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Computer Simulation of Logistics Processes

Standard Objects of Plant Simulation

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Standard Objects of Plant Simulation

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Aim of the lecture

- To introduce objects usage and functionalities of the following groups:
  - Information Flow,
  - UserInterface,
  - MUs,
  - Tools.

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Structure of the lecture

- Standard objects of group “Information Flow”:
  - DataList, DataStack, DataQueue.
  - TimeSequence.
  - Trigger, Generator.
  - AttributeExplorer, XMLinterface, FileInterface, FileLink.
- Standard objects of group “UserInterface”:
  - Comment, Display, Chart, HtmlReport, Dialog, Checkbox, DropDownList, SankeyDiagramm.
- Standard objects of group “MUs”:
  - Part, Container, Transporter.
- Standard objects of group “Tools”:
  - BottelneckAnalyzer, ExperimentManager, GAWizard, TransferStation.

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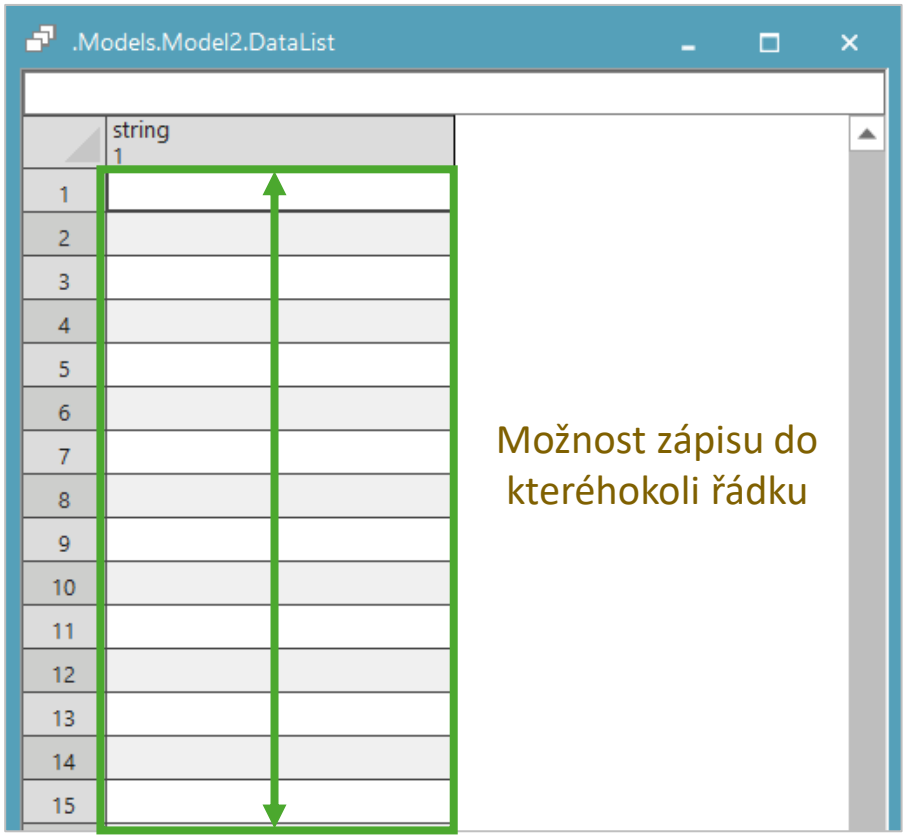
DataList

- Icon 
- Object of the group “Information Flow“.
- It is used as a data queue.
- “DataList” is a list with one column, which is characteristic with the possibility of random access to each of positions inside. Each cell is addressed by a row number. An incoming Part causes the movement all other entities behind, they are moved one position lower.
- We can think of it as a “card file catalogue”, similar to those used in libraries.



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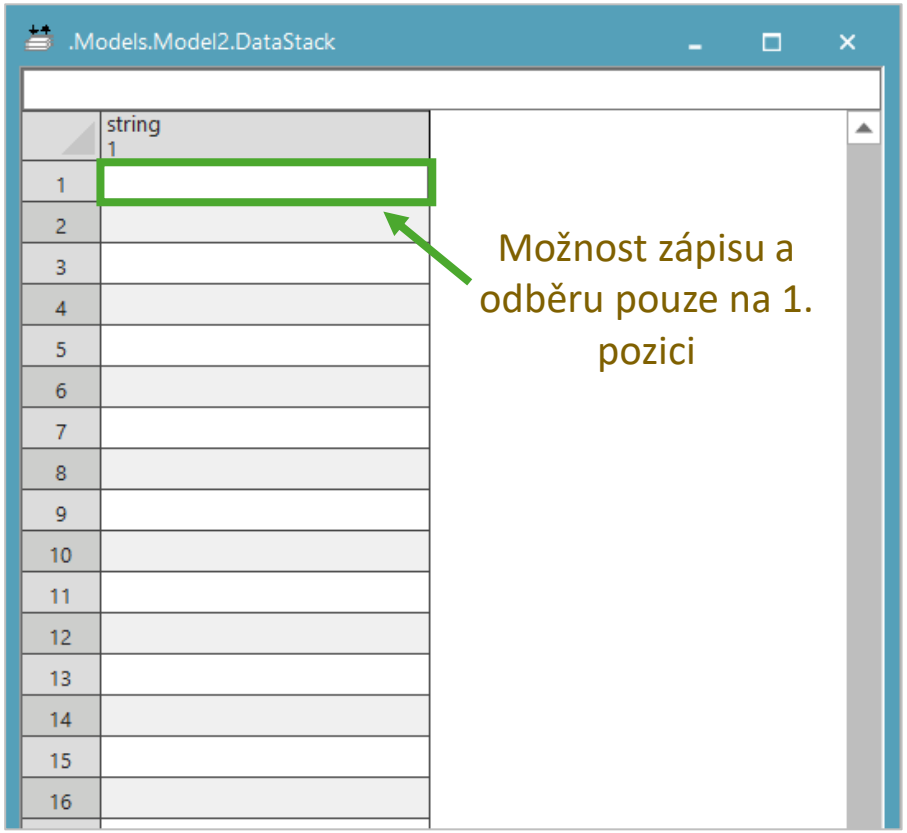
DataStack

- Icon 
- It is used as a queue of data type buffer (stack).
- “DataStack” is a list with one column, which is characteristic with the possibility to access to data in strategy LIFO (Last In First Out).
- Plant Simulation always accesses to data in objects in the upper row. It always uses the first row for inserting object or its taking-out.
- The example is washing dishes. One person washes the plates and stacks them, another person wipes them, i.e. takes plates from the top of stack. Another example is the system of using shopping carts at shopping centers or stacking pallets.



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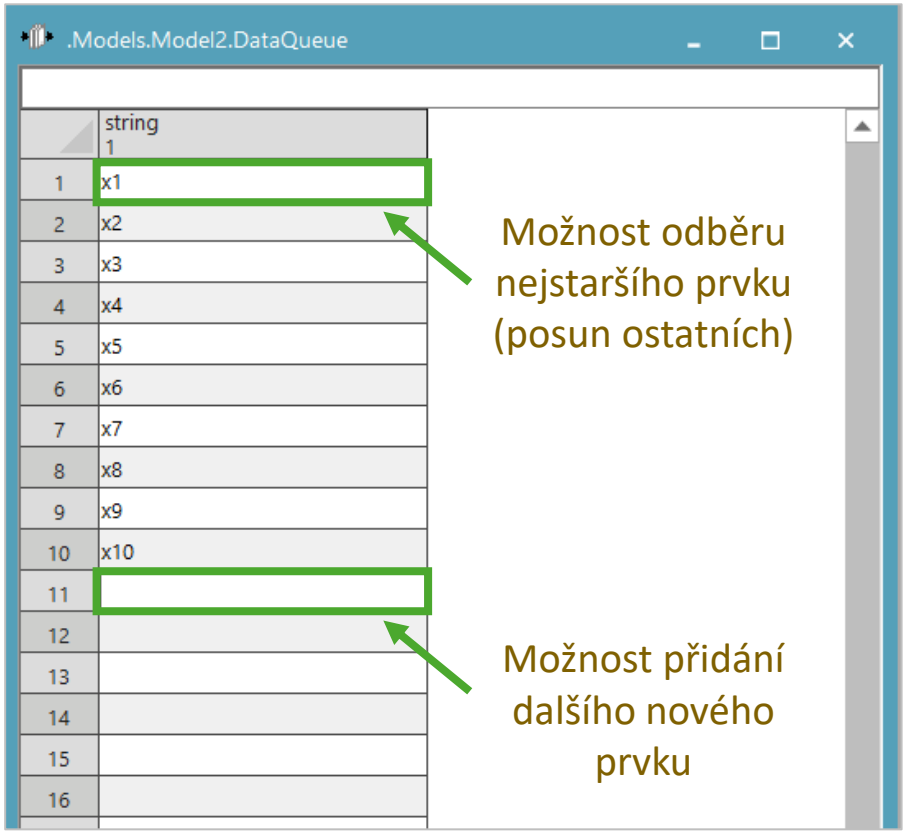
DataQueue

- Icon 
- It is used as data queue.
- “DataQueue” is a list with one column, which is characteristic with the possibility to access to data in strategy FIFO (First In First Out). Each cell is addressed by a row number.
- The object which enters is written on the new last row of the list. The taken-out object is always the oldest one i.e. on the first row. This leads to one-position-up movement of all objects in the list.
- Typical example of this system is ”traffic jam”.



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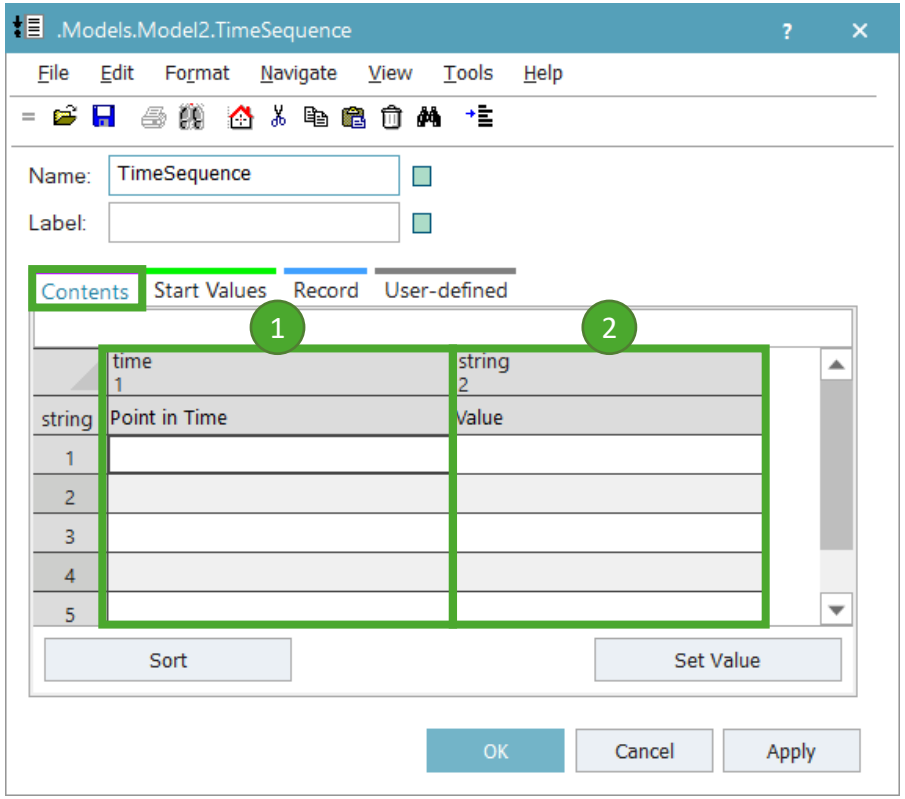
TimeSequence

- Icon 
- It is used as a schedule of time activities.
- The first column is used for entering of time values (1) and the second one for the values associated to this time (2).
- It can be used to record, manage time-related values such as shift schedules and equipment maintenance schedules.
- The object behaves as a list with one column, where cannot be a blank cell or pairs of blank cells.



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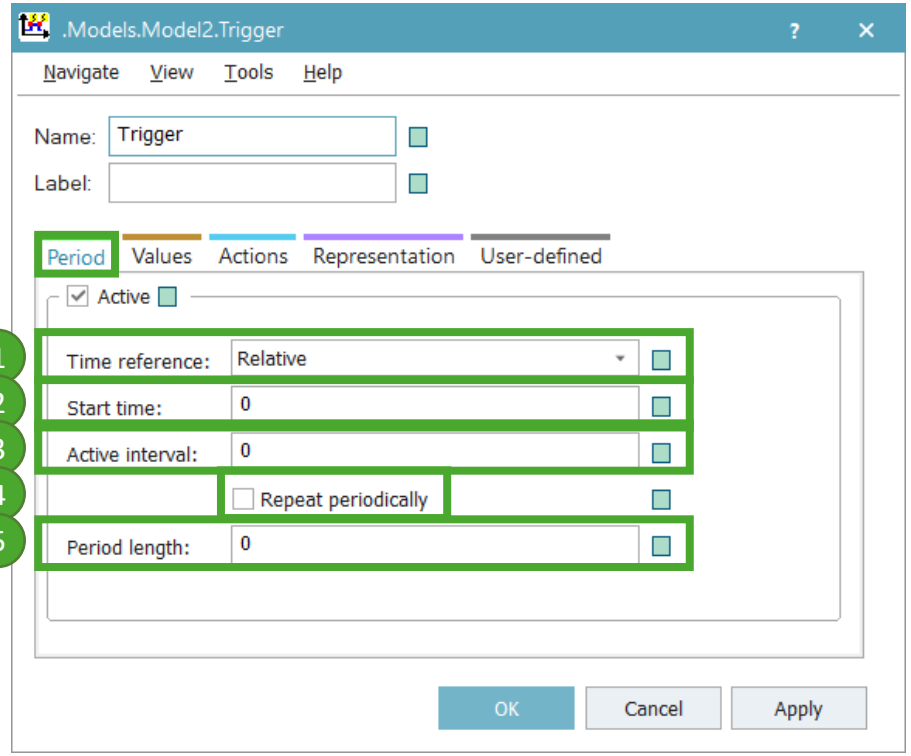
Trigger

- Icon 
- It is used as a trigger of events.
- “Trigger” is able to activate methods and events programmed by them, in the exact time intervals.
- “Time reference” allows to set “absolute” or ”relative” time (1).
- “Start time” represents a time moment, from which “Trigger” starts to work (2).
- “Active interval” (3) defines time interval in which the “Trigger” will be active.
- “Repeat periodically” allows to repeat cyclically defined interval (4).
- “Period length” (5) specifies the duration of one-time cycle during simulation tests. If the box (4) is activated, the cycle will be repeated after the end of period.



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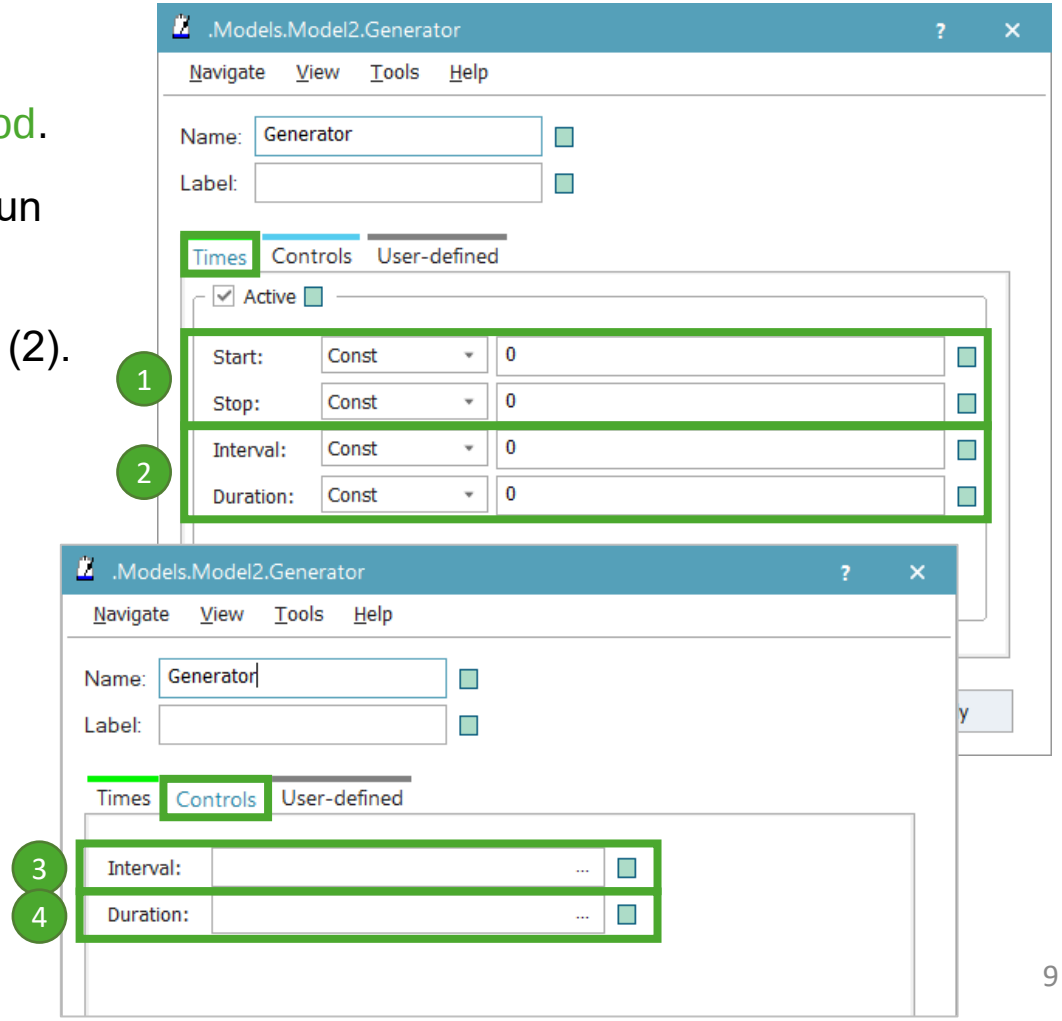
Generator

- Icon 
- It is used as a tool to activate methods in specific interval or period.
- Options “Start” and “Stop” activate the first and the last method run (1) and (2).
- “Interval” defines the time between two activations of the interval (2).
- Option (3) assigns a method to that interval.
- “Duration” determines time range between “Interval Control” (3) and “Duration Control” (4). “Duration Control” can occur always after the “Interval Control”.



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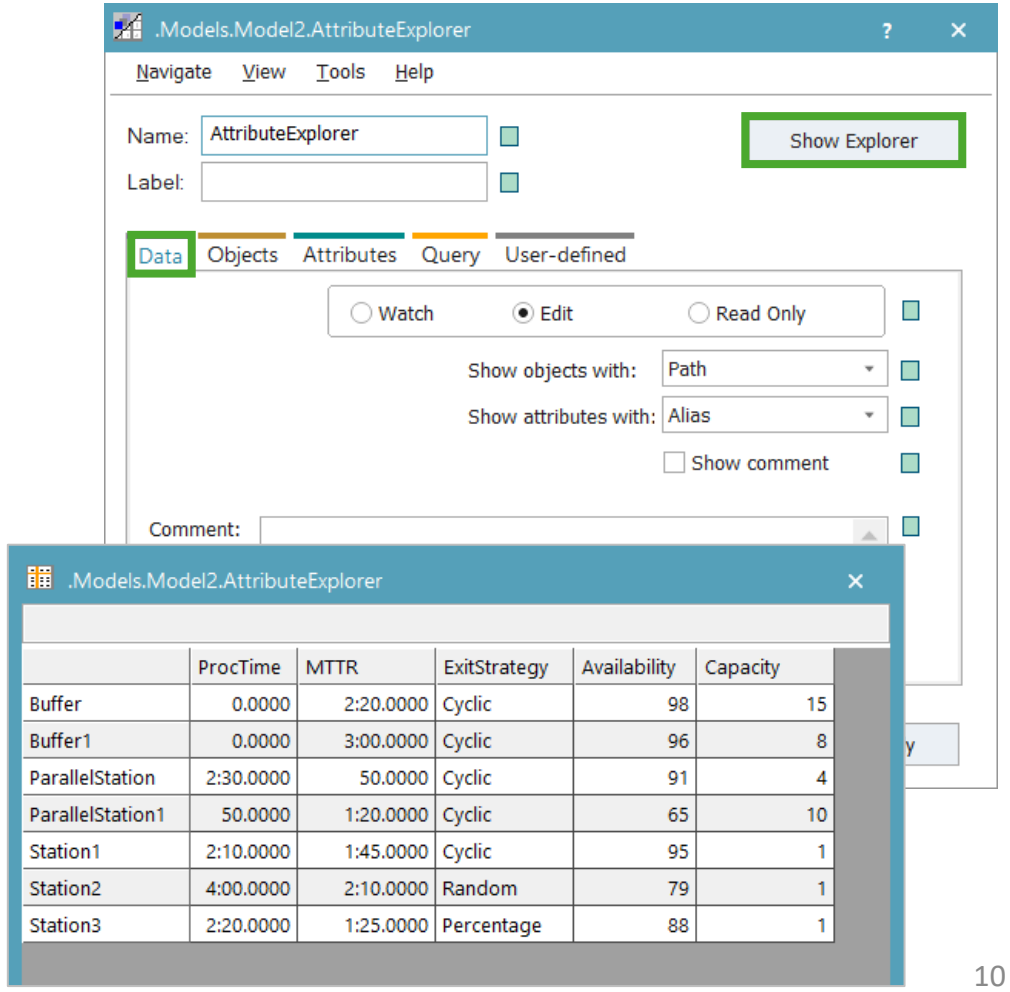
AttributeExplorer

- Icon 
- It is used as a tool for reading, monitoring and modifying attributes of individual objects in one table.
- Different values can be entered, e.g.:
  - Capacities.
  - Processing times.
  - Mean time to repair.
  - Selected strategies.
- Attributes setting can be exported, table modification can be done afterwards out PS (e.g. in MS Excel) and then imported back again. We can test several variants.



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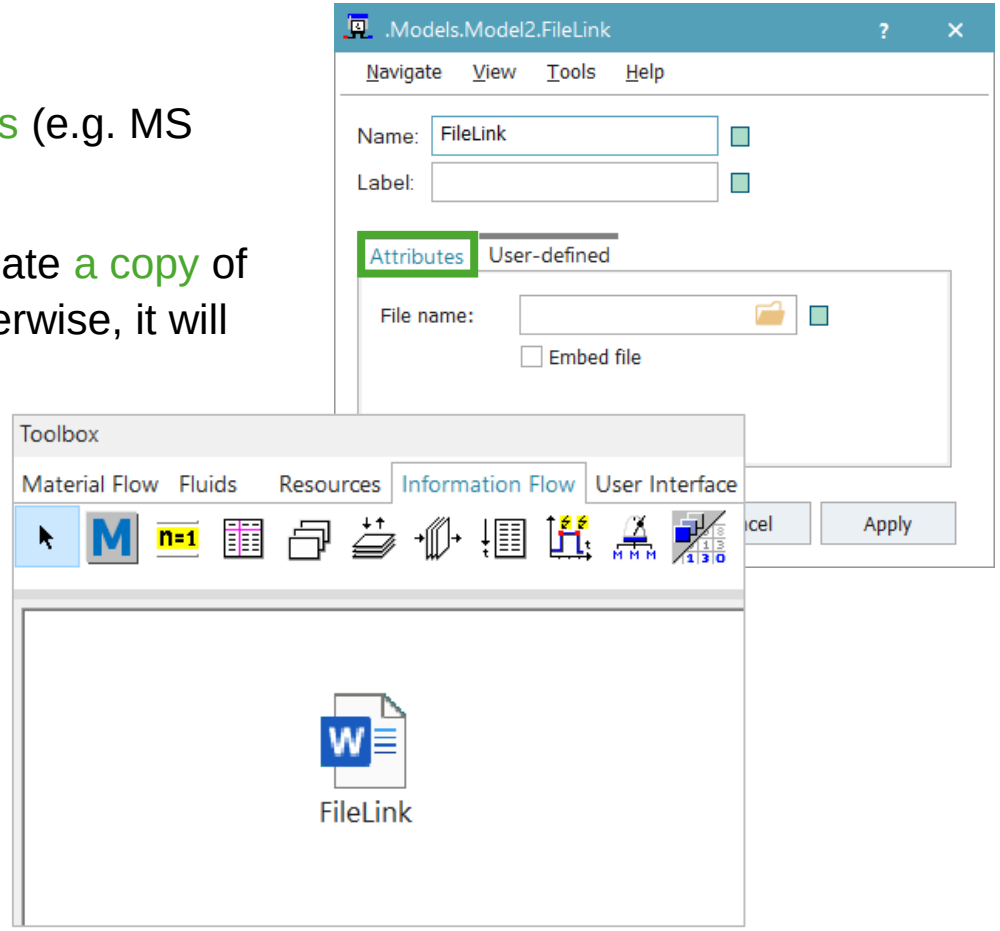
FileLink

- Icon 
- It is used for inserting of files from different data sources (e.g. MS Office), straight into the “Frame” (1).
- While inserting a file we are asked (2), if we want to create a copy of file in the “Frame”? Selecting “Yes” will ensure this, otherwise, it will be only a link on the file.



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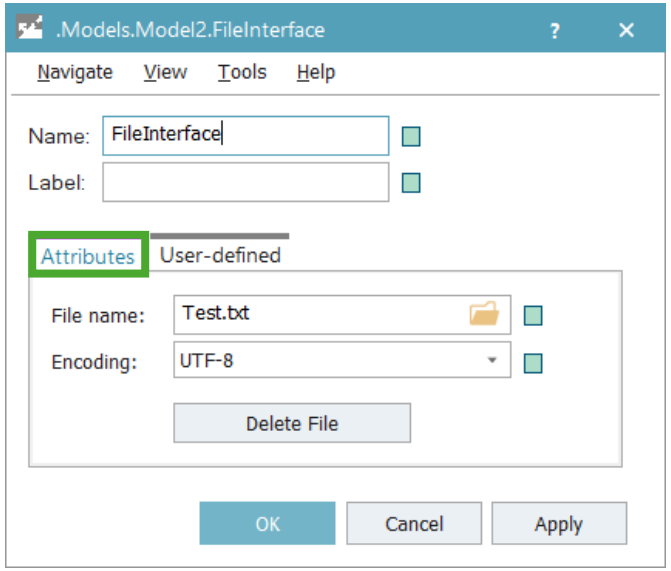
FileInterface

- Icon 
- With this object we can access to data created in other applications. So, we can create “*.txt” files and import them into the PS environment during simulation run.
- “FileInterface” supports only characters of following type:
  - Letters.
  - Numbers.
  - Special characters.



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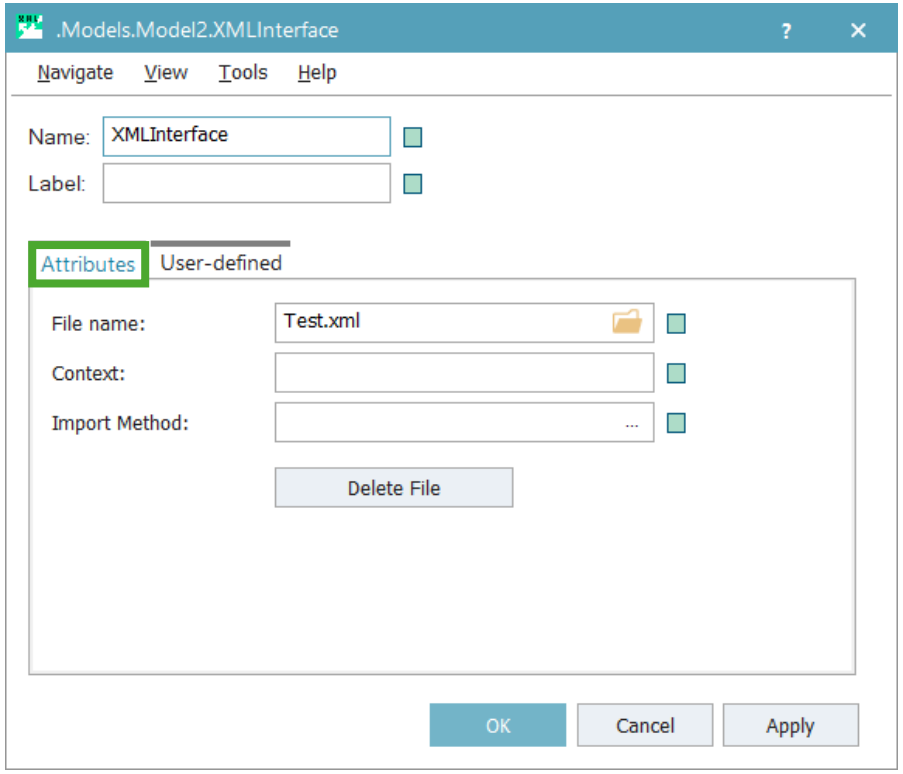
XMLinterface

- Icon 

- It is used as a tool for reading and retrieving data from XML files.
- XML documents have defined structure in ASCII format.
- In this way, data can be loaded in PS e.g. data exported from Process Designer or XML databases.



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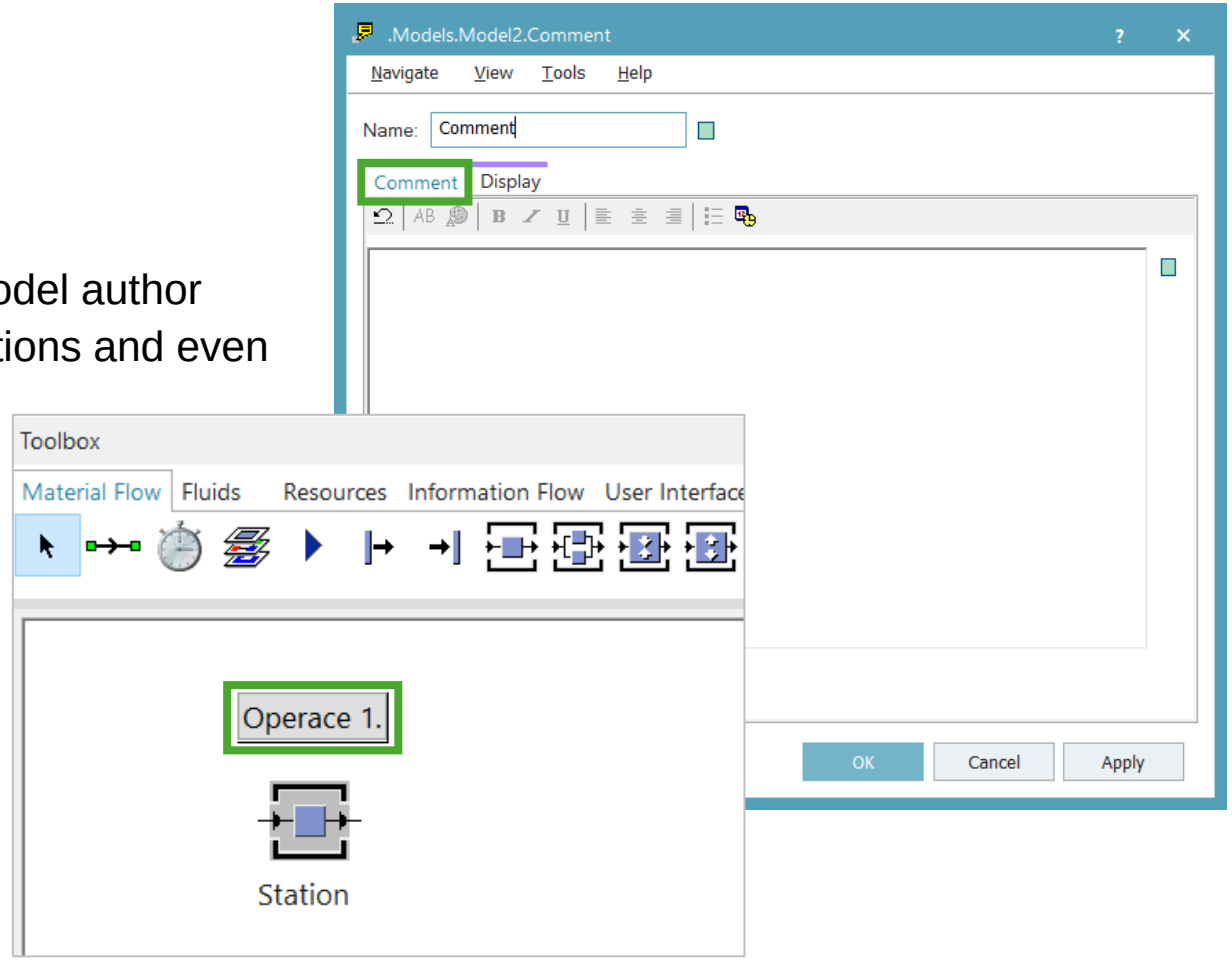
Comment

- Icon 
- Object of the group “User Interface“.
- It used to describe model in words.
- It is useful mainly for teams of coworkers, where the model author can describe and explain useful details, particular situations and even more difficult and complex logic of the model etc.
- It contains simple editor, so it is possible to work with different letter fonts and colors.



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Display

- Icon 
- Object, which is able to show values of different attributes (1) during the simulation run.
- In displayed figure, it monitors failures value of station “SingleProc” i.e. what is the percentage of failures (2) in the device‘s time fund.
- The option “Interval” (3) allows to define time interval, in which the values of the object “Display” will be updated.

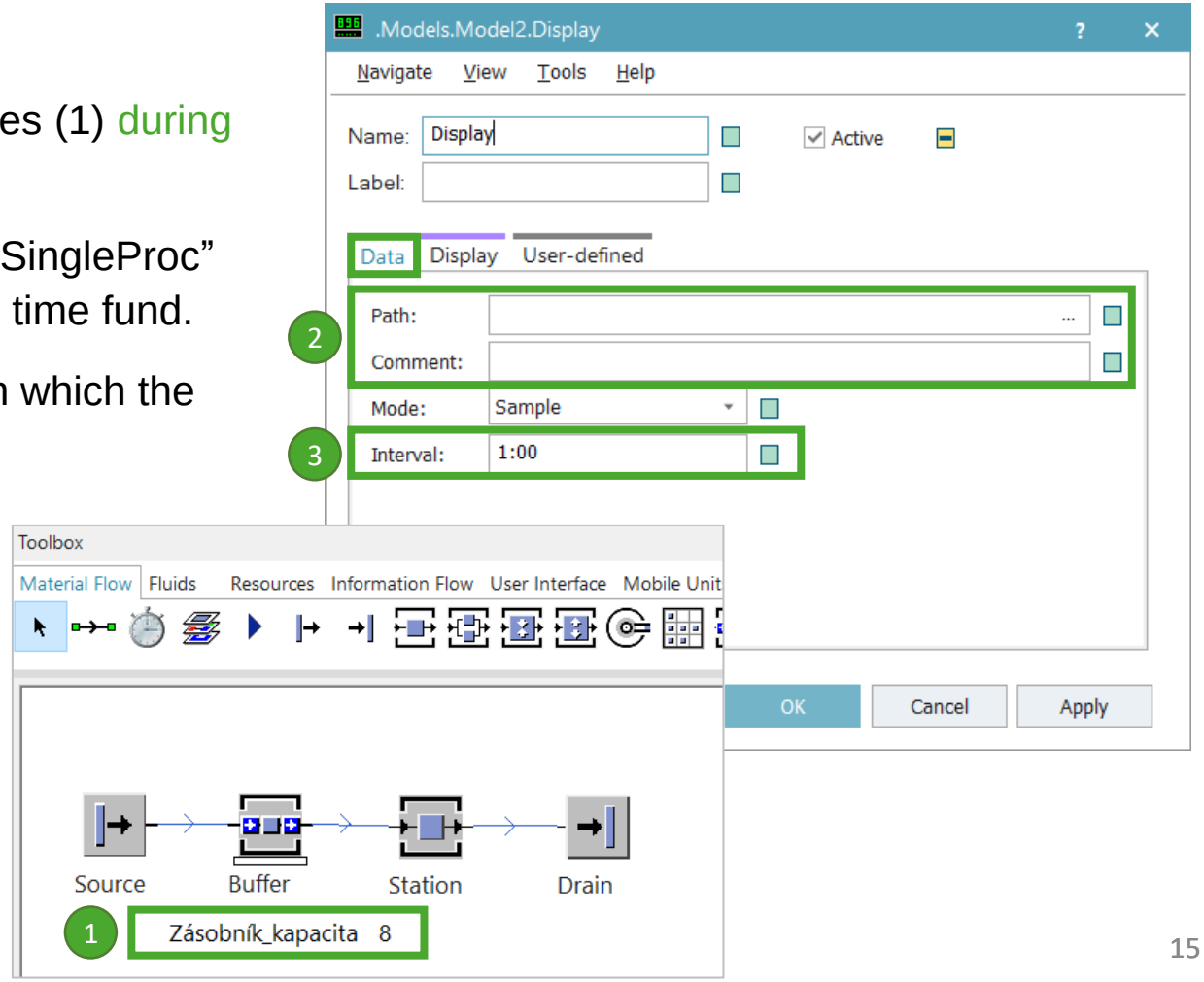

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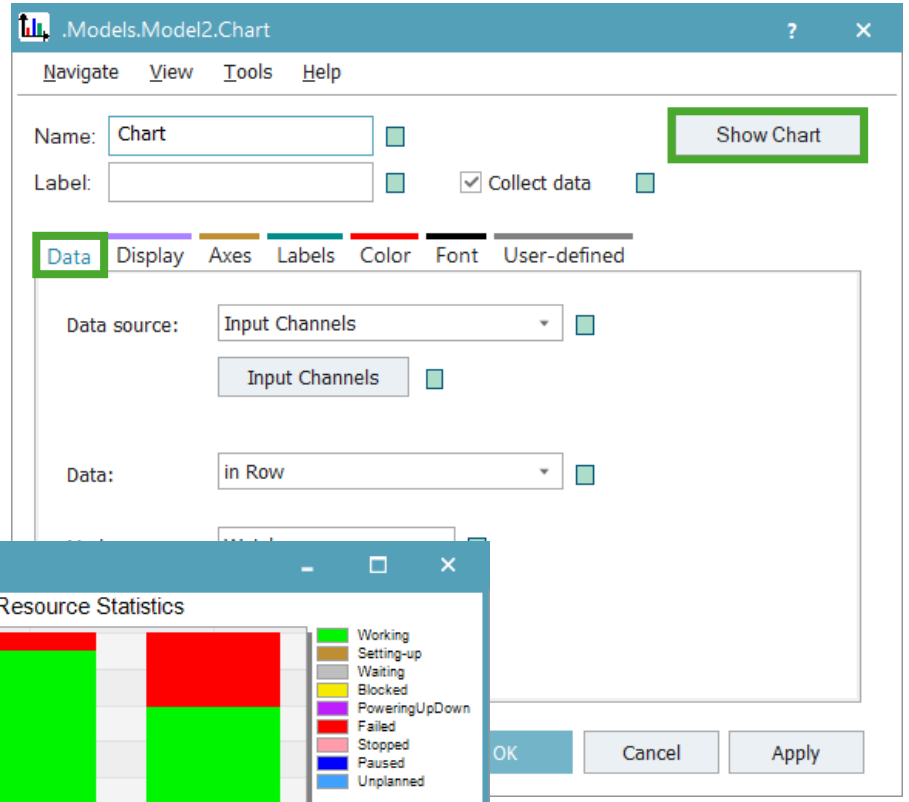
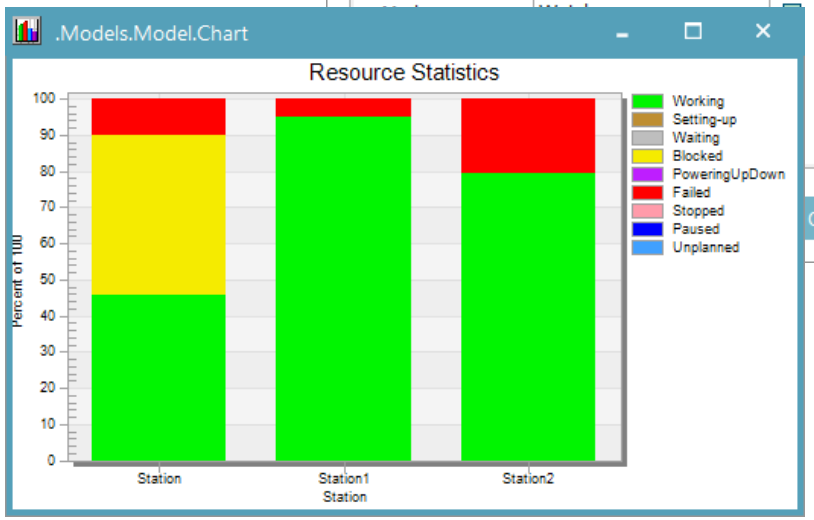
Chart

- Icon 
- The object allows to graphically display the process of monitored variables in simulation time.
- Graphs are very useful not only for the presentation of simulation experiments outputs, but also in the phase of model validation.
- We can select from several graph types (e.g. line, bar, histogram etc.).
- Graphs can be displayed by clicking on the icon, or by animating of this icon as graph itself. Then it is possible to monitor the graph activity directly in the ”Frame” during the simulation experiment.
- Interval of the graph update can be set (it is related to the speed of the simulation experiment).





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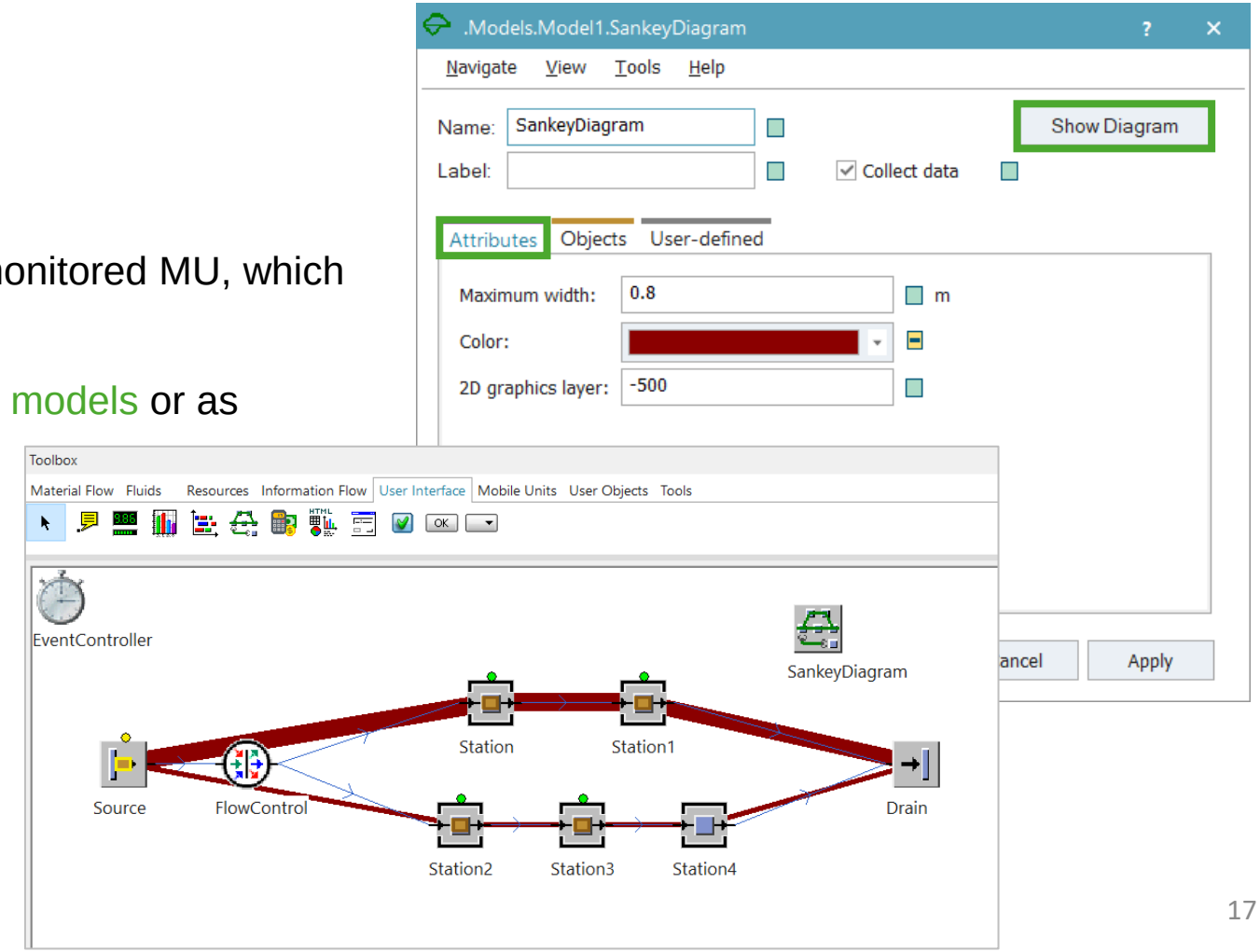
SankeyDiagramm

- Icon 
- Object of the group “Tools”.
- SankeyDiagramm shows material flow intensity.
- It is possible to see individual graph for each of monitored MU, which represents individual intensity in production mix.
- This functionality is useful for debugging complex models or as a supporting material for presenting the results of simulation experiments.



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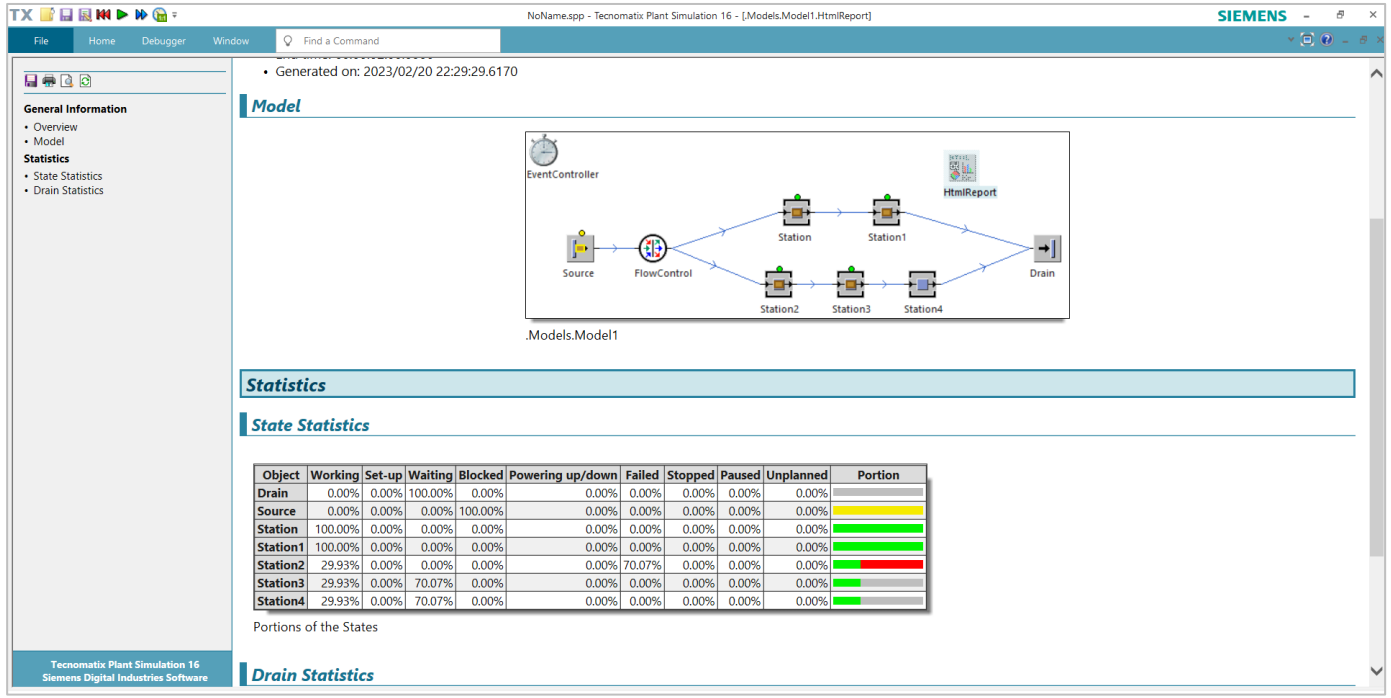
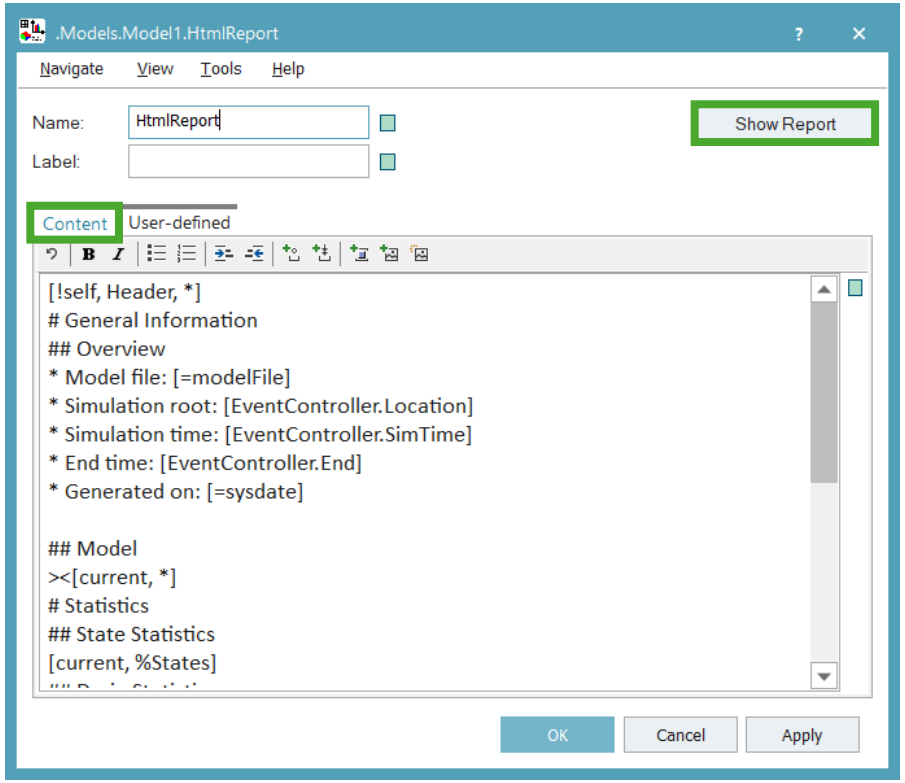
HtmlReport

- Icon 

- An object used to display the results of simulation tests into overview images, tables and diagrams via HTML page.





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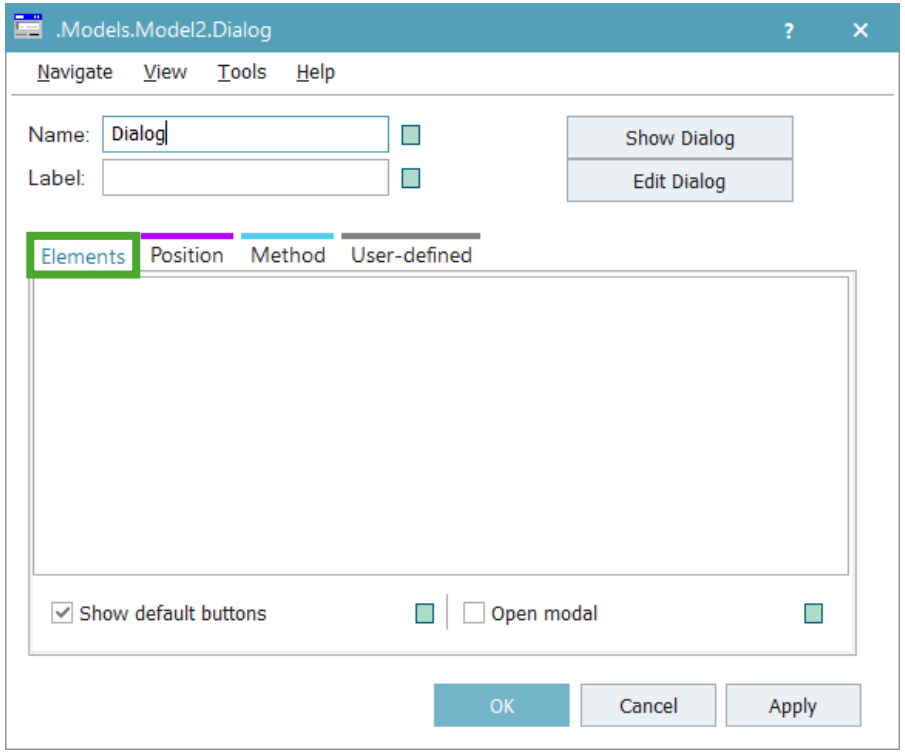
Dialog

- Icon 
- It allows to create dialog interface for more complex models that users can work with. In this way, the PS model gets important information for the right run of simulation experiment.
- The interface prevents from accessing the model and making incorrect changes by uninformed users.



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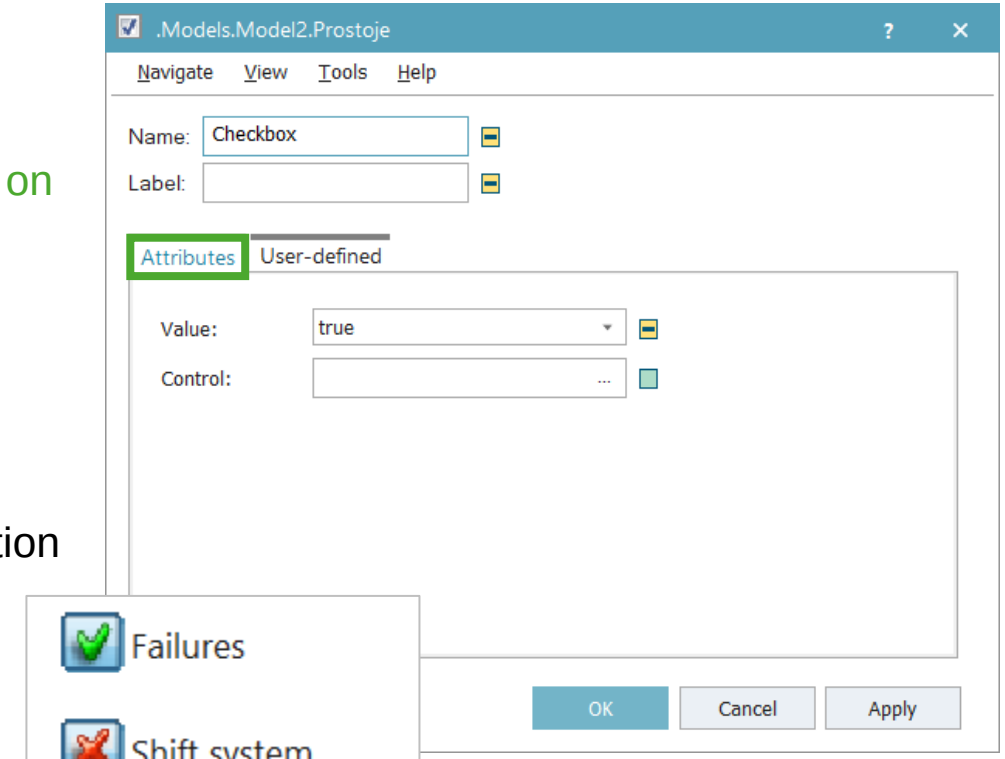
Checkbox

- Icon 
- Allows to define quick interface, which allows to change variable parameters (and even the conditions in the model) by just one click on box.
- Variable is “Boolean” type, i.e. “True/False”.
- It is an individual option for PS user, i.e. possibility of programming “Checkbox” functionalities by form of method are quite wide.
- In case of simulation tests it is possible to enter whether the simulation experiment will respect Failures (YES), Shift system (NO), Supplier failures (YES).



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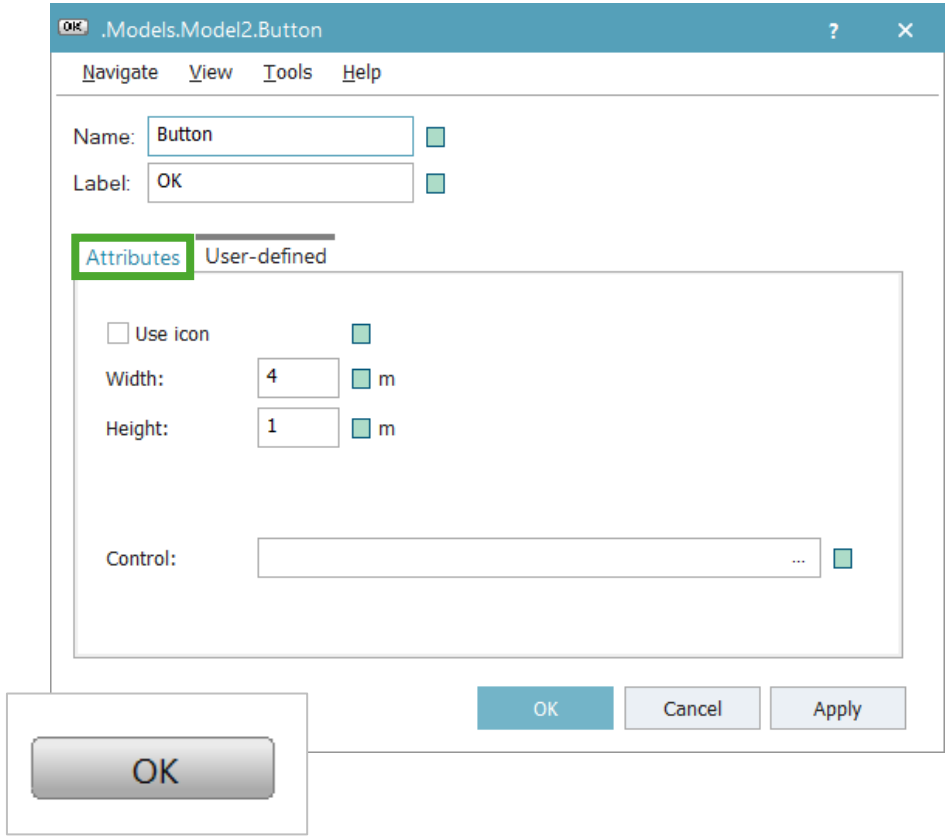
Button

- Icon 

- The button allows to do action, programmed via method, which is entered in the dialog box Control.
- It is useful to change the icon image:
  - e.g. to start video 
  - and to stop video 



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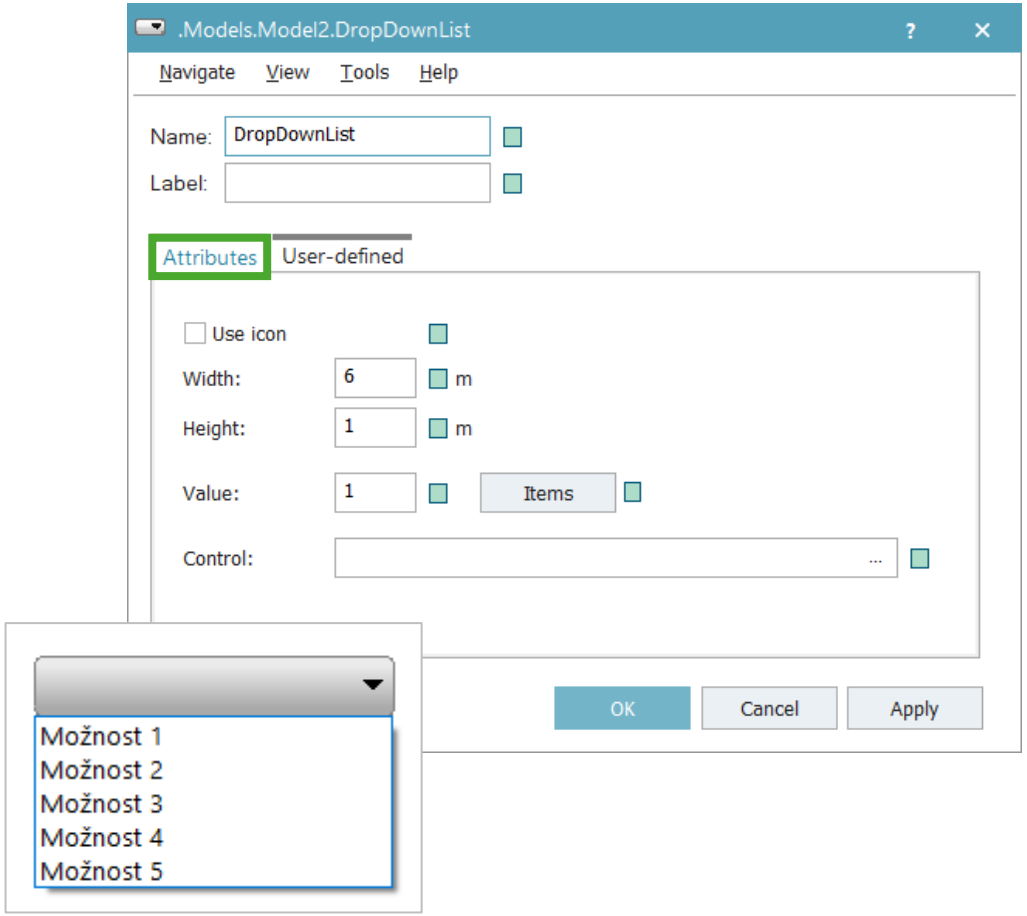
DropDownList

- Icon 
- Characteristics are similar as the “Checkbox” has, but with the possibility to define more variants, which can be changed by user. Typically, it can be different variants of input data or different management strategies for a given production area.
- It is individual option of PS user, i.e. possibilities of programming “User Interface” functionalities by form of method are quite wide.



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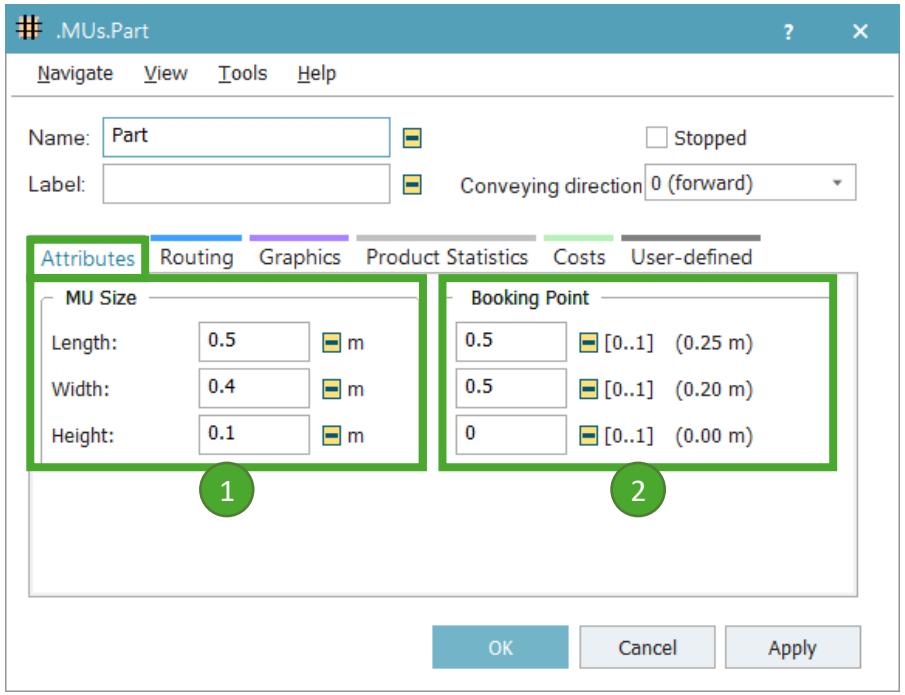
Part

- Icon 
- Object of the group “Mobile Units”.
- Basic object, which represents a moving material object, without the possibility to carry some other objects.
- We can consider this object as:
  - Product.
  - Part.
  - Component part.
- “Part” has defined length, width and height (1).



- “Booking Point” (2) define the point from which the “Part” is identified by other objects as incoming. It is important parameter of length-oriented objects and it is often located in the center of the “Part”.

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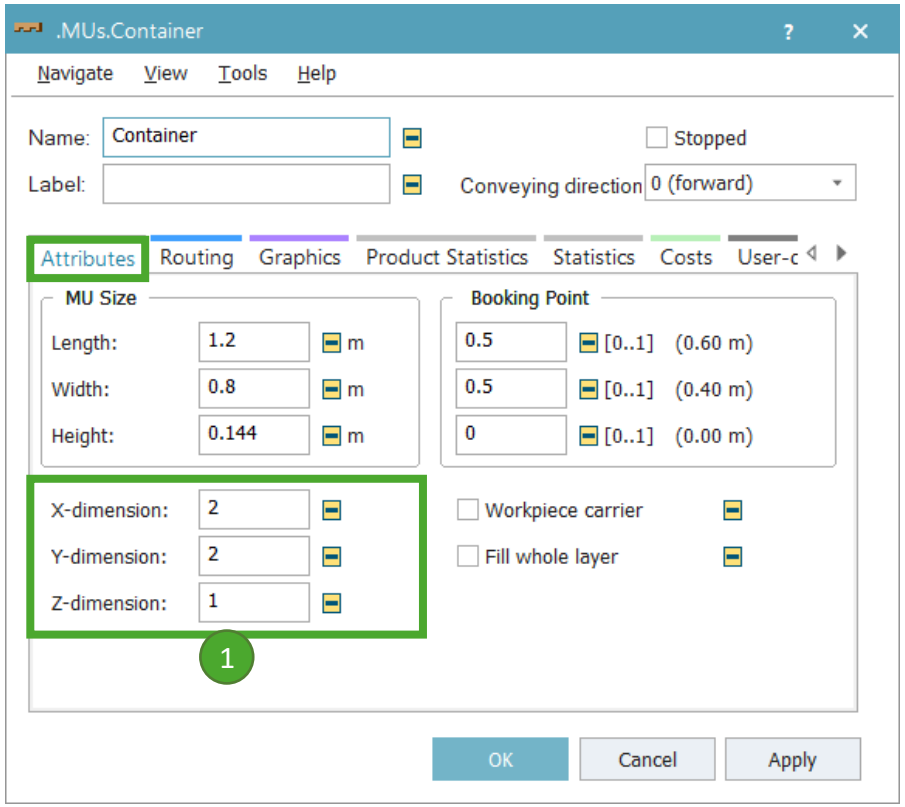
Container

- Icon 
- Object of the group “Mobile Units”.
- “Container” represents a moving object, which is possible to carry some other objects of ”Part” or “Container” type.
- We can consider this objects as:
  - Pallet.
  - Crate.
  - Box.
- The capacity carried by the “Container” is defined by “X-dimension”, “Y-dimension” and “Z-dimension” (1) of the loading space.



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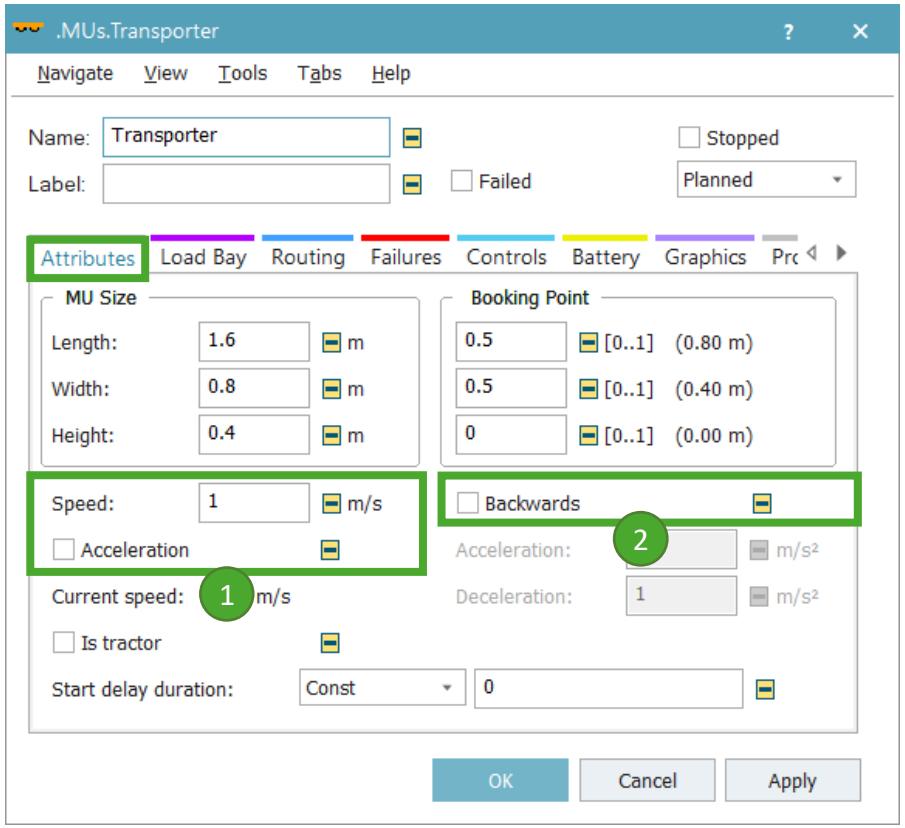
Transporter

- Icon 
- “Transporter” is an active object of the material flow.
- It moves itself on the length-oriented objects (forwards or backwards):
  - “Track”.
  - “TwoLineTrack”.
- It is able to carry “Part”, “Container” or another “Transporter”.
- The object has several parameters such as:
  - Speed and acceleration (1).
  - Backward drive (2).
  - Use as a "Tractor" (for pull and push transport systems).
  - Automatic finding of a path.



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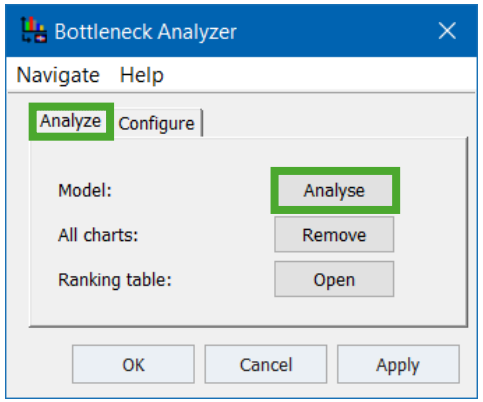
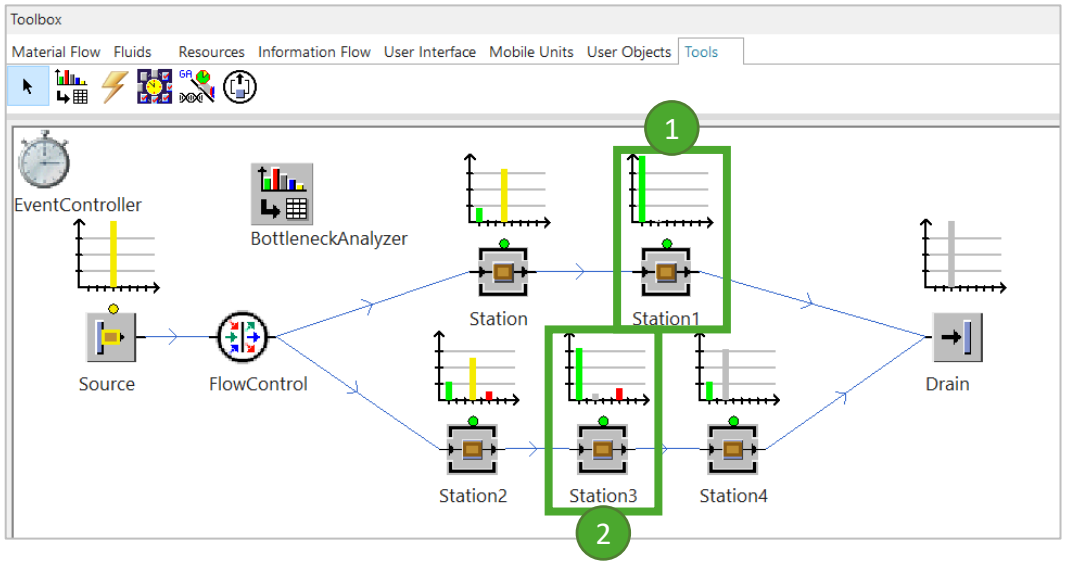
BottleneckAnalyzer

- Icon 
- Object of the group “Tools”.
- The objects displays static statistical data of simulation in the form of charts (1) and (2). It is not possible to monitor these data during the simulation run, only after its end.
- In the figure, objects Station1 and Station3 are probably the bottleneck places of individual branches of production flow (they use 100% of processing time and cause waiting at previous workplaces). We can assume that by speeding up processing on the bottleneck places, the throughput of the system, as a whole, is increased (up to the limit of another bottleneck).





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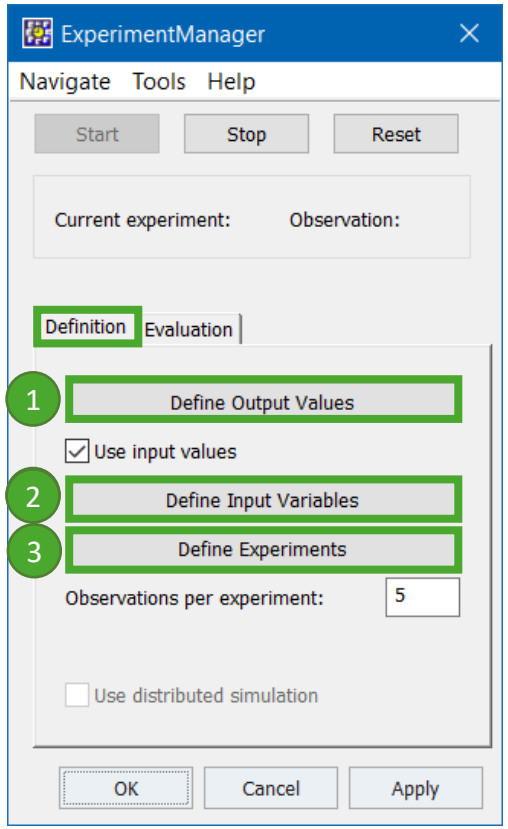
ExperimentManager

- Icon 
- Object of the group “Tools”.
- An effective tool for running large-scale experiments.
- Useful when:
  - we are searching different variants of inputs,
  - we want to achieve statistically significant results.
- A typical use is to define experiments and run simulation experiments overnight (only one license is needed).
- For right functionality it is necessary to define:
  - Output values (1).
  - Input values (2).
  - Matrix of experiments (3).



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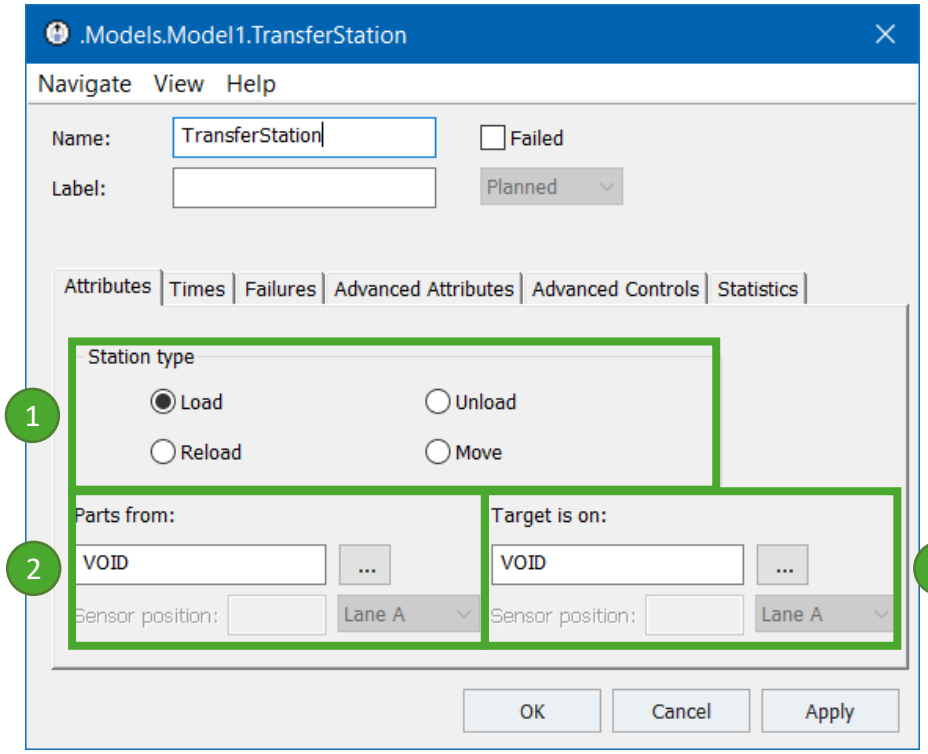
TransferStation

- Icon 
- Object of the group “Tools”.
- Object “TransferStation” represents transfer station or robot.
- It has these functionalities:
  - “Load” (1) – is used for loading of parts from source station on ”Container” or “Transporter”.
  - “Unload” (1) – is used for unloading of parts from “Container” or “Transporter” objects to target station.
  - “Reload” (1) – is used to reload part between two objects of
  - “Container” or “Transporter”.
  - “Move” (1) – is used to move part from one station to another one.
  - “Parts from” (2) and “Target is on” (3) defines places “from – on” MUs should be loaded, unloaded or reloaded.



Thank you for attention

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