

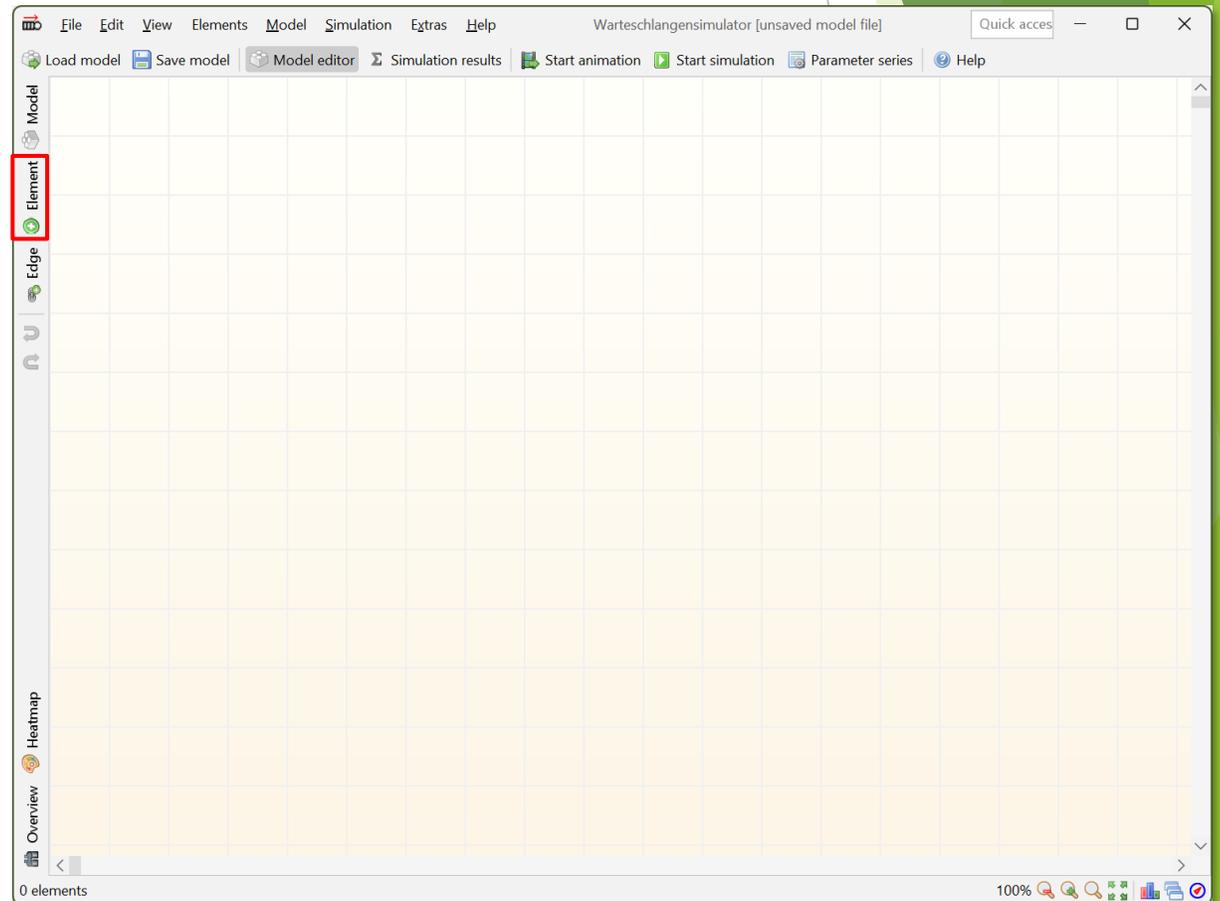
# Warteschlangen- simulator

Tutorial:  
Creating a first queueing model

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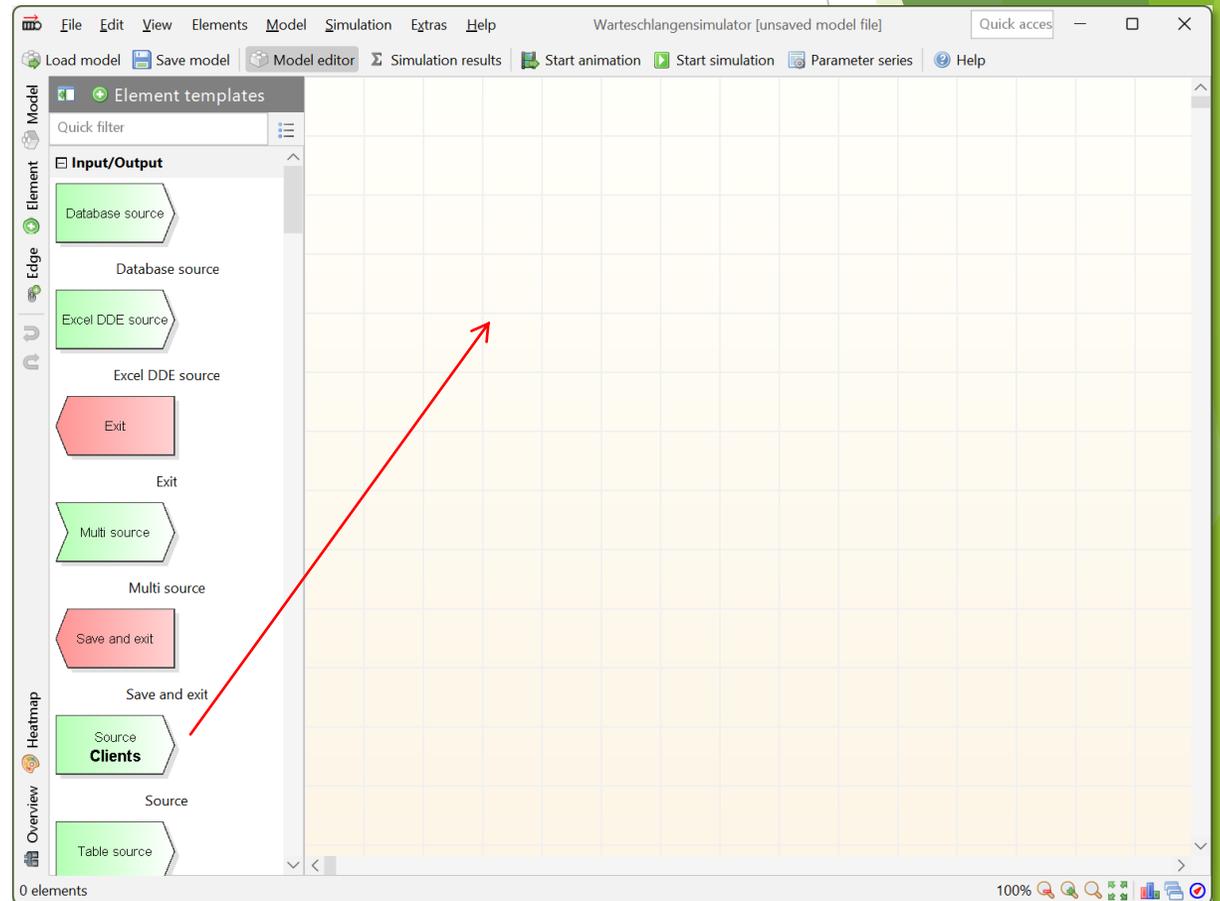
# Adding stations to the model (1)

- ▶ 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.



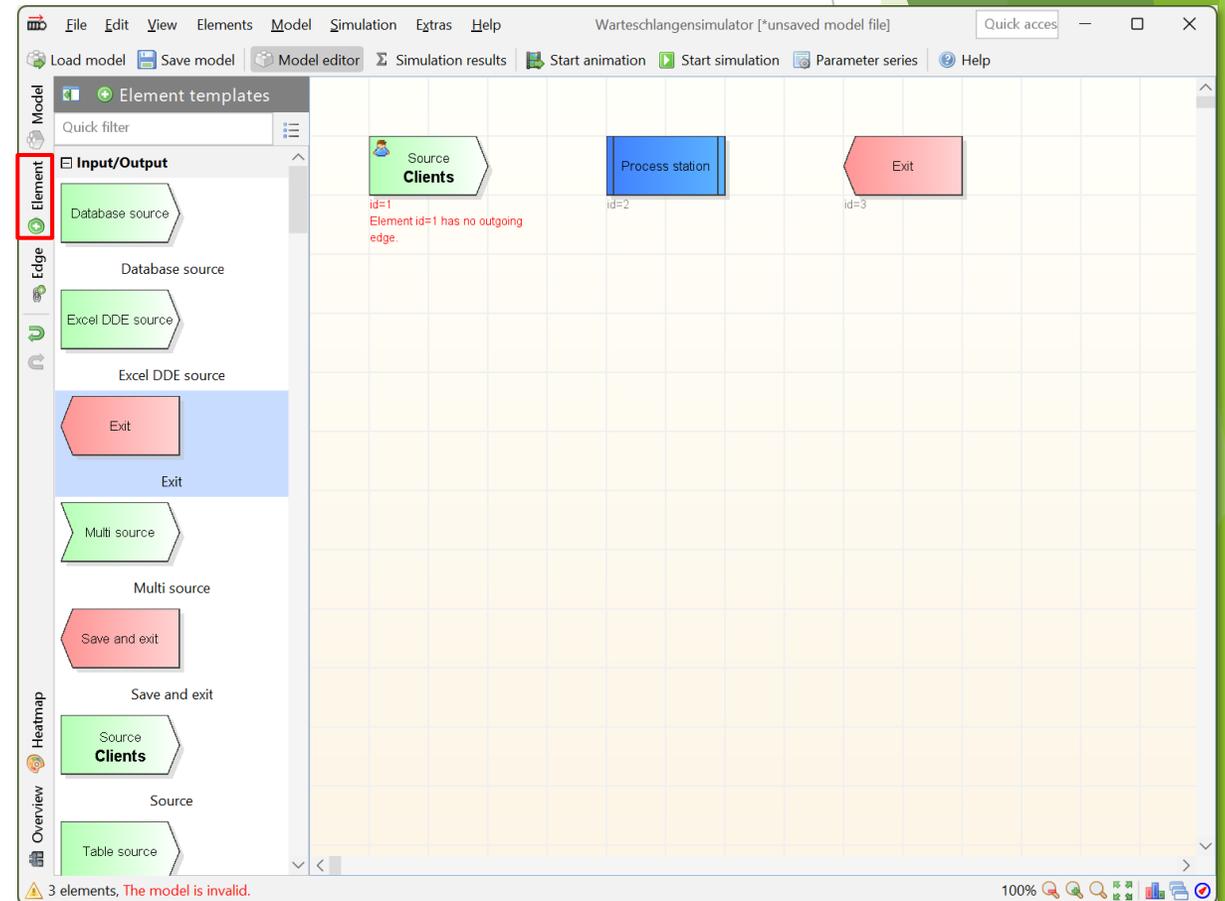
# Adding stations to the model (2)

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



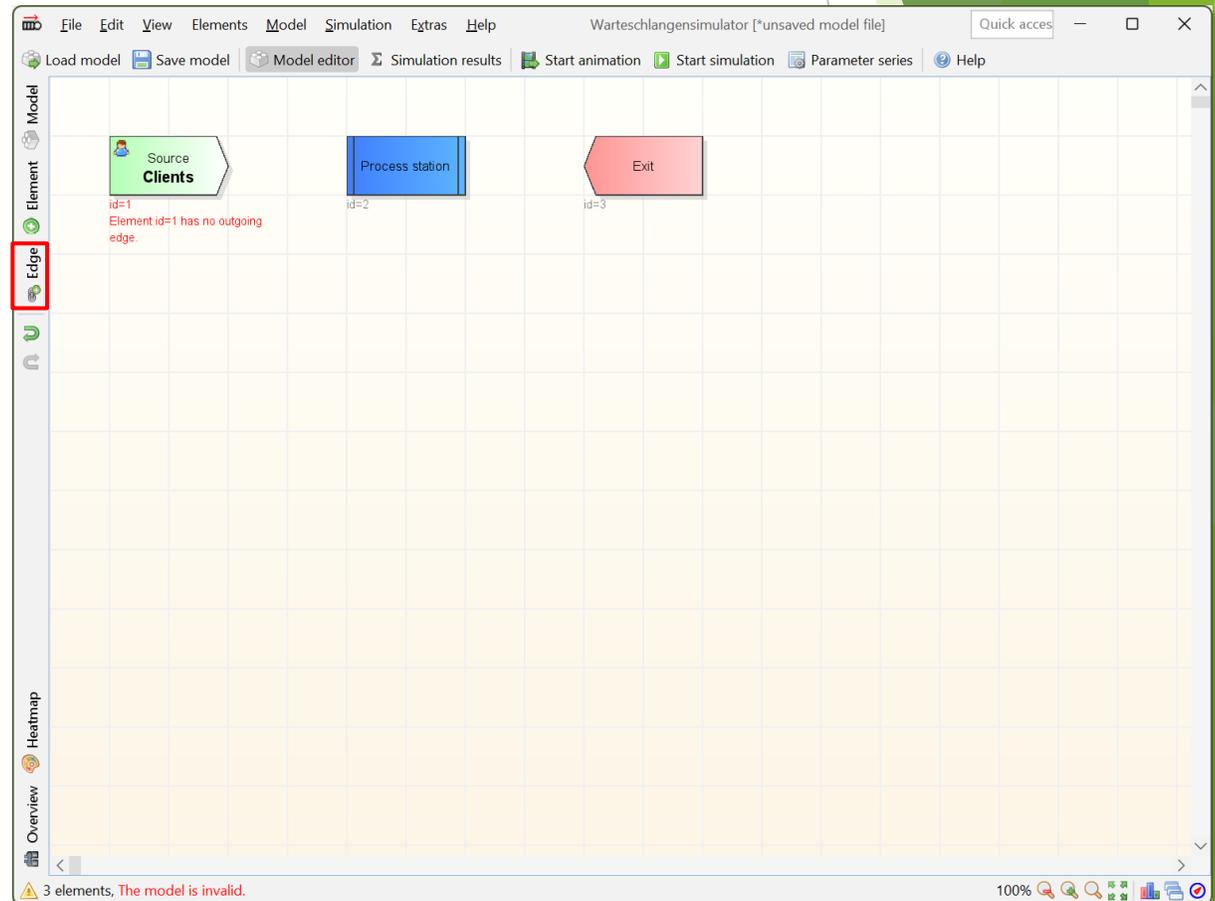
# Adding stations to the model (3)

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



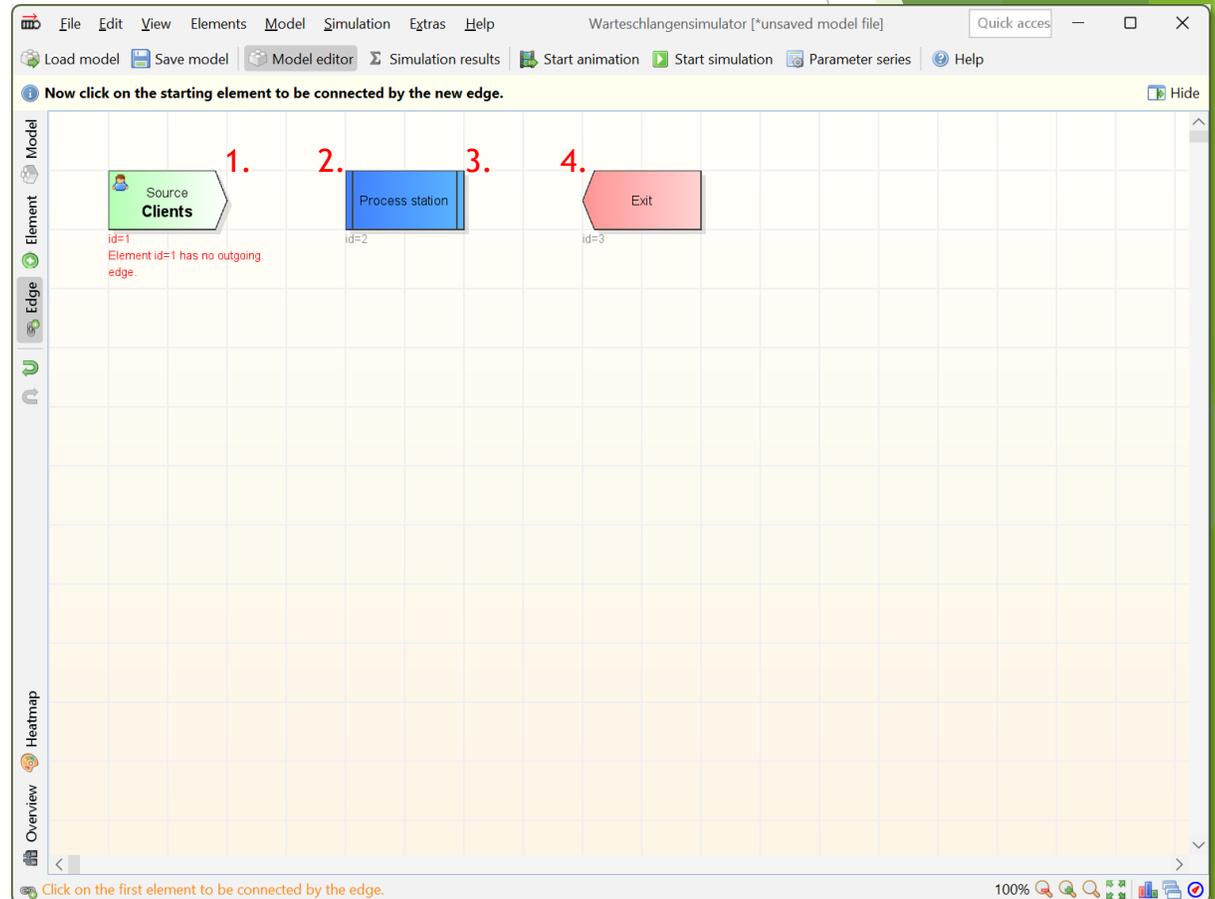
# Connecting the stations (1)

- ▶ 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.



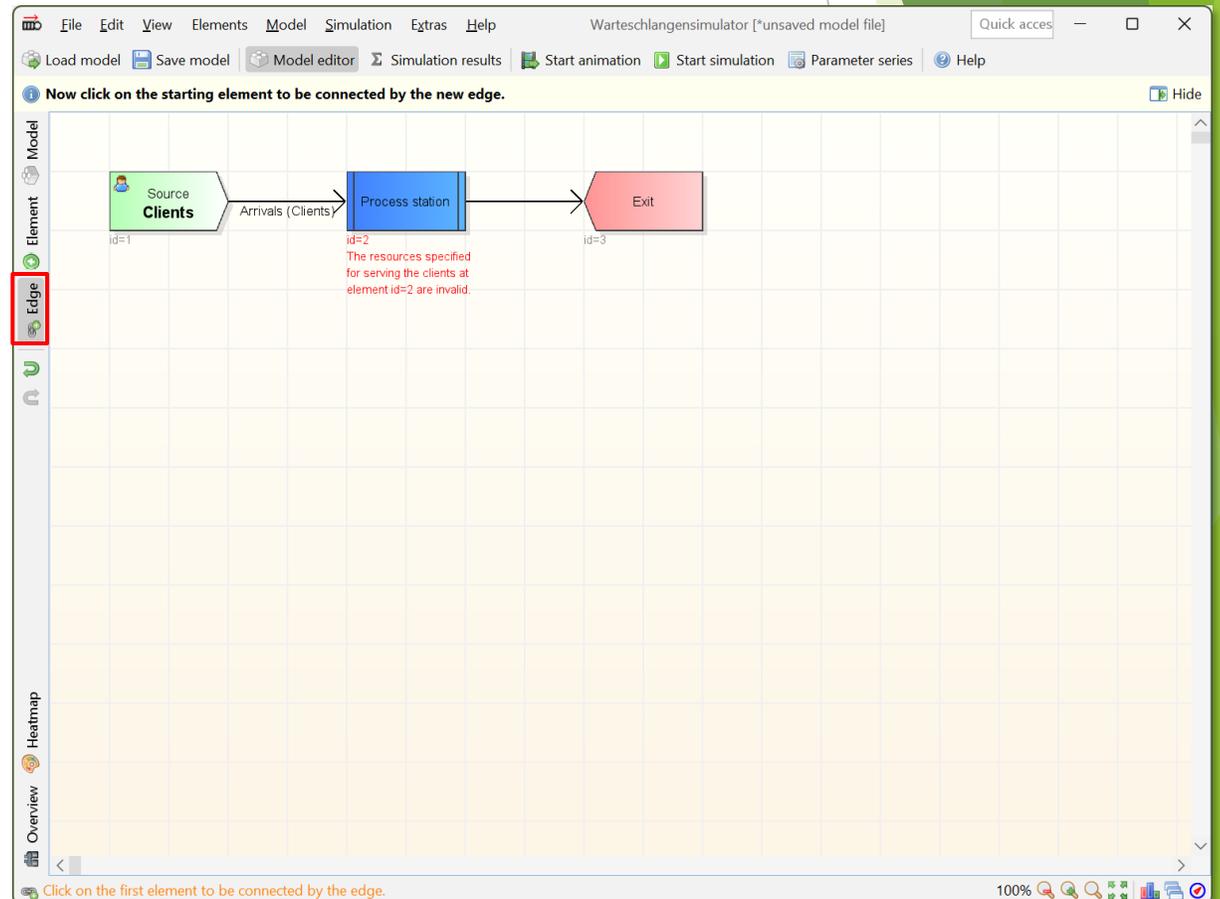
# Connecting the stations (2)

- ▶ 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.



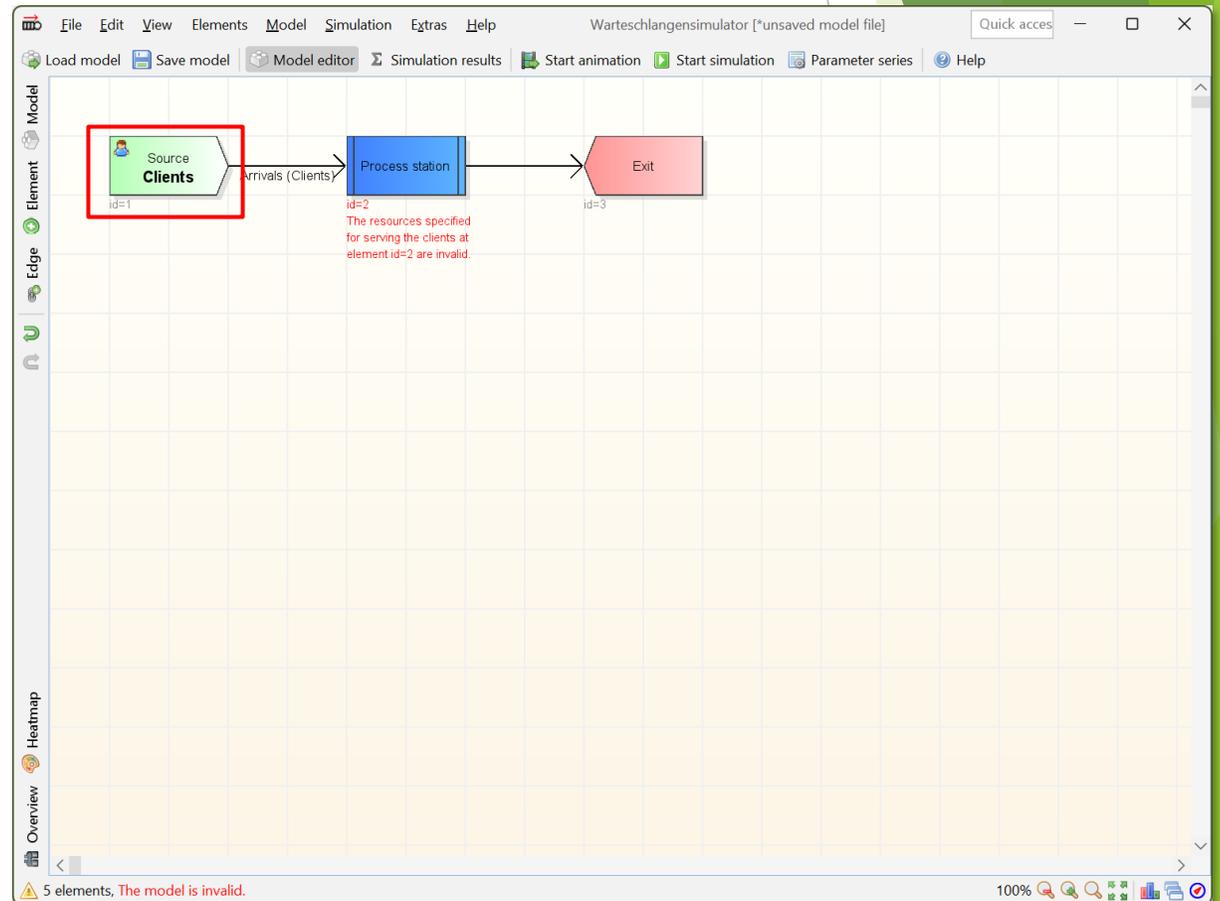
# Connecting the stations (3)

- ▶ 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' section is active, showing 'Probability distribution' selected. The 'Distribution of the inter-arrival times' section shows 'Exponential distribution' with parameters  $E=60$ ,  $Std=60$ ,  $CV=1$ ,  $Sk=2$ ,  $Mode=0$ . A graph displays the density (red curve) and cumulative probability distribution (blue curve) of the inter-arrival times. The 'Edit' button is highlighted with a red box.

# 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.

Edit source (id=1)

Client sources are the starting point of the client's movement through the system. Clients can be generated at a source according to inter-arrival times, expressions, etc. Hide

Name: Clients id=1

Inter-arrival time Batch size: 1 Number of clients: infinite Starting time: immediately Additional condition Assignment of client vari...

Calculation of the inter-arrival times: Probability distribution

Distribution of the inter-arrival times:

Time base: Seconds First arrival at time 0

**Exponential distribution**  
E=50; Std=50; CV=1; Sk=2; Mode=0

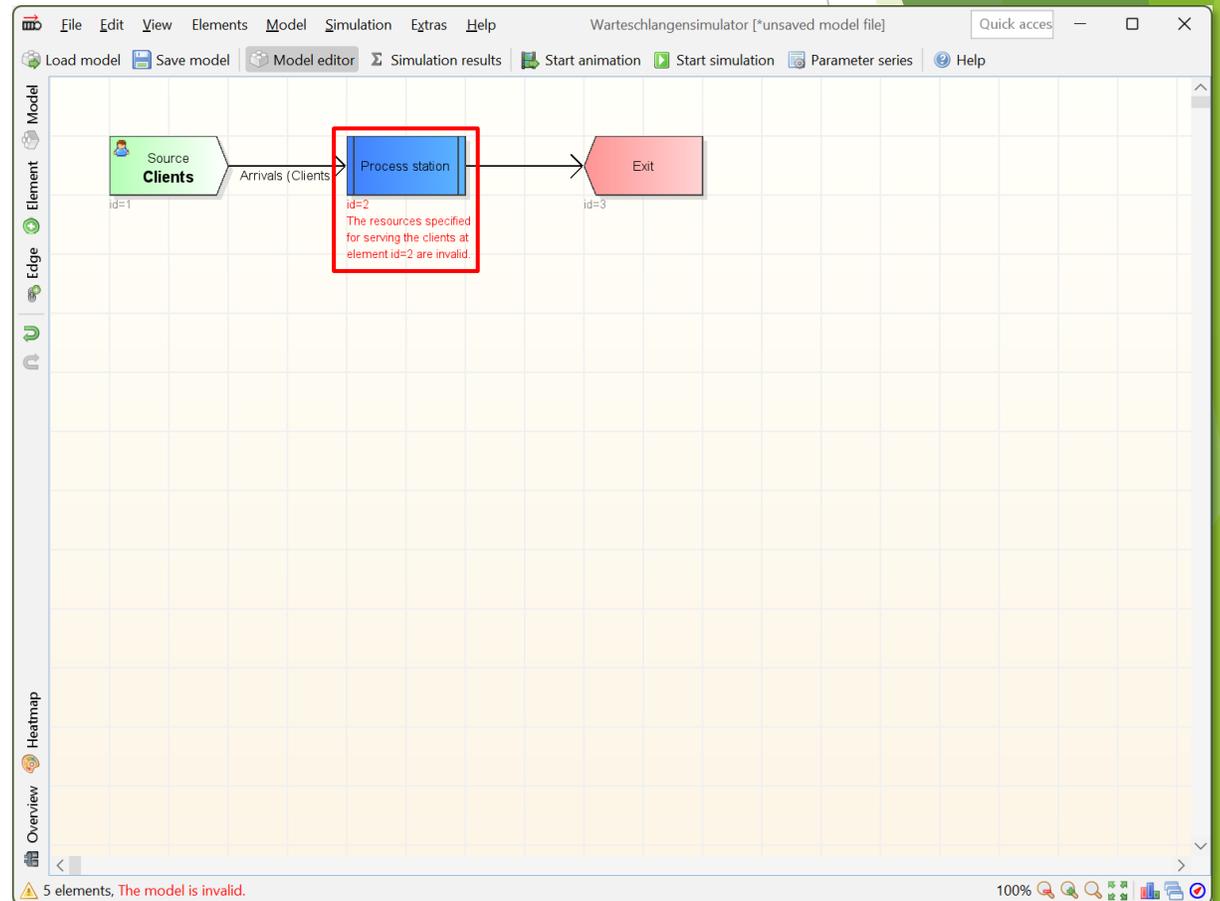
Density  
Cumulative probability distribution

0 450

Ok Cancel Help

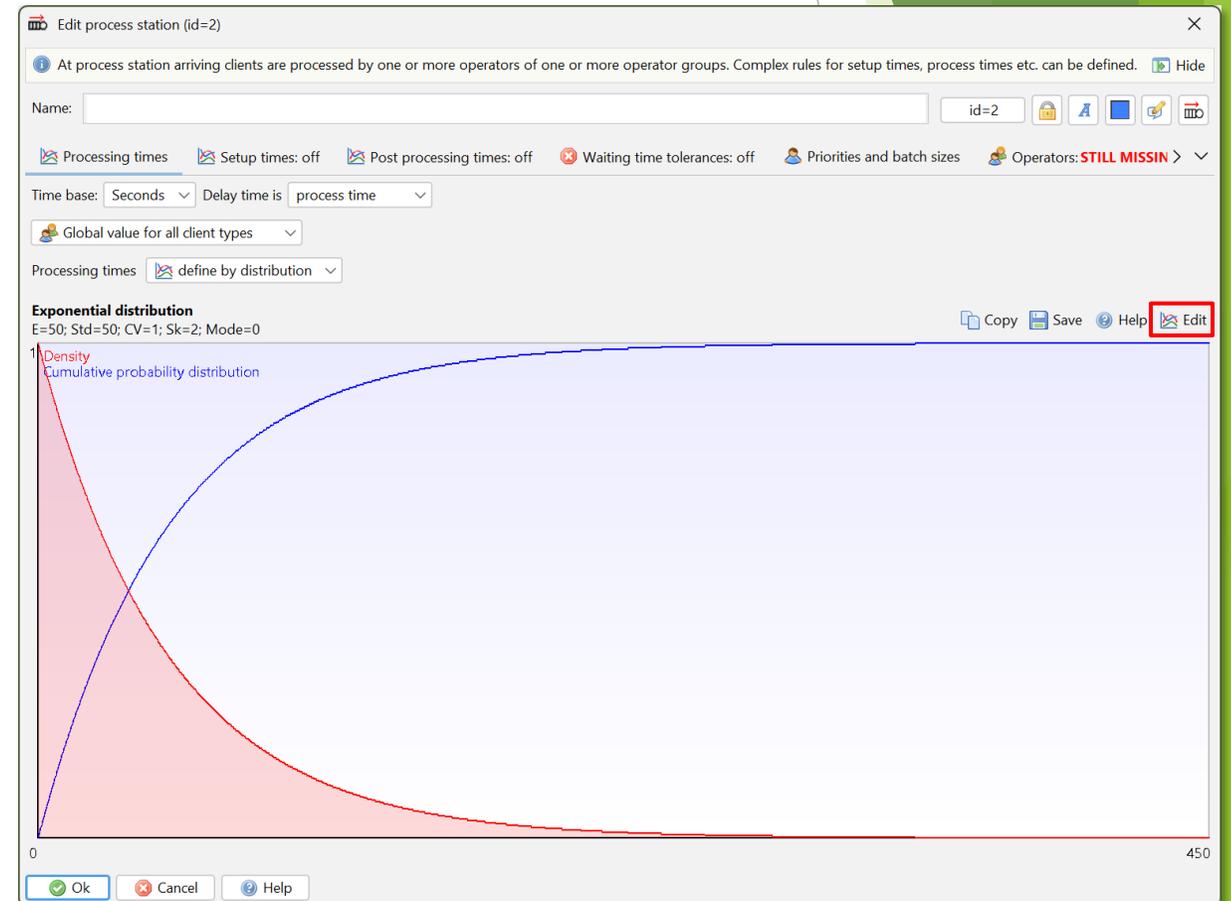
# Configuring the process station (1)

- ▶ 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.



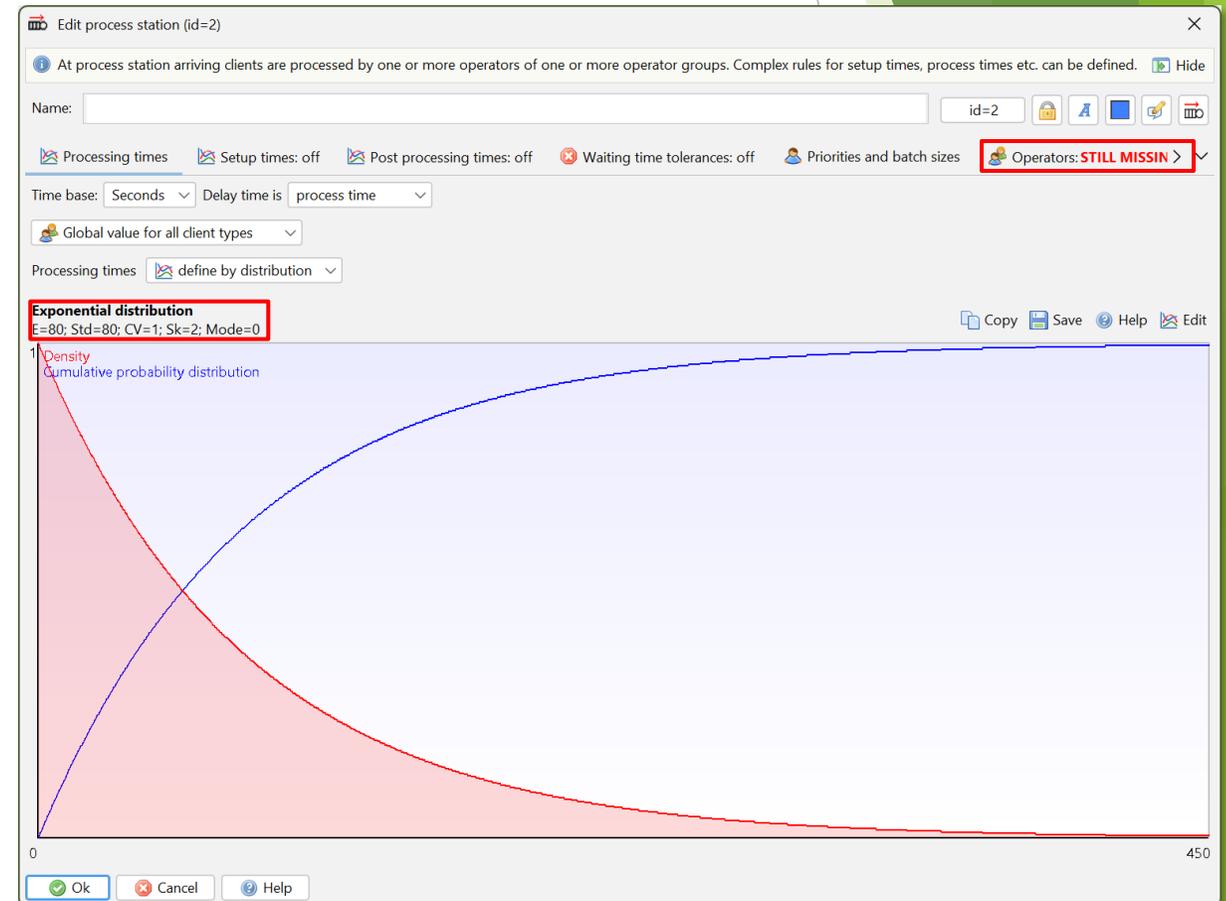
# Configuring the process station (2)

- ▶ 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.



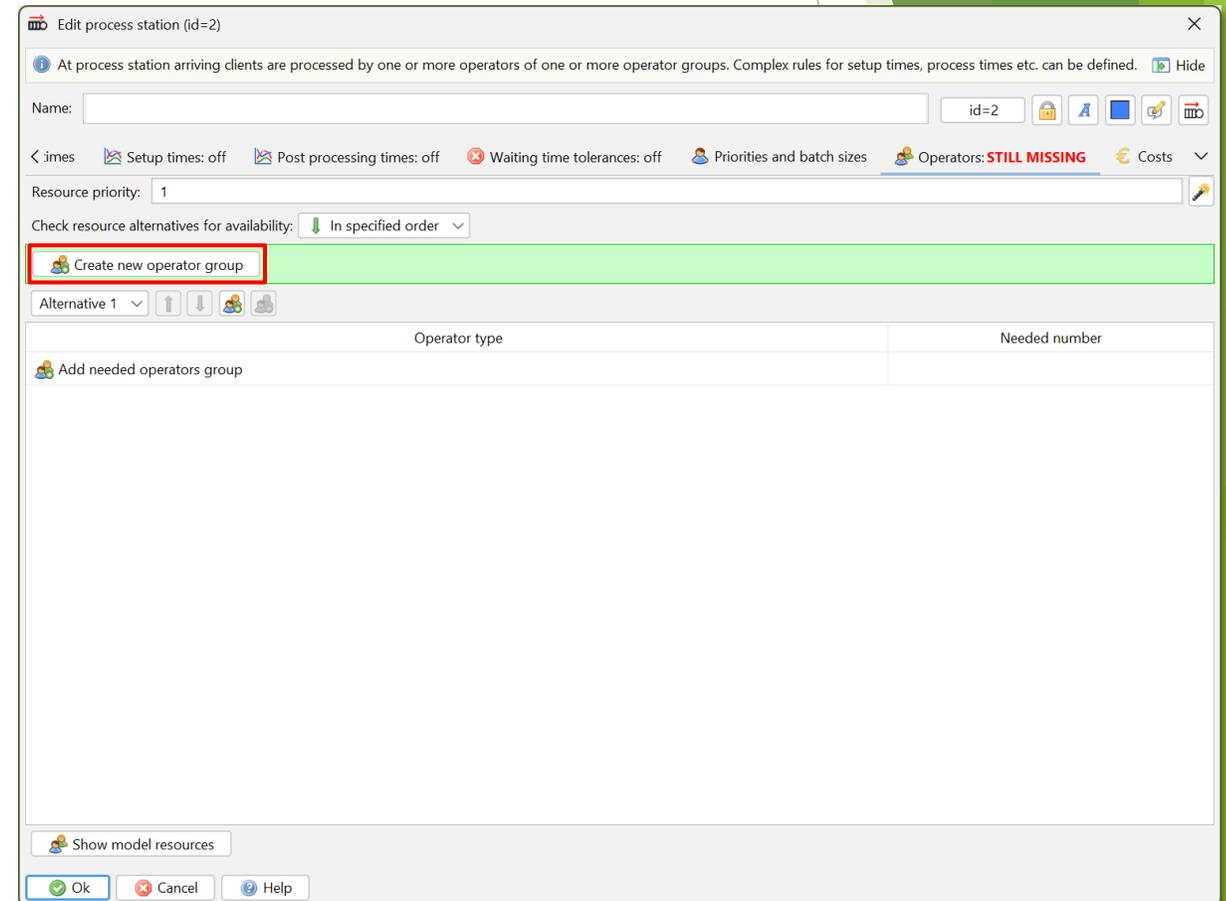
# Configuring the process station (3)

- ▶ 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".



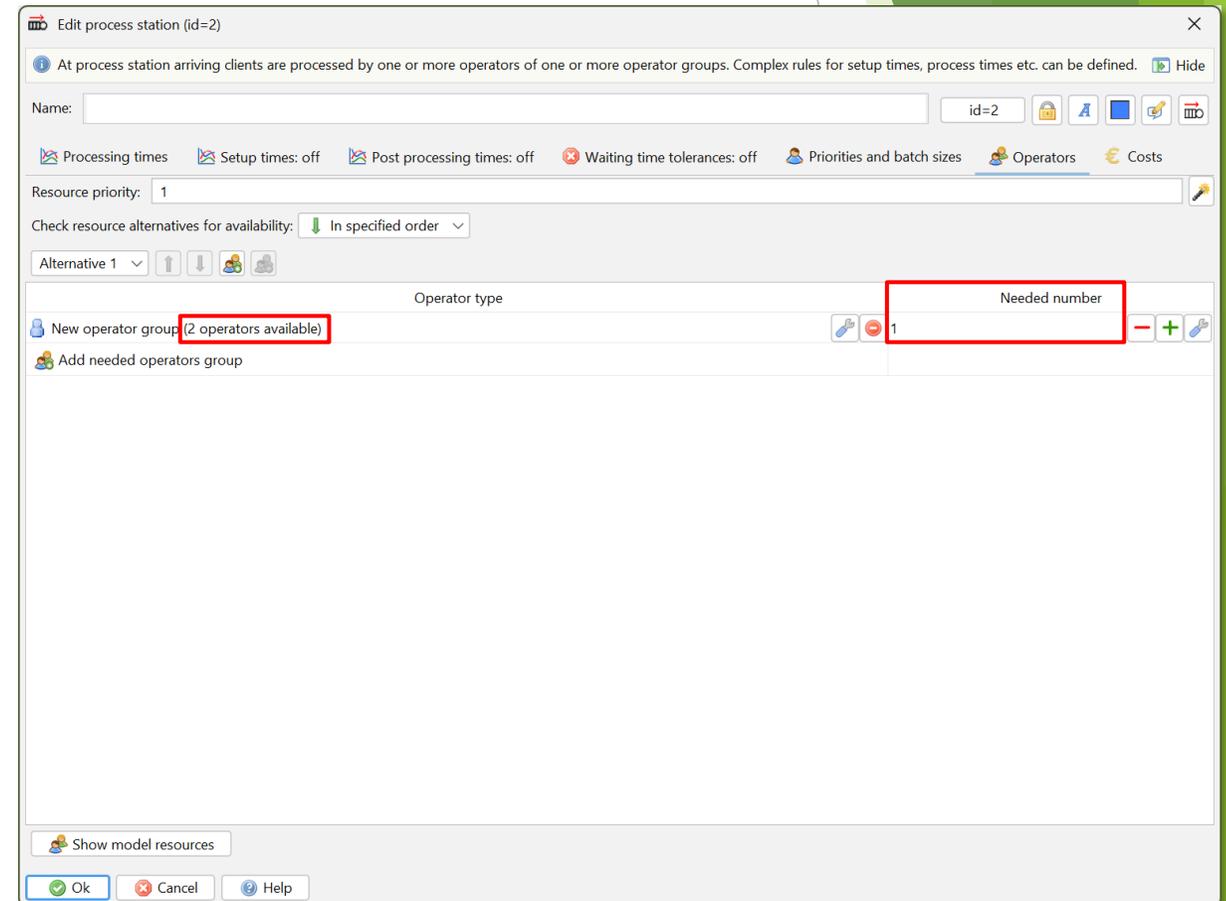
# Configuring the process station (5)

- ▶ 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.

