

ServiceModel: Order Processing System Tutorial¹

You are part of a consulting team brought in to reengineer your customer's order processing operations. The team has worked out a proposal, but needs an effective way to present your recommendations to senior management and, not incidentally, to the customer's employees who will be impacted by the change. Before starting on the model of the proposed changes, however, it has been decided that you need a baseline model. Your team leader has asked you to prepare an animated model to show the client and he has directed other team members to give you the following information. We will go through the construction step-by-step.

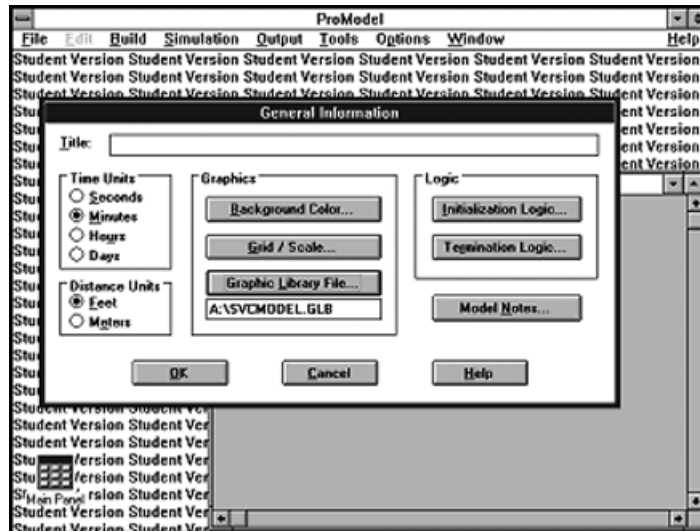
First, let's consider the process. New purchase orders come in every three minutes on average, with the time between arrivals exponentially distributed. The documents are placed in the inbox of the order checker who reviews them for completeness. This individual normally requires one minute to check an order for completeness, but the time may be as much as five minutes if a follow-up call is needed to obtain any missing information. On the other hand, the checker might occasionally complete his work in as little as 30 seconds. Once complete, the forms are placed in an inbox on the desk of a credit checker who verifies the credit of the purchaser. This individual requires three minutes with a standard deviation of one minute. The forms then pass to another inbox, then to the desk of a stock checker who determines whether the item ordered is available from stock (an average of 4 minutes with exponential distribution). If so, the request goes to the inbox of an order picking department that requires ten minutes (normally distributed with a standard deviation of one) to pull the order. There are three individuals working in this department and each works more or less independently. The merchandise is then placed on a conveyor that carries it to shipping. This conveyor is 50 meters long and has a gentle downhill slope to the packaging department. The merchandise moves at 25 meters per minute and backs up in sequence at the end of the conveyor line until it is removed, one at a time, for packing. This last process takes between 2 and 6 minutes with times distributed evenly across this range. Packaged orders leave the system at this point. For the purposes of checking our model, we will want to simulate 100 orders, counting the number completed.

As we construct the model, you may want to note any ideas you may have for making the process more efficient. In fact, you may also be called on to construct a reengineered model for this process.

General Information

Unless indicated otherwise, all mouse clicks indicated below are with the left button. Start ServiceModel and close the shortcut panel. Click on File/New. If the General Information screen does not appear on its own, click on Build/General Information. Set the default time units (minutes) and distance units (meters) by clicking on the appropriate radio buttons. Click on the Graphic Library File button. Look through the list of possible graphic icon libraries in the GLIB subdirectory and click on SVCMODEL.GLB. Click on Open and close the General Information window with a click on OK.

¹ Source: With permission from PROMODEL Corporation, Orem, Utah.



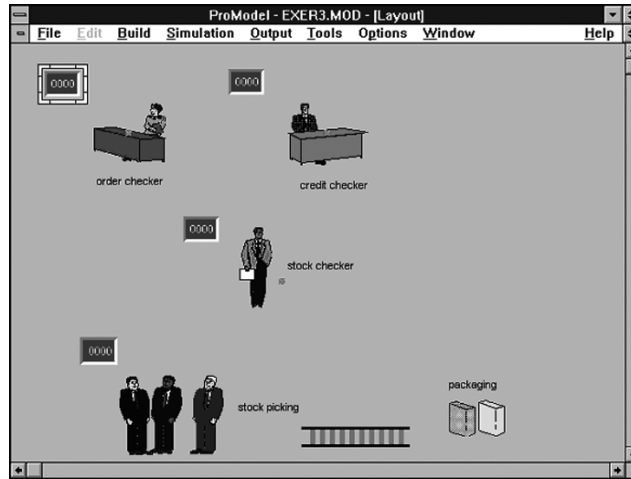
Locations

Next, click on Build/Locations to open the module in which we will define each of the process locations. Let's use a content counter to represent the first inbox where the purchase orders enter the process. Click on the button labeled 00 and click again where you would like to see the box on the layout screen. You will notice that, in addition to placing the icon on the layout, the software has created a register line in which you can now click to define the capacity of this location, as well as name, queuing rules, and so forth. First, change the name in the register to checker_inbox, then click in the capacity box and set it to 20 (meaning the inbox can hold up to 20 orders at once).

Now we should find an icon to represent the order checker or his desk. Scroll through the icons and click to select one. Then click to place it on the layout. Change the name to order_checker and set the capacity to one. Uncheck the box titled New and click on the red spot with an X through it. This is called the entity spot. Click on your icon where you would like the documents to show up when they are at this location. Click on the text button (Aa) and click below the location to transfer the name of the location.

Click in the New box again to continue defining new locations. Continue by defining locations for the credit checker (credit_inbox) and stock checker (stock_inbox), each with their respective inboxes. Set the capacity of each inbox to 20 and the capacity of each of the two checkers to one.



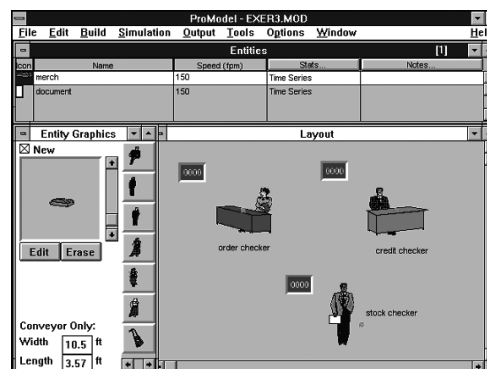


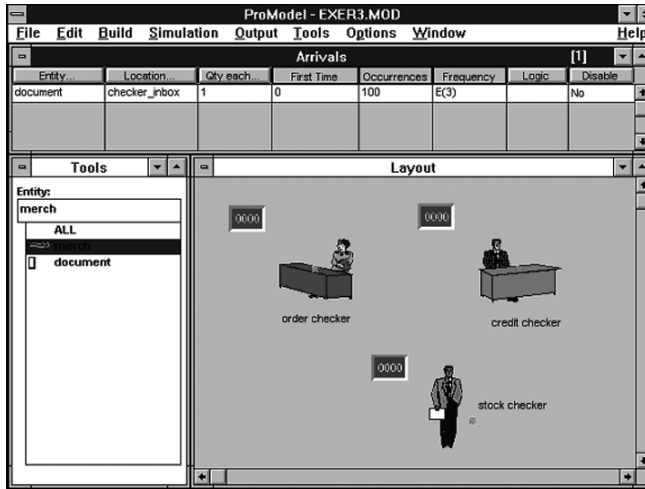
Entity spots are placed with locations when we want to see the entity while it is being processed at that location. With the New box off, the entity spot becomes part of the location. When working with entity spots, remember to turn off the new box or a new location will be created. Forgetting to do this will cause the software to treat the spot as a new location. This is a common mistake and can be easily corrected by deleting an undesired location (highlight the location register line and use Edit/Delete).

Now define an inbox with a capacity of 50 for the stock picking unit. Select your own icon to create the stock picking area itself and set its capacity to three. Locate the packaging station with a capacity of one off to the bottom-right corner, leaving room for a conveyor between stock picking and packaging.

Conveyors

To create a conveyor location, be sure that the New box is checked and click on the button that looks like a yellow step (two down from the counter symbol). Place the conveyor in the layout beginning at the stock picking area and ending at the packaging station. Click (with the left mouse button) on the layout where you want the conveyor to begin. Drag the conveyor arrow to the place where you want the conveyor to end and click (with the right mouse button). The conveyor graphic is now a line; double click on it to define a roller conveyor and use Conveyor Options to set the speed to 25 meters per minute and length of 50 meters. You will also want to be sure that you have an accumulating conveyor. Close the conveyor options box. Give the conveyor a name in the registry line and define the capacity as 10. Click on Rules and select FIFO to ensure that items are sequenced first in, first out.



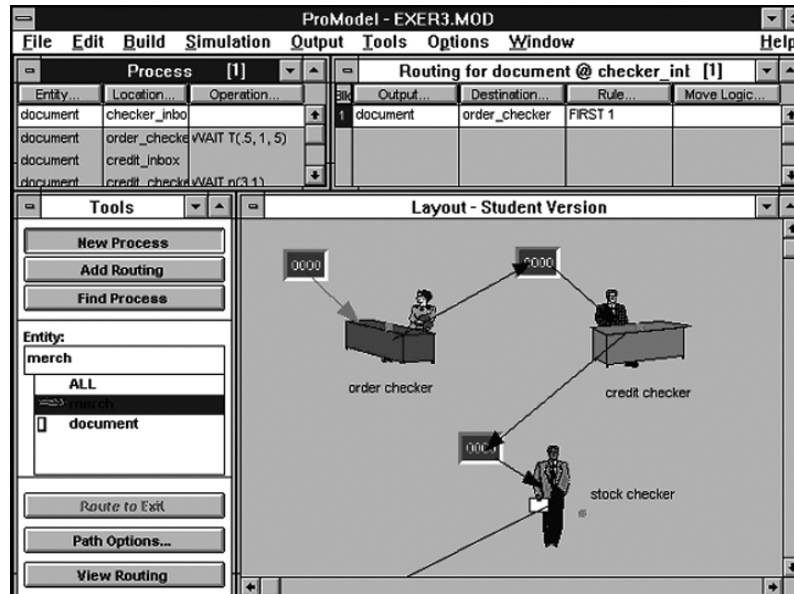


Entities

We now must define two entities used in the model. Click on Build/Entities and select an icon to represent the order (“document”) and another icon to represent merchandise (“merch”) that will be placed on the conveyor by the stock pickers. The size of the icons can be altered using the slide bar to the right of the picture that appears in the Entity Graphics window. You can change the icon names by editing the register lines, but do not worry about the Speed and Stats columns for now.

Arrivals

The scheduling of the arriving documents can now be added by going to Build/Arrivals. Click on document in the Tools window and click on the icon for checker_inbox in the layout screen (location where arrivals appear). The software has started to complete the arrival register for you. The quantity arriving is one and this begins at time 0 (the start of the model run). Since we said we would simulate 100 documents, enter this amount in the



Occurrences box. Remember that the time between arrivals is three minutes, exponentially distributed. Highlight the 1 in the frequency box and then click with the right mouse button. In the Logic Builder click on Distribution functions, then Exponential. Now type in the mean in minutes (3), then click on Return and Paste. This should fill in the required distribution information in the proper format E(3).

Processing

We can now turn to defining the process flows. Begin by clicking on Build/Processing. You should now see the Processing/Routing module. Since a document is the entity that comes into our model, click on the name of this entity in the Tools window. Click (using the left mouse button) on the location where the document arrives (checker_inbox). You should see a stretchable arrow that can be dragged to the next location (the order_checker) where you will click (using the right mouse button) to indicate the next destination in the process flow. The software will create a process routing line that shows the document arriving at the inbox, followed by a box in which we define any processing operations that occur there. Since this inbox is simply a queue or holding location, we will leave the operation time blank. On the routing side, we note that the entity that exits from the inbox is still called a document and that it proceeds to the order_checker. The Rule box identifies the logic used to decide between more than one possible destination. There is only one possibility (the order_checker) from this inbox, so we will leave the default term FIRST in place. The digit that follows indicates how many documents will leave the inbox for each document that arrived. In this case the answer is one, which is also the default.

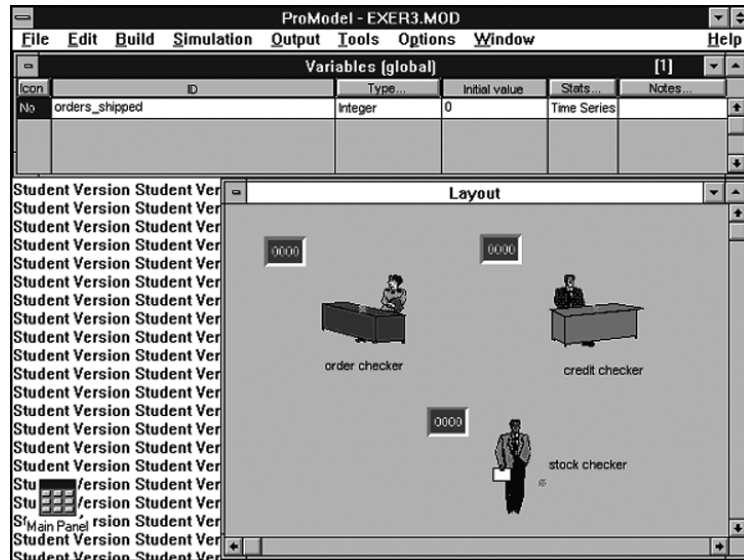
The Move Logic box is used to specify the time required to move from the operating location to the destination (checker_inbox to order_checker) or the name of a transport device. In this case, leave the Move Logic box blank. To continue, we define the processing at order_checker in the same way. Click on document, on the order_checker icon, then on the credit_inbox icon that precedes the credit_checker. This will create a new processing line in the register. If you make an error, click in this register line then select delete from the Edit menu to begin again.

In this case, there is an operation step to be defined. Click the Operation bar above the box and then click on the Build button that looks like a hammer. The Logic Builder will then appear. We can define the operation time at order_checker by clicking on the Wait statement, then the Time button, then on Distribution Functions/Triangular in this sequence. You will then fill in the minimum, mode, and maximum by clicking on the appropriate button and typing in the values (in this case, .5, 1, and 5 respectively). Click on Return and paste this information into the operation window.

You can now define the processing and routing steps for the rest of the model. The wait time for the document at credit_checker should be a normal distribution with a standard

The screenshot shows the ProModel software interface with a menu bar (File, Edit, Build, Simulation, Output, Tools, Options, Window, Help) and a table with three columns: Entity, Location, and Operation. The table contains the following data:

Entity	Location	Operation
document	checker_inbox	
document	order_checker	WAIT T(.5, 1, 5)
document	credit_inbox	
document	credit_checker	WAIT n(3,1)
document	stock_inbox	
document	stock_checker	WAIT e(4)
document	stock_picking_inbox	
document	stock_picking	WAIT n(10,1)
merch	conveyor	move
merch	packaging	WAIT u(4,2)



deviation of 1 and a mean of 3. The stock_checker will have an exponential distribution with a mean of 4. The wait time at stock_picking is 10 minutes, normally distributed, with a standard deviation of 1. (Note: Change the entity leaving stock_picking from “document” to merchandise by using the bar over the Output box and selecting “merch.”) Since all subsequent processing deals with “merch” as the entity, you will want to highlight this entity in the Tools window before defining any other process lines. Enter MOVE in the operation box for the conveyor. The processing time at Packaging is uniformly distributed with a mean of 4 and half range of 2. From Packaging, drag the arrow to Route to Exit at the bottom of the Tools window and left click in the box.

Use the scroll bar to move up and down through the processing lines. Remember that the highlighted routing lines correspond to the highlighted processing lines—they do not necessarily need to be directly across from each other. Check your processing line-by-line. The logic should look like the listing below.

Counters

The last step is to set up a counter that will keep track of the number of orders processed and show this result on the screen. We will do this by defining a variable. Go to Build/Variables(Global) or Build/More Elements/Variables, enter “orders_shipped” as the name of the variable, define it as an integer variable under Type, and set the initial value as 0. Do not worry about the statistical reporting at this point. Now click on the layout screen where you want this counter. Now, return to Processing briefly. Highlight the processing line for the Packaging station and in the Move Logic box enter “INC orders_shipped, 1” (automatically increments by one). This logic will increment the counter each time an order leaves Packaging. You can, of course, also use the Logic Builder to create this statement.

It is time to save and run the model. Go to File/Save and enter a name for your model, followed by the extension .MOD. Click on OK to save and then run your model. If your model runs right off, congratulations! If you receive an error message of some sort, read it carefully and try to identify where in the model you may have made a mistake. Read through the explanation of the model again to double-check your understanding before seeking help from your professor or teaching assistant.