Plant Simulation
Process Designer Interface
Reference manual

Siemens PLM Software

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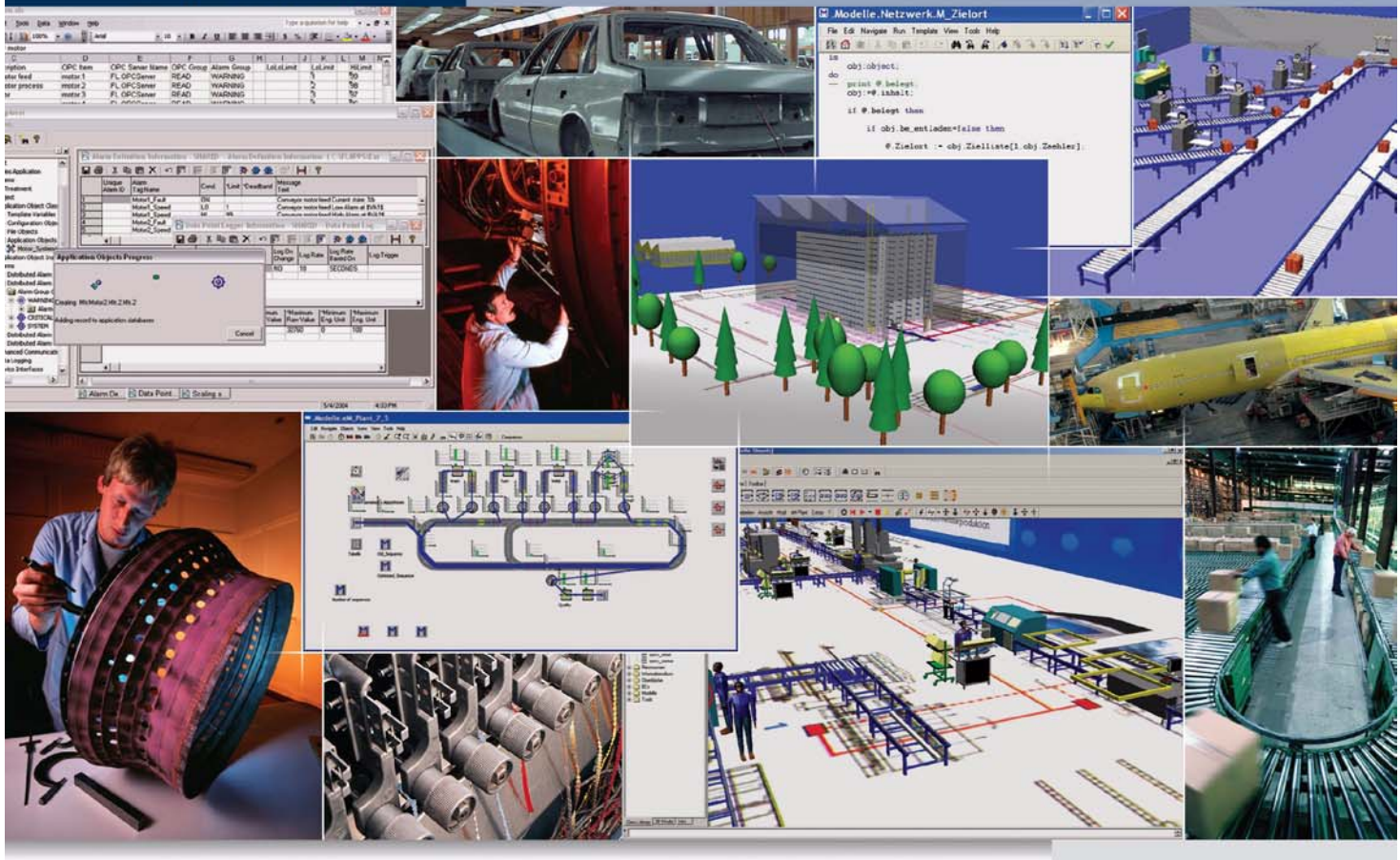

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Plant Simulation Process Designer Interface

Version 9.0

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Process Designer Interface

General information

Installation Instructions, System Requirements

To work with the Process Designer Interface add-on, the following software must already be installed:

- Process Designer version 8 or higher
- Plant Simualtion version 9
- Plant Simualtion model DetailedSimulation.spp version 9.0 or higher

The current version of the Process Designer Interface will be distributed by your local Siemens consultant.

Help File and Documentation

The Process Designer Interface user guideline (Guideline DetailedSimulation_Help_G.pdf or DetailedSimulation_Help_E.pdf) is available by selecting the Help menu in the main Process Designer main dialog.

The system installs this document at the following location:

~\Tecnomatix\eM-Power\eM-Planner\Applications\DetailedSimulation

Use a regular PDF viewer to open and read the document from this file location.

Known Problems

In case the Process Designer Assembly module was used in a way that the assembly tree was created from the operation PERT, the Process Designer Interface will **not** work correctly. This is caused by parts created on the flows having the same name as the operation which can not be handled by Process Designer Interface.

General Introduction

The Process Designer Interface allows you to use discrete event simulation on top of process models defined in Process Designer. Process models describe static components of manufacturing systems as parts or resources, and dynamic components as operations that are necessary to produce certain products. Users can achieve an exact description of the production process by assigning resources and parts to operations and defining (partial) operation sequences.

Discrete event simulation based on Plant Simualtion allows users to evaluate:

- Dynamic behavior of the production system
- Achievable throughput or productivity of production lines
- Impact of buffer and storage sizes on system performance
- System and resource availability
- Bottlenecks in system performance
- Utilization of production resources
- Assignment of human workers to tasks
- Average throughput or production times for products

Simulations can also enhance the defined process model by helping to pinpoint control strategies and weigh alternatives to the production system under evaluation.

Simulation studies are integrated with the Process Designer based workflow and results, such as statistical attributes, can be written back to the process model. This is automatically transferred to Plant Simualtion which

enables the process definition to build directly executable simulation models. Since the Process Designer/Plant Simualtion Integration is generally not “ready-to-use”, it is important to remember some rules-of-thumb when building a running simulation model.

To achieve ease-of-use with Plant Simualtion’s wide range of simulation functionality, the application guides users with clear and simple dialogs. Therefore no specific Plant Simualtion expertise is needed to run and evaluate process models.

Plant Simualtion simulations focus mainly on the production *line*. Within a line, stations define major production steps and the simulation evaluates the material flow and the utilization of resources at this level. In many cases, operations within a station are highly detailed and specialized according to automated robot cells, manual cells or combinations of both. Users may hide this detailed level from the simulation with a “black-box” mechanism, to dictate that only the overall time of a compound operation should be treated in the simulation, but not the nested operations.

Users can simulate complex manufacturing structures with assembly and disassembly operations that connect main and sub-lines to a net of operations sequences.

The generated simulation model may serve simulation specialists as a high level starting point for more detailed and enhanced simulation studies. An Update mechanism allows porting modified process data from Process Designer to enhanced Plant Simualtion simulation models. With configurable object mapping and attribute sets, it is possible to integrate even customer specific objects with Plant Simualtion simulation studies.

Due to the nature of discrete event simulation, Process Designer process models must fulfill some requirements to be ready-for-simulation:

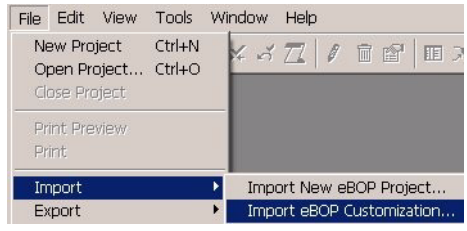
- Source and sink objects should be used for both incoming and leaving parts
- Part flow between resources relevant to the simulation has to be defined
- Part flow may not be cyclic
- Assembly and disassembly operations must be defined properly

See Additional Modeling Constraints for further details.

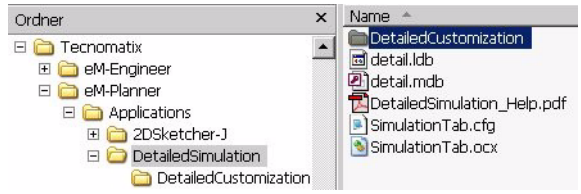
Preparing a Schema for Plant Simualtion Simulation

The Plant Simualtion simulation study requires attributes and settings according to Plant Simualtion specific values. The DetailedSimulation Customization adds these attributes to the object models within a schema.

1 From the file menu, start Process Designer and select Import eBOP Customization.



2 In the Process Designer client installation, select the DetailedCustomization folder.



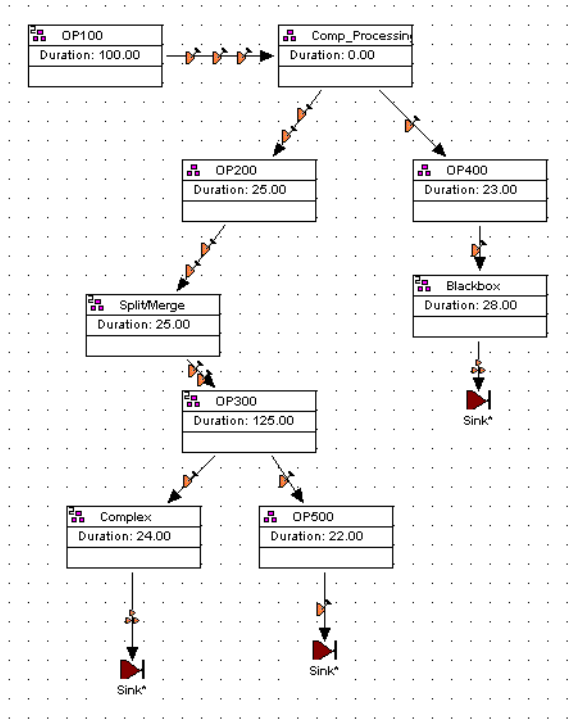
The customization adds attributes for products, operations and resources that display on additional tabs that are visible after the installation of the simulation interface. Please refer to Simulation Tab for Operations for detailed descriptions of the simulation tab contents for resource, operation and part objects.

The demonstration model

In this chapter we want to explain a demonstration model. This demonstration model is not based on a real planning process. The basic function of this model is to demonstrate some used cases. In the following figure you will see the overview of the total planning model. The following chapters describe the sub operations of the compound operations in more detail.

Nearly all operations are build up as twin objects, so for each operation a resource is created and assigned to the operation.

In this demonstration model the resources has the same hierarchy structure as the operations. This is to make it easy to identify the operations and the corresponding resources. Please keep in mind that the resources can have any structure.



Details of Operation OP100

The operation OP100 is shown in more detail. Four operations are used to process three different parts. All parts are created by a source. In the corresponding simulation model all three parts are created in a batch size of 10. So first

ten pieces of product Component_B are created then ten pieces of Component_C and afterwards ten pieces of Component_D are created. Afterwards the sequence starts again.

Operation OP10 has no resources assigned. In this case Plant Simualtion creates a dummy resource (normally a station which operates the product).

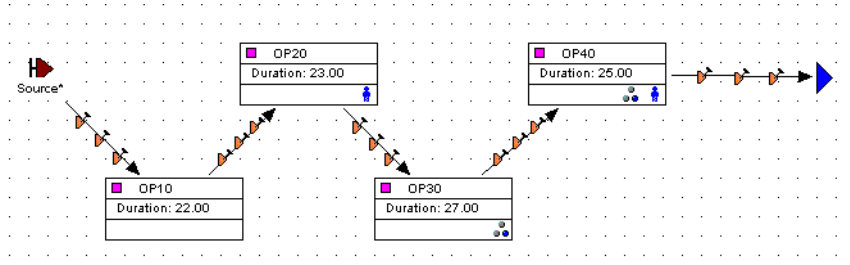
There is a human resource assigned to operation OP20. We assume that this is the way to model a carrying operation. The human resource (worker) is used to carry one piece of the products from one place to another place. In Plant Simualtion it is not possible for a human resource to carry a product. So we also create a dummy resource for carrying the product. Before the operation starts it is necessary for the worker to be at the station. Keep in mind that the real duration for the product to carry can be longer than the time you defined in the operation time. This may be caused by the worker which is finishing another job before he is doing the carry operation.

Operation OP30 has a resource assigned. In the simulation model an Plant Simualtion object depending on the resource definition of the assigned resource will be created. The product will be processed on the resource using the processing time assigned to the operation (the allocated time is used).

In the last operation both a "normal" resource and a human resource are assigned to the operation. As soon as a product arrives at the resource the human resource is requested to do the operation. The product is waiting on the resource until the worker arrives at the resource and starts his work. In case the human resource has to finish another job first, this will increase the processing time.

For the assignment of human resources see chapter 5.2 on page 11.

The products exiting the operation OP40 are processed along the flows. For this purpose we need to know where the products are moved. The interfaces enables us to follow the flows up to the higher level. There we can also move along the flows to the next operation "Comp_processing".



The Operation "Comp_processing"

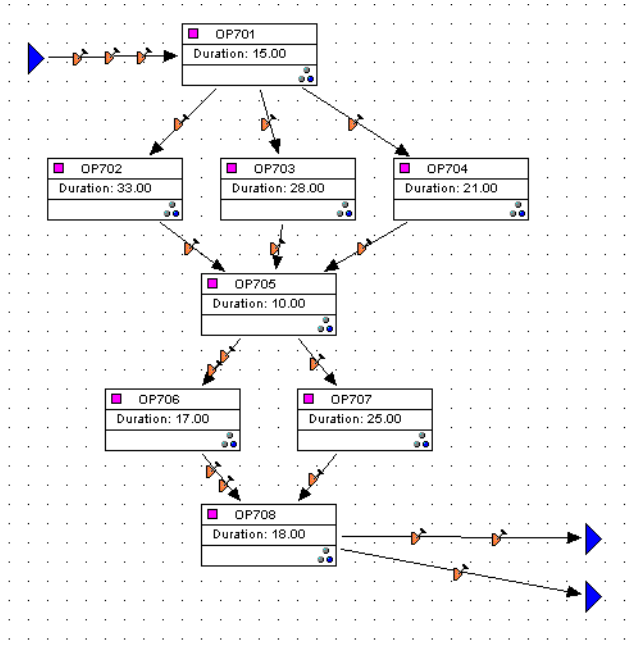
In this compound operation first all parts are processed by operation OP701. The next operation is build up three times. For every product we have a different processing time. Because Process Designer allows only one processing time for an operation we have to create an operation for each product. All three operations OP702, OP703 and OP704 have the same resource assigned.

In the resulting Plant Simualtion model only one resource will be build up, but this resource has different processing times for the products.

Operation OP705 has again the same processing time for all products.

Operation OP706 is processing two products out of the three products and OP707 is processing one product out of the three. Both operations have different resources assigned. In the corresponding Plant Simualtion model two resources will be build up and after finishing the operation OP705 the products will be moved depending on the type of product to the next station.

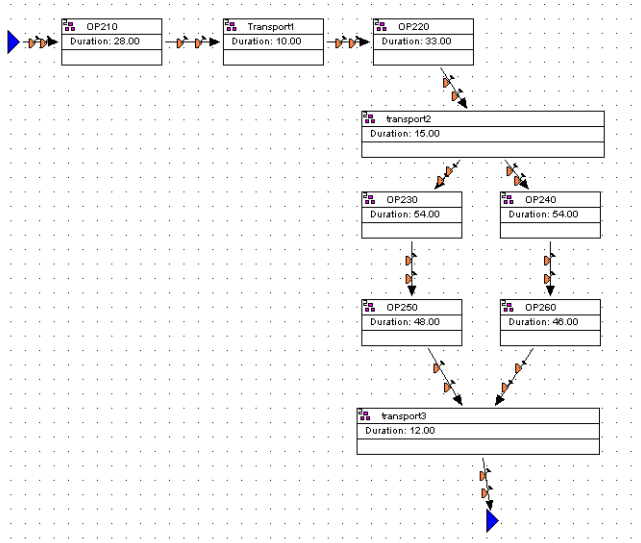
On the upper level the products are processed in different ways so therefore we need two interfaces which are routing the products to the succeeding operation.



The Operation split / merge

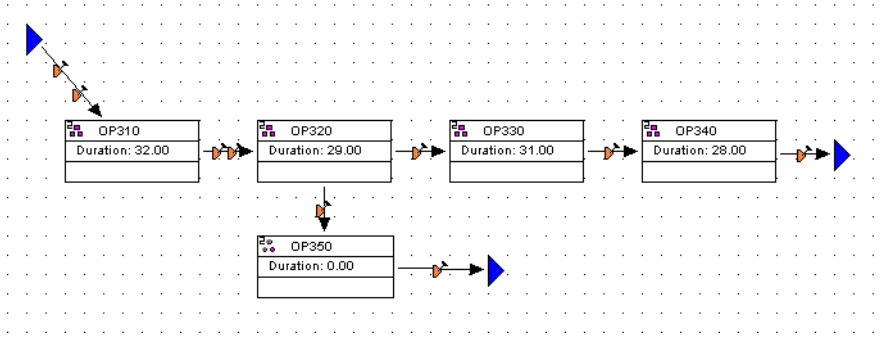
Two of our products are moving along to the compound operation OP200. Within this operation The parts are processed by several operations. Three of these operations, "Transport1", "Transport2" and "Transport3" have resources assigned where the Plant Simualtion type is set to "conveyor". This setting will create a conveyor during the model generation process. This conveyor is used to transfer the products from one station to another station. This type of modeling allows to model the logistic operations between two processing operations. In the same way buffers and other logistic objects can be modeled.

After the operation "Transfer2" the operations "OP230", "OP240" and "OP250", "OP260" are build up in parallel. There are different resources assigned to. The problem here is the fact that we have a very long processing time for these operations instead of a short processing time for the rest of the operation sequence. So we need two stations in parallel to achieve the desired throughput. The operation "Transfer2" is of type "split" which is recognized automatically. It is not necessary to define this operation type. The split operation moves the product to the next free succeeding station.



OP300 Diverging the Products

The two products "Component_B" and "Component_C" are processed by different operations and also different resources. As you can see in the figure below you only have to define different operations and the material routing on the Plant Simualtion side will be done automatically. There are no resources assigned to the operations. Therefore in the generated Plant Simualtion Model the default processing station will be used to model these resources. The name of the resources will be the same as the operation, so it will be easy to identify these resources.



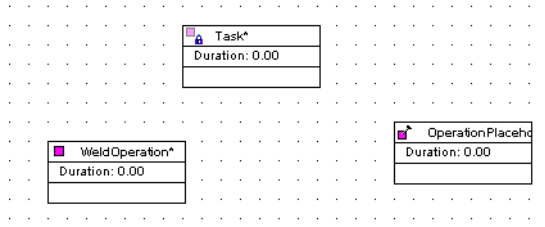
Operation Black box

Drilling down to the operations of the compound operation "Blackbox" shows you the three operations as you can see in the following figure. Three compound operations are defined. These operations are defined as "blackbox" operations which means everything below these compound operations is not relevant for the simulation model. To define a black box operation mark the checkbox "**omit suboperation**". We are not interested in the details of these three operations. If there is no resource defined, the "Blackbox" resource will be build up in the Plant Simualtion model.

It is possible to assign an Plant Simualtion type to the resources assigned to the black box operation. In this case, the defined resource type will be used to build up the simulation model instead of the black box resource. In the PERT-diagram shown in the figure below the operation "BB_1" has a resource assigned to. There is no specific Plant Simualtion type defined for this resource only the capacity of the resource is set to 5. The result will be a black box resource in the Plant Simualtion model with the capacity of 5. It is not possible to assume any relations between the products entering the black box resource and the products leaving them.

There is also a resource assigned to operation "BB_2". This time we define the Plant Simualtion type of the resource as "assembly". In the Plant Simualtion model an assembly object will be constructed.

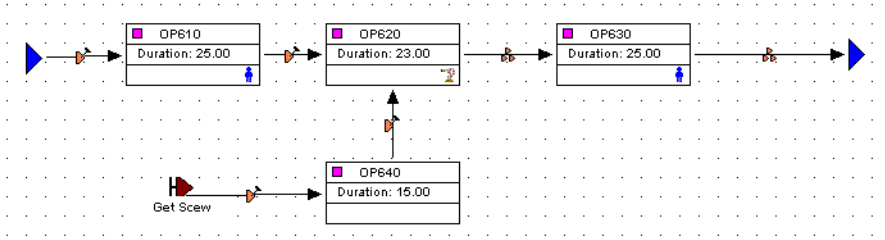
The third operation "BB_3" has also a assigned resource. This time the Plant Simualtion type of the resource is set to "station" and the result in the Plant Simualtion model will be the default station object.



The complex operation

Sometimes an operation done on a specific resource is modeled in more detail. For example: the operation is divided in three sub operations, the first sub operation needs an additional worker for loading the station, then the station is processing the part automatically. In the third step the worker is used again for unloading the station. During the automatic processing of the station the worker can do other jobs. This is a typical scenario for defining the compound operation as a complex operation. On the Plant Simualtion side the PERT-chart is used to build up a frame. This frame has the same behavior as the sub operations of the complex operation. It is possible to assign a resource to the complex operation. For this resource a capacity can be defined which defines the number of products processed in parallel. This capacity is also taken into account on the Plant Simualtion side.

Note: In the complex operation it is also necessary to have products assigned to the flows. This is necessary to identify the type of operation.

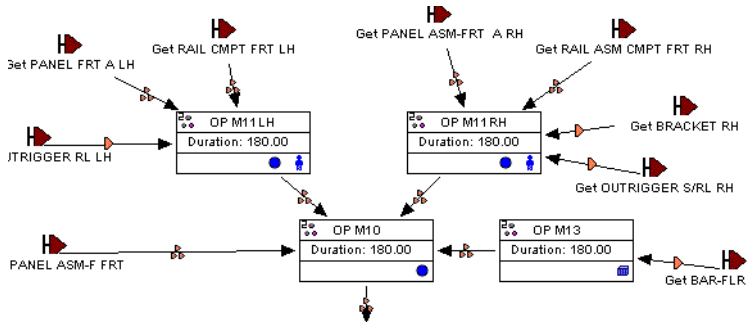


Plant Simualtion Specific Settings and Process Model Prerequisites

Plant Simualtion analyzes the material flow and the corresponding resource utilization of the process model. To enable automatic model generation in Plant Simualtion, users have to follow some rules in the Process Designer process model. Operation PERT provides the best view of simulation constraints on the process model and the defined relations between the objects. All rules can be checked using this view, while keeping the following necessary steps in mind:

- Use Process Designer source objects to create parts at the beginning of an operation sequence
- Use Process Designer sink objects to consume parts/products at the end of an operation sequence
- Assign parts to flows that connect nodes relevant to the simulation
- Determine the Plant Simualtion type for resources and operations relevant to the simulation
- Use interface objects when several parts enter or leave a compound operation

The following PERT diagram represents a typical process model section that users can simulate in Plant Simualtion:



Sources in Process Designer

It is necessary to use sources from the Process Designer model since the outgoing flow of a source object is associated with the product created by the source.

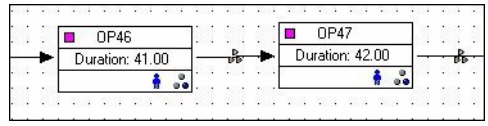
When Plant Simualtion detects a source operation it creates a source object. All products assigned to the outflow of a source are collected and the attribute 'mixpercentage' of the product in the Product tree determines the percentage of parts that are created. If only one product exists on the outflow of the source, the mixpercentage is not relevant and set to 100%. If there is no 'mixpercentage' defined as product attribute, Plant Simualtion calculates the percentage as 100% divided by the number of different parts to produce.

If a source results in more than one product, keep in mind that every product is created in a batch of 5 pieces (default value), or you can change this value in the attribute 'batchsize' of the product in the Product tree.

Resource Assignment to Operations

Each operation should have at least one resource relevant to the simulation assigned to it. You can also add a worker (Process Designer prototype human). If there is more than one resource of this type assigned to the operation, one of the resources should be marked as the primary resource. Use the corresponding checkbox on the Resource Simulation tab.

The primary resource is the resource processing the product. If no primary resource or more than one primary resource is defined then the first resource found will be used as primary resource.



Use of Twin Objects
Twin objects are often used when there is a one-to-one mapping between compound operations and corresponding compound resources. In this case, the resource assignment to the compound operation is implicit.

No Resource Assignment to Operations
If there is no resource assignment to an operation, Plant Simualtion generates a dummy resource to perform the operation.

Only Human Resource Assignment
For cases when only a human resource is assigned to an operation, a dummy resource is created.

If you wish to use human resources in your planning model as well as in your simulation model, remember the following:

The number of human resources is defined by the number of human types in the Resource tree. You can use drag&drop functionality to assign a human resource to one or more operations, since one human resource usually performs more than one operation.

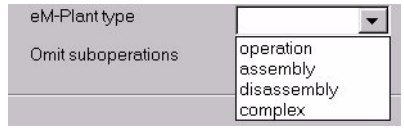
It is not meaningful to define only one human resource and assign this resource to all operations.

Part Assignment to Flows

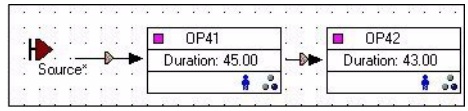
All operation flows relevant to the simulation require the assignment of at least one part. This enables the Plant Simualtion model-generation module to follow the part through the operations that process it. It is possible to assign several parts to one flow. The way Plant Simualtion interprets the assignment of parts to flows depends on the operation type. In the default configuration, Plant Simualtion distinguishes between the following operation types:

- Normal operation — a part that enters is processed and leaves
- Assembly operation — several parts enter and are assembled, one part leaves
- Dismantle (disassembly) operation — one part enters, several parts leave

The operation type is defined on the Simulation tab for operation objects. Use the drop down list to choose one of the predefined operation types.

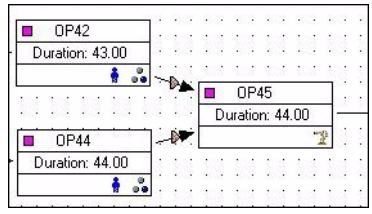


Part Flow in Normal Operations
A “normal” operation is an operation where a part is turned or milled, etc. Each part moves through the operation and the part type does not change. The number of incoming and outgoing parts must be the same. Even if the incoming flow contains several parts, only one part is processed at a time.



Part Flow in Assembly Operations

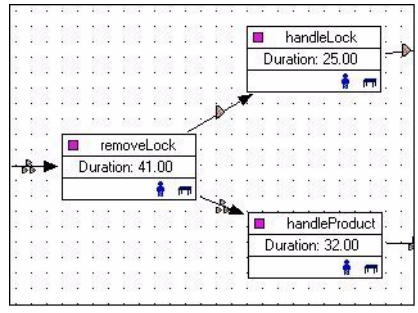
An assembly operation requires at least 2 incoming parts and each incoming part must be on a separate flow. Only one part, the assembled part, leaves. The assembly operation starts as soon as all necessary incoming parts are available.



Note: The system does not permit combining the assembly of two (sub-)products in one operation. Create separate assembly operations for each product.

Part Flow in Dismantle Operations

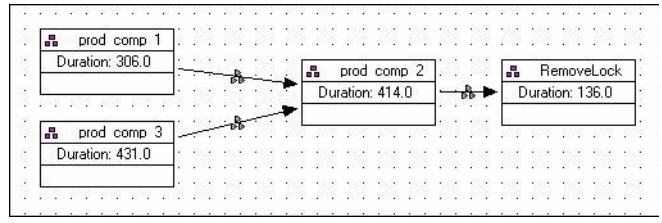
A dismantle (disassembly) operation requires one incoming part and at least two outgoing parts. Each part that leaves must be assigned to a separate flow.



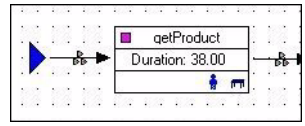
Note: The system does not permit combining the disassembly of two (sub-)products in one operation. Create separate disassembly operations for each product.

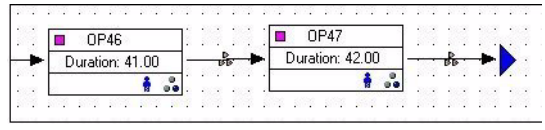
Part Flow and Interface Objects in Compound Operations

Normally, you create a hierarchy of compound operations. You connect all compound operations on all hierarchy levels using flows. You must also assign parts to the flows between compound operations. This is necessary to determine the following operation for a part in the succeeding compound operation once the process model is exported to Plant Simualtion.



It is necessary to use interface objects to establish that a part is entering or leaving a compound operation.





Resource Hierarchy

Compound resources containing resources relevant to the simulation are automatically mapped to Plant Simualtion frame objects. Plant Simualtion frames can be nested and collect all machines of a line in one group, for example.

You can use the resource hierarchy for different purposes:

- To group machines in a factory or line
- To group machines in protective circuits

It is not necessary to define simulation-relevant settings for nested compound resources. These settings are ignored once there is a child, i.e., a child resource assigned to a simulation-relevant operation.

It is not necessary to build the same hierarchy structure for operations and resources.

Note: When modeling with process objects, resources relevant to the simulation may not be located beyond the twin resource.

Attributes of Resources

On the simulation tab of every resource you can use the Plant Simualtion Type field to define the related Plant Simualtion resource used to build the simulation model.

If no type is defined, e-Plant uses the object 'station' to create the resource. In case the corresponding operations are of type ’assembly’ or ’disassembly’ Plant Simualtion objects for assembling and disassembling are used to create the simulation model.

All changes are recorded in the log file.

Refer to Mapping to Plant Simualtion Target Objects to learn how the resource is detected during the model generation process.

While you may assign more than one resource to an operation, only one resource connected to an operation may have the Primary resource option checked. As a result, this resource is used to process the product. If no resource is assigned as the primary resource, the system uses the first simulation-relevant resource which is not a human resource as the primary resource.

Secondary resources (resources which are relevant to the simulation but not primary) are not relevant for the simulation model in this version. In a later version they will be treated as necessary services.

Marking Sub-Operations as Non Simulation Relevant

To prevent a compound operation from being refined and evaluated in detail for nested sub-operations, check the **Omit Sub operations** option on the Operations simulation tab.

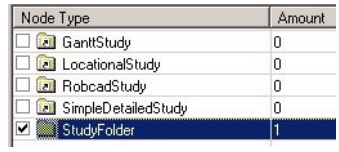
You can set the application to ignore Plant Simualtion specific modeling restrictions (even operation PERT) for nested operations. This enables the application to handle freely defined operation graphs, for example, with any part and resource allocation.

Preparing an Plant Simualtion Simulation Study

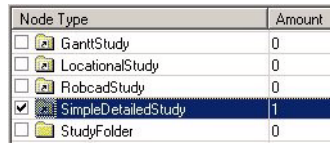
Before starting a simulation study in Plant Simualtion you have to prepare some data in Process Designer. The first step is to create a study folder and a SimpleDetailedStudy object to collect the process data for the subsequent simulation in Plant Simualtion. After defining the scope of the simulation, you also have to set simulation specific attributes and verify that the process model definition is according to the rules described in Plant Simualtion Specific Settings and Process Model Prerequisites.

Creating Plant Simualtion Study Objects

1 Select **New** from the Project tree context menu and create a **StudyFolder**.



2 Select **SimpleDetailedStudy** from the StudyFolder context menu.



3 Open the SimpleDetailedStudy object, it collects the information relevant to the simulation study.

Defining the Scope of a Simulation Study

The major components of the SimpleDetailedStudy object appear in the left-most tree view and in the **Order** and **Import** tabs.

Use the tree view to define the scope of the simulation study and drag&drop items to define shortcuts for:

- the Operation tree, containing the set of operations relevant to the simulation
- the Resource tree, containing resources that are assigned to the operations relevant to the simulation
- the Part tree, containing parts that are used/needed for operations relevant to the simulation (optional)

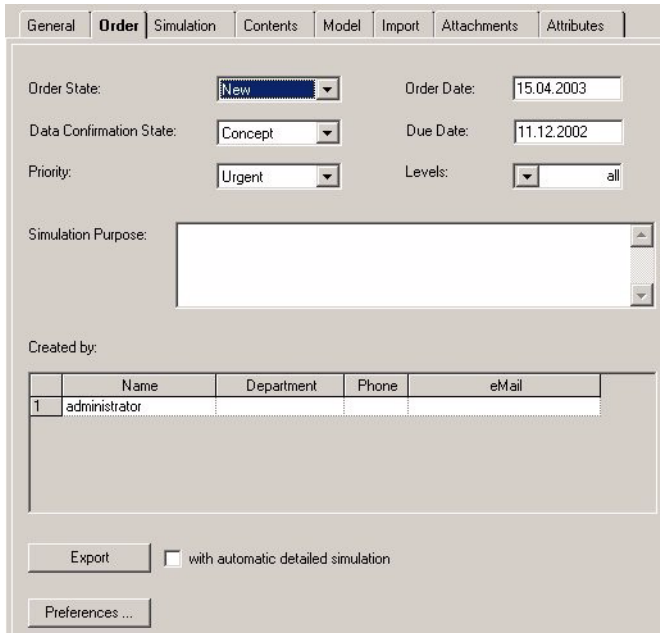
Note: Only one tree is allowed for resource and operation objects since parent/child relations are necessary for proper analysis of the process model. **Always export complete Resource and Operation trees** (you may not use only part of a tree).

- all resource objects must be nodes in one Resource tree
- all operation objects must be nodes in one Operation tree

You can define different simulation studies when using different Operation trees, for example, a number of Operation trees each with a variety of alternatives, or for cases of different Operation trees created at various stages of your project.

Performing a Simulation Study

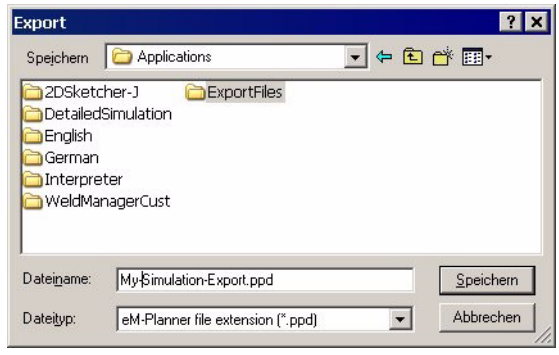
After correctly defining a process model, you can use the Order tab of the DetailedStudy object to export the process model to Plant Simualtion.



You can add administrative information using the State and Date drop-down lists and comments in the Simulation Purpose text field.

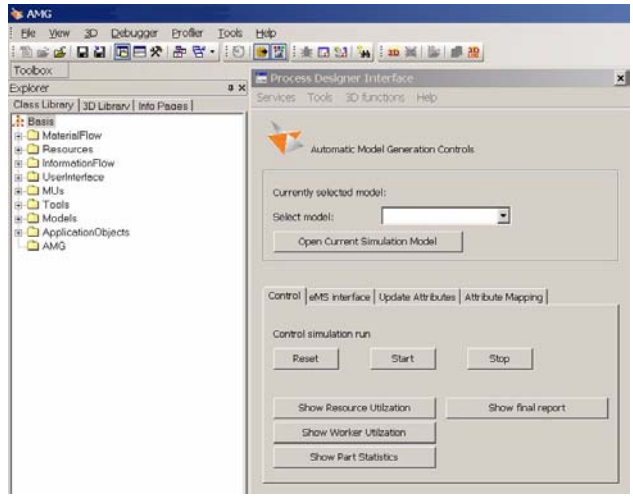
Click Export to export the objects assigned to the DetailedStudy object to a .ppd or .xml file. You are asked to indicate a location for the export file in the File Select dialog.

Note: You must assign at least one Operation tree and one Resource tree to the study. You may not export only part of a tree.



If you check the **with automatic detailed simulation** option, Plant Simualtion is launched automatically with the exported process model. Plant Simualtion reads the process model information and builds up a simulation model.

When the checkbox with automatic detailed simulation is not checked only the exported file is written to the specified file location. The Plant Simualtion application can load and process the export file in offline mode without Process Designer running.



Plant Simualtion model for detailed simulation

Icon of AMG in eM Plant toolbar

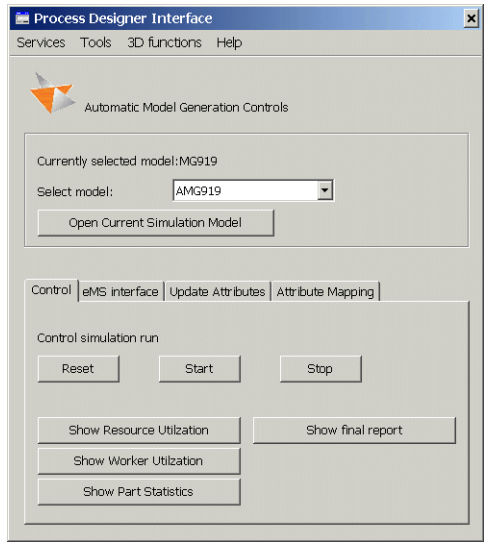
In automatic mode, the simulation starts directly after the model generation phase. Select "**Open**" from the context menu of the eMS Interface icon to open the Process Designer Plant Simualtion Integration dialog. You can use this dialog to control the simulation, show simulation charts and open the simulation model — see Working with the Plant Simualtion Simulation Model.

Click **Preferences** at the bottom of the DetailedStudy order tab to open the Preferences dialog. See Simulation Tabs, Reference for more details.

Note: The Levels drop-down list on the DetailedStudy object is not supported in this version. Settings for this attribute are not yet in use.

Working with the Plant Simualtion Simulation Model

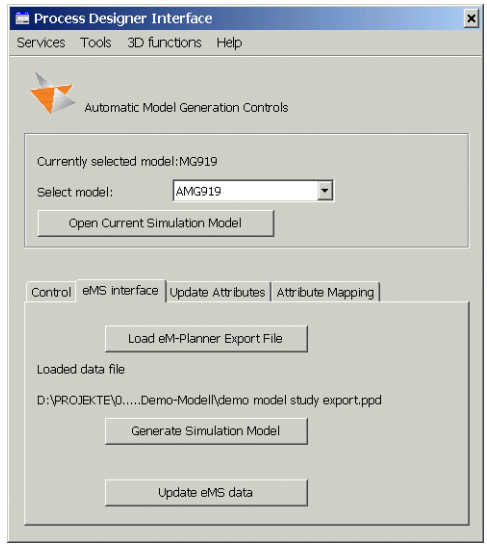
When using the non-automatic offline mode, you must start Plant Simualtion and load the model generator DetailedSimulation.spp. A dialog opens in which you can control the model generation and the simulation itself.



Plant Simualtion controlling dialog

Creating a simulation model

Select the „**Generate**“-tab of the dialog. Press the „**Load**“-button to load the previous generated Process Designer export file. A file selection box opens where you can select a .ppd or .xml file.



The path and the name of the selected and loaded file will be shown in the line below “**Loaded data file**”.

Click **Generate simulation model** to start the generation of the simulation model. After a few seconds the message "Model generation finished" displays. Click **OK**. The class library of Plant Simualtion now displays the AMG folder which contains a new frame called AMGxx (where xx is a number to distinguish the simulation models of various model generations.

The class library after model generation

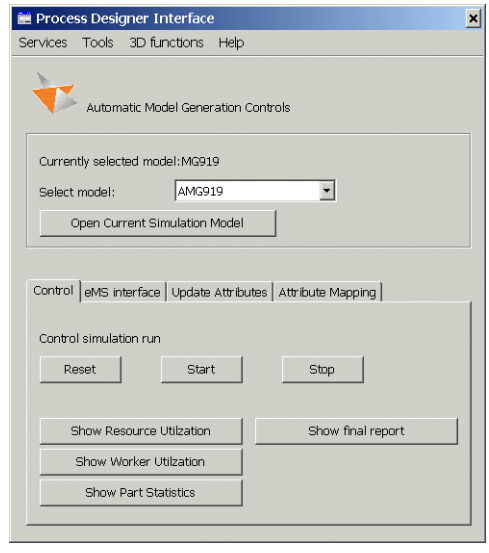
Automatic Mode of Plant Simualtion Simulation

When you launch Plant Simualtion automatically from Process Designer, the Plant Simualtion simulation starts directly after the model generation. Plant Simualtion creates a simulation according to the predefined duration and generates the .ppd file for importing simulation results to Process Designer. The file is named according to the name of the selected export file (Export_file_name.ppd / Export_file_nameINP.ppd).

When this step concludes, Plant Simualtion automatically shuts down and the result file will be imported to Process Designer.

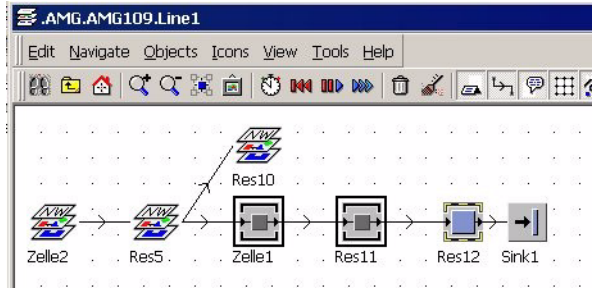
Controling the simulation run

Select the „**Control**"-tab to control the simulation run. In line „**Current selected model**" the name of the model you are controlling at the moment is shown. In the pull down menu below you can select any other existing simulation model to control with this tab.



The AMG dialog

Click **Reset** and **Start** to reset and start the simulation. You can watch the simulation — open the frame of the simulation model by clicking **Open current simulation model** in the Plant Simualtion dialog.



Generated Plant Simualtion model

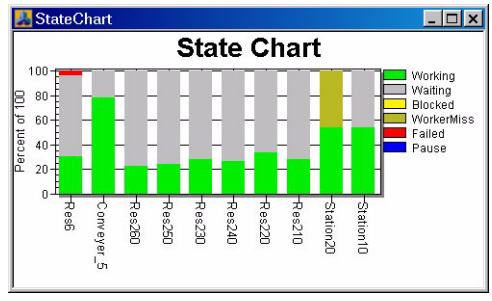
Double-click the event controller and open the **Settings tab** which contains the start time and simulation run duration settings. The **Statistics** setting defines the start time for collecting statistical values, allowing you to start the model evaluation after a warm-up period.

The **Controls tab** provides additional settings to start and run the simulation and to modify the simulation speed.

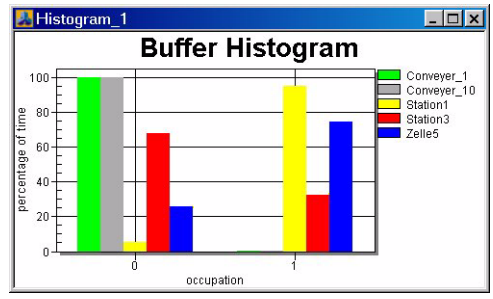
Plant Simualtion event controller

Refer to Simulation Tabs, Reference for information about the statistical simulation results for resources, operations.

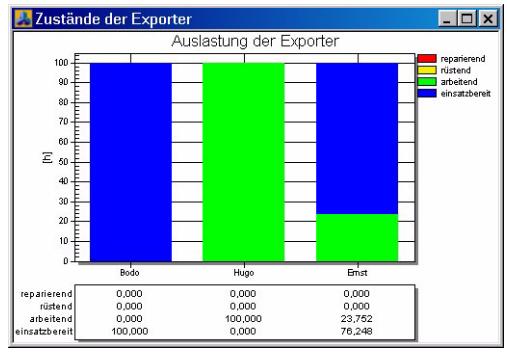
You can view simulation results by clicking **Show resource utilization** for the resource utilization, **Show worker utilization for** the worker utilization and **Show part statistics** to see the part statistics. The results can be watched during the simulation run.



Resource statistics



Buffer Histogram



Worker statistics

Simulation results

The default value for the simulation duration is set to 5 days. After this time has been simulated, a report of the simulation results will be shown. This HTML-report will be stored and can be attached to the Process Designer project or to the eM Planner simulation study. Also the simulation results like resource utilization, worker utilization and so on are stored and can be imported automatically or manually to the eM Planner project. The import mechanism can be started automatically or manually (see Adapting the detailed simulation module)

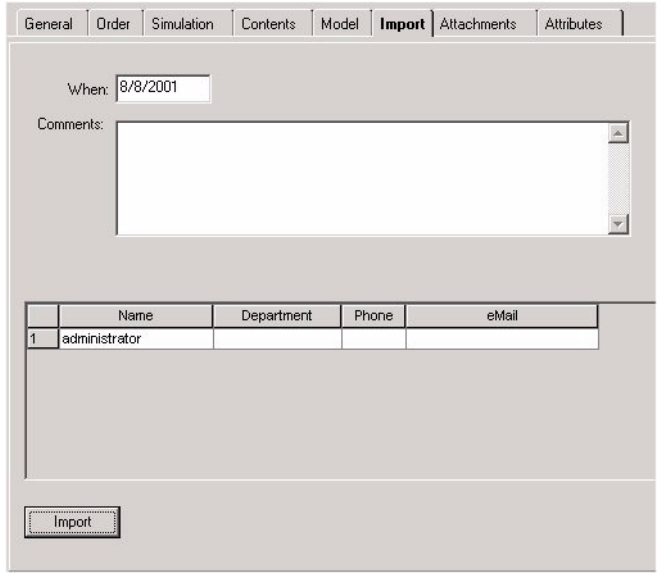
If there are any problems during the model generation process, see the Log file for more information.

The default duration for a simulation run is 5 days. After the simulation run is finished, a File selection box opens, in which you can select a file to which the simulation results are written. This file can be imported to Process Designer.

You can define the duration of a simulation run in the Plant Simualtion Event Controller. To modify this setting, open the simulation model via the Process Designer Plant Simualtion Integration dialog. The event controller is located in the upper left corner.

Importing Simulation Results to Process Designer

Start Process Designer with the corresponding project. Use the DetailedStudy object and select the Import tab to import the results of the simulation run.



The import tab of the DetailedStudy

All results of the detailed simulation run are displayed on the right-hand side of the simulation tabs for resource, operation and part objects. Please refer to Simulation Tabs, Reference for a detailed description of the result values.

The Log file

In case problems arise during model generation, you can refer to the log file for information for information about why the system failed to generate the simulation model. Click **Log file** in the **Tools menu** of the AMG dialog to open an HTML report containing several pages:

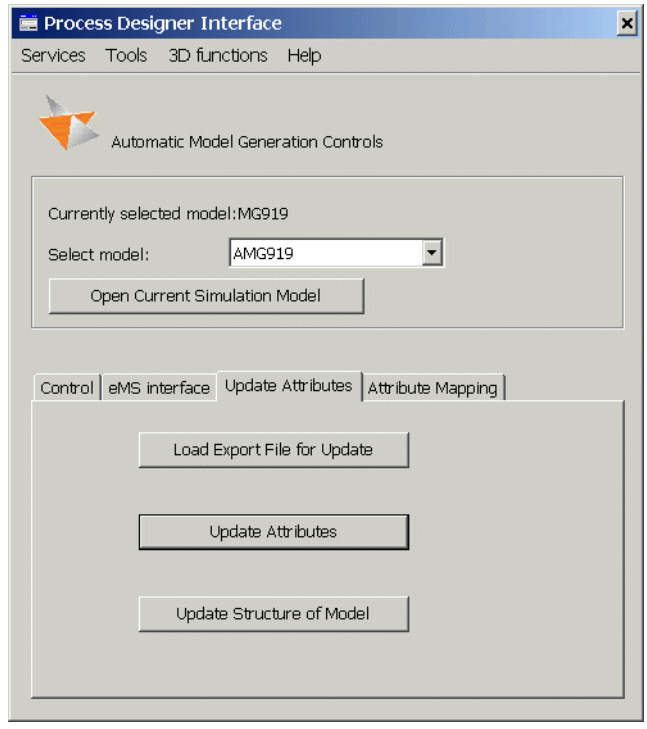
- Info: Contains general information about the generation process.
- Error: Reports on critical error messages — usually fatal errors that caused model generation to fail. If no error occurred, this page is not generated in the log file.
- Products: Contains information about the product and its structure.
- Operations: Contains information about the operations. During the model generation phase, the AMG process analyzes the operations and attempts to identify the type of operation (operation, assembly, disassembly,…). If the user did not define any operation type, AMG sets the type and reports the definition.

Updating the simulation model

Attribute update

With this functionality you can update the attributes of your simulation model. This should be done if the data in Process Designer was changed by the planner and you want to update your simulation model with the new values. This function does not change any structure of your simulation model.

Select the **update**-tab of the dialog for updating the attributes of the simulation model.



Press „**Load export file for update**“ to load the ppd or xml file with the new attribute values. Select the simulation model using the pull down menu. This will activate the button „**Update**“ for the attributes. All attributes defined in Process Designer will be updated. In case the attribute does not exist in the Plant Simualtion object, the attribute will be created. The updated model can be opened directly.

During the attribute update the mapping table for the Process Designer and Plant Simualtion attributes is used to assign the values of an Process Designer attribute to an Plant Simualtion attribute.

Updating the structure of the model

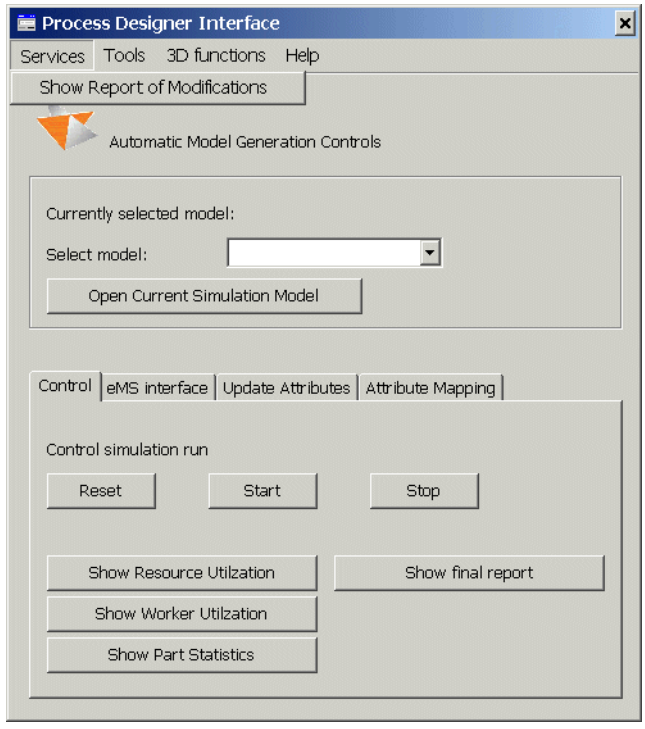
The simulation model created using the eM Planner data can be modified at any time. This may be necessary to add control strategies and/or logistic resources.

This is not a problem for updating the attributes. Only the attributes of those objects created by the AMG will be updated.

When updating the structure of the simulation model all manually done modifications will be preserved. Only the structural modifications of the eM Planner objects will be updated.

For updating the structure of your simulation model select the **update attribute tab**. Press **Load export file for update** to load the previous exported data from eM Planner. After the data are loaded and the internal tables are created the button **update structure** will be activated. Press this button to update your simulation model using the data just loaded. The update structure mechanism does not effect the modifications you have done in your simulation model.

Modifications of the simulation model

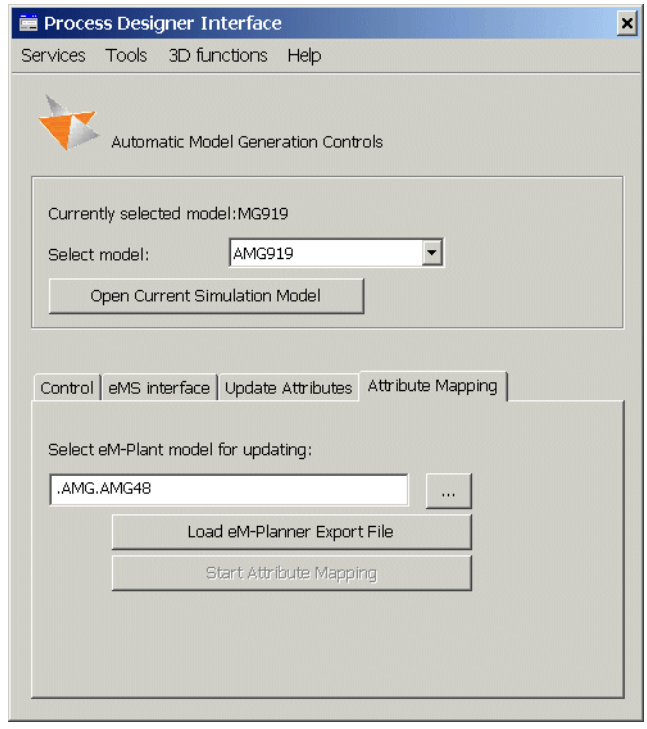


The modifications of the eM Plant simulation model are not transferred to the eM Planner process model. You have the ability to create a modifications report by selecting the tab **Model changes** pressing the button **Show report of modifications**.

Attribute mapping

Sometimes we have an Process Designer model and in parallel an Plant Simualtion model which was not created automatically using Process Designer Interface. If it is necessary to update the Plant Simualtion model with the data of the Process Designer model a mapping mechanism has to be defined matching Process Designer resources to Plant Simualtion objects and the attributes of the resources to any arbitrary Plant Simualtion attribute or variable. For this purpose the **Attribute Mapping** mechanism was designed

To use the attribute mapping the current version of the AMG has to be loaded into the class library of the simulation model. Create a SimpleDetailedStudy for the Process Designer model and make an export file. Select the **Attribute Mapping** tab of the AMG dialog.



Enter the path of the Plant Simualtion model in the input field or select an Plant Simualtion model by pressing the button nearby the input field. In a second step load the ppd file by pressing the button „**Load Process Designer export file**“. After the file was loaded and the internal tables were build a message box will inform you. Press „**Start attribute mapping**“ to start the dialog of the Attribute Mapping.

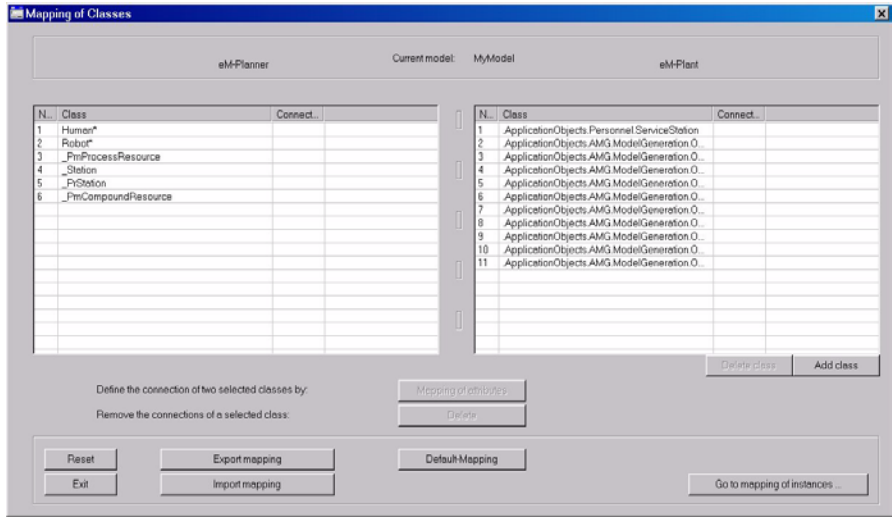
The attribute mapping first tests if there are already mapping information stored in the Plant Simualtion model. You can decide if you want to reuse these data or if you want to create new mapping tables.

If the attribute mapping starts for the first time the mapping tables are empty. All class definitions of the Process Designer export file and all class definitions of the Plant Simualtion class library are collected and shown in the table.

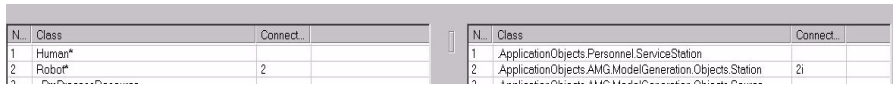
The main dialog shows on the left hand side all class definitions of the Process Designer model. On the right hand side you will see all class definitions of the Plant Simualtion class library. If there were added some classes later on you can append these new classes using the button „Add classes“.

The attribute mapping consist of two phases. In the first phase, the classes will be connected. Here the mapping of the attributes between an Process Designer class and one or more Plant Simualtion classes will be defined. An Process Designer class will be connected with an Plant Simualtion class by double clicking the Process Designer class and afterwards double clicking the Plant Simualtion class.

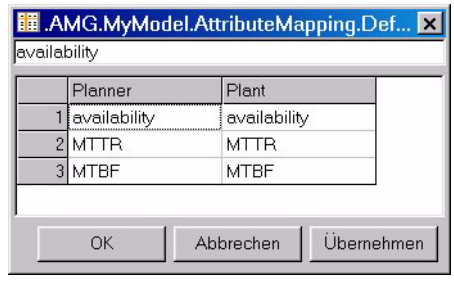
It is not necessary to have a one to one relationship between Process Designer and Plant Simualtion classes. Every class can be related to any number of classes on the opposite side.



The relationship between two classes is shown in the second column of both tables. There the row number of the related class is shown. In the following figure the Process Designer class „Robot“ (row 2) is related with the Plant Simualtion class „Station“(row 2). The character „i“ following the row on the Plant Simualtion table means inherited.

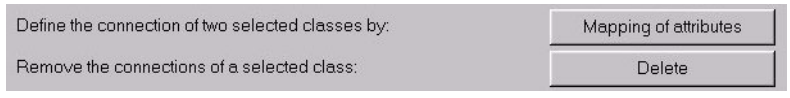


This shows you that the attribute mapping is inherited from the default setting. The default setting can be changed using the button „Default Mapping“ on the Attribute mapping dialog. This will open a mapping table as shown in the following figure where you can enter any arbitrary Process Designer attribute on the left hand side and any Plant Simualtion attribute on the right hand side.



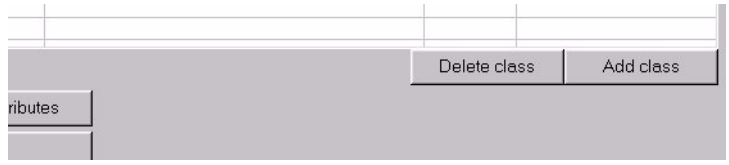
Removing a connection

If a relation between two classes should be removed mark the class and press the button „Delete“. This deletes the relation between the marked class and the class which was related to. In case there are more than one classes retaed to the marked class, a dialog will ask which of the relation should be removed.



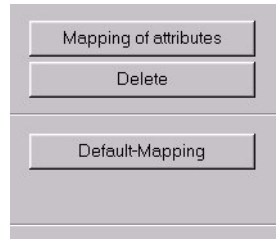
Removing Plant Simualtion classes

If there is a long list of Plant Simualtion classes it is possible to remove some of the Plant Simualtion classes. Mark the class you want to remove and press the „Delete class“-button.



Adapting the default attribute mapping

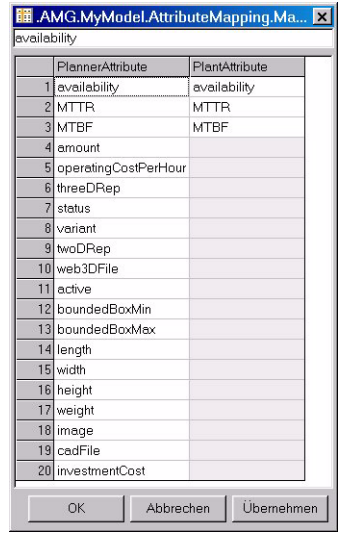
Press the button “**Default Mapping**” to modify the default mapping table of resource classes.



A table will open where you can define the name of the eM Planner attribute and the name of the eM Plant attribute. After closing the table using the “**OK**” button, this table will be used for all defined relations between eM Planner and eM Plant which have the inherit mask (an “i” behind the row number).

Adapting the attribute mapping between two classes

If there are two classes connected, the attribute mapping for this relationship can be modified. Mark one of the classes by double click in the table of the classes and press button “**Mapping of attributes**”. Again a table will be opened where you can define the mapping of attributes for this relationship. If the mapping table is closed and one of the classes is connected with more than one classes of the opposite side, a dialog will ask which connections should be modified.



In the table shown in figure above some attributes of the eM Planner are already defined and the eM Plant attributes “*Availability*”, “*MTTR*” and “*MTBF*” are already mapped. The name of the eM Plant attributes can have dots and in

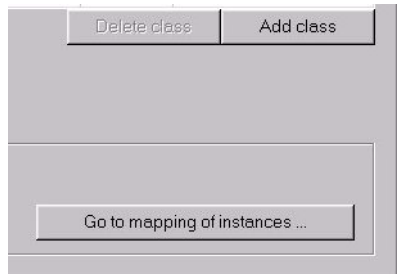
this way they are defining paths to attributes of sub frames. If the field on the eM Plant side is empty, no mapping is done and no value will be written later on.

Keep i n mind that the attribute mapping for a specific relationship will be removed if you are removing the connection between these two classes.

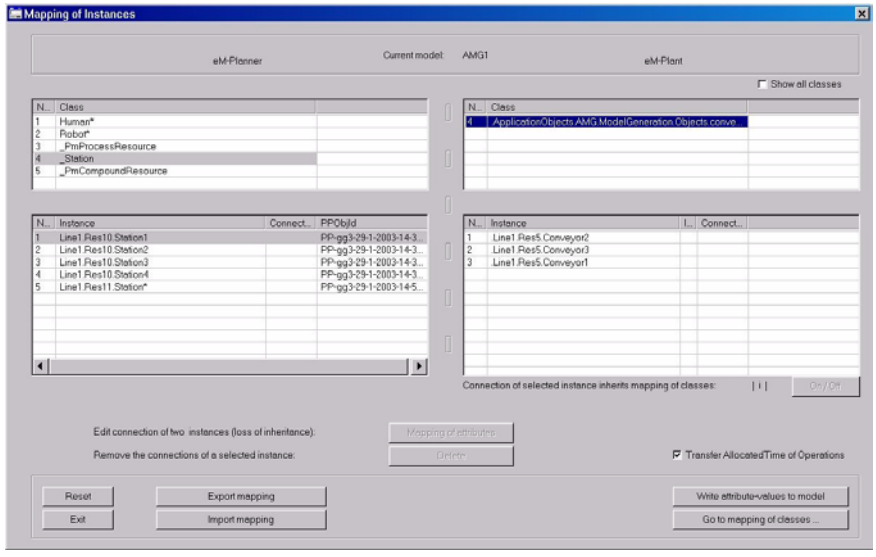
This mapping will only affect the defined relationship. This is shown by the missing character “i” behind the row number.

Relation between instances

Press the button “Go to mapping of instances” to get the corresponding dialog. This is the second phase of the attribute mapping. In this phase the instances are connected. Automatically the mapping of classes will be used for every instance you are connecting.



A dialog will open where you can see the classes in the upper left and right window and the corresponding instances in the lower left and right windows. As soon as an eM Planner class object will be marked in the upper left grid, the instances of this class will be shown in the lower left grid. At the same time the related eM Plant class object will be shown in the upper right grid. In case there are more than one eM Plant objects related to the eM Planner object all related eM Plant classes are shown.

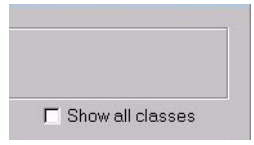


Mark an eM Plant class object in the upper right grid and all instances of this class object will be shown in the lower right grid.

Now the instances can be connected by double clicking the objects in the lower left and right grid.

The connection between two instances will be shown as coordinates, for example (2,3) which means this object is an instance of the class in row two and is connected with the instance in row 3. The character "i" behind the coordinates shows that the mapping of the attributes is inherited from the corresponding classes.

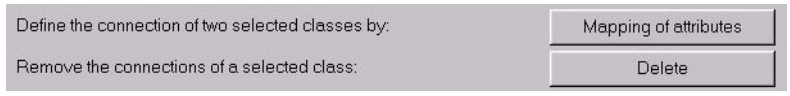
Displaying all or selected Plant Simualtion classes



If the checkbox "**show all classes**" is not marked, only those eM Plant class objects will be shown which are related to the corresponding eM Planner class object. If the checkbox is marked, all available eM Plant class objects will be displayed in the grid.

Adapting the attribute mapping between related instances

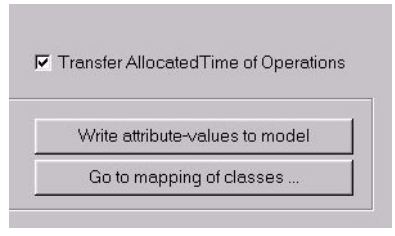
After relating two instances the attribute mapping table is by default the mapping table of the corresponding classes. If you want to use a special mapping table for instances, you first have to double click on the eM Planner instance, double click on the eM Plant instance to mark the relation you want to change and press button "**Mapping of attributes**". This will open a mapping table where you can define the eM Planner attributes and the corresponding eM Plant attributes.



Editing the attribute mapping table for a pair of instances will remove the instance flag. Switch on the inheritance can be done using the button "**on/off**" in the lower right corner of the grids. When switching on the inheritance the mapping table of the instance will be lost and replaced by the mapping table of the classes.

Writing attribute values to the Plant Simualtion model

In eM Planner the processing time (allocated time) is not an attribute of a resource, it is an attribute of the operation done on the resource. Therefore it is also possible using the *Attribute Mapping* for writing the allocated time of operations related to a resource to the eM Plant object. This function will be activated after marking the checkbox "**Transfer allocated time of operations**".



After all settings are done the values can be transferred from eM Planner to eM Plant. Press button "**Write attribute values to model**" to start writing the values. An additional dialog will ask you if you are sure overwriting the attribute values of your model. After pressing "**OK**" the values will be transferred. Every action of the *Attribute Mapping* will be documented in a HTML report which will be shown after the values are written.

Exporting and importing mapping information

The *Attribute Mapping* writes the whole mapping information into the simulation model. There you will find a frame which holds all necessary tables. It is possible to save this frame as an object.

The information about the mapping can also be stored by pressing button "**Export mapping**". A file menu will be shown where you can enter a file name.

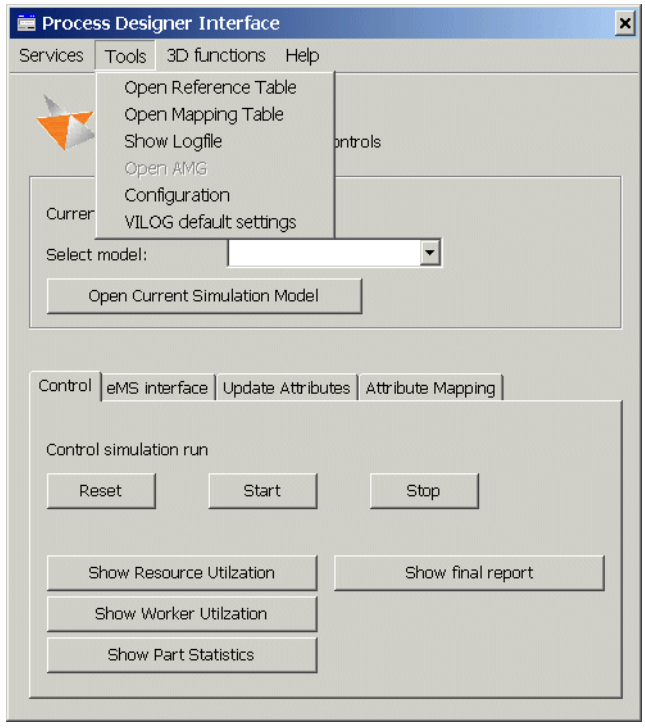
The stored mapping information can be read in at any time by pressing the "**Import mapping**" button. During the importing process several plausibility checks are done. If wrong entries or missing entries are detected a report will collect all this information. A dialog will ask you if the mapping table should be adjusted.

Please note: if any error occurs you have to check the mapping table for inconsistencies.

Adapting the detailed simulation module

The tools menu

Using the pull down menu "**Tools**" opens the menu shown in figure below.



The items of this menu enables the configuration of the detailed simulation according to your business.

The reference table

	string 0	object 1	string 2	table 3
string	plantType	path	method	Attributes
1	singleproc	.ApplicationObjects.AMG.ModelGeneration.Objects.SinglePro		
2	ParallelProc	.ApplicationObjects.AMG.ModelGeneration.Objects.ParallelPr		at
3	Station	.ApplicationObjects.AMG.ModelGeneration.Objects.Station		
4	Assembly	.ApplicationObjects.AMG.ModelGeneration.Objects.Assembly	createAssembly	att
5	Rework	.ApplicationObjects.AMG.ModelGeneration.Objects.ReworkAr		
6	DismantleStatio	.ApplicationObjects.AMG.ModelGeneration.Objects.Dismantle	createDismantle	
7	dismantle	.ApplicationObjects.AMG.ModelGeneration.Objects.Dismantle	createDismantle	
8	disassembly	.ApplicationObjects.AMG.ModelGeneration.Objects.Dismantle	createDismantle	

Use this table to add your own resources. In column **plantType** add a identifier of your choice for your eM Plant object. Add the same identifier to the configuration file (see Configuration File). In column **path** add the path to the object you want to add.

Sometimes it will be necessary to execute a method after creating the object. This method has to be in frame **Constructors** of the AMG. Enter the name of the method in column **method**. The method will be executed after **all** objects are created. There are some methods in frame Constructors which can be used as reference.

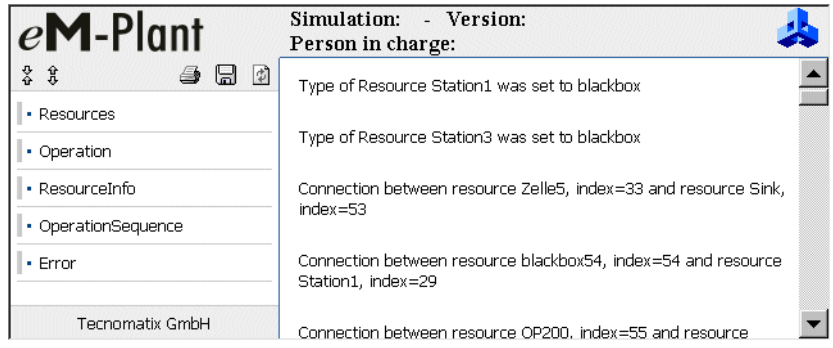
If there is no mapping of the attributes necessary (eM Plant attribute name is the same as eM Planner attribute name) then it is not necessary to enter a value in column **Attributes**. Enter "**default**" in this column to use the predefined default attribute mapping. Enter any other value to define your own attribute mapping.

The mapping table

	string 5	string 6	string 7	string 8	string 9	string 10	string 11	string 12	strir 13
string	Parallelproc	Buffer	Human	SingleprocRetouch	Assembly	Dismantle	Load	Unload	Sink
1			DC_Werker						
2			Human						
3			Worker (M)						
4			Operator						
5			Human (i)						

This table is only for internal use and should not be modified by the user.

The log file

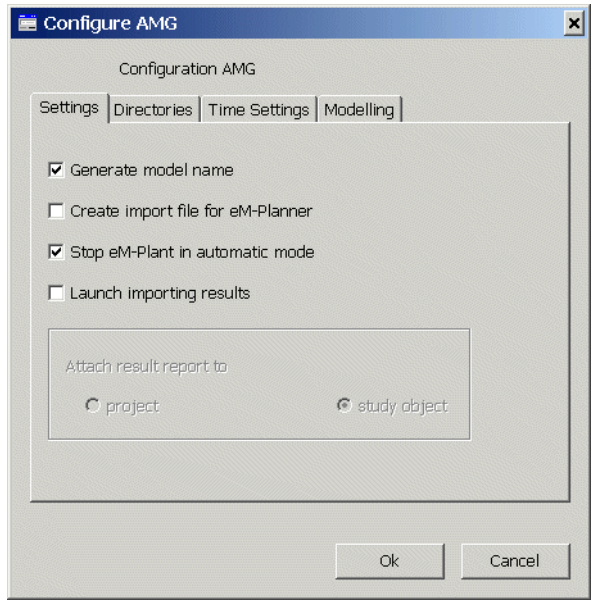


The log file shows a list of all activities done during the model generation process. There you will find information about the problems coming up and the reason why the simulation model could not be created.

Configuration

Selecting the Configuration menu item opens a separate dialog box where several settings can be done. A separate dialog will be opened where different settings can be done. These settings will be stored and are available next time you start the applicationagain. Also these settings are stored together with the created simulation model to allow usage of simulation models with different settings.

Tab Setting



- **Generate model name**

  select this checkbox for generating the name created simulation model by the AMG. Otherwise a dialog box will pop up during the generation process, asking for a name of the simulation model. If this checkbox is set then the name of the created simulation model will be AMGxx where xx is the continues number of the created model.

- **Create import file for eM Planner**

  If this checkbox is set, the result file for importing in eM Planner will be created after the simulation run will be finished.

- **Stop eM Plant in automatic mode**

  If this checkbox is set, in automatic mode the simulation model will be created, a simulation experiment will be done and afterwards the eM Plant will be stopped. Otherwise only a simulation experiment will be done and eM Plant will wait until you stop it. This allows to save the created simulation model or to make several different simulation experiments.

- **Launch importing results**

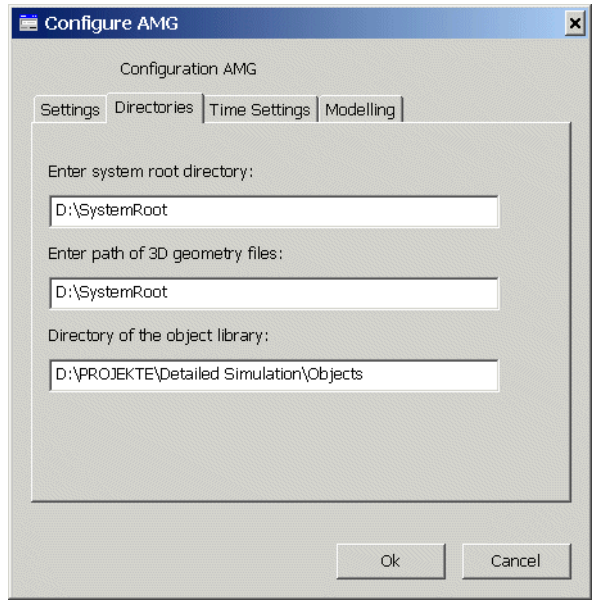
  When this checkbox is set a interface program will be started after a simulation experiment finished which will attach the result file to the eM Planner process model.

- **Attach result report to**

  Select where to attach the result file attach to the project or attach to the study object.

Tab Directories

On this tab you can define several paths of directories.



- **System root directory**

  Enter your system root directory in the input field below. If you want to create a simulation model in 3D, eM Plant automatically loads the geometry files (.co files).

- **Path of 3D geometries**

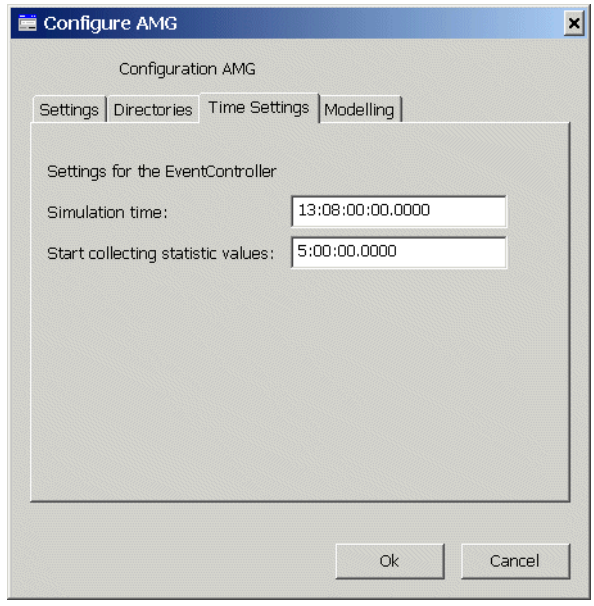
  In case you do not have a Process Designer installation on your computer you can define any other directory to search for the 3D geometry files.

- **Object library**

  Enter the path of the directory where eM Plant can load objects which are not found in the class library and not defined in the reference table. For more information see Using your own Plant Simualtion resource objects)

Tab Times

On this tab you can do some settings regarding the simulation run



- **Simulation time**

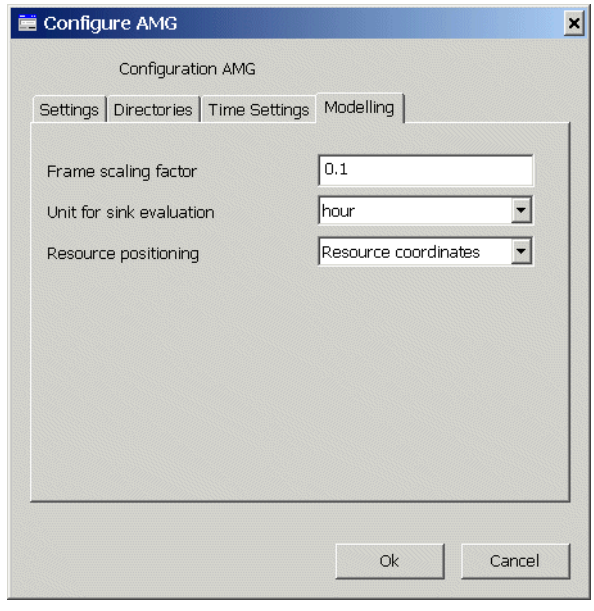
  Enter the time for the duration of a simulation run. This time value will be transfered to the eventcontroller during the model genertion process.

- **Start of statistic collection**

  Enter the time for statistic data reset in this field. This value will be trasferred to the eventcontroller during the model generation proces.

Tab Modelling

On this tab settings are done which will directly influence the created model.



- **Frame scaling factor**

This scaling factor will be used when a frame is created. The resources then will be positioned in this frame according to their coordinates.

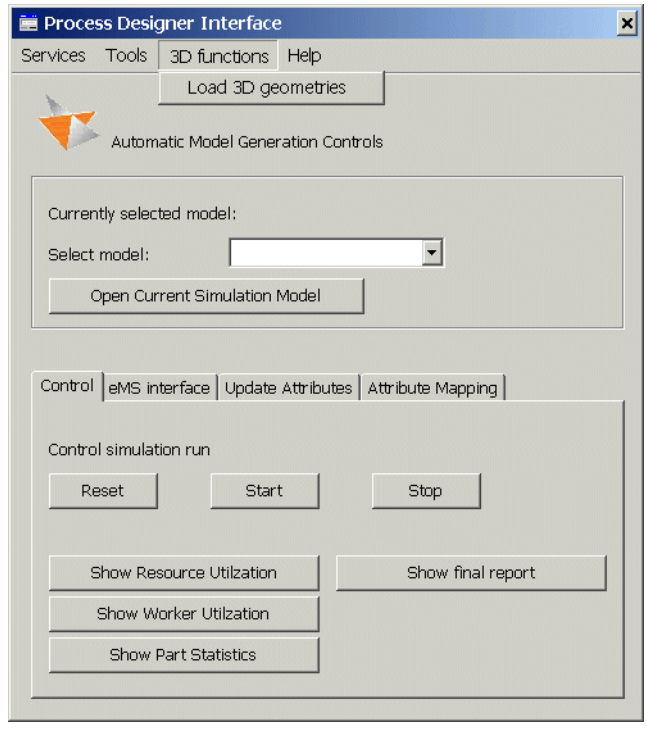
- **Unit of sink statistic**

  Select the unit you want to use for evaluating the data collected by sink objects. Normally the data are evaluated based on hours, as for example throughput per hour. Production processes which have a very long processing time as for example in aircraft industries, would like to select an other time base like day or month.

- **Positioning of resources**

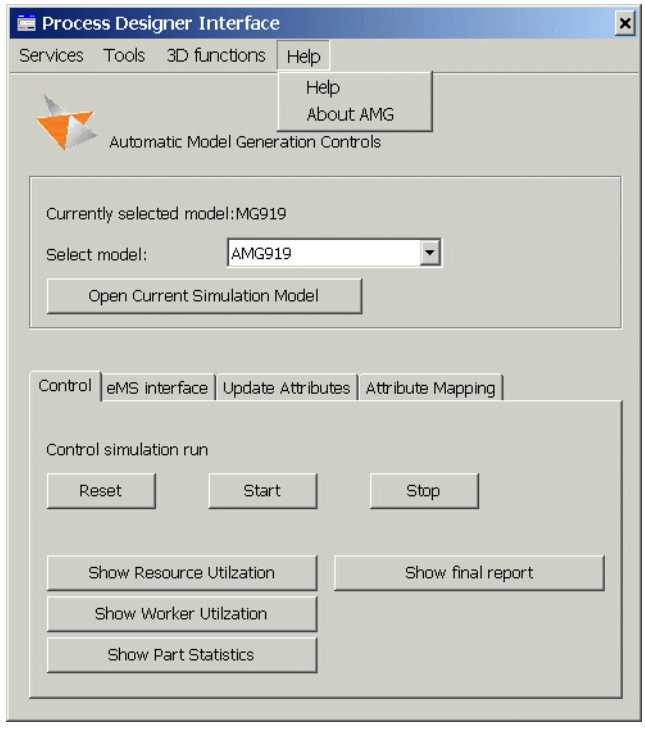
  Resources normally are positioned using their coordinates. In some cases resources did not have valid coordinates and therefore all resources would be located at the same location. To avoid this you can also select to position resources using the coordinates of the corresponding operation.

The 3D menu



Use this menu function to create a 3D modell after you created a simulation model.

The help menu



- **Help**

  This menu item opens the pdf file of the online help. This is the same file as this eM Planner eM Plant Integration chapter.

- **About AMG**

  This menu item opens a message box where you will see the version and date of the current AMG program.

Using your own Plant Simualtion resource objects

Very often it will be necessary to use resources with special behavior. Therefore it is necessary to build up specific resources. To create eM Plant objects which can be used in the model generation process you have to do the following steps.

Build up your resource object using a frame. Call the interfaces for the material flow In1, In2,... for incoming interfaces and Out1, Out2,... for outgoing interfaces.

If there are special attributes for the object, use the same name for the attributes as used in eM Planner. The usage of the attributes has to be defined in the initialization methods.

The following attributes are required by default:

- **proctime**

  This attribute defines the processing time of the resource. The type of the attribute has to be “time” or “real”. The processing time will be defined in seconds.

- **availability**

  This attribute holds the availability of the resource, a real value between 1 and 100.

- **MTTR**

  This attribute represents the mean value of the repair time (mean time to repair). The time is defined in seconds.

- **MTBF**

  Sometimes the mean time between failures is used to define breakdown of the resource. The time is defined in seconds.

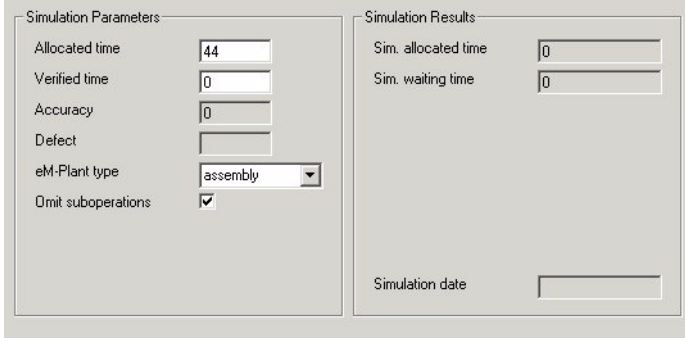
The new resource can be added to the AMG by loading the file DetailedSimulation.spp in eM Plant, click right mouse button in the class library and select "Load object". After loading of the object will be finished open the resource mapping table enter an identifier for the resource, enter the path of the object and enter a constructor method and the attribute mapping if necessary.

If the attribute mapping is not necessary you do not need to load the object by your own. During the generation process AMG first will search for the resource in the resource mapping table. If AMG will not find an entry with the defined eM Plant Type (defined in eM Planner) AMG will search in the objects directory (see Object library) for an object file with the same name as defined in field eM Plant Type of eM Planner. In case the object file exists, AMG will automatically load the object.

Simulation Tabs, Reference

Simulation Tab for Operations

Open the Operation tree and select the Simulation tab which contains additional information about the detailed simulation.



Operation: Plant Simualtion Input Parameters

Parameter	used	Explanation
Allocated time	yes	The operation time in seconds or minutes (according to setting in the Simulation Preferences dialog).
Verified time	-	If no allocated time will be defined the verified time will be used.
Accuracy	-	Not supported yet.

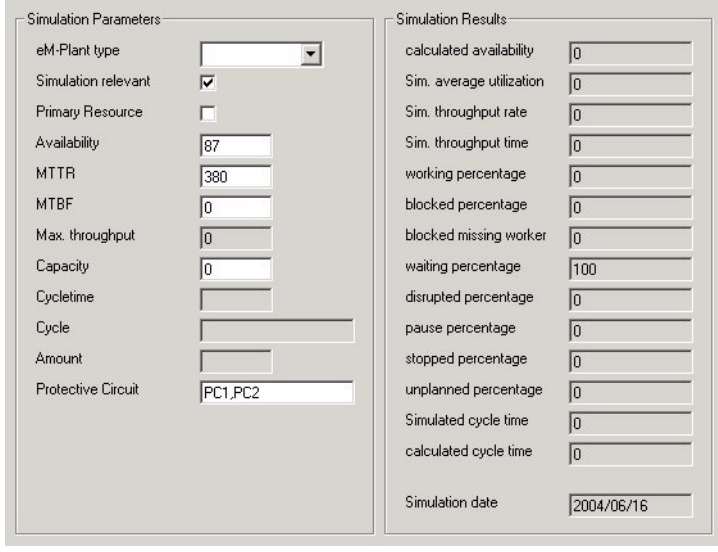
Parameter	used	Explanation
Defect	-	Not supported yet.
Plant Simualtion type	yes	Operation type from a predefined list (assembly,…); if no setting selected, Plant Simualtion determines the operation type according to the part allocation to flows connected to the operation. The default value is empty which means "operation".

Supported Operation Types

Operation type	Description
operation	This is the default operation and is also used when there is no entry in the Plant Simualtion Type field. This operation processes one part at a time. For cases of several parts on incoming flows, the parts are processed one by one in the sequence they arrive.
assembly	Assembly operation; all input parts are consumed and at the end of processing, exactly one part leaves the operation.
disassembly	Disassembly operation; exactly one part enters the operation and several parts leave.

Simulation Tab for Resources

Open the Resource tree and select the Simulation tab which contains a number of text boxes where you enter values for the detailed simulation. It also displays a number of values that result from the detailed simulation.



Resource: Plant Simualtion Input Parameters

Parameter	used	Explanation
Plant Simualtion type	yes	Mapping to an Plant Simualtion object class; resource instances are created in Plant Simualtion using this class.
Simulation relevant	yes	Marks the resource as relevant for the detailed simulation. The default value is 'simulation relevant'.
Primary Resource	yes	If there are several simulation relevant resources assigned to an operation this checkbox can be used to associate a resource with the part once the operation is performed.
Availability	yes	Defines the availability of the resource; range of values: 1 - 100. If there is no value in this field, 100% is assumed.
MTTR	yes	Mean Time To Repair; integer value denoting seconds or minutes according to the setting in the Preferences dialog. One of the values MTTR or MTBF has to be defined with availability between > 0 and < 100. If neither value is defined, availability of 100% is assumed.
MTBF		Mean Time Between Failure; integer value denoting seconds or minutes according to the setting in the Preferences dialog. See above for value definition.
Max Throughput	-	not used yet
Capacity	yes	Integer value denoting the capacity of the Plant Simualtion target object; directly used in buffers; otherwise the value is just copied to the Plant Simualtion custom attribute Capacity.
Cycle time	-	not used yet
Cycle	-	not used yet
Amount	-	not used yet
Protective circuit	yes	String value defining the name of a protective circuit; in the generated Plant Simualtion model a corresponding object is created in the model root frame.

Supported Plant Simualtion Resource Types

The Plant Simualtion resource type defines which Plant Simualtion target objects are created for simulation-relevant Process Designer resources assigned to operations. The resource mapping can be configured.

Note: Simulation-relevant marked resources not used in operations relevant to the simulation are not created on the Plant Simualtion side

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Resource Type	Description
SingleProc	The Plant Simualtion basic object SingleProc is used.
ParallelProc	The Plant Simualtion basic object ParallelProc is used.
Buffer	The Plant Simualtion basic object IOBuffer is used.
Line	The Plant Simualtion basic object Line is used.
Assembly	The Plant Simualtion basic object Assembly is used.
Dismantle	The Plant Simualtion basic object DismantleStation is used.
Station	The Application object Station is used; the functionality is comparable to a SingleProc.

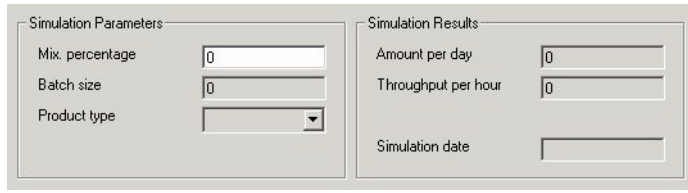
Resource: Plant Simualtion Result Parameter

The values in the right column of the Simulation tab are the statistical results defined after simulation results have been re-imported to Process Designer. Only some of the parameters are used for the detailed simulation.

Parameter	used	Explanation
Calculated availability	-	Not supported yet.
Sim. average utilization	-	Used for Process Designer Interface.
Sim. Throughput rate	-	Used for Process Designer Interface.
Sim Throughput time	-	Used for Process Designer Interface.
Working percentage	yes	Portion where parts are processed on the resource.
Blocked percentage	yes	Portion where finished parts reside on the resource due to blocked or busy successor resources.
Blocked missing worker	yes	The resource could not work due to missing human workers.
Waiting percentage	yes	The resource is ready for processing and waiting for parts.
Disrupted percentage	yes	The resource was in failure mode.
Pause percentage	yes	The resource was in pause mode.
Stopped percentage	-	Not used.
Unplanned percentage	yes	
Simulated cycle time	-	Not supported yet.
Calculated cycle time	-	Not supported yet.

Simulation Tab for Products

Open the Product tree and select the Simulation tab.



The functionality described below, currently not supported, is planned for upcoming versions (all attribute fields are inactive in the current version).

The tab contains the following text boxes:

- Mix. percentage: For cases when there are several products, you can define the percentage of the selected product in the entire production. When only one product exists in the simulation, it is not required to enter a value. When there are several products and you do not specify a value, all products receive an equal portion of the mix. percentage.
- Batch size: The value in this field is used to create batches of the part. If you do not enter a value, 10 is the default.
- Product type: Select the product type from the drop-down control box.
  - S — the product is produced serially in a single flow.

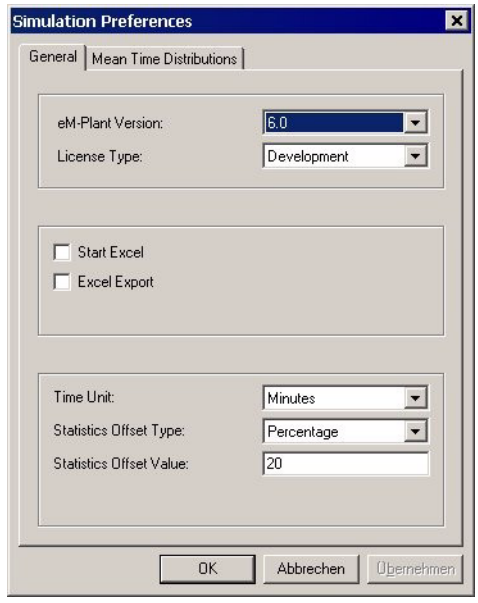
The default Product type value is S, other types are not supported at the moment.

After running a detailed simulation, the fields on the right hand side are filled by the import file created by Plant Simualtion.

- Amount per day: Shows the number of products produced per day
- Throughput per hour: Shows the number of parts per hour.

SimpleDetailedStudy Preferences

The Simulation Preferences dialog is used for Process Designer rough simulation as well as for the detailed simulation. As a result, only some settings are used in the detailed simulation.



Setting	used	Explanation
Plant Simualtion version	yes	Defines the Plant Simualtion version used; recommended value: 7.0.
License Type	yes	Defines whether Plant Simualtion is started in Development, Application or Runtime mode; the corresponding licenses for Plant Simualtion and the AMG module must be present.
Start Excel	-	Only used in Process Designer rough simulation.
Excel Export	-	Only used in Process Designer rough simulation.
Time Unit	yes	The numbers for operation times are interpreted as seconds or minutes in the simulation model.
Statistics Offset Type	-	Only used in Process Designer rough simulation.
Statistics Offset Value	-	Only used in Process Designer rough simulation. You can make corresponding definitions in the Settings tab of the Plant Simualtion EventController dialog.

The MeanTimeDistribution tab settings are not used for the detailed simulation.

Detailed Simulation Configuration

For simulation experts using an Plant Simualtion development license, it is possible to define new classes to be used with the detailed simulation. A description of the requirements for new Plant Simualtion target object structure is beyond the scope of this document. Nevertheless, it is possible to define the set of attributes transferred to the Plant Simualtion objects.

Configuration File

The SimulationTab.cfg configuration file resides in the following folder:

~\Process Designer\Applications\DetailedSimulation

It contains the definition list for values shown in the drop-down lists used in the simulation tabs. Expert users can add or modify these settings according to their requirements.

```
[Resource:eMPlantType]
station
assembly
disassembly
conveyor
buffer
[Operation:eMPlantType]
operation
assembly
disassembly
[Product:ProductType]
S
```

Note: Modifications to these definitions require parallel modifications to the Plant Simualtion mapping table that resides in the Plant Simualtion model DetailedSimulation.spp. Refer to Mapping to Plant Simualtion Target Objects.

Mapping to Plant Simualtion Target Objects

The Plant Simualtion model contains the Process Designer Plant Simualtion Integration dialog with the Configuration tab. This contains a button to open a table for configuring resource types and relevant Process Designer attributes.

The column **plantType** defines names for simulation object classes. Each resource type configured for the Plant Simualtion type of planner resources should be maintained here.

The Path column contains a pointer to the class object in the Plant Simualtion class library. All configured class objects are located in the following Plant Simualtion folder:

.ApplicationObjects.AMG.ModelGeneration.Objects

It is possible to point to Plant Simualtion classes in different locations.

If there is no object class specified, Plant Simualtion searches the entire class library (with the exception of the Internal folder) for an object with the corresponding name. The default object (station) is used if no object is found.

The Method column points to an Plant Simualtion method that is executed after the simulation model is generated. This functionality should be used by Plant Simualtion experts only.

	string 0	object 1	string 2	table 3
ng	plantType	path	method	Attributes
	singleproc	.ApplicationObjects.AMG.ModelGeneration.Objects.SinglePro		
	ParallelProc	.ApplicationObjects.AMG.ModelGeneration.Objects.ParallelPr		at
	Station	.ApplicationObjects.AMG.ModelGeneration.Objects.Station		
	Assembly	.ApplicationObjects.AMG.ModelGeneration.Objects.Assembly	createAssembly	att
	Rework	.ApplicationObjects.AMG.ModelGeneration.Objects.ReworkAr		
	DismantleStatio	.ApplicationObjects.AMG.ModelGeneration.Objects.Dismantle	createDismantle	
	dismantle	.ApplicationObjects.AMG.ModelGeneration.Objects.Dismantle	createDismantle	
	disassembly	.ApplicationObjects.AMG.ModelGeneration.Objects.Dismantle	createDismantle	

Plant Simualtion Configuration Table

Note: Attributes can be viewed, used and evaluated on the Plant Simualtion side but in the current version, the attributes are not updated during the import of simulation results to Process Designer. This functionality is planned for the next version.

You can define a set of attributes (name and data type) for each object in this table. When the object is generated, AMG checks whether the defined attribute exists. If not, AMG creates the attribute using the given data type. AMG attempts to locate the attribute's value in the data transferred from Process Designer and assigns the value to the attribute.

If you wish to define the attribute in Process Designer you must add it to your project's customization.

Attribute set copied to simulation target objects
You enter Process Designer attribute names in the AttrName and AttrTypeX columns. These attributes are transferred to the Plant Simualtion target objects. The Plant Simualtion model generation creates customized attributes of the corresponding type and copies the Process Designer attribute value to the simulation object.

The configuration table is predefined for 8 attributes. However, additional pairs of attribute columns can be added to the configuration table.

Note: Attributes can be viewed, used and evaluated on the Plant Simualtion side, but in the current version, the import of the attributes to Process Designer does not update the simulation results. This functionality is planned for the next version.

In the default implementation, only predefined attributes are used. It is a requirement that simulation experts integrate the use of additional attributes into the Plant Simualtion model.

Additional Modeling Constraints

In addition to the constraints described in Preparing an Plant Simualtion Simulation Study, users should also make sure to fulfill the following requirements for the structure of process models intended for simulation in Plant Simualtion:

- You may not place human objects below a simulation-relevant resource that is mapped to an Plant Simualtion target object.
- You may not place a simulation-relevant resource below another simulation-relevant resource that is mapped to an Plant Simualtion target object.
- In Process Designer, it is possible to allocate simulation-relevant resources and humans to twin resource, but this information is not exported.

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