Define the Claim Capacity value, which is used to manage the maximum number of AGV decision zones in the group.
- Click Remove Decision Zone to remove decision zones from the group.
- Click OK to validate.

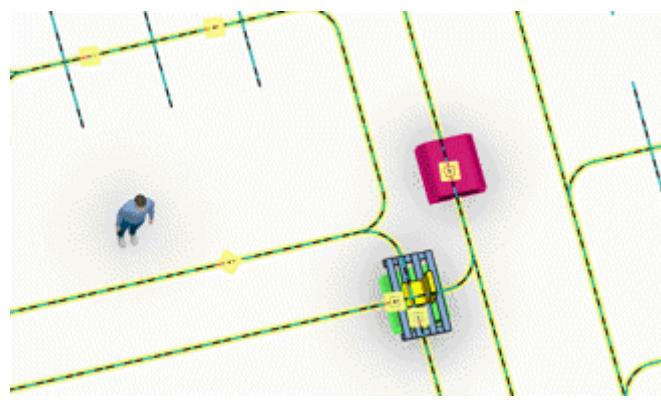
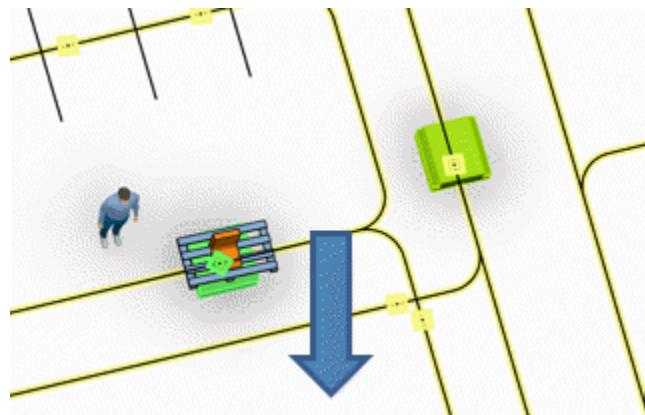
The Select Decision Zone(s) dialog box closes and the Create or Edit AGV Claim Group dialog box appears.

- Modify the request groups by using the Edit Group and Remove Group(s) options.

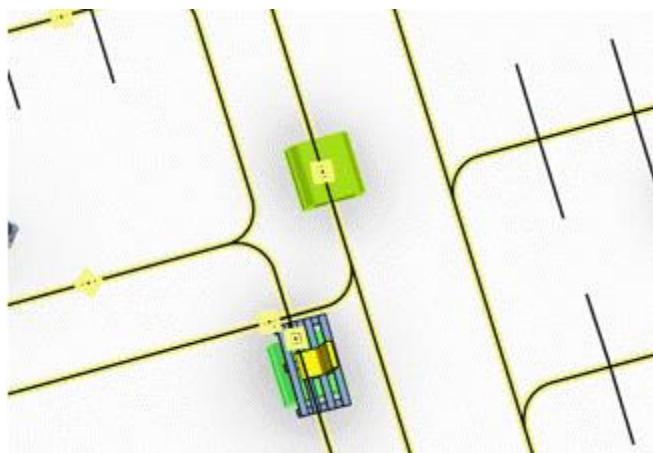
During Simulation, when two AGV come across an intersecting path with a claim group defined, the



first AGV claims a decision zone, which is part of claim group. In this case, the other AGV waits in the previous decision zone in a claim blocked state.



Once the First AGV unclaims the decision zone, which is part of the claim group, then the claim blocked AGV starts moving.





Module-4. D: Defining Resource Pools

This section shows you how to manage resource pools.

In this section:

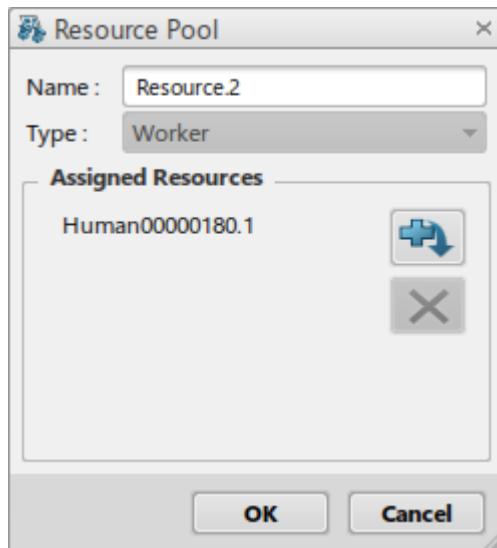
- Assigning a Resource to a Product Flow
- Managing Resource Pools

A. Assigning a Resource to a Product Flow

You can assign one or more resources with the same characteristics to a Product flow, using the Assign Resource Pool command.

Before you begin: To assign a worker to a Product flow, define a Resource zone first.

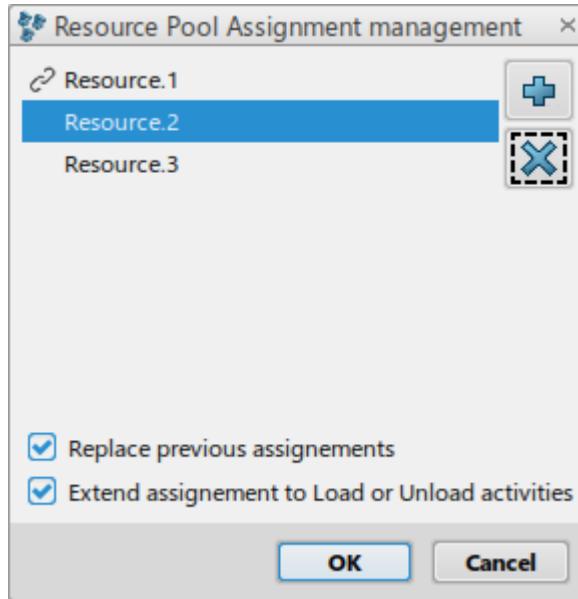
1. Select the Product flow to which you want to assign a resource.
2. In the context toolbar, click Resource Pool Assignment
3. Select the resource you plan to assign to the Product flow in the tree or work area.
4. To validate your choice, click Validate
5. Optional: Click the Resource Pool Table command from the Programming section of the action bar to open the Resource Pool Table.
6. To remove a resource from your selection, right-click the resource that you assigned to the product flow and click Remove from this Resource Pool
7. Optional: To assign a resource with a task already attached to it, select Click to select invoked service and select the task you want the resource to perform.
8. To manage the resource pool you just created, right-click the resource that you assigned to the product flow in the Resource Pool Table, then click Edit Resource Pool .
9. In the Resource Pool dialog box that appears, you can edit the resource pool's Name and Type attributes and assign additional resources to the pool with the Resource Selection command.



10. You can also manage the resource pool you just created by clicking the Resource Configuration command in the Programming section of the action bar.
11. In the Resource Configuration table that appears, right-click a product flow and click Resource Pools > Manage Resource Pool Assignment .



The Resource Pool Assignment management panel appears.



In this panel you can do the following:

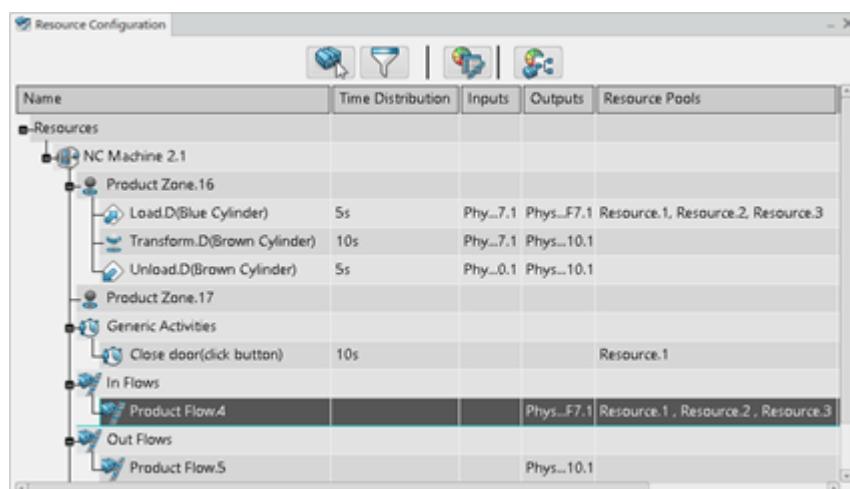
Manage your resource pools by creating a new one with the Create a new Resource Pool command. You can also clear your resource pools with the Unselect all Resource Pools command.

Replace previous assignments for the selected activities and product flows with the Replace previous assignments command.

Extend the resource pool assignment to load or unload activities with the Extend assignments to Load or Unload activities command.

12. To assign multiple resource pools to one product flow, click each required resource pool in the Resource Pool Assignment management panel while pressing Ctrl.

You have added multiple resource pools to one product flow.



You assigned the resource pool to the product flow.

B. Managing Resource Pools

You can create, edit, delete, and manage resource pools with the Resource Pool Table command. This task shows you how to:

- Creating and Editing Resource Pools
- Deleting Resource Pools
- Modifying Assigned Resources in a Resource Pool

Before you begin: Open a scenario with product flows or activities.



Creating and Editing Resource Pools

You can create a new resource pool in the Resource Pool Table.

- From the Programming section of the action bar, click the Resource Pool Table command.

Note: You can also access the Resource Pool Table by clicking the Resource Configuration command in the Programming section of the action bar. Then, in the Resource Configuration table that appears, right-click an object with an assigned resource pool, and click Resource Pools > Manage Assigned

Resource Pools . This opens a limited view of the Resource Pool Table that only lists the selected object's assigned resource pools. In this view, you can perform all capabilities of the Resource Pool Table except for creating a new resource pool.

- In the Resource Pool Table that appears, right-click the Resource Pools row, then click Add Resource Pool .

Name	Activities	Product Flows	Activity Sets	Resource Working Cycle
Resource Pools				
Worker Pools				
Resource.1	Close...ton: Product Flow.4	WhoWi...rce.54	TestWorkingCycle	
OP1.1				
OP2.1				
Resource.2				
OP2.1				
Resource.3		Product Flow.3		
OP1.1				

- Select the resource you plan to assign in the tree or the work area.

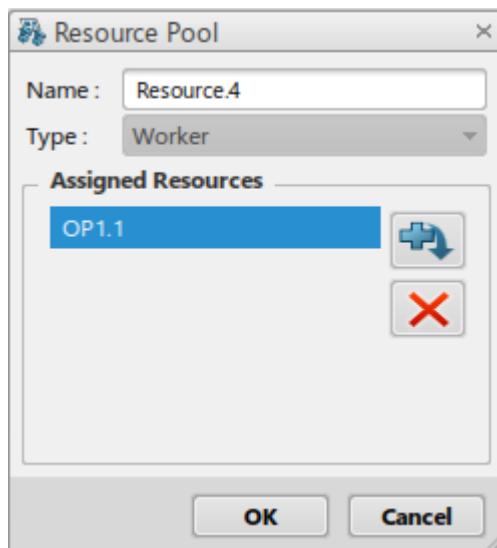
Tip: To assign more than one resource, select the resources one after the other.

- Specify the Quantity of workers required.

Note: You can have more than one worker in a resource pool.

During the simulation, the number of workers that you specified are executing the operation.

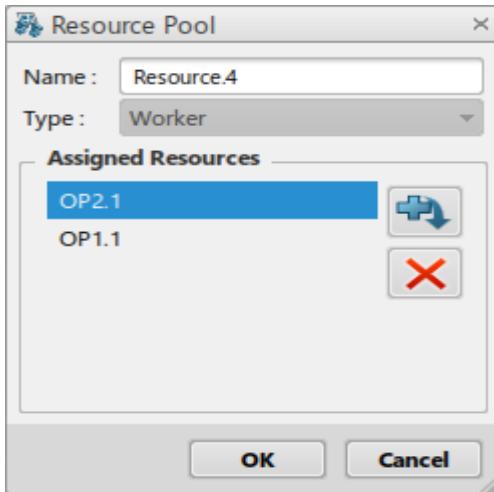
- To validate your choice, click Validate .
- To edit the new resource pool, use the Resource Pool dialog box to modify the resource pool's Name and Type, and Quantity attributes.



- To assign additional resources to the pool, click the Resource Selection command in the Assigned Resources section of the dialog box.
- Select the additional resource that you plan to assign to the resource pool in the tree or the work area, then validate your choice by clicking Validate .



The additional resource is added to the resource pool and is listed under the Assigned Resources section of the Resource Pool dialog box.

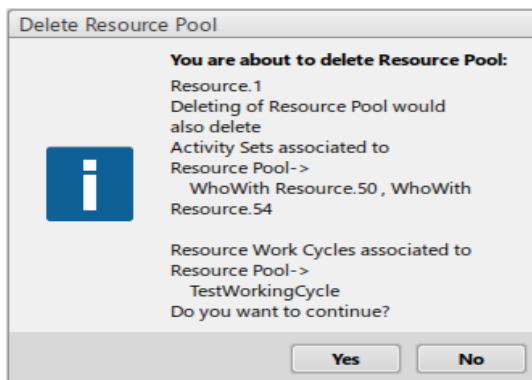


9. To remove a resource from the pool, click the Remove Resource command.
 10. Click OK to close the Resource Pool dialog box, then close the Resource Pool Table.
- You have created and edited the resource pool.

Deleting Resource Pools

You can delete resource pools and separate resources from a pool in the Resource Pool Table.

1. From the Programming section of the action bar, click the Resource Pool Table command.
2. In the Resource Pool Table that appears, right-click a resource pool and click Delete Resource Pool .
3. In the Delete Resource Pool dialog box that appears, click Yes to delete the resource pool and close the dialog box.



4. Close the Resource Pool Table that appears.
- You have deleted the resource pool and it is no longer listed in the table.

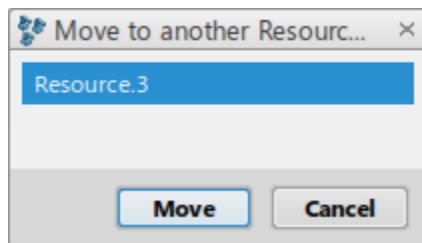
Name	Ac...ies	Pr...ows	Ac...ets	Re...le
Resource Pools				
Worker Pools				
Resource.2				
OP2.1				
Resource.3				
OP1.1				



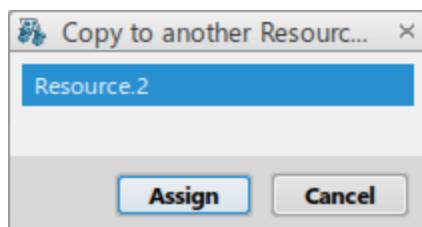
Modifying Assigned Resources in a Resource Pool

You can modify assigned resources in a resource pool with the Resource Pool Table.

- From the Programming section of the action bar, click the Resource Pool Table command.
 - In the Resource Pool Table that appears, right-click an assigned resource in a pool that contains multiple resources and click Remove from this Resource Pool .
- You have removed the resource from the resource pool and it is no longer listed in the resource pool node.
- In the Resource Pool Table, right-click an assigned resource in a resource pool and click Move to another Resource Pool to open the Move to another Resource Pool dialog box.

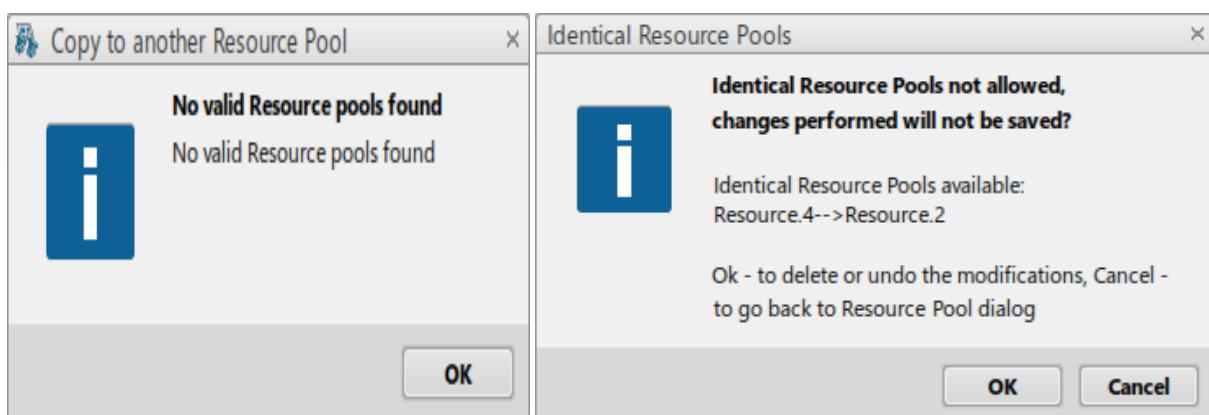


- In the dialog box, select the resource pool and click Move.
- The dialog box closes and the moved resource is now listed under the selected resource pool in the Resource Pool Table.
- In the Resource Pool Table, right-click an assigned resource in a resource pool and click Copy to another Resource Pool to open the Copy to another Resource Pool dialog box.



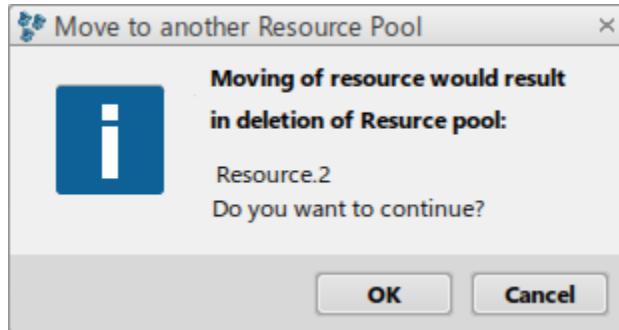
- In the dialog box, select the resource pool and click Assign.
- The dialog box closes and the moved resource is now listed under the selected resource pool in the Resource Pool Table.

7. Close the Resource Pool Table.
Note: Resources in a pool must all be of the same type and there must not be duplicate resources in the pool. If you do not meet this criteria when you move or copy over a resource to another pool, then either of the following messages appear:





If the resource you deleted, moved, or copied over to another pool is the only resource in the pool, then the following message appears:



You have modified assigned resources in a resource pool.

Module-4. E: Managing Activities

This section provides background information on activities and illustrates how to manage activities in a flow.

In this section:

- About Activities
- Adding Activities
- Associating a Task with an Activity
- Defining a Probability Time Distribution for an Activity
- Using Activity Sets

A. About Activities

Activities allow you to specify the action of a resource or a zone.

You can create activities on resources and on In and Out zones, and identify them by means of blue icons. The following activities are available:

Icon	Activity	Resource	Zone
	Create	-	In zone
	Dispatch	-	Out zone
	Buffer	Storage: For example, a pallet	-
	Transfer	Transfer: For example, a conveyor	-
	Transform	Transform: For example, an NC	-



Icon	Activity	Resource	Zone
		machine	
	Load	Machine	-
	Unload	Machine	-
	Pack	Storage: For example, a pallet	-
	Unpack	Storage: For example, a pallet	-

When using Define Factory Flow , activities are automatically created on resources. You can also manually add activities on resources using specific commands. For more information about these commands, see Flyout for Adding Activities.

You can customize the color of activities. See Customizing Preferences.

You can define or undefine the part position on an activity when you right-click the activity in the Resource Configuration table that appears. Then you can click Part Position > Define Part Position or Undefine Part Position.

B. Adding Activities

You can assign activities such as transforming, buffering, or loading to resources and in and out zones.

You can do so using commands from the action bar, the Resource Configuration Table, or from the Product Zone context menu in the Resource Configuration View. This is useful when creating a factory flow manually.

This task shows you how to:

- Add a Create Activity
- Add a Dispatch Activity
- Add a Transform Activity
- Add a Buffer Activity
- Add a Transfer Activity
- Add a Load Activity
- Add an Unload Activity
- Add a Generic Activity
- Create an Activity with Drag-and-Drop
- Add a Pack Activity
- Add an Unpack Activity

Add a Create Activity

You can add a create activity to an in zone.

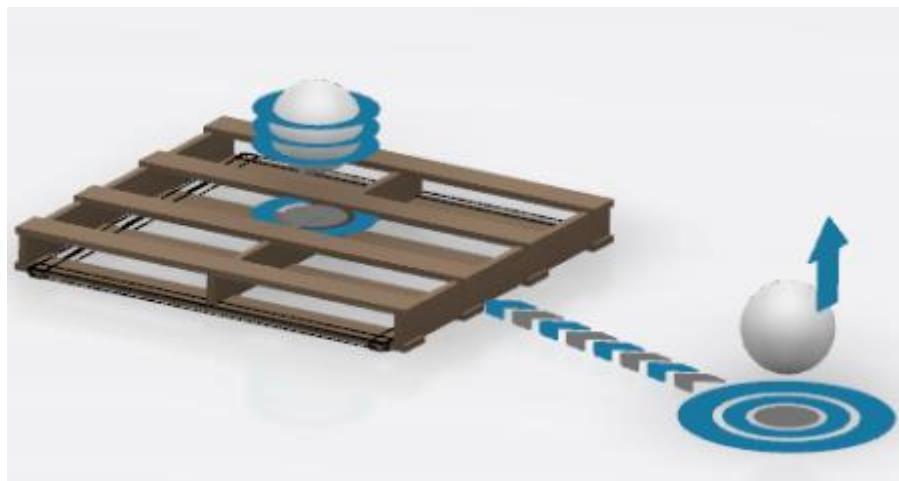
1. From the Programming section of the action bar, click Add Create Activity .
2. Select an in zone.

The in zone is highlighted and a context toolbar appears.

3. In the context toolbar, click Add Product(s) to define a Create Activity and select a product.



4. Press Esc.



The create activity appears on the in zone, symbolized by an up-arrow. The selected product is associated with the activity.

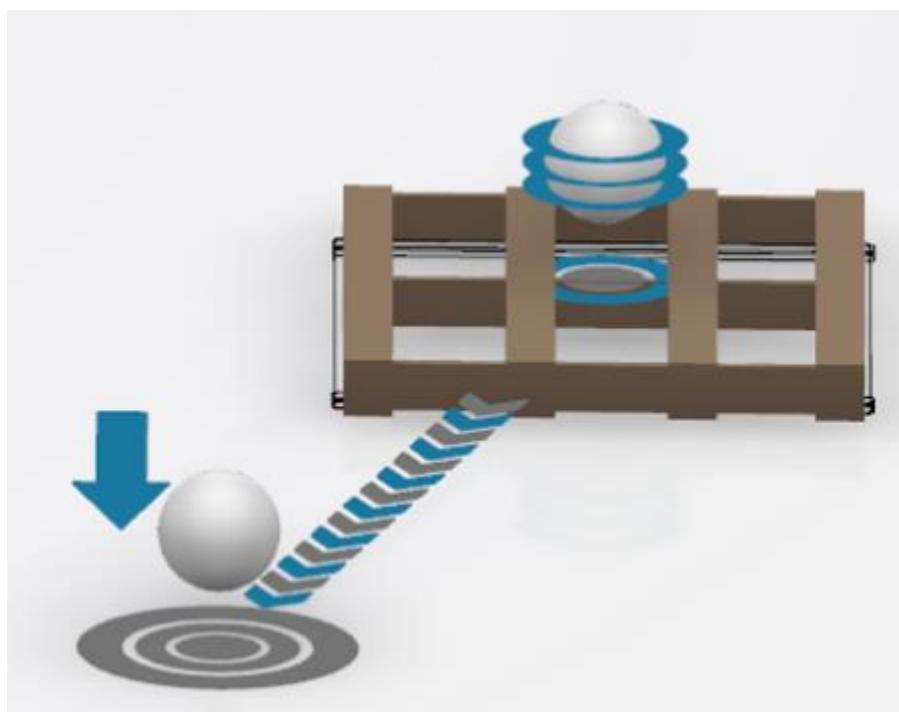
Add a Dispatch Activity

You can add a dispatch activity to an out zone.

1. From the Programming section of the action bar, click Add Dispatch Activity
2. Select an out zone.

The out zone is highlighted and a context toolbar appears.

3. In the context toolbar, click Add Product(s) to define a Dispatch Activity and select a product.
4. Press Esc.



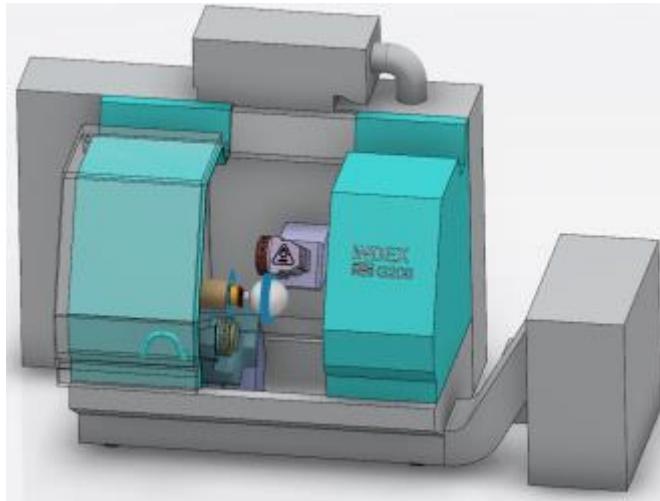
The dispatch activity appears on the out zone, symbolized by a down-arrow. The selected product is associated with the activity.



Add a Transform Activity

You can add a transform activity to a resource such as an NC machine, part inside a pallet, or a mobile storage.

1. From the Programming section of the action bar, click Add Transform Activity .
2. Select a product zone.
3. In the context toolbar, click Add Product(s) to define the Requirement(s) for the Transform Activity  and select an input product.
4. Click Add Product(s) to define the Output for the Transform Activity  and select an output product.
5. Press Esc.



The transform activity appears on the product zone, symbolized by a curved arrow. The selected products are associated with the activity.

6. Click Simulation Options  at the right edge of the work area.

The Simulation Options dialog box appears.

7. Go to the Flow Simulation tab and check the Display inputs at design positions at start of transform activity option.

You have displayed the parts at the design position at the beginning of the transform activity.

8. Select the product zone with the transform activity and click Edit SLA Resource to open the Edit dialog box.
9. Assign or unassign a resource pool by selecting it from the list, then click Assign or Unassign, then specify the Quantity of workers.
10. In the Executing Position list, choose the required home position associated with the resource pools.

You have defined the home position for the Robot and the machine by choosing a position from the list, which applies during the activity's execution.

11. Select several transform activities in the Resource Configuration table, then right-click an activity and select Create Common Inputs Group .
12. Specify if the group is a Transform or an Assembly type.
13. Select the common part for the input group and the output of the group execution.
 - If you choose Assembly, the command adds aux parts to the common input.
 - If you choose Transform, the command transforms the common part and the aux part into a new part.
 - During simulation, once the common part arrives on the machine, all the transform activities of the group begin. The overall output is generated once all the transform activities are completed.



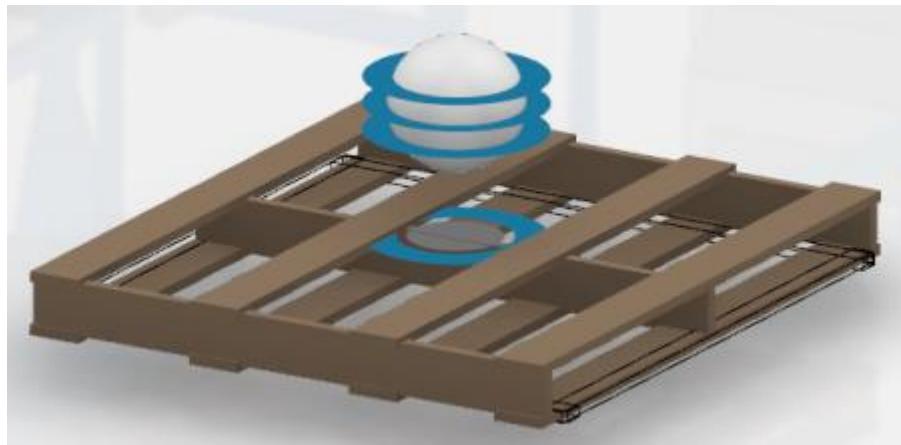
Add a Buffer Activity

You can add a buffer activity to a resource such as a pallet.

1. From the **Programming** section of the action bar, click **Add Buffer Activity** .
2. Select a product zone.

The product zone is highlighted and a context toolbar appears.

3. In the context toolbar, click **Add Product(s) to define a Buffer Activity**  and select a product.
4. Press **Esc**.



The buffer activity appears on the product zone, symbolized by a set of rings.

5. Select the product zone with a buffer activity and click **Edit SLA Resource**.

The **Edit** dialog box appears.

6. In the **Waiting Time** section, enter the required wait time value.

You have defined the waiting time for a product before the buffer reroutes it.

7. Enable **Sequence Mode** and set **Flow Mode Out** to **As Per Sequence**.

During simulation, parts are routed from the buffer activity as per the sequence you defined.

Add a Transfer Activity

You can add a transfer activity to a resource such as a conveyor.

1. From the **Programming** section of the action bar, click **Add Transfer Activity** .
2. Select a first product zone.
3. Select a second product zone.





The transfer activity appears between the two product zones, symbolized by an arrowhead.

4. In the context toolbar, click **Add Product(s) to define a Transfer Activity** and select a product.
5. Press **Esc**.
6. Click **Resource Configuration** from the **Programming** section of the action bar.
7. Right-click the transfer activity in the **Resource Configuration** table that appears and click **Part Position > Define Part Position**.
8. Choose the part position from the **Suggested Products** panel, then use the **Robot** and context menu options to position the part.
9. Click to validate.

You have set the position.

Note: You can unset the position on a transfer activity when you click **Part Position > Undefine Part Position** in the **Resource Configuration** table.

Add a Load Activity

You can load products into a machine by adding a load activity to the machine.

Before you begin: Make sure that the machine has a product zone assigned.

1. From the **Programming** section of the action bar, click **Add Load Activity** .
2. Select a machine.
3. **Optional:** If the machine has several product zones, select the product zone to which you want to assign the activity.
4. Assign or unassign a resource pool by selecting it from the list, then click **Assign** or **Unassign**, then specify the **Quantity** of workers.
5. Select the product you want to load.
6. **Optional:** To edit the activity:
 - a. Select the machine and click **Edit the SLA Resource Behavior and Activities** .
 - b. In the dialog box, modify the parameters as desired.

Add an Unload Activity

You can unload products from a machine by adding an unload activity to the machine.

Before you begin: Make sure that the machine has a product zone assigned.

1. From the **Programming** section of the action bar, click **Add Unload Activity** .
2. Select a machine.
3. **Optional:** If the machine has several product zones, select the product zone to which you want to assign the activity.
4. Assign or unassign a resource pool by selecting it from the list, then click **Assign** or **Unassign**, then specify the **Quantity** of workers.
5. Select the product you want to unload.
6. **Optional:** To edit the activity:
 - a. Select the machine and click **Edit the SLA Resource Behavior and Activities** .
 - b. In the dialog box, modify the parameters as desired.
7. **Optional:** You can also edit the activity when you double-click the unload activity in the **Resource Configuration** table.





8. **Optional:** In the **Edit** dialog box that appears, activate the **Unload On Request** to unload the activity on request.

The unload activity is only executed when there is a request for a part in the downstream resources machine during simulation. If there is no request, then the unload activity is not executed and the resource is blocked while it goes into the wait for output state. Once there is a request for the part, the unload activity is triggered and the machine is un-blocked.

Notes:

- You can also add, create, dispatch, transform, buffer, and transfer activities on zones that already have an activity assigned. Select a zone and, in the context toolbar that appears, select the activity to add.
- You can add a load or unload activity to a machine that is part of a product flow. In this case, you can use the product associated with the product flow can as an input product for the load activity, or output product for the unload activity.
- To delete an activity, right-click the activity and select **Delete**.

Add a Generic Activity

You can add a generic activity to an NC machine using the **Resource Configuration** table. Generic activities include actions such as auto-eject, rotate, open/close door, and so on.

1. Click **Resource Configuration** from the **Programming** section of the action bar.

Note: You can also add a generic activity with the **Add Generic Activity** command in the **Programming** section of the action bar.

2. In the **Resource Configuration** table that appears, right-click on a machine.
3. Click **Add Generic Activity** from the context menu.
4. In the dialog box that appears, enter a name, duration, precedence, and position.
5. **Optional:** If the machine has several product zones, select the product zone to which you want to assign the activity from the list **Products**. Or you can select to add a new product zone.
6. Assign or unassign a resource pool by selecting it from the list, then click **Assign** or **Unassign**, then specify the **Quantity** of workers.
7. Click **OK**.
8. Click the product zone with the generic activity and click **Edit SLA Resource**.

The **Edit** dialog box appears.

9. In the **Executing Position** list, choose the required home position associated with the resource pools.

You have defined the home position for the **Robot** and the machine by choosing a position from the list, which applies at the end of the activity.

10. **Optional:** Define a value in the **Rejection Rate** section and enable the **Quality Check** option.

The value you enter determines which part is marked for rework or good.

The generic activity appears under the **Generic Activities** tree in the **Resource Configuration** table.



Create an Activity with Drag-and-Drop

You can create an activity using drag-and-drop in the **Resource Configuration** table. This activity is mainly for **Planning Integration**.

1. Click the **Resource Configuration** command in the **Programming** section of the action bar.



2. In the **Resource Configuration** table that appears, drag the required operation from the tree and drop it in the required destination in the **Resource Configuration** table.

The activity has the same name as the operation from the tree.

Add a Pack Activity

You can add a pack activity to a resource such as a pallet.

Before you begin: Create a buffer resource to use as a pallet. This buffer contains the buffer activities for all the products that the pallet needs to pack on the conveyor.

1. Click the **Define Mobile Storage** command in the **Setup** section of the action bar then select the buffer resource.

Note: You can also add a pack activity with the **Add Pack Activity** command in the **Programming** section of the action bar.

You have defined the buffer resource as a mobile storage.

2. Click the product zone of the buffer resource.

This product zone is now the starting point of the selected mobile storage.

3. Click the **Resource Configuration** command in the **Programming** section of the action bar.
4. In the **Resource Configuration** table that appears, right-click a product zone.
5. In the context toolbar that appears, click **Add Pack Activity** .
6. Click a pallet resource from the tree or the work area, then select the products that need to be packed on the pallet resource.
7. **Optional:** Create multiple instances of the same pallet and declare them as a mobile storage with **Define Mobile Storage** .

You have defined one pack activity using a pallet. This supports multiple instances of the same pallet without redefining respective pack activities. During simulation, all instances of the pallet execute using the same pack activity as reference.

8. Double-click the pack activity in the **Resource Configuration** table to edit it.
9. In the **Edit** dialog box, click **Add context for pack** under **Context for Pack Activity**.
10. In the **Context for Pack Activity** panel, select context from the suggested context, then click **OK**.

The context is updated in the **Edit** dialog box and all parts appear at the correct location based on the context you specified for the pack activity during simulation.

You have added the pack activity. During simulation, axillary parts are accepted only after the pallet has arrived.

Note: You can edit the pack activity by double-clicking the activity in the **Resource Configuration** table.



Add an Unpack Activity

You can add an unpack activity to a resource such as a pallet.

Before you begin: Create a buffer resource to use as a pallet. This buffer contains the buffer activities for all the products that the pallet needs to unpack on the conveyor.

1. Click the **Define Mobile Storage** command in the **Setup** section of the action bar then select the buffer resource.

Note: You can also add an unpack activity with the **Add Unpack Activity** command in



the **Programming** section of the action bar.

You have defined the buffer resource as a mobile storage.

2. Click the product zone of the buffer resource.

This product zone is now the starting point of the selected mobile storage.

3. Click the **Resource Configuration** command in the **Programming** section of the action bar.
4. In the **Resource Configuration** table that appears, right-click a product zone.
5. In the context toolbar that appears, click **Add Unpack Activity** .
6. Click a pallet resource from the tree or the main 3D, then select the products that you need to unpack on the pallet resource.
7. To edit the activity, double-click the activity in the **Resource Configuration** table.
8. **Optional:** Create multiple instances of the same pallet and declare them as a mobile storage with **Define Mobile Storage** .

You have defined one unpack activity using a pallet. This supports multiple instances of the same pallet without redefining respective unpack activities. During simulation, all instances of the pallet execute using the same unpack activity as reference.

9. **Optional:** In the **Edit** dialog box that appears, activate the **Unload On Request** to unload the activity on request.

The unpack activity is only executed when there is a request for a part in the downstream resources machine during simulation. If there is no request, then the unpack activity is not executed and the resource is blocked while it goes into the wait for output state. Once there is a request for the part, the unpack activity is triggered and the machine is un-blocked.

You have added the unpack activity. During simulation, axillary parts are routed before routing the pallet.

C. Associating a Task with an Activity

You can associate a task previously defined on a resource with an activity. This task is taken into account during the production system simulation.

Note: Tasks created under the robot in the robotic structure cannot be selected.

1. In the work area, select a resource associated with an activity.
A context toolbar appears.

2. Click **Edit the SLA Resource Behavior and Activities** .

The Edition dialog box appears.

3. In the Service name list, select one of the available tasks.
4. To finish, click **OK**.

The task is associated with the activity.

D. Defining a Probability Time Distribution for an Activity

You can define the duration of an activity using a probability time distribution.

Before you begin: Create a factory flow.

1. In the work area, select a resource and click **Edit the SLA resource behavior and activities** in the context toolbar.
2. In the **Edit** dialog box, click **None**.
3. In the **Edit Time Distribution** dialog box, select an item from the **Distribution** list.
4. Define distribution parameters, such as:
 - Distribution



- Mean
- Std. Dev
- Stream

A graph appears, displaying the probability density function based on the defined parameters. Values appear on the vertical axis to show the frequency of occurrence of the activity and on the horizontal axis to show the duration of the activity.

5. You can also click **Initialize from preset** to define distribution parameters from a preset.
6. Click a preset from the **Preset selection** dialog box then click **OK**.

Note: You can set time distribution presets when you click in Me > Preferences > App Preferences > Simulation Virtual Factory > Factory Flow Simulation > Default Values > Time distribution preset > XML file for Time Distribution Preset. Parameters can have expression as well, which includes multiplication, division, addition, and subtraction. Example XML file:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<categories>
    <category name="Category 1" description="My first Category">
        <preset type="Normal" param1="10" param2="2" description="Normal law 10 2">Normal 10</preset>
        <preset type="Normal" param1="30" param2="7" param3="5" description="Normal law 30 7">Normal 30</preset>
        <preset type="Uniform" param1="15" param2="20">Uniform 15</preset>
        <preset type="Triangular" param1="20" param2="30" param3="40">Triangular 30</preset>
    </category>
    <category name="Category 2" description="My second Category">
        <preset type="Exponential" param1="10">Exponential 10</preset>
        <preset type="Lognormal" param1="20" param2="30">Lognormal 20</preset>
        <preset type="Gamma" param1="10" param2="15">Gamma 10</preset>
    </category>
    <category name="Category 3">
        <category name="Subcategory 1">
            <preset type="Beta" param1="10" param2="15" param3="20" param4="30">Beta 10</preset>
        </category>
        <category name="Subcategory 2">
            <preset type="Erlang" param1="10" param2="15">Erlang 10</preset>
        </category>
        <category name="Subcategory 3">
            <preset type="Weibull" param1="10" param2="15">Weibull 10</preset>
        </category>
    </category>
</categories>
```

The values are updated to the presets in the **Edit Time Distribution** dialog box.

7. Click .
8. In the **Edit** dialog box, click **OK**.

E. Using Activity Sets

You can use the Resource Configuration Table to create activity sets and resource working cycles.

This task shows you how to:

- Create an Activity Set
- Edit an Activity Set
- Modifying an Activity Set's Distance and Weight Attributes
- Opening an Activity Set's HTML Report

Before you begin: Create multiple activities or product flows and assign them to a resource pool.



Create an Activity Set

You can create an activity set for multiple activities on the same machine for one resource pool. You can use activity sets to specify a list of machine activities for one resource pool that the same worker needs to execute. The worker chosen from the resource pool will not be available to perform other actions until the activity set complete.

1. From the **Programming** section of the action bar, select **Resource Configuration** .
2. Select multiple activities using **Ctrl** and left-click.
3. Right-click one of the selected activities.
4. In the context menu that appears, select **Activity Sets**, then **Create Activity Set** .
5. **Optional:** To add an activity to an existing activity set, right-click the required activity in the Resource Configuration Table. Then select **Add to Existing Activity Set**  under **Activity Sets** in the context menu.

Note: Assign the selected activity to the same resource pool on the same machine as the activity set.

6. **Optional:** To delete an activity from an activity set, right-click the required activity in the Resource Configuration Table and select **Remove from Activity Set**  under **Activity Sets** in the context menu.

The activity set is displayed in the Resource Configuration Table.

Edit an Activity Set

You can edit an activity set using the context menu in the Resource Configuration Table.

1. Right-click an activity set in the Resource Configuration Table.
2. In the context menu that appears, do one of the following:
 - Select **Rename**  to rename the activity set.
 - Select **Change Assigned Resource Pool**  to modify the assigned resource pool of an activity set.
 - Select **Delete Activity Set**  to delete the activity set.

You have modified the activity set.

Modifying an Activity Set's Distance and Weight Attributes

You can modify an activity set's distance and weight attributes.

1. Select a worker in the tree that is executing activity sets and click **Edit SLA resource** .
2. In the **Edit** dialog box that appears, modify the **Default speed** attribute as required.
3. Select an object that the worker carries in the activity set and click the **Measure Intertia**  command in the **Tools** section of the action bar.
4. In the **Measure Intertia** dialog box that appears, modify the **Mass** attribute in the **Main Results** tab as required.
5. Open the **Simulations Options** dialog box by clicking the **Simulation Options**  command at the right edge of the work area.
6. In the **Flow Simulation** tab, check the **Collect Resource State Times** option.

This shows you information on the resource's behavior during the simulation.

7. On the right edge of the work area, click **States History**.

The **States History** dialog box displays a chart with the simulations statistics.

8. **Optional:** In the dialog box, click the **Export to XML** command and save the file in the required



location.

When you open the saved file in a browser, it displays the values in XML format.

```
<?xml version="1.0"?>
- <StatesHistory>
  <ParametersNMeasures Speed="Meter per
    second" Volume="Cubic meter"
    Weight="Kilogram"
    Length="Millimeter" Time="Second"
    EndTime="133.9" StartTime="0"/>
- <Resources>
  - <Resource Type="ncmachine"
    Name="NC Machine 1.1">
    - <State EndTime="5.40139"
      StartTime="0"
      OperationType="Generic"
      OperationName="Close door(click
      button)" State="Wait for
      Resource(s)">
      <PoolsNWorkers
        ResourcePools="Resource.1"/>
    </State>
    - <State EndTime="15.4014"
      StartTime="5.40139"
      OperationType="Generic"
      OperationName="Close door(click
      button)" State="Wait for
      Resource(s)">
      <PoolsNWorkers
        ResourcePools="Resource.1"/>
    </State>
```

You have edited the activity set's distance and weight attributes.

Opening an Activity Set's HTML Report

You can view an activity set's distance and weight statistics with the HTML Report.

1. Click the Play command of the **Compass** and select a simulation.
2. In the Player, click **Play forward** ▶ .
3. On the right edge of the work area, click **System Performance Monitor** ⏹.
4. Select the **System Utilization** tab.

The chart displays the state of each element of the production system.

5. **Optional:** Click **Open HTML Report** 📄 .

The report displays values on the elements of the production system for **Total Distance Traveled (Millimeter)** and **Total Weight Carried (Kilogram)**.

Activity Sets						
Name	Count	OP1.1			Workers	
		Processed (%)	Total Distance Travelled (Millimeter)	Total Weight Carried (Kilogram)	Processed (%)	Total Distance Travelled (Millimeter)
•nC Machine 1.1						
•With Resource.50 (Resource.1)	3	86.667	4878.851	33.333	0	
Unload.C(Blue Cylinder)						
Unload.B(Purple Cylinder)			4878.851			
Load.C(Purple Rect)						
Unload.A(Grey Rect)						
Load.B(Grey rect)						
Load.A(Green Rect)						
•nC Machine 2.1	2	50	14291.901	50	9413.221	
•With Resource.54 (Resource.1)			14291.901			
Load.D(Blue Cylinder)						
Close door(click button)						

You have opened the activity set's HTML Report and viewed its distance and weight statistics.



Module-4.F: Managing Pathways

This section provides information on collision free worker pathways and illustrates how to manage them.

In this section:

- Generating a Worker Pathway
- Managing Walk Paths
- Creating a Collision Free Pathway

A. Generating a Worker Pathway

You can generate a worker pathway by defining and configuring a pathway.

This task shows you how to:

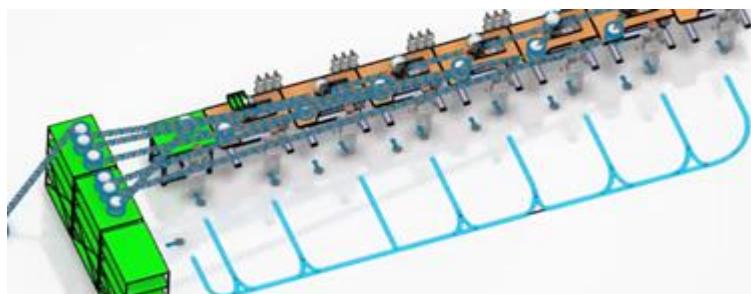
- Defining a Worker Pathway
- Configuring a Worker Pathway
- Adding a Junction Point to the Worker Pathway

Before you begin: Open a scenario with an assembly line that includes workers completing tasks.

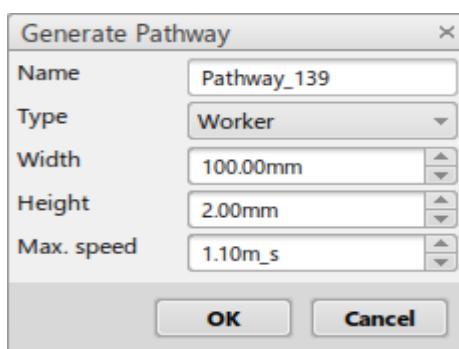
Defining a Worker Pathway

You can define a worker pathway with the **Define Pathway** command.

1. In the **Setup** section of the action bar, click the **Define Pathway** command and select the organization resource to define it as the parent node for the pathway resource.



2. In the **Generate Pathway** dialog box that appears, define the pathway's attributes.



The following attributes are available:

- **Name:** The name of the pathway.
- **Type:** The type of pathway.
- **Width:** The width of the pathway.
- **Height:** The height of the pathway.
- **Max. speed:** The maximum speed of the worker on the pathway.



- Click **OK** to close the dialog box.

You have defined the worker pathway.

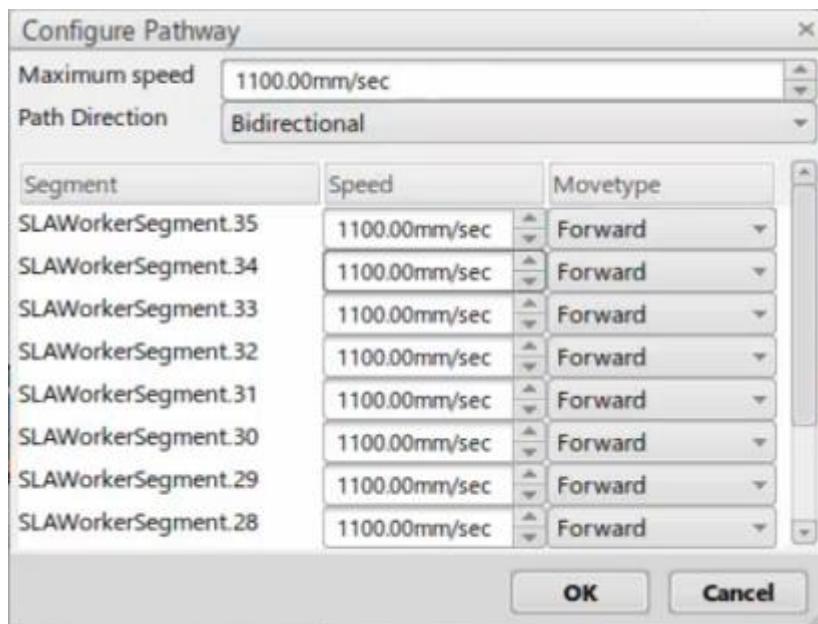
Configuring a Worker Pathway

You can configure a worker pathway with the **Configure Pathway** command. During simulation, the worker moves between the two resource zones with or without a product, and the walk path contains the list of path segments in a sequence.

- In the **Setup** section of the action bar, click the **Configure Pathway** command.

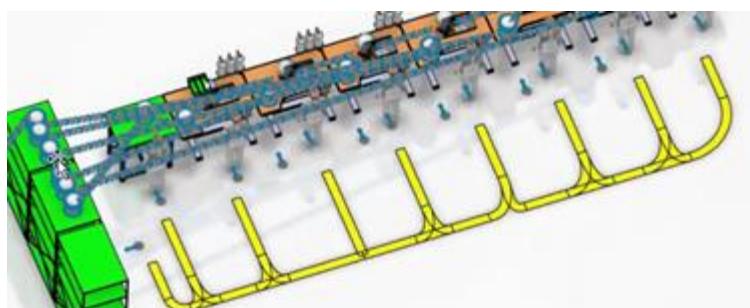
Note: You can also access the command when you select the pathway in the tree.

- In the **Configure Pathway** dialog box that appears, specify the attributes of the path system and its segments.



- Click **OK** to close the dialog box.

You have configured the worker pathway.



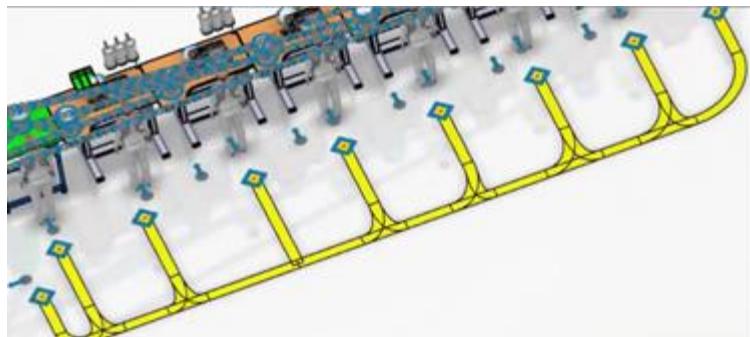
Adding a Junction Point to the Worker Pathway

You can add a junction point to the worker pathway with the **Add a Junction Point** command. A junction point is the point on the worker pathway that connects the pathway to a resource, which you can define anywhere on a segment.

- In the **Programming** section of the action bar, click the **Add a Junction Point** command.

Note: You can also access the command when you select the pathway in the tree.

- Select the segments where you require a junction.



B. Managing Walk Paths

You can specify a specific path for worker movement with or without a product using the Manage Walk Paths command. By default worker takes the shortest possible path on the worker pathway.

Before you begin: Open a scenario with an assembly line that includes workers completing tasks.

- From the Setup section of the action bar, select Manage Walk Paths

The Manage Walk Paths dialog box appears.

- To add a new walk path, select Add

- In the Edit Walk Path dialog box that appears, define the walk path's attributes. The following attributes are available:

- Walk Path Name: The name of the walk path.
- Start Zone: The name of the selected start zone.
- End Zone: The name of the selected end zone.
- Path: The path for the created walk path. Select a path from the list of all the possible paths between the Start Zone and End Zone.
- Product: The product the worker can carry while walking the walk path. Select a product from the list of all the products associated with the Start Zone and End Zone.

Note: The option None indicates that the worker is carrying a non-specified product, or is empty handed.

- Under Segments, define the Move Type. There are three types of move type: Forward, Backward, and Lateral.

Note: Move type for segments connecting a resource zone and a junction point cannot be changed.

Clicking OK saves your selection.

- Optional: To edit a walk path, select Edit in the Manage Walk Paths dialog box.

The Edit Walk Path dialog box appears and you can edit the segment's path, product, or move type.

- Optional: To delete a walk path, select Delete .

You have created a walk path.

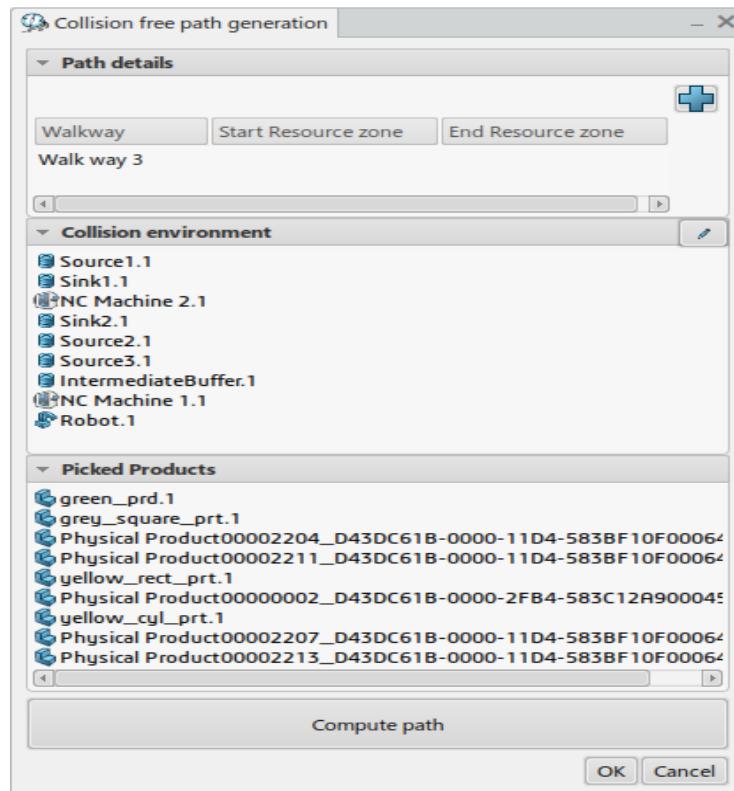
Note: There can only be one walk path defined for the same product.

C. Creating a Collision Free Pathway

You can create a collision free pathway for a worker with the Generate Collision Free Path for Worker command.

Before you begin: Open a scenario with an assembly line that includes workers completing tasks.

- In the Setup section of the action bar, click the Generate Collision Free Path for Worker command to open the Collision free path generation dialog box.



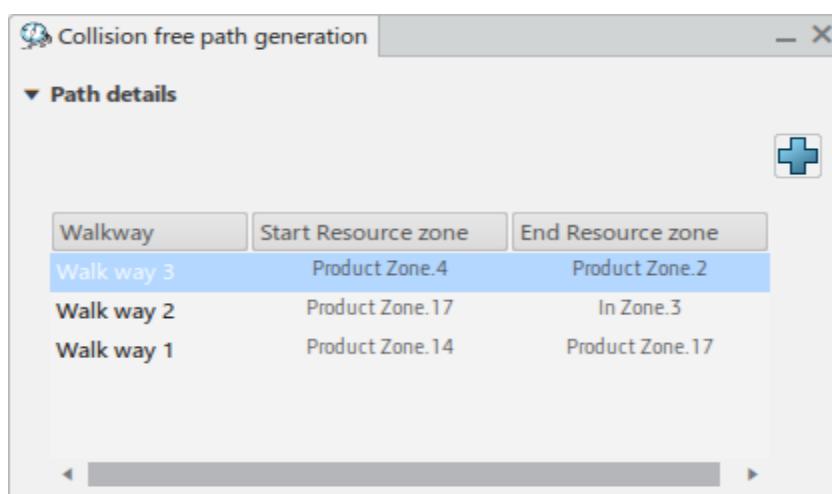
The Collision free path generation dialog box contains the following information:

- Path details: This section lists the pathway that the command generated.
- Collision environment: This section lists the context objects. When you hover over objects in the list, the command highlights them in the work area.
- Picked Products: This section lists the objects carried by workers during the simulation. When you hover over products in the list, the command highlights them in the work area.

Note: By default, the dialog box minimizes this section. You cannot expand this section until you have expanded both the Path details and the Collision environment sections of the dialog box.

- Click the Create new pathway command to create a new pathway.
- Click the Start Resource Zone tab and click a start resource zone from the work area or the tree, then do the same for the End Resource Zone.

The resource zones are listed in the dialog box under Start Resource Zone and End Resource Zone.



Note: You can add additional points that were deleted to modify the path, but these changes are overridden when you click Compute Path. After generating a path, you can click one of the selected resource zones to modify the planar position of the resource zone and snap the Robot into place.



4. Click Compute Path.

The path takes into account the resource zone positions.

5. To remove a pathway, right-click the pathway and click Delete

6. Select an object in the Collision environment section of the dialog box.

The dialog box highlights the selected object.

Note: You can select multiple objects by holding Shift while selecting objects beside one another in the list, or Ctrl while selecting objects that are not next to each other.

7. To remove an object from the collision environment, right-click the object and click Remove

You have removed the object from the list.

8. Select a product in the Picked Products section of the dialog box.

The dialog box highlights the selected product.

9. Click Compute Path.

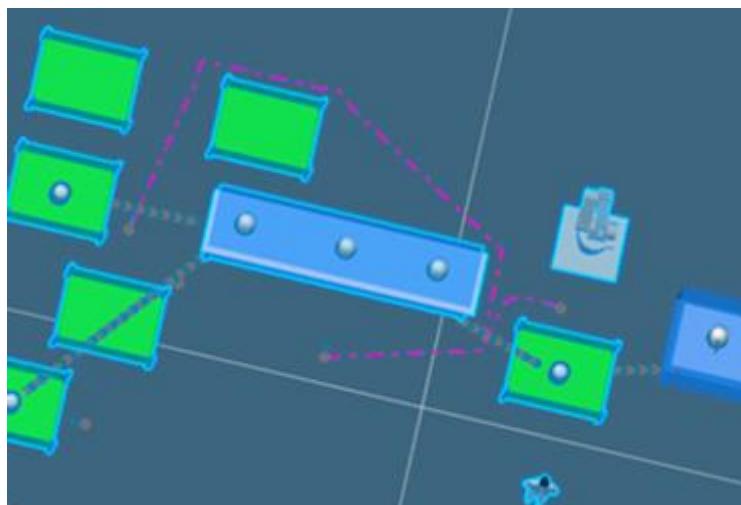
10. Click OK to close the Collision free path generation dialog box.

You have saved the pathway.

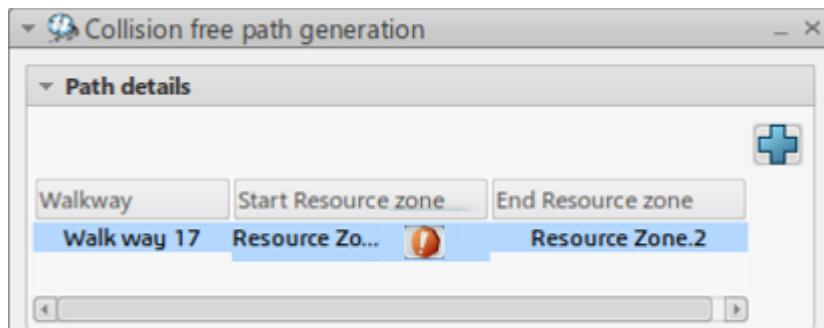
11. To view the pathways, click the App Options command from the Tools section of the action bar.

12. In the App Options dialog box that appears, click Display walk ways , then close the dialog box.

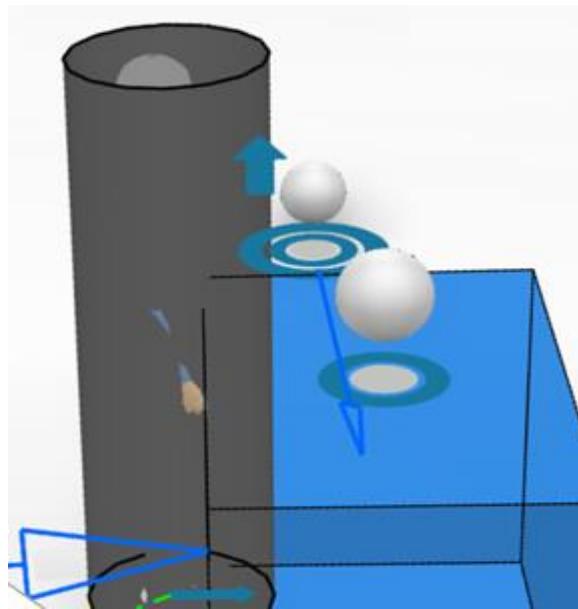
The path is now visible and workers walking between the selected resource zones use this pathway during simulation. Workers also use this pathway during forward and reverse movement, unless you specified otherwise.



Note: If one of the zones is already in collision with any object in the collision environment, then the command does not validate the path. In this case, an error message displays in the Collision free path generation dialog box beside the resource zone with collision.



When you click the error message, a worker inside a cylinder appears at the resource zone with collision.



You have created a collision free pathway for a worker.

Module-4.G: Using Resource Configuration

You can use the Resource Configuration table to visualize the factory flow entity-hierarchy under a given machine and perform planning integration.

In this section:

- About the Resource Configuration Table
- About Planning Integration
- Using Planning Integration

A. About the Resource Configuration Table

The Resource Configuration table is a visualization of a factory flow entity-hierarchy under a given machine.

You can access the **Resource Configuration** table by doing the following:

- Click the **Resource Configuration** command in the **Programming** section of the action bar then select a worker, pathway, activity, zone, or object in the work area or tree.
- Select a worker in the work area then click **Resource Configuration** to view the transfer activities under the worker in the table. In this view, you can edit and define consumables on the worker.
- Select a pathway and click **Resource Configuration** , then right-click a pathway or decision zone to use the context menu options.

The table allows you to build, model, and review selected resources. It presents resources properties in a tabular form and visualizes the selected resource-model tree structure. The various element's context menus allow you to:

- Select multiple elements for edition or deletion.
- Assign resource pools, resource zones, time distributions, or parking zones.
- Edit activities, resources, product zones, or product flows.
- Open a Gantt chart for a selected element.
- Customize the required property columns view.
- Define common inputs group

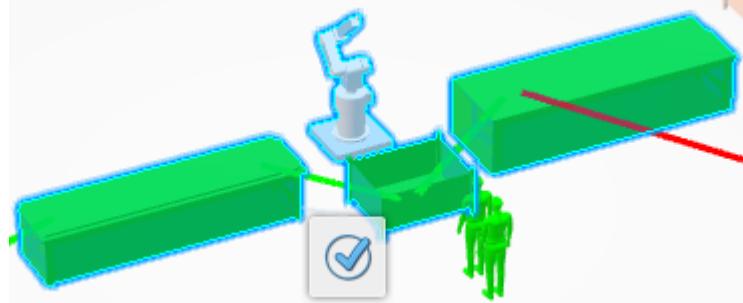


You can reorganize resources using drag-and-drop in the **Resource Configuration** table without corrupting entities defined on the moving resource. For example if an NC machine has product zones, activities, product flows, and many other resources, all of them are retained when you reorganize the resource hierarchy using drag-and-drop.

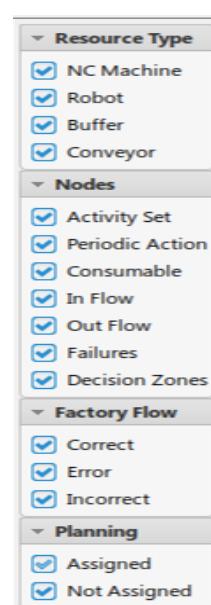
Name	Time Distribution	Inputs	Outputs	Resource Pools	Resource Zones	Parking Zones
Resources						
NC Machine 1.1						Resource-e Zone.5
Product Zone.2						
Transform.A(Grey Rect)	10s	Physical Pr...OF000640F7.1	Physical Pr...OF000640F7.1			
Unload.A(Grey Rect)	5s	Physical Pr...OF000640F7.1	Physical Pr...OF000640F7.1 Resource.t...source.50			
Load.A(Green Rect)	5s	Physical Pr...OF000640F7.1	Physical Pr...OF000640F7.1 Resource.t...source.50			
Product Zone.3						
Transform.B(Purple Cylinder)	10s	Physical Pr...OF000640F7.1	Physical Pr...OF000640F7.1			
Unload.B(Purple Cylinder)	5s	Physical Pr...OF000640F7.1	Physical Pr...OF000640F7.1 Resource.t...source.50			
Load.B(Grey rect)	5s	Physical Pr...OF000640F7.1	Physical Pr...OF000640F7.1 Resource.t...source.50			
Product Zone.4						
Transform.C(Blue Cylinder)	10s	Physical Pr...OF000640F7.1	Physical Pr...OF000640F7.1			
Unload.C(Blue Cylinder)	5s	Physical Pr...OF000640F7.1	Physical Pr...OF000640F7.1 Resource.t...source.50			
Load.C(Purple Cylinder)	5s	Physical Pr...OF000640F7.1	Physical Pr...OF000640F7.1 Resource.t...source.50			
Generic Activities						
Close door(click button)	10s				Resource.t	
Door close (Machine Time)	10s					
Open door	10s					

The following commands are available in the **Resource Configuration** table:

- **Select**: Highlights the selected objects in the main 3D. You can clear highlighted objects by selecting them or by selecting other objects to add to the existing resource configuration by selecting them in the main 3D. Once you complete the required changes, you can click the validate option to end the selection and return to the table to view changes.

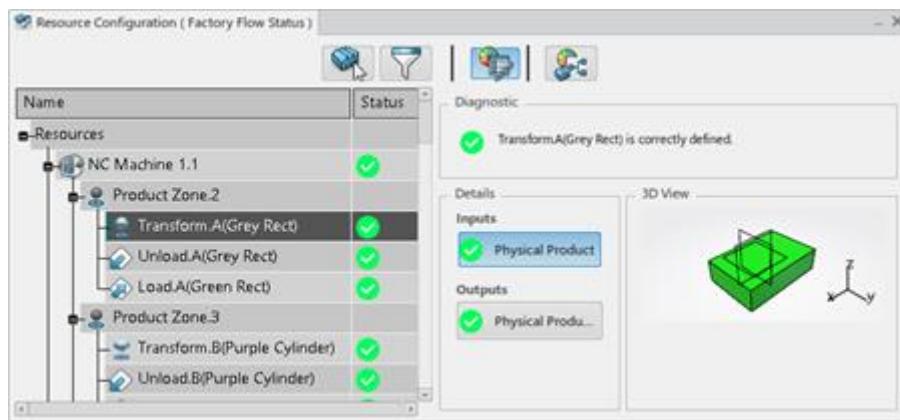


- **Filter** : Filters what appears in the table with options for **Resource Type**, **Nodes**, **Factory Flow**, and **Planning**.

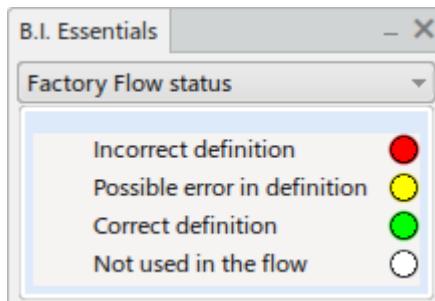




- **Factory Flow Status** : Opens the **B.I. Essentials** panel and computes the status of all items in the table. You can select each item to view the status in depth in the panel that appears beside the table. The panel consists of the following sections: **Diagnostic**, **Details**, and **3D View** if there are no errors, or **Possible Solutions** if there are errors.

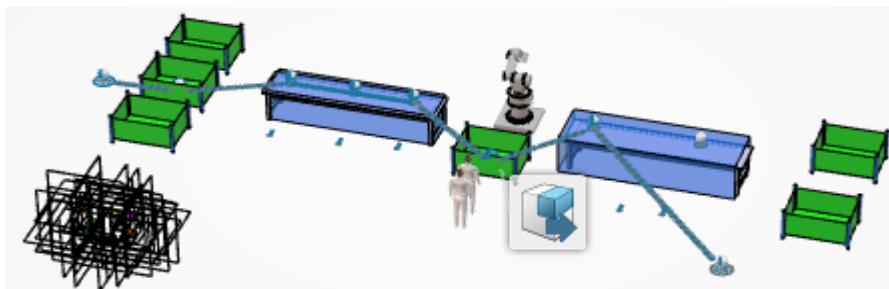


- The **B.I. Essentials** panel for **Factory Flow Status** contains the following information:



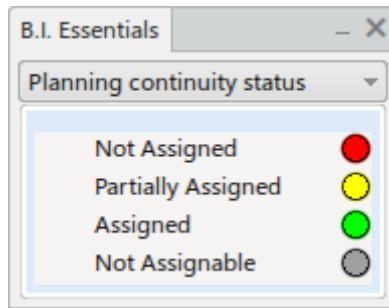
Color	Factory Flow Status
	Incorrect definition: The resource has inputs or outputs that are not provided by a product flow.
	Possible error in definition: The resource may have inputs or outputs that are not provided by a product flow.
	Correct definition: The resource has inputs or outputs that are provided by a product flow.
	Not used in the flow: The resource is not used in the simulation.

- **Planning Continuity Status** : Opens the **B.I. Essentials** panel and checks the status of all items in the table. This command enables the **Synchronize activities with planning** command, which will synchronize the activities and close the table.





- The **B.I. Essentials** panel for **Planning Continuity Status** contains the following information:



Color	Planning Continuity Status
● (Red)	Not Assigned: The activity is not assigned to a product flow.
● (Yellow)	Partially Assigned: The activity may not be assigned to a product flow.
● (Green)	Assigned: The activity is assigned to a product flow.
● (Grey)	Not Assignable: The activity is unassignable.

Activities can be created in the **Resource Configuration** table with drag-and-drop. You can drag an operation or manufactured item from the tree and drop it on a destination in the table. The following drag-and-drop combinations are available:

Operation or Manufactured Item	Destination	Activity Created
General	<ul style="list-style-type: none"> Product Zone of Buffer/NC Machine Decision Zone of the Conveyor 	Transfer Activity
General Note: You must add the generic attribute to the description of the general activity in the Properties dialog box.	NC Machine	Generic Activity
General	<ul style="list-style-type: none"> Product Flow Conveyor 	Transfer Activity
Load Note: You must add the Placing attribute to the description of the load activity in the Properties dialog box.	<ul style="list-style-type: none"> Product Zone of Buffer/NC Machine Decision Zone of the Conveyor 	Load Activity
Load Note: You must add the Pack attribute to the description of the load activity in the Properties dialog box.	Decision Zone of the Conveyor/NC Machine	Pack Activity
Unload Note: You must add the Picking attribute to the description of the unload activity in the Properties dialog	<ul style="list-style-type: none"> Product Zone of Buffer/NC Machine Decision Zone of the Conveyor 	Unload Activity



Operation or Manufactured Item	Destination	Activity Created
box.	Conveyor	
Unload Note: You must add the Unpack attribute to the description of the unload activity in the Properties dialog box.	Decision Zone of the Conveyor/NC Machine	Unpack Activity
Transfer	<ul style="list-style-type: none"> •Product Flow •Conveyor 	Transfer Activity
General /Mfg Item	<ul style="list-style-type: none"> •Product Zone •Buffer 	Buffer Activity
General /Mfg Item	Out Zone	Dispatch
Mfg Item	In Zone	Create Activity

The properties of these created activities are as follows:

- All activities connected to an operation or manufactured item have a green check mark on top of the activity's existing icon.
- The **Name** and **Time Distribution** of the operation is the same as the activity's name and time.
- The **Inputs** and **Outputs** of the operation are the same as the activity's inputs and outputs. When you select an operation in the table, their input and output manufactured items appear highlighted in the tree.
- An operation's worker is assigned as a resource pool to the activity with a restriction of one worker per pool.
- An operation's precedence links and constraints are the same as those of the activity.

B. About Planning Integration

You can use planning integration to map planning items and operations in the Resource Configuration table.

Industrial Engineering

You can map planning items and operations with **Industrial Engineering** (IEN) activities and simulate it in the Factory Flow Simulation App. IEN provides a capability through business rule to customize the operation mapping with IEN activity. You can also control the particular destination type, such as resource, product zone, or flow for the operation or item.

Default Implementation

Planning Type	Attribute and Description Value	Target	Result
Transfer Operation	N/A	Conveyor Resource	Transfer activity on conveyor.
Transfer Operation	N/A	Product Flow	Transfer activity for product flow.
Loading Operation	N/A	Product Zone of Storage or NC Machine	Loading operation on product zone.



Default Implementation

Planning Type	Attribute and Description Value	Target	Result
Unloading Operation	N/A	Product Zone of Storage or NC Machine	Unloading operation on product zone.
Loading/Unloading Operation	Pack/Unpack	Product Zone of Storage or NC Machine	Pack/unpack activity on product zone of storage or NC machine.
Loading/Unloading Operation	Picking/Placing	Product Zone of Storage	Load/unload activity on product zone of storage. Case to limit creation of load/unload on storage only.
General Operation	N/A	Product Zone of NC Machine	Transform activity on product zone of NC.
General Operation	N/A	Out Zone	Dispatch activity on out zone.
General Operation	N/A	Product Flow	General operation flow on the product flow with product flow details populated.
General Operation	N/A	Conveyor Decision Zone	Transform activity on conveyor decision zone.
General Operation	N/A	Product Zone of Buffer	Buffer activity on product zone of buffer resource.
General Operation	Generic	Product Zone for NC Machine	Generic activity on NC machine.
General Operation	Transfer	Product Flow	General operation must have input/output product and executing resource associated.
N/A	N/A	N/A	Transfer activity for product flow.
General Operation	Transfer	Conveyor Resource	Transfer activity for conveyor is created. General operation must have association with the target conveyor resource.
General Operation	Consumable	NC Machine or Robot Resource	Consumable is created on the resource where it is dropped and is attached to the generic activity. Only NC



Default Implementation

Planning Type	Attribute and Description Value	Target	Result
			machine and robot are supported.
General Operation	Cleaning	NC Machine Resource	Periodic action is created on the resource where it is dropped and is attached to the generic activity. Only NC machine is supported.
General Operation	Inspection	NC Machine Resource	Periodic action is created on the resource where it is dropped and is attached to the generic activity assigned to the other machine. Only NC machine is supported. Also select the required SLA resource.
Item	N/A	Product Zone of Buffer	Buffer activity on the product zone of the buffer resource.
Item	N/A	In Zone	Create activity.
Item	N/A	Out Zone	Dispatch activity on out zone.
Item	N/A	Product Flow	Product flow detail on product flow is created.

CATRule Files

Set the attribute for a particular mapping object in the CATRule file. You cannot drag-and-drop operations that are not supported through customization, and a failure message is displayed in this case.

The customization is supported by CATRule file DELSLAPlanningContinuityBL.CATRule. The CATRule logic decides the valid IEN activity depending on the operation type and the target destination. It also decides whether to allow the particular drag-and-drop action depending on the destination and type of operation.

CATRule provides the operation object and parameters about the target. Parameters are detailed in the CATRule file.

You can return the valid activity type for further activity creation if the drag-and-drop action is valid.

You can manage post processors for drag-and-drop items with CATRule
DESLACustomizePlanningContinuityBL.CATRule.



Scope Link

Define scope links for planning integration.

Precedence

Operation precedence and flow between operations are carried forward as precedence between respective mapped activities. Precedences are carried forward between the mapped activities.



Resource Assignments on Operation

The resource assignment is carried forward through resource pool assignment with the restriction of one resource per pool.

Sometimes an operation is associated with an NC machine resource and your required result is to create an activity. In this case, you can only drop the operation on the same NC machine or product zone of the associated NC machine. When you try to drop the resource of this operation type on other NC machines, it results in failure.

Properties of Mapped Activities in the Resource Configuration Table

All activities pointing to an operation or item are marked with on the existing icon of the activity in the **Resource Configuration** table.

Name, Time, input, and output of the operation are set on the activity.

The input and output items are highlighted in the tree when you select them in the **Resource Configuration** table

The worker is assigned on the operation as a resource pool to the activity and has a one worker per pool restriction.

If you must link the same operation to multiple resources or product zones, use DELMIA_FFS_AllowMultipleOperationLinkToActivity=1.

In **Planning Integration**, there is a limit to one worker per pool while mapping the activity to the operation. There cannot be an instance where a mapped activity has an assigned pool with more than one worker.

There is no update mechanism to automatically **Sync activities with planning** with already integrated IEN data.

The functionalities in the **Edit** panel of activities are disabled if the activity is mapped to a planning operation.

C. Using Planning Integration

You can use planning integration to map planning items and operations in the Resource Configuration table.

1. Check Assign Resource Pool for Worker in Simulation Options > Flow Simulation > Planning Integration.
 2. From the Programming section of the action bar, click Resource Configuration .
 3. Drag an operation and drop it on the required product zone.
- Activities with the same name as the operation are created.
4. In the Resource Configuration table, click Planning Continuity Status to identify which operation or item is consumed.

Note: You can also access Planning Continuity Status from the Programming section of the action bar.

The B.I. Essentials panel appears with the tree color marked in the legend and the Resource Configuration table is extended with an expanded view of the operation you select.

5. Select an operation in the table and solve the listed problems, if any.
- The operation's information is displayed in the expanded view as well as possible solutions that you can apply to fix the issue, if any. The Status column in the table indicates if the problem can be resolved, or if you must delete the activity.

6. Click Sync activities with planning to synchronize all the data loaded in the Resource Configuration table.
- Note: You can also access Synchronize with planning in a context menu when you right-click an object in the table.
7. Choose which attributes to sync from the Synchronize panel that appears, then click OK.



The data in the table is synchronized.

You have mapped planning items and operations.

D. Managing Resource Working Cycles

You can create, edit, or delete resource working cycles with the Working Cycle Management command.

This task shows you how to:

- Creating Resource Working Cycles
- Editing Resource Working Cycles
- Deleting Resource Working Cycles
- Modifying Distance and Weight Attributes for Resource Working Cycles
- Opening the HTML Report for a Resource Working Cycle

Before you begin: Open a scenario that includes the following:

- Multiple activities assigned to a common resource pool on at least two different machines.
- A worker in the common resource pool that completes their work on a set of machines before moving onto other pending tasks, if any exist. You can achieve this by using a resource working cycle.

Creating Resource Working Cycles

You can create a new resource working cycle with the **Working Cycle Management** command.

1. From the **Programming** section of the action bar, click **Working Cycle Management** .
2. In the **Manage Working Cycles** dialog box that appears, click the **Add** command in the dialog box then select a machine or activity from the tree or the main 3D.

The machine or activity is selected and the name shows in the **Tools Palette** toolbar.

3. In the toolbar, select **Finish**.
4. In the **Available Resource Pool** panel that appears, select the resource and click **OK**.
5. In the **Edit Working Cycle** dialog box that appears, move machines or activities from the **Available Elements** section with the arrows.

The machines or activities are added to the new resource working cycle and are listed in the **Working Cycle** section of the dialog box.

6. Click **OK**.

The new resource working cycle is listed in the **Manage Working Cycles** dialog box .

7. Click **Close**.

You have created a new resource working cycle.

Editing Resource Working Cycles

You can edit an existing resource working cycle with the **Working Cycle Management** command.

1. From the Programming section of the action bar, click Working Cycle Management .
2. In the Manage Working Cycles dialog box that appears, select a working cycle and click **Edit**.
3. In the Edit Working Cycle dialog box that appears, move required machines or activities in the Available Elements section to the Working Cycle section with the arrows.

You have added these machines or activities to your existing working cycle and you can reorder them with the arrows or with drag-and-drop.

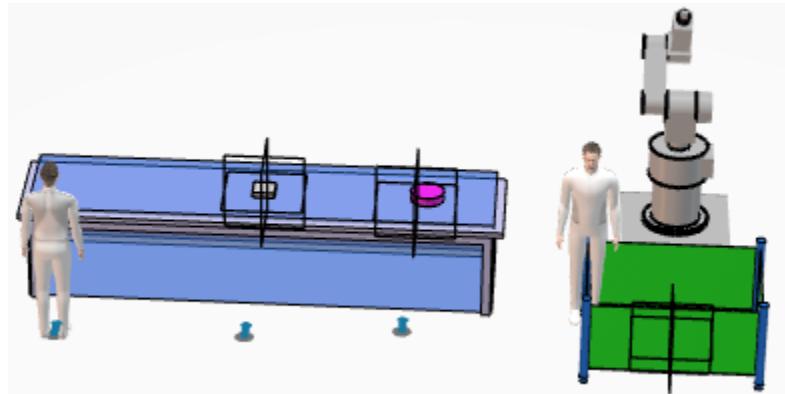
4. Change the value as required in the box next to each resource working cycle in the Working Cycle section of the dialog box.

Note: The value beside each listed item represents the number of times the worker executes the resource working cycle before doing the next one. You can change this value and it must be above zero. For example, if the value is 2, then the worker executes the activity twice before moving on to the next



activity in the resource working cycle. During this execution, other tasks must not interrupt the worker.

By default, The dialog box sets the value to 1.



- To activate the resource working cycle, select it in the dialog box and check Activated.

The status of the working cycle is updated and shown as Activated. A icon is displayed in the Diagnostic column of the Manage Working Cycles dialog box.

- To deactivate the resource working cycle, select it in the dialog box and clear the Activated check box.

The status of the working cycle is updated and shown as Deactivated. No icon is displayed in the Diagnostic column of the Manage Working Cycles dialog box.

- Click OK.

You have updated the resource working cycle.

- Click Close.

You have edited an existing resource working cycle.

Deleting Resource Working Cycles

You can delete a resource working cycle with the **Working Cycle Management** command.

- From the **Programming** section of the action bar, click **Working Cycle Management** .
- In the **Manage Working Cycles** dialog box that appears, select a resource working cycle in the list and click **Delete**.

You have deleted the resource working cycle and removed it from the list.

You have deleted a resource working cycle.

Modifying Distance and Weight Attributes for Resource Working Cycles

You can modify the distance and weight attributes for resource working cycles.

- From the tree, select a machine or activity in a resource working cycle and click **Edit SLA resource** .
- In the **Edit** dialog box that appears, modify the **Default speed** attribute as required.
- Select an object that a worker carries in the resource working cycle and click the **Measure Intertia** command in the **Tools** section of the action bar.
- In the **Measure Intertia** dialog box that appears, modify the **Mass** attribute in the **Main Results** tab as required.
- Open the **Simulations Options** dialog box by clicking the **Simulation Options** command at the right edge of the work area.



- In the Flow Simulation tab, check the **Collect Resource State Times** option.

This shows you information on the resource's behavior during the simulation.

- On the right edge of the work area, click **States History**.

The **States History** dialog box displays a chart with the simulations statistics.

- Optional:** In the dialog box, click the **Export to XML** command and save the file in the required location.

When you open the saved file in a browser, it displays the values in XML format.

```
<?xml version="1.0"?>
- <StatesHistory>
  <ParametersNMeasures Speed="Meter per
    second" Volume="Cubic meter"
    Weight="Kilogram"
    Length="Millimeter" Time="Second"
    EndTime="133.9" StartTime="0"/>
- <Resources>
  - <Resource Type="ncmachine"
    Name="NC Machine 1.1">
    - <State EndTime="5.40139"
      StartTime="0"
      OperationType="Generic"
      OperationName="Close door(click
      button)" State="Wait for
      Resource(s)">
      <PoolsNWorkers
        ResourcePools="Resource.1"/>
    </State>
    - <State EndTime="15.4014"
      StartTime="5.40139"
      OperationType="Generic"
      OperationName="Close door(click
      button)" State="Wait for
      Resource(s)">
      <PoolsNWorkers
        ResourcePools="Resource.1"/>
    </State>
  - <State EndTime="15.4014"
    StartTime="5.40139"
    OperationType="Generic"
    OperationName="Close door(click
    button)" State="Wait for
    Resource(s)">
    <PoolsNWorkers
      ResourcePools="Resource.1"/>
  </State>
</Resources>
```

You have edited the distance and weight attributes for the resource working cycle.

Opening the HTML Report for a Resource Working Cycle

You can view the distance and weight statistics for a resource working cycle with the HTML Report.

- Click the Play command of the **Compass** and select a simulation.
- In the Player, click **Play forward** ► .
- On the right edge of the work area, click **System Performance Monitor** 📈.
- Select the **System Utilization** tab.

The chart displays the state of each element of the production system.

- Optional:** Click **Open HTML Report** 🎯 .

The report displays values on the elements of the production system for **Total Distance Traveled (Millimeter)** and **Total Weight Carried (Kilogram)**.

You have opened the HTML Report for the resource working cycle and viewed its distance and weight statistics.

E. Managing Consumables

You can manage consumables by adding or removing them from machines, robots, or transfer activities. Consumables help to complete tasks since they are objects that the action uses to the point of depletion during a simulation. Consumables can include batteries, welding rods, sanding discs, magnets, castors, and wheels.



This task shows you how to:

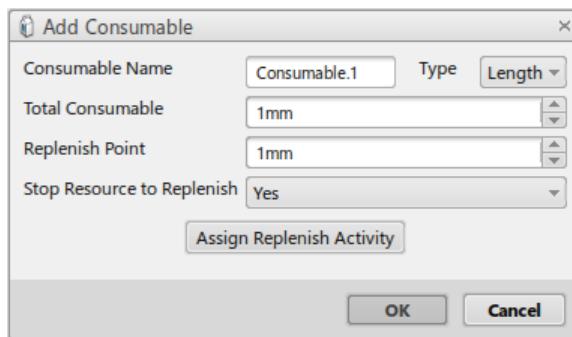
- Adding a Consumable
- Edit a Consumable
- Assigning a Consumable to a Transform Activity
- Removing a Consumable

Before you begin: Open a scenario that includes a machine or a robot and a transfer activity.

Adding a Consumable

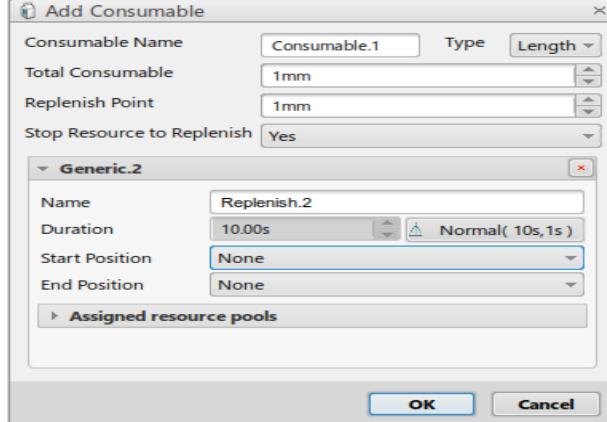
You can add a consumable to a machine or a robot with the **Add Consumable** command.

1. Click the **Resource Configuration** command from the **Programming** section of the action bar.
2. In the **Resource Configuration** table that appears, right-click a machine.
3. Mouse over **Consumables** and click **Add Consumable** .
4. In the **Add Consumable** dialog box that appears, define the consumable's attributes.



You can define the following attributes for the consumable:

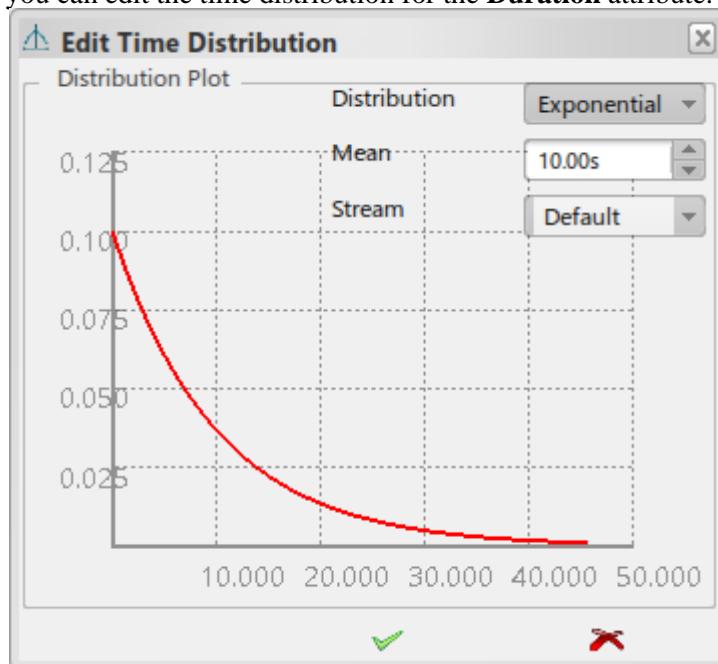
- **Consumable Name:** The name of the consumable.
 - **Type:** The measurement unit in length, width, or volume.
 - **Total Consumable:** The total consumable value.
 - **Replenish Point:** The replenish point for the consumable.
 - **Stop Resource to Replenish:** Allows you to specify whether or not the resource stops to replenish consumed materials.
5. Click **Assign Replenish Activity** and edit the activity's attributes.



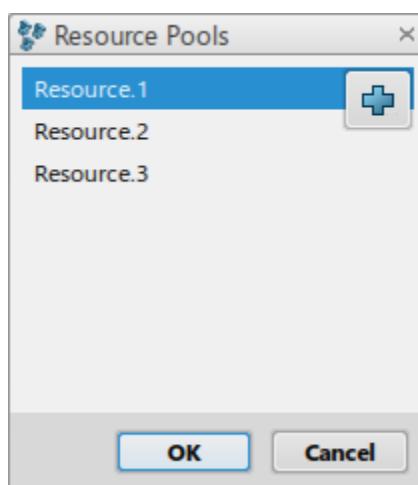


The replenish activity is a generic activity type. You can define the following attributes for the replenish activity:

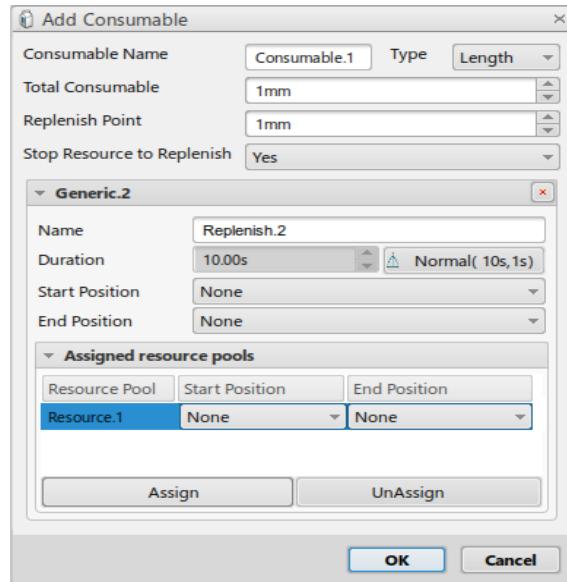
- **Name:** The name of the replenish activity.
- **Duration:** The duration of the replenish activity.
- **Time Distribution** : Opens the **Edit Time Distribution** dialog box, where you can edit the time distribution for the **Duration** attribute.



- **Start Position:** The start position for the replenish activity.
 - **End Position:** The end position for the replenish activity.
6. Click **Assigned resource pools > Assign**.
7. In **Resource Pools** dialog box that appears, select a single resource from the list, or select multiple resources by holding **Ctrl** while selecting several resource pools.



8. Click **OK** to close the dialog box.
- The assigned resource pool is listed in the **Assigned resource pools** section of the **Add Consumable** dialog box.
9. Define the newly assigned resource pool's attributes in the dialog box.



You can define the following attributes for the assigned resource pool:

- **Start Position:** The start position for the resource pool.
- **End Position:** The end position for the resource pool.

You can use also the **Assign** command to add more resource pools and the **Unassign** command to remove resource pools from the replenish activity.

10. Click **OK**.

The dialog box closes and you have added the consumable to the machine or robot.

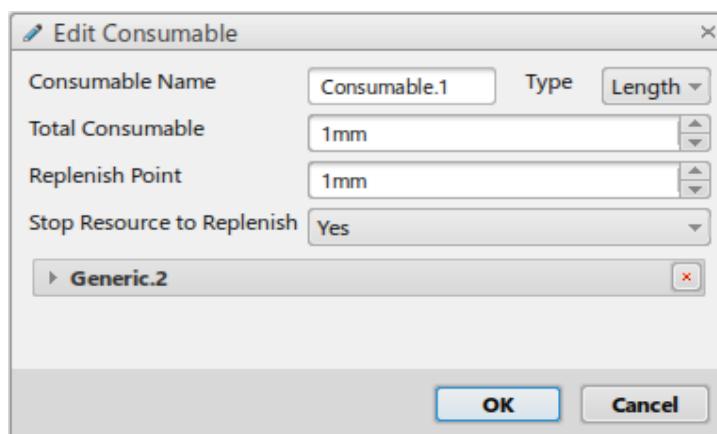
Note: Every time you create a consumable, the command automatically creates a replenish activity that is a generic activity type. This activity appears in the generic activities node under the machine or robot with a consumable. When you delete a consumable, the command deletes the consumable's generic activity as well. You can only delete the consumable's generic activity when you delete the consumable.

You have added a consumable to a machine or robot.

Edit a Consumable

You can edit an existing consumable in the **Resource Configuration** table.

1. Click the **Resource Configuration** command from the **Programming** section of the action bar.
2. In the **Resource Configuration** table that appears, right-click a consumable and click **Edit** .
3. Use the **Edit Consumable** dialog box that appears to edit the consumable.





- Click **OK** to close the dialog box.

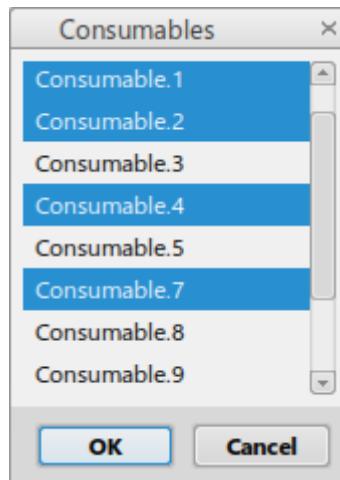
The edited consumable is listed in the **Resource Configuration** table.

You have edited an existing consumable.

Assigning a Consumable to a Transform Activity

You can assign a consumable to a transform activity

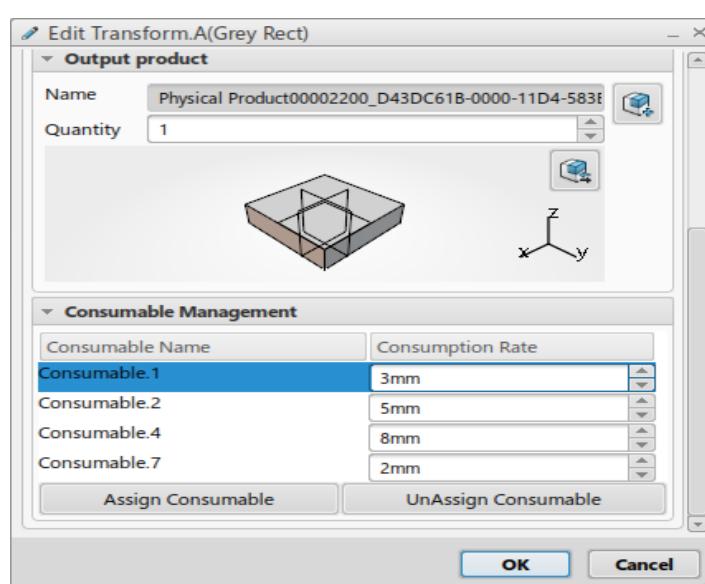
- Click the **Resource Configuration** command from the **Programming** section of the action bar.
- In the **Resource Configuration** table that appears, right-click a transform activity and click **Edit** .
- In the **Edit** dialog box that appears, go to the **Consumable Management** section and click **Assign Consumable**.
- In the **Consumables** dialog box that appears, select a single consumable or multiple consumables by holding **Ctrl** and selecting several consumables.



- Click **OK** to close the dialog box.

The consumables that you added to the transform activity are listed in the **Consumable Management** section of the **Edit** dialog box.

- Edit the consumable's consumption rate by weight with the **Consumption Rate** attribute.





Note: For every execution of the transform activity on a machine or robot, the simulation deducts the defined consumption rate from the total consumable value. When this consumable value presses the replenish point value, the replenish activity begins and the consumable reloads on the machine. During the replenish activity's execution, whether or not the resource stops depends on what you specified for the **Stop Resource to Replenish** option in the **Edit Consumable** dialog box.

7. Assign additional consumables with the **Assign Consumable** command, or remove a consumable from the transform activity with the **Unassign Consumable** command.
8. Click **OK** to close the dialog box.
9. **Optional:** Click **Open HTML Report** .

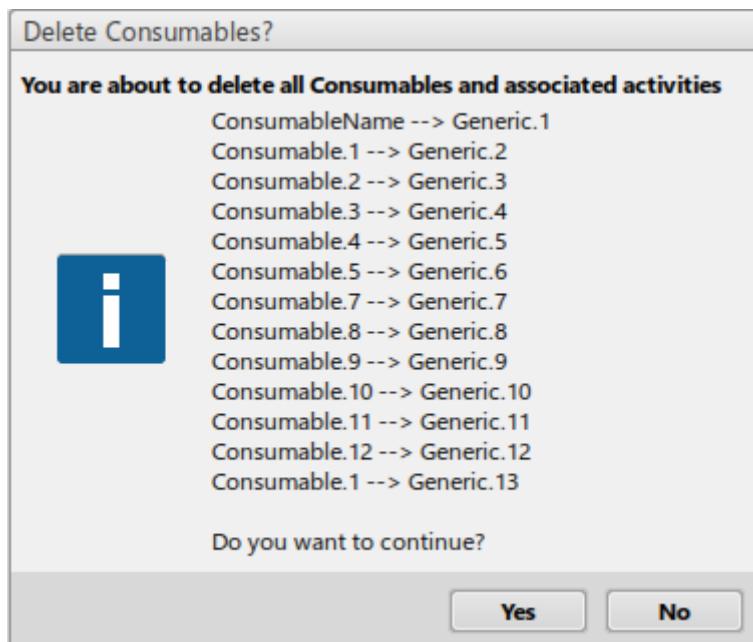
A report appears that displays each consumable's statistics.

You have assigned a consumable to a transform activity.

Removing a Consumable

You can remove all of the consumables from a machine or a robot with the **Remove all Consumables** command.

1. Click the **Resource Configuration**  command from the **Programming** section of the action bar.
2. In the **Resource Configuration** table that appears, right-click a machine with assigned consumables.
3. Mouse over **Consumables** and click **Remove all Consumables**  and review the list of consumables in the **Delete Consumables?** dialog box that appears.



4. Click **Yes** and close the **Resource Configuration** table.

You have deleted all of the consumables from the machine or robot.

F. Managing a Mobile Storage

You can manage mobile storages to evaluate the required number of mobile storage resources required to achieve the required output for production.

Before you begin: Open a scenario with a mobile storage defined on a resource.

1. From the Setup section of the action bar, click **Manage Mobile Storage** .



2. Click an object from the tree or work area, then click OK .
3. In the Manage Mobile Storages dialog box that appears, select one or more mobile storages.
4. Right-click the selection and change the status to Activate  or Deactivate .

Note: You can also activate or deactivate a mobile storage with the Enable Mobile Storage and Disable Mobile Storage options in the Edit dialog box.

5. Click OK to save your changes.
- You have managed mobile storages.

Module-4. H: Resource Configuration Gantt

This section describes how to use the Resource Configuration Gantt chart.

In this section:

- About the Resource Configuration Gantt
- Locate an Object in the Gantt Chart Using Auto-Find
- Exporting Gantt Chart Information to an XML File

A. About the Resource Configuration Gantt

The purpose of the Resource Configuration Gantt is to provide a Resource-Operation view. It also allows operations to be assigned to resources and a time mode to be set on operations.

The following topics are discussed:

- How to Open a Resource Configuration Gantt
- Context Menu
- How to Assign A Precedence Link

How to Open a Resource Configuration Gantt

The Resource Configuration Gantt is opened by right-clicking an NC Machine in the Resource Configuration table then selecting **Gantt definition for Machine** .

Several Resource Configuration Gantt charts can be opened simultaneously on different working resources (multi-selection is allowed).



Context Menu

A set of contextual commands is available for activities in the Gantt chart.

When you right-click any row of the Gantt chart, the following commands are available in the context menu:

- Delete Constraint:** Delete a precedence link.
- Create Activity Set:** Create an activity set with the selected activities.
- Add to Existing Activity Set:** Add the selected activity to an existing activity set.
- Export as XML:** Export the selected activities to an XML document.



How to Assign A Precedence Link

The Resource Configuration Gantt can be used to assign a precedence link.

Drag and drop an activity on to another activity to create a precedence link. Note that loop definitions are checked to prevent issues.

To remove a precedence link, right-click on the activity and select **Delete Constraint**.

You can select several operations using the **Ctrl** key.

B. Locate an Object in the Gantt Chart Using Auto-Find

You can search for an object in the Gantt chart using the Find panel. The Gantt chart then automatically scrolls to the located object.

1. Open the Gantt chart by right-clicking an NC Machine in the Resource Configuration table then selecting **Gantt definition for Machine**

The Gantt chart appears showing the structure.

2. Press **Ctrl** with **F** to open the **Find** panel.
3. In the **Name** field of the **General** tab, enter the name of an object that is not currently visible in the Gantt chart (for example, Loading_1).
4. Press **Find and Select**.

The Gantt chart automatically scrolls to the searched object. The corresponding line is highlighted in the chart.

Note: You can use other capabilities in **Find** panel to search for objects. For example, in the **Advanced** tab, you can use attribute criteria such as **Estimated time** when searching for an operation.

C. Exporting Gantt Chart Information to an XML File

You can export information from the Manufacturing System Gantt chart to an XML file. Filtering and premises details information is also exported to an XML file even if it is not displayed in the Gantt chart. The Export as XML context command is available on any row of the Gantt chart to export information such as object name and type, begin time, and duration to an XML file.

1. Open the Gantt chart by right-clicking an NC Machine in the Resource Configuration table then selecting **Gantt definition for Machine**

The Gantt chart appears showing the structure.

2. Right-click the first row of the Gantt chart and select **Export to XML**.

A file browser dialog box appears.

3. Specify the name and location of the XML file, then click **Save** in the dialog box.

The Gantt chart information is exported to the XML file.

Module-4.I: Simulating Production Systems

This section shows you how to simulate a production system and to collect statistics.

In this section:

- Simulation Concepts
- Displaying Simulation Charts and Exporting a Report
- Simulating a Resource Failure
- Creating Simulation Jobs in Batch Mode

A. Simulation Concepts

This section introduces basic concepts that help you simulating a production system and collecting statistics.



In this section:

- Discrete Event Simulation
- About Simulation Charts and the System Performance Monitor

Discrete Event Simulation

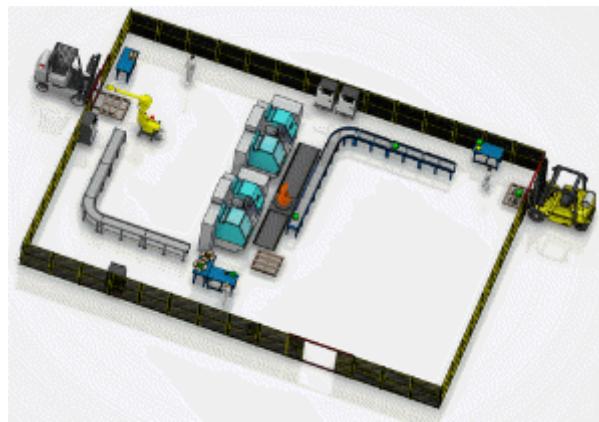
Simulations allow you to visualize at different levels of detail the production system in action. During simulation, charts containing statistics and resource states appear, helping you identify the parameters you need to modify to improve the production system performance.

You can start a simulation by clicking the Play option of the **Compass**.

Note: During simulation, elements that identify flows, zones, and activities are hidden in the work area.

Simulating a production system allows you to detect any problem linked to a product flow, such as bottlenecks. To increase the productivity of the production system, you can stop the simulation at any time and edit product flow or resource parameters.

During discrete event simulation, the product moves from one resource to another. The resources, except workers, are motionless.



About Simulation Charts and the System Performance Monitor

Simulation charts display statistics on elements of the production system (resources, in and out zones) and resource states during simulation. You can use the System Performance Monitor to display charts on the production system or click elements of the production system to display charts specific to these elements.

- Color Code and States
- Simulation Charts of Specific Elements
- Simulation Charts from the System Performance Monitor
- HTML Report
- States History Simulation Charts

Color Code and States

The simulation charts and the work area use colors to identify the state of an element of the production system at a specific moment of the simulation.

The following table shows the colors and the state that they identify:

Color	State
	<ul style="list-style-type: none">•Idle (worker, robot, in zones)•Empty (storage)
	Traveling (worker, robot)



Color	State
	<ul style="list-style-type: none"> Processing (machine, conveyor) Partially full (storage)
	Waiting for input products (machine, conveyor, out zone)
	<ul style="list-style-type: none"> Waiting for output products (machine, conveyor, in zone) Full (storage)
	Failed

To display colors on resources and zones in the work area, select the **State Highlighting** check box in the **Flow Simulation Options** tab of the **Simulation Options**. For more information, see Common

Services for Manufacturing **Simulation Apps** Reference Information: Simulation Options Dialog Box: Flow Simulation.

Simulation Charts of Specific Elements

Simulation charts appear when you click elements of the factory flow (resources, in an out zones) during simulation.

Basic Simulation Charts

When selecting a resource or zone, a panel appears with basic information on the selected element. Below is an example of the typical panel that appears when selecting a machine:



The icon on the left specifies the machine state at the current moment of the simulation. The table below lists the icons with the corresponding states for each element of the production system:

Icon	State	Applies to...
	Idle	<ul style="list-style-type: none"> Worker Robot In zone
	Processing	<ul style="list-style-type: none"> Machine Worker Robot
	Processing	Conveyor
	Traveling	Worker
	Traveling	Robot



Icon	State	Applies to...
	Waiting for input products	<ul style="list-style-type: none"> Machine Conveyor Out zone
	Waiting for output products	<ul style="list-style-type: none"> Machine Conveyor In zone
	Failed	<ul style="list-style-type: none"> Machine Conveyor In zone Out zone
	Empty	Storage
	Partial	Storage
	Full	Storage

Depending on the element of the production system you select, other icons such as the following ones appear:

Icon	Description
	Number of products handled by a resource or zone.
	Time a resource spend handling the products.
	Number of products already handled by a resource or zone.
	Cycle time of a product.

Detailed Simulation Charts

When expanding the **Chart Details** area of the panel, detailed simulation charts appear providing information on products, state times, and activities. The following charts appear in the **System State** and **Statistics** tabs:

Chart	Description
Products & Requests	Blue bar: indicates the number of products handled by the resource or zone. Red bar: indicates the number of input products expected by the resource or zone.
Operations	Indicates the time spent by a resource in a specific activity. Note: This chart is available for machines only.
Products	Blue bar: indicates the total number of input products. Green bar: indicates the total number of output products.
State Times	Indicates the time spent by a resource in a specific state.



Simulation Charts from the System Performance Monitor

The System Performance Monitor simulation charts are a compilation of charts of the production system elements. They allow you to have an overview of the performance of the production system. You can access the System Performance Monitor by clicking **System Performance Monitor** at the right edge of the work area.

Depending on which options you set in the **Flow Simulation Options** tab of the **Simulation Options** dialog box, different tabs are available. To customize options for the System Performance Monitor, see *Common Services for Manufacturing Simulation Apps* : *Reference Information: Simulation Options Dialog Box: Flow Simulation*.

Charts such as the following ones appear in the System Performance Monitor:

Chart	Description
System Utilization	Indicates the state of each element of the production system. An icon below the horizontal axis identifies each element.
Overall Inventory	Blue section of the pie chart: indicates the total number of input products of the general production system. Red section of the pie chart: indicates the total number of output products of the production system.
System Specific Inventory	Blue bar: indicates the total number of input products for each element of the production system. Green bar: indicates the total number of output products for each element of the production system.
Cycle Time	Indicates the time required for the factory flow to complete.

HTML Report

The HTML report is a table generated from the simulation charts. It provides the detailed statistic values of the general production system and of its elements. You can export the report to XLS and ONE formats.

Below is an example of an HTML report generated from the System Performance Monitor. It contains several tables specific to in and out zones (Arrival & Dispatch), resources (Storage, Worker), and the general production system (Production).

Element Type	Arrival & Dispatch	Production	Storage	Worker	Robot
Arrival & Dispatch:					
Production:					
System	Products	Products	Storage Times	Utilization (%)	
Main Spindle	Input: Prepared Committed Shipped Assembled Packed Processing Walk for Input	Output: Max Avg Min Max Avg Empty Period			
	1 1 1 1 1 0 0	6 18 0 11.361 1.309 0	27.918		
Storage:					
System	Products	Content	Working Time	Storage Times	Utilization (%)
pr000000124_00000012-0000-1284-3100004150010%031.2	2 2 1 0.10 4.18 4.307 4.195 1.209 11.390				99.3
pr000000124_00000012-0000-1284-3100004150010%031.1	1 0 1 0.04 0 0 0 11.361 1.309				11.361
pr000000124_00000012-0000-1284-3100004150010%031.3	1 1 1 0 0 0 0 13.3 0				0
Worker:					
Worker Name	Products Transferred	State Times: Idle Travelling	Distance Travelled	Utilization (%)	
pr000000124_00000012-0000-1284-3100004150010%031.1	1 0.65 12.34 1.3456 94.004				
pr000000124_00000012-0000-1284-3100004150010%031.3	1 7.834 5.945 3538.135 98.113				

You can access the HTML report by clicking **Open HTML Report** at the bottom of the simulation chart panels.

States History Simulation Charts

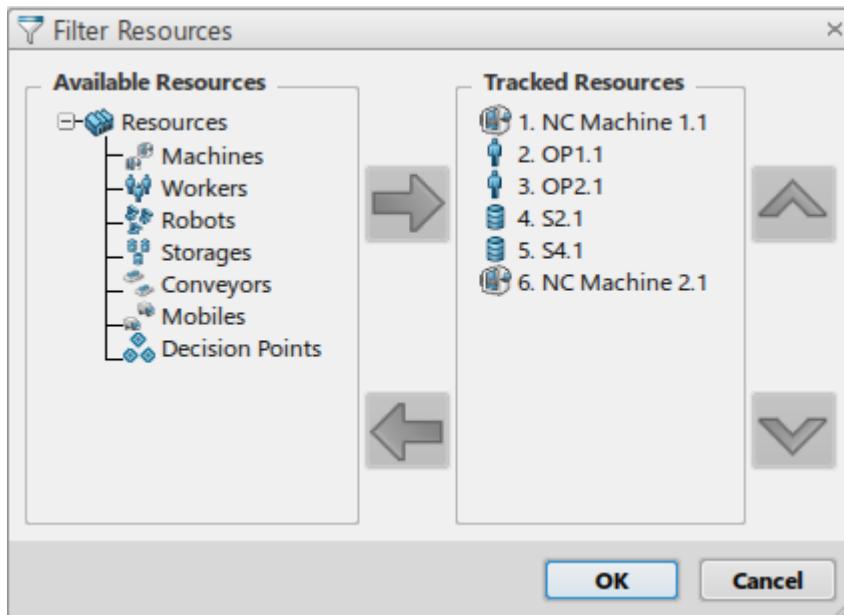
The **States History** command displays a simulation chart that shows the simulation statistics.

You can access the **States History** command in the right edge of the work area. The **States History** dialog box contains the following information:



Commands:

- **Filter Resources:** Allows you to define resources as either **Available Resources** or **Tracked Resources**.



- **Export to XML:** Allows you to export the chart data as an XML file and save it in the required location. When you open the saved file in a browser, it displays the values in XML format.

```
<?xml version="1.0"?>
- <StatesHistory>
  <ParametersNMeasures Speed="Meter per
    second" Volume="Cubic meter"
    Weight="Kilogram"
    Length="Millimeter" Time="Second"
    EndTime="133.9" StartTime="0"/>
- <Resources>
  - <Resource Type="ncmachine"
    Name="NC Machine 1.1">
    - <State EndTime="5.40139"
      StartTime="0"
      OperationType="Generic"
      OperationName="Close door(click
      button)" State="Wait for
      Resource(s)">
      <PoolsNWorkers
        ResourcePools="Resource.1"/>
    </State>
    - <State EndTime="15.4014"
      StartTime="5.40139"
      OperationType="Generic"
      OperationName="Close door(click
```

Plot Settings:

- **Start Time:** The time of the simulation where the chart begins.
 - **End Time:** The time of the simulation where the chart ends.
 - **Apply:** Applies your changes.
 - **Reset:** Resets your changes to the original values.
 - **-1h:** Goes back 1 hour from the current simulated time.



- **-2h:** Goes back 2 hours from the current simulated time.
- **-4h:** Goes back 4 hours from the current simulated time.
- **-8h:** Goes back 8 hours from the current simulated time.
- **Fit in View:** Fits the chart in the current window display size.

Legends:



B. Displaying Simulation Charts and Exporting a Report

You can display simulation charts that collect statistics on specific elements of the production system such as resources and zones. You can also display simulation charts on the production system using the System Performance Monitor. You can then export a report with the collected statistics.

This task shows you how to:

- Display Specific Simulation Charts
- Display States History Simulation Chart
- Display Simulation Charts Using the System Performance Monitor
- Export a Report

Display Specific Simulation Charts

You can display simulation charts that collect statistics on resources and zones by selecting resources and zones during simulation.

1. Click the Play command of the **Compass**.
2. Select a simulation.



3. In the Player, click **Play forward** ► .
4. During simulation, click a resource, for example a conveyor.
5. Expand the **Chart Details** area of the simulation statistics panel that appears.
6. Click the **Statistics** tab.

Charts appear and display the number of products handled by the conveyor and its state time.

7. **Optional:** Click **Open HTML Report** 📄 .

A report appears displaying values on several conveyor statistics.

8. For buffer resources, click **Tracking Stats** 🕋 to view a chart that displays individual products and their quantity.

You can view the buffer resource statistics in the **State Times** chart, such as the **Buffer Partial with No Reorder** buffer state.

Note: Every time you update the buffer resource, a new bar appears in the chart.

Display States History Simulation Chart

You can display the **States History** simulation chart, which collects statistics on resources and zones during simulation.

1. Click the Play command of the **Compass**.
2. Select a simulation.
3. In the Player, click **Play forward** ► .
4. On the right edge of the work area, click **States History**.

The **States History** dialog box displays a chart with the simulations statistics.

5. **Optional:** In the dialog box, click the **Export to XML** command and save the file in the required location.

When you open the saved file in a browser, it displays the values in XML format.

```

<?xml version="1.0"?>
- <StatesHistory>
  <ParametersNMeasures Speed="Meter per
second" Volume="Cubic meter"
Weight="Kilogram"
Length="Millimeter" Time="Second"
EndTime="133.9" StartTime="0"/>
- <Resources>
  - <Resource Type="ncmachine"
Name="NC Machine 1.1">
    - <State EndTime="5.40139"
StartTime="0"
OperationType="Generic"
OperationName="Close door(click
button)" State="Wait for
Resource(s)">
      <PoolsNWorkers
        ResourcePools="Resource.1"/>
    </State>
    - <State EndTime="15.4014"
StartTime="5.40139"
OperationType="Generic"
OperationName="Close door(click
button)" State="Wait for
Resource(s)">
      <PoolsNWorkers
        ResourcePools="Resource.1"/>
    </State>
  </Resources>
</StatesHistory>

```



6. For buffer resources, mouse over a line in the Gantt chart to view the tooltip information.
The tooltip displays quality tracking for a buffer resource.
You have accessed the **States History** simulation chart.

Display Simulation Charts Using the System Performance Monitor

You can display simulation charts that collect statistics on the general production system using the System Performance Monitor.

Before you begin: Set the System Performance Monitor options. See [Simulation Options Dialog Box](#).

1. Click the Play command of the **Compass**.
2. Select a simulation.
3. In the Player, click **Play forward** ► .
4. On the right edge of the work area, click **System Performance Monitor** 📈 .
5. Select a tab, such as the **System Utilization** tab.

Charts appear and display the state of each element of the production system.

6. **Optional:** Click **Open HTML Report** 📄 .

A report appears displaying values on the elements of the production system.

Export a Report

You can export a report from the simulation charts, to XLS and ONE formats.

1. At the bottom of any of the simulation chart panels, right-click **Open HTML Report** 📄 .
2. Select either **XLS** or **ONE**.

C. Simulating a Resource Failure

You can create and simulate a failure on a resource (conveyors, NC machines, and industrial machines only) to estimate its impact on factors such as throughput or repair costs.

This task shows you how to:

- Create a Failure
- Edit a Failure
- Remove a Failure
- Simulate a Failure
- Specify Machines Impacted by a Failure

Create a Failure

You can create a failure on a mobile resource and define repair parameters to fix the failure.

1. From the **Programming** section of the action bar, click **Add Failure** 🚧 .
2. Select a mobile resource, such as a worker or a robot.
3. In the **Define Failure** dialog box, define any of the following parameters such as:
 - Schedule mode
 - Start Mode
 - End Mode
 - Failure Name
 - Duration



4. In the **Repair** area, define any of the following parameters such as:
 - Repair Name
 - Time to Repair
5. Click **OK**.

You have created the failure on the selected resource.

Edit a Failure

You can edit the parameters of a failure using **Edit Failure**.

1. From the **Programming** section of the action bar, click **Edit Failure**
2. Select a resource that has a failure assigned.
3. **Optional:** If more than one failure is assigned to the resource, select the failure to edit in the **Select Failure** dialog box.
4. In the **Edit Failure** dialog box, edit any of the required parameters and click **OK**.

You have updated the failure with your modifications.

Remove a Failure

You can remove a failure from a resource using **Delete Failure**.

1. From the **Programming** section of the action bar, click **Delete Failure**
2. Select a resource that has a failure assigned.
3. In the **Delete Failure** dialog box, select the failure to delete, and click **OK**.

The failure is no longer assigned to the resource.

Simulate a Failure

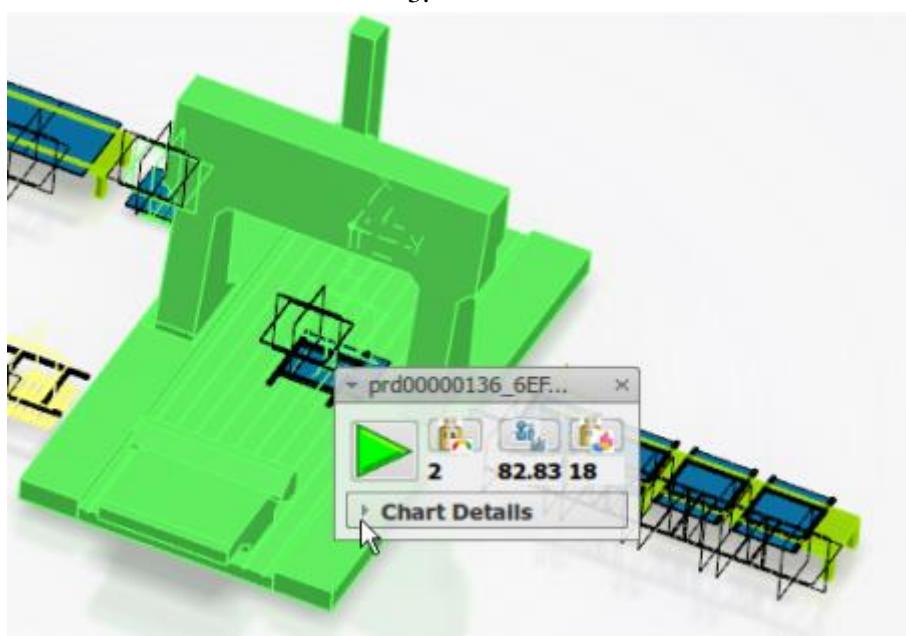
You can simulate a failure and collect statistics such as repair time.

1. Click the **Play** option on the **Compass** and in select **Discrete Event Simulation** from My Play Experiences.

The factory flow is simulated.

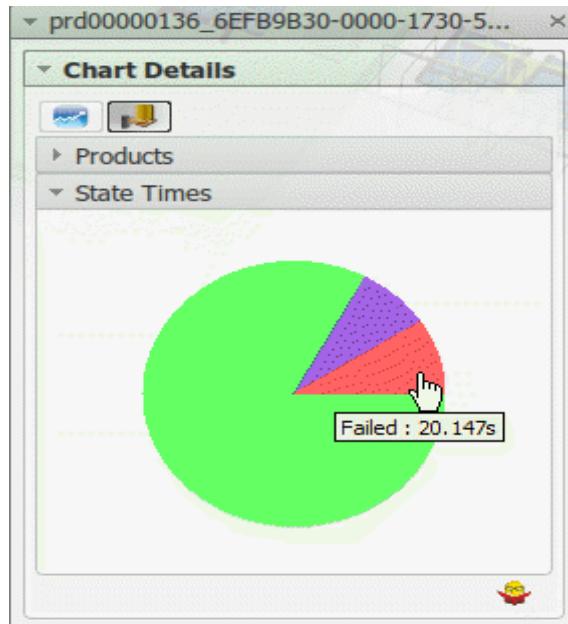
2. Click a resource and expand the **Chart Details** area in the panel that appears.

3.





A red area represents the failure state time. Information on the failure state time appears when you hover over the red area.



4. **Optional:** Click **Open HTML Report**.
- A panel appears with detailed information on the failure.

Failures

Repairs	System	Count	Repair Time			Requirement Time		
			Min	Max	Avg	Min	Max	Avg
Repair.1		4	21.352	45.141	31.85	11.2	19.5	15.1

Note: You can also view worker, production, and failure impact statistics in the **HTML Report**. You can further view failure statistics in the **Global HTML Report** and the **States History** Gantt chart.

Specify Machines Impacted by a Failure

You can specify which NC machines are impacted by a failure in the **Define Failure** dialog box to stop them at the end of their activity.

1. Click the **Add Failure** command in the **Programming** section of the action bar and select a resource.
2. In the **Impacted Machines** section of the **Define Failure** dialog box, click the **Add** command, then select the NC machine in the tree or the main 3D.

The selected NC machine is added to the list under **Impacted Machines**.

At the time of failure, the NC machine will enter the **Failed** state. When a failure occurs, all the impacted NC machines listed stop at the end of their current activity and will enter the **Stopped** state.

Note: You can remove any NC machine from the list by clicking the **Remove** command in the dialog box.

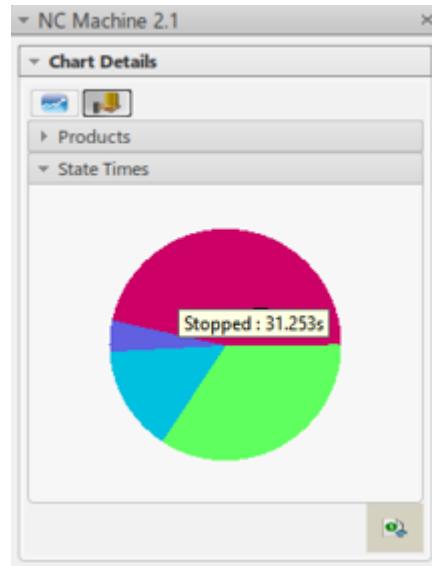
3. Click **Open HTML Report**.
- A panel appears with detailed information on the failure.



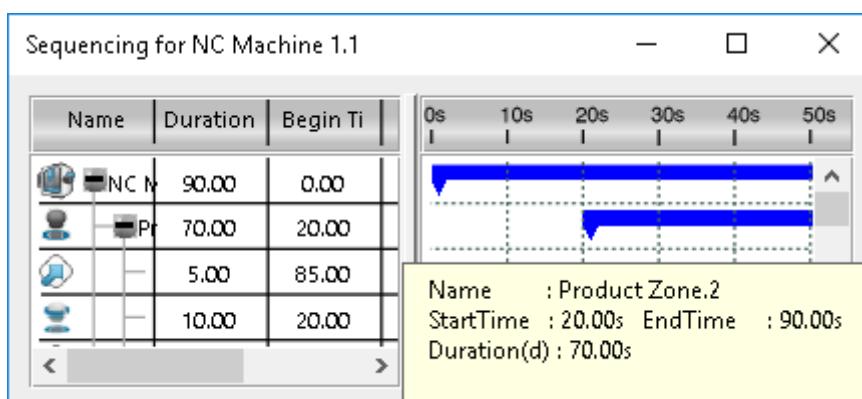
Failures

Repairs	Count	Repair Time (Second)			Requirement Time (Second)		
		Min	Max	Avg	Min	Max	Avg
Repair.1 (NC Machine 1.1)	1	31.253	31.253	31.253	0	0	0

4. Click the impacted NC machine and expand the **Chart Details** area in the panel that appears. The **Chart Details** panel shows the stop time when you hover over the red area.



5. Select the impacted NC machine in the tree and click the **Gantt definition for Machine** . The panel shows sequencing for the impacted NC machine.



You have specified NC machines impacted by a failure.

D. Creating Simulation Jobs in Batch Mode

You can create simulation jobs in batch mode with **Batch Simulation Monitor**.

- From the **Analysis & Output** section of the action bar, click **Batch Simulation Monitor** .
- In the **FFS Batch Queue** that appears, click **Create** to create a new simulation job.
- Define the simulation settings for the simulation job in the **FFS Batch Job Definition Panel**.

Note: If you create more than one simulation job, you must separately define the simulation settings for each job in batch mode.

In the **FFS Batch Job Definition Panel**, you can edit the following:

- Active UI Object:** Noneditable field that lists the name from the dataset that is open.
- Comments:** Section where you can add comments for reference.



- **Simulation Inputs:** Run Time, Warm-up Time, and Number of Runs.
- **Simulation Outputs:** Where you can choose the output format from XML, HTML, Both, or Resource-Specific HTMLs. You can also choose the directory to store the simulation output in.

4. Click **OK** to create the simulation job and to begin execution.

The **FFS Batch Queue** lists the new simulation job and provides the following information:

- **Active Object:** Lists simulation job.
- **Comment:** Lists user comments.
- **Status**
 - **Defined:** Job definition is successful.
 - **Waiting:** Waiting for job to start.
 - **Started:** Execution of job has started.
 - **Computed:** Job execution has ended.
 - **Failed:** Job execution failed.
 - **Canceled:** Job execution canceled by user.
- **Progress:** Percent of the simulation job completed.
- **Output Location:** Location you specified to store the results for this job.
- **Start Time:** Time when job started.
- **End Time:** Time when job ended.
- **Return Status:** Message from batch if successful, or message with the reason for failure.

5. To stop the current execution of the simulation job, select a row and click **Stop**.

The simulation job that you selected stops execution and is still present in the panel, but shows a **Failed** status.

6. To permanently delete a simulation job, select a row and click **Delete**.

You have permanently deleted the simulation job.

7. Click **OK** to close the dialog box and validate your changes.

Note: You can also invoke batch simulation from EKL action in the Engineering Rules Capture app.

You have created simulation jobs in batch mode.

Module-4.J: Defining Conveyors

This section shows you how to define conveyors during a simulation.

In this section:

- Simulating Power and Free Conveyors
- Managing Conveyors

A. Simulating Power and Free Conveyors

You can define a flow based on Power and Free conveyors and simulate the flow.

This task shows you how to:

- Define Points on a Conveyor to Load, Unload, and Route Products
- Route Products on Specific Branches of an Intersection
- Optimize the Traffic Routing
- Prepare the Carriers Before Simulation
- Simulate Power and Free Conveyors



Before you begin:

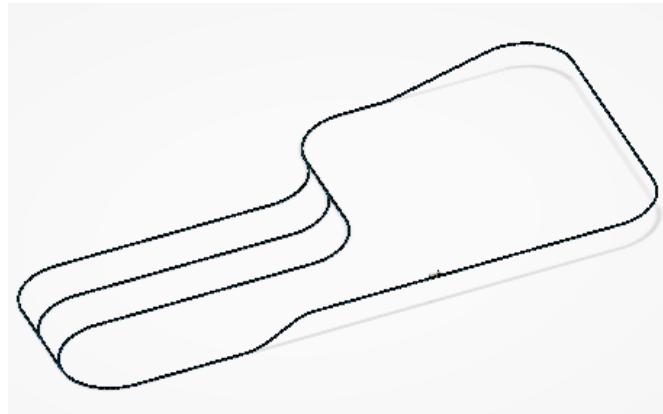
- Create a Power and Free conveyor in Equipment Design.
- Define a layout in Plant Layout Design.

Define Points on a Conveyor to Load, Unload, and Route Products

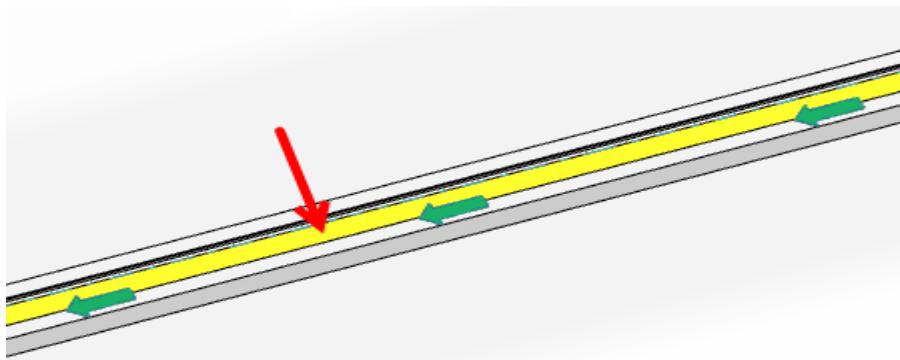
You can define decision zones on a Power and Free conveyor. Decision zones identify points where to load, unload, and route products. You can define one decision zone per conveyor only.

This scenario shows how to define a zone to load products and a zone to unload products.

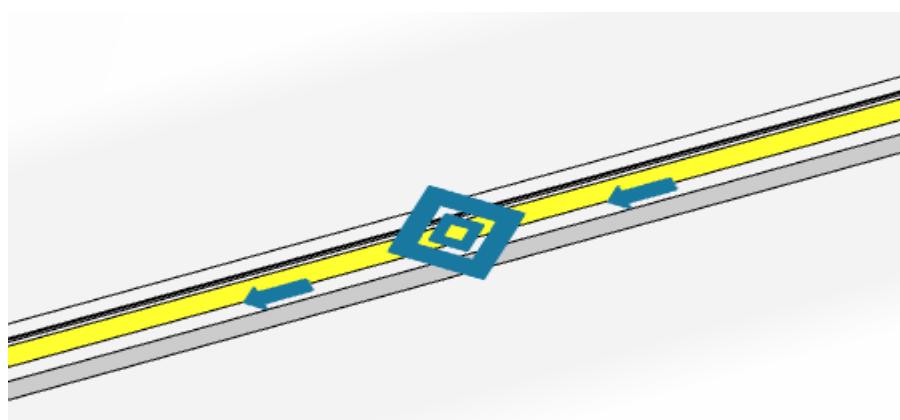
1. Open a Power and Free conveyor similar to the one below.



2. From the **Programming** section of the action bar, click **Add PnF Decision Zone**.
3. Select a pathway on the conveyor.



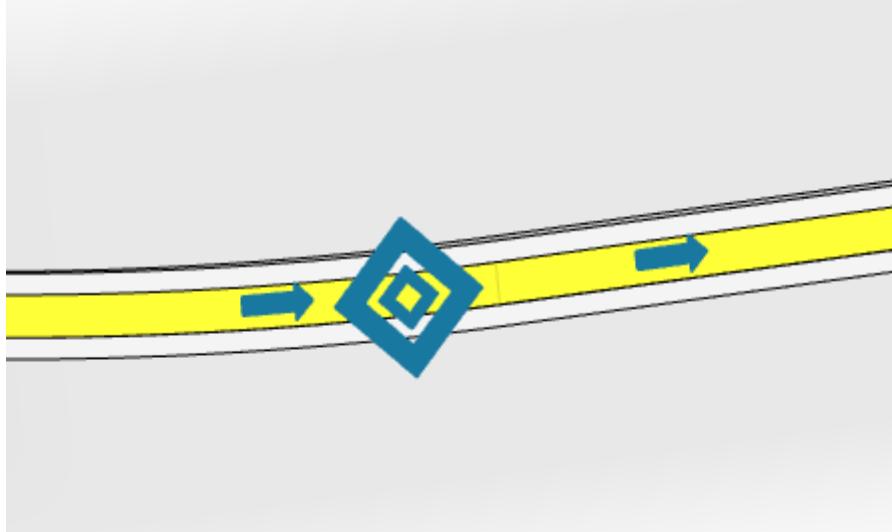
4. Select a point on the conveyor where to load products.
- A decision zone appears on the selected point.





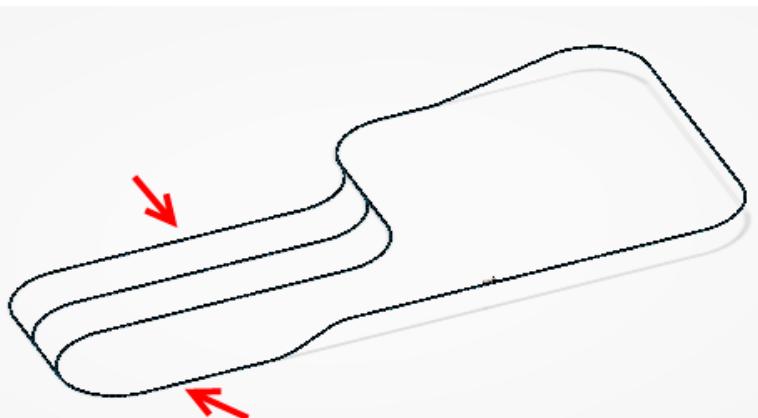
5. Select another point on the conveyor where to unload products.

A decision zone appears on the selected point.



6. Press **Esc** when done.
7. Select the first decision point and click **Edit SLA Resource** in the context toolbar that appears.
8. In the **Edit Decision Point** dialog box that appears, create a load activity as follows:
 - a. Enter a value in the **Claim capacity** box to define a maximum number of carriers that can move to the decision zone at the same time.
 - b. Click **Load products** from the **Load/unload option** list.
 - c. Click **OK** when done.
9. Click the second decision point and click **Edit SLA Resource** in the context toolbar that appears.
10. In the **Edit Decision Point** dialog box that appears, create an unload activity as follows:
 - a. Enter a value in the **Claim capacity** box to define a maximum number of carriers that can move to the decision zone at the same time.
 - b. Select **Unload products** from the **Load/unload option** list.
 - c. Click **OK** when done.

Two zones to load and unload products are now defined on the conveyor. The zones are identified by red arrows on the image above.



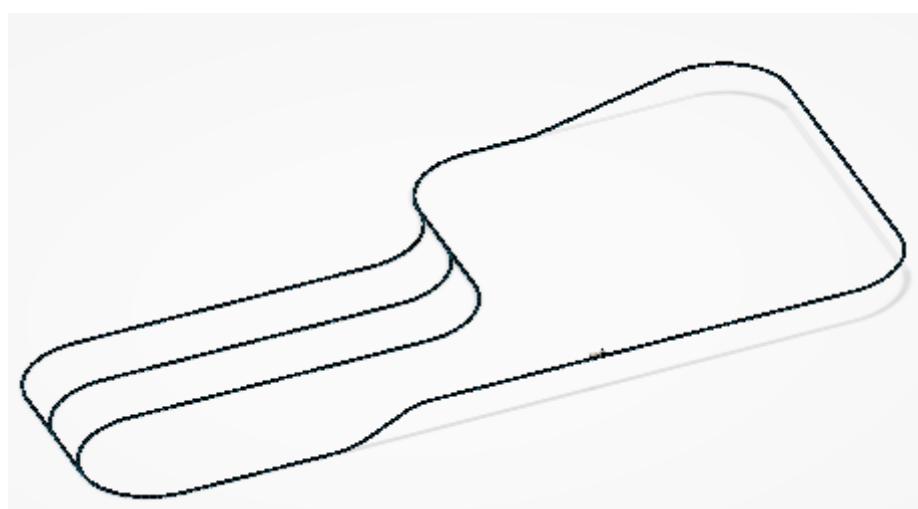
You can now define a product zone on the carriers to specify the number of products to be loaded and unloaded. For more information, see Add a Product Zone.



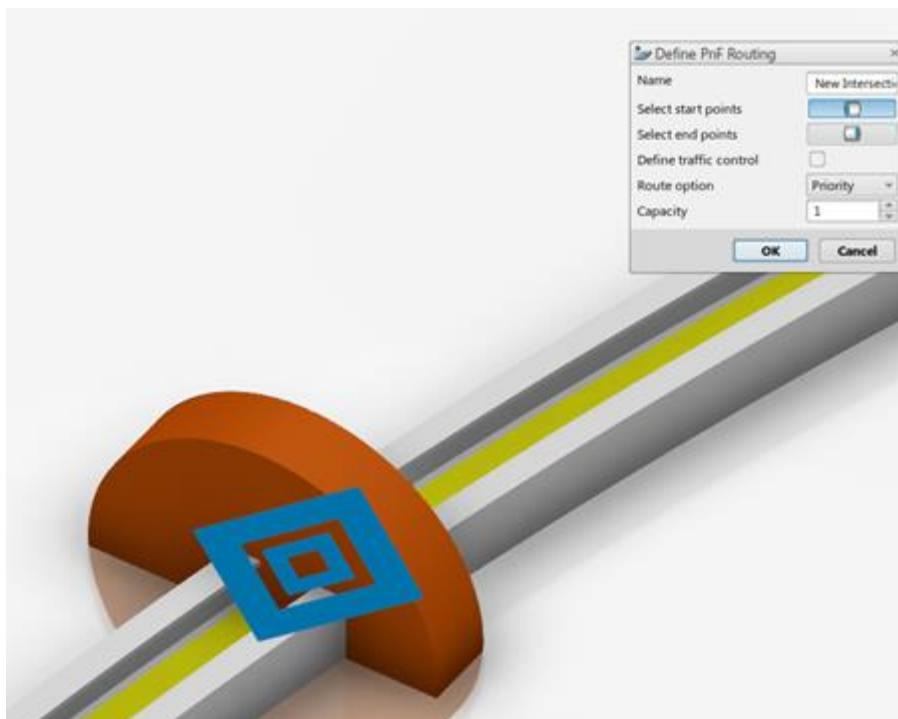
Route Products on Specific Branches of an Intersection

You can define routes on a Power and Free conveyor to direct products on specific branches of an intersection.

1. Open a Power and Free conveyor similar to the one below.

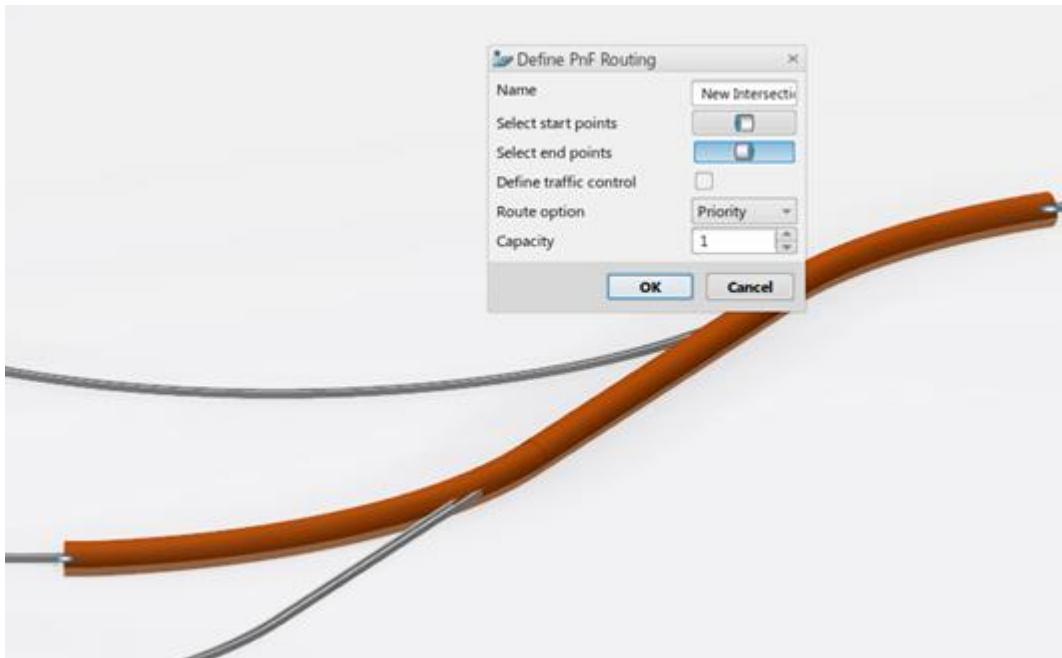


2. From the **Programming** section of the action bar, click **Pnf Routing Definition**.
3. Select a pathway and then a point on the conveyor before the intersection.



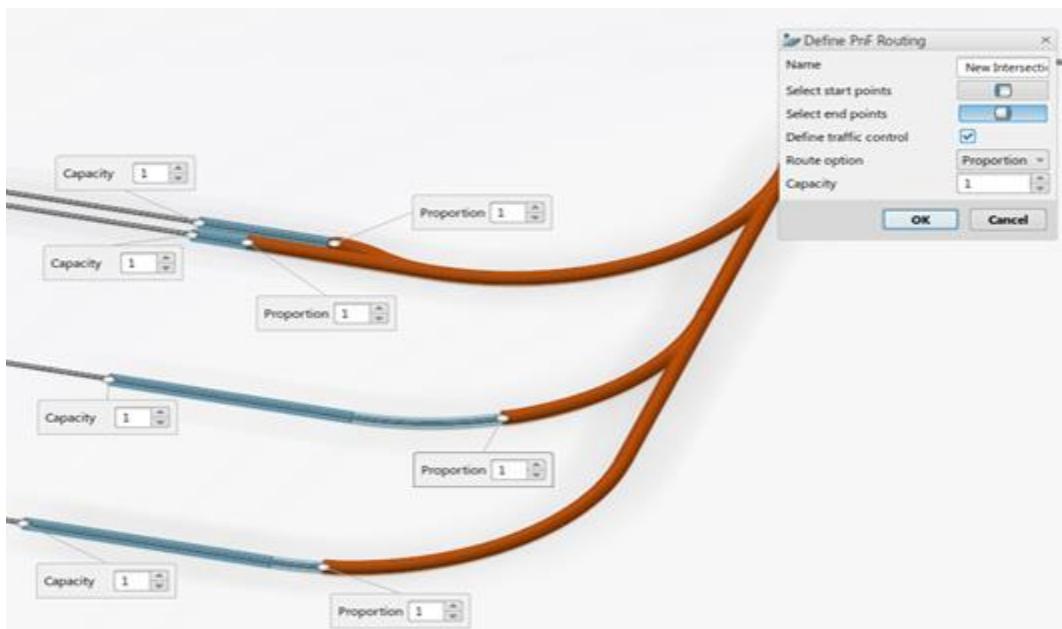
A Power and Free decision zone is created on the pathway selected. The **Define Pnf Routing** dialog box appears, letting you specify routing parameters.

4. In the **Define Pnf Routing** dialog box, click **Select end points**, and select another point after the intersection.



A Power and Free decision zone is created on the selected point. A brown pipe appears in the work area and identifies the route defined.

5. In the **Define PnF Routing** dialog box, specify the route options, such as:
 - **Priority:** routes carrier from a decision zone to a target decision zone based on priority value. This option is set by default.
 - **Product based:** routes carrier from a PnF decision zone to different segments, based on the type of product on the carrier.
 - **Define Traffic control:** when selected, creates a traffic control area that limits the number of carriers in that area. You can edit the value in the box that appears in the work area, located at the end of the traffic control area.
6. Continue in the same way to define routes on other branches.



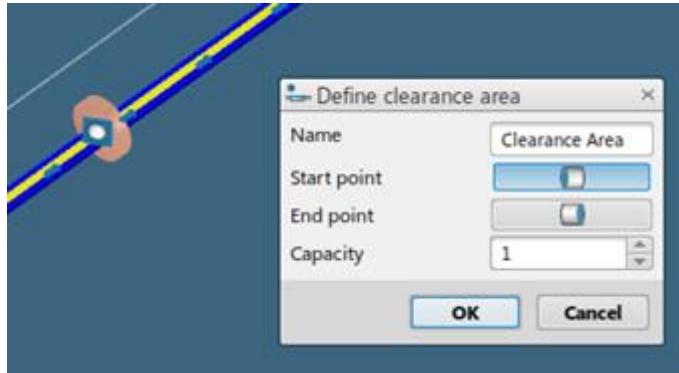
Brown pipes appear on all the branches, identifying routes. Blue pipes also appear, identifying traffic control areas.



Optimize the Traffic Routing

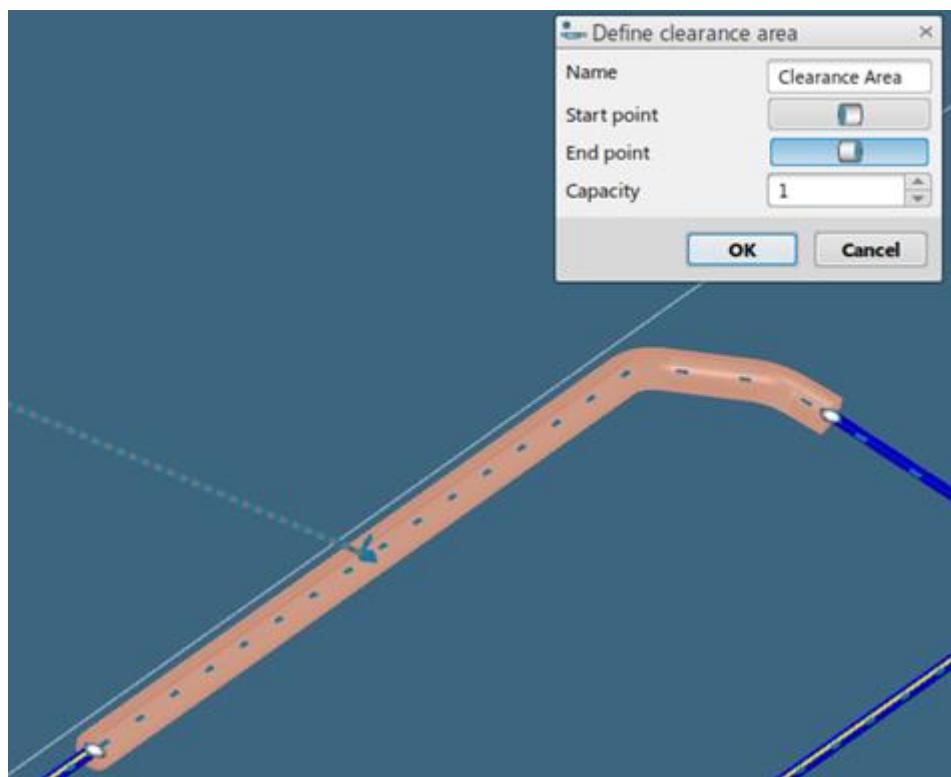
You can specify a maximum number of carriers to circulate within the same segment of a Power and Free conveyor, by defining a clearance area. This avoids carriers to accumulate on the conveyor.

1. From the **Programming** section of the action bar, click **Pnf Clearance Area Definition** .
2. Select a pathway and then a point on the conveyor to define the clearance area start point.



A Power and Free decision zone is created on the pathway selected. The **Define Clearance Area** dialog box appears, letting you specify clearance parameters.

3. In the **Define Pnf Routing** dialog box, click **End point**, and select another point on the conveyor to define the clearance area end point.



A Power and Free decision zone is created on the selected point. A colored pipe appears in the work area, identifying the clearance area.

4. In the **Define Pnf Routing** dialog box, enter a value in the **Capacity** box to specify the number of carriers allowed on the clearance area at the same time.
5. Continue in the same way to define other clearance areas.



Prepare the Carriers Before Simulation

To simulate carriers, you must define a transfer activity on each carrier attached to the conveyor.

Before you begin:

- The carriers in session must have a port defined. You can define ports in Equipment Design.
- Define a product zone on a carrier using **Add Product Zone**. Make sure to select the **Apply all instances** check box to create a product zone on all the instances of the selected carrier. For more information, see Add a Product Zone.

- From the **Programming** section of the action bar, click **Generate Transfer Activity**.
- Select the conveyor.

The product zone previously defined appears on the conveyor. The **Add the Product that flows** contextual command and a dialog box appear. The dialog box displays the list of existing ports. In our example, no port is found.

- Click **Add the Product that flows** and select a product to be loaded on the carrier.
- Click **OK** when done.

Transfer activities are automatically created on all instances of the selected carrier. Carriers are now defined as resources. You can edit them and simulate them.

Simulate Power and Free Conveyors

You can simulate Power and Free conveyors and collect statistics such as carrier state times.

- Click **Play** in the **Compass** and select **Discrete Event Simulation** from **My Play Experiences**. The Power and Free conveyor flow is simulated.
- Click a resource such as a carrier and expand the **Chart Details** area in the panel that appears. A panel appears with information on products and state times, specific to the selected carrier.
- Optional:** Click **Open HTML Report**.

A panel appears with detailed information on the selected carrier.

Carrier								
Run	Products Transferred	State Times				Distance Travelled	Utilization (%)	
		Carrier Dog Wait	Carrier Stop	Carrier Empty	Carrier Loaded			
1	1	186.975	158.764	730.191	1174.887	146768.29	60.225	

B. Managing Conveyors

You can manage conveyors by editing stations, and by defining conveyors as continuous flow lines before simulating the scenario.

This task shows you how to:

- Editing Stations
- Define a Conveyor as a Continuous Flow Line
- Routing Parts with Cyclic Non-Blocking
- Simulate a Transform Activity on a Conveyor

Before you begin: Open a scenario containing a conveyor.

Editing Stations

You can define and edit stations on a conveyor.

Before you begin: Define the decision zones on the conveyor.



1. Click the **Resource Configuration**  command in the **Programming** section of the action bar.
2. In the **Resource Configuration** table that appears, right-click a conveyor.
3. In the context toolbar that appears, click **Edit Stations** .

In the **Create/Edit Stations** table that appears, mark the beginning and end of each station.

Station	Start Zone	End Zone
Station.4	DecisionZone.1	DecisionZone.2
Station.5	DecisionZone.3	DecisionZone.5
Station.6	DecisionZone.4	DecisionZone.7

Add Station **Remove Station**

OK **Cancel**

Note: For each operation defined on the decision zone, if there is worker assigned then there must be a resource zone assigned as well.

You have edited the stations on a conveyor.

Define a Conveyor as a Continuous Flow Line

You can define a conveyor as a continuous flow line and play the simulation using a mobile storage pallet with the mobile storage pallet flowing directly to the conveyor. A mobile storage is a storage type that you have defined as mobile, which allows it to be on a conveyor.

Before you begin: Open a scenario with a mobile storage pallet on a conveyor and a buffer activity.

1. Select a conveyor and click **Edit SLA Resource** or **Edit Product Flow**.
2. In the **Processing Mode** section of the **Edit** dialog box that appears, select the **Continuous Flow Line** option to define the conveyor as a continuous flow line.

Note: The part accumulation mode is always nonaccumulating for a continuous flow line, so you must manually ensure appropriate speed and part spacing on the conveyor.

3. To specify the position of the part on the conveyor during simulation, right-click a part in the **Resource Configuration** table, then click **Part Position > Define Part Position**.

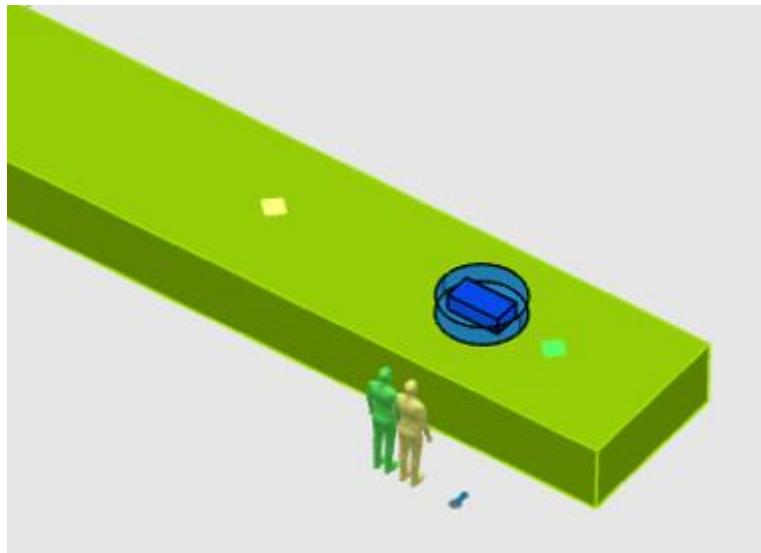
You have modified the part position during simulation.

4. Click the **Play**  command on the **Compass** to begin the simulation.

The continuous flow line simulation plays with the mobile storage pallet flowing directly to the conveyor. The simulation also shows the product flows for the parts moving directly to the decision zone.

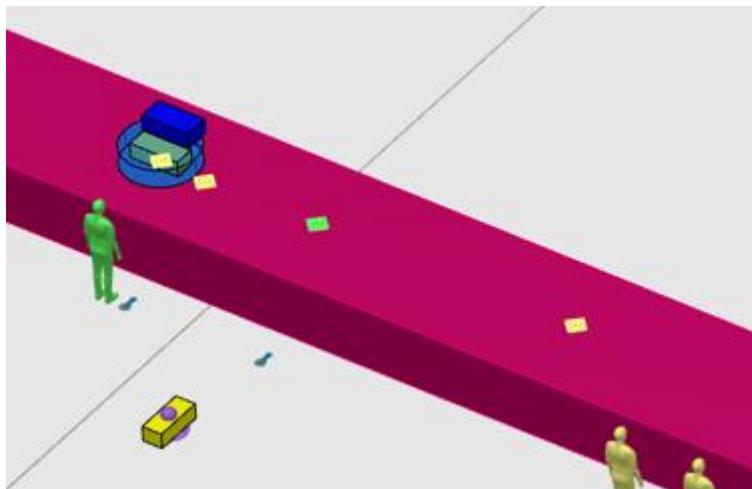
Note:

- During the simulation, you must trigger the operation at the decision zone when the mobile storage pallet meets the decision zone.
- Due to this, the mobile storage pallet must flow directly to the conveyor during the operation.
- If there is a worker assigned to the operation, then the worker must move along with the mobile storage pallet.



The worker must also meet at the midpoint of the mobile storage pallet on the moving conveyor. When the pack activity is complete, the part will be at the corresponding product zone of the mobile storage pallet.

5. Stop the simulation if the operation is not complete before the mobile storage pallet reaches the end of the conveyor.



6. Resume the simulation when the unpack activity is complete, then route parts out of the conveyor.
7. Select the buffer activity and click **Edit SLA Resource** or **Edit Product Flow**.
8. In the **Edit** dialog box that appears, check the **Sequence Mode** option to control the production sequence of machines.

When you define the sequence mode on the buffer activity, the buffer sequences parts based on the resource level capacity only.

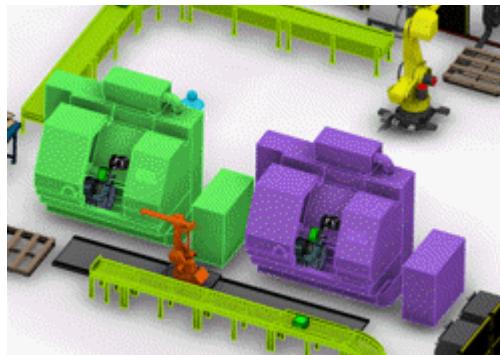
You have defined the conveyor as a continuous flow and simulated the scenario with a buffer activity.

Routing Parts with Cyclic Non-Blocking

You can enable cyclic Non-Blocking to control how the conveyor routes parts.

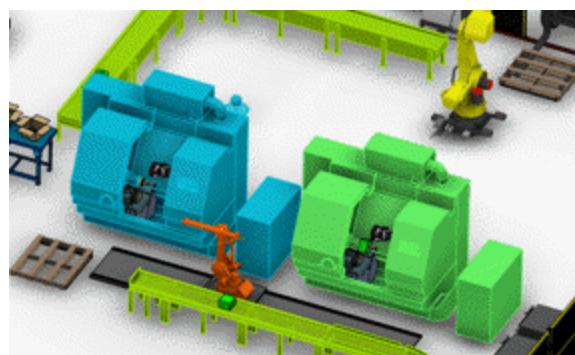
1. Select the first conveyor in the work area and click **Edit SLA resource**
2. In the **Edit** dialog box that appears, set **Flow mode OUT** to **Cyclic Non-Blocking**.

The first conveyor routes parts to downstream resources on the second conveyor in a cyclic manner. If the downstream resource is blocked, it routes to the next resource in the cycle.



3. Select the second conveyor in the work area and click **Edit SLA resource**
4. In the **Edit** dialog box that appears, set **Flow mode IN** to **Cyclic Non-Blocking**.

The second conveyor accepts the part in a cyclic manner from upstream resources on the first conveyor. If the part is not available in an upstream resource, then it takes from the next resource in the cycle.

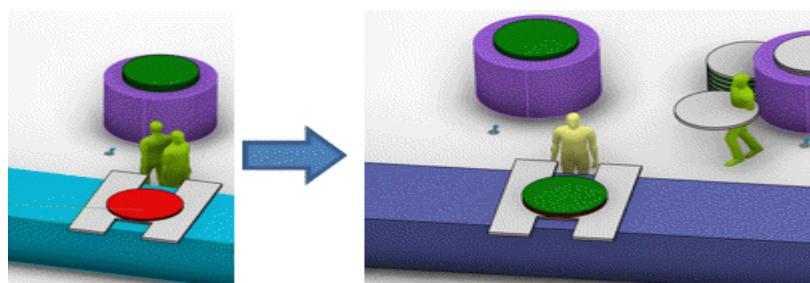


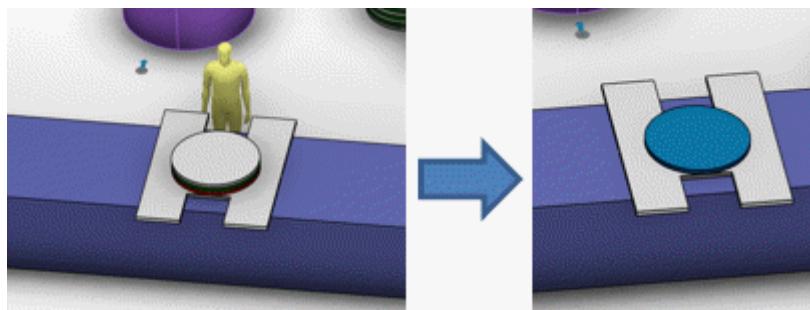
Simulate a Transform Activity on a Conveyor

You can edit a transform activity and set the input and output to parts inside the pallet or mobile storage, then simulate it along a conveyor decision zone.

1. Click **Resource Configuration** from the **Programming** section of the action bar.
2. Right-click an existing transform activity in the **Resource Configuration** table that appears and click **Edit** .
3. In the **Edit** dialog box that appears, define the first **Input Product** as a part inside the pallet or a mobile storage, then define other parts as subsequent inputs.
4. Specify the **Output Product** as a part inside the pallet or a mobile storage, then define other parts as subsequent outputs.
5. Click **OK**, then close the **Resource Configuration** table.
6. Click **Play** from the 3DCompass to start the simulation.

The part inside the pallet moves across the conveyor decision zone with the transform activity that you defined. The transform activity is executed on the part inside the pallet.





Note: If the transform activity has an additional input apart from the part already inside the pallet, then the decision zone requests for a part from an external source. The activity to be launched is decided based on the first part inside the pallet.

C. Adding a Product to a Factory Flow

You can add a product to an existing factory flow. For factory flows with several junctions, you can add a product and route the product to one branch or all the branches of the junction.

The same robot or worker that you previously assigned to the product flow handles any product you add.

This task shows you how to:

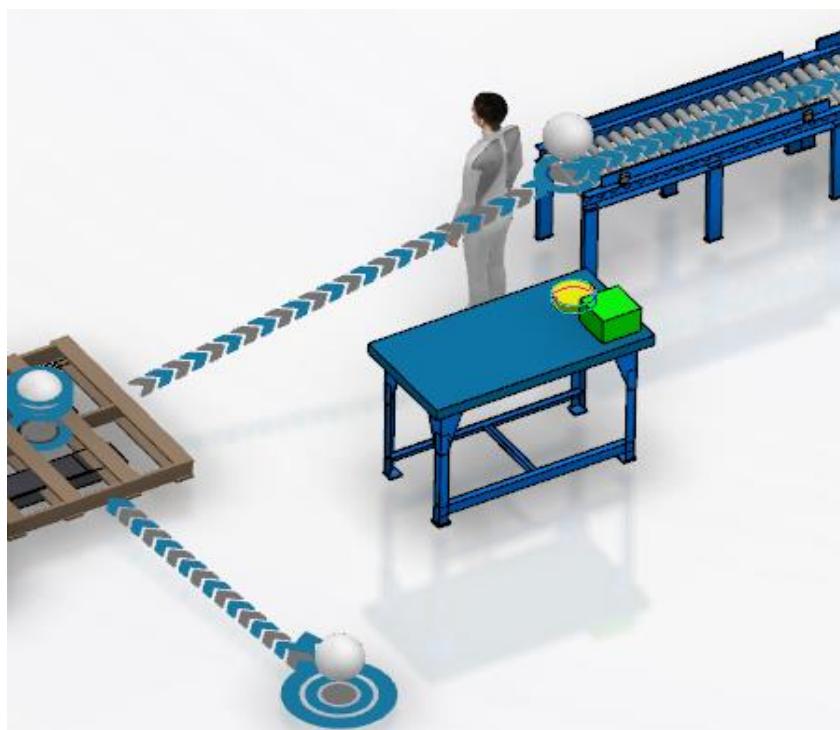
- Add a Product to a Factory Flow
- Route a Product to One Branch
- Route a Product to Several Branches

Add a Product to a Factory Flow

You can add input and output products to an existing factory flow using **Add Product in Factory Flow**.

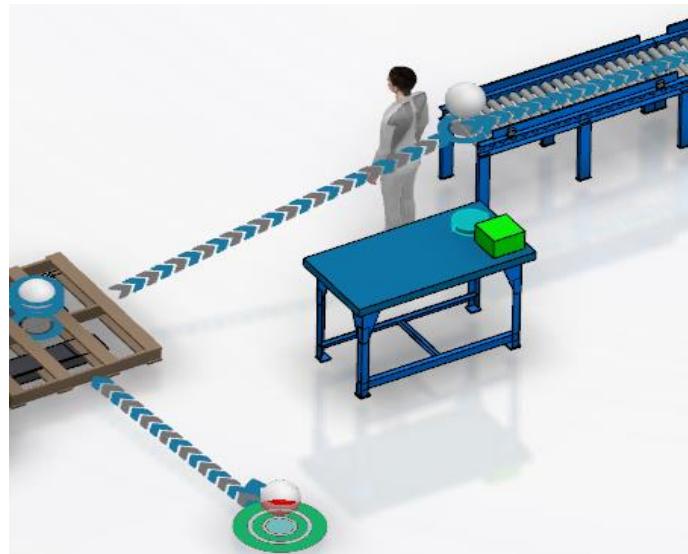
Before you begin: Open a production system with a factory flow already defined.

1. From the **Programming** section of the action bar, click **Add Product in Factory Flow** .
2. Select the input product to add.



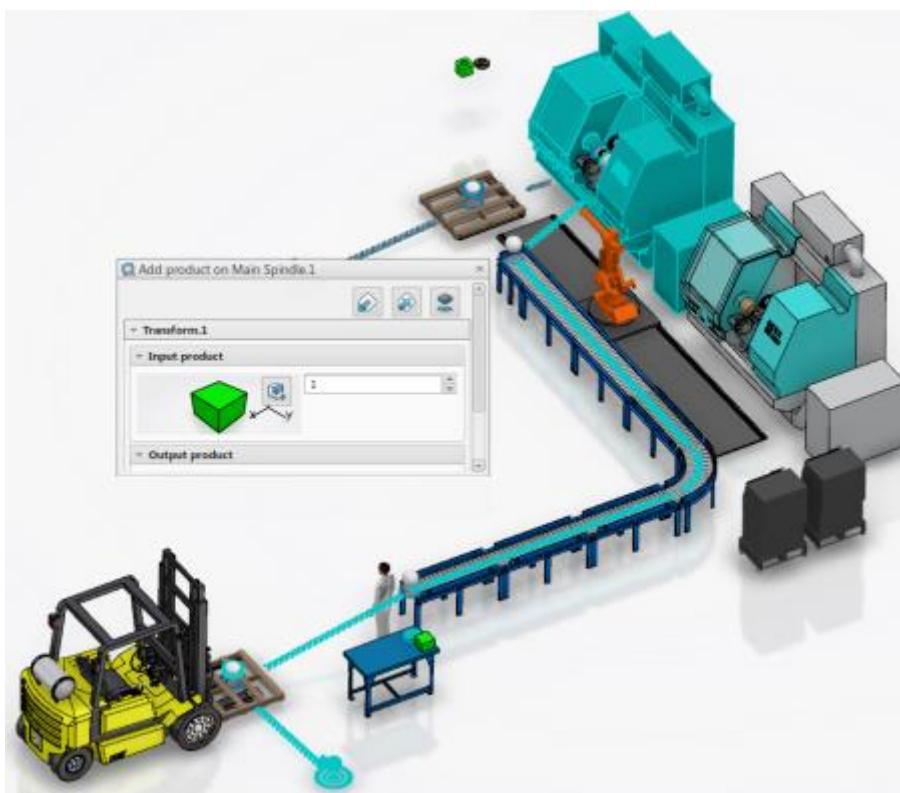


3. Select the in zone of the factory flow to add the product at the start of the flow.



Alternatively, you can select a resource in the flow to add the product directly in the factory flow.

4. In the **Add Product From In Zone** dialog box that appears, click **Next** to add the product.
You have highlighted the product route. Sometimes a resource supports a transform, load, or unload activity such as an NC machine. If that resource is also part of the factory flow, then the product routes up to that resource only. The **Add Product** dialog box appears letting you create an activity on the resource.

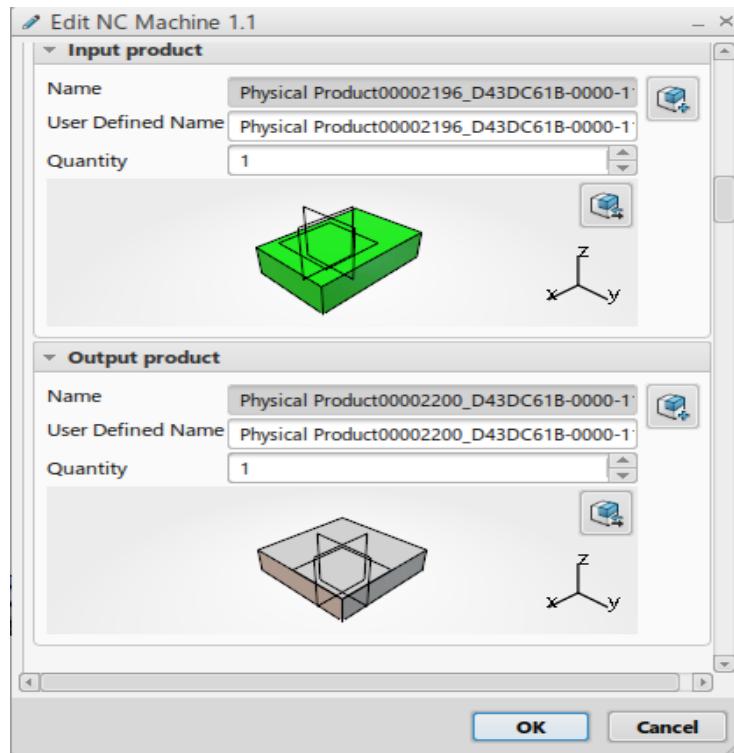


5. **Optional:** Create an activity on the resource as follows:

- a. In the tree, select the machine that you added a product to, and click **Edit SLA resource**.
- b. In the **Edit** dialog box that appears, go to the **Input Product** or **Output Product** section of the **Edit** dialog box that appears.

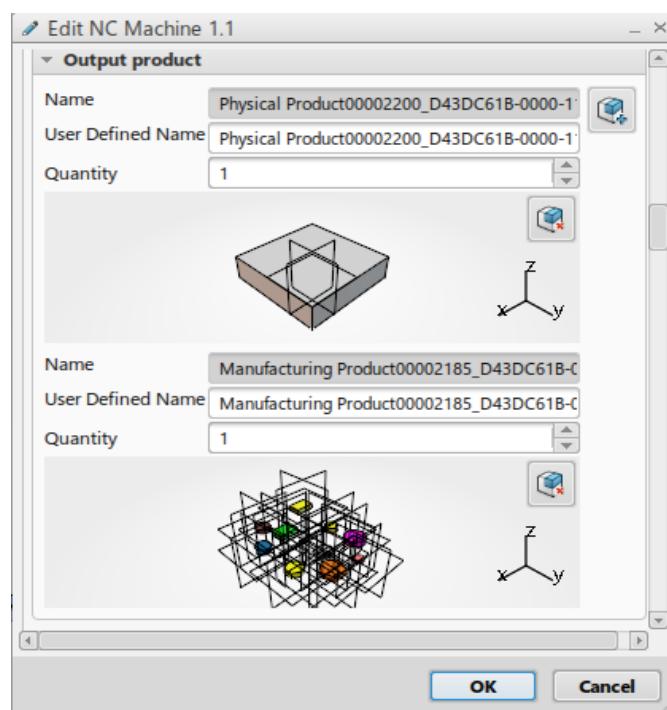


By default, the input product is the input and output product of the activity.



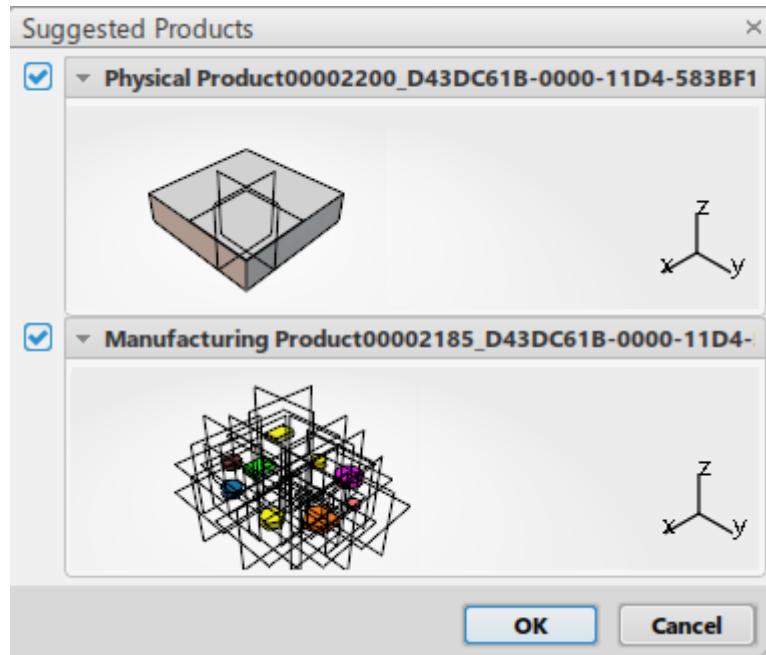
- c. Click **Add Input Product** or **Add Output Product** and select an input or an output.

The selected input or output appears in the dialog box with the **Name** and **User Defined Name** attributes visible.



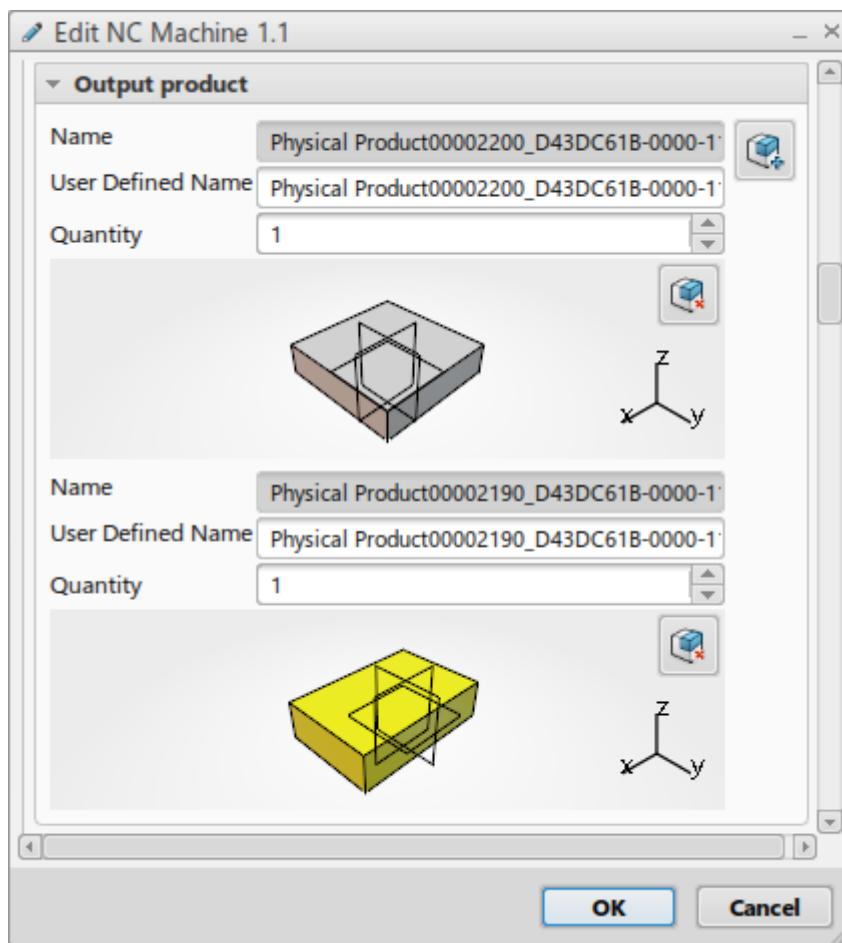
- d. Click **Replace the Product** and select a new input or output from the **Suggested Products** dialog box, then click **OK**.

The **Suggested Products** dialog box displays the products based on logical rules depending on edition cases.



- e. Click **OK** to close the **Edit** dialog box, to validate the creation of the activity, and to route the output product to the end of the factory flow.

The replacement input or output appears in the dialog box with the **Name** and **User Defined Name** attributes visible.



Note: You can also delete a product with the **Remove the Product** command in the **Edit** dialog box.



- In the **Add Product on Out Zone** dialog box, click **Validate** to confirm the product route.

Route a Product to One Branch

You can add input and output products to a factory flow and route the products to one branch of the junction only.

Before you begin: Open a production system with a factory flow with several junctions.

- From the **Programming** section of the action bar, click **Add Product in Factory Flow**
- Select the input product to add.
- Select the in zone of the factory flow to add the product at the start of the flow.

Alternatively, you can select a resource in the flow to add the product directly in the factory flow.

- In the **Add Product From In Zone** dialog box, click **Next** to route the product up to the first junction.
- In the context toolbar, click **Route Product to One Flow** to route the product to one branch of the junction.
- Select the branch where to route the product.
- Optional:** If the branch routes the product to a resource that supports a transform or load activity, such as an NC machine, create an activity on the resource as follows:
 - In the **Add Product** dialog box, select an activity such as a transform activity.

By default, the input product is the input and output product of the activity.

- In the **Output Product** area of the dialog box, click **Replace The Product** and select a new output.

The selected output appears in the **Add Product** dialog box.

- Click **Next** to validate the creation of the activity and to route the output product to the end of the factory flow.
- In the **Add Product From Out Zone** dialog box, click **OK** to validate.

Route a Product to Several Branches

You can add input and output products to a factory flow and route the products to all the branches of the junction.

Before you begin: Open a production system with a factory flow with several junctions.

- From the **Programming** section of the action bar, click **Add Product in Factory Flow**
- Select the input product to add.
- Select the in zone of the factory flow to add the product at the start of the flow.

Alternatively, you can select a resource in the flow to add the product directly in the factory flow.

- In the **Add Product From In Zone** dialog box, click **Next** to route the product up to the first junction.
- In the context toolbar, click **Route Product to All Flows** to route the product to all the branches of the junction.

The product routes to all the branches until it meets a new junction. A context toolbar appears at the next junction.

- Optional:** Continue to click **Route Product to All Flows** to include the following branches until the end of the factory flow.
- In the context toolbar, click **Validate** to confirm your selection and exit the command.

You have added the product to all the branches of the factory flow.



C. Managing Sensors

You can add or edit a sensor either on a manufacturing cell or area tree node. The sensor allows you to detect transient products.

This task shows you how to:

- Add a Sensor
- Edit a Sensor

Add a Sensor

You can add a sensor on a manufacturing cell or area tree node using **Add or Edit Sensor**.

1. From the **Programming** section of the action bar, click **Add or Edit Sensor**
2. In the tree, select either a manufacturing cell or area node.
3. In the work area, select a point where you want to position the sensor.
4. To edit the sensor position and direction, click **Edit sensor position and direction** and use the **Robot** to define the position and direction of the sensor.
5. To edit the sensor beam length and the detection mode, click **Edit beam length and detection mode of the sensor** .

The **Edit Sensor Parameters** dialog box appears.

6. Set the sensor beam length and detection mode as follows:
 - a. Enter a new value in the **Beam Length** text box.
 - b. Select a new mode from the **Detection Mode** list.
7. To finish, click **Validate the current parameters of the sensor** .

The sensor appears in the tree and work area.

Edit a Sensor

You can edit a sensor on a manufacturing cell or area tree node using **Add or Edit Sensor**.

1. From the **Programming** section of the action bar, click **Add or Edit Sensor**
2. In the tree, double-click the sensor to edit.
3. In the context toolbar, select any of the following commands:
 - To edit the sensor position and direction, click **Edit sensor position and direction**
 - To edit the sensor beam length and the detection mode, click **Edit beam length and detection mode of the sensor** .
4. To finish, click **Validate the current parameters of the sensor** .

D. Using B.I. Essentials in Factory Flow Simulation

You can use B.I. Essentials to reveal attributes of the objects in your session. Color codes corresponding to the different values of an attribute are applied to the objects.

1. From the Tools section of the action bar, click **B.I. Essentials**

The following B.I. enables you to reveal attributes specific to the Factory Flow Simulation app:

- Factory Flow Status

Note: You can also access the B.I. Essentials panel through the Resource Configuration table. You can do this by clicking the Factory Flow Status command or the Planning Continuity Status command in the table.



2. Click Factory Flow Status from the list.
- B.I. Essentials applies colors to all objects in the tree and in the 3D area accordingly.

E. Customizing Preferences

You can customize Preferences for Factory Flow Simulation.

1. From the top bar, select Me > Preferences.
2. In the left-hand pane, expand **Simulation**, and then **Process Flow and Plant**.
3. Select **Factory Flow Simulation**.
4. In the right-hand pane, expand the section corresponding to the options you want to customize.

Section	Description
Display	Customize representation color and size.
Default Values	Customize buffer activity times and conveyor behavior.
Digital Continuity	Customize digital continuity settings.
Pathway	Customize the value for segment connection tolerance.
Report Formatting	Customize the local path of the XSLT style sheets directory for Gantt and Simulation report generation.

5. Specify these options according to your needs.



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THANK YOU

