

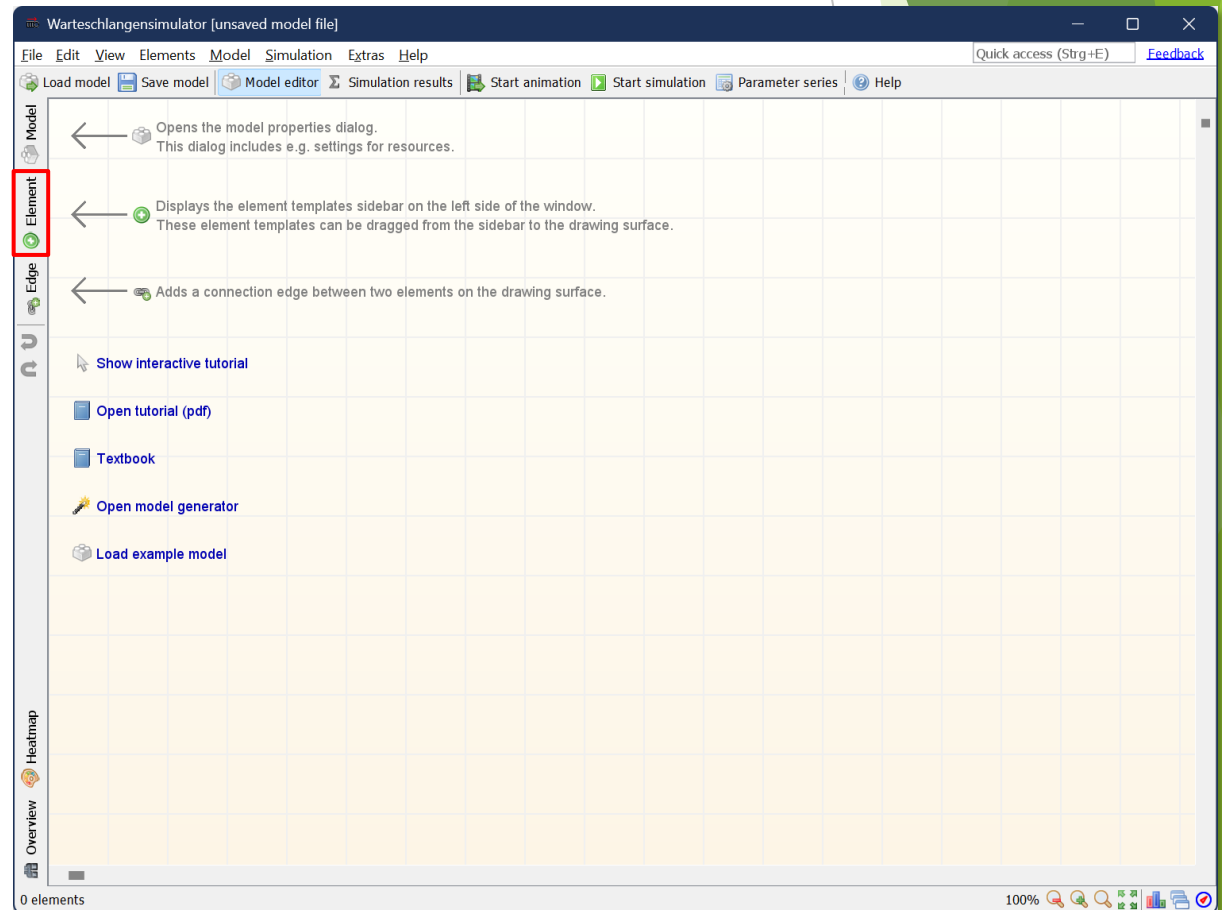
Warteschlangen- simulator

Tutorial:
Creating a first queueing model

Alexander Herzog
TU Clausthal / SWZ
www.simzentrum.de

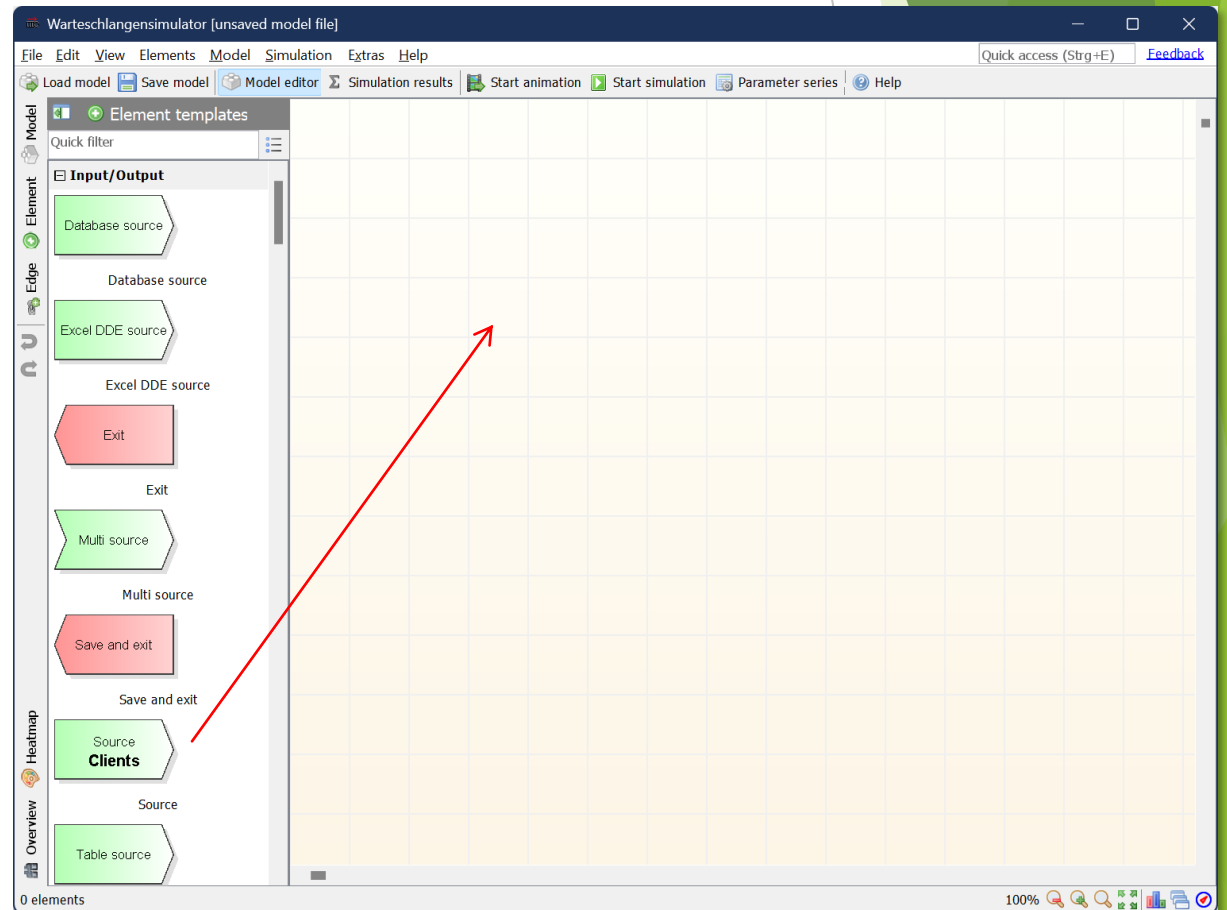
Adding stations to the model (1)

- ▶ In Warteschlangensimulator queueing systems are modelled in form of flow charts.
- ▶ Our model will consist of a source, a process station and an exit element.
- ▶ To add these elements to the drawing surface open the element templates panel by clicking on “Element” on the left toolbar.



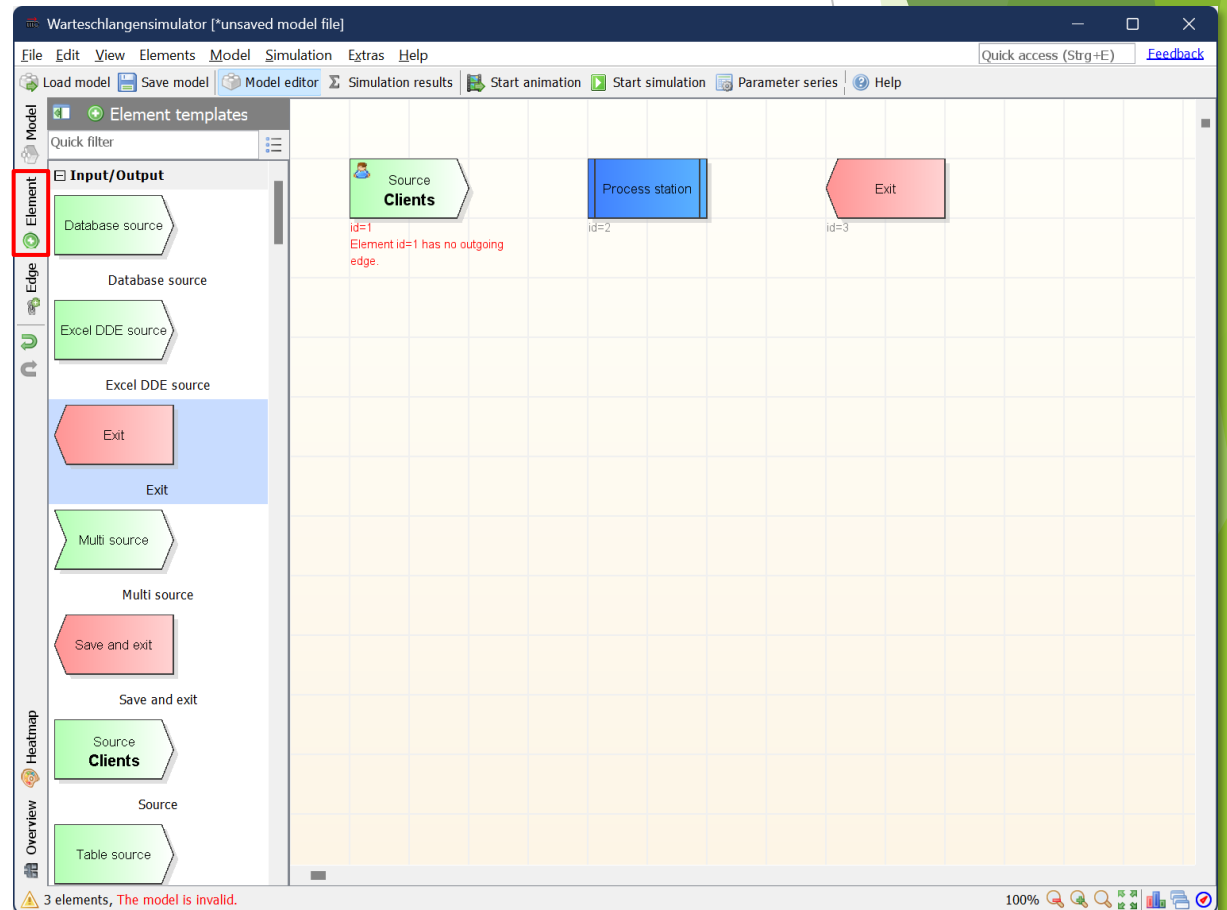
Adding stations to the model (2)

- ▶ Drag and drop a “Source”, a “Process station” and an “Exit” to the drawing surface.



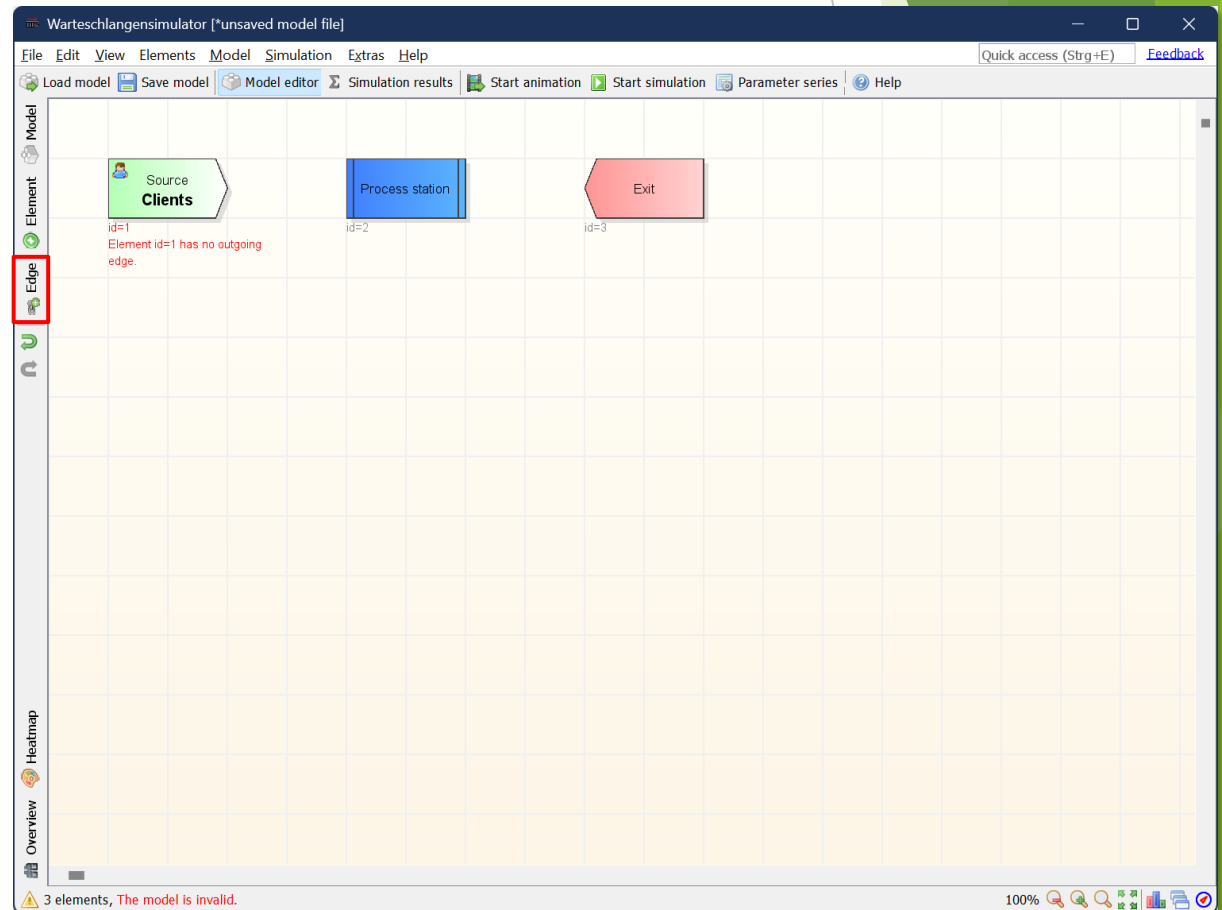
Adding stations to the model (3)

- ▶ After adding the elements again click on “Element” to close the templates panel.



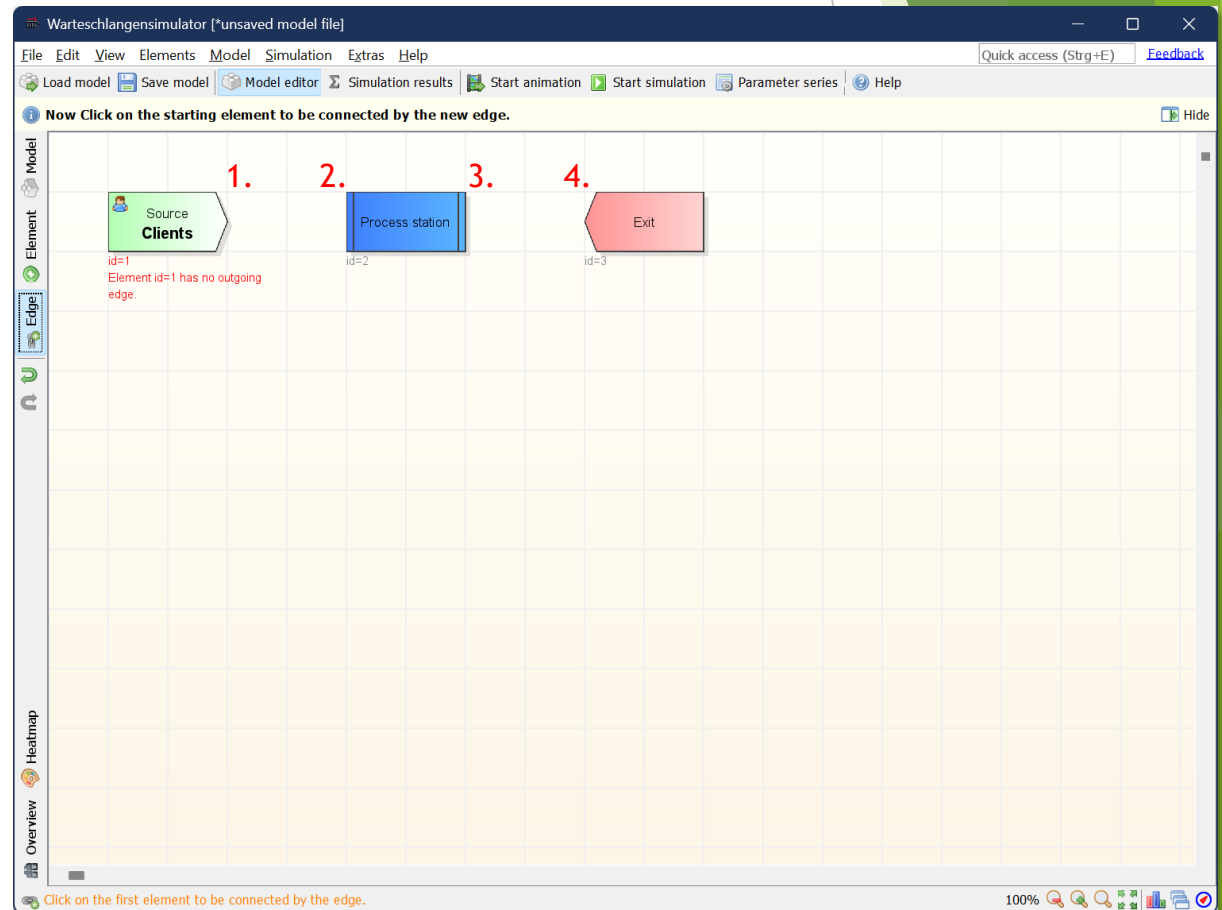
Connecting the stations (1)

- ▶ As next step, the three stations need to be connected.
- ▶ Clients created at the source are to be directed to the process station. After being served the clients should leave the system via the exit station.
- ▶ To activate the connections adding function click on the “Edge” button on the left toolbar.



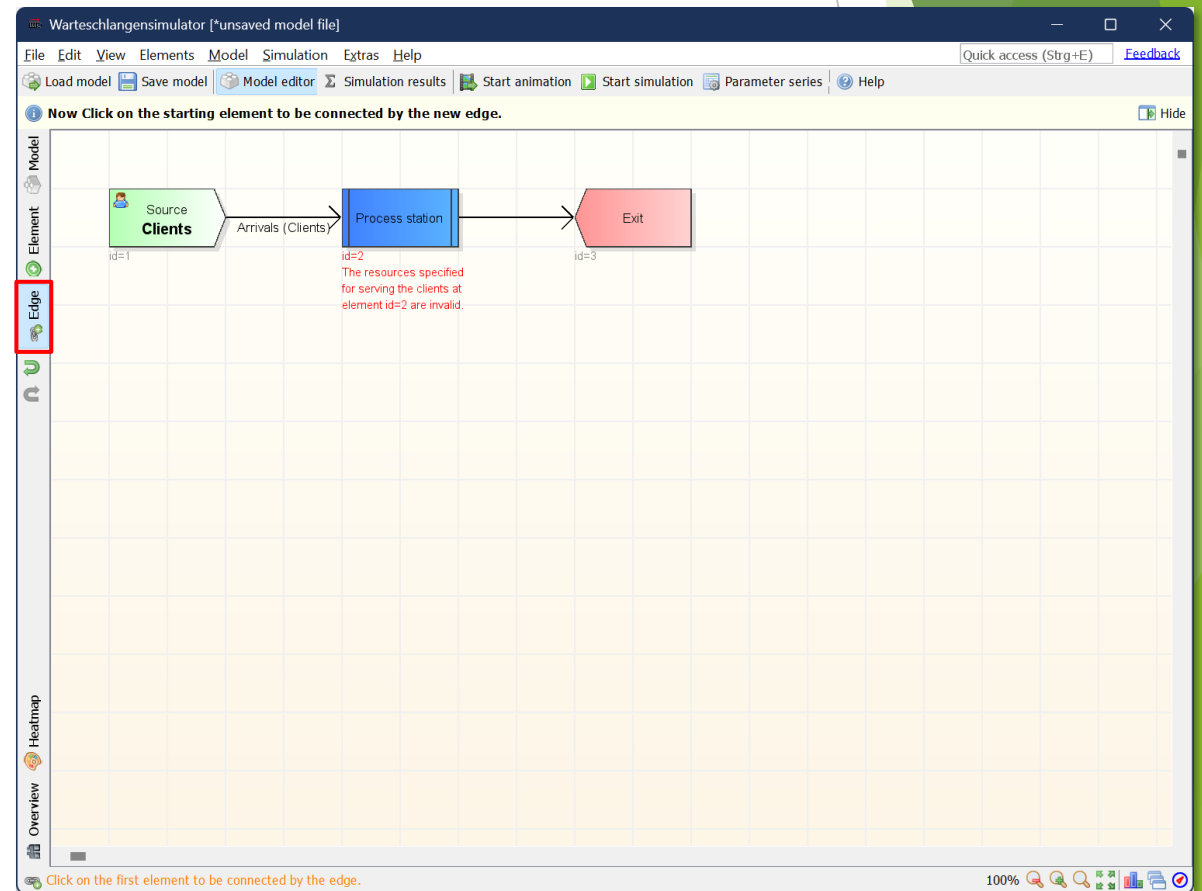
Connecting the stations (2)

- ▶ Edges are added by clicking the source and then the destination element of a connection.
- ▶ So click on “Source” and then on “Process station”.
- ▶ After adding the first edge click on “Process station” and then on “Exit” to add the second connection.



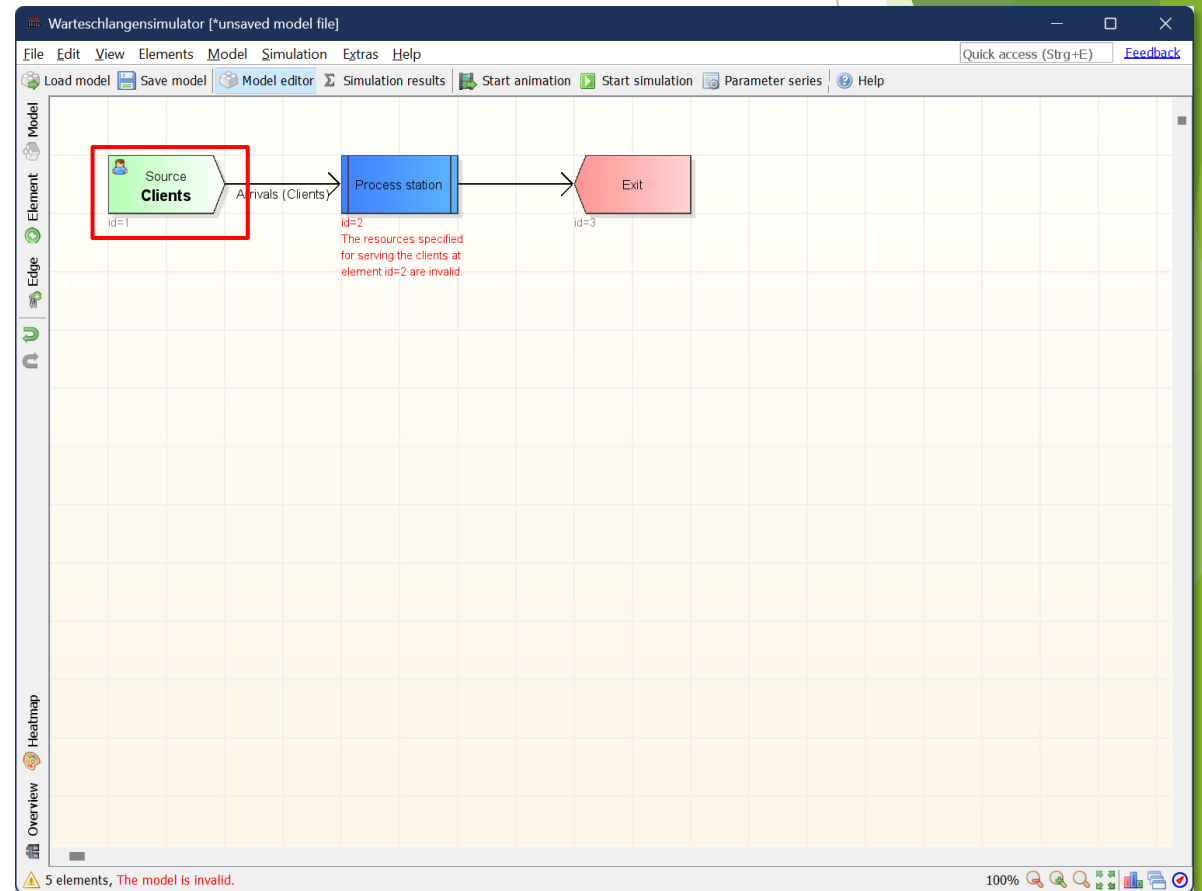
Connecting the stations (3)

- ▶ After adding the connections deactivate the connections adding function by clicking the “Edge” button on the left toolbar again.



Configuring the source station (1)

- ▶ Now the stations need to be configured.
- ▶ To define the properties of the source, **double click on the source station.**



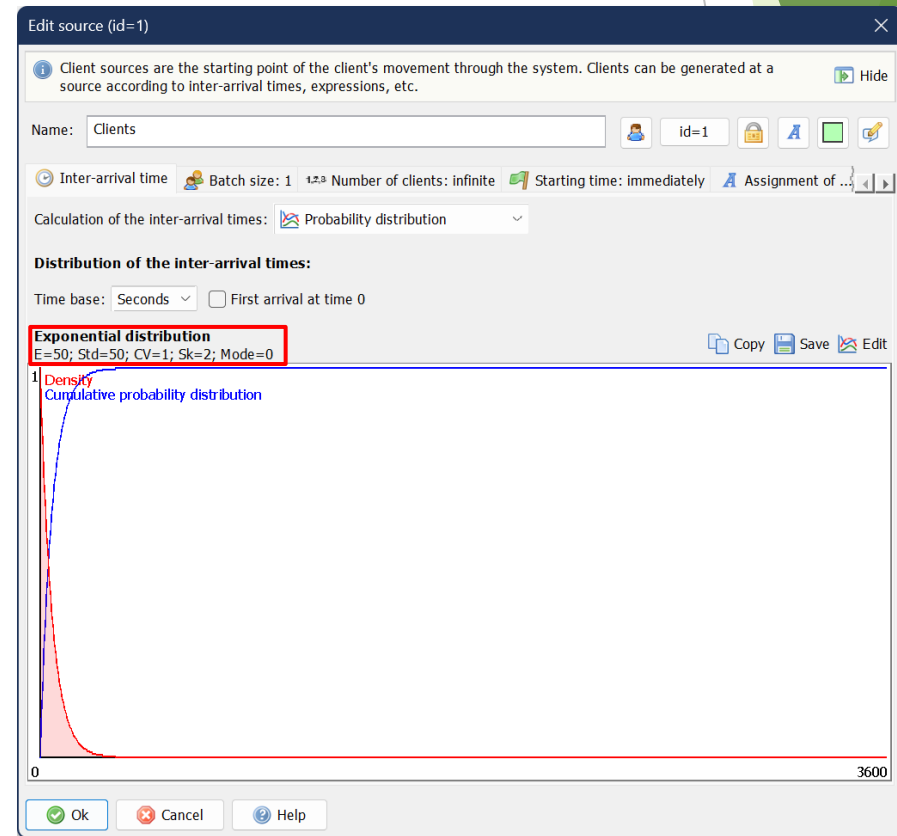
Configuring the source station (2)

- ▶ In the default case the exponential distribution with an average inter-arrival time of 60 seconds is chosen.
- ▶ We want an average inter-arrival time of 50 seconds, so we click on “Edit” and change the average inter-arrival time.

The screenshot shows the 'Edit source (id=1)' dialog box. The 'Name' field is 'Clients'. The 'Inter-arrival time' is 60 seconds. The 'Batch size' is 1, 'Number of clients' is infinite, and 'Starting time' is immediately. The 'Calculation of the inter-arrival times' is set to 'Probability distribution'. The 'Distribution of the inter-arrival times' is 'Exponential distribution' with parameters $E=60$, $Std=60$, $CV=1$, $Sk=2$, and $Mode=0$. The 'Time base' is 'Seconds' and 'First arrival at time 0' is checked. The 'Edit' button is highlighted with a red box. The graph shows the density and cumulative probability distribution of the inter-arrival times.

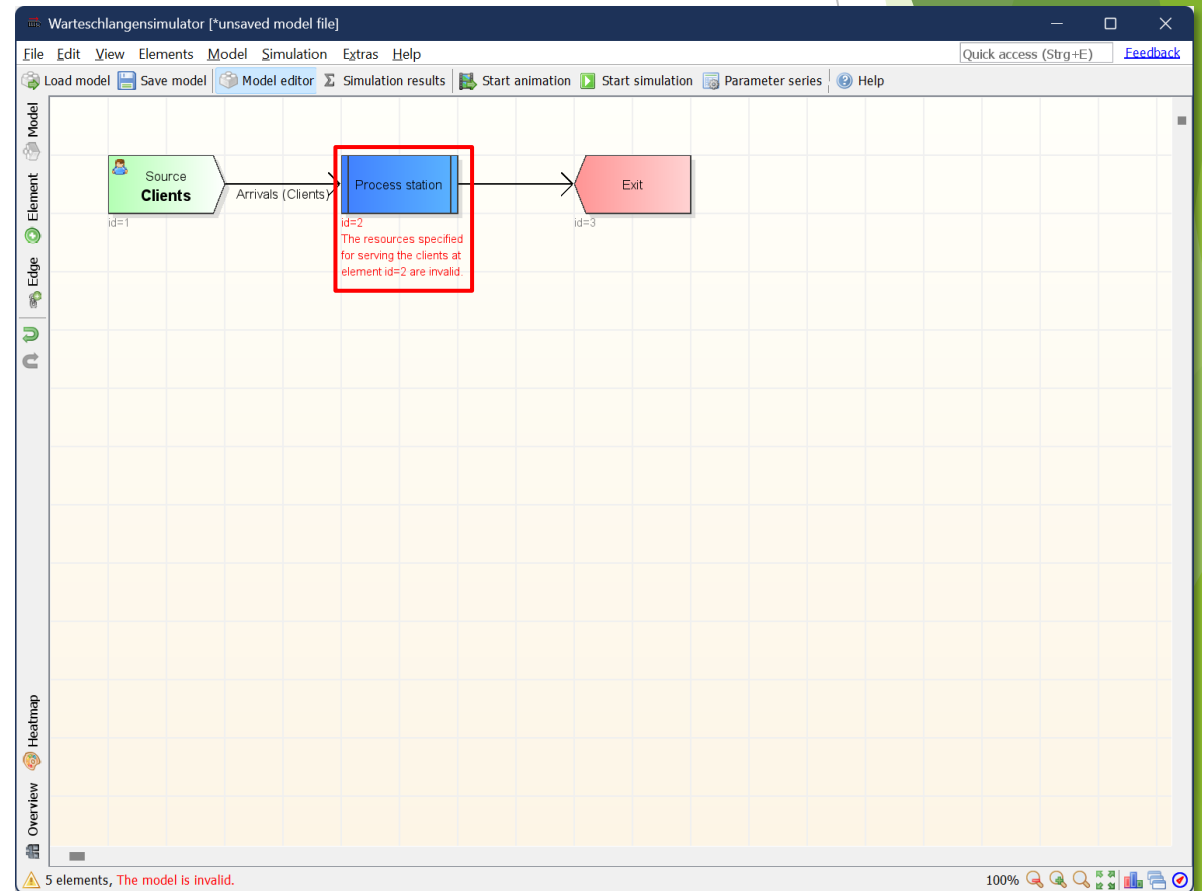
Configuring the source station (3)

- ▶ After closing the distribution editor the new inter-arrival time is shown in the source properties dialog.
- ▶ The dialog can be closed by clicking “Ok” now.



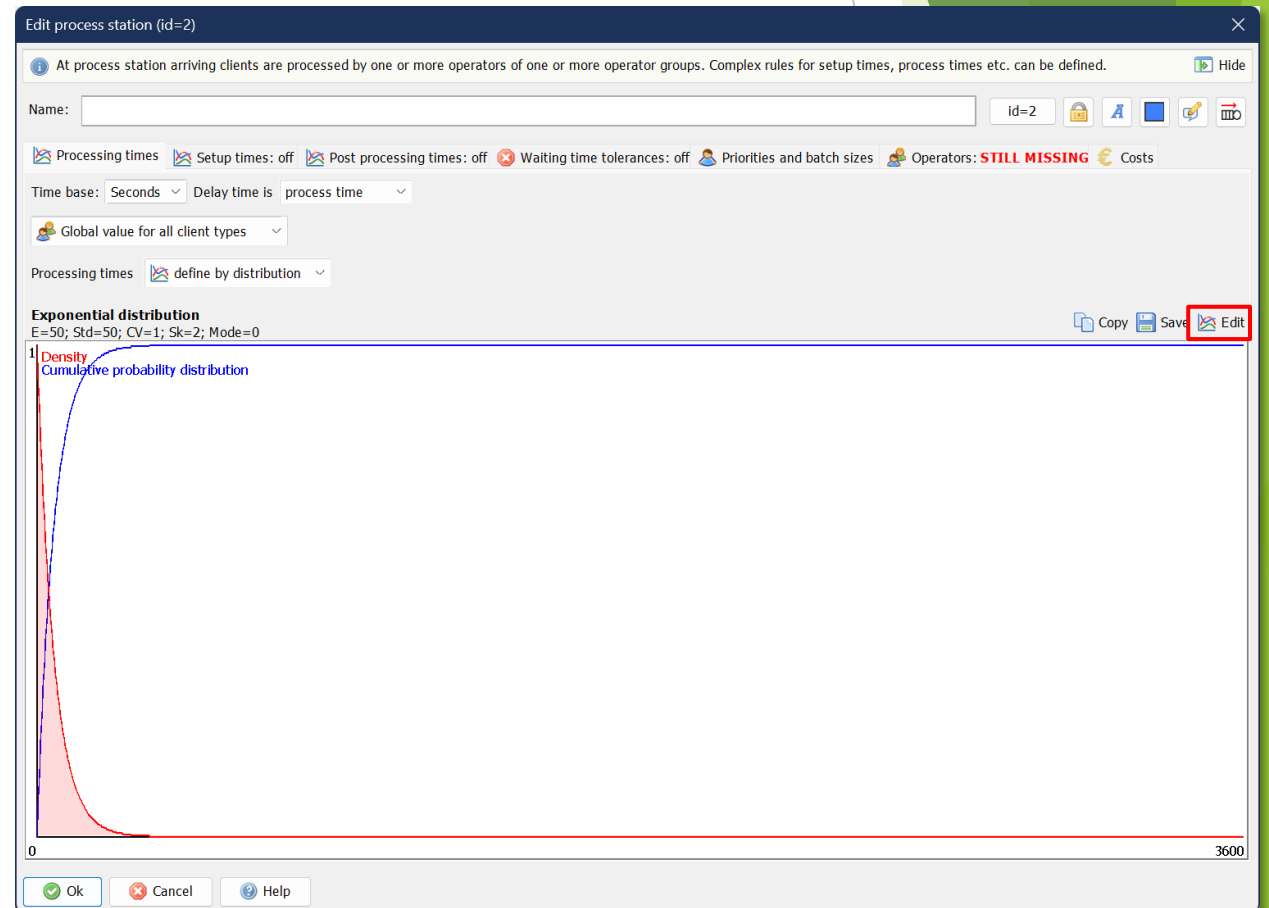
Configuring the process station (1)

- ▶ As the last step the process station needs to be configured.
- ▶ By **double clicking the process station element** the properties dialog for this station can be opened.



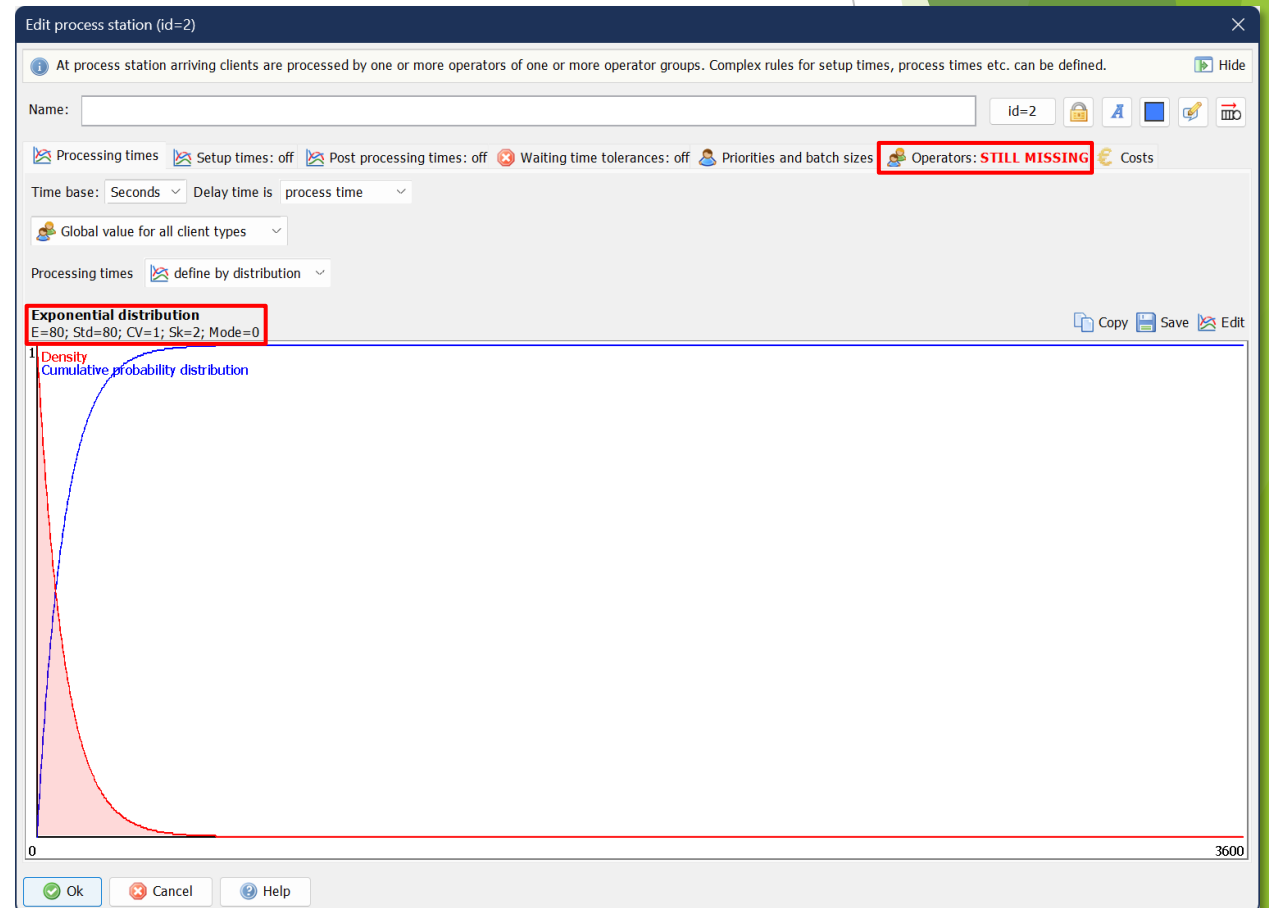
Configuring the process station (2)

- ▶ In the default case the exponential distribution with an average service time of 50 seconds is chosen.
- ▶ We want an average service time of 80 seconds, so we click on “Edit” and change the average service time.



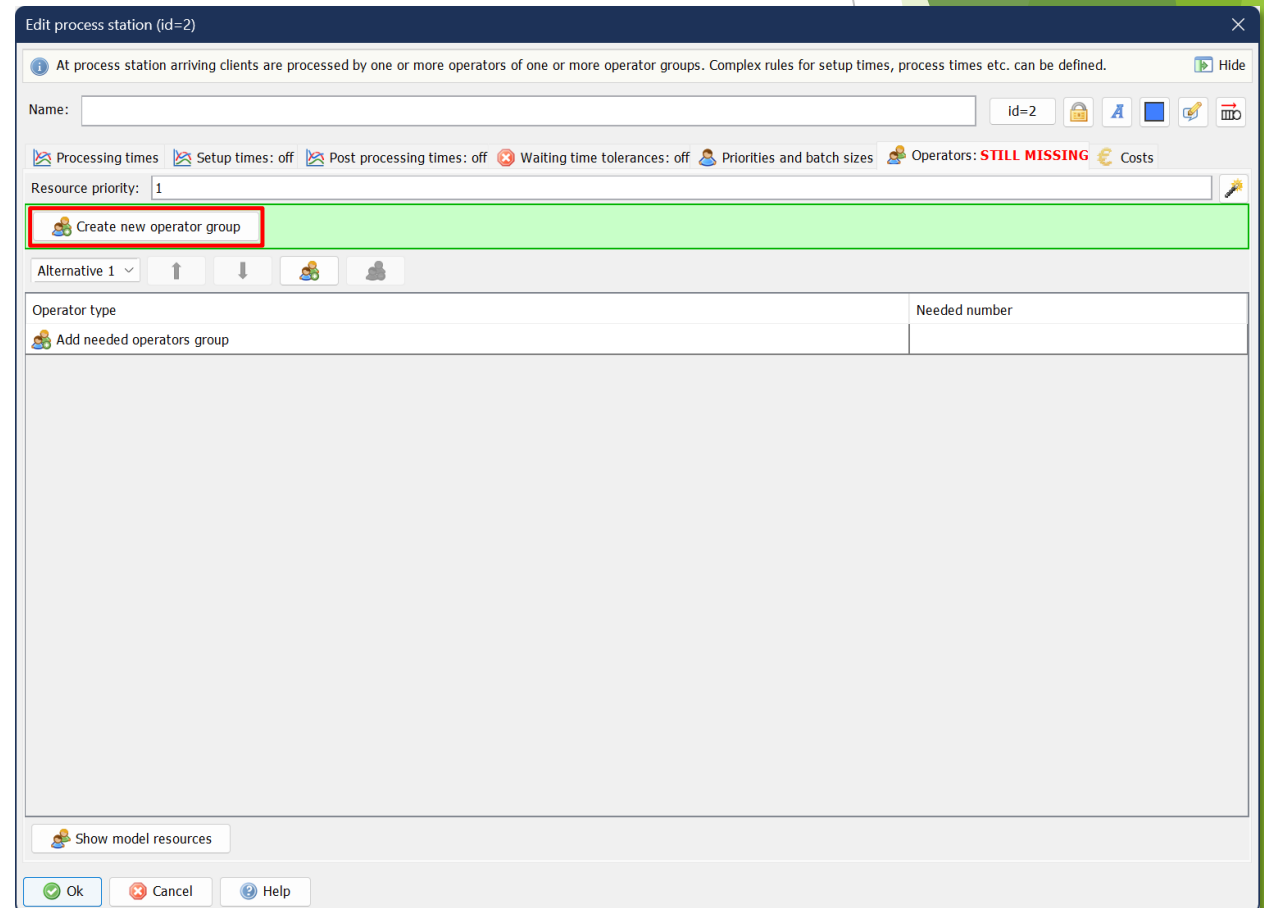
Configuring the process station (3)

- ▶ After closing the distribution editor the new service time is shown in the process station properties dialog.
- ▶ To make the process station work, we need to add operators as the last step. Therefore the “Operators” dialog page needs to be activated.



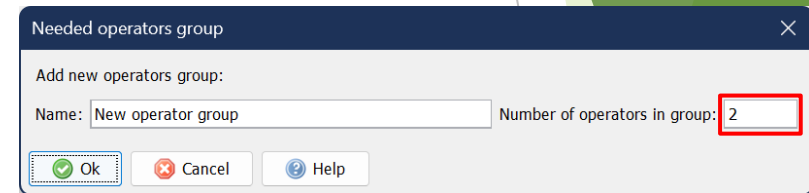
Configuring the process station (4)

- ▶ There are no operator groups in the system at the moment.
- ▶ So we need to create an operator group and assign it to the process station. This can be done by clicking "Create new operator group".



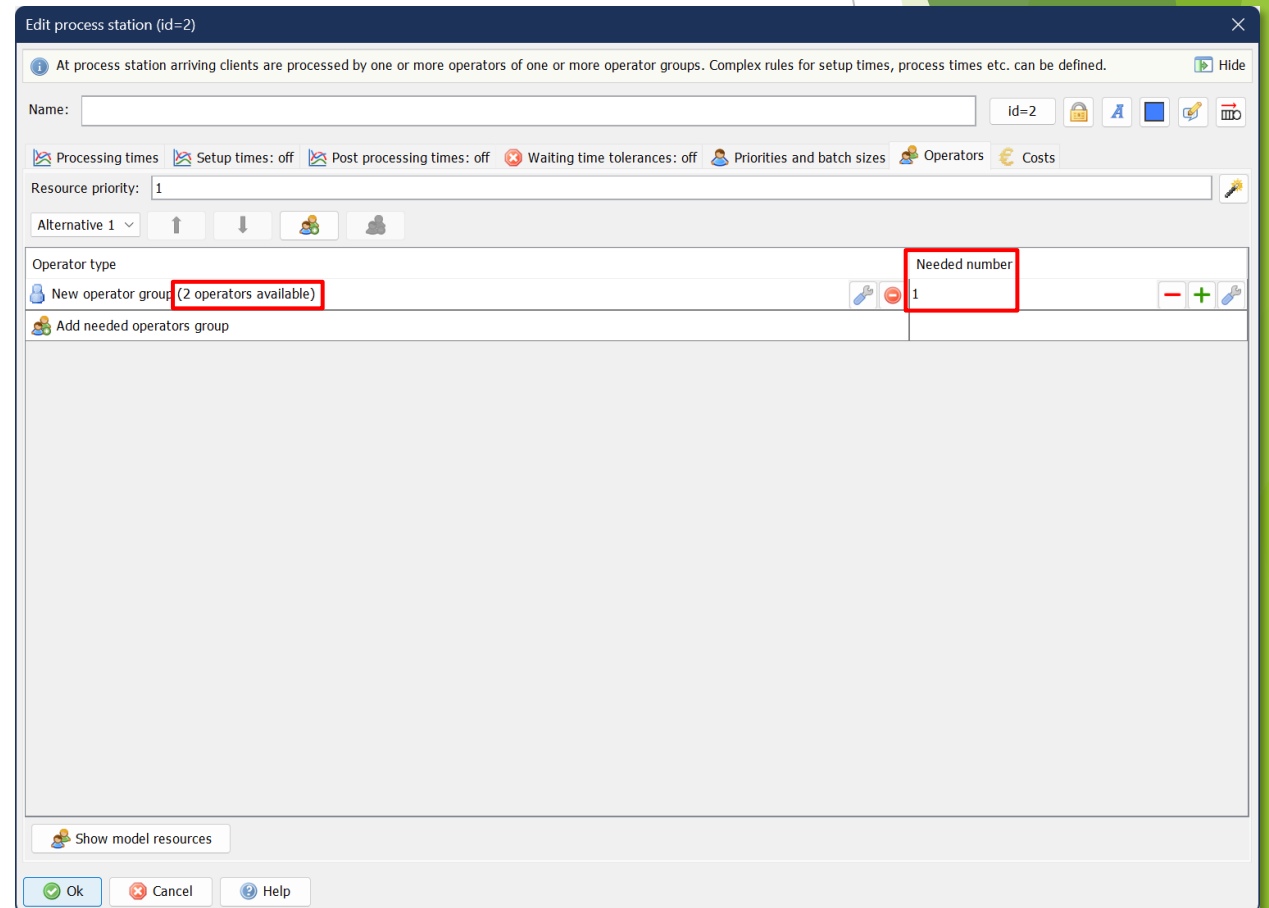
Configuring the process station (5)

- ▶ In the dialog for creating a new operator group the group size (the number of available operators in this group) can be specified.
- ▶ Because we want to create a $M/M/c$ system with $c=2$, we enter a **group size of 2**.



Configuring the process station (6)

- ▶ Two operators are available in the group and one is needed to serve a client.
- ▶ That's all. The dialog can be closed by clicking “Ok” now.



Running simulations or animations

- ▶ The model can be animated or simulated now by clicking “**Start animation**” or “**Start simulation**” on the toolbar.
- ▶ You will find more tutorial documents in the **Help** menu of Warteschlangensimulator.
- ▶ Many ready-to-run models can be loaded via the “**Load example**” menu item of the **File** menu.

