POLITECHNIKA GDAŃSKA

MODELING OF LOGISTICS PROCESSES

ACTIVITY #6

Conveyor system and quality control

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ADTRANS
ADVANCED DATA ANALYSIS FOR TRANSPORTATION AND MOBILITY ACADEMIC TEACHERS

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1. Objective and new skills

The aim of the task is to consolidate the ability to configure the logic of the flow of elements and to introduce new options controlling the entry of elements into model objects. Additionally, basic information about conveyors will be introduced for the first time. Their detailed configuration will be the subject of subsequent classes.

New skills
Basic conveyor configuration
Prioritizing the handling of selected items - *Pull option*
Saving label values from other labels

2. Assumptions and input data

1. The source generates products according to an exponential distribution with a scale parameter value of 10 seconds.
2. The system has a number of details given in the global table.
3. Products are stored in one common buffer and then sent to processing stations.
4. Efforts should be made to evenly load the machines.
5. Processing time on each machine ranges from 100 to 120 seconds for products processed for the first time.
6. After processing, the products are transported by a conveyor belt system to the quality control station.
7. The control time is fixed at 10 seconds.
8. It was assumed that 20% of the products do not meet quality standards. They must be reprocessed.
9. The reprocessing time is between 120 and 130 seconds. In addition, such products are treated as a priority and handled first.
10. A product that fails to meet quality standards again is removed from the system.
11. All model parameters are placed in the global table.
12. A record of the processing of subsequent products is kept. Each of them has its own unique serial number.
13. The load on buffers and machines will be analyzed.

The material was based on: K. Jurczyk, FlexSim , user manual.
InterMarium Sp. z o . o. , Krakow 2022

Figure 1 shows the target structure of the model.

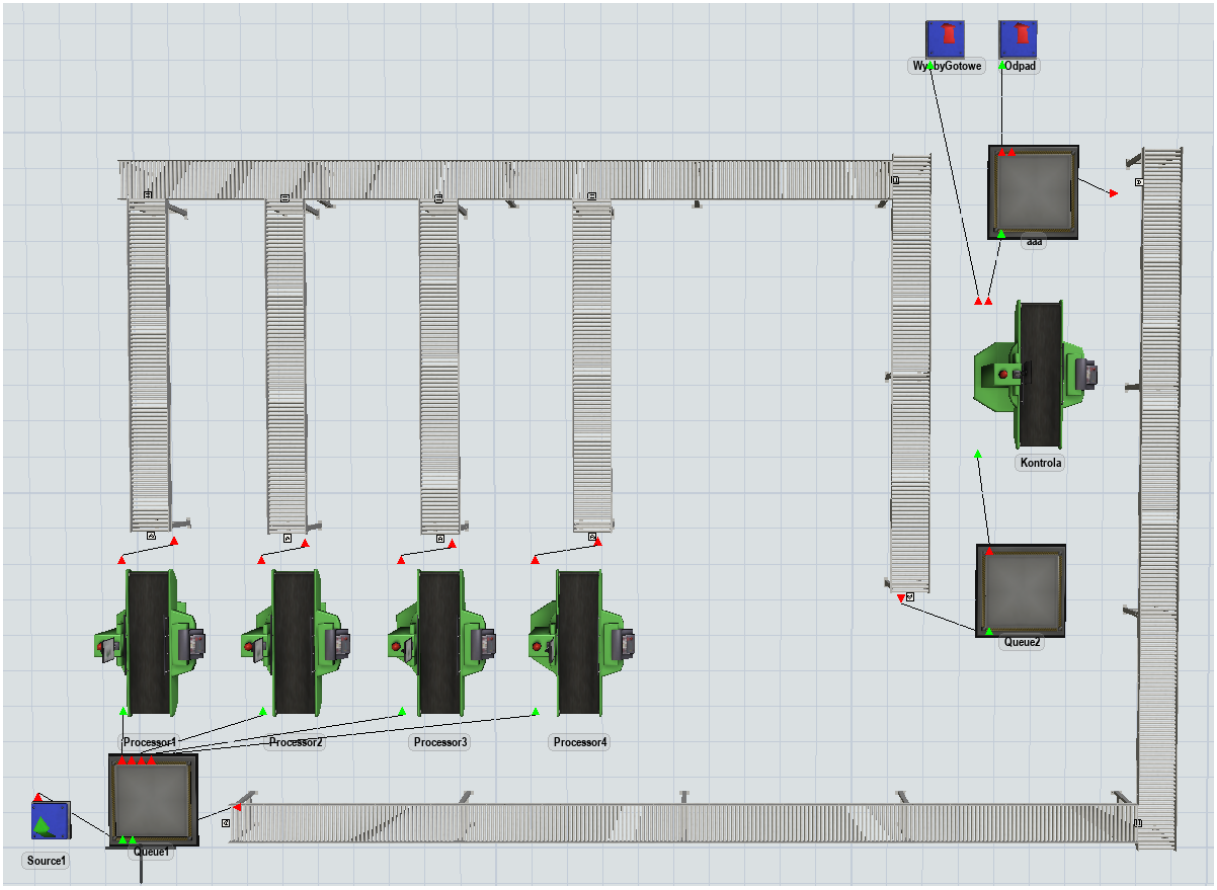


Fig. 1. Target structure of the model

The input data is presented in the *Data table* in Figure 2.

	Wartosc
CzasMiedzyProduktami	10
RodzajDetalu	8
CzasPrzetwarzaniaMin	100
CzasPrzetwarzaniaMax	120
CzasNaprawyMin	120
CzasNaprawyMax	130
CzasKontoli	10
LiczbaDozwolonychNapraw	1
Odpad	20

Fig. 2 Input data

3. Object parameters and flow logic

3.1. Flow element

For the flow element in *Flowitem Bin,* four labels must be added as shown in Figure 3:

1. DetailType – contains information about the product type.
2. SerialNumber – a unique number for each item.
3. NumberOfControls – number of quality tests for a given product.
4. Start Time – information about the start time of processing

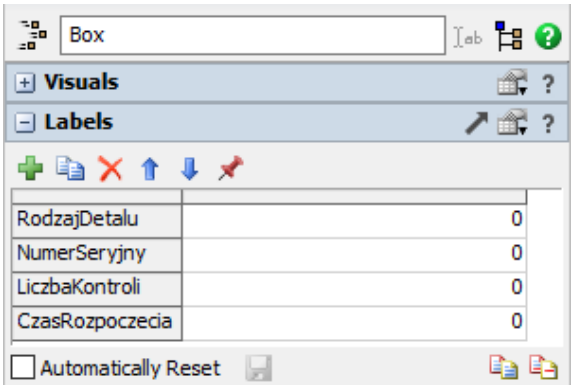


Fig. 3 Labels for the flow element

3.2. Source

The time between subsequent products will be determined by referring to the appropriate cell in the *Data table* (Fig. 4).

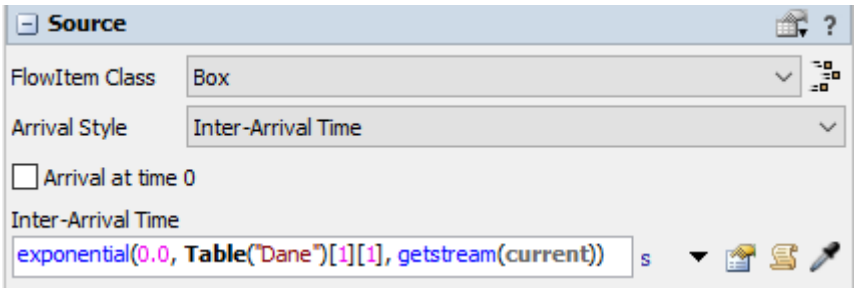


Fig. 4 Source Settings

Marking flow elements with a SerialNumber label will be carried out in two steps. This is a solution suitable for a basic level of knowledge of the program. The first step will be to add a label called Number to *Source1* (Fig.5). Each product that will be generated by the source will automatically increase its value by 1. Then the current value of the Number label will be assigned to each element leaving the source and in the form of a SerialNumber label.

It belongs in the section *Triggers* to choose *On Creation* → *Data* → *Increment Value* (Fig . 6). Next, you need to indicate the label whose value will be increased (Number) .

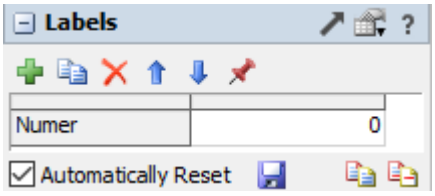


Fig. 5 Label Number on *Source1*

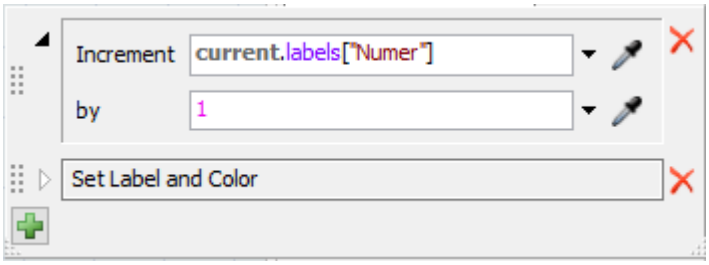


Fig. 6 Increasing the value of the label Number on *Source1*

The second step is to add the entered value of the Number label to the SerialNumber label when exiting the source – *OnExit* → *Data* → *Set Label* . In the dialog box (Fig. 7), select the appropriate label name, this time already placed on the product, and give it a value corresponding to the Number from Source label.

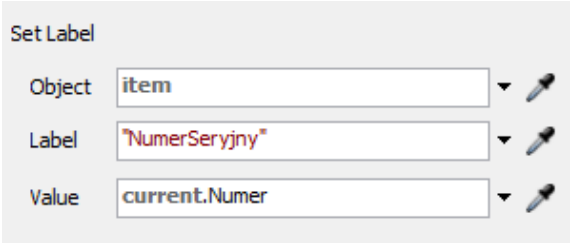


Fig. 7. Assigning a value to the SerialNumber label

The last action will be to mark the type of product generated by *Source1* and assign it a color. We will use the already known reference to the global table *Data* - *On Creation* → *Data* → *Set Label and Color* (fig. 8) .

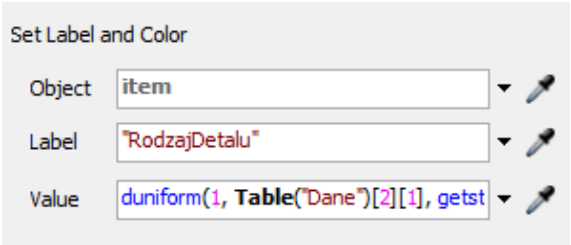


Fig. 8. Element type and color settings

3.3. Processing stations

The processing time on each of the four machines will be set based on the values in the *Data* table. The processing time will depend on the number of checks *Processor* → *Process Time* → *Values by Case.* The expression used to set the appropriate processing time is **item**.NumberOfChecks (Fig. 9). If its value is zero, the control time will be equal to a random number between 100 and 120 seconds, otherwise between 120 and 130 seconds.

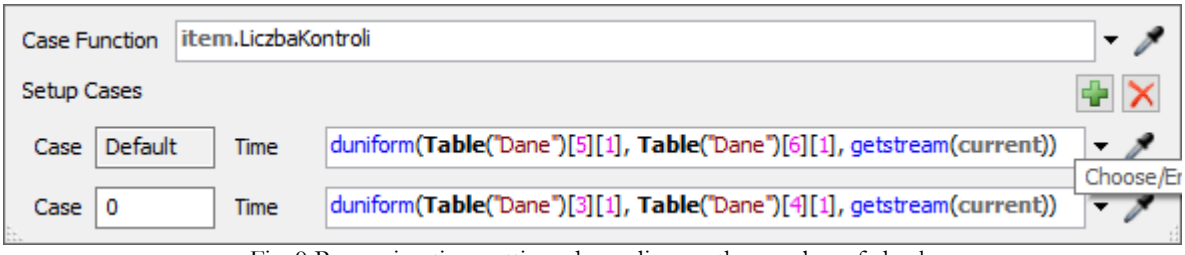


Fig. 9 Processing time settings depending on the number of checks

The next task, according to the assumptions, is to assign the appropriate task priority, i.e. to make the elements for reprocessing enter the machines first. This means giving priority to the elements with a higher value of the Control Number label. In the Machine *Input* tab, select *Pull → Pull Best Item*. In the next window, enter the settings as in Fig. 10.

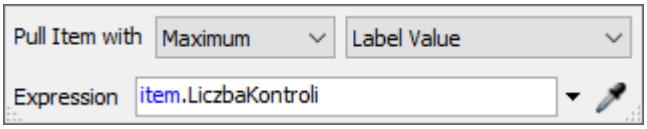


Fig. 10. Priority for items to be recycled

StartTime label remains to be set , which will be set each time the element enters the processing station. *OnEntry → Date* should be selected on it → *Set Label* . The current model time should be set as the *Value* label using the Model.time command (Fig. 11).

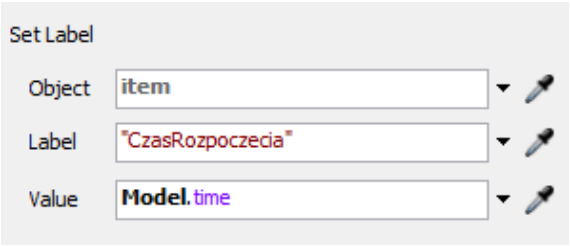


Fig. 11. Assigning the start time of processing

3.4. Quality control station

The quality control time is taken from the *Data table* (Fig. 12). In the *Output* tab, the flow logic is defined, taking into account 20% of defective elements (Fig. 13).

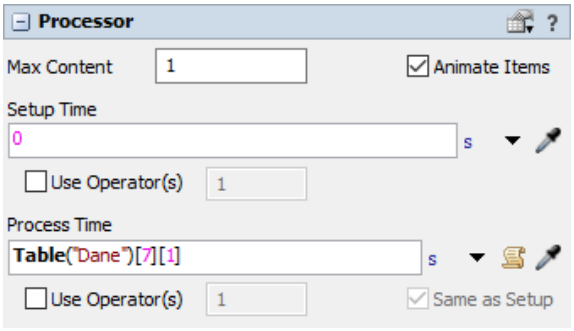


Fig. 12 Quality control time

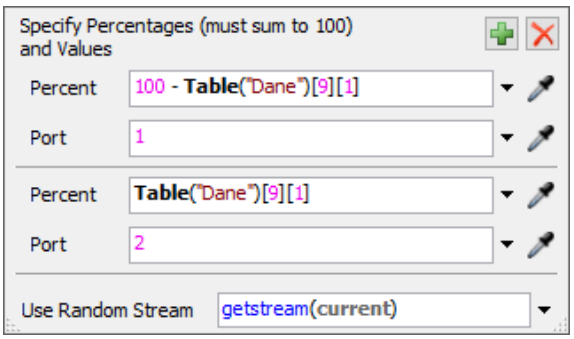


Fig. 13 Quality control station output settings

Port 1 is intended for finished products, while Port 2 directs products for reprocessing to the *Queue3* buffer (Fig. 14).

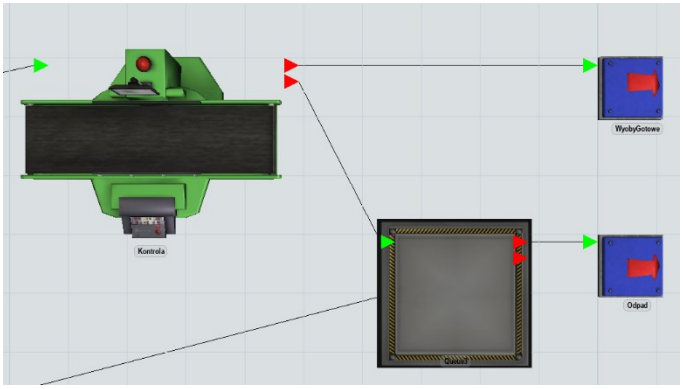


Fig. 14. Outgoing calls from the quality control station

The last step is to add a trigger that sets the label with the number of checks: *On Process Finish* → *Data* → *Increment Value* (Fig. 15).

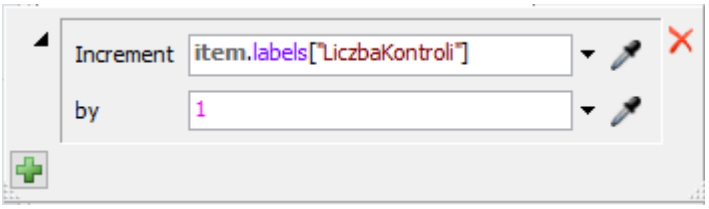


Fig. 15. Assigning a value to the ControlNumber label

3.5. Buffers

There are three buffers in the model:

1. *Queue1* – before processing stations. *Output section* you should enter the settings (Fig. 16) so that parts 1 to 4 are sent to the next machines, while any parts with other numbers that appear will be distributed randomly.
2. *Queue2* – remains at default settings.
3. *Queue3* – before the quality control station. In the *Output section* , enter the settings so that the parts with the number of inspections greater than the allowed number of repairs are removed from the system to the *Waste output* on the output port 1 (Fig. 17). The parts for which repairs are allowed go to the conveyor connected to the buffer via port 2.

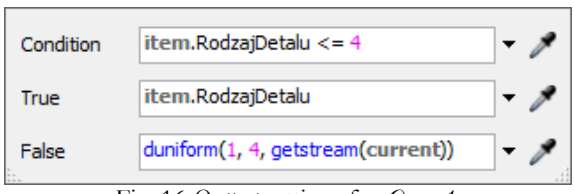


Fig. 16 *Output* settings for *Queue1*

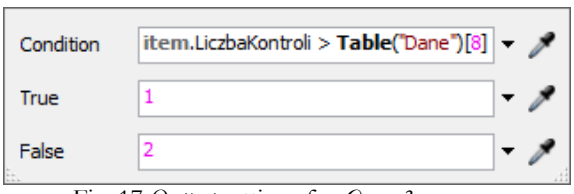


Fig. 17 *Output* settings for *Queue3*

3.6. Conveyor system

The model uses a simple conveyor system connecting individual elements. The detailed settings of the conveyors will be discussed in the next classes, but now the goal of the task is to correctly arrange and connect the necessary elements.

After transferring to the *StraightConveyor* you can define the flow direction indicated by the yellow arrow. Red crosses will also appear at the ends of the selected conveyor, allowing you to change its length and rotation angle (Fig. 18).

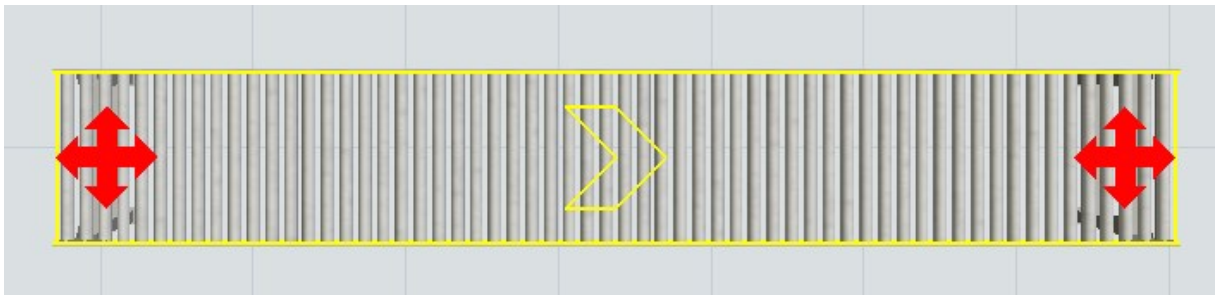
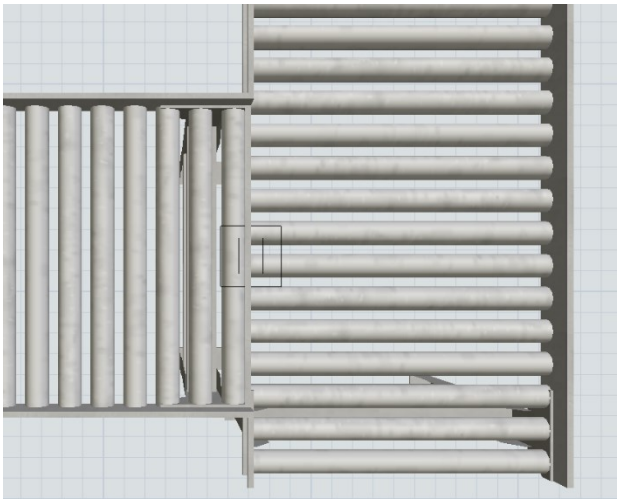


Fig. 18 Basic view of the conveyor

The basic parameters of the conveyor can be modified in its settings (Fig. 19). Objects of this type do not have a *Ports section*, but they are connected to other objects using regular directional connections "A".

Conveyors are connected to each other by moving them, while maintaining the same height of the connecting points. The connection symbol is visible in Fig. 20 in the form of a black square.

Fig. 20. Conveyor connection symbol



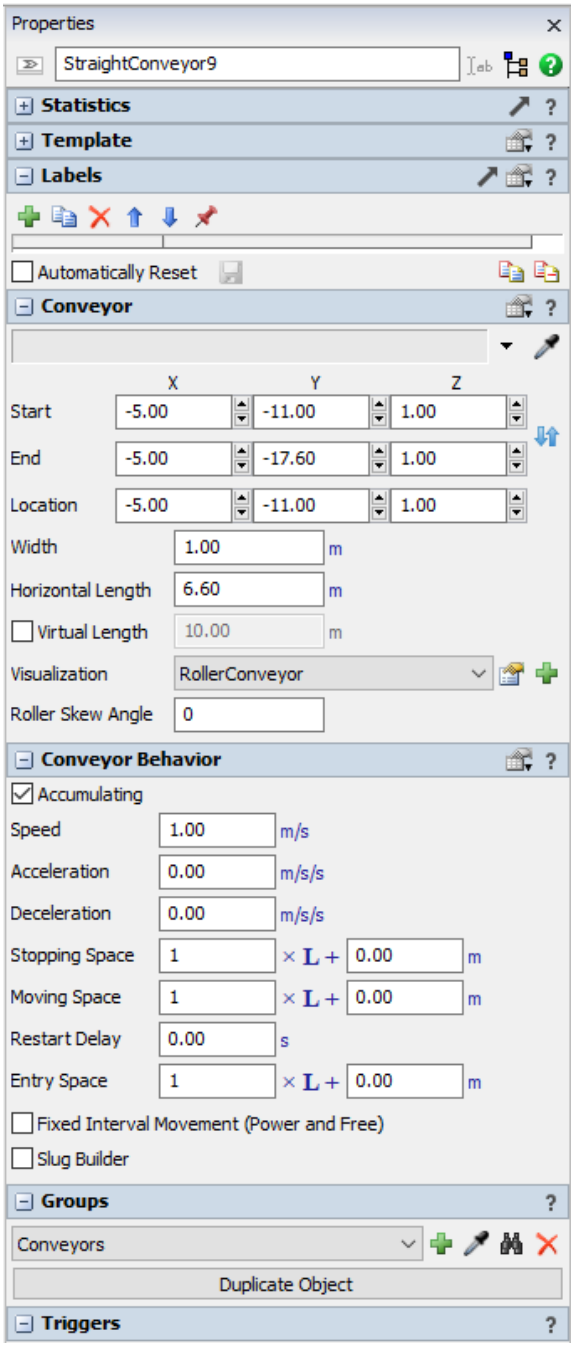
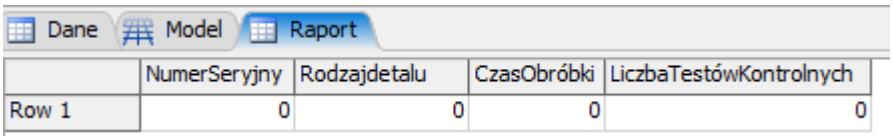


Fig. 19 Conveyor settings

3.7. Report

The simulation results will be analyzed in the global *Report table,* with the headers shown in Figure 20.



Report table settings

The table will be updated every time a machining operation is completed on each machine. You should also check *On Reset → Delete All Rows* to clear the table contents after each reset and restart.

The trigger on the processing stations is responsible for completing the table: *Triggers → On Process Finish → Date → Add Row and Data to Global Table* . It should be configured as shown in Figure 21.

After running the simulation, subsequent entries will appear in the *Report table (Fig. 22).*

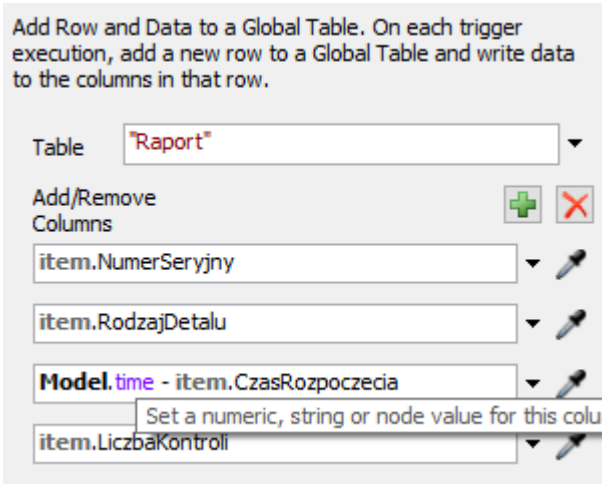


Fig. 21. Data recording trigger configuration in *the Report table*

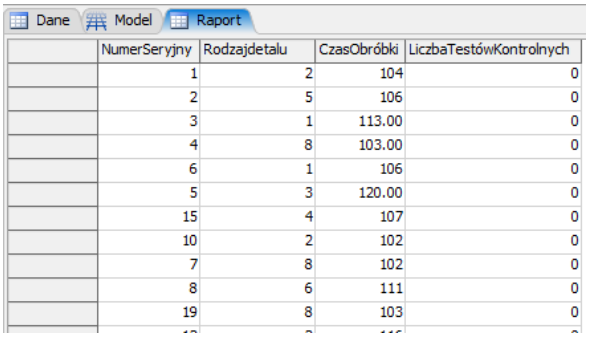


Fig. 22. Data in the *Report table*