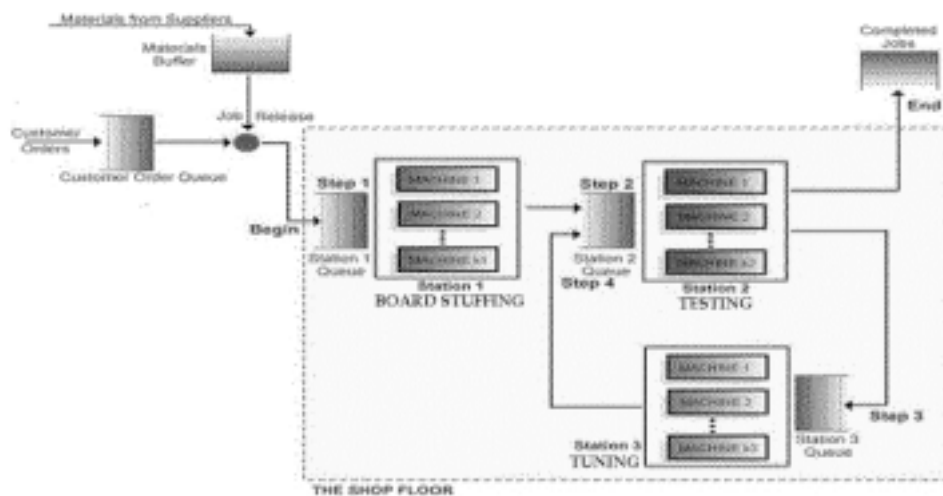# Littlefield Technologies: Overview

Introduction

Littlefield Technologies is a job shop which assembles Digital Satellite System receivers. These receivers are assembled from kits of electronic components procured from a single supplier. The assembly process consists of four steps carried out at 3 stations called **board stuffing**, **testing** and **tuning**. The first step consists of mounting the components onto PC Boards and soldering them. This is done at the board stuffing station. The digital components are then briefly tested at the testing station in step 2. In the third step, key components are tuned at the tuning station. Finally, the boards are exhaustively "final tested" in step 4 at the testing station before delivery to the customer. Every receiver passes final test.

All the stations consist of automated machines which perform the operations. You may purchase additional machines during the assignment. Board Stuffing machines cost $90,000, testers cost $80,000, and tuning machines cost $100,000. You can also sell any machine at a retirement price of $10,000, provided there is at least one other machine left at that station. The operators are paid a fixed salary, and increasing the number of machines at a station does not require any increase in the number of operators.

Orders arrive randomly at the factory. Each order is for 60 receivers. When an order arrives it is matched up with 60 raw kits and becomes a manufacturing lot. If an order arrives and there are less than 60 raw kits in the materials buffer, the order waits in the customer order queue pending arrival of raw kits. In addition, orders are not accepted if the total number of orders in the system (waiting for kits or in process) exceeds 100. If it is allowed in the assignment, the 60 kits may be sub-divided into several manufacturing lots just prior to entering the factory. Processing a lot on each machine entails performing a setup on the machine, processing each kit in the lot (one at a time), and then sending the completed lot on to the next station. Once all the receivers in an order are completed, the order is shipped immediately. A job is not shipped to its customer until all of the lots in the job are completed.

Raw kits are purchased from a single supplier and cost $10 per kit ($600 per order). There is also a fixed cost of $1000 per shipment of raw kits, independent of the shipment size. The supplier requires four days to ship any quantity of raw kits. An order for new raw kits is placed with the supplier when the following three criteria are met: (1) the inventory of raw kits is less than the material reorder point, (2) there are no orders for raw kits currently outstanding, and (3) the factory has sufficient cash to purchase the specified order quantity. If it is allowed in the assignment, you may set the reorder point and order quantity independently to any multiple of 60 kits, as long as that multiple is greater than zero.

The current pricing contract is as follows. An order does not leave the factory until all 60 kits in the order are completed. A customer order filled within the quoted lead time of 24 hours earns $1000. If an order is still in the factory 24 hours after it arrived, then a lateness penalty is incurred. Specifically, the total revenue for an order linearly decreases from $1000 for a 24-hour lead time to $0 for the maximum lead time of 72 hours. Orders that take longer than 72 hours to fill generate no revenue at all. If it is allowed in the assignment, you may select from a menu of other contracts for future orders. More lucrative contracts will have shorter quoted lead times and shorter maximum lead times.

You will have some cash on hand when the assignment begins. This amount is depleted by buying machines as well as by buying raw kits from the supplier. The revenue earned from filled orders increases the cash balance. The balance earns interest (compounded every simulated day) at a compounded rate of 10% per year. There are no taxes. All fixed overhead over which you have no control, such as salaries, rent, utilities, etc. are ignored. To reduce the chance of bankruptcy, you are not allowed to purchase a machine if the resulting cash balance would be too low to purchase an order of raw materials at the current order quantity.

The winning team is the team with the most cash at the end of the game. You can compare the cash status of your team to other teams by clicking on the "Overall Standing" button on the bottom of the web page.

Registering your team

Before the first assignment begins, you will need to create and register your team. There should be four students per team. Come up with a team name consisting only of lower-case letters (no punctuation) and a team password. Your instructor will give you the address for the registration web page. The web page is shown at the top of the next page.

Welcome to ...

Type in your access code here, and click the OK button. [   ]

OK   Clear

On the registration page, you will first have to enter the code given in class. Once you have entered the code, you will be asked for the team name and the password that you came up with. Finally, you will be asked for the names of each of the team members. After you submit this information from the web page, your team will be registered. Later, if you decide to change you team name, password, or members before the assignment begins, you can simply return to the registration page, enter the same team name and password you entered the first time, and then make your changes. To completely remove your team, delete all of the team members' names and save the resulting team. You will not be able to make any changes to your team after the assignment begins.

Accessing your factory

When the assignment begins, you can access your factory from the entry web page using the team name and password that you previously registered. Your instructor will give you the address for the entry web page. The entry web page is shown below.

The following points about configuring your browser are crucial to successful access. However, these will also be the defaults on most PC's, so you will only need to worry about this list if things don't appear to be working right. You can access the web page

Team ID : [   ]

Password : [   ]

OK   Clear

from any Netscape Navigator 3.0 or later browser, or any Internet Explorer 3.0 or later browser. The following instructions apply to Netscape 3. If you use a different browser, you should take equivalent actions.

- You should enable Java and Javascript on your browser. To do this on Netscape 3, select *Network Preferences* under the *Options* menu of Netscape, choose *Languages*, and check *Enable Java* and *Enable Javascript*.

- To be able to download data from graphs later, you should select *General Preferences* under the *Options* menu of Netscape 3. Then choose the *Helpers* menu and choose *Save to Disk* as the action for *text/plain*. This will save data you download from the web page as a text file, which you can then open using Microsoft Excel.

Using the simulator

The web-based simulator runs continuously. That is, if you view the site at 10 am on January 16 and then view it again at 11 am on the same day, you will see that some simulated time has elapsed. One hour of real time corresponds to 24 hours of simulated time. You have no control over the simulator's clock. **You may need to wait for a few simulated days to see the effects of your decisions, so constant monitoring is not necessary.**

When you login, your factory's status is automatically updated. Whenever you make a change (like increasing the number of machines), the factory is also updated. To update the factory status otherwise, you must click on the *update* button on the bottom of the web page. In light of the slow speed of the simulator, there will usually be no need for frequent updating.

More information on the assignments will be distributed shortly before each assignment begins. This information will specify the number of days that each simulation will run. While the assignments are running, you can access the page as frequently as you wish. At the end of the assignments, the page is frozen (i.e. you cannot alter anything on it), and the simulator is immediately run for several additional simulated days. You can then access your factory's final status for that assignment.

The web page seen after logging in will have a schematic diagram of the job shop as seen in the figure on page 1. Clicking on an icon on the schematic will reveal a menu and corresponding data. For example, clicking on a station icon will reveal a menu that gives data about the station, as well as buttons for additional menus that allow you to change the number of machines at the station or view the historical utilization the station. In similar fashion, you can get other information as described in the table on the following page. You will also be able to download the data into text files which can be opened by Microsoft Excel, for further analysis, by clicking on a button in these menus.

Icons on the Littlefield Technologies web page:

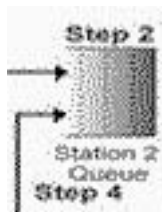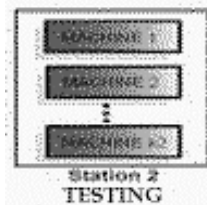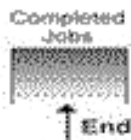| **ICON**	**INFORMATION AVAILABLE**
Order Queue:	• Number of new customer orders by day
	• Average number of orders waiting for kits by day
	• Current pricing contract for arriving orders
	• Lot size
Materials Buffer:	• Number of kits (raw materials) in the buffer at the beginning of each day, whenever inventory hits zero, and whenever new shipments arrive
Station Queues:	• Average number of receivers in process waiting while all the machines in the station are busy, by day
Stations:	• Number of machines in each station
	• Scheduling Policy used (for tester only)
	• Historical utilization of the station by day (i.e., the average fraction of time a machine was busy at that station during that day)
Completed Jobs:	• Numbers of orders completed by day (by pricing contract)
	• Average order lead time by day (by pricing contract)
	• Average revenue per order by day (by pricing contract)

Clicking on the above icons will also enable you to change certain features of the factory such as the number of machines in a station. Assignment handouts will explain which features you can change.

Sources and uses of cash can be obtained by clicking on the *cash* button on the web page. Sources of cash are revenue, money raised from the sale of machines, and interest. Uses of cash are raw material (kit) purchases and the purchase of additional machines. Finally, you can check the overall standing of your team using the *overall standing* button.

Capacity Management at Littlefield Technologies

Background

In early January, Littlefield Technologies (LT) opened its first and only factory to produce its newly developed Digital Satellite System (DSS) receivers. LT mainly sells to retailers and small manufacturers using the DSS's in more complex products. LT charges a premium and competes by promising to ship a receiver within 24 hours of receiving the order, or the customer will receive a rebate based on the delay.

The product lifetime of many high-tech electronic products is short, and the DSS receiver is no exception. After 268 days of operation, the plant will cease producing the DSS receiver, retool the factory, and sell any remaining inventories. In the initial months, demand is expected to grow at a roughly linear rate, stabilizing after about 5 months. After another month, demand should begin to decline at a roughly linear rate. Although orders arrive randomly to LT, management expects that, on average, demand will follow the trends outlined above.

Management's main concern is managing the capacity of the factory in response to the complex demand pattern predicted. Delays resulting from insufficient capacity would undermine LT's promised lead times and ultimately force LT to turn away orders.

Assignment

It is now late February, and LT has started to notice that a few of their receivers have been delivered after their due dates. In response, management has installed a high-powered operations team (you) to manage the factory's capacity. For the next 168 simulated days you must buy or sell machines to maximize the factory's overall cash position. Currently there is one board stuffing machine, one tester, and one tuning machine.

You may also change the way testing is scheduled. Currently, jobs at the tester are scheduled First-In-First-Out (FIFO), but you can give priority status either to the short initial tests or the long final tests.

When the assignment begins, there will already be 50 days of history available for your review, representing the period from early January to late February. The simulator will run at a rate of 1 simulated day per 1 real hour for the next week. After the assignment window ends, an additional 50 days of simulation will be executed at once. Thus, there will be a total of 268 days of simulation corresponding to a product life time of about 9 months.

After this simulation is over, you can check the status of your factory, but the factory will no longer be running.

Your team should turn in one two-page summary of what actions you took during the week you had access to the factory, why you took those actions, and in retrospect whether you think you did the right thing. Show analysis to justify your conclusions. Your team's grade will be partially based on your performance, but mainly based on your summary. The summary cannot exceed 2 pages in length, and no appendices are allowed.