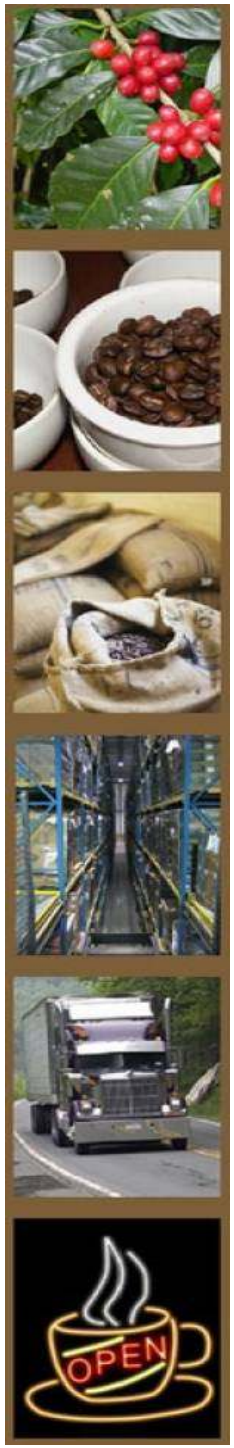
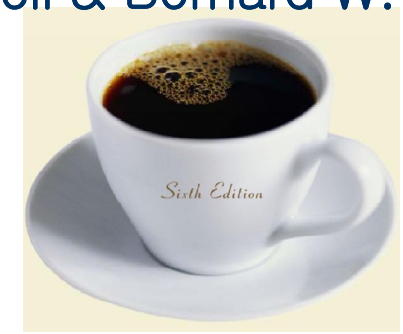


Chapter 6

Processes and Technology

Operations Management - 6th Edition

Roberta Russell & Bernard W. Taylor, III



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Lecture Outline

- Process Planning
- Process Analysis
- Process Innovation
- Technology Decisions

Process Planning

- Process
  - a group of related tasks with specific inputs and outputs
- Process design
  - what tasks need to be done and how they are coordinated among functions, people, and organizations
- Process strategy
  - an organization's overall approach for physically producing goods and services
- Process planning
  - converts designs into workable instructions for manufacture or delivery

Process Strategy

- Vertical integration
  - extent to which firm will produce inputs and control outputs of each stage of production process
- Capital intensity
  - mix of capital (i.e., equipment, automation) and labor resources used in production process
- Process flexibility
  - ease with which resources can be adjusted in response to changes in demand, technology, products or services, and resource availability
- Customer involvement
  - role of customer in production process

Outsourcing

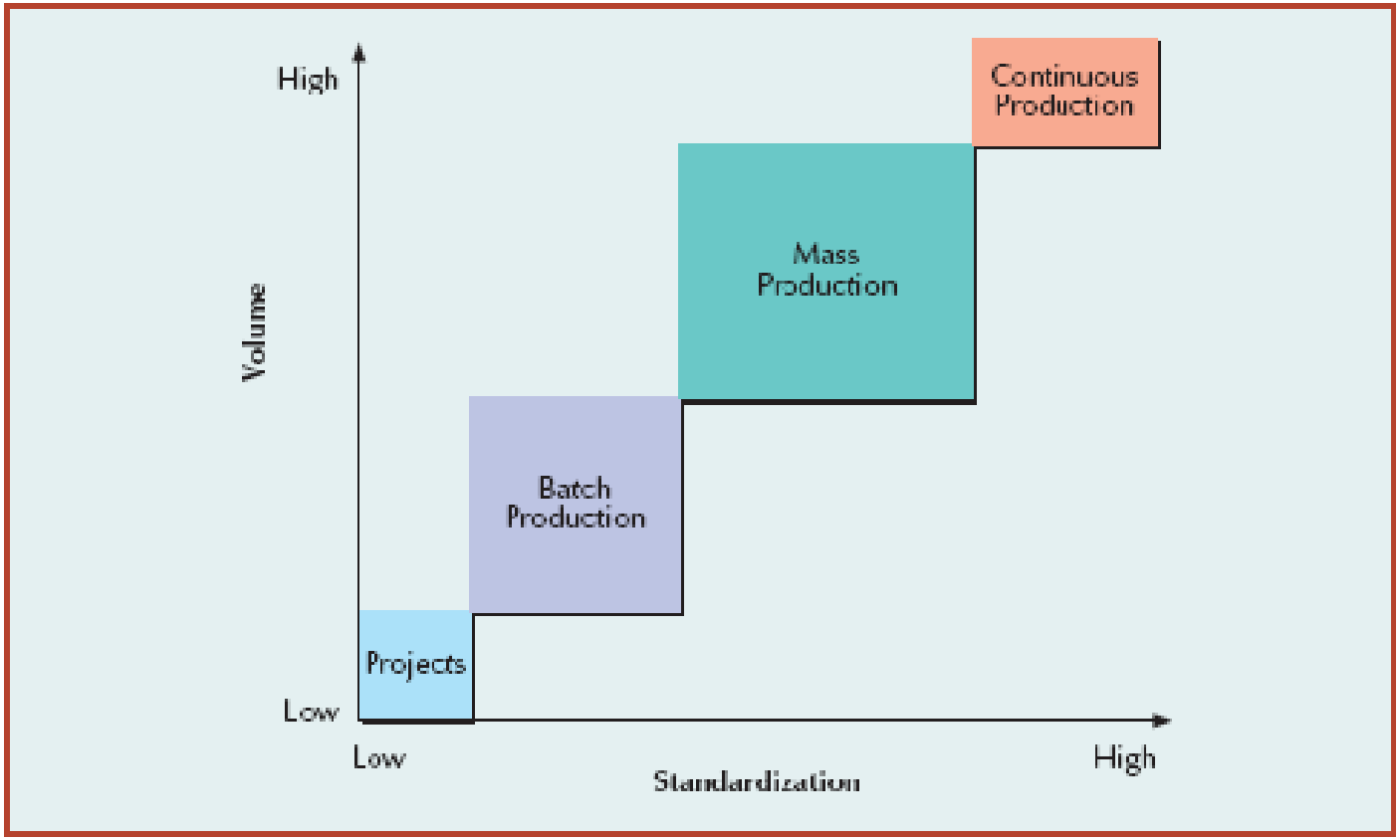
- Cost
- Capacity
- Quality
- Speed
- Reliability
- Expertise

Process Selection

- Projects
  - one-of-a-kind production of a product to customer order
- Batch production
  - processes many different jobs at the same time in groups or batches
- Mass production
  - produces large volumes of a standard product for a mass market
- Continuous production
  - used for very-high volume commodity products

Sourcing Continuum

Product-Process Matrix



Source: Adapted from Robert Hayes and Steven Wheelwright, *Restoring the Competitive Edge Competing through Manufacturing* (New York, John Wiley & Sons, 1984), p. 209.

Types of Processes

	PROJECT	BATCH	MASS	CONT.
Type of product	Unique	Made-to-order (customized)	Made-to-stock (standardized)	Commodity
Type of customer	One-at-a-time	Few individual customers	Mass market	Mass market
Product demand	Infrequent	Fluctuates	Stable	Very stable

Source: Adapted from R. Chase, N. Aquilano, and R. Jacobs, *Operations Management for Competitive Advantage* (New York:McGraw-Hill, 2001), p. 210

Types of Processes (cont.)

	PROJECT	BATCH	MASS	CONT.
Demand volume	Very low	Low to medium	High	Very high
No. of different products	Infinite variety	Many, varied	Few	Very few
Production system	Long-term project	Discrete, job shops	Repetitive, assembly lines	Continuous, process industries

Source: Adapted from R. Chase, N. Aquilano, and R. Jacobs, *Operations Management for Competitive Advantage* (New York:McGraw-Hill, 2001), p. 210

Types of Processes (cont.)

	PROJECT	BATCH	MASS	CONT.
Equipment	Varied	General-purpose	Special-purpose	Highly automated
Primary type of work	Specialized contracts	Fabrication	Assembly	Mixing, treating, refining
Worker skills	Experts, crafts-persons	Wide range of skills	Limited range of skills	Equipment monitors

Source: Adapted from R. Chase, N. Aquilano, and R. Jacobs, *Operations Management for Competitive Advantage* (New York:McGraw-Hill, 2001), p. 210

Types of Processes (cont.)

	PROJECT	BATCH	MASS	CONT.
Advantages	Custom work, latest technology	Flexibility, quality	Efficiency, speed, low cost	Highly efficient, large capacity, ease of control
Dis-advantages	Non-repetitive, small customer base, expensive	Costly, slow, difficult to manage	Capital investment; lack of responsiveness	Difficult to change, far-reaching errors, limited variety
Examples	Construction, shipbuilding, spacecraft	Machine shops, print shops, bakeries, education	Automobiles, televisions, computers, fast food	Paint, chemicals, foodstuffs

Source: Adapted from R. Chase, N. Aquilano, and R. Jacobs, *Operations Management for Competitive Advantage* (New York:McGraw-Hill, 2001), p. 210

Process Selection with Break-Even Analysis

- examines cost trade-offs associated with demand volume
- Cost
  - Fixed costs
    - constant regardless of the number of units produced
  - Variable costs
    - vary with the volume of units produced
- Revenue
  - price at which an item is sold
- Total revenue
  - is price times volume sold
- Profit
  - difference between total revenue and total cost

Process Selection with Break-Even Analysis (cont.)

Total cost = fixed cost + total variable cost

$$TC = c_f + vc_v$$

Total revenue = volume x price

$$TR = vp$$

Profit = total revenue - total cost

$$Z = TR - TC = vp - (c_f + vc_v)$$

Process Selection with Break-Even Analysis (cont.)

$$TR = TC$$

$$vp = c_f + vc_v$$

$$vp - vc_v = c_f$$

$$v(p - c_v) = c_f$$

$$v = \frac{c_f}{p - c_v}$$

Solving for Break-Even Point (Volume)

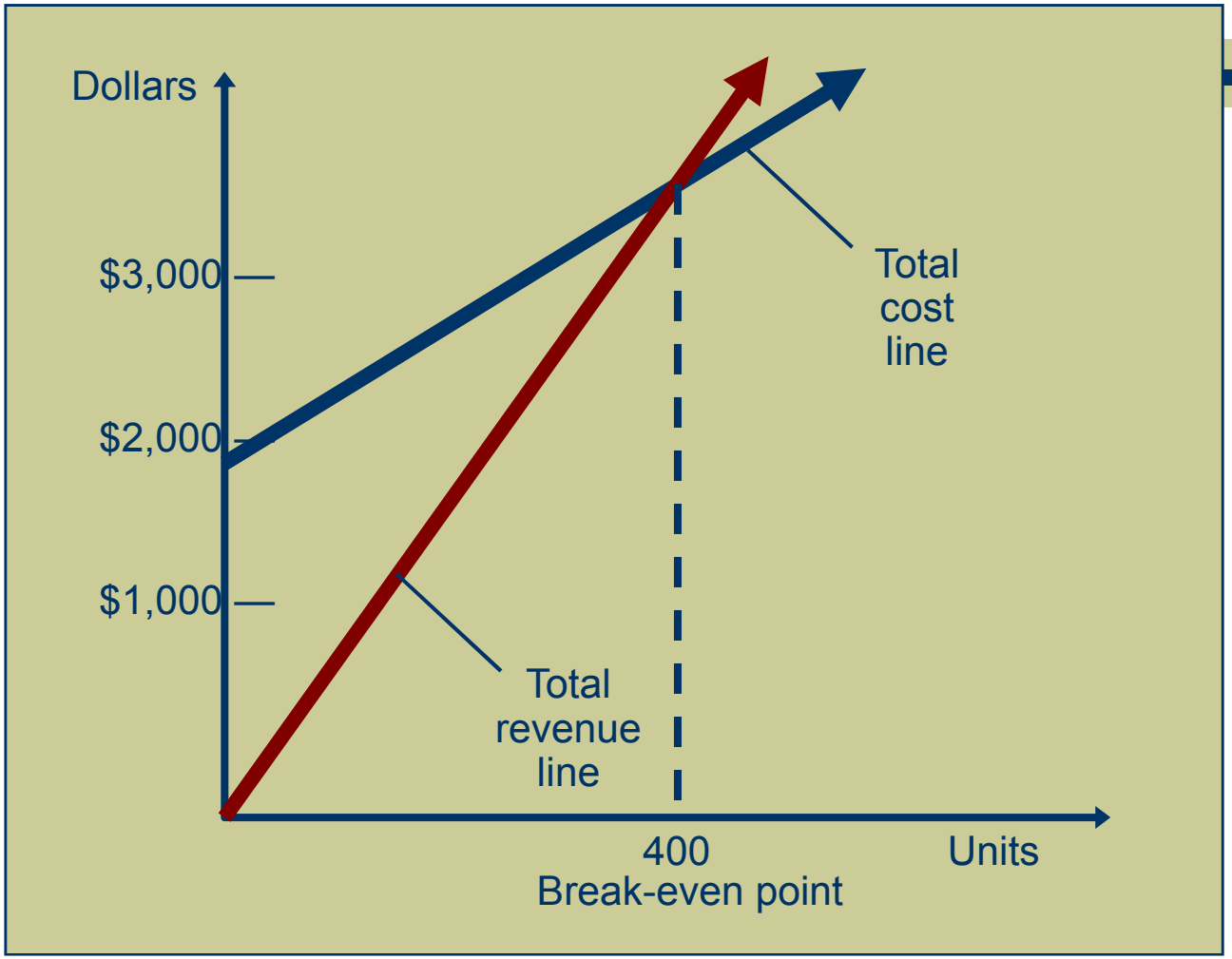
Break-Even Analysis: Example

Fixed cost = c_f = $2,000
Variable cost = c_v = $5 per raft
Price = p = $10 per raft

Break-even point is

$$v = \frac{c_f}{p - c_v} = \frac{2000}{10 - 5} = 400 \text{ rafts}$$

Break-Even Analysis: Graph



Process Plans

- Set of documents that detail manufacturing and service delivery specifications
  - assembly charts
  - operations sheets
  - quality-control check-sheets

Process Selection

Process A *Process B*

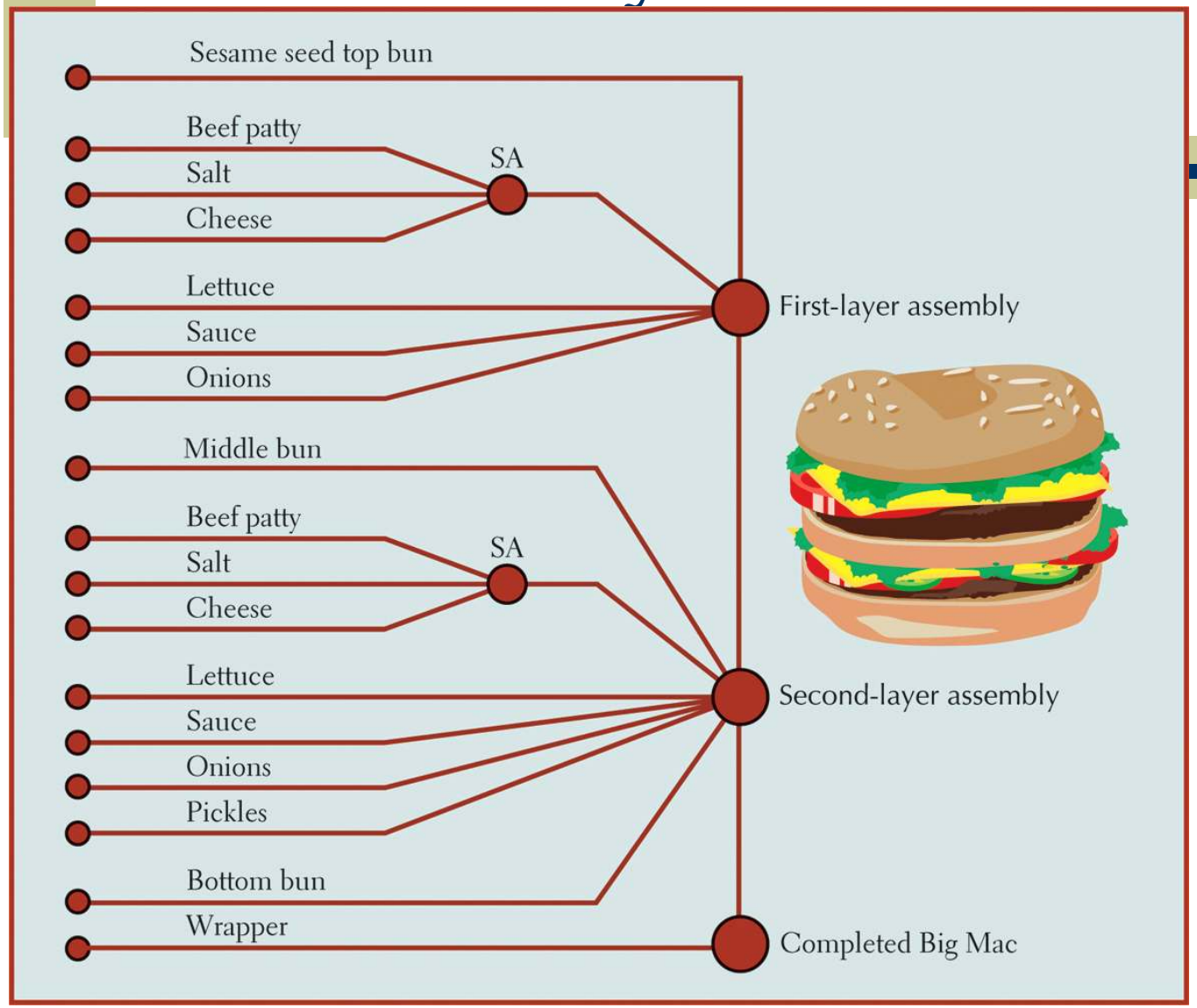
$$\$2{,}000 + \$5v = \$10{,}000 + \$3v$$

$$\$2v = \$8{,}000$$

$$v = 4{,}000 \text{ rafts}$$

Below or equal to 4,000, choose A
Above or equal to 4,000, choose B

Process Analysis



- systematic examination of all aspects of process to improve operation

An Operations Sheet for a Plastic Part

Part name Crevice Tool
Part No. 52074
Usage Hand-Vac
Assembly No. 520

Oper. No.	*Description*	*Dept.*	*Machine/Tools*	*Time*
10	Pour in plastic bits	041	Injection molding	2 min
20	Insert mold	041	#076	2 min
30	Check settings & start machine	041	113, 67, 650	20 min
40	Collect parts & lay flat	051	Plastics finishing	10 min
50	Remove & clean mold	042	Parts washer	15 min
60	Break off rough edges	051	Plastics finishing	10 min

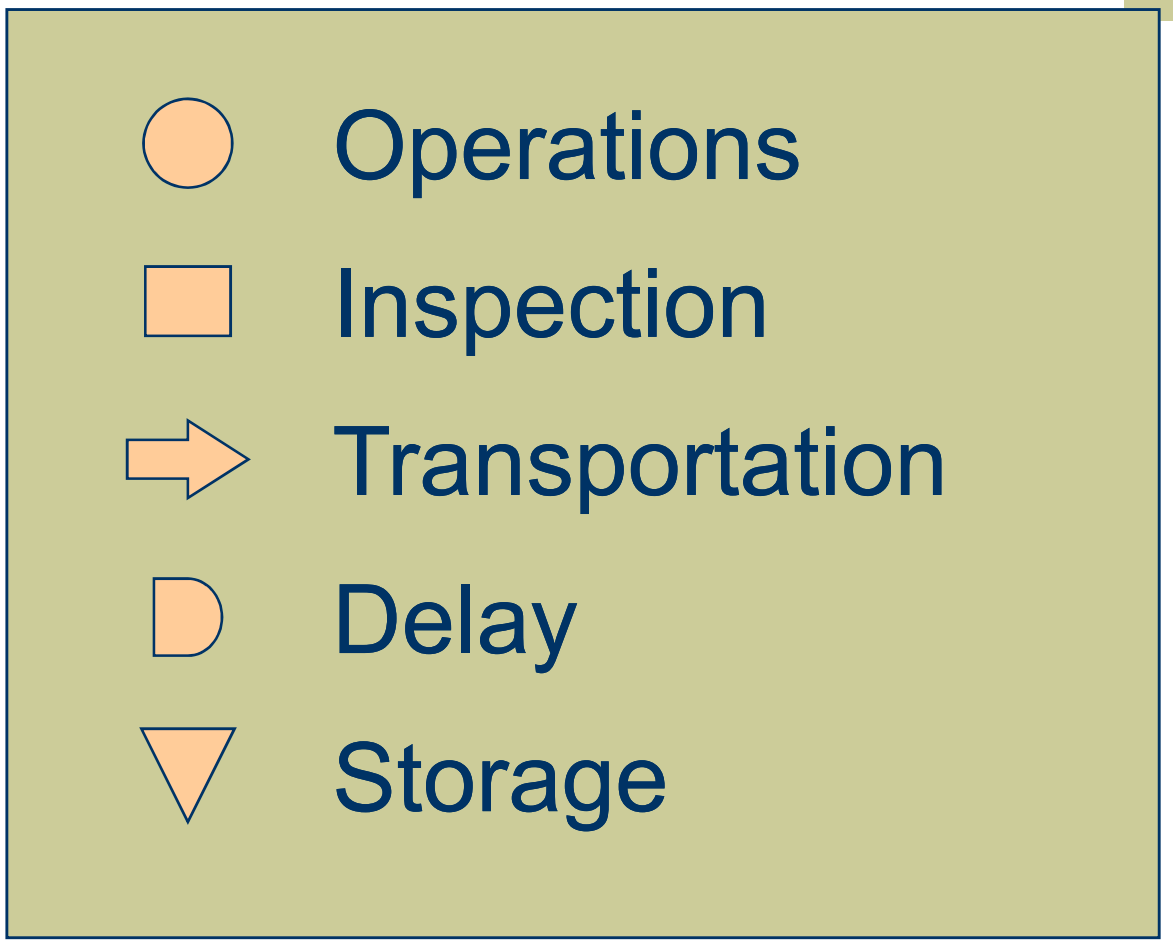
Process Analysis

- Building a flowchart
  - Determine objectives
  - Define process boundaries
  - Define units of flow
  - Choose type of chart
  - Observe process and collect data
  - Map out process
  - Validate chart

Process Flowcharts

- look at manufacture of product or delivery of service from broad perspective
- Incorporate
  - nonproductive activities (inspection, transportation, delay, storage)
  - productive activities (operations)

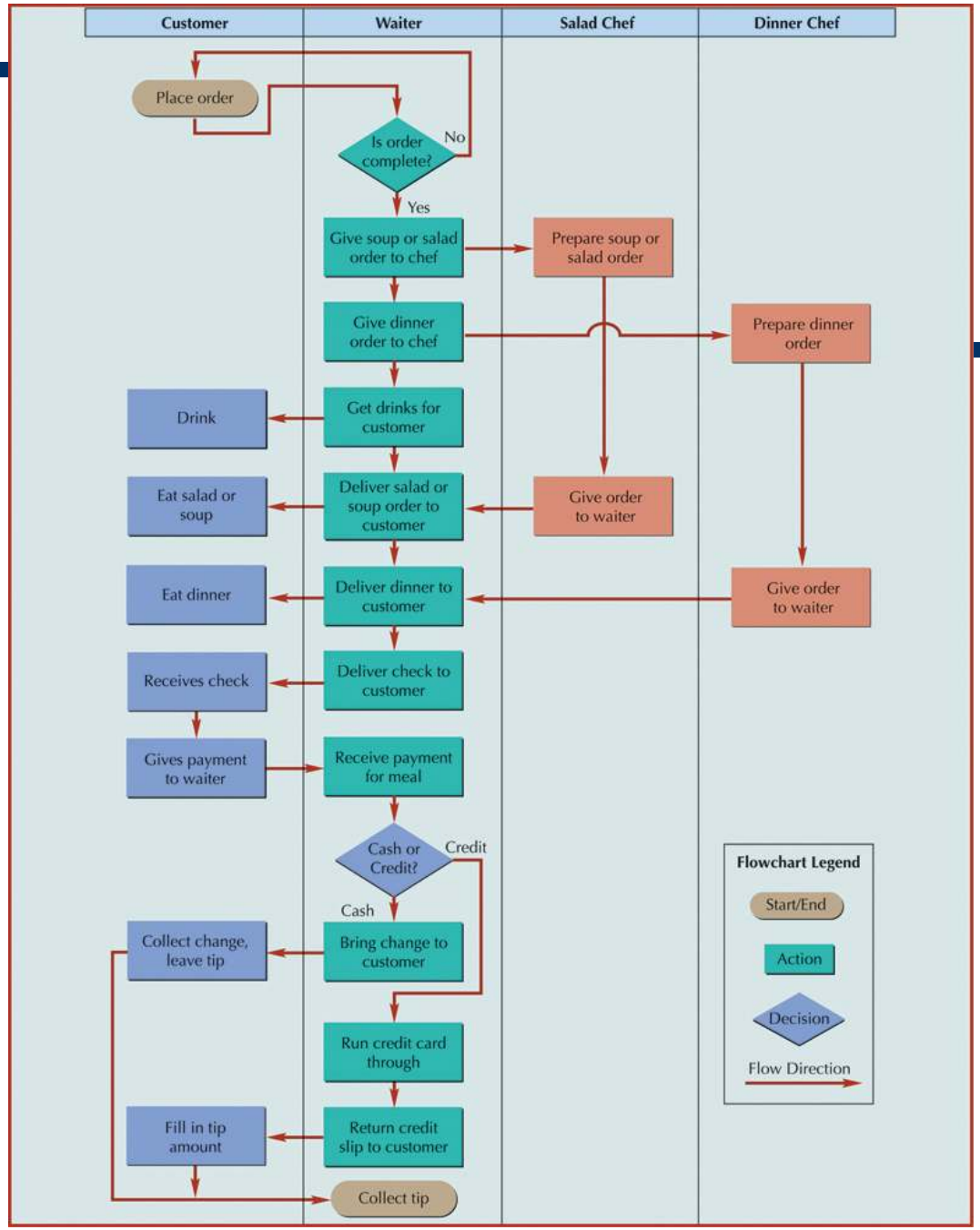
Process Flowchart Symbols



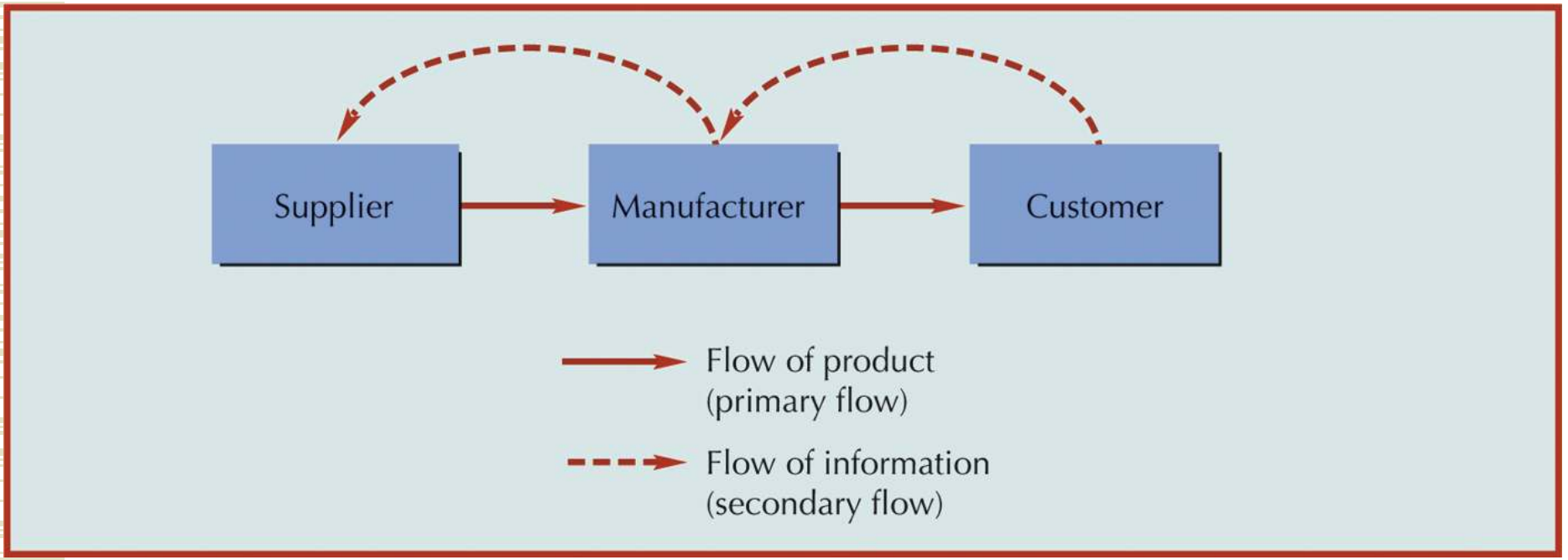
Process Flowchart of Apple Processing

Date: 9-30-06 Location: Graves Mountain
Analyst: TLR Process: Applesauce

Step	Operation	Transport	Inspect	Delay	Storage	Description of process	Time (min)	Distance (feet)
1	●	⇨	□	D	▽	Unload apples from truck	20	
2	○	⇨	□	D	▽	Move to inspection station		100 ft
3	○	⇨	■	D	▽	Weigh, inspect, sort	30	
4	○	⇨	□	D	▽	Move to storage		50 ft
5	○	⇨	□	D	▼	Wait until needed	360	
6	○	⇨	□	D	▽	Move to peeler		20 ft
7	●	⇨	□	D	▽	Peel and core apples	15	
8	○	⇨	□	D	▼	Soak in water until needed	20	
9	●	⇨	□	D	▽	Place on conveyor	5	
10	○	⇨	□	D	▽	Move to mixing area		20 ft
	Page 1 of 3					Total	450	190 ft

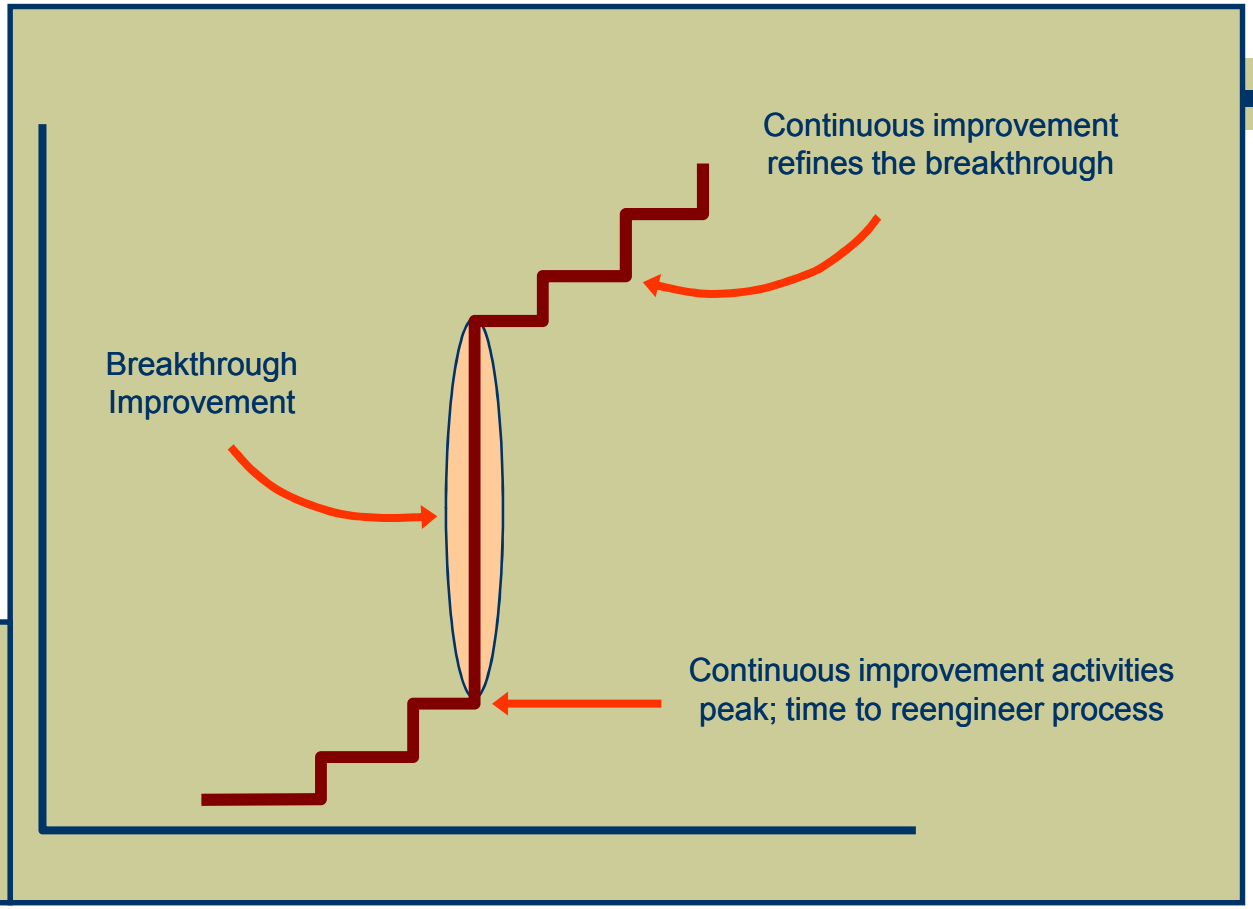


Simple Value Chain Flowchart

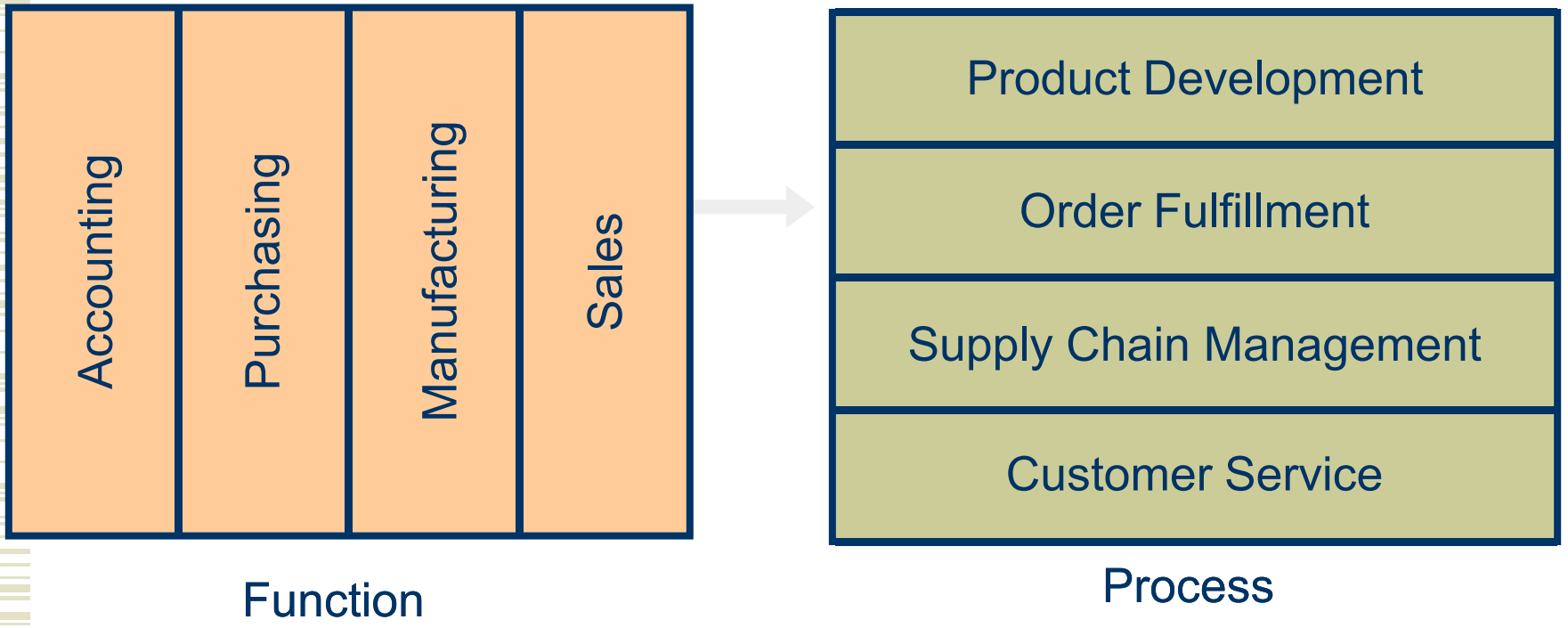


Process Innovation

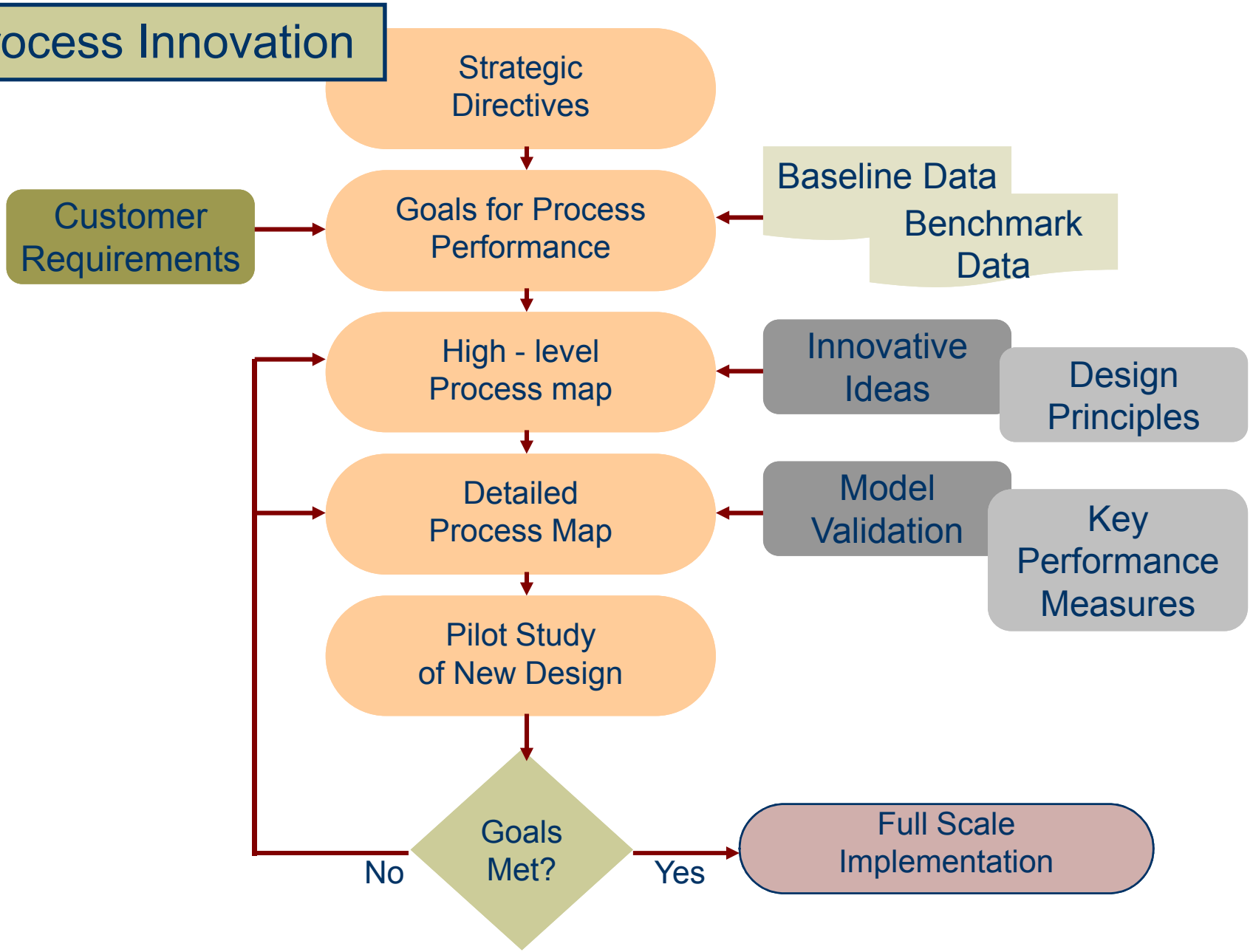
Total redesign of a process for breakthrough improvements



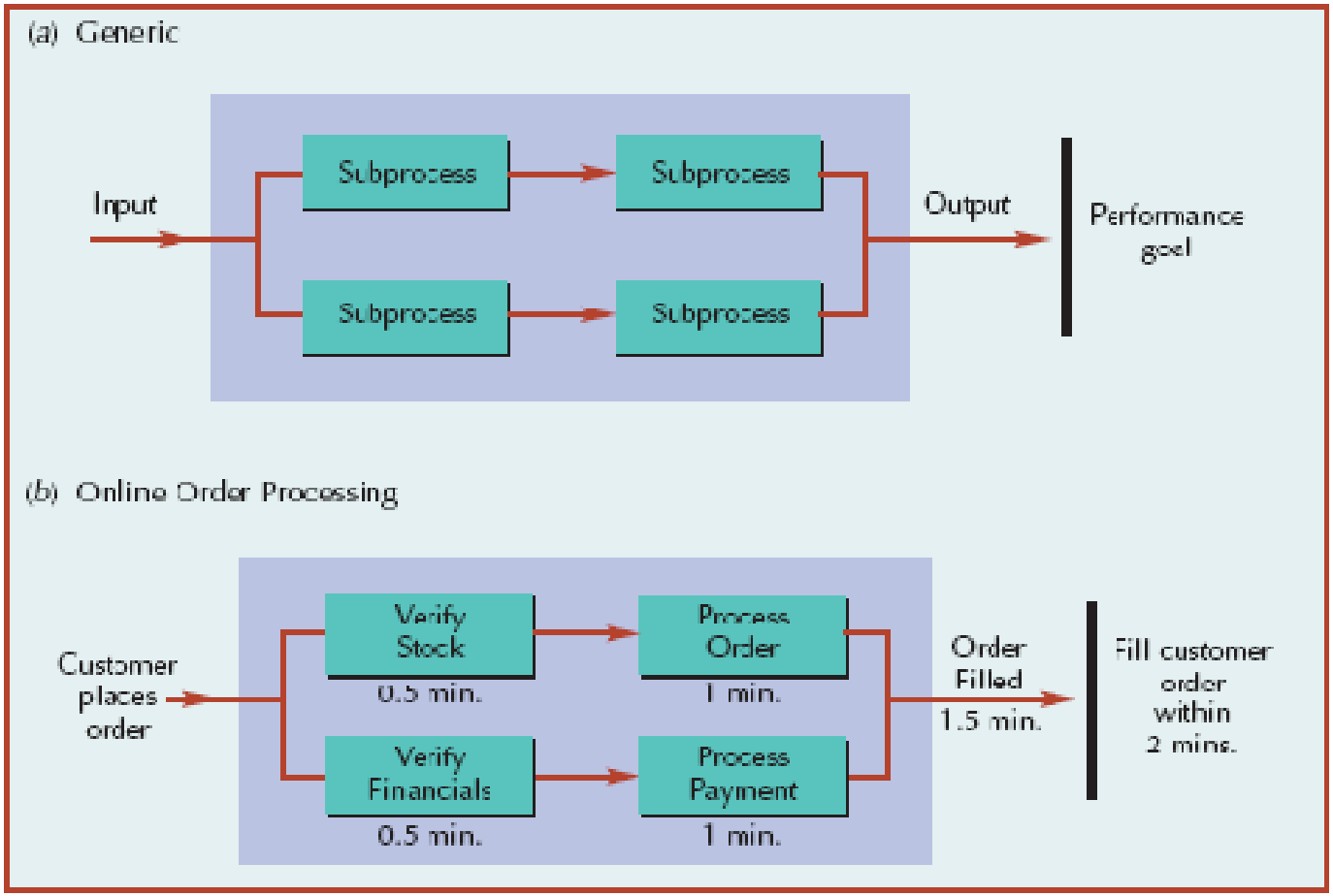
From Function to Process



Process Innovation



High-Level Process Map



Principles for Redesigning Processes

- Remove waste, simplify, and consolidate similar activities
- Link processes to create value
- Let the swiftest and most capable enterprise execute the process
- Flex process for any time, any place, any way
- Capture information digitally at the source and propagate it through process

Principles for Redesigning Processes (cont.)

- Provide visibility through fresher and richer information about process status
- Fit process with sensors and feedback loops that can prompt action
- Add analytic capabilities to process
- Connect, collect, and create knowledge around process through all who touch it
- Personalize process with preferences and habits of participants

Techniques for Generating Innovative Ideas

- Vary the entry point to a problem
  - in trying to untangle fishing lines, it's best to start from the fish, not the poles
- Draw analogies
  - a previous solution to an old problem might work
- Change your perspective
  - think like a customer
  - bring in persons who have no knowledge of process

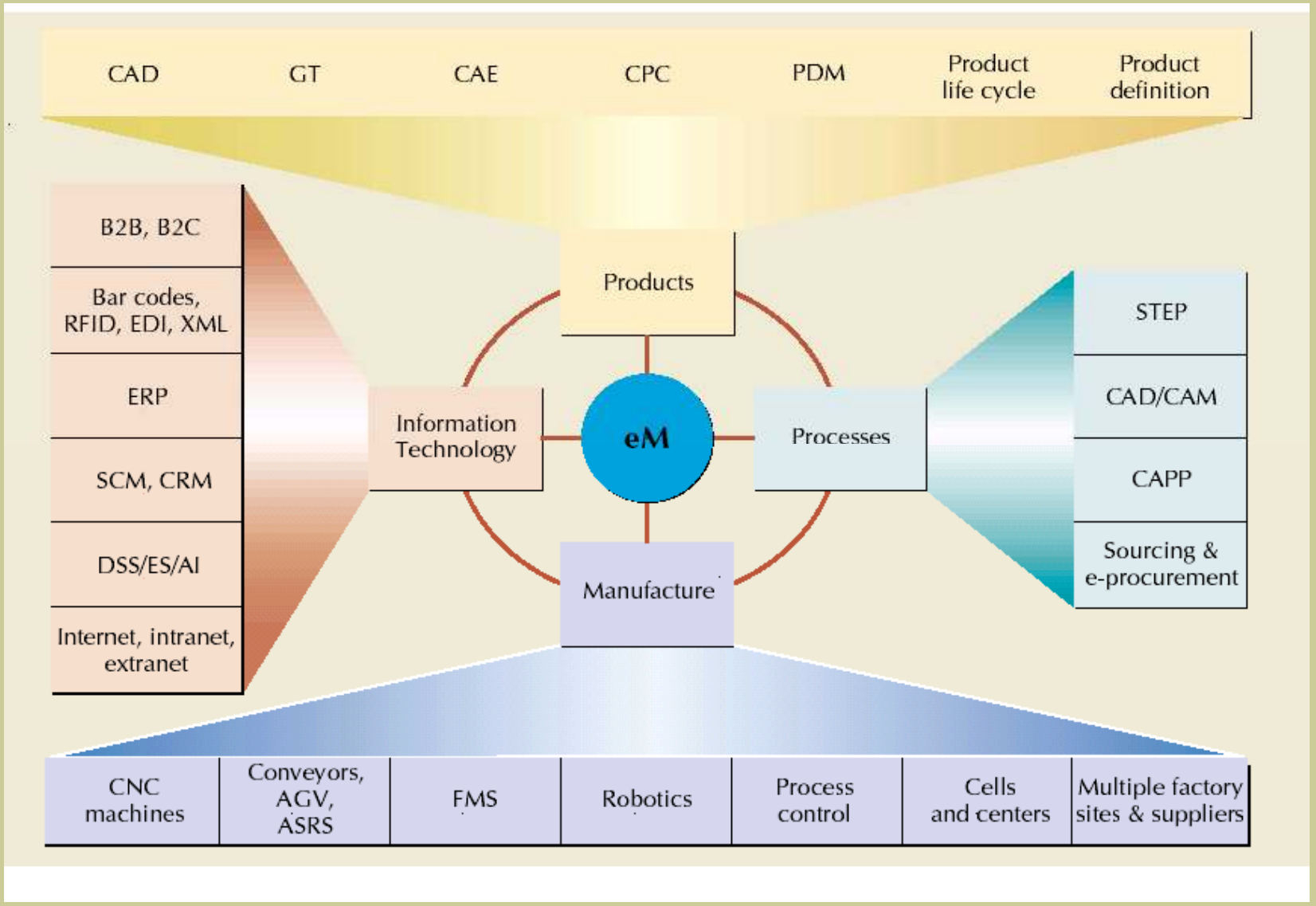
Techniques for Generating Innovative Ideas (cont.)

- Try inverse brainstorming
  - what would *increase* cost
  - what would *displease* the customer
- Chain forward as far as possible
  - if I solve this problem, what is the next problem
- Use attribute brainstorming
  - how would this process operate if. . .
    - our workers were mobile and flexible
    - there were no monetary constraints
    - we had perfect knowledge

Technology Decisions

- Financial justification of technology
  - Purchase cost
  - Operating Costs
  - Annual Savings
  - Revenue Enhancement
  - Replacement Analysis
  - Risk and Uncertainty
  - Piecemeal Analysis

Components of e-Manufacturing



A Technology Primer

Product Technology

- Computer-aided design (CAD)
- Group technology (GT)
- Computer-aided engineering (CAE)
- Collaborative product commerce (CPC)

- Creates and communicates designs electronically
- Classifies designs into families for easy retrieval and modification
- Tests functionality of CAD designs electronically
- Facilitates electronic communication and exchange of information among designers and suppliers

A Technology Primer (cont.)

Product Technology

- Product data management (PDM)
- Product life cycle management (PLM)
- Product configuration

- Keeps track of design specs and revisions for the life of the product
- Integrates decisions of those involved in product development, manufacturing, sales, customer service, recycling, and disposal
- Defines products “configured” by customers who have selected among various options, usually from a Web site

A Technology Primer (cont.)

Process Technology

- Standard for exchange of product model data (STEP)
- Computer-aided design and manufacture (CAD/CAM)
- Computer aided process (CAPP)
- E-procurement

- Set standards for communication among different CAD vendors; translates CAD data into requirements for automated inspection and manufacture
- Electronic link between automated design (CAD) and automated manufacture (CAM)
- Generates process plans based on database of similar requirements
- Electronic purchasing of items from e-marketplaces, auctions, or company websites

A Technology Primer (cont.)

Manufacturing Technology

- Computer numerically control (CNC)
- Flexible manufacturing system (FMS)
- Robots
- Conveyors

- Machines controlled by software code to perform a variety of operations with the help of automated tool changers; also collects processing information and quality data
- A collection of CNC machines connected by an automated material handling system to produce a wide variety of parts
- Manipulators that can be programmed to perform repetitive tasks; more consistent than workers but less flexible
- Fixed-path material handling; moves items along a belt or overhead chain; "reads" packages and diverts them to different directions; can be very fast

A Technology Primer (cont.)

Manufacturing Technology

Automatic guided vehicle (AGV)	A driverless truck that moves material along a specified path; directed by wire or tape embedded in floor or by radio frequencies; very flexible
Automated storage and retrieval system (ASRS)	An automated warehouse—some 26 stores high—in which items are placed in a carousel-type storage system and retrieved by fast-moving stacker cranes; controlled by computer
Process Control	Continuous monitoring of automated equipment; makes real-time decisions on ongoing operation, maintenance, and quality
Computer-integrated manufacturing (CIM)	Automated manufacturing systems integrated through computer technology; also called e-manufacturing

A Technology Primer (cont.)

Information Technology

Business – to – Business (B2B)	Electronic transactions between businesses usually over the Internet
Business – to – Consumer (B2C)	Electronic transactions between businesses and their customers usually over the Internet
Internet	A global information system of computer networks that facilitates communication and data transfer
Intranet	Communication networks internal to an organization; can be password (i.e., firewall) protected sites on the Internet
Extranet	Intranets connected to the Internet for shared access with select suppliers, customers, and trading partners

A Technology Primer (cont.)

Information Technology

Bar Codes	A series of vertical lines printed on most packages that identifies item and other information when read by a scanner
Radio Frequency Identification tags (RFID)	An integrated circuit embedded in a tag that can send and receive information; a twenty-first century bar code with read/write capabilities
Electronic data interchange (EDI)	A computer-to-computer exchange of business documents over a proprietary network; very expensive and inflexible
Extensive markup language (XML)	A programming language that enables computer – to – computer communication over the Internet by tagging data before its is sent
Enterprise resource planning (ERP)	Software for managing basic requirements of an enterprise, including sales & marketing, finance and accounting, production & materials management, and human resources

A Technology Primer (cont.)

Information Technology

Supply chain management (SCM)	Software for managing flow of goods and information among a network of suppliers, manufacturers and distributors
Customer relationship management (CRM)	Software for managing interactions with customers and compiling and analyzing customer data
Decision support systems (DSS)	An information system that helps managers make decisions; includes a quantitative modeling component and an interactive component for what-if analysis
Expert systems (ES)	A computer system that uses an expert knowledge base to diagnose or solve a problem
Artificial intelligence (AI)	A field of study that attempts to replicate elements of human thought in computer processes; includes expert systems, genetic algorithms, neural networks, and fuzzy logic