



SUPPLY CHAIN DRIVERS AND METRICS

1. DRIVERS OF SUPPLY CHAIN PERFORMANCE

- To understand how a company can improve supply chain performance in terms of responsiveness and efficiency, we must examine the logistical and cross-functional drivers of supply chain performance: facilities, inventory, transportation, information, sourcing and pricing.



- These drivers interact with each other to determine the supply chain's performance in terms of responsiveness and efficiency.
- As a result, the structure of these drivers determines if and how strategic fit is achieved across the supply chain.



EACH DRIVER AND DISCUSS ITS IMPACT ON THE PERFORMANCE OF THE SUPPLY CHAIN.

○ Facilities

- Facilities are the actual physical locations in the supply chain network where product is stored, assembled, or fabricated.
- The major types of facilities are production sites and storages sites.
- Decision regarding the role, location, capacity, and flexibility or facilities have a significant impact on the supply chain's performance.



○ Inventory

- Inventory encompasses all raw materials, work in process, and finished good within a supply chain.
- Changing inventory policies can dramatically alter the supply chain's efficiency and responsiveness.



- For example, a clothing retailer can make itself more responsive by stocking large amounts of inventory and satisfying customer demand from stock.
- A large inventory increases the retailer's cost, thereby making it less efficient. Reducing inventory makes the retailer more efficient but hurts its responsiveness.



○ Transportation

- Transportation 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.



○ 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.



○ Sourcing

- Sourcing is the choice of who will perform a particular supply chain activity such as a 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.



○ Pricing

- Pricing determines how much a firm will charge for goods and services that it makes available in the supply chain.
- Pricing affects the behavior of the buyer of the good or service, thus affecting supply chain performance.



- Our definition of these drivers attempts to delineate logistics and supply chain management.
- Supply chain management includes the use of logistical and cross-functional drivers to increase the supply chain surplus.



- Cross-functional drivers have become increasingly important in raising the supply chain surplus in recent years.
- While logistics remains a major part, supply chain management is increasingly becoming focused on the three cross-functional drivers.



2. FRAMEWORK FOR STRUCTURING DRIVERS

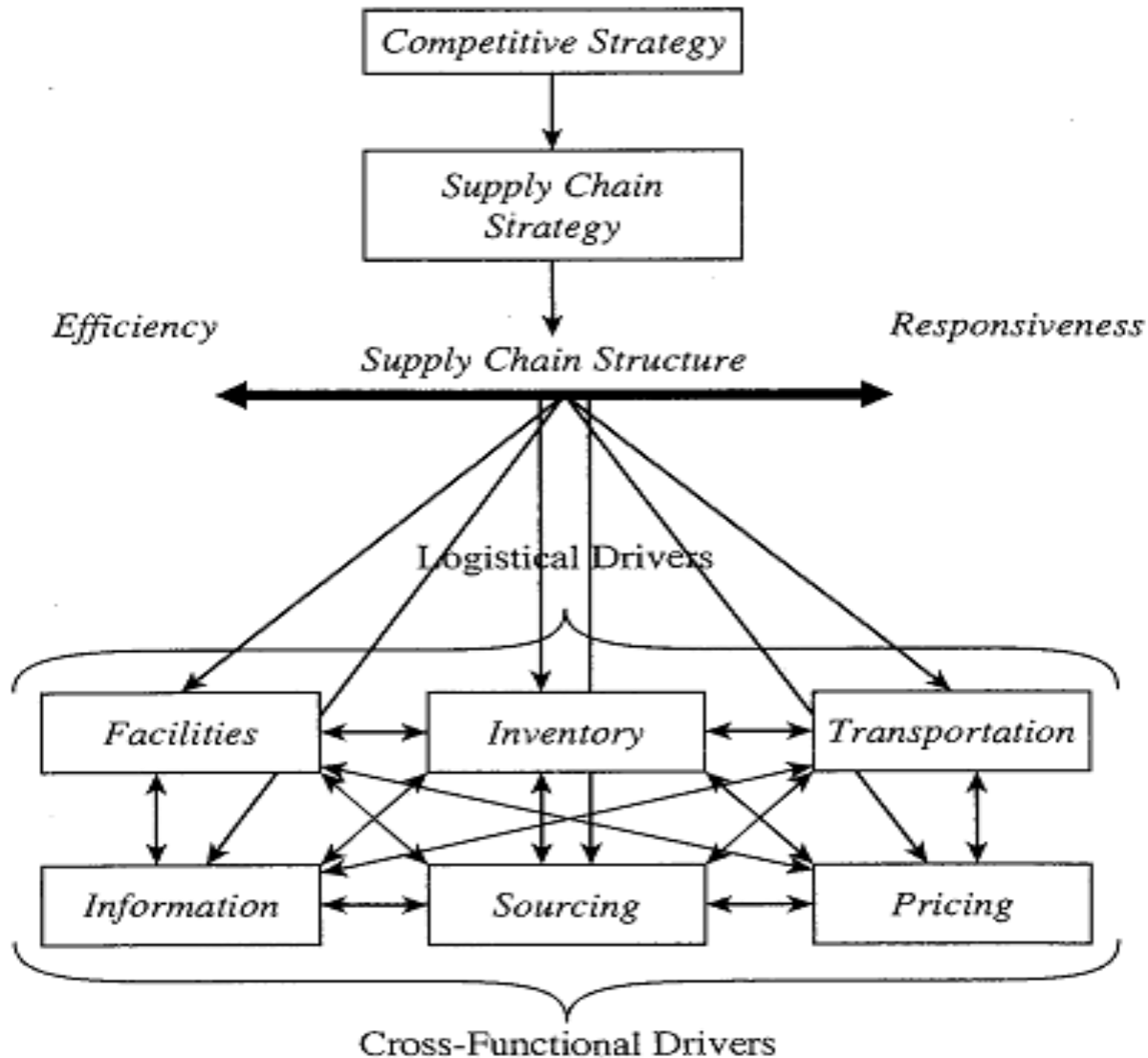
- The goal of a supply chain strategy is to strike the balance between responsiveness and efficiency that fits with the competitive strategy.
- To reach this goal, a company must structure the right combination of the three logistical and three cross-functional drivers discussed earlier.



- For each of the individual drivers, supply chain managers must make a trade-off between efficiency and responsiveness based on interaction with the other drivers.
- The combined impact of these drivers then determines the responsiveness and the profits of the entire supply chain.



SUPPLY CHAIN DECISION-MAKING FRAMEWORK



- Most companies begin with a competitive strategy and then decide what their supply chain strategy ought to be.
- The supply chain strategy determines how the supply chain should perform with respect to efficiency and responsiveness.



- The supply chain must then use the three logistical and three cross-functional drivers to reach the performance level the supply chain strategy dictates and maximize the supply chain profits.
- Although this framework is generally viewed from the top down, in many instances, a study of the six drivers may indicate the need to change the supply chain and potentially even the competitive strategy.



3. COMPONENT OF FACILITIES DECISIONS

- a. Role
- b. Location
- c. Capacity
- d. Facility-Related Metrics



a. Role

- For production facilities, firms must decide whether they will be flexible, dedicated, or a combination of the two.
- Flexible capacity can be used for many types of products but is often less efficient, whereas dedicated capacity can be used for only a limited number of products but is more efficient.



- Firms must also decide whether to design a facility with a product focus or a functional focus.
- A product-focused facility performs many different functions (e.g. fabrication and assembly) in producing a single type of product.



- A functional-focused facility performs few functions (e.g., only fabrication or only assembly) on many types of products.
- A product focus tends to result in more expertise about a particular type of product at the expense of the functional expertise that comes from a functional methodology.



d. Facility-Related Metrics

- **Capacity:** measure the maximum amount a facility can process
- **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 and delays increase with increasing utilization.
- **Theoretical flow/cycle time of production** measures the time required to process a unit if there are absolutely no delays at any stages.



- **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.
- **Flow time efficiency** is the ratio of the theoretical flow rate to the actual average flow time
- **Product variety** measures the number of products/products families processed in a facility. Processing costs and flow times are likely to increase with product variety.



- **Volume contribution of top 20 percent SKUs and customers** measures the fraction of total volume processed by a facility that comes from the top 20 percent SKUs or customers. An 80/20 outcome in which the top 20 percent contribute 80 percent of volume indicates likely benefits from focusing the facility where separate processes are used to process the top 20 percent and the remaining 80 percent.



- **Processing/setup/down/idle time** measures 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.
- **Average production batch size** measures the average amount produced in each production batch. Large batch sizes will decrease production cost but increase inventories in the supply chain.
- **Production service level** measures the fraction of production orders completed on time and in full



e. Overall Trade-Off: Responsiveness versus Efficiency

- The fundamental trade-off that managers face when making facilities decisions is between the cost of the number, location, and type of facilities (efficiency) and the level of responsiveness that these facilities provide the company's customers.



- Increasing the number of facilities increases facility and inventory costs but decreases transportation costs and reduce response time.
- Increasing the flexibility of a facility increases facility costs but decreases inventory costs and response time.



4. COMPONENTS OF INVENTORY DECISION

a. Cycle inventory

- Cycle inventory is the average amount of inventory used to satisfy demand between receipts of supplier shipments.

b. Safety inventory

- Safety inventory is inventory held in case demand exceeds expectation; it is held to counter uncertainty. If the world were perfectly predictable, only cycle inventory would be needed. Because demand is uncertain and may exceed expectations, companies hold safety inventory to satisfy an unexpectedly high demand.



c. Seasonal inventory

- Seasonal inventory is built up to counter predictable variability in demand.
- Companies using seasonal inventory build up to inventory in periods of low demand and store it for periods of high demand when they will not have the capacity to produce all that is demanded.



d. Level of product availability

- Level of product availability is the fraction of demand that is served on time from product held in inventory.
- A high level of product availability provides a high level of responsiveness but increases cost because a lot of inventory is held but rarely used.



e. Inventory-related metrics

- **Average inventory** measure the average amount of inventory carried. Average inventory should be measured in units, days of demand, and financial value.
- **Product with more than a specified number of days of inventory** identifies the products for which the firm is carrying a high level of inventory. This metric can be used to identify products that are in oversupply or identify reasons that justify the high inventory, such as price discounts, or being a very slow mover.



- **Average replenishment batch size** measures the average amount in each replenishment order. The batch size should be measured by SKU in terms of both units and days of demand. It can be estimated by averaging over time the difference between the maximum and the minimum inventory (measured in each replenishment cycle) on hand.



- **Average safety inventory** measures the average amount of inventory on hand when a replenishment order arrives. Average safety inventory should be measured by SKU in both units and days of demand. It can be estimated by averaging over time the minimum inventory on hand in each replenishment cycle.



- **Seasonal inventory** measures the amount of both cycle and safety inventory that is purchased solely due to seasonal changes in demand



- **Fill rate** measures the fraction of orders/demand that were met on time from inventory. Fill rate should not be averaged over time but over a specified number of units of demand (say, every thousand, million, etc).



- **Fraction of time out of stock** measures the fraction of time that a particular SKU had zero inventory. This fraction can be used to estimate the demand during the stock out period.



f. Overall trade-off: Responsiveness versus Efficiency

- The fundamental trade-off that managers face when making inventory decisions is between responsiveness and efficiency.
- Increasing inventory generally makes the supply chain more responsive to the customer.
- A higher level of inventory also facilitates a reduction in production and transportation costs because of improved economies of scale in both functions. This choice increase inventory holding cost



5. COMPONENTS OF TRANSPORTATION DECISIONS

- a. Designing of transportation network
- b. Choice of transportation mode
- c. Transportation-related metrics
 - **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)



- **Average incoming shipment size** measures the average number of units or dollars in each incoming shipment at a facility
- **Average inbound transportation cost per shipment** measures the average transportation cost of each incoming delivery. Along with the incoming shipment size, this metric identifies opportunities for greater economies of scale in inbound transportation.



- **Average outbound transportation cost** measures the cost of sending product out of a facility to the customer. Ideally, this cost should be measured per unit shipped, but it is often measured as a percentage of sales.
- **Average outbound shipment size** measures the average number of units or dollars on each outbound shipment at a facility.



- **Average outbound transportation cost per shipment** measures the average transportation cost of each outgoing delivery.
- **Fraction transported by mode** measures the fraction of transportation (in units or dollars) using each mode of transportation. This metric can be used to estimate if certain modes are overused or underutilized.



- d. Overall trade-off: responsiveness versus efficiency
- The fundamental trade-off for transportation is between the cost of transporting a given product (efficiency) and the speed with which that product is transported (responsiveness). Using fast modes of transport raises responsiveness and transportation cost but lowers the inventory holding cost.



6. COMPONENTS OF INFORMATION DECISIONS

- a. Push versus pull
- b. Coordination and information sharing
- c. Forecasting and aggregation planning
- d. Enabling technology
- e. Information-related metrics
 - **Forecast horizon** identifies how far in advance of the actual event a forecast is made. The forecast horizon must equal the lead time of the decision that is driven .
 - **Frequency of update** identifies how frequently each forecast is updated.



- **Forecast error** measures the difference between the forecast and actual demand.
- **Seasonal factors** measures the extent to which the average demand in a season is above or below the average in the year.
- **Variance from plan** identifies the difference between the planned production/inventories and the actual values.
- **Ratio of demand variability to order variability** measures the standard deviation of incoming demand and supply orders placed.



f. Overall trade-off: Responsiveness versus efficiency

- Good information can help a firm improve both its responsiveness and efficiency. The information driver is used to improve the performance of other drivers, and the use of information is based on the strategic position the other drivers support.
- Accurate information can help a firm improve efficiency by decreasing inventory and transportation costs.
- Accurate information can improve responsiveness by helping a supply chain better match supply and demand.



7. COMPONENTS OF SOURCING DECISION

- a. In-House or Outsource
- b. Supplier Selection
- c. Procurement
- d. Sourcing-related metrics
 - **Days payable outstanding** measures the number of days between when a supplier performed a supply chain task and when it was paid
 - **Average purchase price** measures the average price at which a good or service was purchased during the year. The average price should be weighted by the quantity purchased at each price.



- **Range of purchase price** measures the fluctuation in purchase price during a specific period. The goal is to identify if the quantity purchased correlated with the price
- **Average purchase quantity** measures the average amount purchased per order. The goal is to identify whether a sufficient level of aggregation is occurring across locations when placing an order.



- **Fraction on-time deliveries** measures the fraction of deliveries from the supplier that were on time
- **Supply quality** measures the quality of product supplied
- **Supply lead time** measures the average time between when an order is placed and the product arrives



- e. Overall trade-off: increases the supply chain profits
 - Sourcing decisions should be made to increase the size of the total profit to be shared across the supply chain.
 - The total profits are affected by the impact of sourcing on sales, service, production costs, inventory costs, transportation costs, and information cost.



- Outsourcing to a third party is meaningful if the third party raises the supply chain profits more than the firm can by its own.
- In contrast, a firm should keep a supply chain function in-house if third party cannot increase the supply chain profits or if the risk associated with outsourcing is significant.



COMPONENTS OF PRICING DECISIONS

- a. Pricing and economies of scale
- b. Everyday low pricing versus high-low pricing
- c. Fixed price versus menu price
- d. Pricing-related metrics
 - **Profit margin** measures profit as a percentage of revenue. A firm needs to examine a wide variety of profit margin metrics to optimize its pricing, including dimensions such as type of margin (gross, net, etc), scope (SKU, product line, division, firm), customer type, and others.
 - **Days sales outstanding** measures the average time between when a sale is made and when the cash is collected.



- **Incremental fixed cost per order** measures the incremental costs that are independent of the size of the order. These include changeover costs at a manufacturing plant or order processing or transportation costs that are incurred independent of shipment size at a mail-order firm.
- **Incremental variable cost per unit** measures the incremental costs that vary with the size of the order. These include picking costs at a mail-order firm or variable production costs at a manufacturing plant.



- **Average sale price** measures the average price at which a supply chain activity was performed in a given period. The average should be obtained by weighting the price with the quantity sold at that price.
- **Average order size** measures the average quantity per order. The average sale price, order size, incremental fixed cost per order, and incremental variable cost per unit help estimate the contribution from performing the supply chain activity



- **Range of sale price** measures the maximum and the minimum of sale price per unit over a specified time horizon.
- **Range of periodic sales** measures the maximum and minimum of the quantity sold per period (day/week/month) during a specified time horizon. The goal is to understand and correlation between sales and price and any potential opportunity to shift sales by changing price over time.



- e. Overall trade-off: Increase firm profits
- All pricing decisions should be made with the objective of increasing firm profits.
 - This requires an understanding of the cost structure of performing a supply chain activity and the value this activity brings to supply chain.



- Strategies such as everyday low pricing may foster stable demand that allows for efficiency in the supply chain.
- Other pricing strategies may lower supply chain costs, defend market share, or even steal market share.
- Differential pricing may be used to attract customers with varying needs, as long as this strategy helps either increase revenues or shrink costs, preferably both.



9. OBSTACLE TO ACHIEVING STRATEGIC FIT

- a. Increasing variety of product.
- b. Decreasing product life cycle
- c. Increasingly demanding customers.
- d. Fragmentation of supply chain ownership
- e. Globalization
- f. Difficulty executing new strategies



- a. Increasing variety of product.
 - Product proliferation is rampant today.
 - With customer demanding ever more customized products, manufacturers have responded with mass customization and even segments-of-one (companies view each customer as an independent market segment) views of the market.



- Products that were formerly quite generic are now custom-made for a specific consumer. The increase in product variety complicates the supply chain by making forecasting much more difficult.
- Increased variety tends to raise uncertainty, and increased uncertainty hurts both efficiency and responsiveness within the supply chain.



b. Decreasing product life cycle

- In addition to the increasing variety of product types, the life cycle of products has been shrinking.
- Today there are products whose life cycles can be measured in months, compared to the old standard of years.



- This decrease in product life cycle makes the job of achieving strategic fit more difficult, as the supply chain must constantly adapt to manufacture and deliver new products, in addition to coping with these products' demand uncertainty.
- Shorter life cycle increase uncertainty while reducing the window of opportunity within which the supply chain can achieve fit.
- Increased uncertainty combined with a smaller window of opportunity has put additional pressure on supply chains to coordinate and create a good match between supply and demand.



c. Increasingly demanding customers.

- Customers are constantly demanding improvements in delivery lead times, cost, and product performance. If they do not receive these improvements, they move on to new suppliers.
- Many companies had periodic, standard price increases-not due to a rise in demand or any other factor, but simply because raising prices was the way business was done.
- Now, one repeatedly sees companies that cannot force through any price increases without losing market share.



- Today's customers are demanding faster fulfillment, better quality, and better-performing products for the same price they paid years ago.
- This tremendous growth in customer demands means that the supply chain must provide more just to maintain its business.



- d. Fragmentation of supply chain ownership
- Over the past several decades, most firms have become less vertically integrated. As companies have shed noncore functions, they have been able to take advantage of supplier and customer competencies that they themselves did not have.



- This new ownership structure, has also made managing the supply chain more difficult. With the chain broken into many owners, each with its own policies and interest, the chain is more difficult to coordinate.
- Potentially, this problem could cause each stage of a supply chain to work only toward its own objective rather than the whole chain's, resulting in the reduction of overall supply chain profitability.



e. Globalization

- Supply chains today are more likely than ever to be global.
- Establishing a global supply chain creates many benefits, such as the ability to source from a global base of suppliers who may offer better or cheaper goods than were available in a company's home nation.
- Globalization adds stress to the chain, because facilities within the chain are farther apart, making coordination much more difficult.



f. Difficulty executing new strategies

- Creating a successful supply chain strategy is not easy.
- Once a good strategy is formulated, the execution of the strategy can be even more difficult. For instance, Toyota's production system, which is a supply chain strategy, has been widely known and understood. Yet this strategy has been a sustained competitive advantage for Toyota for more than two decades.



- Does Toyota have a brilliant strategy that no one else can figure out? Their strategy is brilliant, but many others have figured it out.
- The difficulty other firms have had in in executing that strategy. Many highly talented employees at all levels of the organizations are necessary to make a supply chain strategy successful.
- Skillful execution of a strategy can be as important as the strategy itself.



- **Key point: Many obstacles, such as rising product variety and shorter life cycle, have made it increasingly difficult for supply chains to achieve strategic fit. Overcoming these obstacle offers a tremendous opportunity for firms to use supply chain management to gain competitive advantage.**

