Make-to-Order Production with VIDEO

The make-to-order environment assumes that customers place orders for unique products and are happy to wait for their product to be manufactured and delivered. Examples are manufacturing of equipment for new factories such as large printers, crushing plants, conveyor belts, injection moulding machines, agricultural equipment, etc.

Rules 1 and 2 remains valid as is, but customer demand is expressed as a due date and a product specification. Filling an order perfectly means delivering the specified product on or earlier than the promised due date - being exceptionally reliable.

We can ignore demand variability and need to protect only against supply variability because there is little demand variability after an order has been placed and no production should be done before a due date is fixed. The primary protection mechanism is therefore production time buffers, although inventory buffers of raw materials or components might be necessary to be able to reduce production time buffers to be within customers' tolerance time (the time they are willing to wait for delivery). This is rule 3.

Rule 4 in this case: Release to production only what has been ordered by the customer a time buffer before the promised due date. Promised due dates are determined based on load.
In all cases we have to abolish local efficiencies in order to maximise flow, rule 5.

Rule 6 remains the same. Buffer status sets priorities for everybody in the system and focuses improvements.

Understanding the details of the application of these rules requires the help of an educational simulator, GSIM.

In the next section you will learn the GSIM simulator and all its features. I am also enforcing a local optimum that will frustrate you to such an extent that you will want to abolish it everywhere.


Downloading the GSIM Simulator:

Please download the following .zip folder, extract and save ALL contents into the SAME folder on your computer: **GSim.zip** **(https://lms.tuit.co.za/courses/429/files/51107/download?verifier=j5JLqoIfBfpHlcKSixQzhOiq0SoB3cPJUzhN1VB5&wrap=1)** ☑ **(https://lms.tuit.co.za/courses/429/files/51107/download?verifier=j5JLqoIfBfpHlcKSixQzhOiq0SoB3cPJUzhN1VB5&wrap=1)**
We will be referring to the various files in the folder during the remainder of this course.

Here is the first simulator we will use. GSIM 312. (*Click on the GSIM.exe/GSIM file to run the application, then select Params.312 file by selecting File and Open from the Top Menu of the Goldratt Simulator).*

This factory employs 5 different resource types, 1 blue, 2 green, 2 cyan, 2 magenta and 1 brown resource. The available capacity of each resource is 8 hours a day for 5 days (40 hours or 2400 minutes per week).

Each resource has a setup time, to change from doing one job to doing another, 15 minutes for resource blue, 120 minutes for green, 60 minutes for cyan, 30 minutes for magenta and 0 minutes for resource brown. Brown is doing assembly jobs and does not need to change anything to assemble a different product.

The grid defined by the vertical numbers 1 to 9 and the horizontal letters A to H is used to identify different jobs as well as different Finished Products and Raw Materials. This factory produces 3 products, A, D and F, shown at the top of the slide, from 4 Raw Materials A, C, E and F shown at the bottom of the slide. A resource is instructed to do a job if you click and drag the resource to the job on the grid.
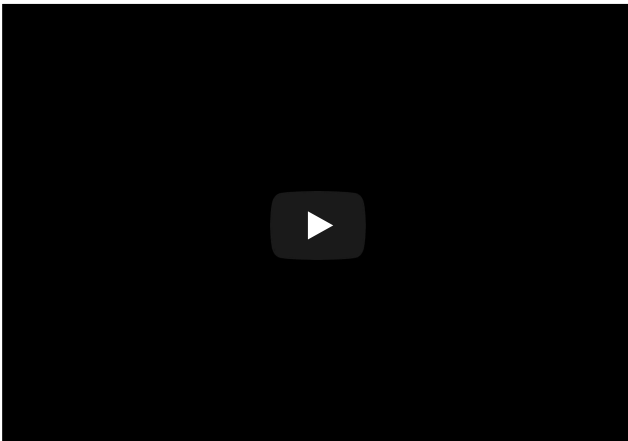
If you are unable to view this video (or the quality is bad), please read the notice below.

Let me describe one of the flows. Raw Material F (with currently 0 stock on hand – the white circle with the number 0) is first processed by a green resource. A green resources takes about 15 minutes to process 1 unit of RM F. Any processed inventory will show in the square after the job. Green need to be instructed to do job F1 for this processing to be done. It can however only start the processing on this job after the 120 minutes setup time and of course if there is raw material on hand. The next step in the flow is job F2 done by a cyan resource. You have to instruct a cyan resource to do this job and it will start as soon as the 60 minutes setup is complete. This job takes about 12 minutes per unit from start to finish. Then a magenta resource can do job F3 with a processing time of about 20 minutes. At the start of the simulation 10 units of this material (raw material F already processed through jobs F1, F2 and F3) are present. It has been processed to this point the previous week. Next, the blue resource has to do job F5, it takes about 14 minutes per unit to do, then a magenta resource can do job F7 (7 minutes per unit) and a cyan resource can do job F9 (10 minutes per unit) to produce an end product F.   The demand for this product is 40 units per week. In this case we again have a perfect customer. She will take and pay for every completed unit as soon as it is produced, up to 40 units. If you produce more than 40 units of this product it will

remain in the system as finished product inventory. The inventory quantity will show in the square below the demand circle.

The flows to produce the other two products are a little bit more complex. Product A is produced with two raw materials, A and C, processed by green resources for 4 and 5 minutes respectively and then assembled into a subassembly by resource brown. This subassembly is used to produce product A as well as D. Product A is produced by different resources in the sequence shown, green (15 minutes), cyan (15 minutes), magenta (20 minutes) and finally by cyan resources (18 minutes). The demand for product A is 40 units per week.

Product D is produced from the A and C subassembly (there are 25 units on hand) in a final assembly with another component that is produced from raw material E in the sequence with the different resources and processing times shown.

The simulator will run for 1 week (5 days) and 8 hours a day. The cash available is 10000 and the fixed expenses that has to be paid at the end of the week is 11000. Download the gsim.exe and params 312 files into the same folder on your computer, run the gsim.exe file and open the params 312 file when prompted by the application (Open Session window).

To activate a resource to do a specific job, simply click and drag the resource to the job on the grid. Try it by activating job F1 by selecting and dragging a green resource to the job. If you are successful, a + sign will appear on the job and F1 setup will be indicated on the resource. If you click on the big red circle it will change to green with the words RUNNING. In the top circle you will notice that the timer is running and if you select the info button you will see that the setup time of 120 minutes for the green resource is counting down. But nothing else is happening.

Stop the simulator by clicking on the GREEN button to get RED FREEZE. You need to understand the environment better before we proceed to be able to make good flow decisions.

The task bar in the top left corner is like in all applications. The first button is used to open params files, the second opens a scheduling window (do not worry about it now, we will use it later) the next allows you to Choose Automatic Operating Mode (again do not worry about it now). The next button allows you to Analyze Resource Utilisation for different demand data, BM is for Buffer Management information (two sets of traffic lights will appear) and the Info button gives more information about prices and what is happening on active jobs. The + and – buttons speed up or slow down the speed at which the simulator runs. Be careful when you use these buttons to allow you enough time to give instructions and make decisions. If you need time to make a decision and take action, FREEZE the simulation, take the actions you want and RUN it again.

If you select the "info" button on the top bar of the simulator, you will see that the processing time information for each job changes to B:20. No job will run in this simulator with a batch of less than 20 units. This view also shows that the selling price for Product A is 180, for D it is 240 and 180 for product F. Raw material A costs 30, C 35, E 30 and F 65.

You should be able to calculate Throughput per product with this information. Which one of the products has the highest Throughput?

You can activate every resource to any job that it can perform at any time. A resource will stop working on a job if you assign it somewhere else. A resource cannot do another resource's job though. For example we can activate all resources that is required to do processing of raw material F to product F by dragging the appropriate resource to the appropriate job. Click and drag a green resource to the F1 position, a cyan to job F2, a magenta to job F3. the blue resource to job F5, the other magenta to job F7 and the other cyan to job F9. Nothing happens though because the simulator is not running yet. If you click on the big red FREEZE button, it will change to green and RUNNING. You will notice when you have done this that all resources are now setting up and time is running in the top left circle.   But nothing is flowing yet. Let's focus on the blue resource. After 15 minutes the setup is complete but processing does not start. Why? Although it has 10 units on hand to process, it is waiting for a batch of 20, the operating policy that is in place (the resources are very obedient, a paradise plant after all). You can over ride this policy by clicking on the job and selecting One-Time Override Batch on the Set Task Parameters window that appears. You have to click OK to give the instruction.

Every one of the obedient resources is adhering to the batch sizing policy. You have to do "One-Time Override Batch" all the time for every resource that you want to start producing on the assigned job before 20 units are available.

The green resource will not process anything without raw material after completing its 120 minute setup. Click on the F RM circle and the Purchase RM window opens where you must enter the quantity that you want to purchase. In this run, we probably have to buy at least 40 units to be able to adhere to the batch size policy and to satisfy the market demand of 40 units, even though we have 10 units already in the flow. We have again a perfect supplier, the material is immediately delivered and we pay the supplier immediately, cash is reduced to 7400 (10000-(65*40)).

Verify this with the simulator.

We have now assigned all resources except brown and one of the green resources. All of them are idle, except for blue (if you selected the One-Time Override Batch for job F5) and green after 120 minutes. The other resources are waiting for a full batch. You can over ride this again if you want to. For example, click on the F9 job, tick the On-time Override Batch box and select OK. The simulator is always frozen after this action and you have to click on the red circle again to run. You can do this any time for each of the jobs, but you are violating a policy (and confusing your resources).

Run the simulator by clicking on the red FREEZE button. It will change to green RUNNING.

An "End of Day" window will appear after the simulator has run for a day, reporting on the Throughput that was achieved on the day. Close the window and click on the red button to keep on running.

You have to activate resources on the right jobs to process the raw materials into finished product and to try to satisfy customer demand for the 3 products. Try to satisfy the market demand for product F as the first exercise to learn to use the simulator and experience the effect of batching. You can activate more than one resource on a job (it doubles the completion rate).

 At the end of the week the " End of week Financial Statement" is shown. It reports on Net Profit, End of Week Cash, ROI (annualized), Throughput, Sales, Operating expenses and Inventory at Raw Material value. It also reports on Resource utilization as well as how the market demand was satisfied. (This week, only the demand for product F was satisfied with the resulting poor financial performance).

To run the simulator again you have to activate params 312 by selecting it from the open file button on the top menu bar - first button from the left.

Tip:

A Set Task Parameters window opens when you click on any job. In this window you can Limit Production to a specified quantity, when the next resource is activated on this job. Only the limited quantity will be produced and then the resource will go into hold mode. You can also define the Fixed Batch Size for that job.

Run GSIM312 a few times, trying to satisfy all the market demand. You are in charge, so you can change policies, if you want to.

Notice:
If the following link doesn't open in your browser, your browser may be blocking 3rd party content and scripts. To solve this please do the following on the different browsers. • **Internet Explorer:** *At the bottom of the screen, a yellow notification will appear asking you to "Show all content". Click on this to view everything.* • **Google Chrome:** *In the URL toolbar, on the right-hand side, a small 'silver' shield will appear. Click on the shield and then click "Load unsafe Script".* • **Mozilla Firefox:** *On the left-hand side, right next to the "Back" button, there will be a shield next to it. Click on the shield and 'Disable protection on this page".* By allowing 3rd party scripts to run, the secure link has been disabled as can be seen in the title bar on the left where HTTPS would be disabled. It is best to re-enable this at a later stage. To re-enable the browser secure link, simply right-mouse-click any link on the system and select OPEN IN NEW TAB. This new tab will be secure and you can close the tab that is unsecured. **To improve the quality of the video:** • View the video in fullscreen mode or • Select 'Settings' and 'Quality' and then select a higher resolution.

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    (https://lms.tuit.co.za/courses/429/modules/2293)
• **Production and Supply Chain**
    (https://lms.tuit.co.za/courses/429/modules/2294)

Related Topics:

• **Introduction to Production and Supply Chain with VIDEO**
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• **Make-to-Availability and Supply Chain with VIDEO**
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