TECNOMATIX Plant Simulation

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Description of the Delivery Concept Demo Model for Tecnomatix Plant Simulation

Last Change: December 2008

CONTENT

1. Description

This model shows the production of trolleys.

Note, that some actions in this description are not available in the Plant Simulation Viewer (in case you run this model from the Plant Simulation Demo-DVD), since the Plant Simulation Viewer does not allow any modeling or changes of parameters. Actions which are not allowed in the Plant Simulation Viewer are marked with an asterix (*). In the model for the Plant Simulation Viewer, some of the actions marked with an asterix (*) will happen automatically at the end of the simulation.

1.1 Objective

The objective of this simulation study is to find out

- what is the best delivery concept for the factory (once per hour, once per day, twice per day)
- how the shift system in one part of the factory will affect the target output (1 shift, 2 shifts or 3 shifts system), considering the required number of stations for each type of shift
- how many pallets are needed

Besides that, the model demonstrates the ability to load up-to-date data about orders from a Microsoft® Access® database or a Microsoft® EXCEL® datasheet (*).

1.2 System Characteristics

There are multiple dependencies in the production system, because of assembly processes (so assembly parts must arrive in time).

1.3 Workflow

Simulate three different delivery concepts simultaneously.

Evaluate the effect of changing the shift system in the wheels production department.

1.4 Results

Use the simulation to find out

- The best delivery concept and required shift system with respect to the total output per day
- The throughput rate of the system and throughput time of the trolleys
- The required quantity of pallets

2. Demo Instructions

This model demonstrates the following Plant Simulation features:

- Ability to run two different scenarios simultaneously against each other.
- Usage of hierarchy
- Advantages of inheritance and re-usability of objects.

2.1 Study Overview

Open the first factory Factory1 by double-click.

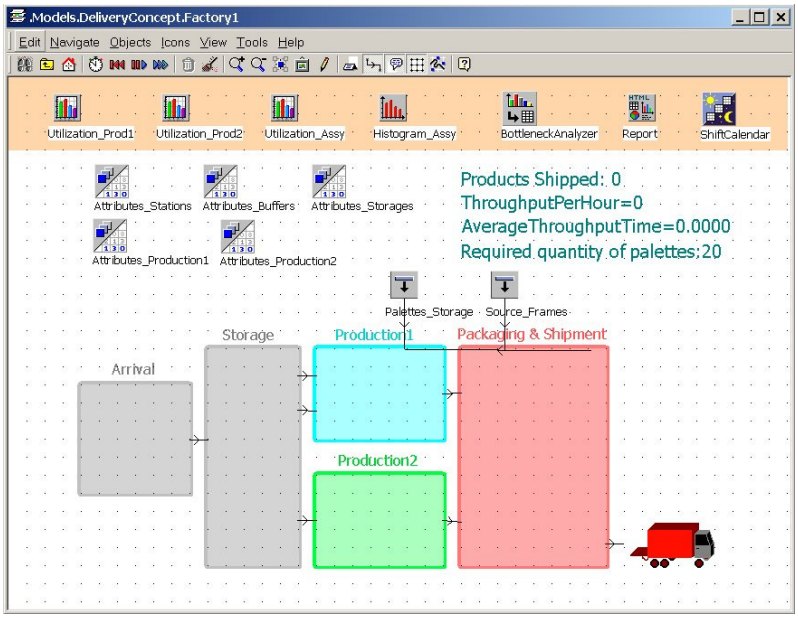


Figure 1: Factory 1

Start the simulation run using the Start/Stop icon in the toolbar of the model. To restart the simulation, click first on the Reset icon left of the Start/Stop icon, then click on the Start/Stop icon again.

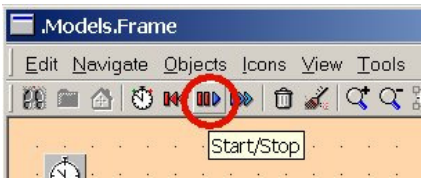


Figure 2: Start/Stop icon in the toolbar

Double-click each of the departments to look at the content.

Plates, bars and wheels enter the system at the Arrival department. The Source generates the parts according to the schedule in the Orders table. To change the schedule, just click on the Set button next to the delivery concept (Once per hour, twice per day, once per day) (*).(*) On

the Plant Simulation Demo-DVD, you find those different strategies are activated in the models Factory1, Factory2 and Factory3 in the main frame DeliveryConcept.

Then, the parts move on a conveyor system to the Storage. In the Storage, the FlowControl sorts the parts and stores it in one storage for each type of part. Right-click the Storage_Dimensions chart and choose Show Display Window from the context menu to look at the buffer occupation.

In Production1, the plates and the bars go through a multi stages production process, at the end they are loaded on pallets.

Look at the chart for the bars (choose Show Display Window from the context menu). The chart shows the utilization of the stations where the bars are produced. You will note, that the station Grinding2 is missing in the chart.

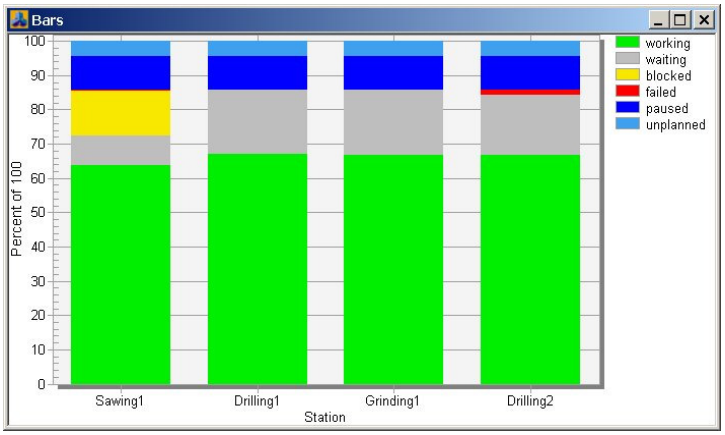


Figure 3: Utilization Chart

To add the station, just drag&drop it on the Bar chart.

Production2 contains 6 parallel stations for the production of wheels. The number of active stations depends on the shift system:

- a 3-shift system requires only 3 active stations
- a 2-shift system requires 4 stations and
- a 1-shift system requires all 6 stations.

Use the Set button to change the type of shift. Compare the results Products Shipped, ThroughputPerHour and AverageThroughputTime for the different shift systems in the window Factory1 (*). The shift calendar shows the active shift system.

To look at the station utilization, right-click the Utilization chart and choose Show Display Window from the context menu.

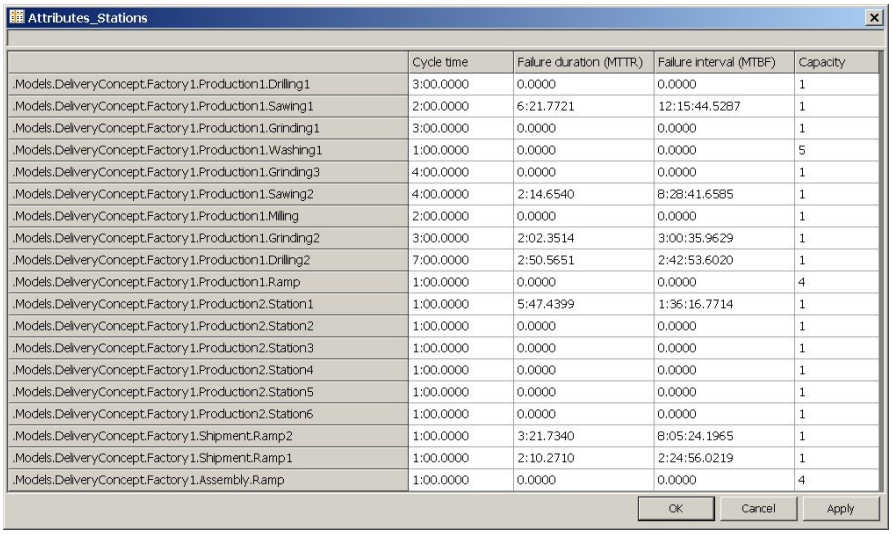
In the Assembly & Packaging department, plates and bars are unloaded from the pallets. All parts are assembled on the Assembly_Station and the trolleys leave the department on a conveyor system. Look at the charts for the utilization of the Assembly_Station and the buffer occupation.

In the Shipment department, the trolleys leave the system. Right-click on the Throughput_Plotter and choose Show Display Window from the context menu to see how the throughput per hour is changing over the time.

Summary: The usage of hierarchies in Plant Simulation allows handling complex systems in a well-structured and efficient way. Plant Simulation provides a number of chart types (utilization chart, buffer histogram, plotter and many more) which you configure by just using drag&drop.

2.2 Change Model Parameters

The factory window, look at the attribute explorer objects. Right-click an explorer Attributes_Stations and choose Show Display Window from the context menu. The attribute explorer allows very comfortably to view and to edit parameters of the objects you have in your model.



	Cycle time	Failure duration (MTTR)	Failure interval (MTBF)	Capacity
.Models.DeliveryConcept.Factory1.Production1.Drilling1	3:00.0000	0.0000	0.0000	1
.Models.DeliveryConcept.Factory1.Production1.Sawing1	2:00.0000	6:21.7721	12:15:44.5287	1
.Models.DeliveryConcept.Factory1.Production1.Grinding1	3:00.0000	0.0000	0.0000	1
.Models.DeliveryConcept.Factory1.Production1.Washing1	1:00.0000	0.0000	0.0000	5
.Models.DeliveryConcept.Factory1.Production1.Grinding3	4:00.0000	0.0000	0.0000	1
.Models.DeliveryConcept.Factory1.Production1.Sawing2	4:00.0000	2:14.6540	8:28:41.6585	1
.Models.DeliveryConcept.Factory1.Production1.Milling	2:00.0000	0.0000	0.0000	1
.Models.DeliveryConcept.Factory1.Production1.Grinding2	3:00.0000	2:02.3514	3:00:35.9629	1
.Models.DeliveryConcept.Factory1.Production1.Drilling2	7:00.0000	2:50.5651	2:42:53.6020	1
.Models.DeliveryConcept.Factory1.Production1.Ramp	1:00.0000	0.0000	0.0000	4
.Models.DeliveryConcept.Factory1.Production2.Station1	1:00.0000	5:47.4399	1:36:16.7714	1
.Models.DeliveryConcept.Factory1.Production2.Station2	1:00.0000	0.0000	0.0000	1
.Models.DeliveryConcept.Factory1.Production2.Station3	1:00.0000	0.0000	0.0000	1
.Models.DeliveryConcept.Factory1.Production2.Station4	1:00.0000	0.0000	0.0000	1
.Models.DeliveryConcept.Factory1.Production2.Station5	1:00.0000	0.0000	0.0000	1
.Models.DeliveryConcept.Factory1.Production2.Station6	1:00.0000	0.0000	0.0000	1
.Models.DeliveryConcept.Factory1.Shipment.Ramp2	1:00.0000	3:21.7340	8:05:24.1965	1
.Models.DeliveryConcept.Factory1.Shipment.Ramp1	1:00.0000	2:10.2710	2:24:56.0219	1
.Models.DeliveryConcept.Factory1.Assembly.Ramp	1:00.0000	0.0000	0.0000	4

Figure 4: Attribute Explorer

Close the dialog. Drag&drop the source Source_Pallets on the explorer Attributes_Stations and choose Show Display Window from the context menu again. Now, the explorer also shows the parameters of the source.

Summary: Checking and changing parameters of many objects is very simple in Plant Simulation using the attribute explorer object. Define the objects you would like to display in the explorer window by drag&drop.

Double-click the ShiftCalendar object in the factory window. It shows the general shift system for the factory. The tab Resources shows the objects which use this shift calendar. Note, that the source Source_Frames is missing. Close the dialog of the shift calendar. Drag&drop the Source_Frames on the ShiftCalendar and look at the Resources tab again. Now, you find the source Source_Frames at the end of the table on the Resources tab.

Summary: Drag&drop is a basic functionality in Plant Simulation for many features. It allows very fast and easy modeling.

2.3 Model Evaluation

Go back to the DeliveryConcept window (if you don't have it open any more, double-click the DeliveryConcept object in the Class Library window). Right-click the BottleneckAnalyzer and choose Analyze from the context menu (*). In the factory windows, you'll see small charts above each department and each station. Double-click Production1 to look at the charts inside. The meaning of the colors is

- Grey: empty
- Green: working
- Yellow: blocked (i.e. waiting for assembly parts or waiting for successor stations to become empty)
- Red: disrupted
- Blue: paused

The bottleneck charts tell you immediately, where stations are waiting (because material is missing) or where the material flow gets stuck (blocking behavior).

In the DeliveryConcept window, right-click the SankeyDiagram and choose Display Sankey from the context menu (*). In the factory windows, you'll see a blue line which shows the flow of material for the bars. The thickness of the line shows, how many parts per hour went a certain way. Double-click Production1 to look at the Sankey chart inside. You'll see that most of the bars went to the stations Drilling1/Grinding1. If you double-click Sawing1, chose the tab Exit Strategy and click on the Open List button, you'll see that 70% of the bars move to successor 1 (Drilling1) and 30% move to successor 2 (Drilling2).

Note, that you can insert multiple Sankey charts using different colors for multiple part types.

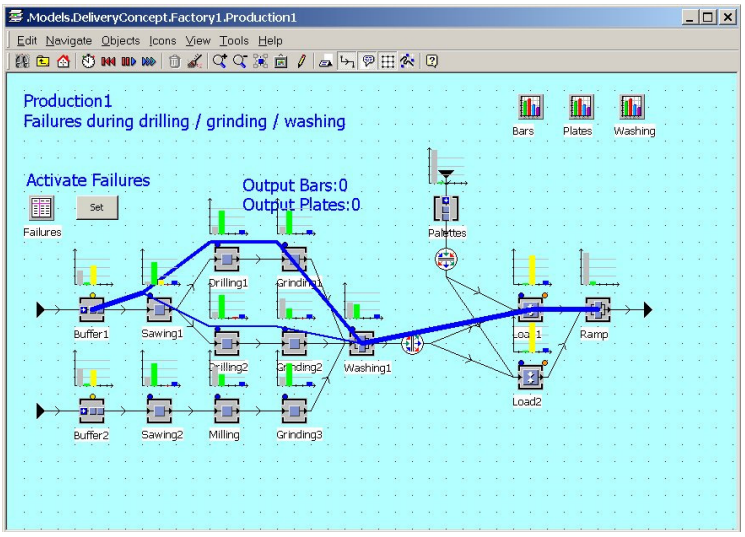


Figure 5: Bottleneck and Sankey Chart

The Sankey chart shows you if

- parts take the way you expect them to take (showing modeling errors)
- lines are balanced well
- where you have most of the traffic in your factory

Compare the results Products Shipped, ThroughputPerHour and AverageThroughputTime in the factory windows Factory1, Factory2 und Factory3 at the end of the simulation.

Summary: Plant Simulation provides several easy-to-use tools to analyze and evaluate your simulation model.

2.4 Model Documentation

Right-click the Report object in the factory window and choose Show Display Window from the context menu. The Plant Simulation HTML report opens. Click on the various pages in the tree structure on the left hand side to look at the documented results.

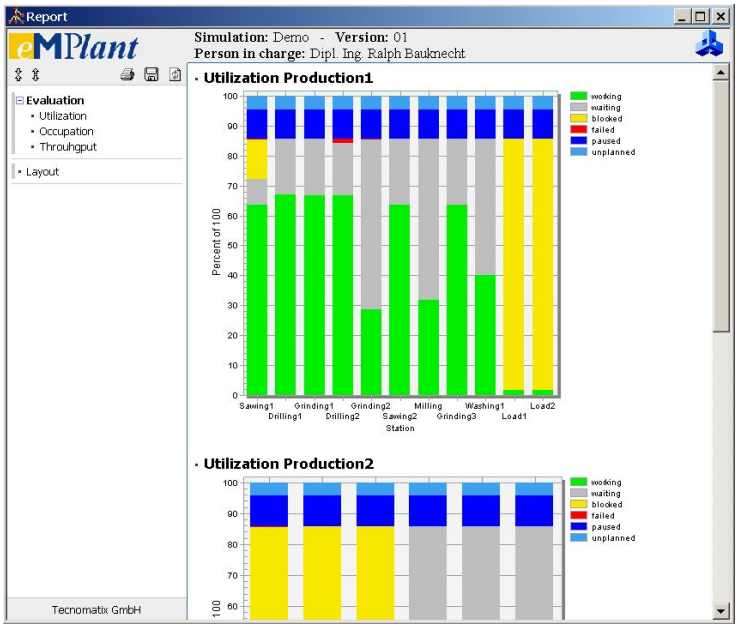


Figure 6: HTML Report

Note, that you can save the report in html format by a mouse click on the Save the result portfolio icon. Now you can open it with any web browser by a double click on the _Start.htm file included in the folder you just created.

Summary: Plant Simulation provides the possibility to document your results in an HTML report which contains the updated result values, charts, description, the model layout itself, etc.

3. Result of the Simulation Study

When you compare the results of the 3 factories, you will notice, that Factory2 and Factory3 (delivery twice per day and once per day) show the highest throughput. The reason is that in Factory1, because of the time span between two deliveries, sometimes the material flow is cut off in Production1. In Factory2 and Factory3, there's enough material in the store, so that the flow of material can continue.

This study shows that continuous delivery is not always the best solution. The best solution is the one which fits best to all the dependencies you have in your factory and simulation is the way you verify this solution.