

Lecture 8: Matching Supply and Demand: Managing the Tug of War

Perishability and Simultaneity Review

Perishability is a characteristic of service that makes it difficult or impossible to inventory. In manufacturing, inventory is used to level out demand – you build up inventory to correct forecast errors or account for different levels of demand during the year.

Simultaneity implies perishability.

Supply Chain Management

- There may be uncertainty in some links of the supply chain
- There are exogenous factors controlling the process – some of which you have control over, and some you don't
- Since you can't build inventory up in services as you can in manufacturing, what do you do?
- Merrill Lynch case involves matching supply and demand, though management doesn't treat it that way.
- Why is it so difficult to manage in a service industry? Main reason is that the solution to problems is not intuitive. We will try nonetheless; to see the core of the problem. We will also in the process observe the dynamics of these operational systems.

Examples and Discussion of Different Types of Service Companies:

1. Barbershop – This barbershop is located near a university and has two kinds of customers: college students and business people. The barber charges one low rate for everyone (since he serves students). Sometimes, customers have to wait a long time when they come in for a haircut. Students can walk to the shop, but it's difficult for business people to park in the area. What are some ideas for increasing the barbershop's revenue with the same amount of work?

- Offer a VIP membership card – those patrons will be served first. However, the barber doesn't want to discriminate against anyone.
- Raise the price, and have student discounts during certain hours (during which the business people don't come in). However, the barber is worried about advertising a higher price in his store window – it might scare his potential customers.
- Have a reservation system, maybe one that starts at certain times. Can we charge a premium for that, or should be charging more for walk-ins since it is a luxury?
- Hire a part-time worker for peak times.
- Bundle services: have a shoe shine person at barbershop for the business customers. (This is easier if you have a reservation system because you know who is coming in when.)
- Even though barber is reluctant to charge different prices, he doesn't realize that price is associated with value, not cost. You can charge more for a reservation system because you're offering more value to customers. Everyone deserves the same respect, but you can give different services to different people. This simple example has the same characteristics of bigger business we'll look at today.

2. Trucking Company – The company provides trucking services for a supply chain. They have other customers who do not belong to the supply chain, although the supply chain customers are their priority because they signed a contract with them. Non-supply chain customers can ask for service whenever they want; they don't have contracts with the company. Why would they want to have these non-supply chain customers?

- Company has already incurred fixed costs and have excess capacity. If they only serve the supply chain customers, they're not maximizing the utilization of their assets.
- They don't want to become dependent on one customer.
- Non-supply chain customers could become supply chain customers in the future.
- They also need to be able to refuse business – if they have one empty truck left and get a request from a non-supply chain customer, they may want to save it for the supply chain customer if they have an additional request – to keep them loyal.

3. Airline – Company has 100 seats for a Boston to San Francisco flight scheduled for 3 months from now. There is only one class in the plane and two types of customers: tourists and business people. Tourists go through a travel agent and book in large groups well in advance – but they expect lower prices. Business people buy their seats the last minute and pay full price. A travel agency calls and asks for 25 seats and a big discount – what should the airline do?

- If the plane flies with empty seats, that's lost revenue.
- They do not want to take too much risk; they want some business people on the flight to make more money.
- Can overbook flight and take that risk, given statistics of past flights.
- What is the airline's objective function here? To get over fixed costs first, and maximize profit. It's not about utilization (having a full plane/truck/hospital/hotel), it's about *profit*. They should make the best use of their resources even if the plane is not full when it flies.

4. Catalog Company – This is the biggest evidence that we can control external demand to a great extent. When they send catalogs, they expect a certain response rate (people would not call if they do not send a catalog). But, they are not sure about the demand for new products, so they need a call center large enough to be ready if many people call. Even though they create or manipulate the demand, it's still hard to match supply and demand.

5. Semiconductor Company – They manufacture the chips that are placed on wafers. At the end of the production, they end up with a large percentage of chips that within their specifications. However, some are below the specifications (they are discarded) and some that exceed the specifications (they can be sold at a premium). They receive an order that calls for more of the regular chips than they have – what should they do?

- Can give customer an “upgrade” by including some of the best chips in the wafer, too.
- But what if another customer calls asking for an order of the best chips?

What do these examples have in common?

- Segmentation because they have different customers with different needs.
- Similar dilemma: There is a tradeoff between service and profit.

- There is uncertainty in supply and uncertainty in demand. The crux of the matter is how to manage this uncertainty. If the companies knew what customers would call in advance, they wouldn't have a problem because they would know the demand for chips or trucks.

Questions to answer over the next few days:

- **What are the consequences of uncertainty for a dynamic (ever-changing) system?** Dynamic systems are essentially all the systems we have in mind in this course. It is not easy for us to predict the inputs and environment for these systems, so we need some intuition first on the behavior of these systems under different input or environmental conditions.
- **How do companies deal with uncertainty?** This course will provide you with some kind of taxonomy to help.

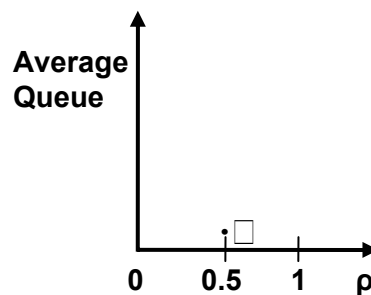
Question for Next Class

A question to think about for next class: We have one machine receiving customer orders to process. The arrival rate is λ jobs/hour. The service rate to fulfill the orders is μ jobs/hour. Diagram of this:



Suppose we have 1 job order/hour ($\lambda = 1$) and capacity to produce 2 jobs/hour ($\mu = 2$). What is our utilization rate? $\rho = \lambda / \mu = 0.5$

Given this, on average will we have a queue of orders waiting to be fulfilled? It depends on the distribution of arrivals, so we may or may not have a queue. To build a graph out of this, at 0.5, we may have a queue (represented by the point in the graph below). The question is for you to draw the rest of the graph:



Summary

We saw today that dynamic systems (those that change over time) have difficult tradeoffs that management has to make. They cannot be solved instantly; we need to think about them and use our judgment in many cases. We also need to attempt to understand the consequences of uncertainty and how to deal with it.