# Modelling and Simulating a Technological Flow Using the FlexSim Application

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**Abstract:** *Today, one of the great challenges for any factory is to be flexible enough to produce a wide range of products. Also, to keep production costs under control. In general, the implementation of a technology for the realization of a new product brings with it high costs for refurbishment, production planning, supply logistics, etc. It is necessary to make the right decisions for refurbishment, in the sense that with minimal investment the new product can be made in the quantity, quality and delivery terms established. The FlexSim software models simulates and predicts systems from a wide range, such as manufacturing, warehousing, health, material handling, logistics, etc. FlexSim visualizes and predicts the results that will take place after the change in the production flow. That is why FlexSim is a powerful tool that allows the optimization of a system, before its implementation in the factory. This leads to a reduction in production costs and implementation time of the new type of product. This paper aims to model and simulate a technological flow using FlexSim software, to present the working methodology, benefits and results that can be obtained.*

**Keywords:** *simulation, technological flow*

## 1 INTRODUCTION

Today, one of the great challenges for any factory is to be flexible enough to produce a wide range of products. Also, to keep production costs under control.

It is known that the implementation of technologies for the realization of new products comes with additional costs necessary for refurbishment, production planning, supply of materials, devices. It is necessary to make the right decisions for refurbishment, in the sense that with minimal investment the new product can be made in the quantity, quality and delivery terms established.

The FlexSim software models simulates and predicts systems from a wide range, such as manufacturing, warehousing, health, material handling, logistics, etc.

A series of scientific articles present different aspects, capabilities of FlexSim software.

Thus, Luściński and Ivanov [1] present a study on the simulation of industry 4.0 factories based on the ontology on flexibility using FlexSim software.

In paper [2] „Simulation and Optimization of Automated Warehouse Based on Flexsim", to reduce the logistics costs and commodity storage costs in the operation of e-commerce enterprises, was used FlexSim software to model the system, discrete event simulation, system optimization.

In paper [3] an introduction is made in the presentation and use of FlexSim software.

In general, the implementation of a technology to produce a new product, brings with it high costs for investment in production line, production planning, supply logistics etc.

It is necessary to make the right decisions for refurbishment, in the sense that with minimal investment the new product can be made in the quantity, quality and delivery terms established.

FlexSim visualizes and predicts the results that will take place after the change in the technological flow.

That is why FlexSim is a powerful tool that allows the optimization of a system, before its implementation in the factory.

This leads to a reduction in production costs and implementation time of the new type of product.

## 2 FLEXSIM SOFTWARE

In generally when we want to make a simulation for a system (technological flow), we can have 2 situations:

1) the technological flow exists, and we make the simulation to improve the system or

2) we want to implement a new system and we make the simulation to be able to decide what is the best solution for that technological flow.

In this paper we consider the second situation. we want to implement a new system

In figure 1 is presented a diagram showing the technological flow of processes to be modeled.
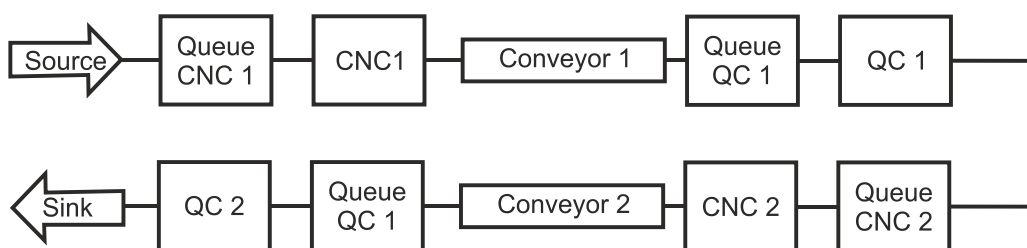


*Fig. 1. Diagram showing the technological flow of processes to be modeled*

Within the technological flow we have a workpiece that is to be processed. It goes through 2 machining operations using CNC and 2 quality control operations related to each machining operation. Conveyors are used to move the workpiece from one working point to another.

We want to know how many parts can be processed within 8 hours, what is the degree of use of the equipment, also what is the occupancy rate of the operators who serve the equipment.

To do this we will use FlexSim software.

In FlexSim to modelling and simulate a tehnological flow (a system) are some basic steps [5]:

1) Create a layout using library objects;
2) Make port connection;
3) Edit the look and behavior of objects;
4) Run the simulation;
5) View the results.

### 1.1 Create a layout using library objects

In a model we need a source to create the items (the workpieces). Before any operation (process) the items are waiting to be processed. That's why a queue is inserted before each operation. Conveyors are used to move the items (the workpieces) from one working.

In figure 2 is presented the layout create in FlexSim, corresponding with the technological flow of processes to be modeled.
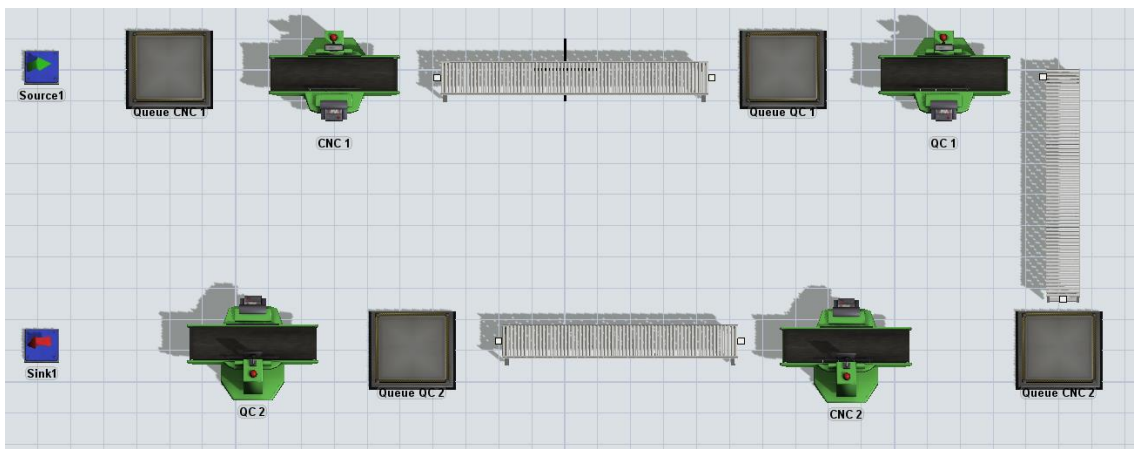


*Fig. 2. Layout create in FlexSim.*

### 1.2 Make port connection

Because we want the workpieces (flow items) to move according to the technological flow, must be established the connections between the ports.

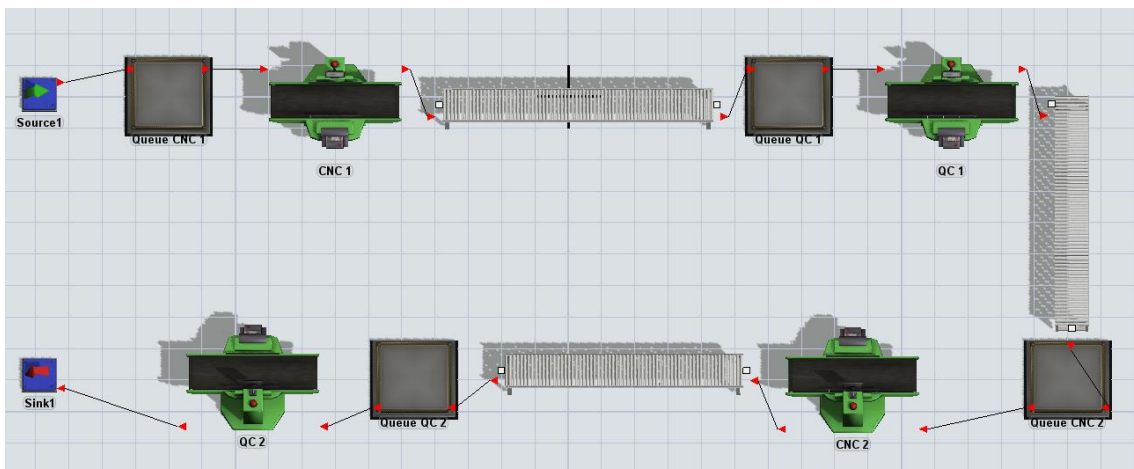In figure. 3 it presented the connections between resources.



*Fig. 3. Connections made in model.*

### 1.3 Edit the look and behavior of objects (properties)

For each process we know the time. According with the time off every process it is setup the corresponding process (resource) in the model.

The time to enter in the flow between 2 items is known and is 5 minutes. In figure 4 is presented the properties set-up for source.
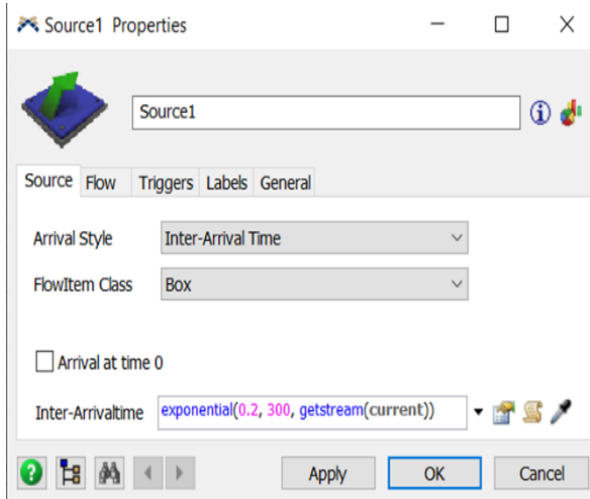


*Fig. 4. Setup the properties for source1*

The setup time and process time for each operation are known.

In figure 5 is presented the setup of properties for process CNC1. It is knowing the setup time is 1 minute and the process time is 4 minutes.
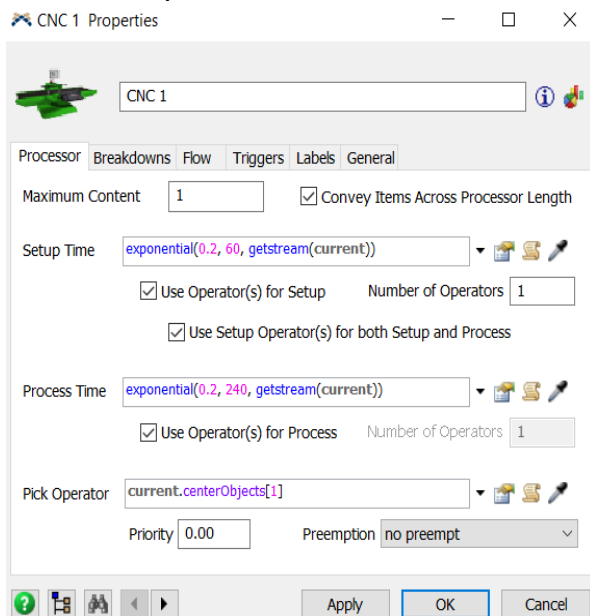


*Fig. 5. Setup the properties for process CNC1*

At the same time, within the technological flow, the operators that serve the different processes are introduced.

CNC operators take workpieces from the appropriate queues, service the CNC according to the process properties setting, and then move the workpiece to the conveyor.

This is set to use the operators in the processes. Thus, in figure 5 at setup process and process time the option of using the operators and their number, if applicable, is checked.
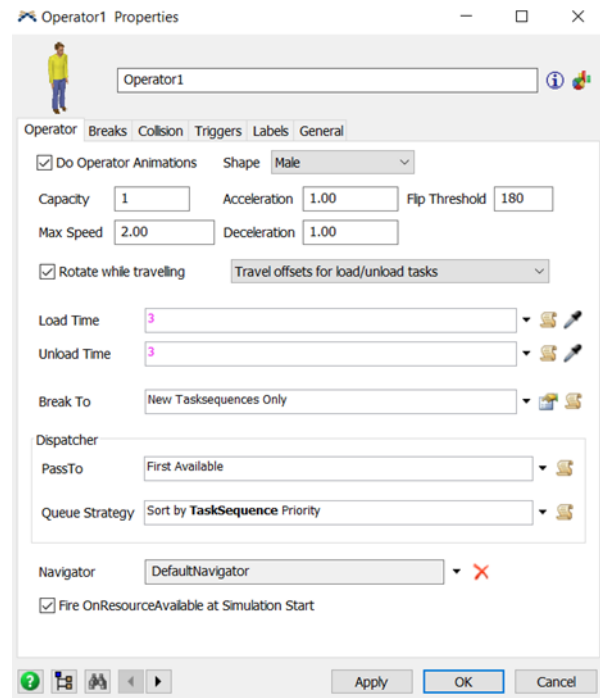
In figure 6 is presented the options setup for operators.



*Fig. 6. Setup the properties for operator*

It can be seen that a number of properties can be set for operators, including maximum speed, acceleration, deceleration, load time, unload time and many others.

### 1.4 Run the simulation

After making the model in accordance with the real situation, the simulation can be run.

To run the model, it is necessary to establish the simulation period. In this case 8 hours.

In this model I assume that all parts pass quality control.

In figure 7 is presented the layout of model at the star off the simulation.

The operators and their corresponding connections can be observed.

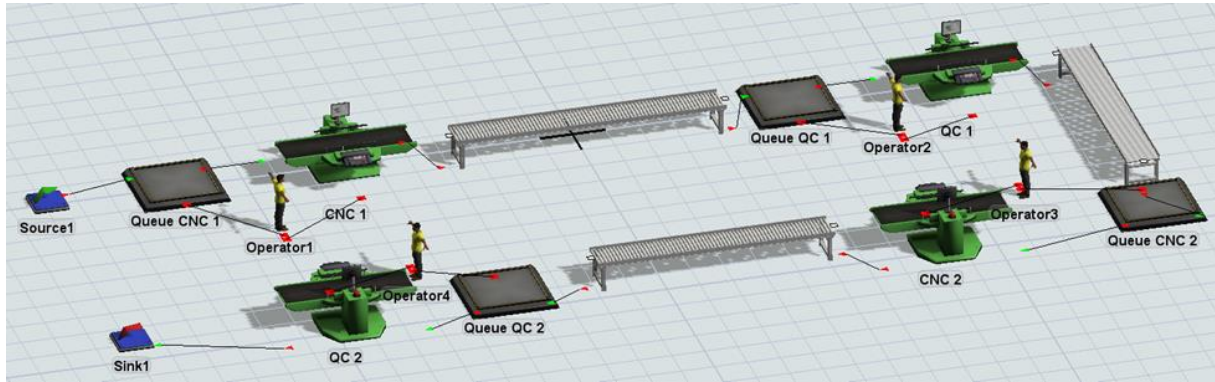There are a number of 4 operators, one for each operation in the technological flow.

*Fig. 7.* The layout of model at the star off the simulation

### 1.5 View the results

After running the model, we can obtain different type of information from our model. You can use a dashboard to generate reports with the data we are interested in.

#### 1.5.1 What is the degree of use of equipment?

We want to know the occupancy rate of the equipment used in the 4 processes.

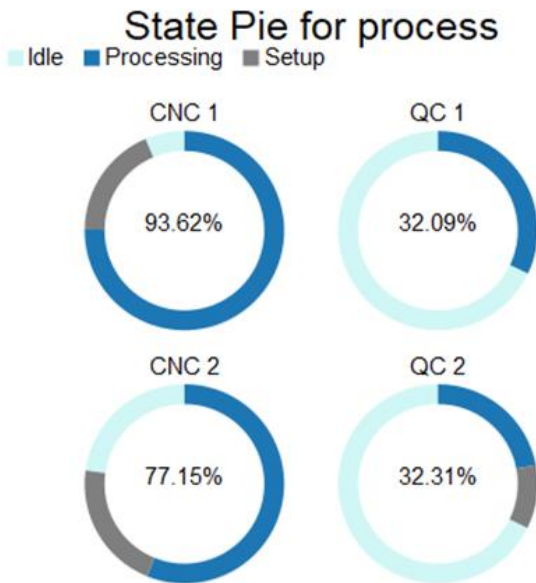In figure 8 we can see the state pie with this informations.



*Fig. 8.* T*he degree of use of equipment*

#### 1.5.2 What is the degree of use for operators?

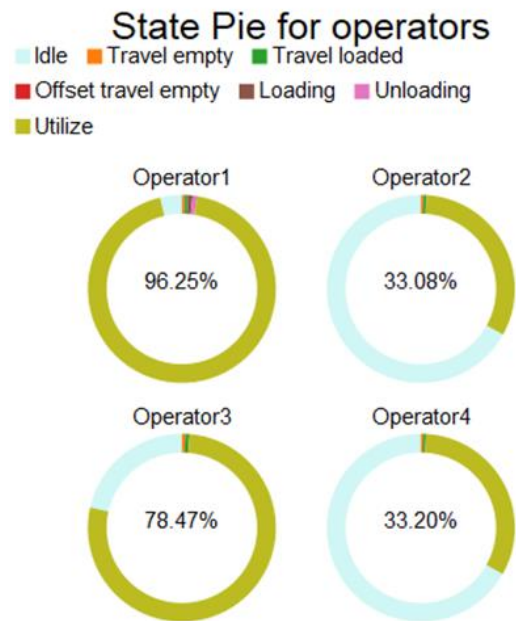In figure 9 we can see the degree of use for operators.



*Fig. 9.* T*he degree of use for operators*

#### 1.5.3 How many parts have been processed in 8 hours?

To find out the number of parts processed in 8 hours it is necessary to know the number of items that arrived in sink1.

In figure 10 is presented the numbers of parts processed in 8 hours.



*Fig. 10.* the numbers of parts processed in 8 hours

### 1.5.4 What is the maximum number of workpieces waiting in queues?

In figure 11 we can see the maximum number and the average of workpieces waiting in queues.

| Content | | |
|---|---|---|
| | Maximum | Average |
| Queue CNC 1 | 24.0 | 11.3 |

| Content | | |
|---|---|---|
| | Maximum | Average |
| Queue QC 1 | 3.0 | 0.1 |

| Content | | |
|---|---|---|
| | Maximum | Average |
| Queue CNC 2 | 10.0 | 2.5 |

| Content | | |
|---|---|---|
| | Maximum | Average |
| Queue QC 2 | 4.0 | 0.1 |

*Fig. 11.* T*he maximum number of workpieces waiting in queues*

### 1.5.5 What is the average time for workpieces waiting in queues?

After simulation we can find what is the average, minim and maxim staytime of workpieces in the queues corresponding to the 4 processes (figure 12).

**Staytime for workpieces**

| Object | AvgStaytime | MinStaytime | MaxStaytime |
|---|---|---|---|
| Queue CNC 1 | 3393.89 | 5.01 | 6223.43 |
| Queue QC 1 | 46.02 | 1.95 | 555.21 |
| Queue CNC 2 | 988.07 | 2.69 | 2612.25 |
| Queue QC 2 | 49.87 | 1.85 | 571.09 |

*Fig. 12.* T*he staytime for workpieces waiting in queues*

Observation. Unit of measure for time was second (in all simulation).

As presented above, different information about the modeled and simulated technological flow can be obtained, depending on what you want to know about the respective system.

All the desired information can be saved as csv files and used later.

## 3 CONCLUSIONS

1) FlexSim software model, simulate and predict systems from a wide range of domains.
2) FlexSim can be utilised to simulate an existing process to see how can be improved or a new process to see what resources are necessary to implements the process in reality.
3) FlexSim visualizes and predicts the results that will take place after the change in the technological flow. This leads to a reduction in production costs and implementation time of the new type of product.

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