Supply Chain Management

What is a Supply Chain?

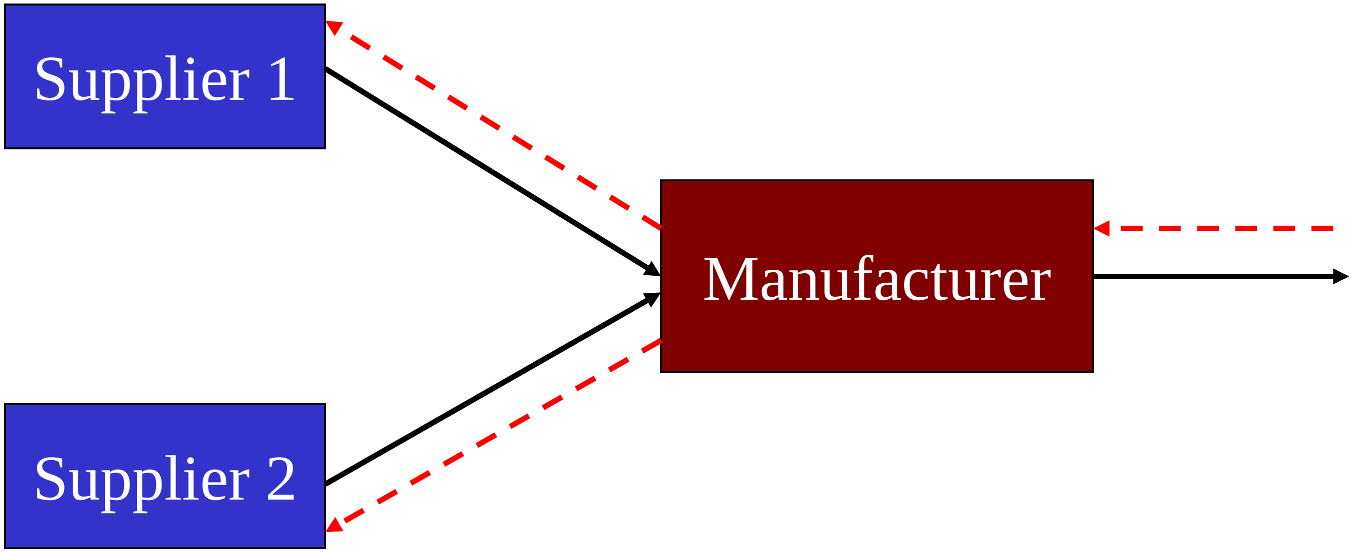
What is a Supply Chain?

A **supply chain** is the system of organizations, people, activities, information and resources involved in moving a product or service from supplier to customer. Supply chain activities transform raw materials and components into a finished product that is delivered to the end customer.

What is a Supply Chain?

The concept of supply **chain** defines a series of companies **interlinked** together by a flow of material and information in order to serve the end customer.

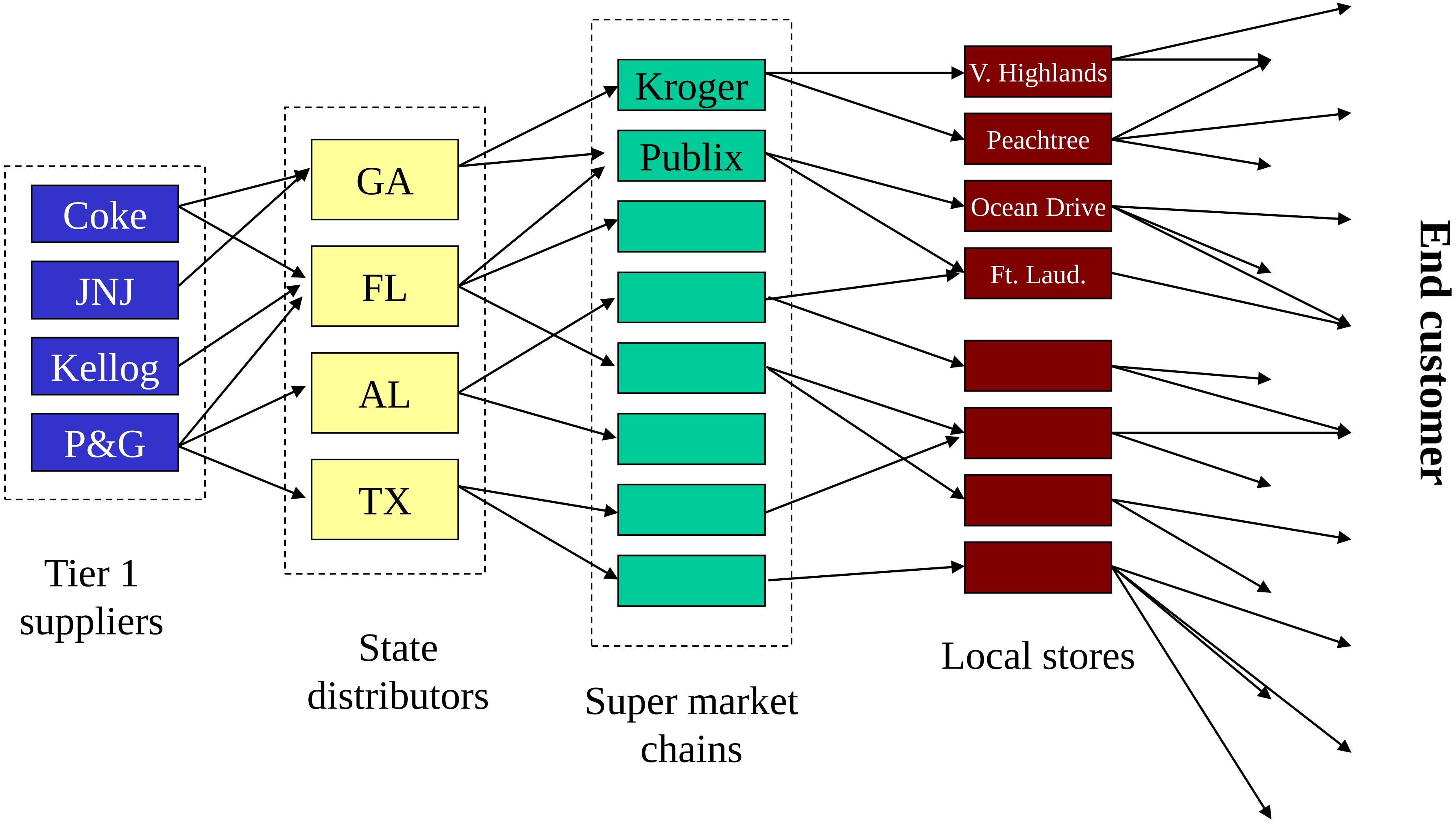
Material and Information Flow…



Forward: Flow of material

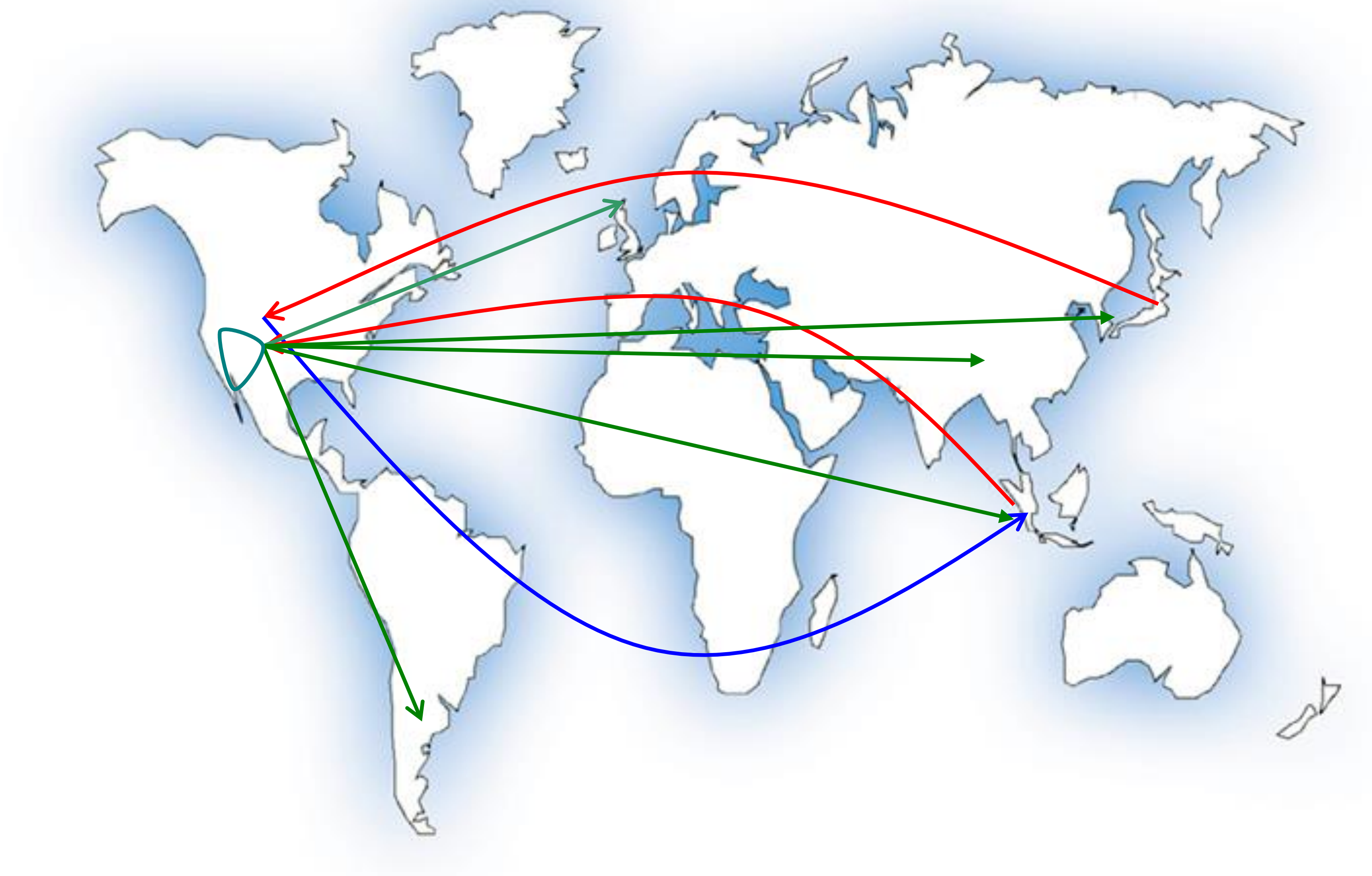
Backward: Flow of information

A Supply Chain Example…



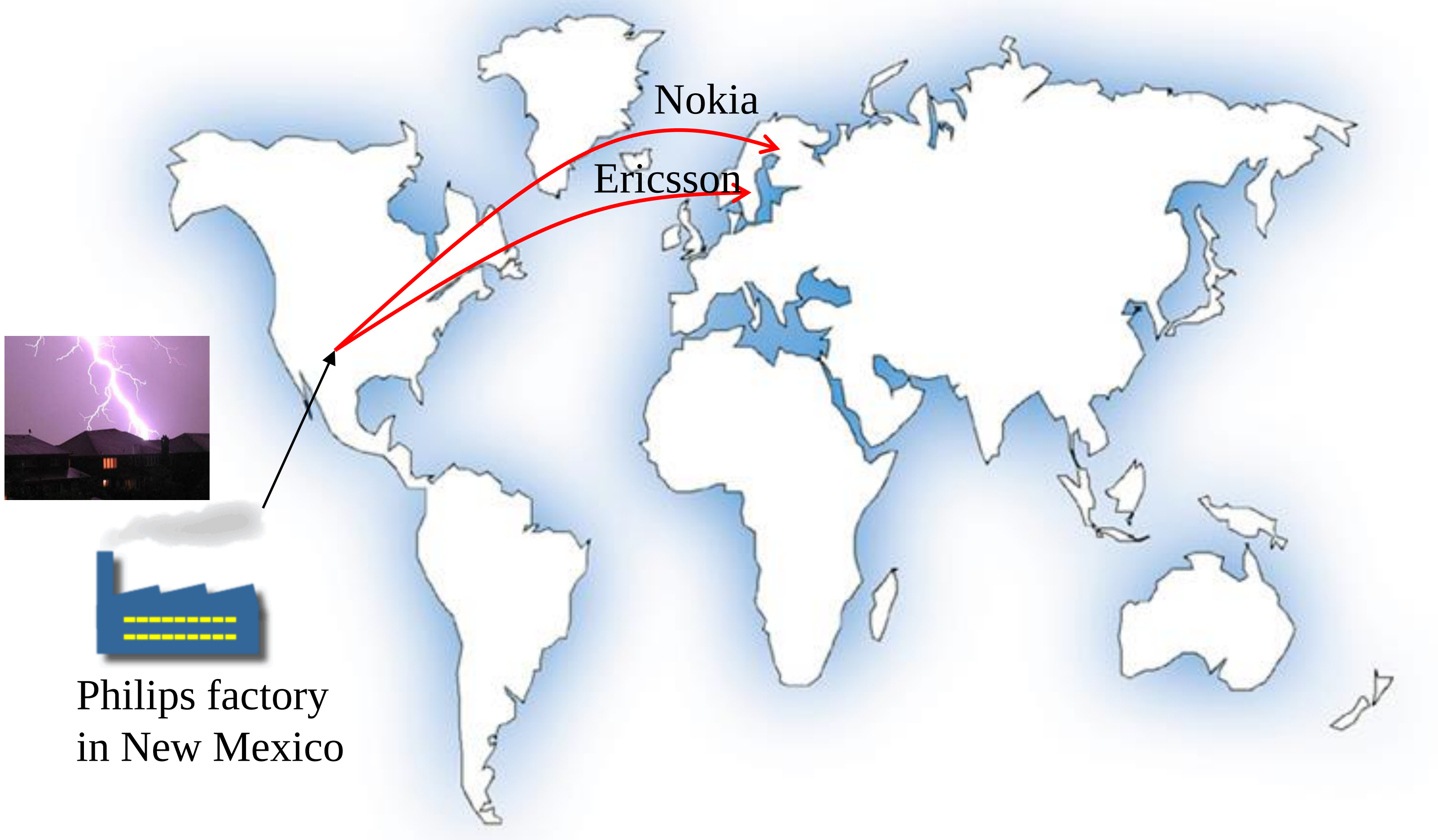
Supply Chain Story I

On tracing the journey of a part



Source: *The Resilient Enterprise*

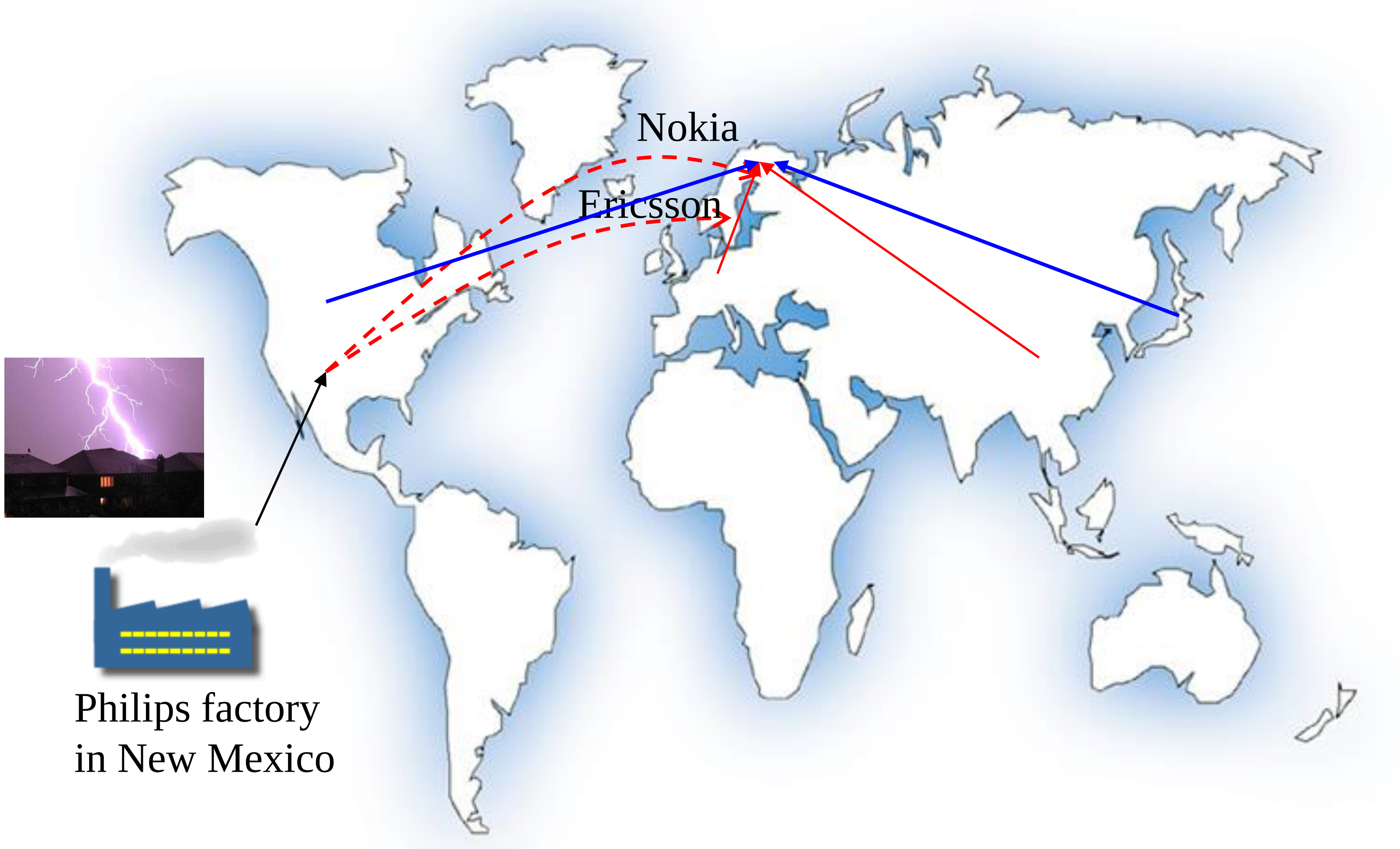
Supply Chain Story II



Source: *The Resilient Enterprise*

Supply Chain Story II

On responding to a supply chain disruption



Source: *The Resilient Enterprise*

Supply Chain Story III

On Internal communication and collaboration

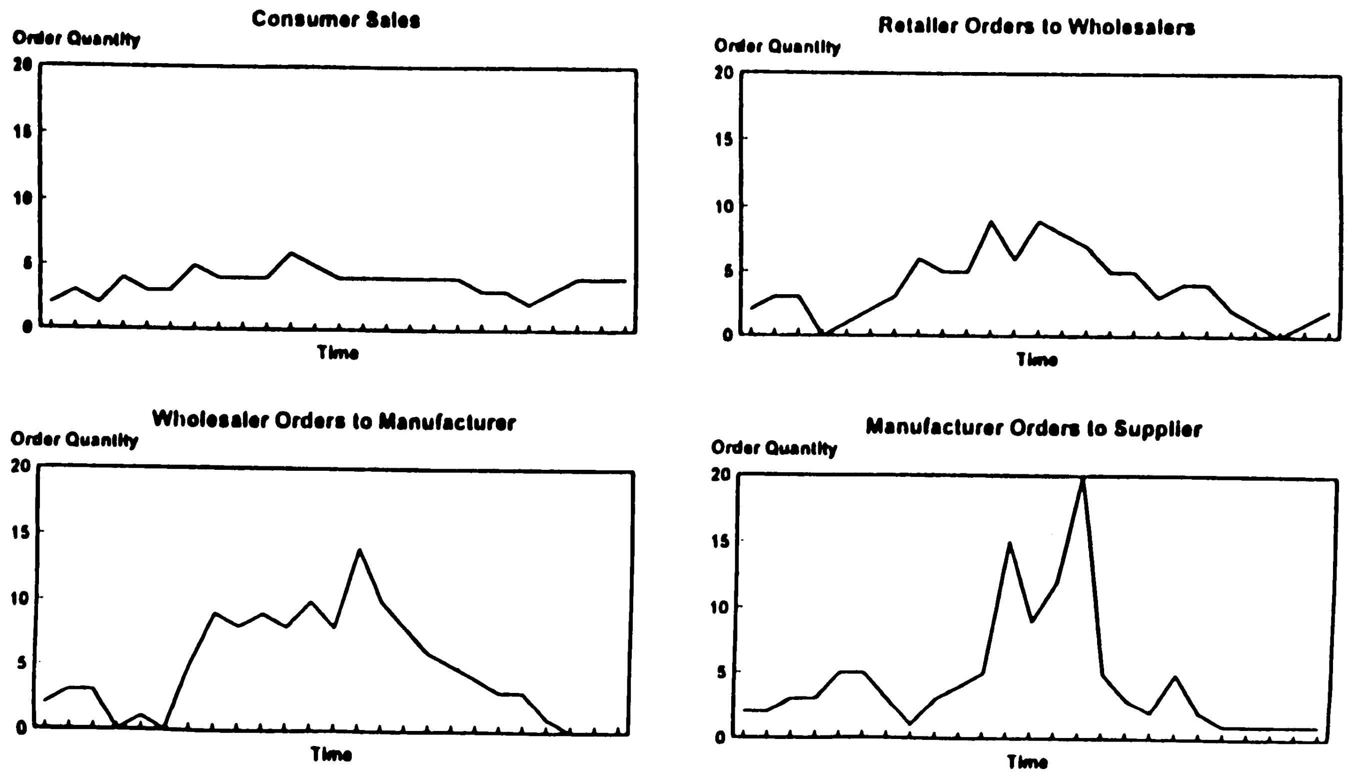
In the mid-1990s, the Swedish car manufacturer Volvo found itself with excessive stocks of green cars. To move them along, the sales and marketing departments began offering attractive special deals, so green cars started to sell. But nobody had told the manufacturing department about the promotions. It noted the increase in sales, read it as a sign that consumers had started to like green, and ramped up production.

Source: Chain reaction, The Economist, Jan 31, 2002

Supply Chain Story IV

On external communication and collaboration

Figure 1:
Increasing Variability of Orders Up the Supply Chain

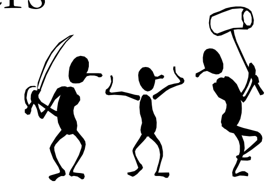


Supply Chain Story V

On supplier management

US auto man.

Suppliers



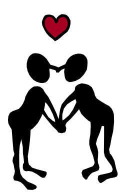
Arm’s Length

“The Big Three [US automakers] set annual cost-reduction targets [for the parts they purchase]. To realize those targets, they’ll do anything. [They’ve unleashed] a reign of terror, and it gets worse every year. You can’t trust anyone [in those companies]”

-Director, interior systems supplier to Ford, GM, and Chrysler, October 1999*

Suppliers

Toyota



Partnership

“Toyota helped us dramatically improve our production system. We started by making one component, and as we improved, [Toyota] rewarded us with orders for more components. Toyota is our best customer.”

-Senior executive, supplier to Ford, GM, Chrysler, and Toyota, July 2001**

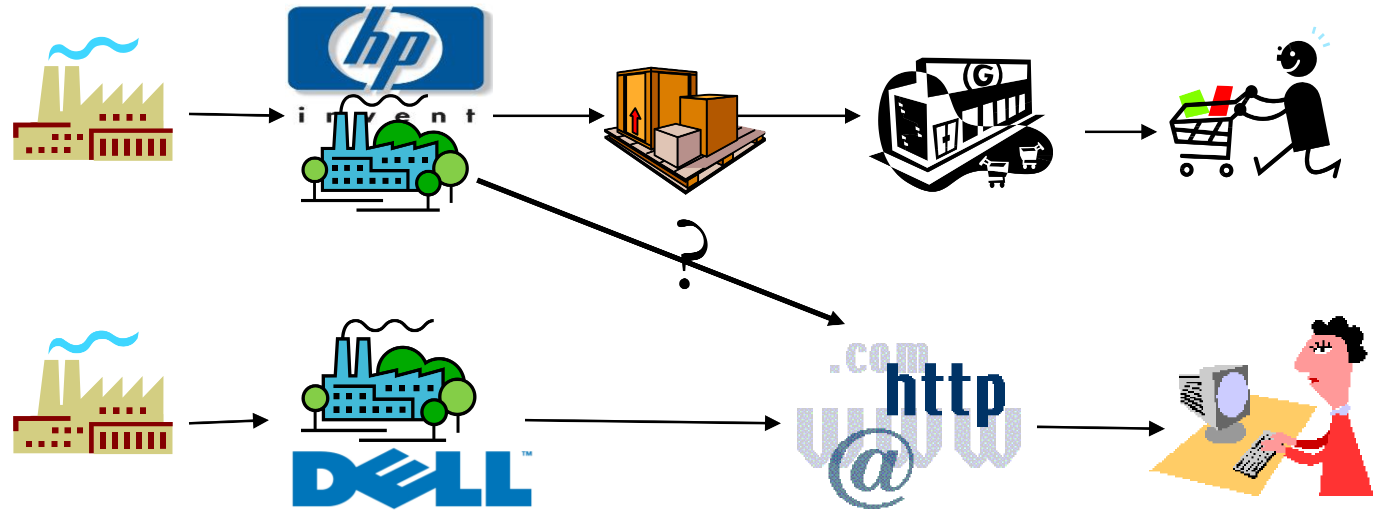
* And ** Source: Building Deep Supplier Relationships, HBR, December 2004

Supply Chain Story VI

On gaining competitive advantage

Traditional Supply Chain

Dell Supply Chain



- On April 20, 2001 Dell toppled Compaq as the world's largest PC maker*
  - Dell's market share was 12.8% as opposed to Compaq's market share 12.1%
- Compaq and HP could not get into a price war with Dell because
  - Dell's profit margin was 18%
  - Compaq and HP's profit margins were in single digits

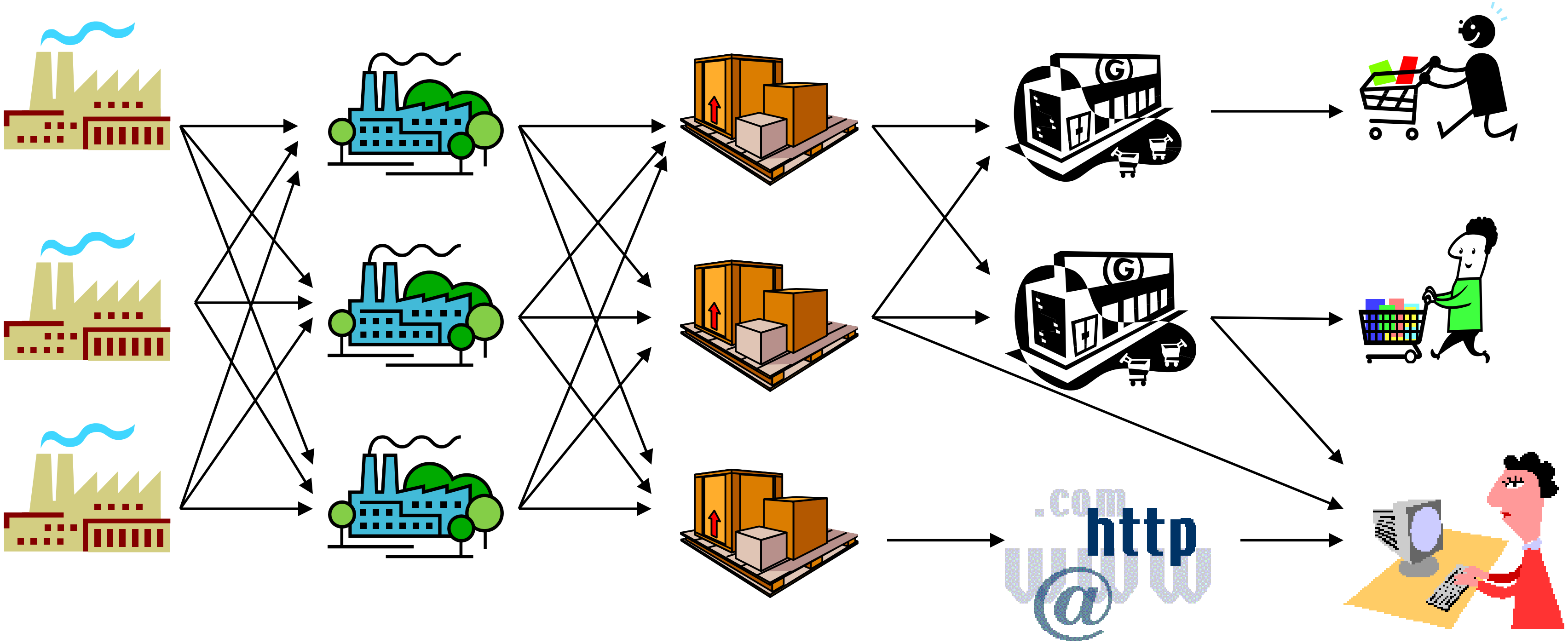
*Source: Forbes.com, April 24, 2001

Supply Chain Story VII

On gaining competitive advantage

In the late 1970s, with about 200 stores, Wal-Mart was a relatively small retailer. At that time, Sears and Kmart dominated the retail market. Since then, Wal-Mart gained significant market share from these retailers and became the largest and most profitable retailer in the world. Today, Wal-Mart is admired for its collaboration and technology driven supply chain practices and is leading the retailing industry with its innovative supply chain practices.

Supply Chain

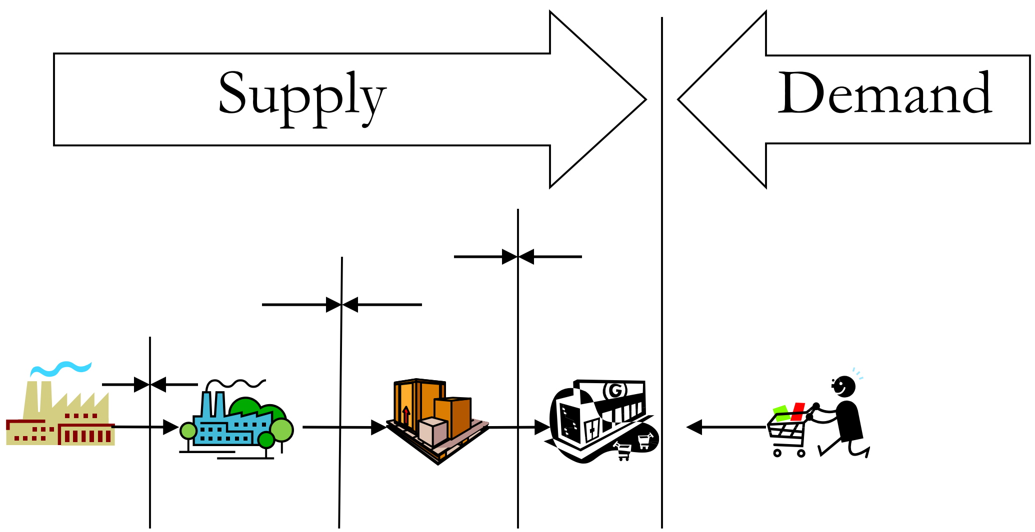


Supplier → Manufacturer → Distributor → Retailer → Customers

Supply Chain Management

Supply Chain Management is

the design and management of processes
across organizational boundaries
with the goal of matching supply and demand
in the most cost effective way.



Mission impossible: Matching Supply and Demand

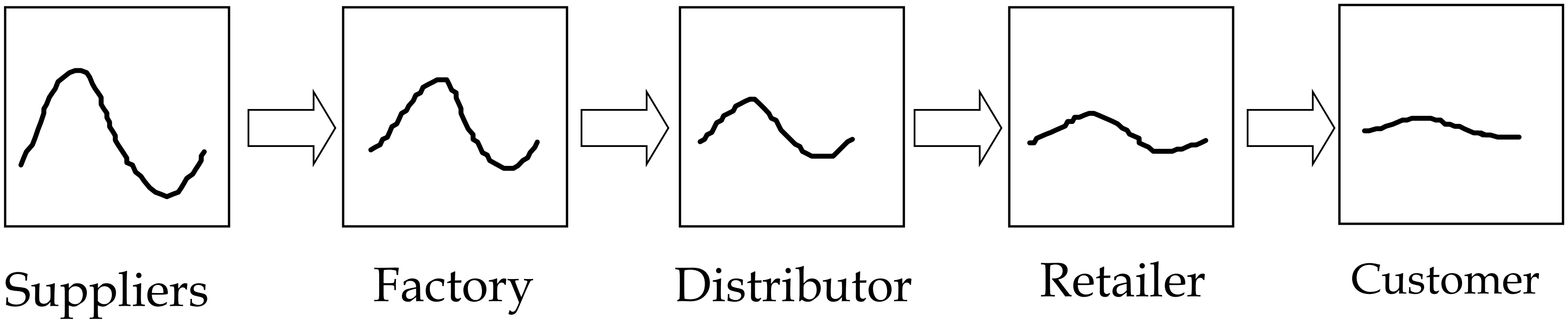
Why so Difficult to Match Supply and Demand?

- Uncertainty in demand and/or supply
- Changing customer requirements
- Decreasing product life cycles
- Fragmentation of supply chain ownership
- Conflicting objectives in the supply chain
- Conflicting objectives even within a single firm
  - Marketing/Sales wants: more FGI inventory, fast delivery, many package types, special wishes/promotions
  - Production wants: bigger batch size, depots at factory, latest ship date, decrease changeovers, stable production plan
  - Distribution wants: full truckload, low depot costs, low distribution costs, small # of SKUs, stable distribution plan

Losing Sight of the Common Objective

The Bullwhip Effect

Amplification of variability as you move up in the supply chain



- Demand variability increases as we move away from market and towards supply
- Pervasive across most industries
- Increases costs and degrades service

Causes of the Bullwhip Effect

- Over-reaction to backlogs
- Lack of communication
- Lack of coordination
- Delay times for information and delivery of materials

More Causes of the Bullwhip Effect

- Order batching (ordering costs, transportation economics, sales incentives)
- Shortage gaming (concerns about potential supply shortage)
- Price variations (promotions $\Rightarrow$ forward buying)
- Demand forecast updating
  - Multiple forecasts - no visibility of end consumer demand

Impact of the Bullwhip Effect

- High inventory/lost sales/backlog cost
- Low customer satisfaction
- Low operational efficiency
  - underutilization
  - overtime
  - expediting
- Unnecessary capacity investment
- Swings in working capital

Bullwhip Causes and Countermeasures

Order Batching

• High order cost	⇒ Electronic data interchange (EDI) & computer aided ordering (CAO)
• Full truck load economies	⇒ 3rd party logistics; assorted truckloads
• Random or correlated ordering	⇒ Regular delivery appointments

Shortage Gaming

• Proportional rationing scheme	⇒ Allocation based on past sales
• Ignorance of supply conditions	⇒ Shared capacity and supply information
• Unrestricted orders & free return policies	⇒ Flexibility limited over time; capacity reservations

Bullwhip Causes and Countermeasures

Fluctuating Prices

• High-low pricing	⇒ Every day low pricing (EDLP)
• Delivery & purchase not synchronized	⇒ Special purchase contract

Demand Signaling

• No visibility of end demand	⇒ Access point of sale (POS) data
• Multiple forecasts	⇒ Single control of replenishment or vendor managed inventory (VMI)
• Long lead time	⇒ Quick response or lead time reduction

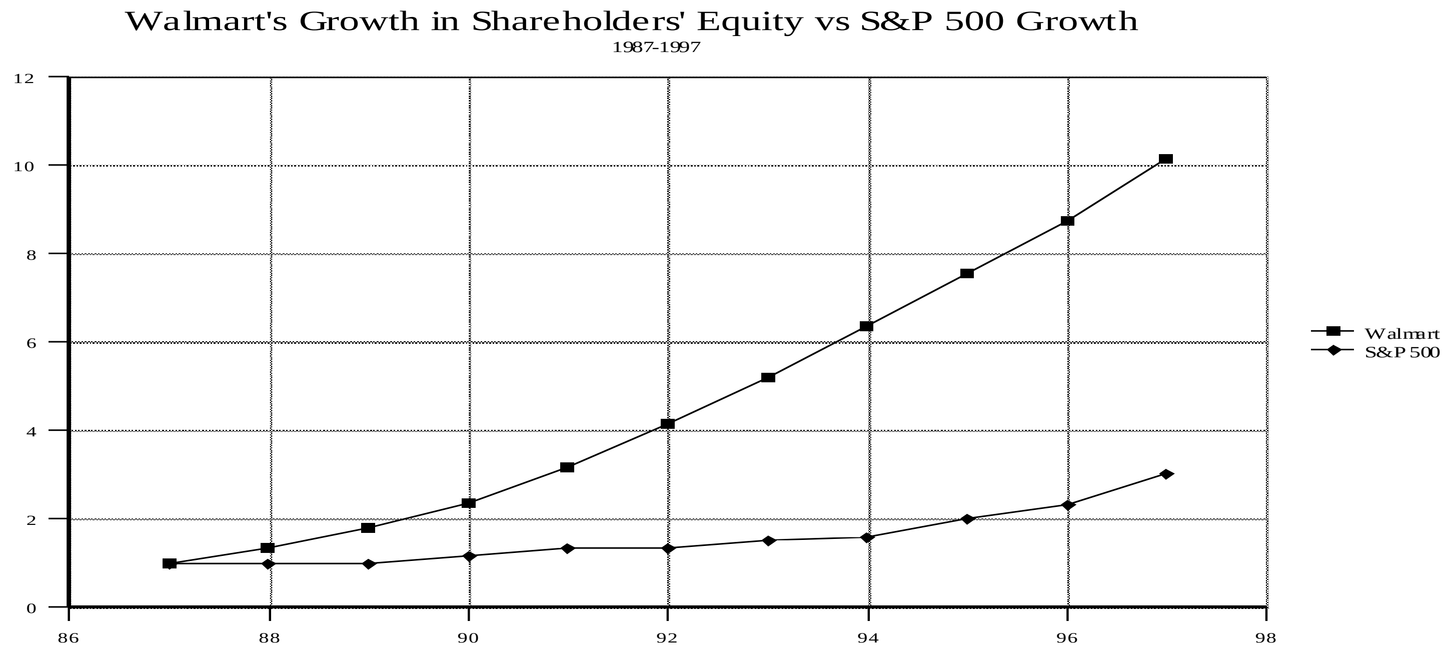
Vendor Managed Inventory (VMI)

- In a traditional supply chain, retailer would decide when and how much to order
- Under VMI, the supplier decides (instead of the retailer) on when and how much to replenish
- The retailer and the supplier mutually agree on an objective that the supplier will use to guide replenishment decisions
- The retailer shares point-of-sales data with the supplier
- Since the supplier acts as the sole decision maker, the incentive-misalignment problem is solved

Vendor Managed Inventory (VMI)

- Potential drawbacks
  - Retailers may know demand better than the suppliers
  - Under VMI, the retailer may not exert effort to sell more of the supplier's product
  - Instead the retailer may try to sell more of the competitor's product
- The next step: Collaborative Planning Forecasting and Replenishment (CPFR) Initiative

Wal-Mart's Phenomenal Success



At IPO: $1000 of Wal-Mart shares → Became worth $2M + dividends paid in 1993

Wal-Mart: 256 B sales in 2004 =IBM+HP+Dell+Microsoft+Cisco+2 B

Wal-Mart: Efficient Supply Chain

- Procurement
- Distribution
- Product Assortment
- Pricing

Supply Chain Performance Measures

- Cost
  - <u>Total Supply Chain Cost</u> is the sum of all supply chain costs for all products processed through a supply chain during a given period
  - <u>Inventory Turnover</u> is the ratio of the cost of goods sold to the value of average inventory.
  - <u>Weeks of inventory</u> is the ratio of average inventory to the average weekly sales
- Customer Service
  - <u>Average Response Time</u> is the sum of delays of ordering, processing, and transportation between the time an order is placed at a customer zone and the time the order arrives at the customer zone

What do these measures mean?

- Inventory Turnover: how often the company replenishes inventory. High value of inventory turnover means that the inventory was not sitting around a long time.

- Weeks of Supply: how many weeks worth of inventory does the company have on hand. High value of weeks of supply means that the firm has a lot of inventory sitting around.

Inventory Turns

Excerpts from financial statements of Kmart and Wal-Mart

Kmart	1998	1999	2000	2001	2002
Inventory	$6.367B	$6.536B	$6.350B	$5.796B	$4.825B
Tot.Revenue	$33.674B	$35.925B	$37.028B	$36.151B	$30.762B
COGS	$26.319B	$28.161B	$29.732B	$29.853B	$26.258B
Net Income	$0.518B	$0.364B	($0.268B)	($2.446B)	($3.219B)

Wal-Mart	1998	1999	2000	2001	2002
Inventory	$16.497B	$17.076B	$19.793B	$21.644B	$22.749B
Tot.Revenue	$117.958B	$137.634B	$165.013B	$191.329B	$217.799B
COGS	$93.438B	$108.725B	$129.664B	$150.255B	$171.562B
Net Income	$3.526B	$4.430B	$5.377B	$6.295B	$6.671B

Source: Matching Supply with Demand: An Introduction to Operations Management, Cachon and Terwiesch

Inventory Turns

$$\text{Inventory Turns} = \frac{\text{COGS}}{\text{Inventory}}$$

Inventory Turns for Kmart and Wal-Mart

	1998	1999	2000	2001	2002
Kmart	4.15	4.34	4.68	5.14	5.45
Wal-Mart	5.70	6.40	6.63	7.01	7.60

- Inventory Turns is a common benchmark in retailing
- Inventory Turns≈10 for grocery retailers (Safeway, Kroger), ≈1.5 for jewelry (Tiffany), ≈ 4 department stores (JCPenny)

Inventory Productivity

How long does it takes you to transform a dollar invested in inventory into sales (hopefully profitably)

Little's Law: $L=\lambda W$

Inventory = Flow Rate x Flow Time

What is the flow rate? COGS

Flow Times for Kmart and Wal-Mart

	1998	1999	2000	2001	2002
Kmart	88 days	84 days	78 days	71 days	67 days
Wal-Mart	64 days	57 days	55 days	52 days	48 days

Efficient S. Chain: Procurement

- In 90s, Wal-Mart began to bypass wholesalers
- Expanded private label business (used unbranded suppliers)
- Build partnerships with many suppliers
- Retail Link: suppliers could access POS and inventory
  - What are the benefits?
- Example: Wal-Mart and P&G partnership (JIT II)

Wal-Mart and P&G Partnership

THE WALL STREET JOURNAL.

Consumer-Products Giant Helps Huge Retailer Make Specialty Items Mainstream, Jan 31, 2005

Early on, P&G employees, who relocated to Fayetteville to be close to Wal-Mart, called their adopted home Fayette-nam, and often griped about Wal-Mart's demands. Still, P&G and Wal-Mart came up with specific goals. In their first collaboration, Wal-Mart complained that Pampers diapers sat for too long in its warehouses, costing it money. Wal-Mart buyers were shipping diapers from the factory every two weeks. After gaining access to Wal-Mart's sales data, P&G assigned one manager to monitor the data and order just enough Pampers to meet sales but not too much so that the diapers sat in the warehouse.

Efficient S. Chain: Distribution

- At the end of 2003: 84 Wal-Mart DCs
- DC's functioned as the hubs in a hub-and-spoke network
- Distribution costs accounted for 2-3% of Wal-Mart's revenues compared to 4-5% for other retailers
- Wal-Mart mastered large scale "Cross Docking"
- Automation of distribution: RFID technology
- Inventory turns were a key measure of the overall performance of the supply chain

Efficient S. Chain: Product Assortment

- Stocked mix of nationally branded and private label products
  - What are the pros and cons of nationally branded and private label products?
- Product assortment managed by store ⇒ more variety
  - What are the pros and cons of offering more variety?
  - Pro: More variety than competitors ⇒ customer satisfaction
  - Con: More variety than competitors ⇒ higher costs

Pricing Strategy: EDLP

THE WALL STREET JOURNAL.

How Wal-Mart Got Ready Early, Nov 28, 2005

Another aggressive move: Wal-Mart announced early last week that it would match competitors' prices on promoted items -- even the after-rebate price -- provided Wal-Mart had the identical item in stock. While this isn't a new policy for Wal-Mart, it was the first time the company repeatedly advertised it. "By reminding people we match prices, shoppers will know they don't have to run around." said Mr. [Sonny Littlefield], the Arlington store manager.

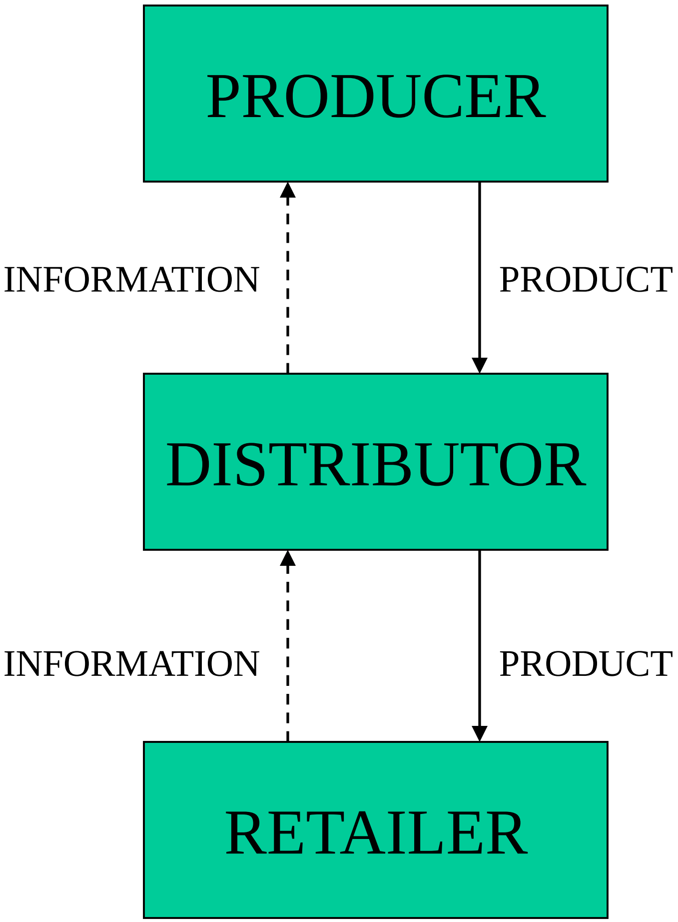
WAL★MART ALWAYS LOW PRICES. Always

- Wal-Mart: every day low price (EDLP) retailer
  - What are the advantages of EDLP?
- Store managers allowed to match or beat the lowest competing price
- What is really allowing Wal-Mart to have lowest prices?

Wal-Mart: Market Position

- First: Small town rural strategy
  - Only 55% compete directly with Kmart and 23% with Target
  - Have displaced small local merchants
  - Only competition is the Wal-Mart in the next town
- Second: Clearly defined competitive position: emphasis on nationally branded products and EDLP
  - Reinforce EDLP by posting competitors' prices weekly

Traditional vertically disintegrated supply chain



Role of the Distributor

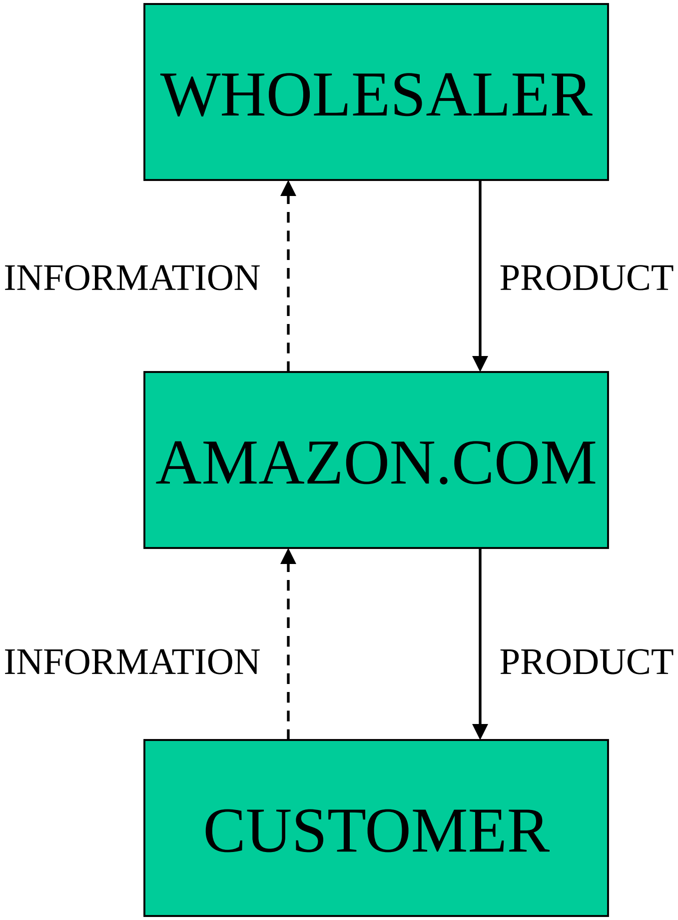
- Central purchasing for small and independent retail locations
- Quick replenishment for retail locations (daily orders)
- One-stop shopping for retailers: avoids dealing with multiple manufacturers
- Local presence
- Stocking large number of manufacturer SKUs
- Breaking the bulk
- Single-point contact

Role of the Store

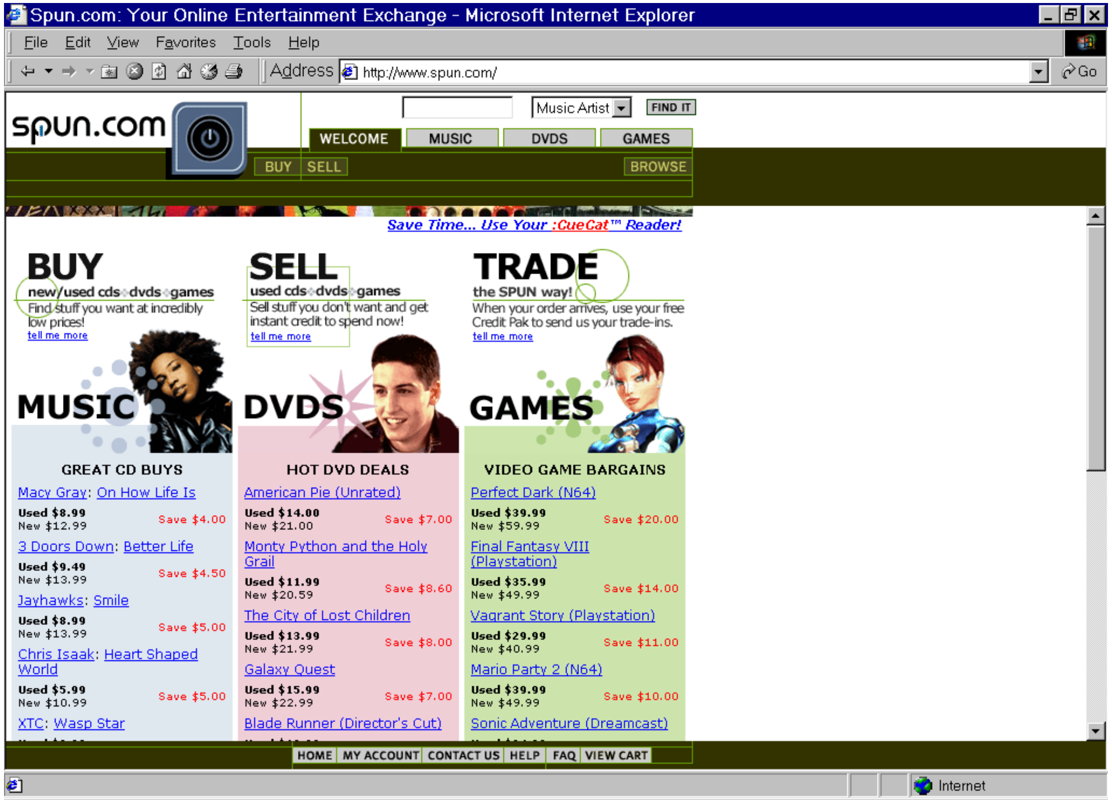
- One-stop-shop experience for customers
- Demand satisfied immediately
- Break bulk for customers
- Customer can inspect and try the good

Supply Chain Structures on Internet

Traditional vertically disintegrated channel



Meet Spun.com



Cheap tricks*

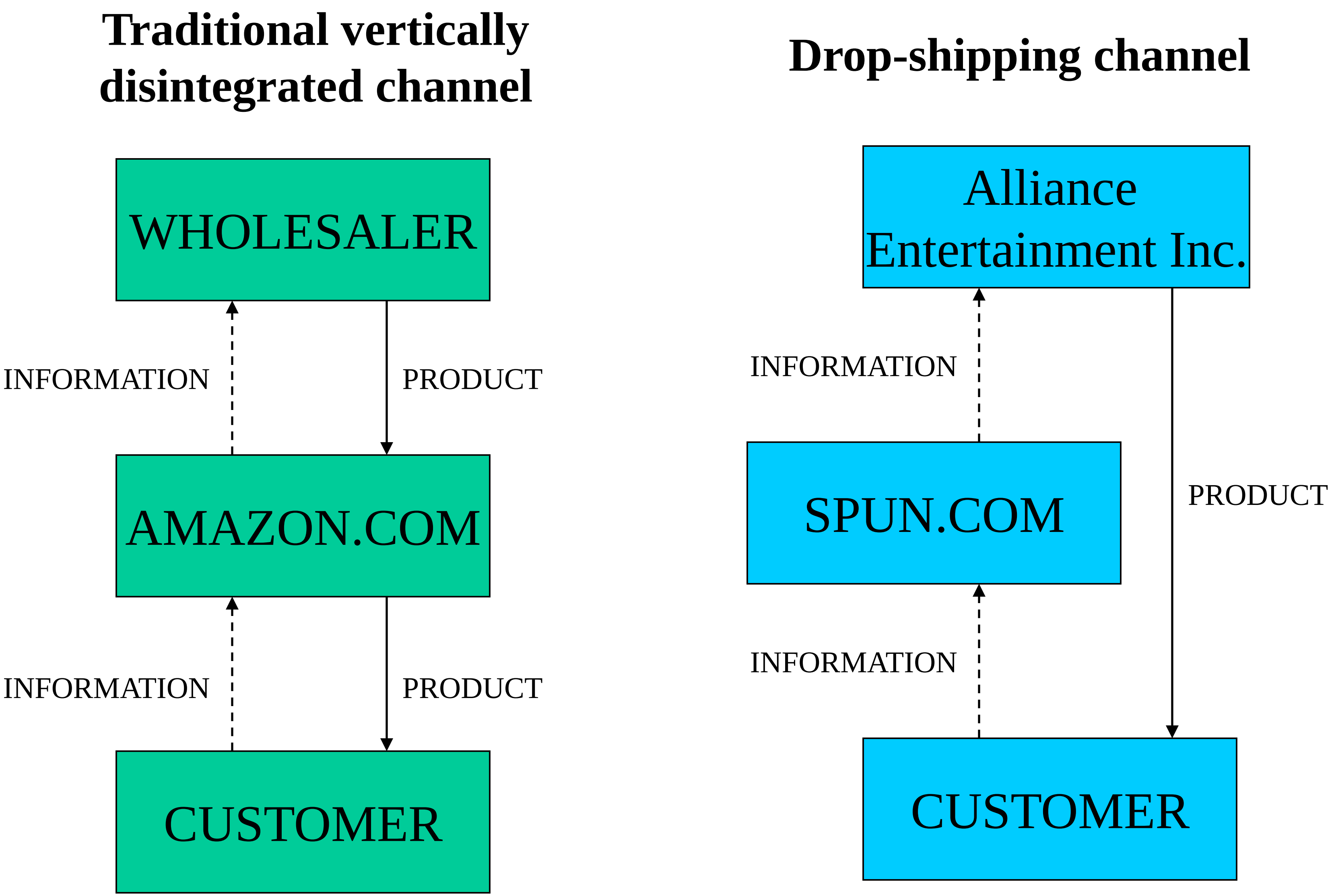
- •Start-up capital: $825,000
- •200,000 CD titles available for immediate shipment
- •No inventory

Other Retailers: Proflowers.com, Zappos.com, Outpost.com, …

Other Wholesalers: Baker & Taylor, Ingram, etc.

*Forbes, February 21, 2000, 116

Supply Chain Structures on Internet



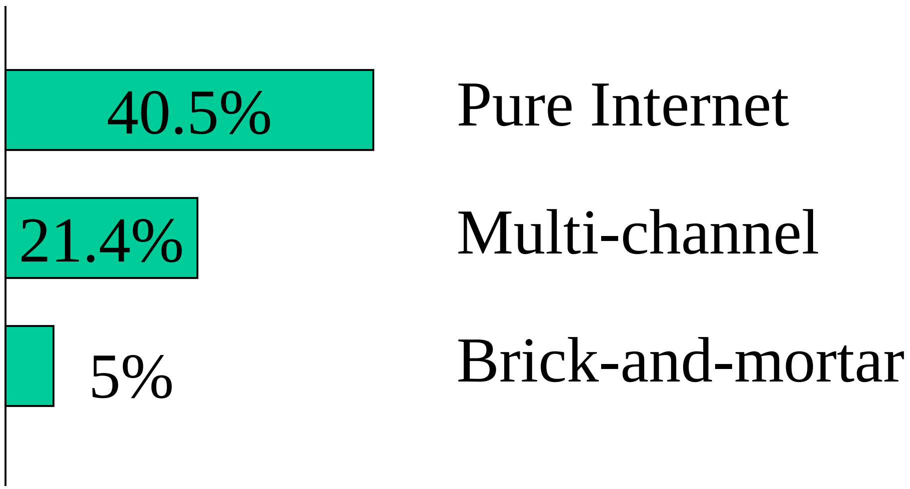
Drop-Shipping in a Click World*

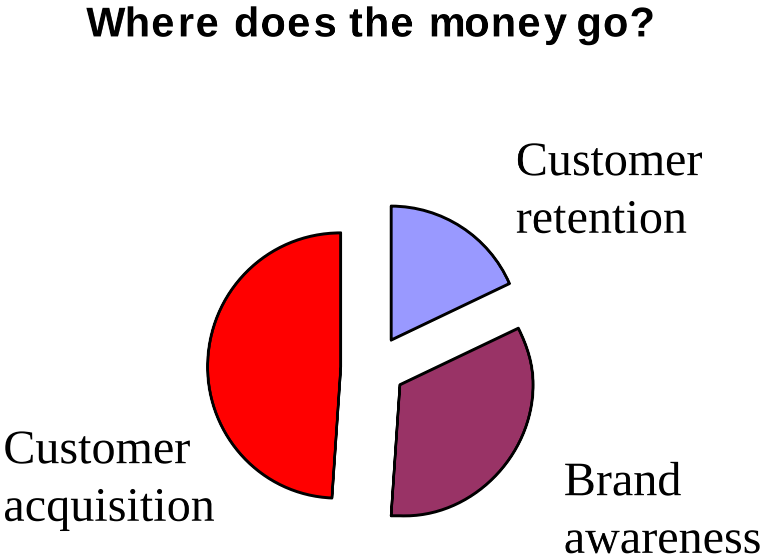
Primary way company fulfills online orders	Type of retailer	
	Internet-only	Multi-channel (on-line plus brick)
From company facility that existed	13.9%	61.5%
From company facility that was developed	30.6%	10.3%
Drop-shipped	**30.6%**	**5.1%**
Outsourced	8.3%	17.9%
From facility operated by a partner	8.3%	2.6%
Electronic fulfillment (software)	5.6%	0%
Other	2.7%	2.6%

*The state of eRetailing 2000. Supplement to "eRetailing World" March 2000.

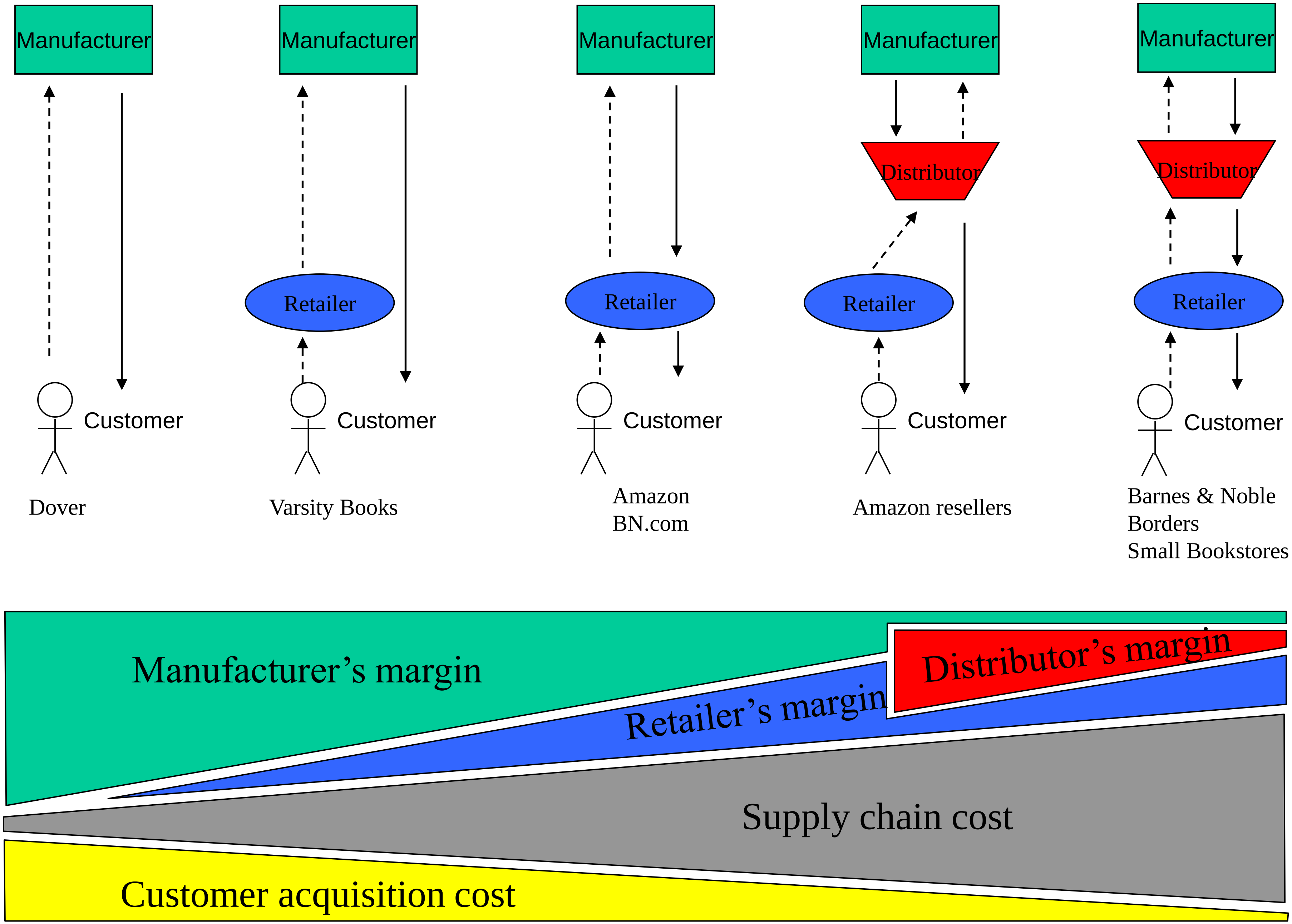
Marketing expenditure of the Internet Retailer

Marketing budget as % of sales



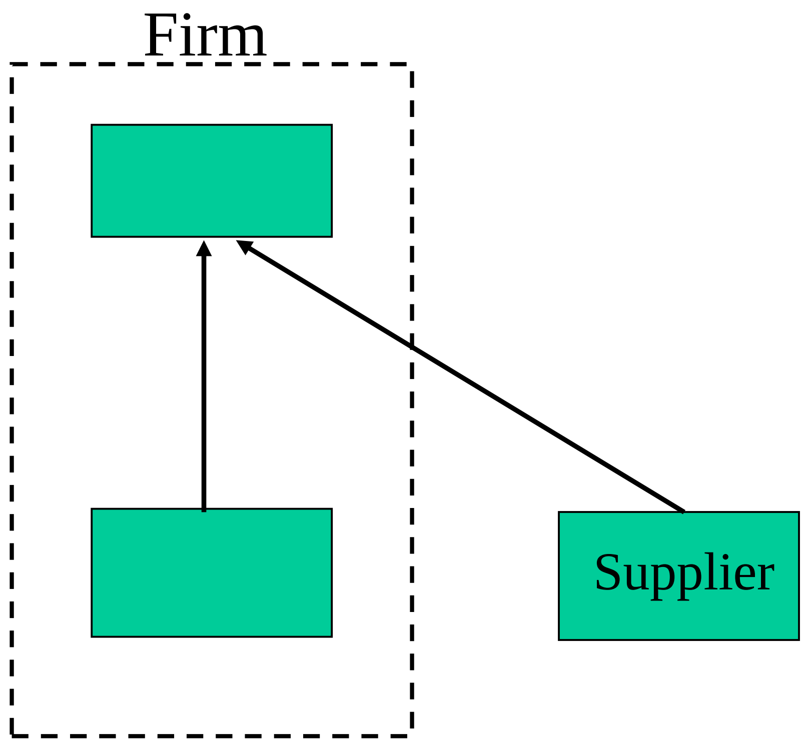


Supply Chain Alternatives



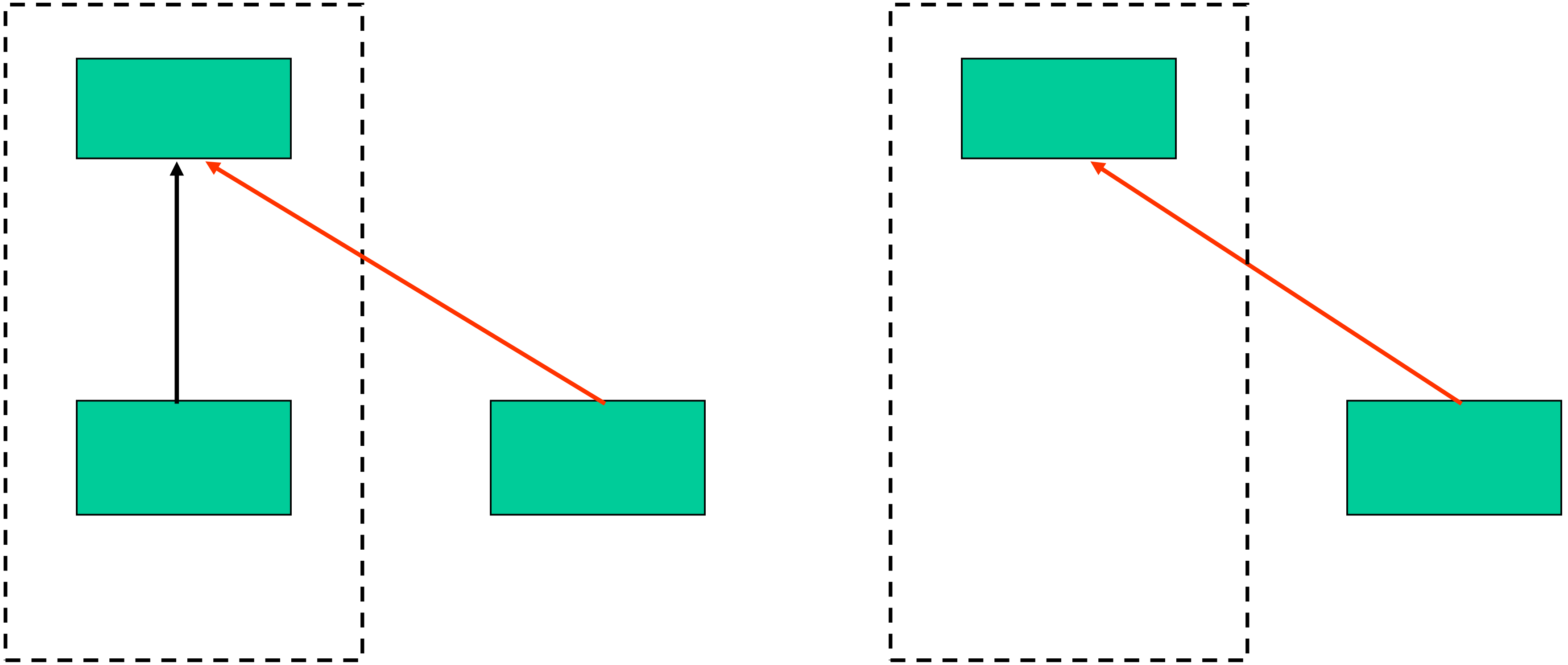
Outsourcing

Outsourcing: moving some of the firms internal activities and decisions to outside providers



Question: When should the firm outsource activities?

Outsourcing



A firm may outsource some of its activities…

… or the whole of it!

Examples of outsourcing

- Toshiba has outsourced manufacturing to Solectron
- GM has outsourced its interior design to Delphi
- Many firms outsource problem solving to McKinsey & Co.
- Advertising is often outsourced completely.
- Many companies outsource logistics and transportation.

Why do firms outsource?

- Organizational reasons
  - Focus on service
  - Focus on core capabilities
  - Transform the organization
  - Increase flexibility

- Operational reasons
  - Improve performance (quality, productivity, etc.)
  - Obtain expertise, skill, and technology
  - Risk management

Why do firms outsource?

- Financial reasons
  - Transfer assets to the outsourcing partner.
  - Free up resources for investment in other purposes.
- Cost driven reasons
  - Transform fixed costs into variable costs.
  - Reduce costs through outsourcing partner efficiencies.
- Revenue driven reasons
  - Expand and grow with the help of another organization.
  - Obtain access to outsourcing partner's network.

Global Sourcing

- Current trend in manufacturing
- Effort to reduce production costs by switching production to low costs regions (operational reason)
- Exploit the variability in foreign exchange rate (financial reason)

Some examples….

- BMW produces the Z3 in South Carolina
- HP manufactures printers in Taiwan
- Software firms are producing code in India
- Nike produces shoes in China