Module 1

Drivers of Supply Chain Performance Measures:

1. **Facilities**: These are the actual physical locations in the supply chain network where product is stored, assembled, or fabricated. The two major types of facilities are production sites and storage sites. Decisions regarding the role, location, capacity, and flexibility of facilities have a significant impact on the supply chain's performance.
    - FACILITY-RELATED METRICS
        i. **Capacity** measures the maximum amount a facility can process.
        ii. **Utilization** measures the fraction of capacity that is currently being used in the facility. Utilization affects both the unit cost of processing and the associated delays. Unit costs tend to decline (PPET increases) and delays increase with increasing utilization.
        iii. **Processing/setup/down/idle time** measure the fraction of time that the facility was processing units, being set up to process units, unavailable because it was down, or idle because it had no units to process. Ideally, utilization should be limited by demand and not setup or downtime.
        iv. **Production cost per unit** measures the average cost to produce a unit of output. These costs may be measured per unit, per case, or per pound depending on the product.
        v. **Quality losses** measure the fraction of production lost due to defects. Quality losses hurt both financial performance and responsiveness.
        vi. **Theoretical flow/cycle time** of production measures the time required to process a unit if there are absolutely no delays at any stage.
        vii. **Actual average flow/cycle time** measures the average actual time taken for all units processed over a specified duration such as a week or month. The actual flow/cycle time includes the theoretical time and any delays. This metric should be used when setting due dates for orders.
        viii. **Flow time efficiency** is the ratio of the theoretical flow time to the actual average flow time. Low values for flow time efficiency indicate that a large fraction of time is spent waiting.
        ix. **Product variety** measures the number of products/product families processed in a facility. Processing costs and flow times are likely to increase with product variety.
        x. **Average production batch size** measures the average amount produced in each production batch. Large batch sizes will decrease production cost but increase inventories.
        xi. **Production service level** measures the fraction of production orders completed on time and in full.
2. **Inventory**: Inventory encompasses all raw materials, work in process, and finished goods within a supply chain. The inventory belonging to a firm is reported under assets. Changing inventory policies can dramatically alter the supply chain's efficiency and responsiveness.
    - INVENTORY-RELATED METRICS
        i. **Cash-to-cash cycle time** is a high-level metric that includes inventories, accounts payable, and receivables.
        ii. **Average inventory** measures the average amount of inventory carried. Average inventory should be measured in units, days of demand, and financial value.

iii. **Inventory turns** measure the number of times inventory turns over in a year. It is the ratio of average inventory to either the cost of goods sold or sales.
iv. **Average replenishment batch size** measures the average amount in each replenishment order.
v. **Average safety inventory** measures the average amount of inventory on hand when a replenishment order arrives.
vi. **Seasonal inventory** measures the difference between the inflow of product (beyond cycle and safety inventory) and its sales that is purchased solely to deal with anticipated spikes in demand.
vii. **Fill rate (order/case)** measures the fraction of orders/demand that were met on time from inventory
viii. **Obsolete inventory** measures the fraction of inventory older than a specified obsolescence date

3. **Transportation**: This entails moving inventory from point to point in the supply chain. Transportation can take the form of many combinations of modes and routes, each with its own performance characteristics. Transportation choices have a large impact on supply chain responsiveness and efficiency.
    - TRANSPORTATION-RELATED METRICS:
        i. **Average inbound transportation cost** typically measures the cost of bringing product into a facility as a percentage of sales or cost of goods sold (COGS).
        ii. **Average incoming shipment size** measures the average number of units or dollars in each incoming shipment at a facility
        iii. **Average inbound transportation cost per shipment** measures the average transportation cost of each incoming delivery.
        iv. **Average outbound transportation cost** measures the cost of sending product out of a facility to the customer.
        v. **Average outbound shipment size** measures the average number of units or dollars on each outbound shipment at a facility
        vi. **Average outbound transportation cost per shipment** measures the average transportation cost of each outgoing delivery
4. **Information**: Information consists of data and analysis concerning facilities, inventory, transportation, costs, prices, and customers throughout the supply chain. Information is potentially the biggest driver of performance in the supply chain because it directly affects each of the other drivers. Information presents management with the opportunity to make supply chains more responsive and more efficient.
    - INFORMATION-RELATED METRICS:
        i. **Forecast horizon** identifies how far in advance of the actual event a forecast is made. The forecast horizon must be greater than or equal to the lead time of the decision that is driven by the forecast.
        ii. **Frequency of update** identifies how frequently each forecast is updated.
        iii. **Forecast error** measures the difference between the forecast and actual demand.
        iv. **Seasonal factors** measure the extent to which the average demand in a season is above or below the average in the year.
        v. **Variance from plan** identifies the difference between the planned production/inventories and the actual values.

vi. **Ratio of demand variability to order variability** measures the standard deviation of incoming demand and supply orders placed

5. **Sourcing**: Sourcing is the choice of who will perform a particular supply chain activity such as production, storage, transportation, or the management of information. At the strategic level, these decisions determine what functions a firm performs and what functions the firm outsources. Sourcing decisions affect both the responsiveness and efficiency of a supply chain.
    - SOURCING-RELATED METRICS:
        i. **Days payable outstanding** measures the number of days between when a supplier performed a supply chain task and when it was paid.
        ii. **Average purchase price** measures the average price at which a good or service was purchased during the year.
        iii. **Range of purchase price** measures the fluctuation in purchase price during a specified period. The goal is to identify if the quantity purchased correlated with the price.
        iv. **Average purchase quantity** measures the average amount purchased per order.
        v. **Supply quality** measures the quality of product supplied.
        vi. **Supply lead time** measures the average time between when an order is placed and when the product arrives.
        vii. **Fraction of on-time deliveries** measures the fraction of deliveries from the supplier that were on time.
        viii. **Supplier reliability** measures the variability of the supplier's lead time as well as the delivered quantity relative to plan.
6. **Pricing**: Pricing determines how much a firm will charge for the goods and services that it makes available in the supply chain. Pricing affects the behaviour of the buyer of the good or service, thus affecting supply chain performance.
    - PRICING-RELATED METRICS:
        i. **Profit margin** measures profit as a percentage of revenue
        ii. **Days sales outstanding** measures the average time between when a sale is made and when the cash is collected.
        iii. **Incremental fixed cost per order** measures the incremental costs that are independent of the size of the order.
        iv. **Incremental variable cost per unit** measures the incremental costs that vary with the size of the order.
        v. **Average sale price** measures the average price at which a supply chain activity was performed in a given period
        vi. **Average order size** measures the average quantity per order
        vii. **Range of sale price** measures the maximum and the minimum of sale price per unit over a specified time horizon

Enablers of Supply Chain Performance:

Three major enablers that have helped firms and nations in reducing supply chain costs are briefly discussed below.

1. Improvement in Communication and IT: Computing power has become cheaper and communication costs too have come down. This has helped firms in coordinating global supply chains in a cost-effective manner. Advances in enterprise resource planning (ERP) systems have helped firms in automating several business processes resulting in seamless information flow throughout the company across different functions. The way ERP systems have changed the nature of information flow within organization, Internet technology is likely to change the nature of information flow in interfirm transactions. In the past, only large companies could integrate with partner firms using expensive EDI technologies. Now, even small firms can communicate with their chain partners using the worldwide web at a fraction of the earlier cost. Companies are realizing that they can replace physical inventory by information. . Companies that have successfully exploited IT have made major changes in their supply chain structure, systems, processes and strategy.

2. Emergence of Third-party Logistics Providers: Traditionally, many firms have been managing their logistics activities internally. Lately, companies have realized that they need to focus their energies on managing core business activities, and hence have been exploring the possibility of outsourcing logistics activities to third-party logistics (3PL) service providers. In developed countries, almost 90 per cent of the logistics activities are outsourced and are managed by 3PL companies. Apart from bringing in the much needed professionalism to the field, 3PL companies have economies of scale as they are able to pool demand across customers.

3. Enhanced Inter-firm Coordination Capabilities: Successful coordination across a global network of companies has been a comparatively new phenomenon in the corporate world. It has been realized that for a network to function meaningfully one needs a firm to play the role of the “strategic centre”, While each company in the network focuses on its core competencies, the strategic centres function as a leading and orchestrating system. Consequently, supply chains become more efficient and responsive.