

Burgh Threads Case Study



Background

Burgh Threads is a small clothing manufacturing business. They produce simple, durable garments including T-shirts, jeans and dresses. Last year, a popular vlogger mentioned the brand in a widely viewed video. Since the video was posted they have seen sales increase, and their fulfillment rates decrease. The owner is reluctant to invest in more equipment or hire more workers, because she fears that the increased demand may be temporary. However, the company knows they are losing sales opportunities by having items out of stock. Burgh Threads is looking for other ways to increase its fulfillment rates.

The factory operates as a make-to-stock system. They have an inventory of finished goods that is used to fulfill orders. They replenish the inventory by releasing manufacturing orders to their factory and creating the garments. The quantity in the manufacturing order will be the reorder quantity specified for the item and the order will be released when the finished goods inventory for the item falls below the reorder point. They do not allow backordering, so if they are out of stock on an item, the customer cannot order it and will likely buy clothing somewhere else instead.

Because of the size of the company, they only have one industrial engineer and no supply chain analyst. The industrial engineer has collected time study data on the processes in the factory. She noticed that there was a substantial amount of set-up time for orders and believes that the factory could improve productivity by increasing the lot sizes of

the manufacturing orders. The lot size is the number of garments in a single manufacturing order. However, she knows that if she increases the lot size on all orders, the overall lead times may increase, and the total inventory will be higher. She wants to determine a lot size strategy, which entails changing the reorder quantity and reorder points for the items.

Problem Description

There are currently three clothing designs that come in various sizes and colors. In total there are 52 unique items that can be ordered. Each unique item has its own Stock Keeping Unit(SKU) number and inventory is tracked separately for each SKU. Each SKU has a reorder point and reorder quantity. When the number of garments for the SKU falls below the reorder point, a manufacturing order is released to the factory for a number of garments based on the reorder quantity (lot size). Some setup tasks are done once per order and other tasks must be done for every garment in the order.

Management has agreed to allow the average finished goods inventory to increase, but to no more than 1000 items. They would like for the fulfillment rate to be at least 95% for all SKUs. The fulfillment rate is the percentage of time that a customer tries to order an item that Burgh Threads is able to fulfill the order with available inventory. They also would like to see their revenue improve. Because the items sell at different prices, the revenue will be dependent on the number of items sold for each item, not just the total number of items sold. They would like to see a model that projects the average inventory, fulfillment rates and total revenue over a 120-day period.

System Description

Manufacturing orders are for a specific SKU, which has a unique design, size and fabric color. The number of garments in the order can range from 1 garment to 50 garments. Due to the difficulty of cutting more than 50 layers of cloth at a time and carrying large amounts of fabric, the order quantity may not exceed 50 garments. The material handler moves orders between stations, except for the move between Sewing and QA. The material handler will carry no more than 3 orders at a time.

When manufacturing orders are released to the factory floor, the material handler picks up the material from the cloth storage area and brings it to the cutting area. In the cutting area, all pieces for all garments in an order are cut together using a Die Cutting Press. Before running the press, the press operator checks to see if the stamping die is the correct design for the garment, which is unique to each style and size. If the die needs to be changed, the press operator will go to the shelf and pick up the correct die to install on the machine and install it. Orders in the cutting area are generally processed in a First-In-First-

Out order, but an exception will be made if there is an order in the queue that needs the same die as the order that was just processed. If that is the case, the setup step can be skipped, so the operator will select that order and process it before processing other orders in the queue. There is only one cutting die in the factory. The run time for the machine is consistent and does not depend on the number of garments in the order or the design.

After the fabric is cut into a design, the material handler will move it to the sewing area. The sewing area has four sewing machines, each operated by a sewist. The orders will be placed in the queue at the sewing machine that has the fewest number of orders in its queue. The garments must be sewn with the correct color of thread, which depends on the fabric for the garment. If the machine has a different color, the sewist must change the thread before sewing the garment. Once the sewist starts sewing garments for an order, the sewist will not start another order until he or she has finished sewing garments for that order. After sewing all the garments for an order, the sewist places the order on the Quality Assurance(QA) table.

At the QA table the quality inspector checks each garment for defects. Recent data has shown that he only finds a defect in approximately 1 out of every 5000 garments. Defective garments are not sold and will not generate revenue. The inspector will finish inspecting all the garments in an order before moving on to the next order. QA inspects manufacturing orders in the order that they arrive. After QA inspects an order, the material handler moves it to Finished Goods Storage and the garments are added to the inventory that can be used to fulfill orders.

Data Collection

Here is a summary of the data that the industrial engineer has collected.

Map of the Facility

The circles represent the areas where the material handler picks up or drops off orders.

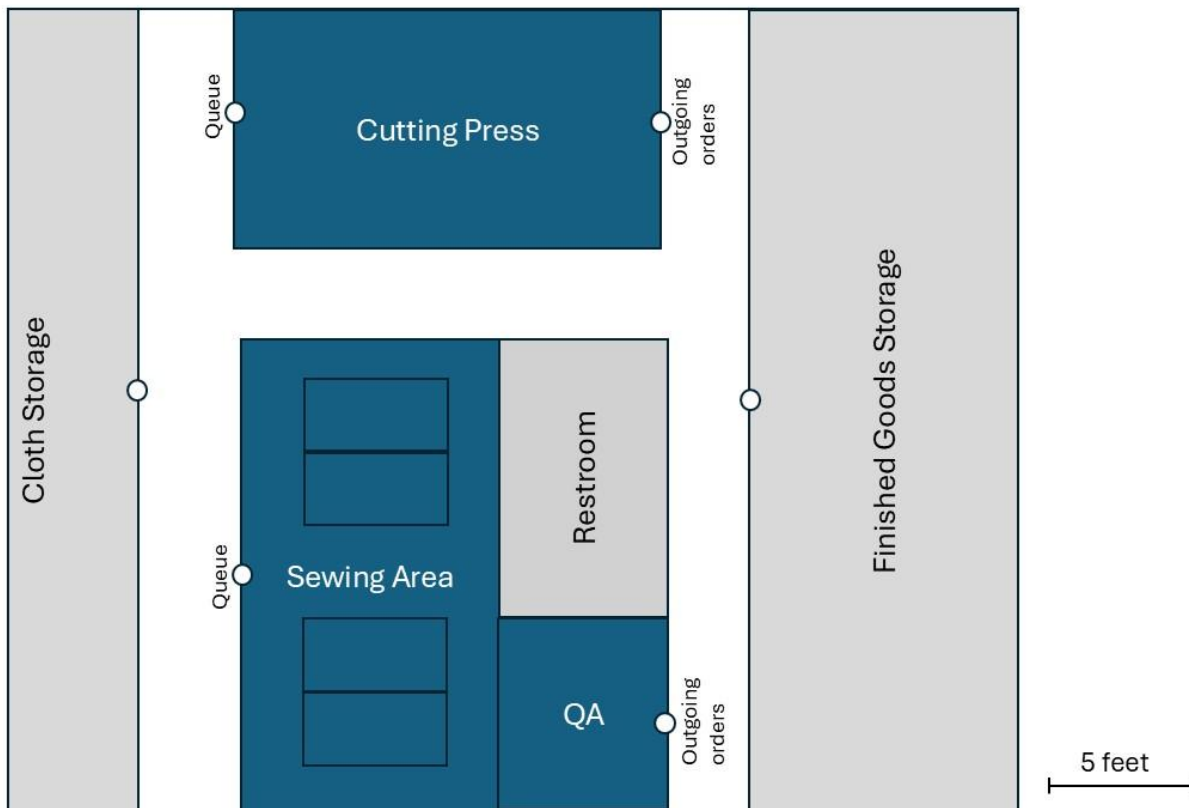


Figure 1: A map of the facility.

Time Study Data

Time studies have been done on the following activities, and the data is compiled in the file TimeStudyData_BurghThreads.xlsx:

- The time to sew a garment. This data also includes the design of the garment, because the industrial engineer believes that the time to sew a garment depends on those attributes. Three tasks were studied: Change Thread, Sew Garment and Put Order on QA table.
- The time to change the die on the Cutting Press. Each observation includes the time to remove the die from the previous design, put the die back on the rack, select the die for the next design and install the die on the machine.
- The time it takes the material handler to pick up or drop off orders. Each observation is picking up or dropping off one order. The time does not include walking from station to station, but the industrial engineer estimates that the material handler walks at a pace of 3 miles per hour.
- The time it takes QA to inspect a garment. Each observation is for one garment.

The time to run the cutting press has so little variation that you can treat it as a deterministic processing time. The run time for the Cutting Press is 20 minutes.

Work Schedule

The factory operates on weekdays only. The workers begin their day at 9 AM, and have a ten-minute morning team meeting before beginning their work. They take 10-minute breaks at 11 AM and 3 PM. They take a 30-minute lunch break at 12:30 PM. The workers go home at 5 PM. The worker will stop working at the end of the shift and pick up where they started at the beginning of the next shift. All machines must have an operator present to run.

Thread Colors

The following table shows the thread colors for the fabrics.

Thread Color	Fabric(s)
Black	Black Cotton, Plaid Cotton, Striped Cotton
Blue	Blue Cotton, Light Wash Jean, Dark Wash Jean
Green	Green Cotton
Grey	Grey Cotton
Red	Red Cotton

Fulfillment Operations

The Fulfillment operations have already been modeled and provided in the file `ClothingFactory_FulfillmentOnly.spfx`. The model includes a table of SKUs that specifies design, size and fabric. The table also includes the starting inventory, which will be the inventory at the beginning of the run, and the price the garments are sold for. Your task is to add the garment manufacturing processes to this model and use the model to make recommendations on reorder quantities and reorder points. Manufacturing orders will arrive from Fulfillment at the node “PickUpFromClothStorage” and the garments will be added to finished goods inventory when the `ManufacturingOrder` entities are destroyed at the `PutInStorage` sink. The number of defective garments found by QA should be assigned to the `ModelEntity` State “DefectiveGarmentNumber.” The number of garments added to the inventory will be the lot size minus the number of defective garments.

You may update the values of the Lot Size and Reorder Point properties in the Stock Keeping Unit table. The lot size should be no more than 50. You may also add properties and states to the table or change properties to foreign keys if you choose to do so. The manufacturing order will have a reference to a row in the Stock Keeping Unit table when it arrives at `PickUpFromClothStorage` and the row reference should not be changed or unset. The Orders Per Month, Number Per Order, Starting Inventory and Price fields should not be changed, and the Fulfillment processes should not be changed other than altering the Lot Sizes and Reorder Points in the Stock Keeping Unit table. Place the objects for your model of the factory in the blue box in the facility view, where the `PickUpFromClothStorage` node and sink already exist. Views have been saved in the Pivot Grid results to help you view the fill rate, inventory and revenue.

Summary

You have been tasked with creating a model of the manufacturing process for Burgh Threads. With the model you must be able to make recommendations on the lot size and reorder point to use for each of the 52 SKUs that Burgh Threads produces. Your model should show that the average finished goods inventory will be less than or equal to 1000 if the recommended lot sizes and reorder points are used. The metrics that management will want to see are the average number of garments in inventory, fill rate per SKU and expected revenue over the next 120 days.

Hints

- Simio has a function that independently samples a random expression for a specified number of times and returns the sum.
- Changeover logic can be defined for a task dependent setup task in a task sequence.