**IE 7200-Supply Chain Engineering**

**Homework-1**

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**Question 1: What is a supply chain?**

A supply chain consists of all parties involved, directly or indirectly, in fulfilling a customer request. Within each organization, such as manufacturer, the supply chain includes all functions involved in receiving and filling a customer request. These functions include, but are not limited to new product development, marketing, operations, distribution, finance, and customer service. The supply chain includes **four stages** the suppliers, manufacturer distributor ,retailer and the costumer. A supply chain is **dynamic and involves the constant flow** of **information, material, and funds** between different stages.

**Question 2: What is the objective of a supply chain?**

The objective of every supply chain is to **maximize the overall value generated**. The value a supply chain generates is the difference between what the final product is worth to the customer and the effort the supply chain expends in filling the customer’s request. For most commercial supply chains, value will be strongly correlated with supply chain profitability, the difference between the revenue generated from the customer and the overall cost across the supply chain. As mentioned in the first question the dynamic flow between each stage should be controlled in order to maximized the total supply chain profitability.

**Question 3: What are the three key supply chain decision phases and their significances?**

These decisions fall into three categories:

**Supply chain strategy or design** *:* During this phase, a company decides how to structure the supply chain over the next several years. It decides what the chain’s configuration will be, how resources will be allocated and etc .

**Supply chain planning**: For decisions made during this phase, the time frame consider is a quarter to a year. Companies start the planning phase with a forecast for the coming year (or a comparable time frame) of demand in different markets.

**Supply chain operation**: The time horizon here is weekly or daily, and during this phase companies make decisions regarding individual customer orders.

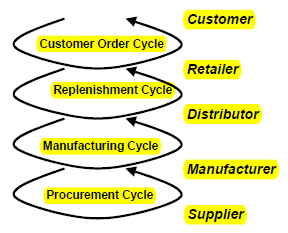
**Question 4: What are the cycle and push/pull views of a supply chain?**

There are different views of this process; **Cycle view and Push /Pull view**.

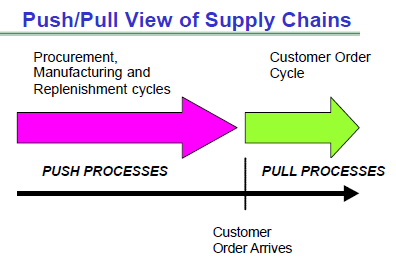
1) **Cycle view** of supply chain process has following cycles

* Customer order cycle
* Replenishment cycle (at retailer/distributor)
* Manufacturing cycle (distributor/manufacturer)
* Procurement cycle (manufacturer/supplier)

The information flows from top to bottom and the products flow from bottom to top.



2) **Push/Pull view**: The processes in a supply chain are divided into two categories depending on whether they are executed in response to a customer order or in anticipation of customer orders. Pull processes are initiated by a customer order, and push processes are initiated and performed in anticipation of customer orders. The pull process works well with a custom ordering as the push process works well with mass production.



**Question 5: How can supply chain macro processes be classified?**

**Supplier** **Relationship Management** (**SRM**) :would include the goal of ensuring supplies at the best cost and terms, depending on whether it is a tactical purchase, a strategic buy, a negotiated purchase, or an engineered item.

**Internal Supply Chain Process (ISCM)**

includes a number of activities with respect to receiving, conversion and dispatch of finished goods. **Customer Relationship Management (CRM):** The focal organization orients itself to synchronize its role agents and processes to serve its customers. Customer delight happens only if the product meets the customers' satisfaction in terms of time, quantity, responsiveness and cost.

**Question 6: Why is achieving strategic fit critical to a company’s overall success?**

**Competitive strategy**: defines the set of customer needs a firm seeks to satisfy through its products and services. A company's competitive strategy clearly spells out the set of customer needs that it seeks to satisfy through its products and services having a defined set of attributes.

**Supply chain strategy**: determines the nature of material procurement, transportation of material. The supply chain strategy includes supplier strategy, operations strategy, and logistics strategy.

**Strategic fit**: Consistency between customer priorities of competitive strategy and supply chain capabilities specified by the supply chain strategy

The supply chain design or supply chain strategy must be in alignment with competitive strategy. **Competitive and supply chain strategies should have the same goals. A company may fail because of a lack of strategic fit or because its processes and resources do not provide the capabilities to execute the desired strategy**. A supply chain design can be taken up only after the competitive strategy is finalized and a supply chain needs to be redesigned or modified whenever there is a change in competitive strategy.

**Question7: How does a company achieve strategic fit between its supply chain strategy and its competitive?**  
Strategic fit between competitive strategy and supply chain strategy refers to the consistency between the customer needs that the competitive strategy aims to satisfy and the supply chain capabilities that the supply chain strategy aims to build.

**Three steps are involved.**

1. Understanding the customer needs regarding attributes of supply.

2. Understanding the supply chain attributes (alternatives available)

3. Achieving strategic fit. Making decision on the supply chain to best serve the needs of the target segment customers.

**1. Understanding the customer needs regarding attributes of supply:**

Some of the attributes or dimensions of the supply are as follows: The quantity of the product needed in each lot purchased. Preferred purchase quantity of the customer. The response time from customer's enquiry. The variety of products needed (applicable in case of a retail store, restaurant etc.). The service level required (shortage of item

**2. Understanding the supply chain attributes (alternatives available)**

Supply chain responsiveness is measured by the abilities of the chain to do the following: Ability to respond to fluctuations in demand Ability to provide short lead times. Ability to handle large variety of products

**3. Achieving strategic fit. Making decision on the supply chain to best serve the needs of the target segment customers.**

The greater the implied demand uncertainty, the more responsive a supply chain has to be. More responsive supply chains are more costly supply chains. When compared directly with less responsive but more efficient supply chains, their costs may look excessive.

**Question 8: What are the major drivers of supply chain performance?**

In order to reach the strategic fit we need to provide a consistency between responsiveness and efficiency. To that we need to understand the logistical and cross-functional drivers of supply chain performance. There are three logistical drivers (viz., facilities, inventory and transportation) and three cross-functional drivers (viz., information, sourcing and pricing) that determine the performance of any supply chain.

**Facilities:** places where inventory is stored, assembled, or fabricatedproduction sites and storage sites

**Inventory:** raw materials, WIP, finished goods within a supply chain inventory policies.

**Transportation:** moving inventory from point to point in a supply chaincombinations of transportation modes and routes

**Information** data and analysis regarding inventory, transportation, facilitiesthroughout the supply chain potentially the biggest driver of supply chain performance

**Sourcing**  functions a firm performs and functions that are outsourced

**Pricing** Price associated with goods and services provided by a firm to thesupply chain

**Question 9: What is the role of each driver in creating strategic fit between supply chain strategy and competitive strategy?**

1. **Facilities:** Facilities include all locations in the supply chain to store, assemble, or fabricate inventory. Whatever the function, decisions regarding location, capacity, and flexibility of facilities significantly affect supply chain performance**.**

**Role in Competitive Strategy:** Economies of scale (efficiency priority), Larger number of smaller facilities (responsiveness priority) production facilities must decide if flexible (responsive) or dedicated

(efficient) and warehouses and DC’s must decide if primarily cross docking or storage

1. **Inventory**: Inventory "stockade" exists in all supply chains because of a mismatch between supply and demand. Mismatches are often intentional, such as the case when cost-effectiveness dictates batch sizes or when future demand is unclear and immediate customer delivery is required

**Role in the Supply Chain:** Source of cost and influence on responsiveness and the impact on material flow time: time elapsed between when material enters the supply chain to when it exits the supply chain throughput rate at which sales to end consumers occur.

**Role in Competitive Strategy:** If responsiveness is a strategic competitive priority, a firm can locate larger amounts of inventory closer to customers. If cost is more important, inventory can be reduced to make the firm more efficient

1. **Transportation:** Transportation moves the product between different locations in a supply chain and significantly affects both responsiveness and efficiency.

**Transportation: Role in** **the Supply Chain:** Moves the product between stages in the supply chain .Has a large impact on responsiveness and efficiency. Faster transportation allows greater responsiveness but lower efficiency. Also affects inventory and facilities.

**Transportation: Role in the Competitive Strategy** If responsiveness is a strategic competitive priority, then faster transportation modes can provide greater responsiveness to customers who are willing to pay for it Can also use slower transportation modes for customers whose priority is price (cost) Can also consider both inventory and transportation to find the right balance.

**4. Information:** Even though information does not have a physical presence, it is still a major supply chain driver. Information deeply affects every part of the supply chain in several ways. **Information: Role in the Supply Chain:** The connection between the various stages in the supply chain allows coordination between stages Crucial to daily operation of each stage in a supply chain – e.g., production scheduling, inventory levels

**5. Sourcing:**

**Sourcing: Role in the Supply Chain:** Set of business processes required to purchase goods and services in a supply chain Which tasks will be outsourced and which will be performed within the firm Supplier selection, single vs. multiple suppliers, contract negotiation

**Role in the Competitive Strategy:** Sourcing decisions are crucial because they affect the level of efficiency and responsiveness in a supply chain in-house vs. outsource decisions- improving efficiency and responsiveness

**6. Pricing:**

**Role in the Supply Chain:** Pricing determines the amount to charge customers for goods and services in a supply chain Pricing strategies can be used to match demand and supply.

**Role in the Competitive Strategy:** Firms can utilize optimal pricing strategies to improve efficiency and responsiveness Low price and lower level of product availability Vary prices by response times.

**Question 10: What are the major obstacles to achieving strategic fit?**

* Increasing variety of products
* Decreasing product life cycles
* Increasingly demanding customers
* Fragmentation of supply chain ownership
* Globalization
* Difficulty executing new strategies

**Problem 11. Use a 3-month moving average and a 5-month moving average to forecast demand for the first 6 months of year 2 for the following data:**

For a simple 3-months moving average, we take a average of the previous three months demand as our forecast for next month: the forecast for the first 6 months of the second year is reported in the **Table.1** below. The 5-months moving average is similar to 3-months MA, except now we take average of the previous five months demand.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  | **Forecast** | | **Error** | |
| **Year** | **Month** | **Demand** | **3-Month MA** | **5-Months MA** | **Absolute Error for 3-Months MA** | **Absolute Error for 5-Months MA** |
| 1 | **Jan** | 100 |  |  |  |  |
| **Feb** | 120 |  |  |  |  |
| **Mar** | 140 |  |  |  |  |
| **Apr** | 160 | 120.00 |  | 40.00 |  |
| **May** | 155 | 140.00 |  | 15.00 |  |
| **Jun** | 150 | 151.67 | 135 | 1.67 | 15 |
| **Jul** | 145 | 155.00 | 145 | 10.00 | 0 |
| **Aug** | 140 | 150.00 | 150 | 10.00 | 10 |
| **Sep** | 135 | 145.00 | 150 | 10.00 | 15 |
| **Oct** | 145 | 140.00 | 145 | 5.00 | 0 |
| **Nov** | 160 | 140.00 | 143 | 20.00 | 17 |
| **Dec** | 200 | 146.67 | 145 | 53.33 | 55 |
| 2 | **Jan** | 210 | 168.33 | 156 | 41.67 | 54 |
| **Feb** | 230 | 190.00 | 170 | 40.00 | 60 |
| **Mar** | 250 | 213.33 | 189 | 36.67 | 61 |
| **Apr** |  | 230.00 | 210 |  |  |
| **May** |  | 230 | 210 |  |  |
| **Jun** |  | 230 | 210 |  |  |
|  |  |  |  |  |  |  |
|  | **Total Error** |  |  |  | **228.33** | **287** |
|  | **MAD** |  |  |  | **22.83** | **28.7** |

**Problem 12. Consider a noise-free constant-model set of data, *Dt* = 10 for *t* = 1, 2, 3,.....,8. Suppose first-order single exponential smoothing is used to forecast with an initial condition of *F*1 = 5. Show that a high α value will damp out initial errors more quickly than a low α. Use α values of 0.1 and 0.6 to show this.**

The speed at which the older responses are dampened is a function of the value , **when is close to 1 damping is quick and when is close to 0 damping is slow**. It is illustrated in this table:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Towards Past Observation** | | | | | | | |
| **a** | **(1-a)** | **(1-a)^2** | **(1-a)^3** | **(1-a)^4** | **(1-a)^5** | **(1-a)^6** | **(1-a)^7** |
| **0.1** | 0.9 | 0.810 | 0.729 | 0.656 | 0.59049 | 0.531441 | 0.478296 |
| **0.6** | 0.4 | 0.160 | 0.064 | 0.0256 | 0.01024 | 0.004096 | 0.001638 |

We choose the best value for so the value which results in the smallest MSE. I used the following formula to calculate the exponential smoothing.

To compute the mean square error, first compute the error for each period: Et = Dt − Ft. Take that number and square it, then take the average over all periods: MSE=

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **t** | **Dt** | **Exponential smoothing (0.1)** | **Et** | **Et^2** | **Exponential smoothing (0.9)** | **Et** | **Et^2** |
| 1 | 10 | 5.00 | 5.00 | 25.00 | 9.500 | 0.500 | 0.250 |
| 2 | 10 | 5.50 | 4.50 | 20.25 | 9.550 | 0.450 | 0.202 |
| 3 | 10 | 5.95 | 4.05 | 16.40 | 9.595 | 0.405 | 0.164 |
| 4 | 10 | 6.36 | 3.65 | 13.29 | 9.636 | 0.365 | 0.133 |
| 5 | 10 | 6.72 | 3.28 | 10.76 | 9.672 | 0.328 | 0.108 |
| 6 | 10 | 7.05 | 2.95 | 8.72 | 9.705 | 0.295 | 0.087 |
| 7 | 10 | 7.34 | 2.66 | 7.06 | 9.734 | 0.266 | 0.071 |
| 8 | 10 | 7.61 | 2.39 | 5.72 | 9.761 | 0.239 | 0.057 |
|  |  |  |  |  |  |  |  |
|  |  |  | Sum | 107.20 |  | Sum | 1.072 |
|  |  |  | **MSE** | **13.40** |  | **MSE** | **0.133996** |

It can be seen that when =0.9 the MSE is smaller.