Lecture 5- Supply Chain Strategies and Trade-Off

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Recap
The lead-time Gap Problem

• The time it takes to procure, make and deliver the finished product to a customer is longer than the time the customer is prepared to wait for it.

Source: Christopher (2016)
Reducing the Lead Time Gap- The Solution

• Reducing the gap can be achieved by:
  • shortening the logistics lead-time (end-to-end pipeline time)
  • whilst simultaneously trying to move the customer’s order cycle closer by gaining earlier warning of requirements through improved visibility of demand

Source: Christopher (2016)
Finding the Zone of Strategic Fit

• It follows that increasing implied uncertainty from customers and supply sources is best served by increasing responsiveness from the supply chain.

• So Find ways to make it possible to react to demand within the customer’s order cycle

Chopra and Meindl (2013, p. 28)
Bullwhip Effect - Increasing Variability of Orders up the Supply Chain

Lee et al. (1997)
Summary- What Caused the Bullwhip Effect?

- Control theory (Lee et al, 1997 a,b)
- Forridge (Towill, 1997)
- Demand amplification (Forrester, 1961)
- Order-batching (Burbidge, 1984)
- Rationing game (Houlihan, 1987)
- Price fluctuation

Economic theory

Behavioural science
Supply Chain Trade-Offs
The Objective of a Supply Chain

• Maximize overall value created

\[ \text{Supply Chain Surplus} = \text{Customer Value} – \text{Supply Chain Cost} \]
Customer Value Ratio

• Christopher (2016) cites the Customer Value ratio (Johansson et al, 1993).
• Customer Value =

\[
\text{Quality} \times \text{Service} \times \frac{\text{Cost} \times \text{Time}}{	ext{Time}}
\]

The functionality, performance and technical specification of the offer.

The availability, support and commitment provided to the customer.

The customer’s transaction costs including price and lifecycle costs.

The time taken to respond to customer requirements.

Customer Value Proposition

• High quality products
• Product Innovation
• Quick response times
• Excellent service
• Experience
• Low prices
Matching Supply Chain Strategy with Customer Value Proposition

• No firm can compete successfully on all dimensions of customer value

• Management needs to pick its goals

• Then design a supply chain strategies to deliver that specific value proposition
Examples Supply Chain Strategy matching Customer Value Proposition

<table>
<thead>
<tr>
<th>Customer Value Proposition</th>
<th>Example</th>
<th>Operations Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>High fashion content at a reasonable price</td>
<td>Zara</td>
<td>Speed to market</td>
</tr>
<tr>
<td>Customer experience</td>
<td>Dell Direct</td>
<td>Responsiveness through configure-to-order</td>
</tr>
<tr>
<td>Product innovation</td>
<td>Apple</td>
<td>Efficiency through outsourced manufacturing and logistics</td>
</tr>
<tr>
<td>Everyday low pricing</td>
<td>Wal-Mart</td>
<td>Cost efficiency</td>
</tr>
<tr>
<td>Product selection and availability</td>
<td>Amazon</td>
<td>Efficient and reliable order fulfillment</td>
</tr>
</tbody>
</table>

SC Strategy affect three measures of performance

- Quality
- Cost/Efficiency
- Time/Responsiveness

Service
Responsiveness and Efficiency Defined

• **Responsiveness** includes a supply chain’s ability to do the following:
  • Respond to wide ranges of quantities demanded
  • Meet short lead times
  • Handle a large variety of products
  • Build highly innovative products
  • Meet a high service level
  • Handle supply uncertainty

• **Efficiency** is the inverse of the cost of making and delivering a product to the customer
  • **Increases in cost lower efficiency**
Efficiency Focus

• The firm **focuses on low-cost strategies** across all functional areas.
• This includes supplier selection, manufacturing, product design, and distribution and logistics.
• Typically, in such a strategy, production and distribution decisions are based on:
  • long-term forecasts,
  • inventory of finished goods is positioned close to market demand,
  • supplier selection is based mostly on component costs.
• Hence, **sourcing from low-cost countries** is often the mantra.
Responsiveness Focus

• By contrast, a responsive strategy focuses on speed, order fulfillment, service level, and customer satisfaction.

• Here, the objective is not necessarily to squeeze as much cost out of the supply chain as is humanly possible but

• Rather to eliminate stockouts and satisfy demand by competing on response time and speed to market.
## Comparison of Efficient and Responsive Supply Chains

<table>
<thead>
<tr>
<th></th>
<th>Efficient Supply Chains</th>
<th>Responsive Supply Chains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary goal</td>
<td>Supply demand at the lowest cost</td>
<td>Respond quickly to demand</td>
</tr>
<tr>
<td>Product design</td>
<td>Maximize performance at a minimum product cost</td>
<td>Create <em>modularity</em> to allow postponement of product differentiation</td>
</tr>
<tr>
<td>strategy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pricing strategy</td>
<td>Lower margins because price is a prime customer driver</td>
<td>Higher margins because price is not a prime customer driver</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>Lower costs through high utilization</td>
<td>Maintain capacity flexibility to buffer against demand/supply uncertainty</td>
</tr>
<tr>
<td>strategy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inventory strategy</td>
<td>Minimize inventory to lower cost</td>
<td>Maintain <em>buffer inventory</em> to deal with demand/supply uncertainty</td>
</tr>
<tr>
<td>Lead-time strategy</td>
<td>Reduce, but not at the expense of costs</td>
<td>Reduce aggressively, even if the costs are significant</td>
</tr>
<tr>
<td>Supplier strategy</td>
<td>Select based on cost and quality</td>
<td>Select based on speed, flexibility, reliability, and quality</td>
</tr>
</tbody>
</table>


*Source: Chopra and Meindl (2013)*
The Challenge

• Traditional operations strategies have often focused on efficiency OR responsiveness OR a combination of the two.

• **No firm can be both:**
  • extremely efficient, and thus compete on price
  • and at the same time highly responsive,
  • while maintaining an extraordinary service level

• When business is booming, executives concentrated on maximizing speed

• When the economy headed south, firms desperately tried to minimize supply costs
Conflicting objectives

• **Responsiveness** will generally incur higher operating costs
• Because inventory and capacity must be increased, which increases costs.
• So **Responsiveness comes with an increase in cost**
• **Increase cost means lower Efficiency**

• An **efficient** supply chain, in contrast, lowers cost by eliminating some of its responsive capabilities
• Therefore, a high efficiency level, that is, a low-cost operations strategy, **typically increases time to serve customers** and does not emphasize a high level of service.
Cost Responsiveness Trade Off - Efficient Frontier Curve

- Represents a range of possible strategies, each with a corresponding cost (efficiency) and response time (responsiveness).
- Point A – Your current strategy on the efficient frontier curve. This strategy invests in a deliberate trade-off between efficiency and responsiveness.

Simchi-Levi (2012)
SC Optimization - Shift the Curve Downwards

• **Point B**-
  If this is possible, then for the same level of efficiency, you can improve response time

• **Point C**-
  Alternatively, for the same level of responsiveness, you can improve operations efficiency and hence reduce costs

• More importantly, there is a range of strategies between B and C where the firm improves both efficiency and responsiveness

Simchi-Levi (2012)
SC Trade Off- In Summary

• A firm can improve both its responsiveness and its cost performance by moving the efficient frontier downwards.

• A firm on the efficient frontier can improve its responsiveness only by increasing cost and becoming less efficient.

• Such a firm must then make a trade-off between efficiency and responsiveness.

Simchi-Levi (2012)
Defying the Odds- Firing on all cylinders

• Generic Drugs (Gx) Companies
  • Inventory levels 25% lower than Rx
  • Conversion cost 40% lower than Rx
  • Higher Outsourcing
  • More Responsive Supply Chain

• FMCG Companies
  • operates with one-third to one-fifth of the inventory of Gx companies
  • forecast accuracy is ten percentage points higher
  • perform at 98.6 percent service level

• Tech Companies
  • Amazon
  • Apple
  • Dell
Foxconn - Manufacturing Giant Behind Apple, Microsoft, Good, Dell and More

https://www.youtube.com/watch?v=k51HxvguZdQ
Why Making Apple iPhones in America Is So Hard | WSJ

https://www.youtube.com/watch?v=GP7QF3rEIlI
The Perils of Efficiency

• High-speed, low-cost supply chains are unable to respond to unexpected changes in demand or supply

• Companies’ obsession with speed and costs also causes supply chains to break down during the launch of new products

• Efficient supply chains often become uncompetitive because they don’t adapt to changes in the structures of markets.
Triple A Supply chain (Lee 2004)

• Efficiency is necessary, but it isn’t enough

• Great supply chains are:
  • **Agile**- They react speedily to sudden changes in demand or supply.
  • **Adaptable**- over time as market structures and strategies evolve.
  • **Align**- the interests of all the firms in the supply network so that companies optimize the chain’s performance when they maximize their interests.
Push and Pull view of Supply Chain
Push/Pull View of Supply Chain Processes

• Supply chain processes fall into one of two categories depending on the timing of their execution relative to customer demand

• **Push:**
  • Execution is initiated in anticipation of customer orders *(speculative)*
  • Push processes operate in an uncertain environment because customer demand is not yet known

• **Pull:**
  • Execution is initiated in response to a customer order *(reactive)*
  • Pull processes operate in an environment in which customer demand is known

• They are, however, often constrained by inventory and capacity decisions that were made in the push phase
Push vs Pull

Push vs. Pull

Make all we can just in case  Make what’s needed when we need it

- Poor Communication
- High Inventories
- Production Approximation
- Waste
- Large Lots

- Small Lots
- Better Communication
- Waste Reduction
- Management by Sight
- Actual Consumption
- Low Inventories
- Production Precision
Push Strategy

• Production and distribution decisions are based on long-term forecasts.
• Typically, the manufacturer bases its demand forecasts on orders received from the retailer’s warehouses.
• A push-based supply chain therefore is slow to react to the changing marketplace, which can lead to:
  • An inability to meet changing demand patterns, and
  • The obsolescence of supply chain inventory as demand for certain products disappears.
In addition, variability of orders received from retailers is typically much higher than variability in customer demand.

This increase in variability propagates upstream in the supply chain.

This is the so-called **bullwhip effect**.

This *increase in variability leads to*:

- Excessive inventories due to the need for large safety stocks,
- Larger and more variable production batches,
- Unacceptable service levels, and
- Product obsolescence.
Pull Strategy

• Production and distribution are demand driven so that they are coordinated with true customer demand rather than forecast demand.

• In a pure pull system, the firm does not hold any inventory and responds only to specific orders.

• This is enabled by fast information flow mechanisms that transfer information about customer demand, e.g., point-of-sale (POS) data, to the various supply chain participants.
Advantages and Disadvantages of Pull Strategy

• **Pull systems are intuitively attractive** since they lead to:
  • Decreased lead times, which are achieved by better anticipating incoming orders from the retailers,
  • Decreased inventory at retailers’ warehouses since inventory levels at these facilities increase with lead times,
  • Decreased variability in the system and, in particular, variability faced by manufacturers due to lead time reduction, and
  • Decreased inventory at the manufacturer due to the reduction in variability.

• **Significant reduction:**
  • inventory level and costs

• **An enhanced ability to manage resources**

• Pull-based systems are often difficult to implement when lead times are so long that it is impractical to react to demand

• Also, in pull-based systems, it is frequently more difficult to take advantage of economies of scale in manufacturing and transportation since planning is not done far ahead to take advantage of this capability
Push Pull Strategy

Chopra and Meindl (2013)
Implementing a Hybrid- Push Pull Strategy

• In a push-pull strategy, some stages of the supply chain, typically the initial stages, are operated in a push-based manner while the remaining stages employ a pull-based strategy.

• The interface between the push-based stages and the pull-based stages is known as the push-pull boundary.

Push/Pull View – Dell

• Dell builds customized computers to order for its customers
• In this case, the arrival of a customer order triggers production of the product
• The manufacturing cycle is thus part of the customer order fulfillment process in the customer order cycle—PULL
• Dell, however, does not place component orders in response to a customer order. Inventory is replenished in anticipation of demand—PUSH

Chopra and Meindl (2013)
• To implement a push-pull strategy, determine the location of the push-pull boundary.

• For instance:
  • Dell locates the push-pull boundary at the assembly point,
  • While furniture manufacturers locate the boundary at the production point
Characteristics of the push and pull portions of the supply chain

<table>
<thead>
<tr>
<th>Portion</th>
<th>Push</th>
<th>Pull</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective</td>
<td>Minimize cost.</td>
<td>Maximize service level.</td>
</tr>
<tr>
<td>Complexity</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Focus</td>
<td>Resource allocation</td>
<td>Responsiveness</td>
</tr>
<tr>
<td>Lead time</td>
<td>Long</td>
<td>Short</td>
</tr>
<tr>
<td>Processes</td>
<td>Supply chain planning</td>
<td>Order fulfillment</td>
</tr>
</tbody>
</table>

Appropriate supply chain strategy for a particular product

• Should the firm use:
  • a Push-based supply chain strategy
  • a Pull-based strategy or
  • a Push-Pull strategy
Matching SC Strategies with Products—Effect of demand uncertainty and economies of scale

• **Box 1**- Pull-based SC Strategy

• **Box 3**- Push-based SC Strategy

• **Box 2 and 4**- Push-Pull SC Strategy

Intuitively, the longer the lead time, the more important it is to implement a push-based strategy.

Strategies for Innovative and Functional Products

• **Functional Products** - Push Strategy
  - where the focus is on efficiency, cost reduction, and supply chain planning

• **Innovative Products** - Pull Strategy
  - focus is on responsiveness - time, service level, and order fulfillment

Flexibility and the manufacturing strategy

• **Build-to-stock strategy**-
  • inventory is built based on forecast-
  • **Push strategy** ✓
  • Focus on cost reduction and effective forecast

• **Assemble-to-order strategy**-
  • individual products are assembled based on customer configuration
  • **Pull strategy** ✓

• **Build-to-order strategy**-
  • **Pull-Push strategy**
  • lot sizes are produced after receiving a customer order
  • focuses on efficiency or cost reduction through economies of scale

Supply Chain Designs

Make-to-Stock Strategy

Component Supplier -> Manufacturer

Order based on forecast

Supply to forecasted demand

Order based on forecast

Supply to forecast

Finished Goods Inventory -> Customer

Customer order

Ship to order

Krajewski et al. (2016)
Supply Chain Designs

Assemble-to-Order Strategy

Component Supplier → Standardized Component Inventory → Fabrication → Assembly → Customer

Order based on forecast → Supply as needed

Supply to Forecasted Demand

Customer order

Krajewski et al (2016)
Appropriate Supply Chain Strategies
Right Supply Chain Strategy in total

• Use of a menu of tactics that include:
  • Optimizing push-pull boundaries
  • Postponement strategies
  • Strategic inventory
  • Flexibility and the Manufacturing strategy
  • Agile
  • Lean
  • Hybrid of Lean and Agile
Generic Supply Chain Strategies
Effect of Demand and Supply Characteristics

- **‘Kanban’ Continuous replenishment** - as each product is sold or used it is replaced.
- **Lean** - Materials, components or products can be ordered ahead of demand, cost reduction
- **Agile** - enabling quick response
- **Hybrid lean/agile solution** - holding strategic inventory in some generic or unfinished form, with final configuration being completed rapidly once real demand is known.

Source: Christopher (2016)
Toyota Production System 5S Just, Just in Time, Kaisen

https://www.youtube.com/watch?v=jY17QvU99dw
How Zara Took Over The Industry Using Fast Fashion

https://www.youtube.com/watch?v=l8_gmYNCOQ1g