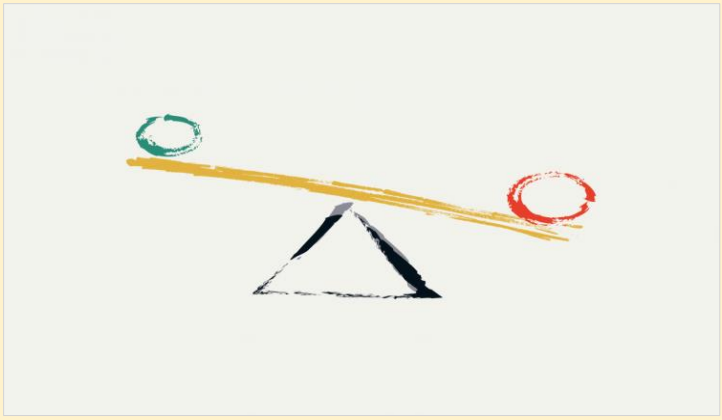
Lecture 5- Supply Chain Strategies and Trade-Off



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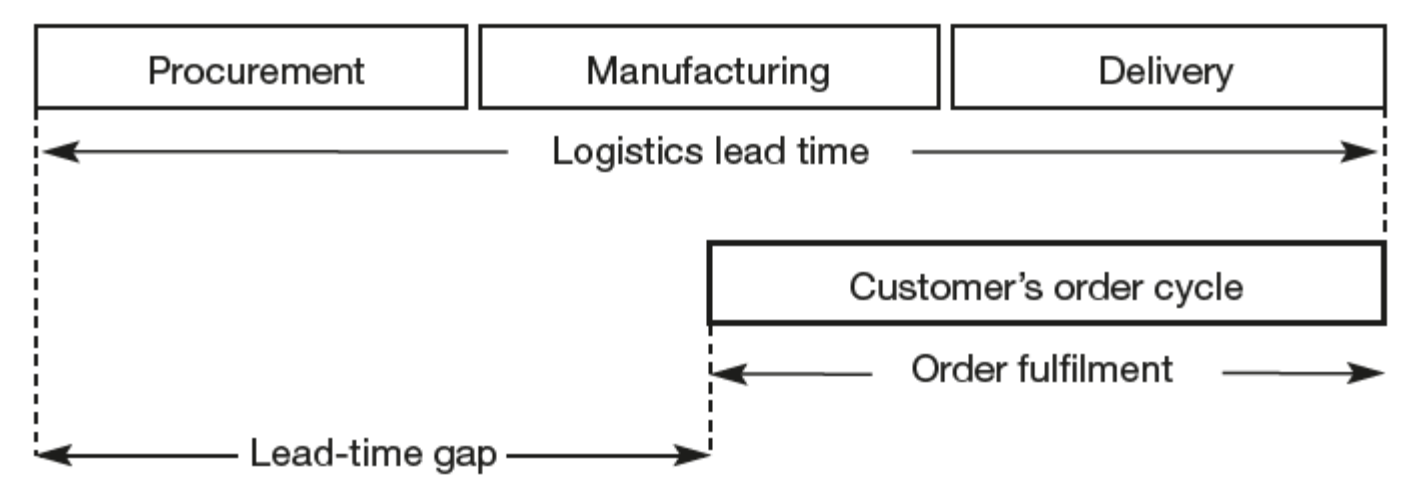
Recap

The lead-time Gap Problem

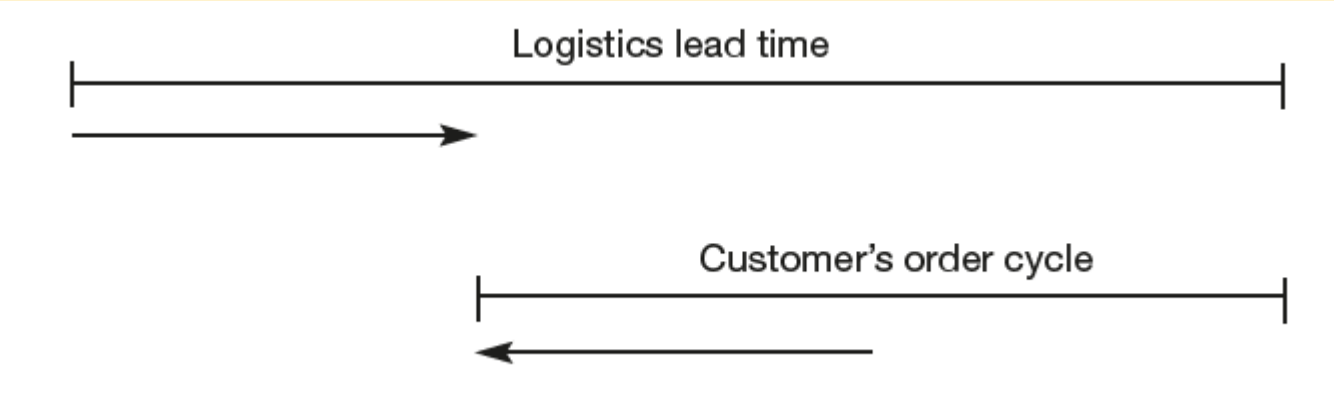
- The time it takes to procure, make and deliver the finished product to a customer is longer than the time the customer is prepared to wait for it.



Source: Christopher (2016)

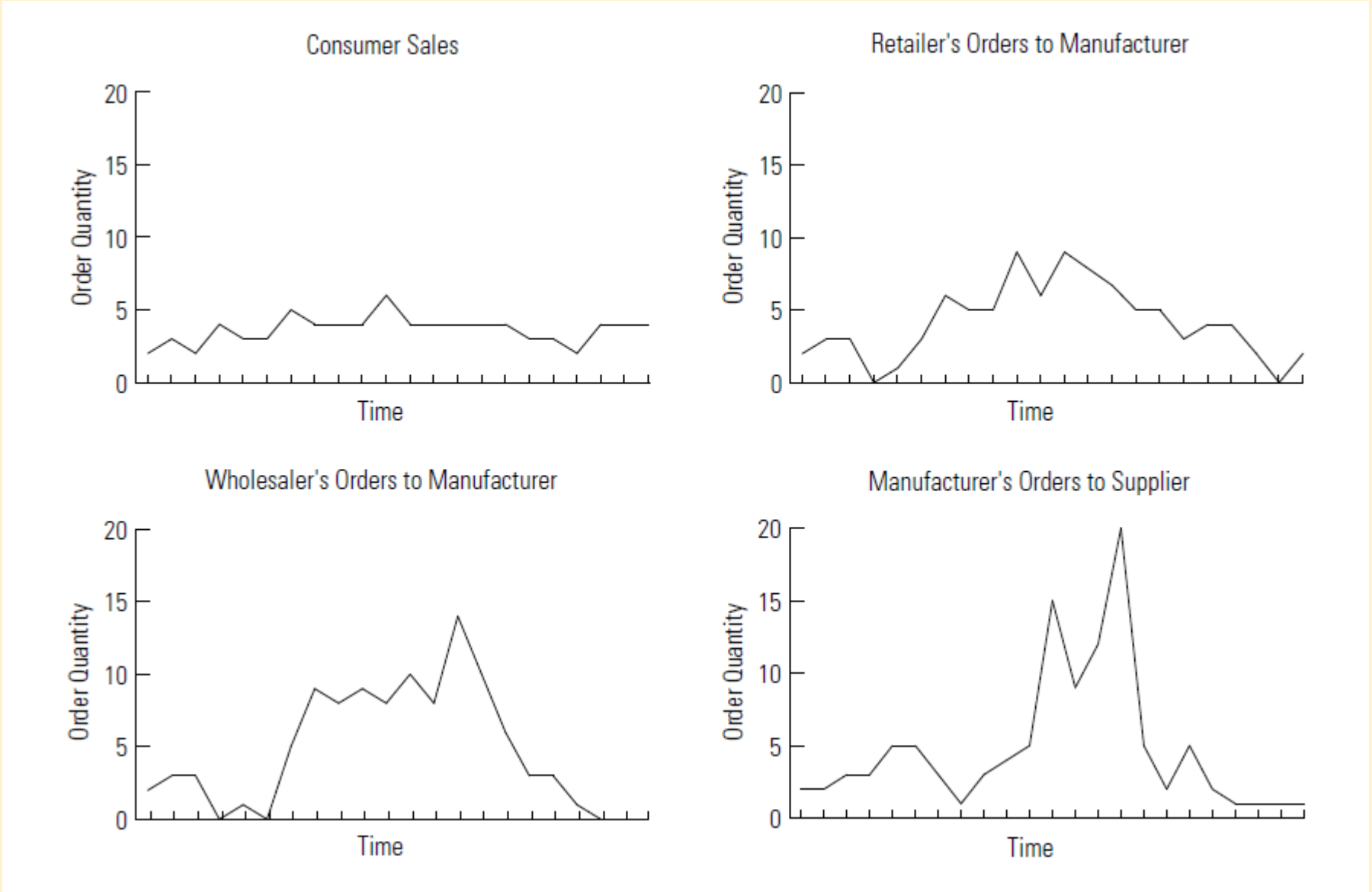
Reducing the Lead Time Gap- The Solution

- 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**



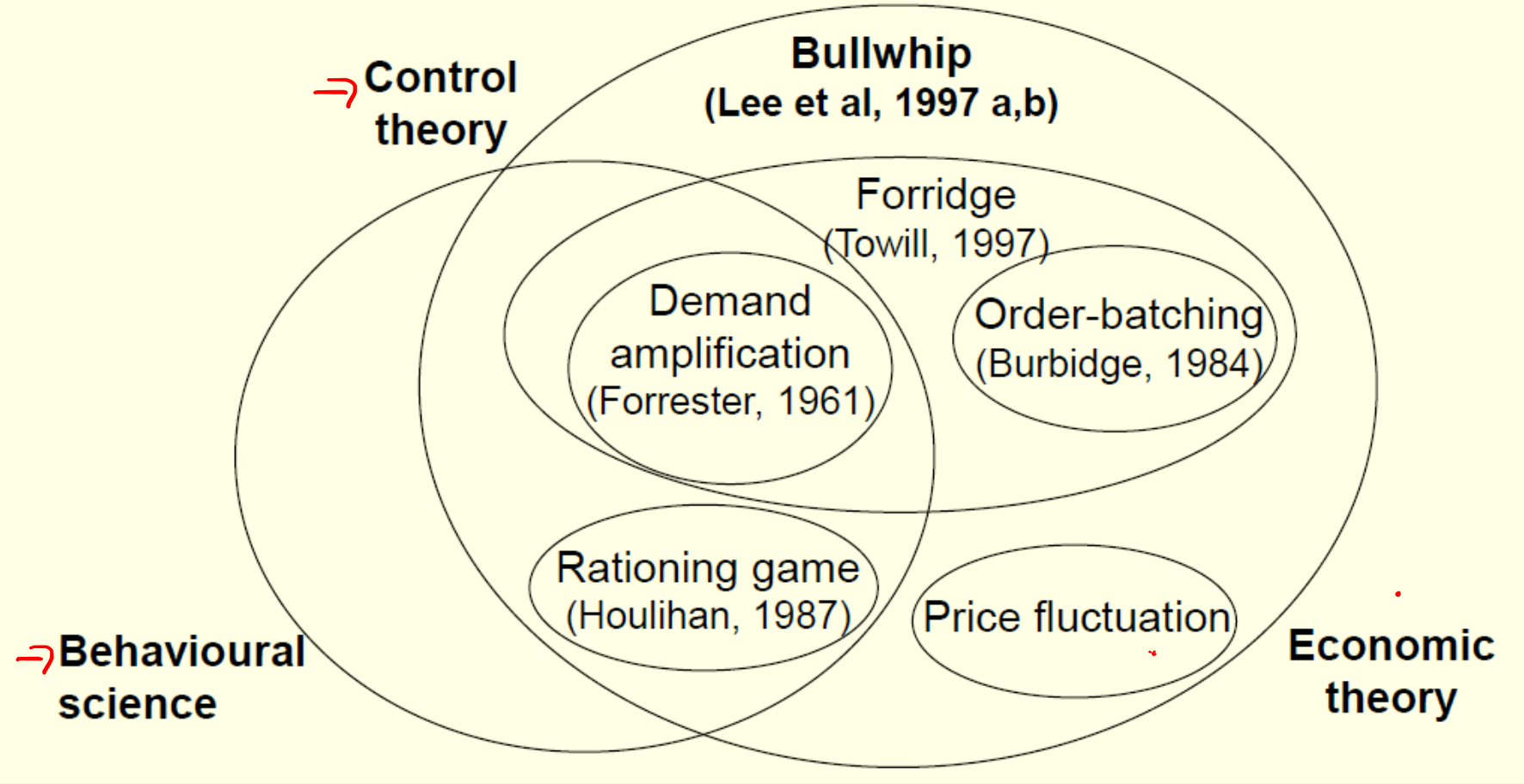
Source: Christopher (2016)

Increasing Variability of Orders up the Supply Chain



Lee et al. (1997)

Summary- What Caused the Bullwhip Effect?



Supply Chain Trade-Offs

The Objective of a Supply Chain

- Maximize overall value created

Supply Chain Surplus
= Customer Value – Supply Chain Cost

Customer Value Ratio

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

The functionality, performance and technical specification of the offer.

The availability, support and commitment provided to the customer.

$$\frac{\text{Quality} \times \text{Service}}{\text{Cost} \times \text{Time}}$$

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

The time taken to respond to customer requirements.

- Source: Johansson, H.J. et al., Business Process Re-engineering, John Wiley, 1993

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

Five ways to compete in the market

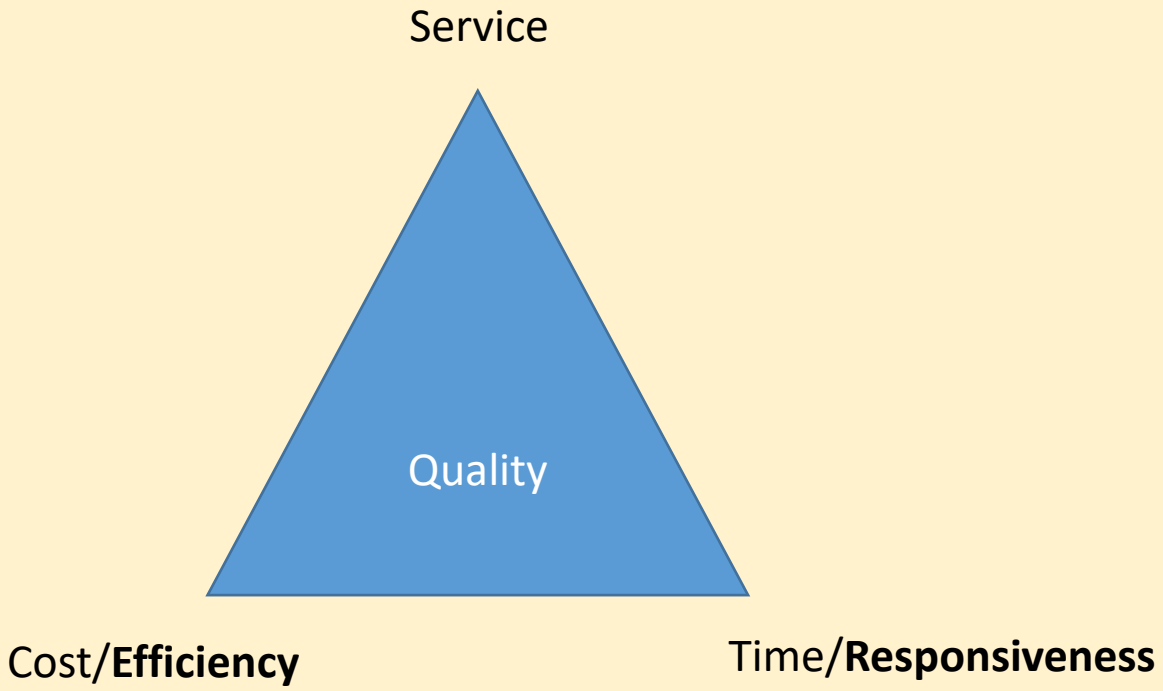
Customer Value Proposition	Example	Operations Strategy
High fashion content at a reasonable price	Zara	Speed to market
Customer experience	Dell Direct	Responsiveness through configure-to-order
Product innovation	Apple	Efficiency through outsourced manufacturing and logistics
Everyday low pricing	Wal-Mart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

Simchi-Levi (2010)

How Zara Took Over The Industry Using Fast Fashion

https://www.youtube.com/watch?v=I8_gmYNCQ1g

SC Strategy affect three measures of performance



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

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

Source: Adapted from "What Is the Right Supply Chain for Your Product?" Marshall L. Fisher, *Harvard Business Review* (March–April 1997), 83–93.

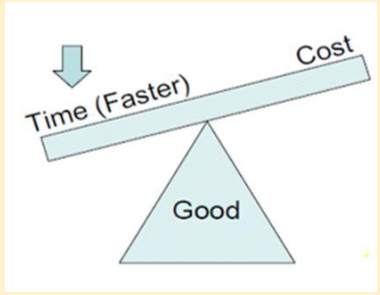
Source: Chopra and Meindl (2013)

The Challenge

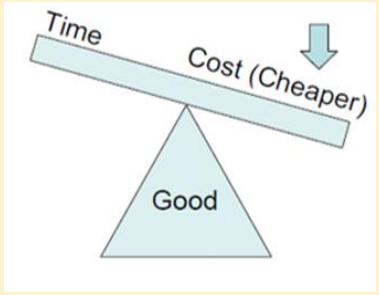
- Traditional operations strategies have often focused on efficiency **OR** responsiveness **OR** a combination of the two
- **No firm can be both:**
  - **extremely efficient,** and thus compete on price
  - and at the same time **highly responsive**,
  - while maintaining an **extraordinary service 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.

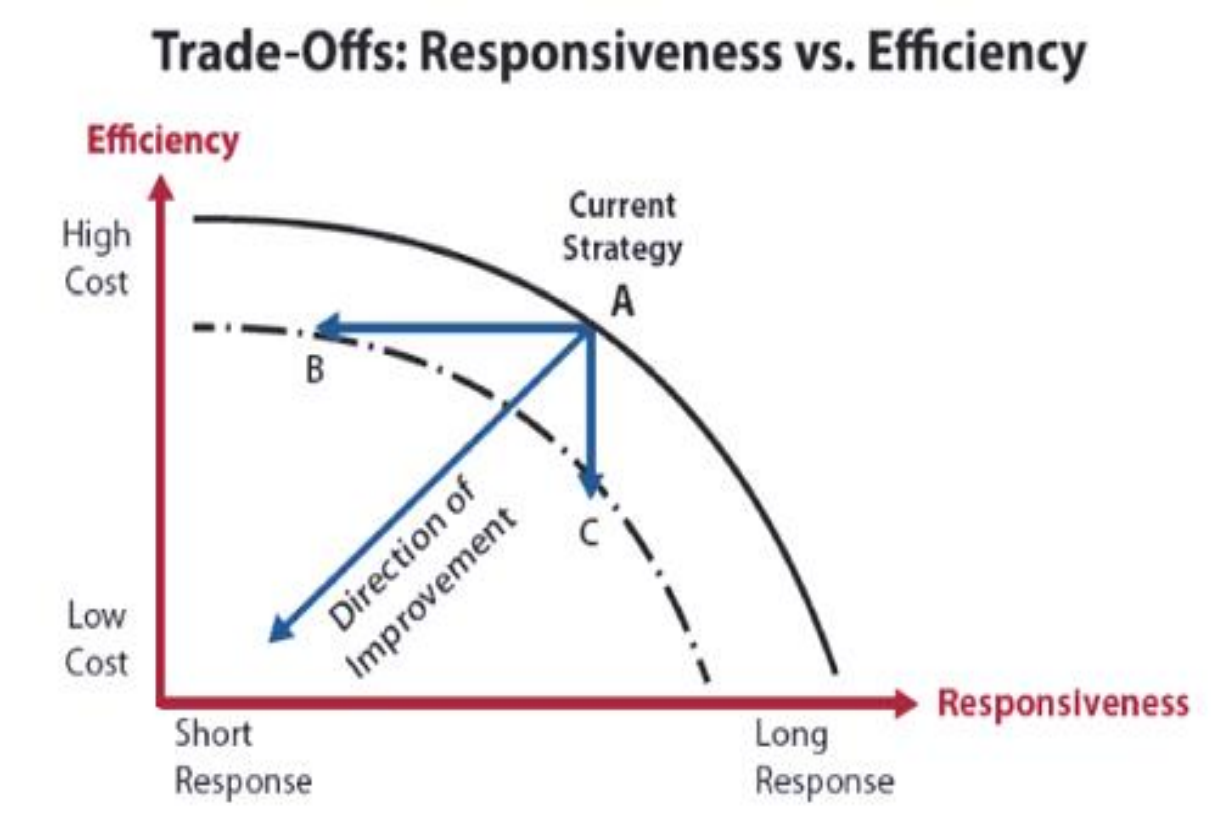


Cost Responsiveness Trade Off- **Efficient Frontier** Curve

- 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

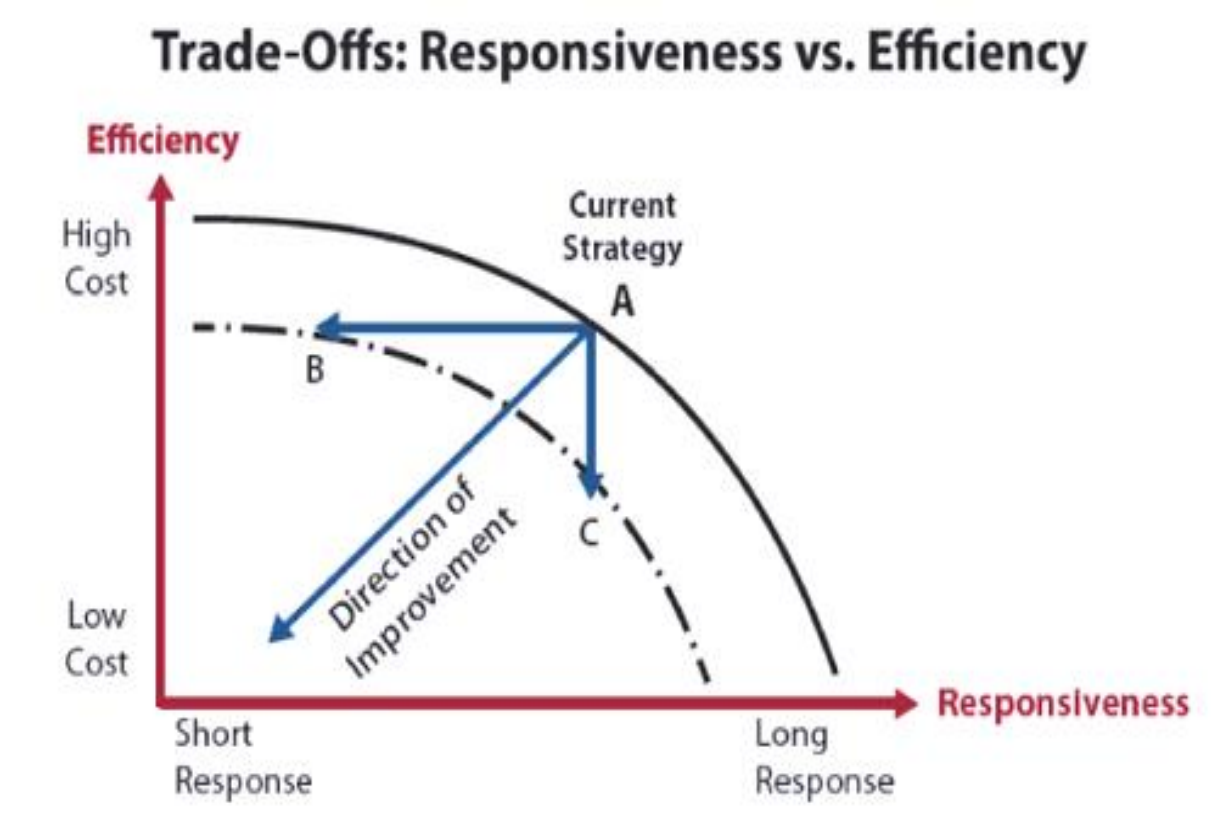
- Point B-

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**

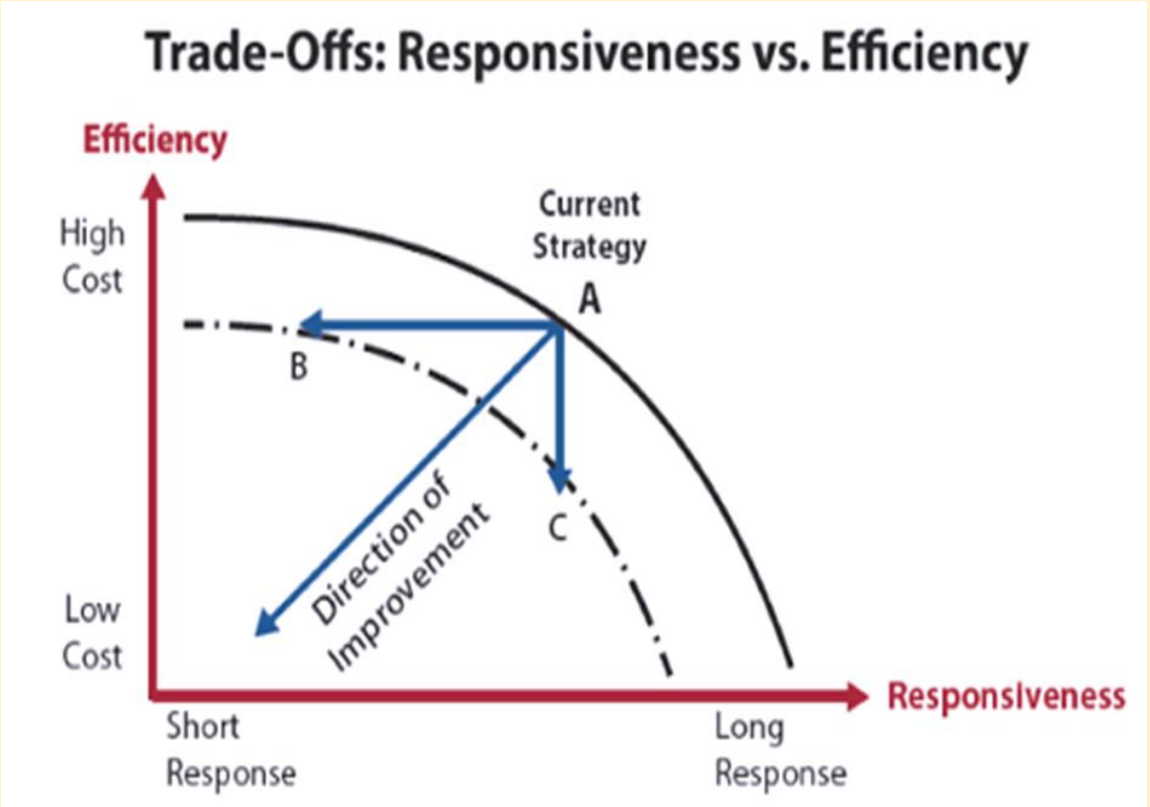
- More importantly, there is a range of strategies between B and C where the firm improves both efficiency and responsiveness



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)

Activity: Quiz

- Go to: https://forms.gle/HpfPyvZgV9C46Ccz8
- Post your score on the chat

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
- Tech Companies
  - Amazon-
  - Apple
  - Dell
- 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

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

Suppliers "push" products to their customers by marketing

Customers "pull" products from suppliers by placing orders

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 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.

Push supply chain example

Supply Chain Integration – Push Strategies

- Classical manufacturing supply chain strategy
- Manufacturing forecasts are long-range
  - Orders from retailers' warehouses
- Longer response time to react to marketplace changes
  - Unable to meet changing demand patterns
  - Supply chain inventory becomes obsolete as demand for certain products disappears
- Increased variability (Bullwhip effect) leading to:
  - Large inventory safety stocks
  - Larger and more variably sized production batches
  - Unacceptable service levels
  - Inventory obsolescence
- Inefficient use of production facilities (factories)
  - How is demand determined? Peak? Average?
  - How is transportation capacity determined?
- Examples: Auto industry, large appliances, others?

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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.

Pull supply chain example

Supply Chain Integration – Pull Strategies

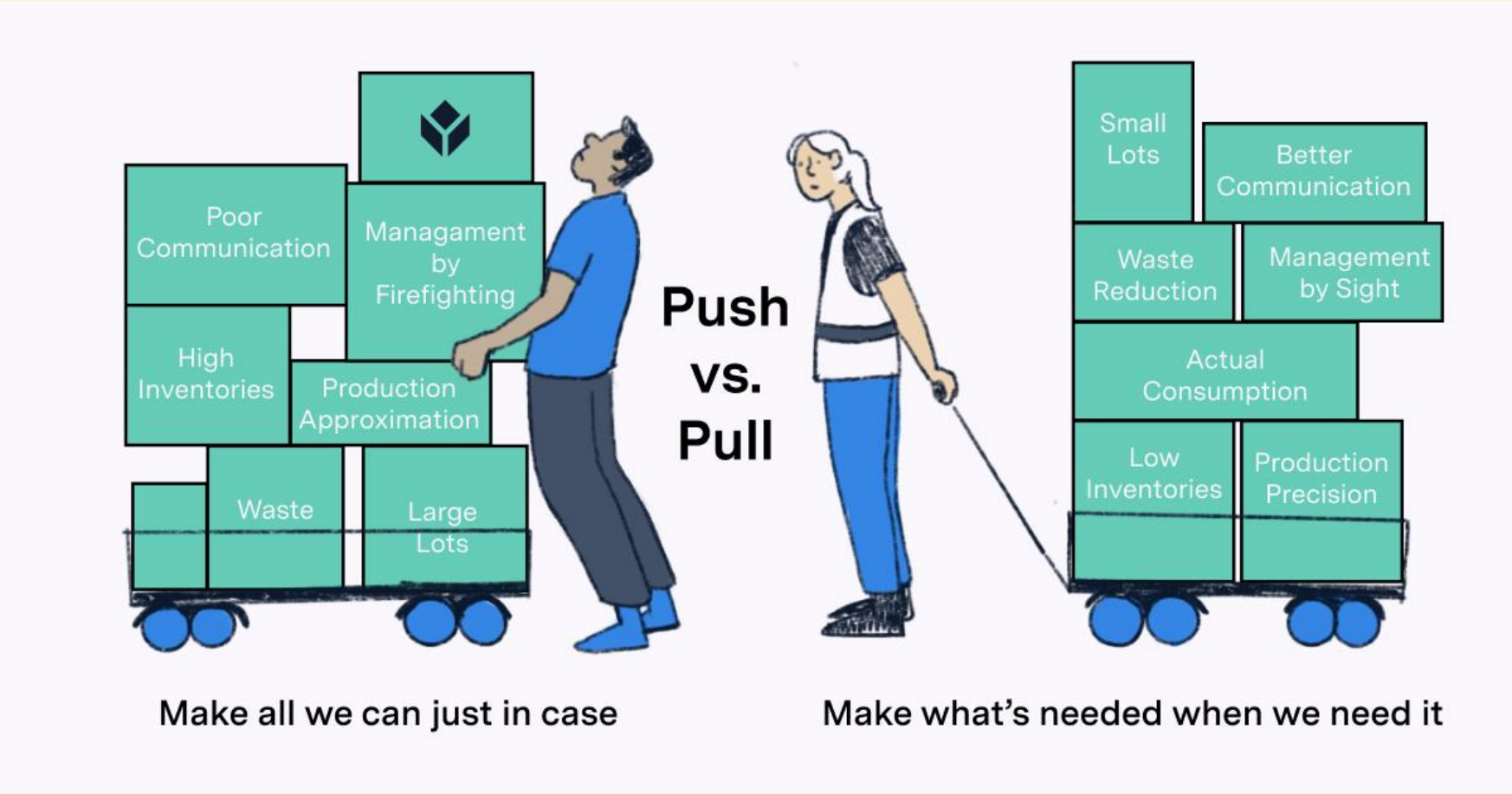
- Production and distribution are demand-driven
  - Coordinated with true customer demand
- None or little inventory held
  - Only in response to specific orders
- Fast information flow mechanisms
  - POS data
- Decreased lead times
- Decreased retailer inventory
- Decreased variability in the supply chain and especially at manufacturers
- Decreased manufacturer inventory
- More efficient use of resources
- More difficult to take advantage of scale opportunities
- Examples: Dell, Amazon

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 vs Pull


Poor Communication
Managament by Firefighting
High Inventories
Production Approximation
Waste
Large Lots
Push vs. Pull
Small Lots
Better Communication
Waste Reduction
Management by Sight
Actual Consumption
Low Inventories
Production Precision
Make all we can just in case
Make what's needed when we need it

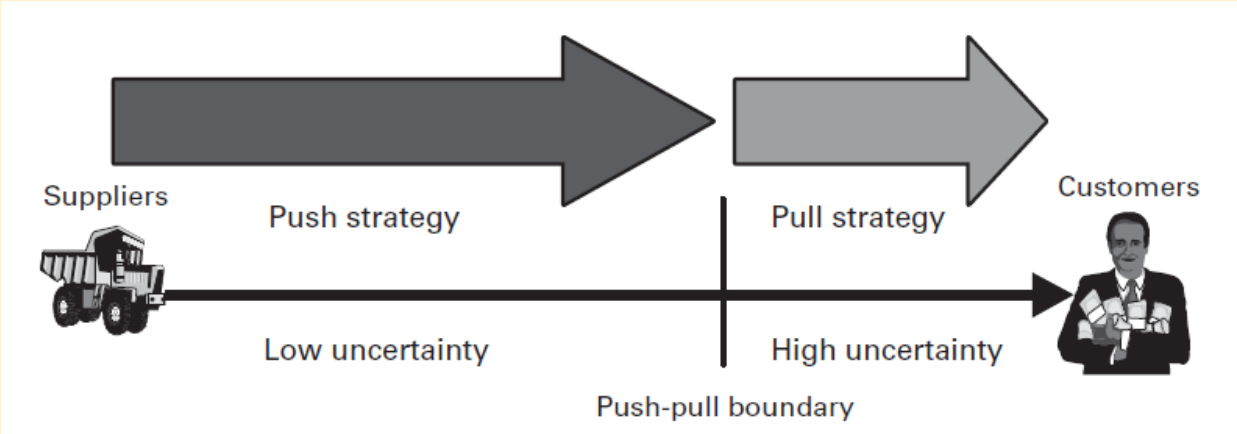
Characteristics of the push and pull portions of the supply chain

Portion	Push	Pull
Objective	Minimize cost.	Maximize service level.
Complexity	High	Low
Focus	Resource allocation	Responsiveness
Lead time	Long	Short
Processes	Supply chain planning	Order fulfillment

Simchi-Levi (2010)

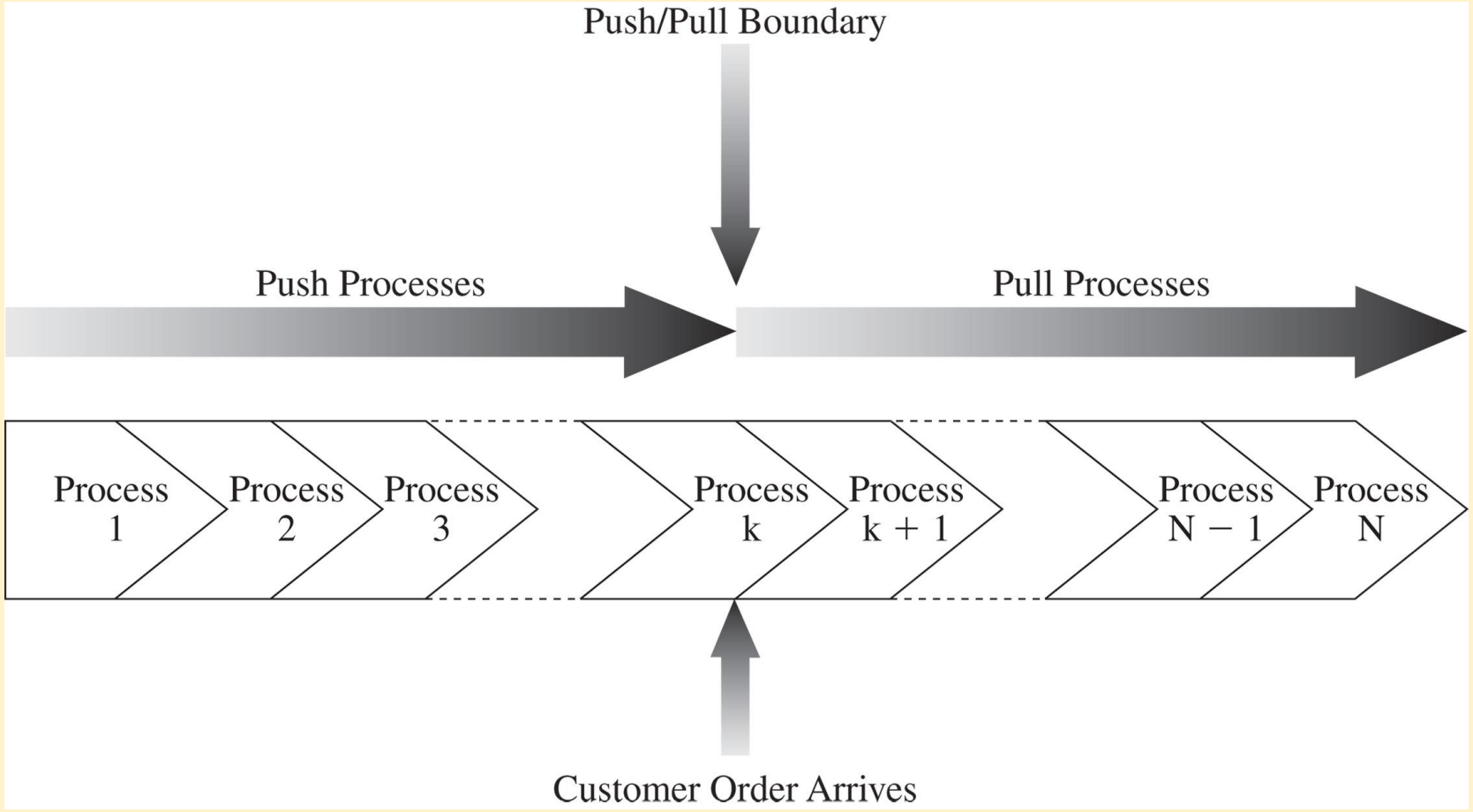
Implementing a Hybrid- Push Pull Strategy

- 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**



Simchi-Levi (2010)

Push Pull Strategy

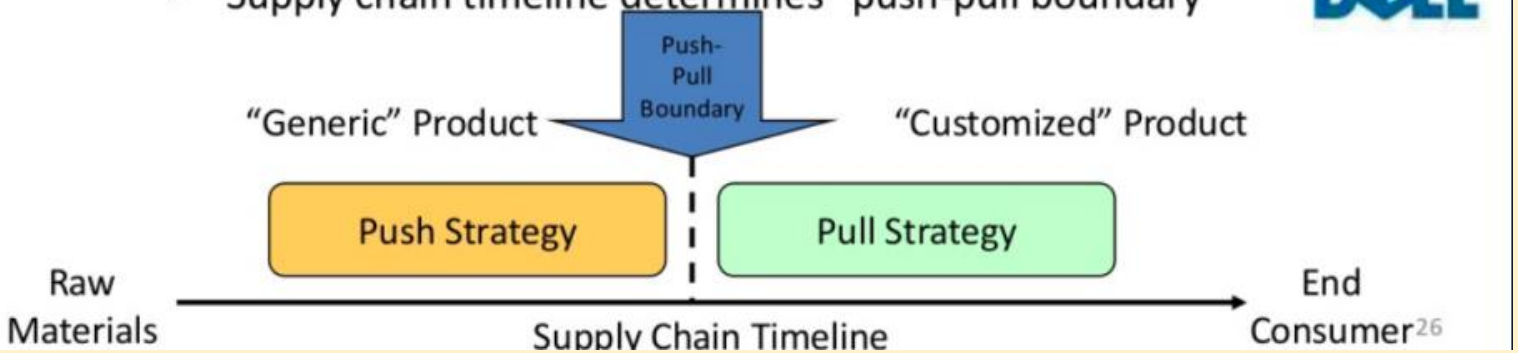


Chopra and Meindl (2013)

Push/Pull Strategies example

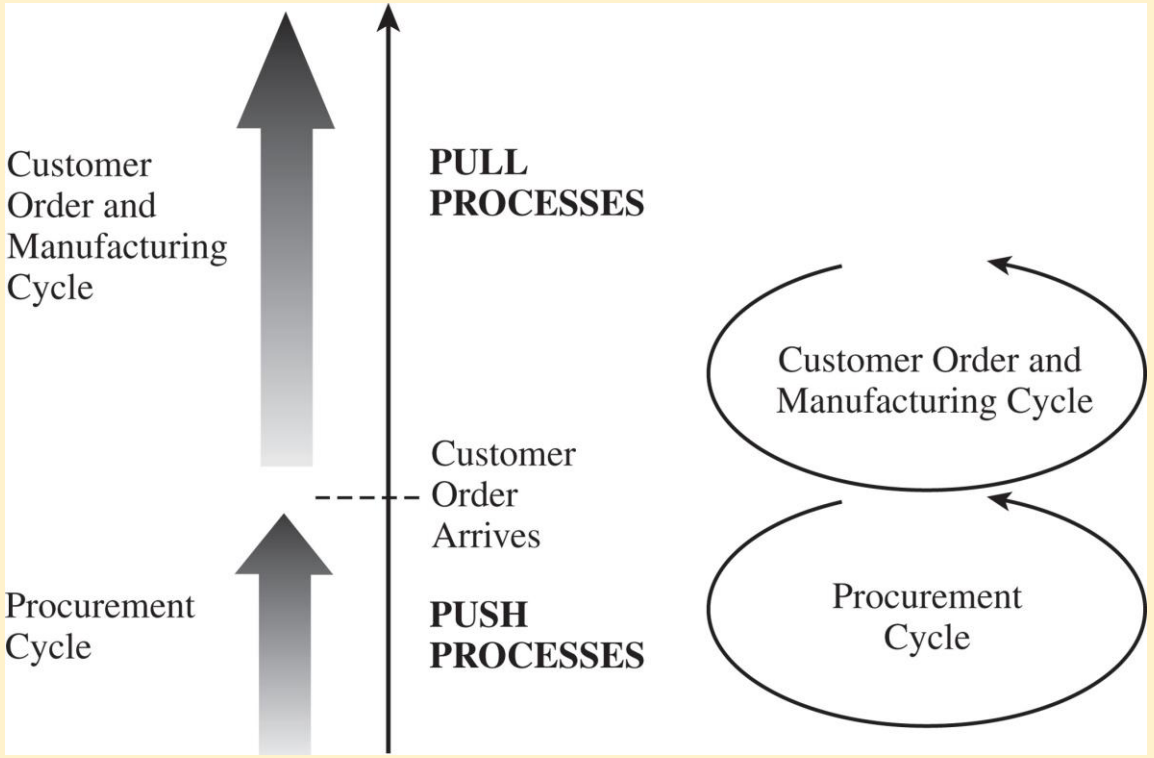
Supply Chain Integration – Push/Pull Strategies

- Hybrid of "push" and "pull" strategies to overcome disadvantages of each
- Early stages of product assembly are done in a "push" manner
  - Partial assembly of product based on aggregate demand forecasts (which are more accurate than individual product demand forecasts)
  - Uncertainty is reduced so safety stock inventory is lower
- Final product assembly is done based on customer demand for specific product configurations
- Supply chain timeline determines "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**

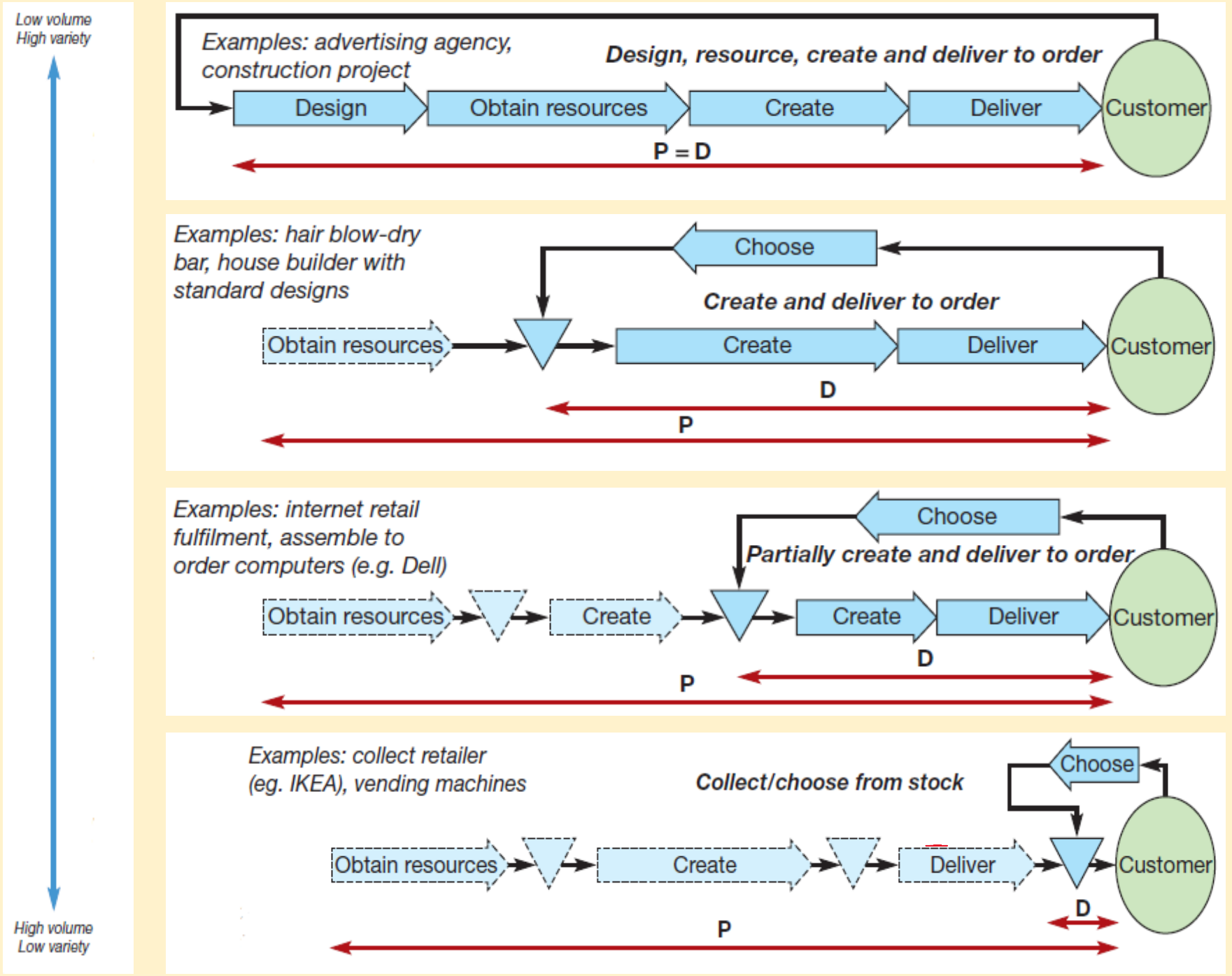


Chopra and Meindl (2013)

- 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

Link to the Lead Time Gap Problem- P:D Ratio

Slack et al 2013

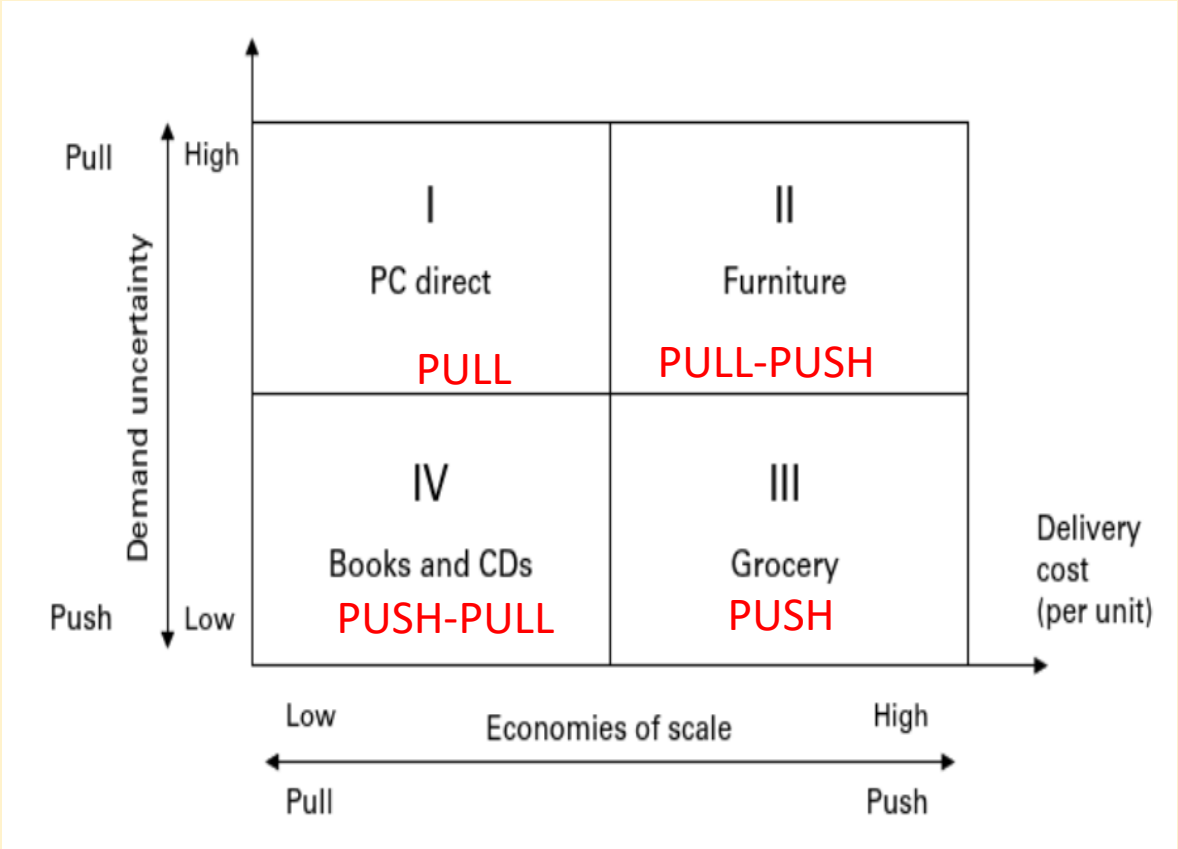


Which Strategy to Select?

- 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



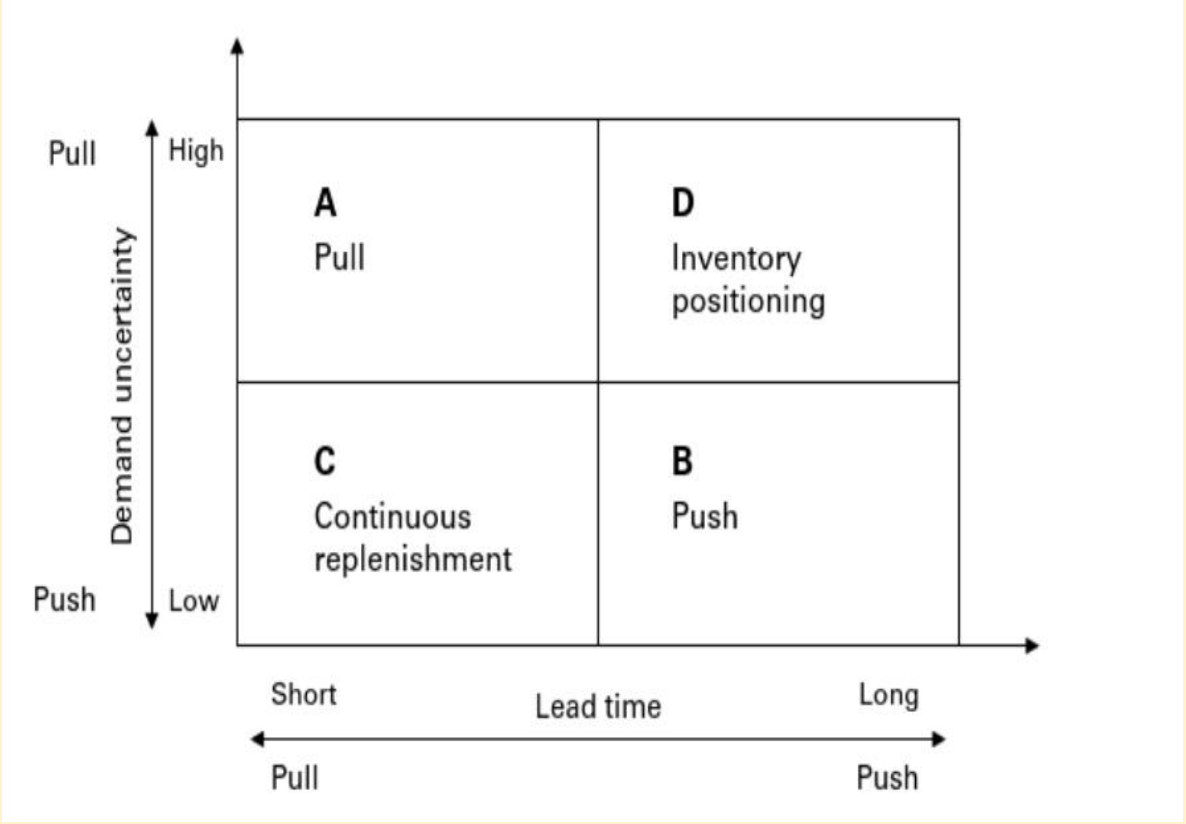
Simchi-Levi (2010)

Activity: McDonald's Push Pull Boundary

- Where would you place the Push-Pull boundary?

Matching SC Strategies with Products-
Effect of Lead Time and Demand Uncertainty

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



Simchi-Levi (2010)

Strategies for Innovative and Functional Products

- **Functional Products-**

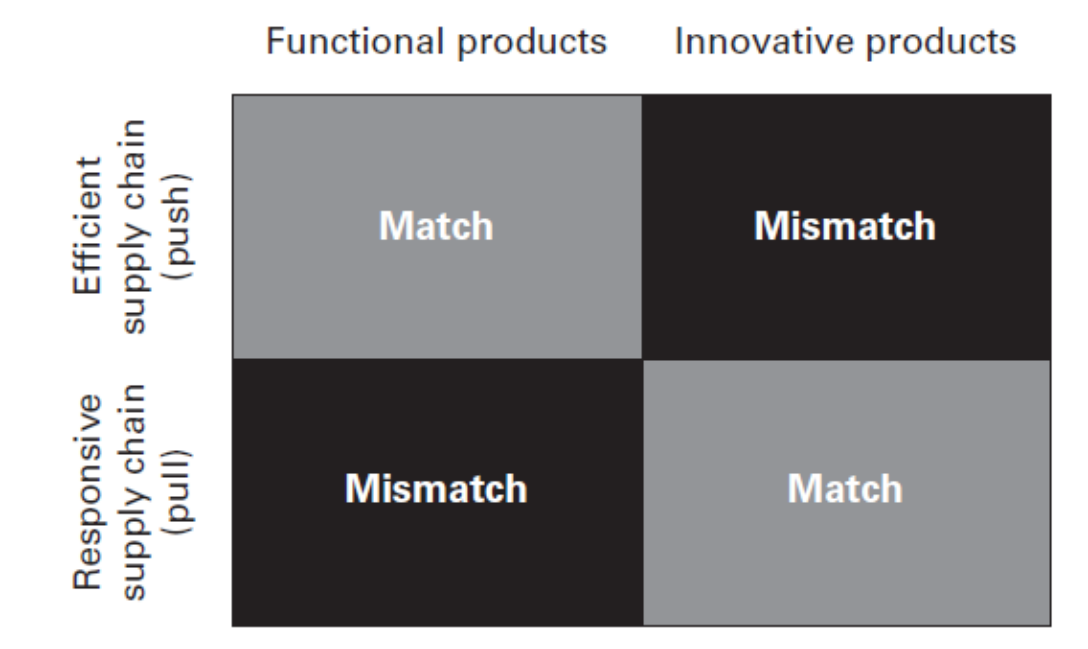
  Push Strategy

  - where the focus is on efficiency, cost reduction, and supply chain planning

- **Innovative Products-**

  Pull Strategy

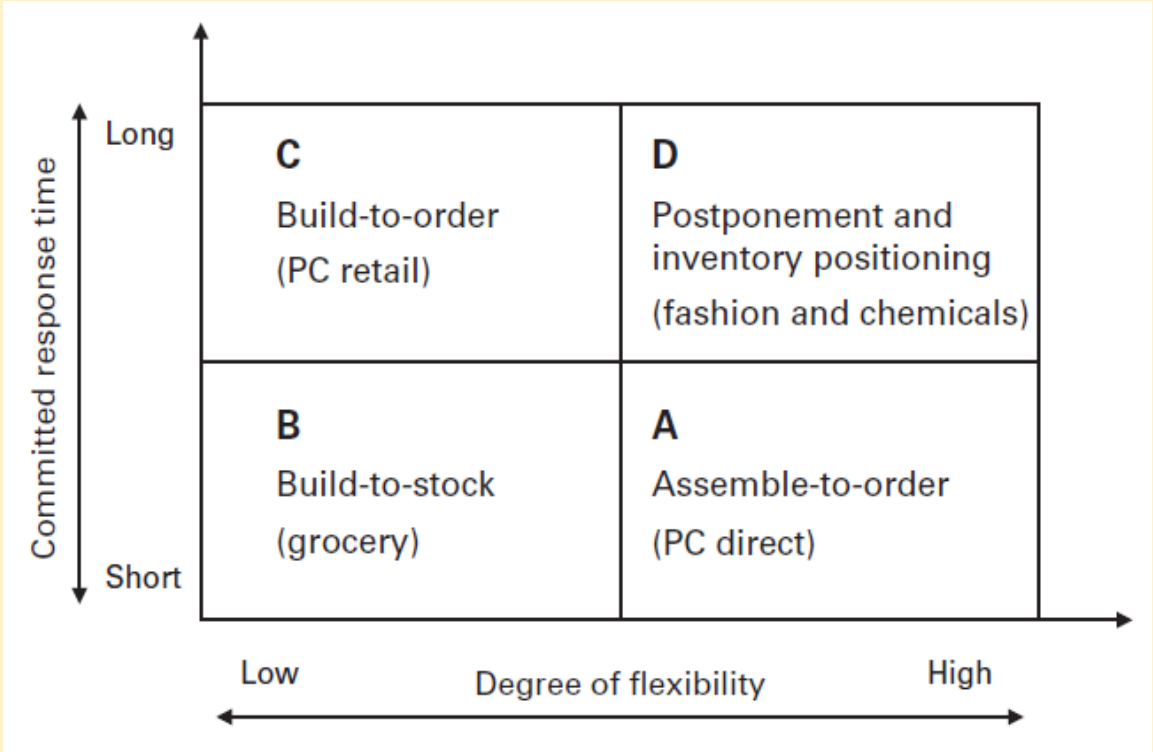
  - focus is on responsiveness - time, service level, and order fulfillment



From M. L. Fisher, " What Is the Right Supply Chain for Your Product?, " Harvard Business Review (March – April 1997): 105 – 117.

Flexibility and the manufacturing strategy

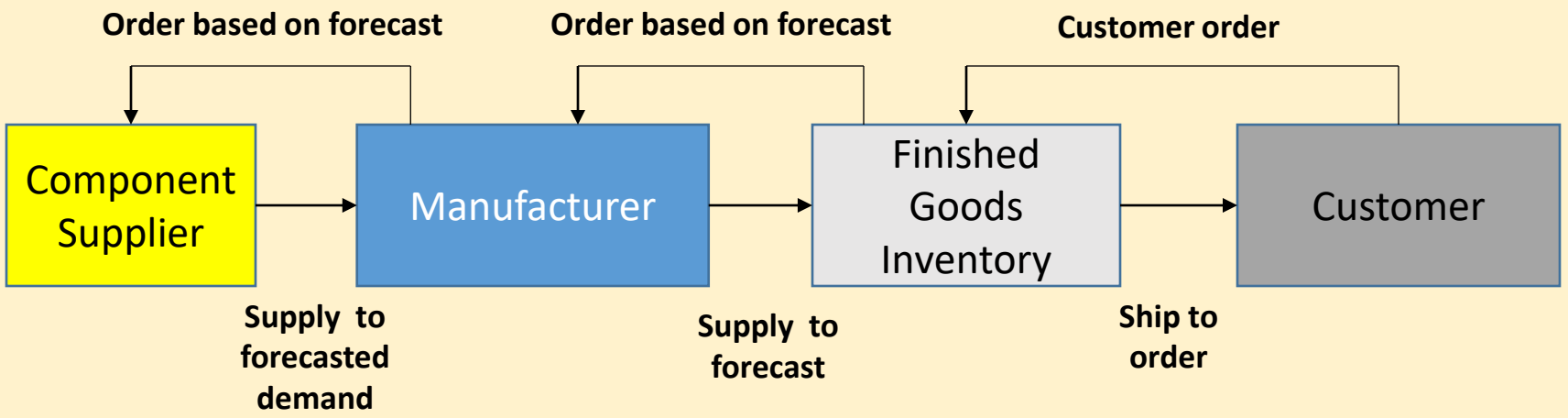
- **Build-to-stock strategy-**
  - inventory is built based on forecast-
  - Push strategy.
  - Focus on cost reduction and effective forecast
- **Assemble-to-order strategy-**
  - individual products are assembled based on customer configuration
  - Pull strategy
- **Build-to-order strategy-**
  - Pull-Push strategy
  - lot sizes are produced after receiving a customer order
  - focuses on efficiency or cost reduction through economies of scale



Simchi-Levi (2010)

Supply Chain Designs

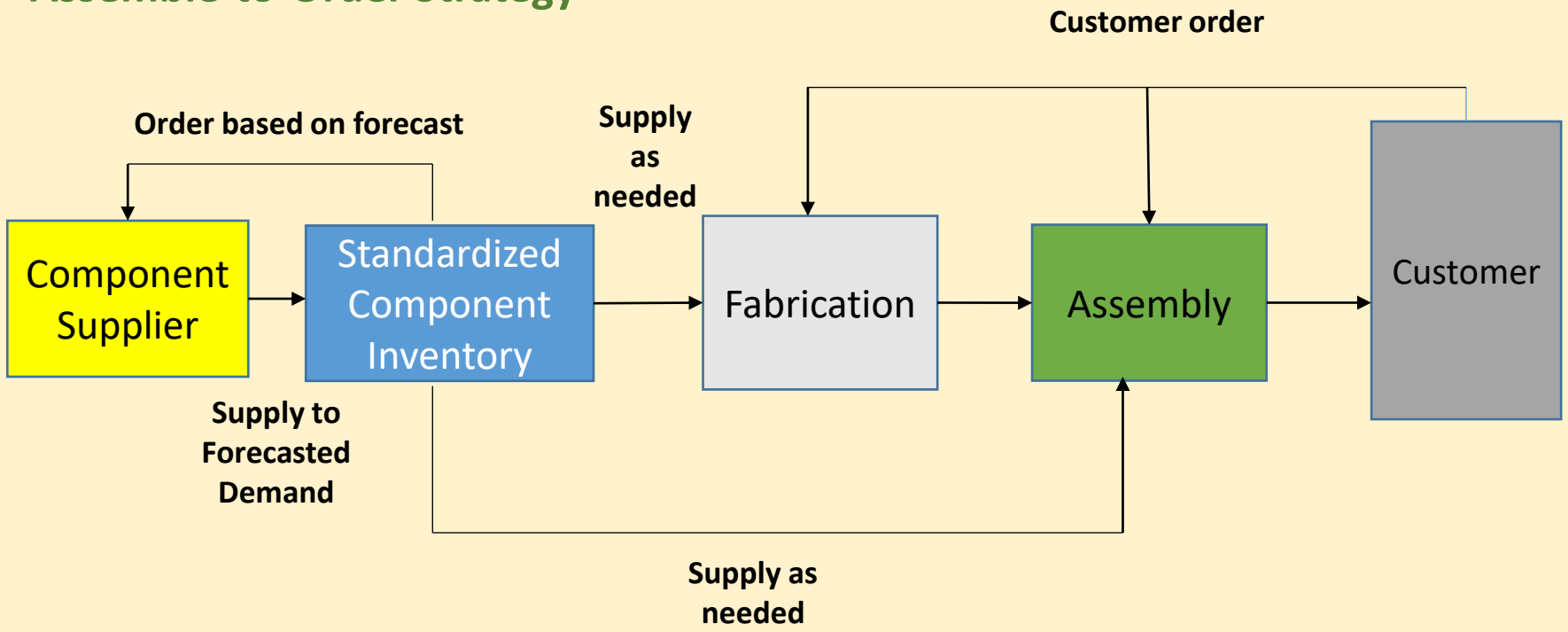
Make-to-Stock Strategy



Krajewski et al (2016)

Supply Chain Designs

Assemble-to-Order Strategy



Krajewski et al (2016)

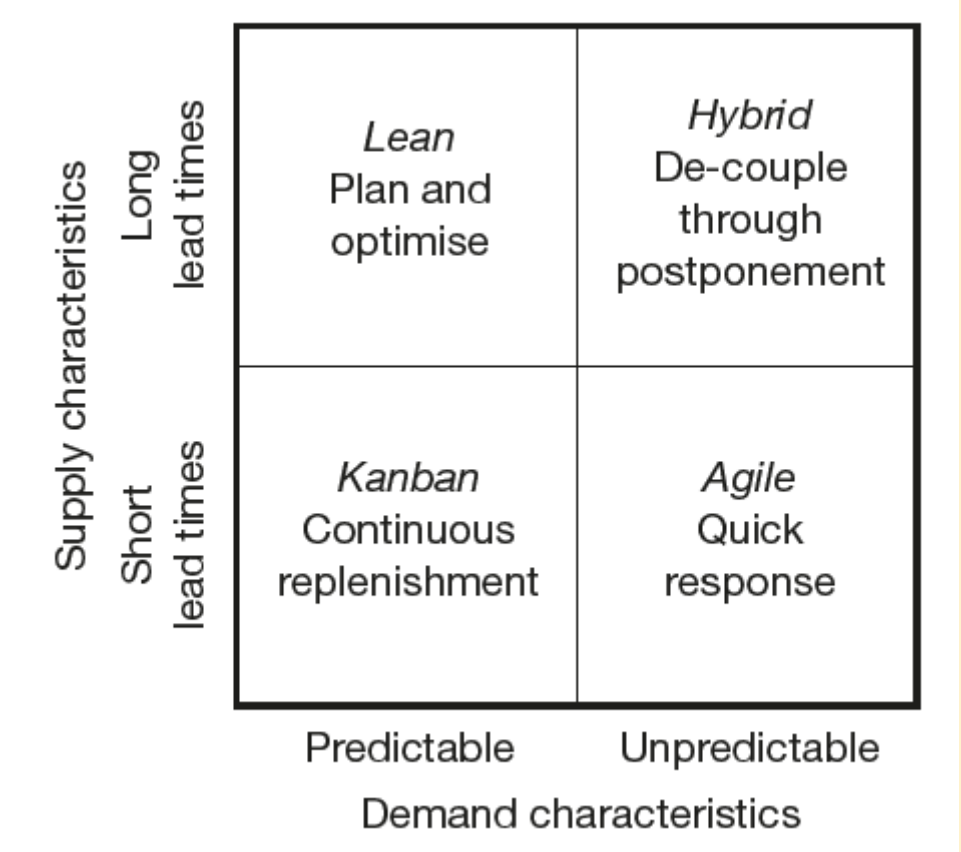
Right Supply Chain Strategy in total

- Use of a menu of tactics that include:
  - Manufacturing strategy
  - Push/Pull Strategy
  - Optimizing push-pull boundaries
  - Postponement strategies
  - Strategic inventory
  - Agile/Lean Strategy
  - Hybrid of Lean and Agile

Contemporary 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)