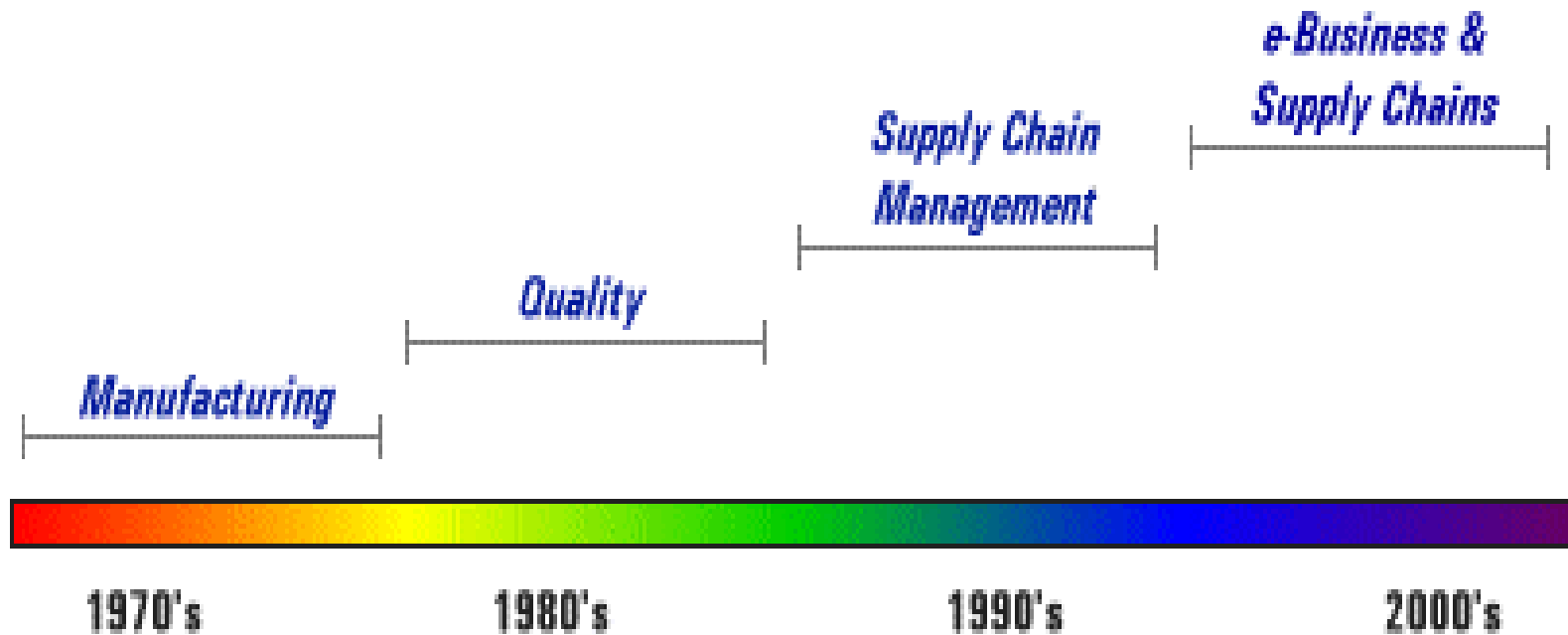


# Supply Chain Management

# Business Trends

## Business Initiative Trends in Manufacturing



# What is a Supply Chain ?

- All activities associated with the flow and transformation of goods from raw materials to end users.
- The term supply chain refers to the entire network of companies that work together to design, produce, deliver, and service products.
- A network of facilities including:
  - Material flow from suppliers and their “**upstream**” suppliers at all levels,
  - Transformation of materials into semi-finished and finished products (**internal process**)
  - Distribution of products to customers and their “**downstream**” customers at all levels.

# Components of the Supply Chain

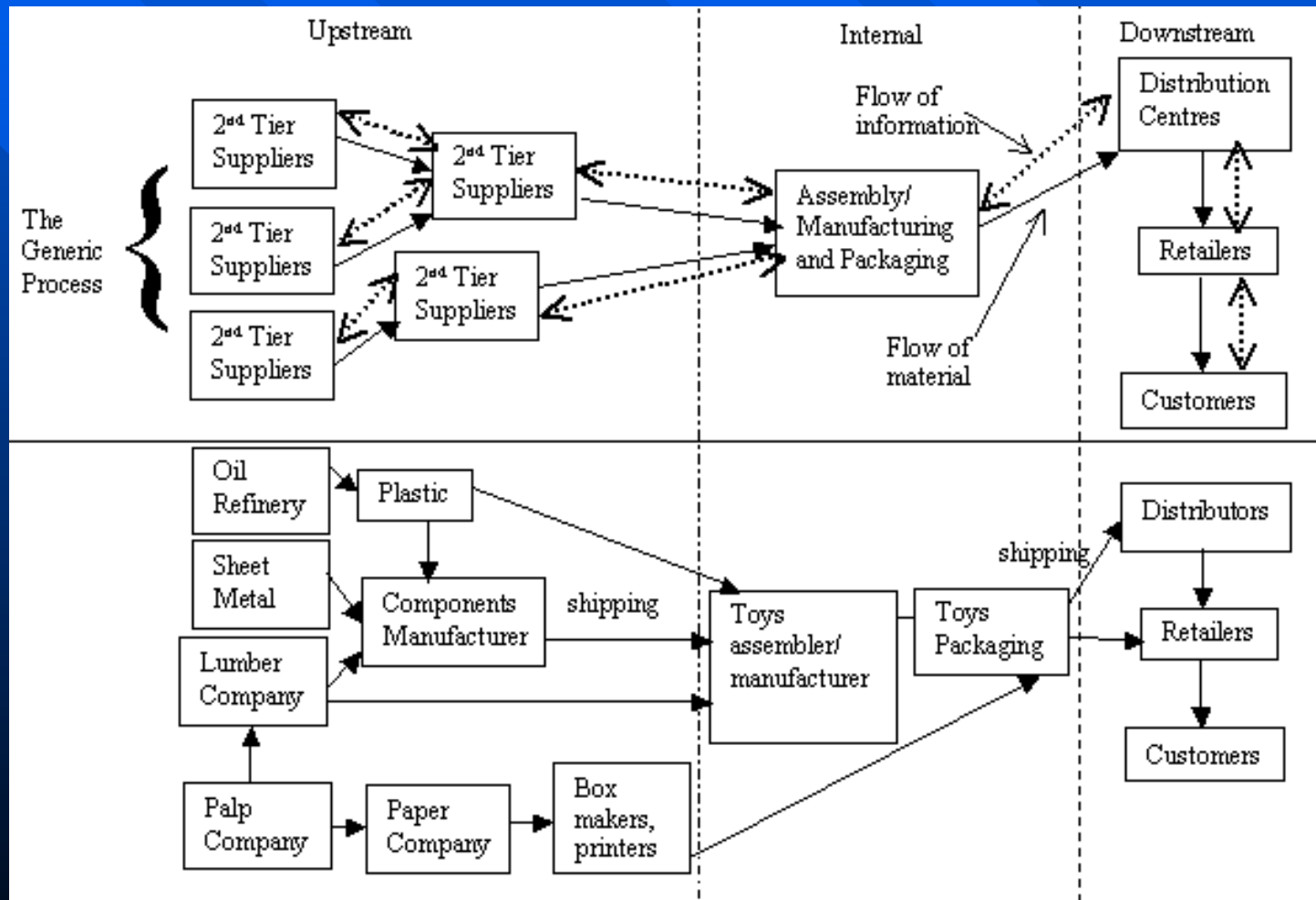
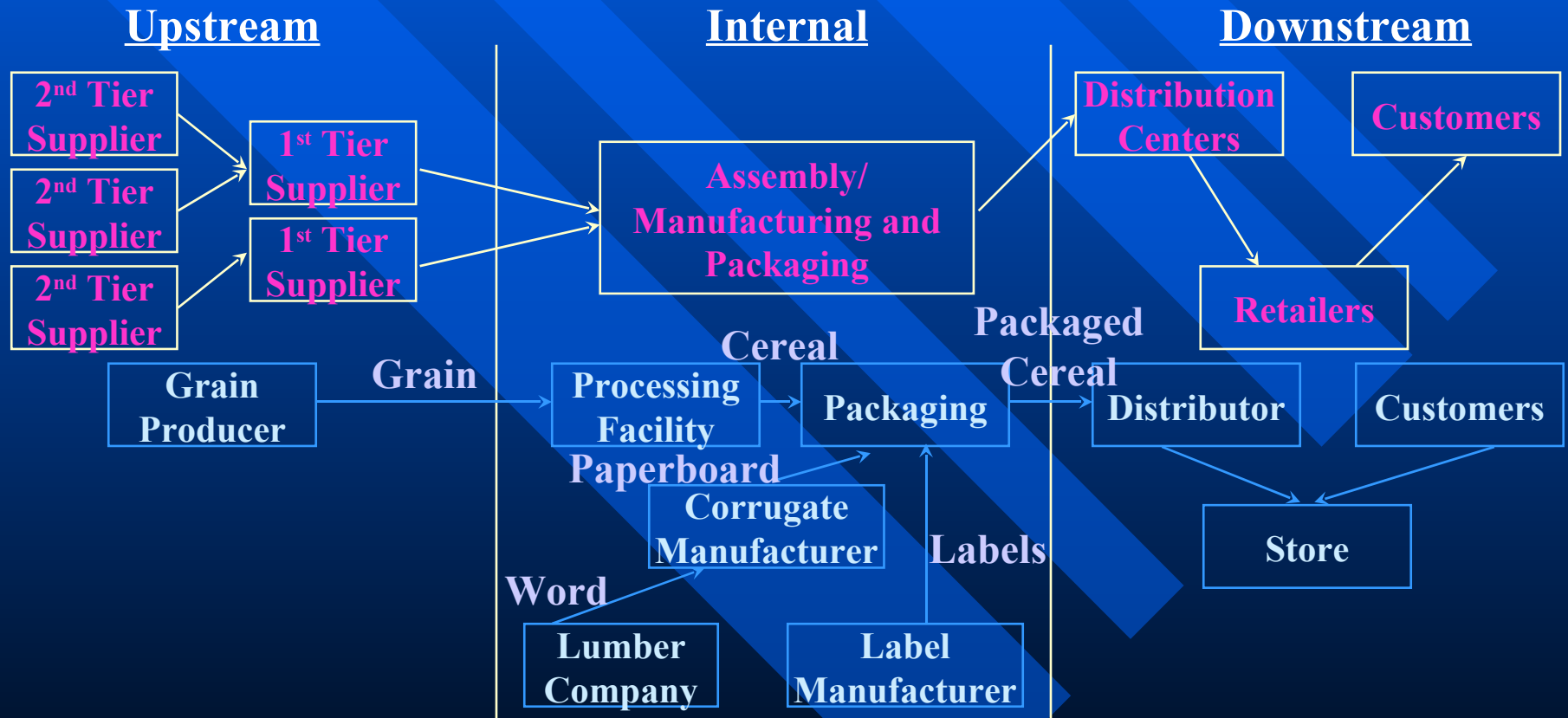
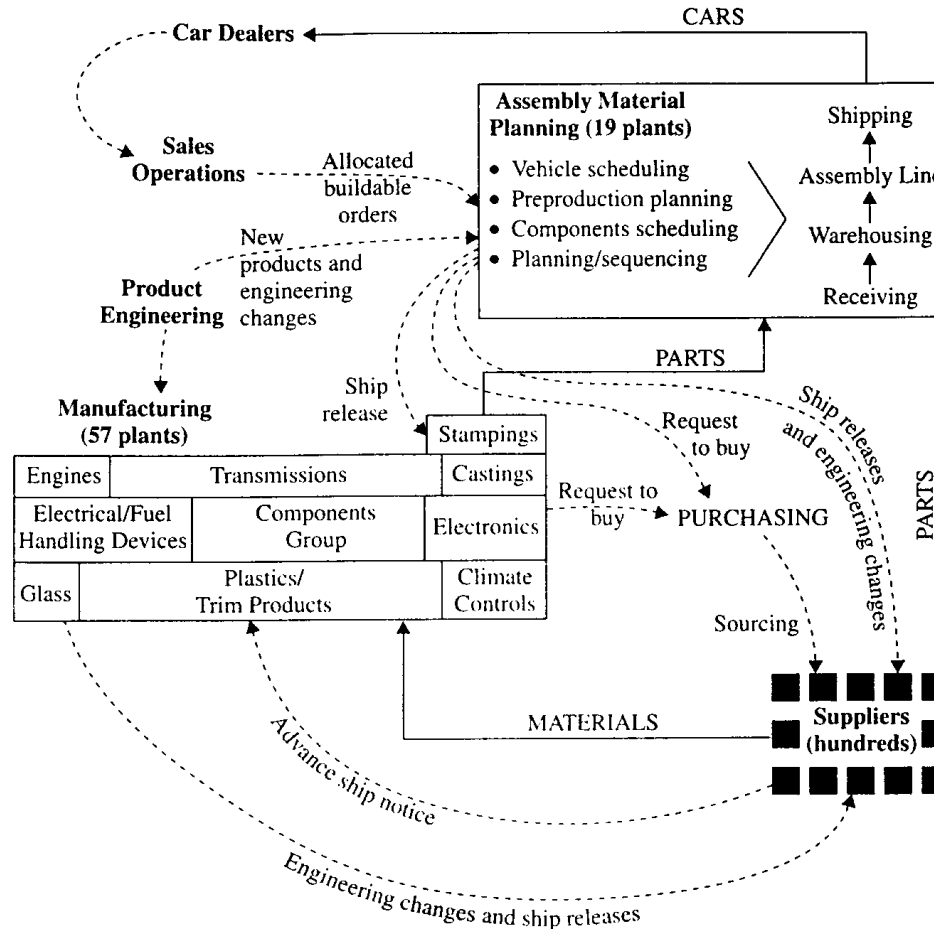


Fig. 13.3 Supply Chains of Toys Making (--- = information)

# Example of SC



# Complex-nonlinear Supply Chain



**FIGURE 13.4** An Automotive Supply Chain

Source: Modified from Handfield and Nichols F. (1999) pg. 3

# Three Flows in SC

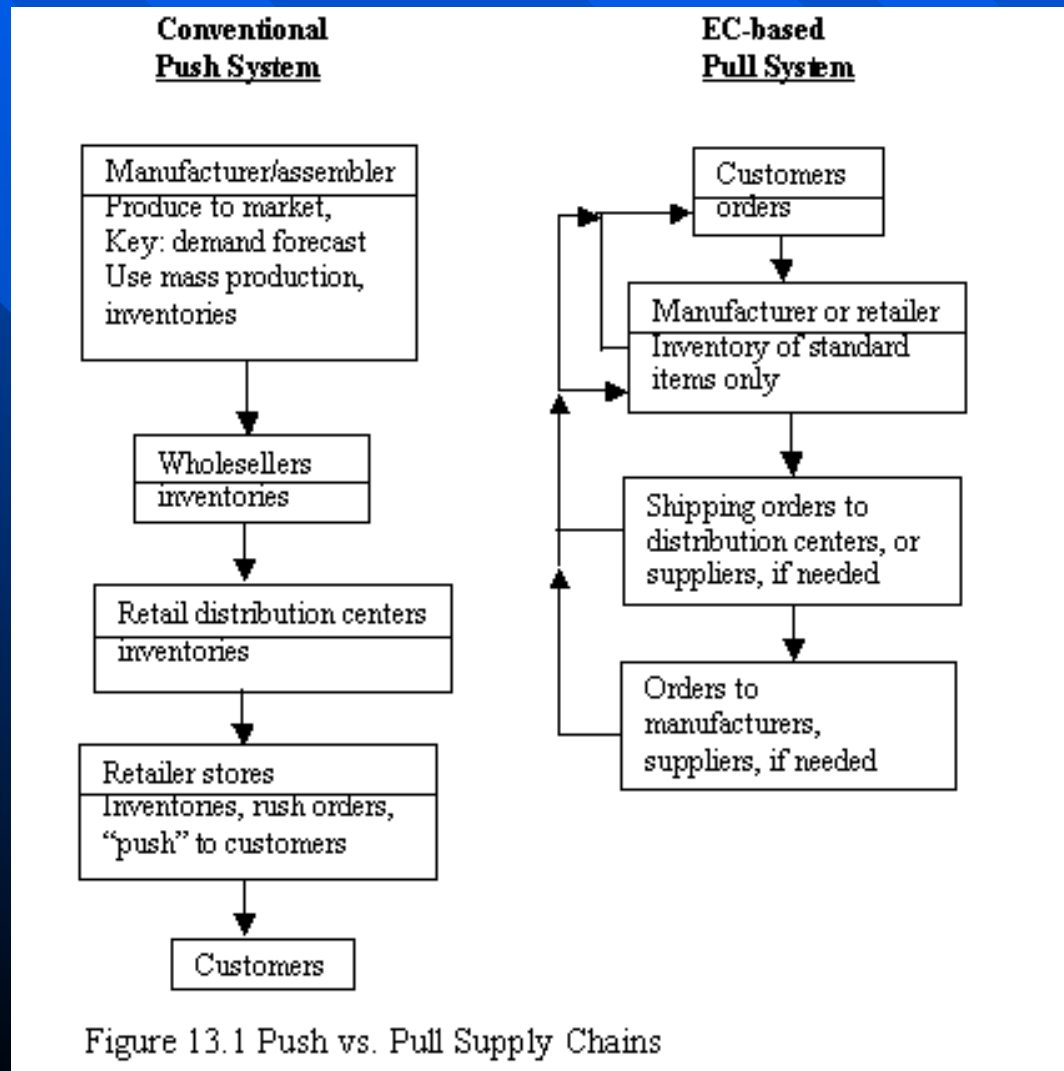
- There are three kinds of flows in a supply chain: **material, information, capital.**
- Downstream
  - Material: Products, Parts
  - Information: Capacity, Delivery Schedules
  - Finance: Invoices, Pricing, Credit Terms
- Upstream
  - Material: Returns, Repairs, After-sales Services
  - Information: Orders, Point-of-sale Data
  - Finance: Payments

# Push vs. Pull in supply chains

- *Push or Building-to-stock(BTS)*: Producing stock on the basis of anticipated demand. Demand forecasting can be done via a variety of sophisticated techniques (some from the Operations Research area and some using Data Mining).
- *Pull or Building-to-order(BTO)*: Producing stock in response to actual demand (firm orders).
- *The Push-Pull Point*: In many supply chains, upstream units employ BTS, while downstream units employ BTO strategies. The point in the supply chain where the switch-over (from BTS to BTO) occurs is called the Push-Pull point.
- Optimally locating the Push-Pull point is a key determinant of supply chain performance.
  - Examples ?



# The Push vs. Pull Model

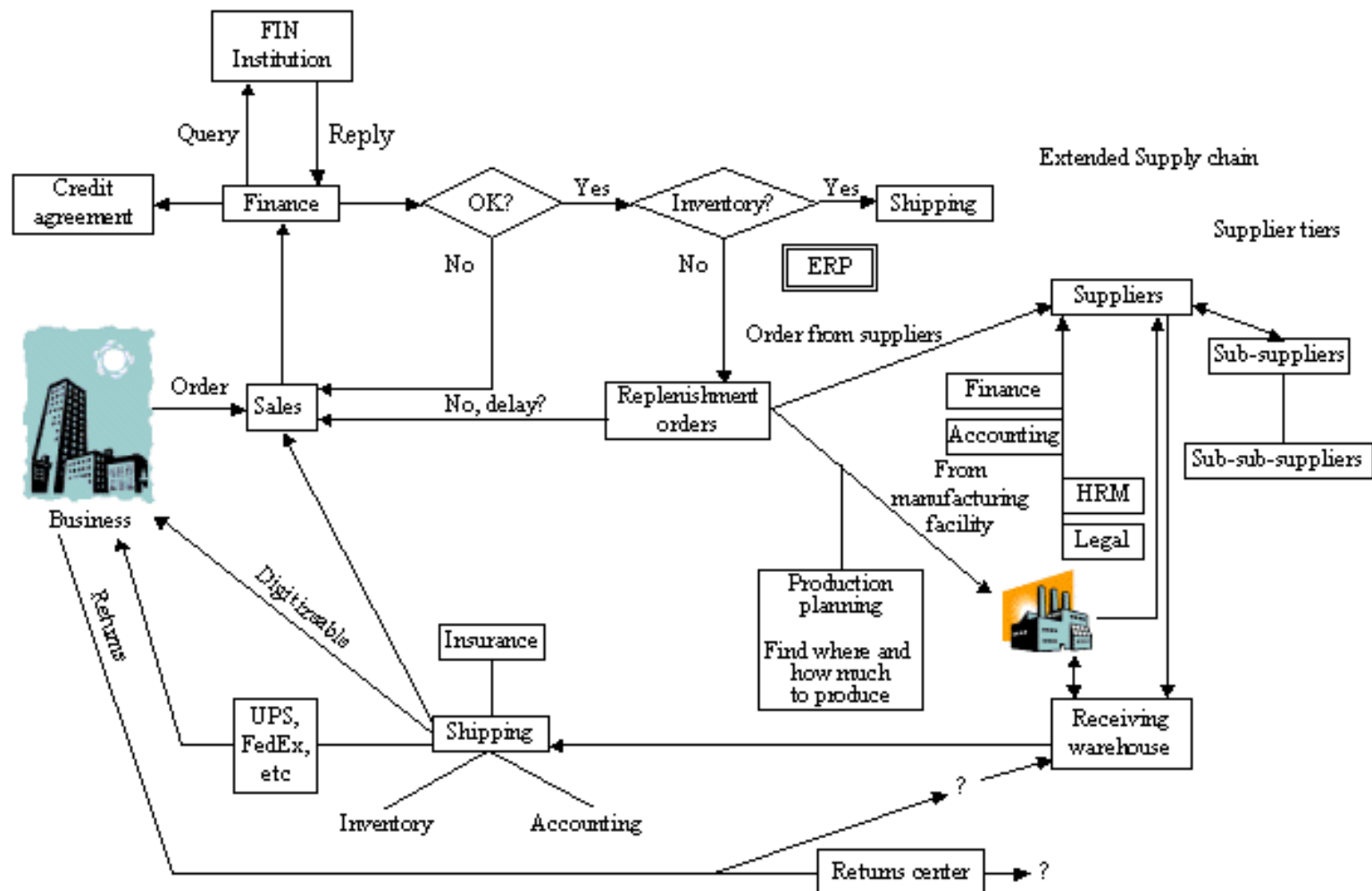


# Major Concepts

- Order fulfillment
  - Deliver right order on time
- Front office operations: order taking, advertisement, CRM
- Back office operations: Accounting, finance, inventor, packaging, logistics
- Logistics: Managing the flow of goods, information and money along the supply chain

# The Process of Order Fulfillment

Fig. 13.2 Order Fulfillment and Logistic System



# The Steps of Order Fulfillment

1. Payment Clearance
2. In-stock availability
3. Packaging, shipment
4. Insuring
5. Production (planning, execution)
6. Plant services
7. Purchasing, warehousing
8. Demand forecast
9. Accounting, billing
10. Customer contacts
11. Returns (Reverse logistics)

# Supply Chain Management (SCM)

- A set of processes and sub-processes which attempt to implement and optimize the functions, connected entities, and interacting elements of a supply chain.
- Involves:
  - Organizations, procedures, people.
  - Activities: Purchasing, delivery, packaging, checking, warehousing, etc.
  - Establishment of long-term relationships with suppliers (supply alliances) and distributors
  - Effective flow of information through the supply chain
  - *Supply chain optimization*

# Key Business Areas

- Enterprise performance
- Customer service
- Order management
- Demand planning
- Warehouse distribution
- Partnerships
- Supplier/supply base management

# Benefits of SCM

- Reduce uncertainty along the chain
- Proper inventory levels in the chain
- Minimize delays
- Eliminate rush (unplanned) activities
- Provide good customer service

# Global Supply Chain

- Can be very long
- Possible cross-border problems
- Need information technology support for:
  - communication and collaboration
- Possible delays due to: customs, tax, translations, politics



# Problems along the Supply Chain

- Delays in production, distribution etc.
- Expensive Inventories
- Lack of partners' coordination
- Uncertainties in deliveries
- Poor demand forecast
- Interference with production
- Poor quality

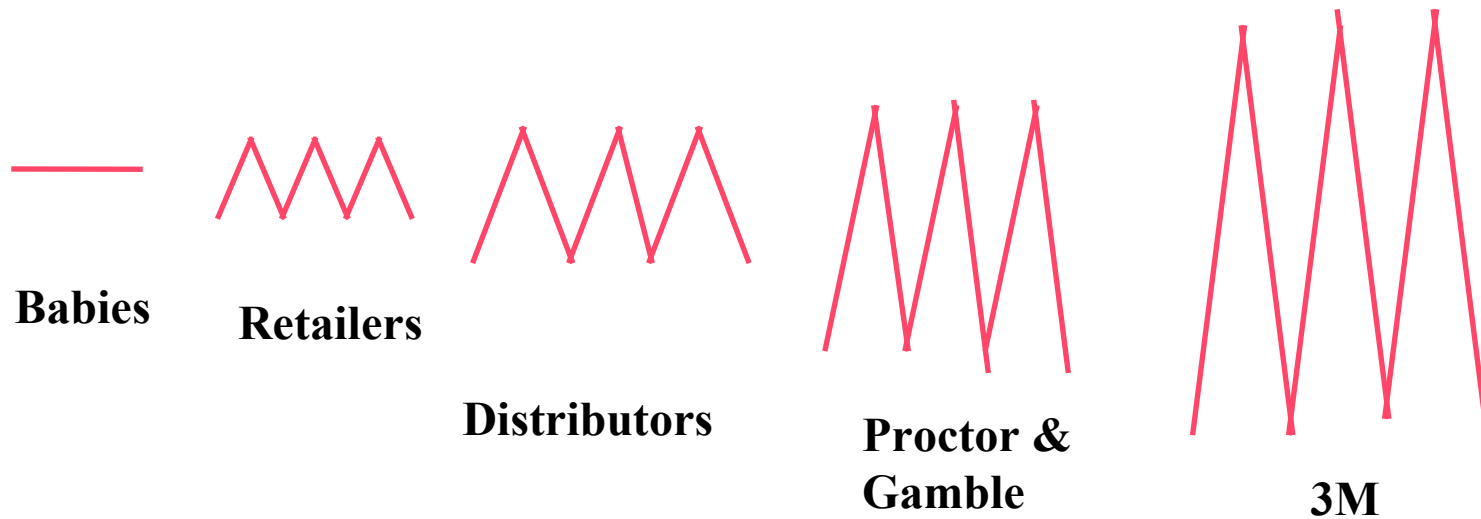
# More Challenges

- Complexity of the supply chain network
  - e.g. large numbers of suppliers and distributors
- Complexity in product structure and manufacturing process
  - How much product differentiation/ customization/ localization should be supported ?
  - Where do you customize a product (upstream or downstream) ?
- decentralized control/organizational "silos"
- increasing pressure for customer service and asset utilization

# Variability in the supply chain

- Demand variability
  - Even the most sophisticated demand forecasting tools often fail to anticipate demand
  - Examples of demand variability problems ?
- Process variability
  - Production unit downtimes
  - Unexpected staff absences
- Supply variability
  - e.g., late deliveries from suppliers

# The Bullwhip Effect



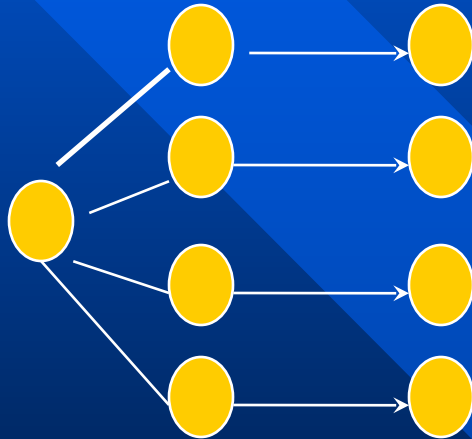
- Slight changes in actual demand create problems

# Common Causes of the Bullwhip Effect

- Demand forecast mismatches
  - Demand forecasting distributed across units in the supply chain
- Order Batching
  - Sometimes helps achieve economies of scale
- Price Fluctuations
  - “forward buy” inducements through lower prices
- Others:
  - partners build “just in case” inventories
  - lack of trust among partners
  - cannot order material from suppliers

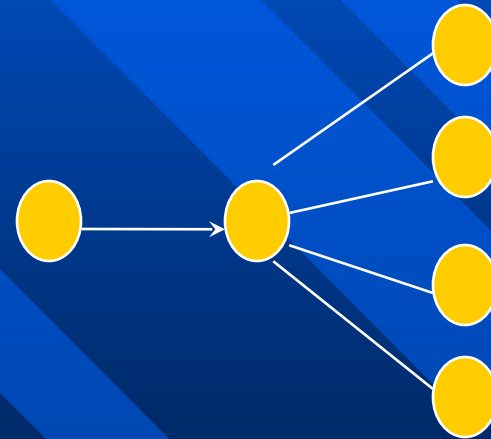
# Product design

*Upstream differentiation*



- The product is built for a specific market before it is shipped out of the factory

*Downstream differentiation*



- The product has been designed so that localization (or customization or differentiation) can occur as close as possible to the local market.

Example: The Hewlett-Packard Deskjet Printer.  
*How might you localize ?*

# Technology in the SC

- The internet and the web can be very effective communication enhancers
- Software includes **demand forecasting tools** and **planning tools** to allow all SC members to coordinate their activities and adjust their production levels.
- Software can allow members to:
  - review past performance
  - monitor current performance
  - predict future production levels of products.

# Web SCM

- Share information about consumer demand
- Receive rapid notification of product design changes and adjustments
- Provides specs and drawings more efficiently.
- Increase speed of processing transactions.
- Reduce cost of handling transactions.
- Reduce errors in entering transaction data
- Share information about defect rates and types.



# Example 1: Cisco

- Making use of the internet in its own supply chain.
- Products are manufactured by contract manufacturers (CM)
- Integrated well with both its CM's and its component suppliers.
- Communicates a single forecast through both levels of suppliers, reducing the bullwhip effect.
- Display their product and component requirements to their entire chain.

# Example 1: Benefits for Cisco

- Eliminated paper purchase orders and invoices
- Communicate engineering change orders electronically to all partners
- 90% of sales are made over the internet
- US\$875 million annual internet savings (more than 50% due to SC initiatives)
- Lead times reduced 75%
- Low manufacturing manpower requirements despite rapid growth
- Cost reductions of 20%-28% every year.

# Example 2: Dell

- Create “Virtual integration” : the entire supply chain acts like a single integrated company.
  - Upstream partners: contract manufacturers (CM) and component suppliers
  - Downstream partners/customers (most are business corporations)
- Share information with suppliers on inventory levels.
- Maintain long-term relationships with key suppliers for design collaboration.

# Example 2: Benefits for Dell

- Dell and Suppliers work together as a “Virtual Enterprise”
- BTO benefits (low inventory)
- Dynamic pricing: change prices rapidly in response to demand and availability
- Strong links to corporate customers

# Example 3: Covisint

## ■ B2B Supply Chain Benefits

- Automated procurement
  - » lower procurement costs
  - » lower inventories
- Collaboration:
  - » complete visibility
  - » less bullwhip
- Efficient market
  - » More profits
- Sell unused capacity

# Supply chain integration:

## Benefits

- Tangible benefits
  - Inventory reduction, personnel reduction, productivity improvement, order management improvement, financial cycle improvements.
- Intangible benefits
  - Information visibility, new / improved processes, customer responsiveness, standardization, flexibility, globalization, and business performance.

# Evolution of Software Integration

- Completely Independent of each other
- **MRP**= Material Requirements Planning:
  - Inventory, production
- **MRPII**=Manufacturing Requirements Planning
  - more integrated, MRP+Finance+labor
- **ERP**=Enterprise Resources Planning
  - All functional areas
- **Extended ERP**=Include suppliers, customers

# MRP Core Concepts

- Key questions:
  - How much of an item is needed to meet demand? When?
  - What parts and components are required? When?
  - When to order parts and components?
- Dependent demand
  - production (or procurement) of parts and materials is directly linked to demand for the final product.
- Time-phased scheduling
  - parts and components must be ordered in advance to accommodate lead times between order placement and receipt.



# Enterprise Resource Planning (ERP)

- **ERP** = Integrating business processes and activities in real time
- Solves many supply chain problems
- Necessary for medium to large corporations
- May be useful for SMEs too
- Need to interface with EC order taking system
- Manages all routine transactions in the Enterprise

# Post ERP (2nd Generation)

- 1st generation - transaction processing orientation
- 2nd generation
  - including decision making capabilities
  - EC requires decision support
  - EC requires business intelligence
- SCM software: Production Planning, Manpower utilization, Profitability models, market analysis.
- Integration of SCM capabilities
- Other added functionalities: CRM, KM

# ASP

- Leasing information systems application
- Back to the days of “time sharing”
- A risk prevention strategy
- Very popular with ERP (expensive, cumbersome)

# Supply chain *optimization*

- Business objective: improve supply chain efficiency (velocity ?), optimize operation of the supply chain
- Metrics for efficiency - what do we optimize ?
  - Define the problem in terms of *decision variables*
  - Define an *objective function* in terms of the decision variables. The goal would be to *maximize* or *minimize* the value of this function, i.e., to find an allocation of values to the decision variables such that the value of this function is either maximized or minimized.
  - Supply chain optimization is the continuous process of seeking optimal allocations of values to decision variables

# Common optimization problems:

## I

- *Long-term planning* (time-frame: several months/years):
  - Questions:
    - » How much of each product type should I manufacture ? When ? Where ? (Assumes a network of manufacturing centers with potential duplication of manufacturing capability)
    - » How much should I keep in inventory (both for manufacturing inputs and outputs) ? Where ? (Assumes a distributed network of warehouses)
  - Constraints:
    - » Capacity constraints (both manufacturing and inventory)
    - » Demand profile
    - » Process constraints (downtimes, planned outages)
    - » Supply variability
  - Objectives: Profit/revenue maximization, maximizing asset utilization, minimization of deviation from demand profile, minimization of deviation from target inventory profile

# Common optimization problems: II

- *Medium-term planning/scheduling* (time-frame: a few months/weeks):
  - Similar to long-term planning, but with scheduling constraints and objectives added
- *Unit scheduling/reactive scheduling*:
  - Questions:
    - » In what sequence should orders/jobs be manufactured ? Which job should I process on a given production unit at a given point in time ? Should I go into overtime ?
  - Constraints:
    - » Capacity constraints
    - » Sequencing constraints
    - » Orders + deadlines
    - » Process constraints (downtimes etc.)
  - Objectives: Minimize makespan (i.e., maximize asset utilization), minimize deviation from order deadlines, maximize profit/revenue

# Common optimization problems: III

- *Shipping:*
  - How do I allocate orders to trucks ?
  - What routes should trucks travel on ?
  - How do I allocate truck to routes ?

# Major classes of optimization techniques:

- From the field of operations research (OR)
  - Linear programming
  - Integer programming....
- From the field of artificial intelligence (AI)
  - Constraint programming
  - Heuristic search techniques



# Supply Chain Mgt. Software

- Includes demand forecasting tools and planning capabilities to allow all supply chain members to coordinate their activities and adjust their production levels
- Firms offering SCM software:
  - i2 Technologies RHYTHM
  - Manugistics

# Purchasing, Logistics & Support Software

- **Enterprise Resource Planning** (ERP) software is designed to integrate manufacturing, finance, distribution, and other internal business functions into one information system
- Major ERP vendors include -
  - Baan
  - J.D. Edwards
  - Oracle
  - PeopleSoft
  - SAP

# B2B E-Commerce Software

- Designed to help companies build Web sites that host:
  - Catalog
  - Marketplace and
  - other commercial sales activities
- Major software packages include:
  - Netscape - SellerXpert & ECXpert,
  - OpenMarket Transact, IBM's Websphere.
  - MS Site Server, and Ariba

The end

Questions?