Product management

Product economy analysis and description

Lecture 12

Three aspect of product related decision

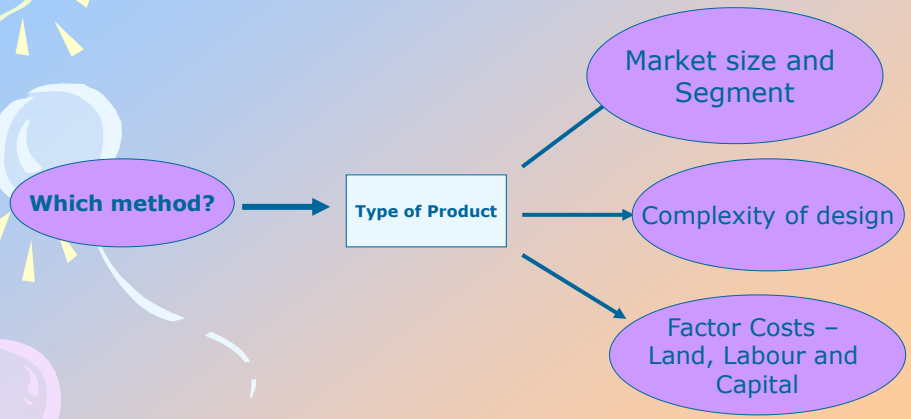
- Production method
- Capacity planning and use
- Customization of production process

Production Methods

The choice of production method and the factor inputs depends on such things as:

- the nature of the product
- factor costs
- the scale of production

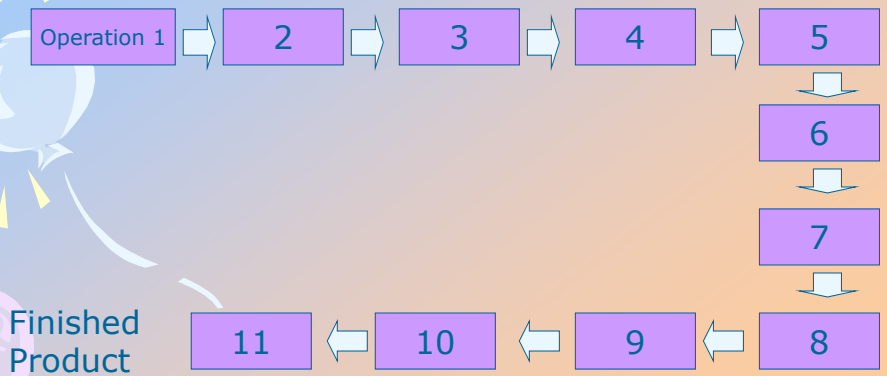
Production Decisions



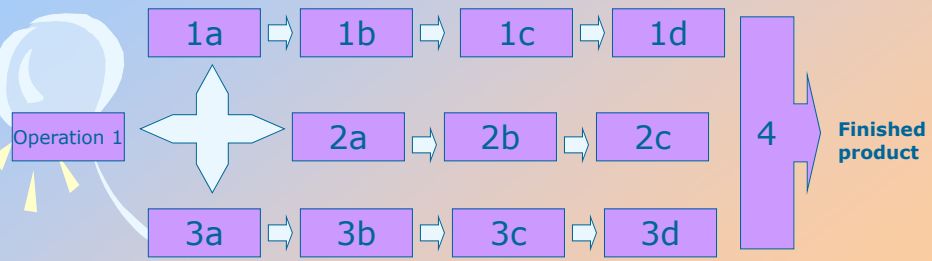
Production Methods

- **Job Production** – One-off production - each item might have particular specifications
- **Flow Production** – suitable for mass market products that are identical
- **Batch Production** – each stage of the production process has an operation completed on it before moving on to the next stage – allows modifications to be made to products that otherwise are the same

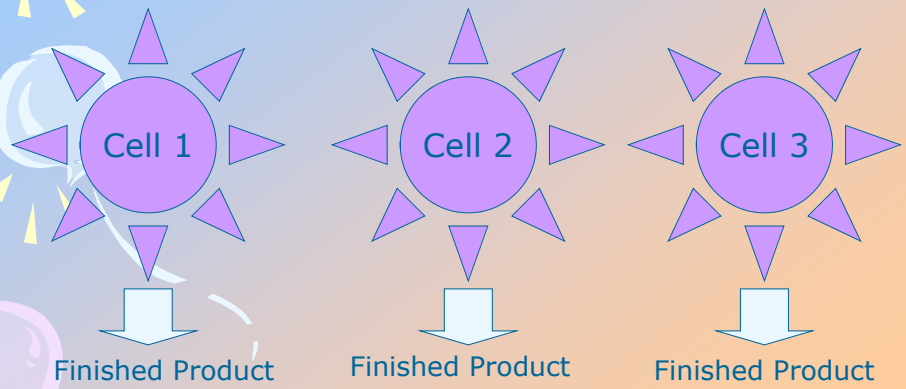
Production Methods



Production Methods



Production Methods



Production Methods

- The design of the production space can influence:
  - Output levels
  - Factor use
  - Efficiency
  - Cost levels
  - Quality assurance procedures

Basic Types of Production Processes

- Intermittent Production System
  - Production is performed on a start-and-stop basis, such as for the manufacture of made-to-order products.
- Mass Production
  - A special type of intermittent production process using standardized methods and single-use machines to produce long runs of standardized items.

Basic Types of Production Processes (cont'd)

- Mass Customization
  - Designing, producing, and delivering customized products to customers for at or near the cost and convenience of mass-produced items.
  - Mass customization combines high production volume with high product variety.
  - Elements of mass customization:
    - Modular product design
    - Modular process design
    - Agile supply networks

Basic Types of Production Processes (cont'd)

- Continuous Production Processes
  - A production process, such as those used by chemical plants or refineries, that runs for very long periods without the start-and-stop behavior associated with intermittent production.
  - Enormous capital investments are required for highly automated facilities that use special-purpose equipment designed for high volumes of production and little or no variation in the type of outputs.

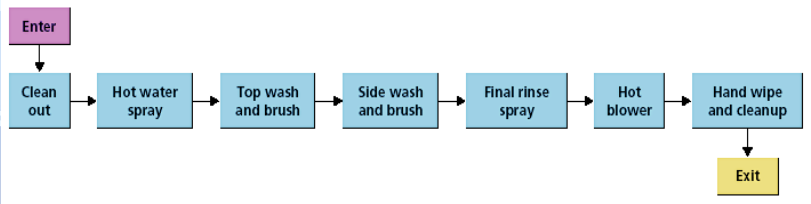
The Facility Location Decision

- Decision Factors:
  - Customer convenience
  - Transportation costs
  - Labor costs and availability
  - Sources of supplies and raw materials
  - Owner preferences for specific locations
  - Government policies, rules, regulations and incentives
  - Site cost and availability

Facility and Production Layout

- Facility Layout
  - The configuration of all the machines, employee workstations, storage areas, internal walls, and so forth that constitute the facility used to create a firm's product or service.
- Product Layout
  - A production system design in which every item to be produced follows the same sequence of operations from beginning to end, such as an assembly line.

Product Layout for Carwash



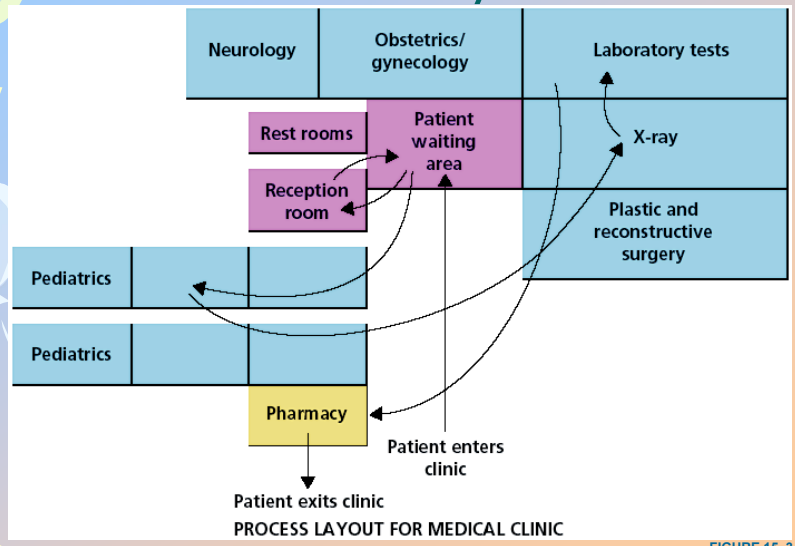
Source: Everett Adam Jr. and Ronald Ebert, *Production and Operations Management* (Upper Saddle River, NJ: Prentice Hall, 1992), p. 254.

FIGURE 15–2
G.Dessler, 2003

Facility and Production Layout (cont'd)

- Process Layout
  - A production system design in which similar machines or functions are grouped together.
- Fixed-Position Layout
  - A production system arrangement in which the product being built or produced stays at one location and the machines, workers, and tools required to build the product are brought to that location as needed, as for the building of ships or other bulky products.

Process Layout



Source: Everett Adam Jr. and Ronald Ebert, ***Production and Operations Management*** (Upper Saddle River, NJ: Prentice Hall, 1992), p. 254.

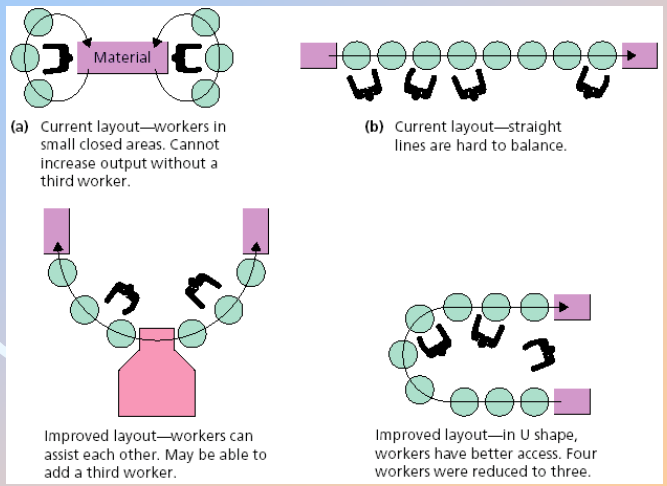
FIGURE 15–3
G.Dessler, 2003

Facility and Production Layout (cont'd)

- Cellular Manufacturing Layout
  - A combination of process and product layouts, in which machines and personnel are grouped into cells containing all the tools and operations required to produce a particular product or family of products.

G.Dessler, 2003

Improving Layouts by Moving to the Cellular Manufacturing Concept



Source: Source: Barry Render and Jay Heizer, *Principles of Operations Management*, 2nd ed., © 1997. Reprinted by permission of Prentice Hall, Inc., Upper Saddle River, NJ.

FIGURE 15–4
G.Dessler, 2003

Operations Planning And Control Techniques

- Operations or Production Planning
  - The process of deciding what products to produce and where, when, and how to produce them.
- Operations or Production Control
  - The process of ensuring that the specified production plans and schedules are being adhered to.

G.Dessler, 2003

Capacity/Facility Planning

- **How much and what kind of physical equipment is needed to support production goals?**
- *Basic Capacity Calculations*: stand-alone capacities and congestion effects (e.g., blocking)
  - *Capacity Strategy*: lead or follow demand
  - *Make-or-Buy*: vendoring, long-term identity
  - *Flexibility*: with regard to product, volume, mix
  - *Speed*: scalability, learning curves

Overview of Lecture

- Review Mass Customization Paradigm
- Classifying Mass Customization
- Determining the Shift to Mass Customization
- Transitioning to Mass Customization

Recall: Paradigm of Mass Customization

- The breakdown of mass production began in the 1960s, accelerated in the 1970s, and finally burst fully into management consciousness in the 1980s.
- Mass customizers believe that a company will:
  - have greater sales if it better satisfies its customers' individual needs and wants,
  - further fragment the market by offering even more variety and customization, and
  - better satisfy customers' needs and wants through further market fragmentation.
- The new paradigm of MC is variety and customization through flexibility and quick responsiveness.

Recall: Role of *Production* in MC Firm

Focus:

- Total process efficiency

Positive Effects:

- Low overhead and bureaucracy
- Optimum quality
- Elimination of waste
- Continual process improvement
- Low inventory carrying costs
- High labor productivity

Recall: Role of *Production* in MC Firm

- Integration of thinking and doing
- High utilization of and investment in worker skills
- Sense of community
- Low total costs
- High production flexibility
- Greater variety at lower costs

Detrimental Effects:

- Demanding, stressful environment?

Recall: Role of *R&D* in MC Firm

Focus:

- Continual, incremental improvements

Positive Effects:

- Continual improvements, eventual technological superiority
- Integration of innovation and production
- Frequent process innovations
- Low costs and short cycle times
- Mutually beneficial relationships with other firms
- Better fulfillment of customer wants and needs

Detrimental Effects:

- Lack of breakthrough innovations?

Recall: Role of *Marketing* in MC Firm

Focus:

- Gaining market share by fulfilling customer wants and needs—first domestically, then in export markets

Positive Effects:

- Filling the niches
- Ability to respond quickly to changing customer needs
- Market takeover
- High sales domestically and through exports
- Technology-intensive products

Detrimental Effects:

- Too enamored with technology?

Recall: Role of *Finance/Accounting* in MC Firm

Focus:

- Information useful for managers and workers

Primary Benefit:

- Sound long- and short-term decisions
- Long-term investments in capital, people, and technology
- Low costs, high profits
- Attention to core competencies
- Long-term supplier interdependence

Detrimental Effects:

- Stockholders ignored?

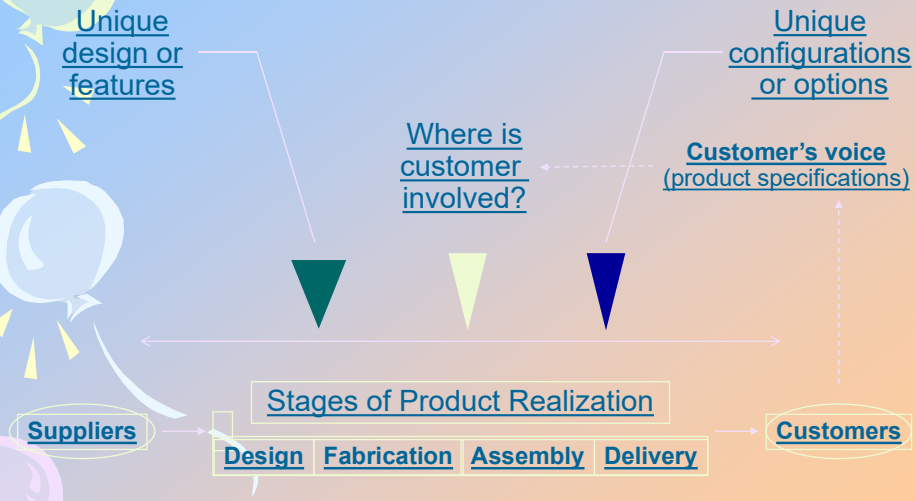
Comparison of MP and MC Paradigms

	Mass Production	Mass Customization
Focus	Efficiency through stability and control	Variety and customization through flexibility and quick responsiveness
Goal	Developing, producing, marketing, and delivering goods and services at prices low enough that nearly everyone can afford them	Developing, producing, marketing, and delivering affordable goods and services with enough variety and customization that nearly everyone finds what they want
Key Features	• Stable demand • Large, homogenous markets • Low-cost, consistent quailty, standardized goods and services • Long product development cycles • Long product life cycles	• Fragmented demand • Heterogeneous markets • Low cost, high quality, customized goods and services • Short product development cycles • Short product life cycles

Mass Customization

- Mass customizers seek to:
  - Provide personalized, custom-designed products at prices so close to those traditionally offered only for mass-produced merchandise
  - Give customers exactly what they want, at the price they want, and at the time they want it
  - Provide sufficient variety in products and services so that virtually every customer is able to purchase a customized product for a price near the mass-produced item
- Customization ≠ product variety
- Customized products are uniquely produced for each customer; therefore, customers must be involved in the process at some point!

Point of Customer Involvement



Adapted from:

- Duray, R., and Milligan, G. W., 1999, "Improving Customer Satisfaction through Mass Customization," *Quality Progress*, Vol. 32, No. 8, pp. 60-66.

Results of Customer Involvement

Customer Involvement	Design	Fabrication	Assembly	Delivery
Product Variety	All unique	Unique fit	Combinatorial	Combinatorial
Production Planning	Made-to-order	Tailored-to-order	Assembled-to-order	Made-to-stock or JIT
Information Technology	Design-oriented	Order processing	Order processing, scheduling	Point-of-sale Inventory

Adapted from:

- Duray, R., and Milligan, G. W., 1999, "Improving Customer Satisfaction through Mass Customization," *Quality Progress*, Vol. 32, No. 8, pp. 60-66.

Four Types of Mass Customization

Transparent customizers use standard packaging but provide customers with unique products and services without letting them know explicitly that those products have been customized for them

Collaborative customizers work directly with customers to help them articulate their needs and make customized products

Transparent | Collaborative

Adaptive | Cosmetic

Product Change / No Change

No Change / Change

Representation

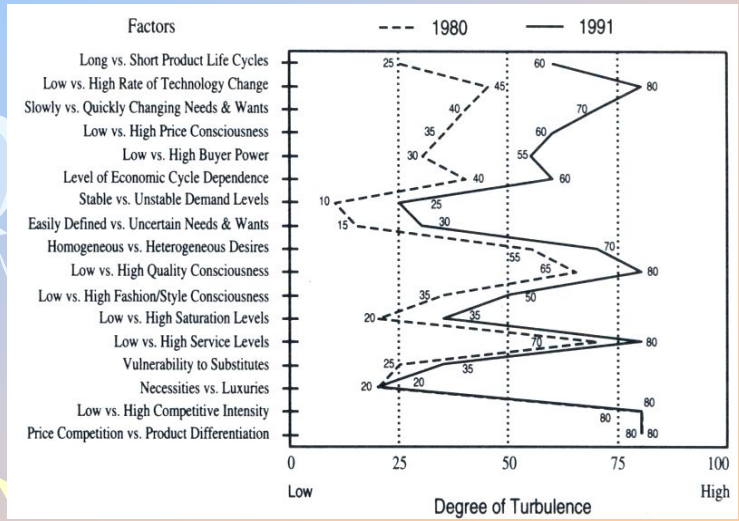
Adaptive customizers offer a standard, but customizable product that is designed so that customers can alter it

Cosmetic customizers present a standard product to different customers but individually customize packaging, advertising, etc.

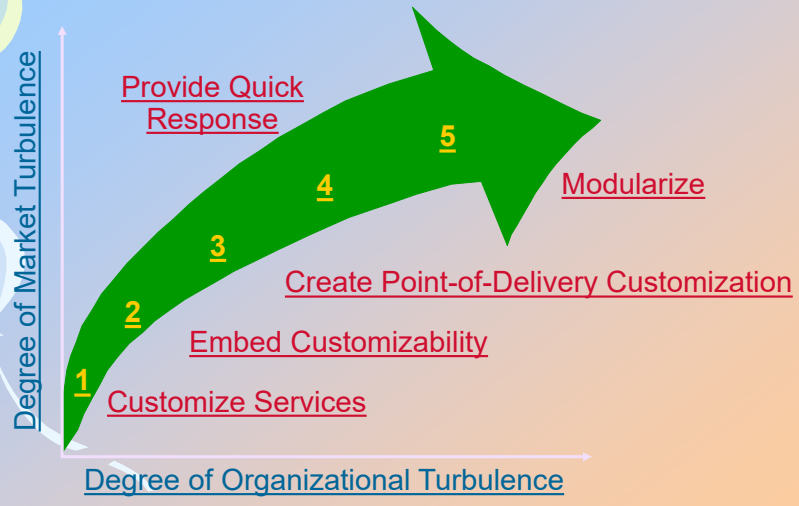
Adapted from: Gilmore, J. H, and Pine, J. B., II, 1997, "The Four Faces of Mass Customization," *Harvard Business Review*, Jan-Feb., pp. 91-101.

Pine's Degree of Market Turbulence

Pine (1993) introduces the Market Turbulence Map to assess when to shift to MC



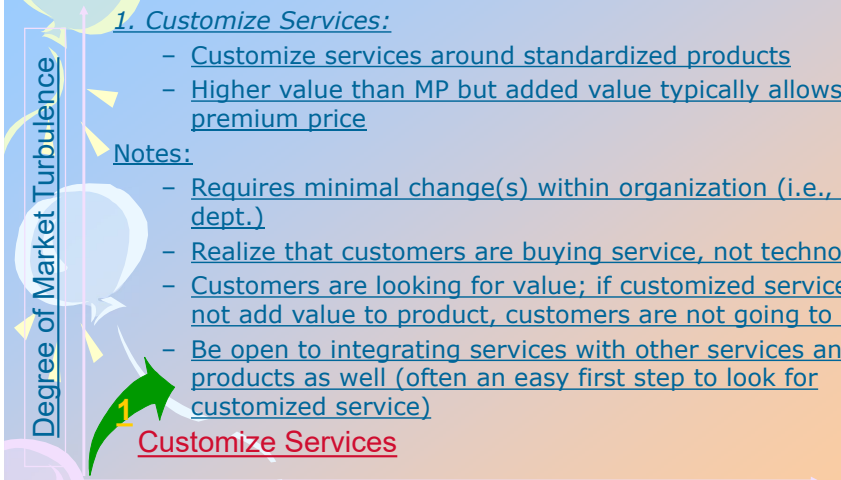
Pine's Five Steps to Mass Customization



Sources:

- Pine, B. J., II, 1993, "Mass Customizing Products and Services," *Planning Review*, Vol. 22, No. 4, pp. 6(8).
- Pine, B. J., II, 1993, Mass Customization: The New Frontier in Business Competition, Harvard Business School Press, Boston, MA.

Step 1: Customize Services



1. Customize Services:

- Customize services around standardized products
- Higher value than MP but added value typically allows a premium price

Notes:

- Requires minimal change(s) within organization (i.e., service dept.)
- Realize that customers are buying service, not technology
- Customers are looking for value; if customized service does not add value to product, customers are not going to pay for it
- Be open to integrating services with other services and products as well (often an easy first step to look for customized service)

Warning: **The competitive advantage through customized service is not sustainable. Anyone can do it, and you must be ready to adapt/move**

Step 2: Embed Customizability

2. Embed Customizability

- MP goods or services that people can adapt to their individual needs

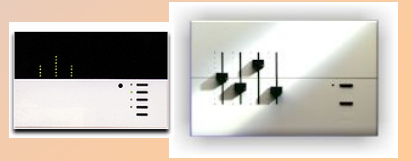
Notes:

- Requires minimal changes within organization, but creativity and innovation on designers' part
- Starts pushing company into MC since designers must embed customizability

***Warning*: Can over-design a product, and it becomes difficult to charge a premium since someone else can provide precisely what user wants for less cost**

LUTRON
THE WORLD LEADER IN LIGHTING CONTROLS SINCE 1961

- Lutron makes customizable lighting control systems for commercial and residential applications including hotel lobbies, ballrooms, conference rooms, and exec offices.
- Lutron has rarely shipped the same lighting system twice.
  - Work with individual customers to extend the product line until they have 100+ models from which to choose.
  - Engineering and production redesign the product line with 15-20 standardized components that can be configured into the same 100+ models.



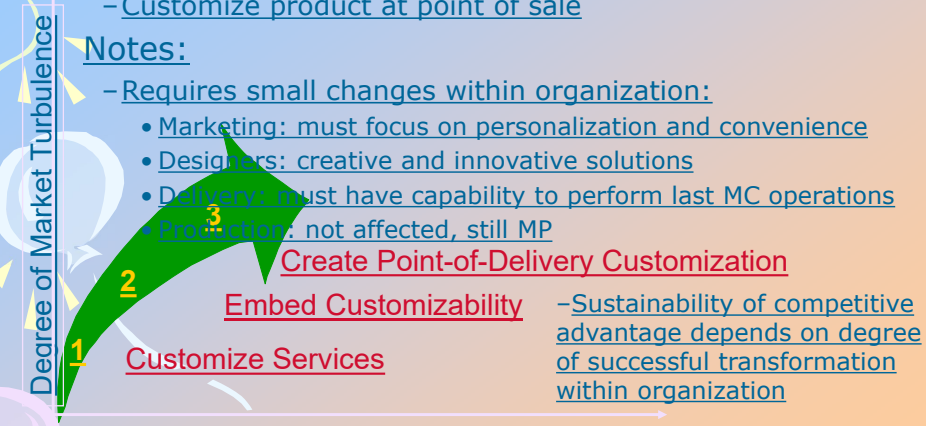
Step 3: Point-of-Delivery Customization

3. Create Point-of-Delivery Customization

- Customize product at point of sale

Notes:

- Requires small changes within organization:
  - Marketing: must focus on personalization and convenience
  - Designers: creative and innovative solutions
  - Delivery: must have capability to perform last MC operations
  - Production: not affected, still MP



- Sustainability of competitive advantage depends on degree of successful transformation within organization

Warning: (1) **Production and delivery must be integrated and well coordinated, and designer must consider impact of point-of-delivery on product**
(2) requires lots of IT to speed response and know/understand customers

Product Postponement at HP


2100


4050


5000

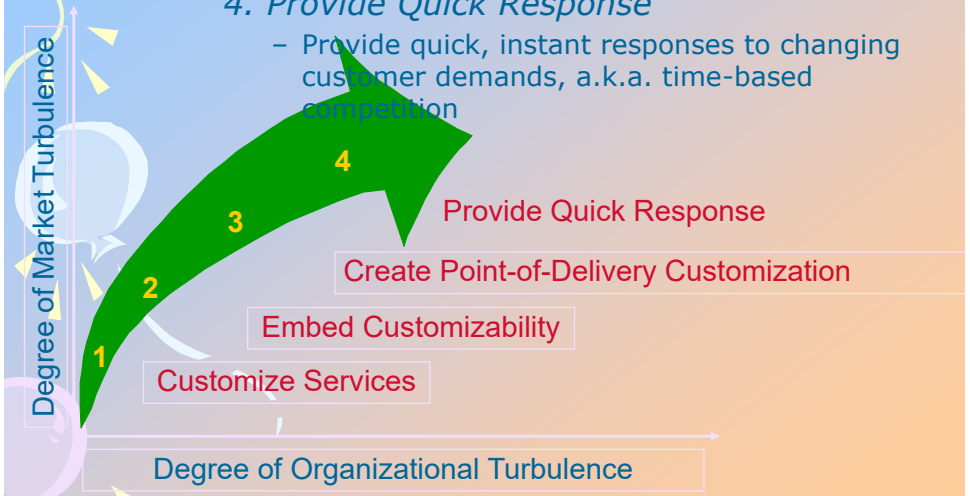

8100

- Distribution Problem:
  - Printers are manufactured for countries with varying voltages
  - Elapsed time b/n distributor's order entry and receipt: ~1 month
  - Demands often changed during transit
  - Factory shipped to three distinctly different markets
- Distribution Solution:
  - Customization shifted to distribution centers
  - Power supply was modularized to allow for postponement
  - Resulted in reduction of transportation lead time and unit costs
  - Backorders and excess inventory were virtually eliminated

Step 4: Provide Quick Response

4. Provide Quick Response

- Provide quick, instant responses to changing customer demands, a.k.a. time-based competition



Step 4: Provide Quick Response

Notes:

- Must shorten product development process
- Reduce tool set-up times in manufacturing
- Shorten order-to-delivery cycle
- Sustainability of competitive advantage depends on degree of successful transformation within organization

Warning:

- Lots of organization changes are required for success
- Large capital investments for Computer Aided Manufacturing (CAM), Flexible Manufacturing Systems (FMS), Agile Manufacturing Systems (AMS), or Reconfigurable Manufacturing Systems (RMS)
- Large inventories needed in order to response quickly
- Requires lots of IT to speed response and know/understand customers

National Bicycle Industrial Company (NBIC)

- Kotha (1995) examines three key issues in MC firms:
  - Are mass production and mass customization strategies really as incompatible as suggested by Pine and his co-authors?
  - How does a firm that derives a major portion of its revenues from mass production implement mass customization?
  - How does knowledge creation enable strategic flexibility in the context of mass customization?
- Kotha examines National Bicycle Industrial Company:
  - NBIC is Japan's second largest manufacturer of bicycles and one of Japan's premier MC firms
  - NBIC is also a mass producer of bicycles, deriving over 90% of its sales revenues from mass production

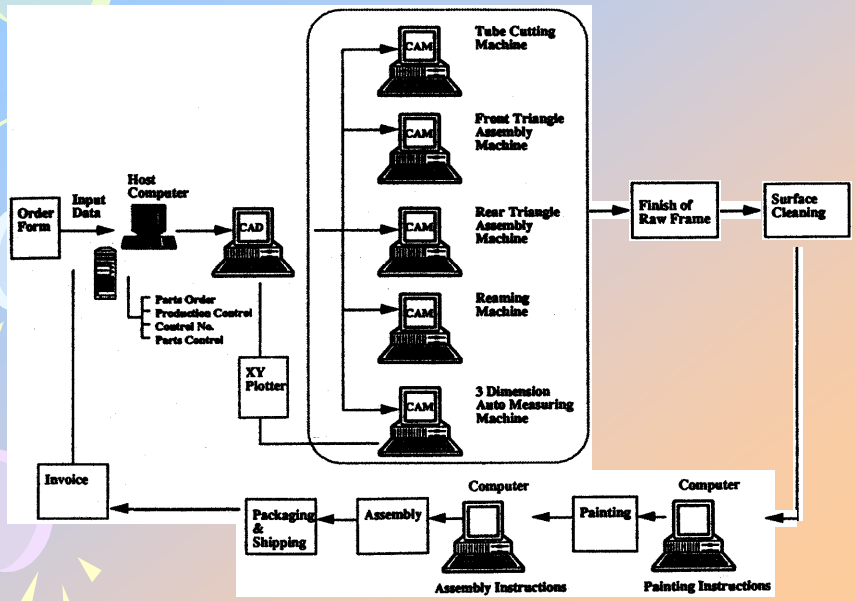
NBIC

- Produces bicycles under three different brand names:
  - *Panasonic* - high quality, high-priced sports and fashion bicycles (top of the line)
  - *National*
  - *Hikari* - basic transportation bicycles from home to work
- NBIC has two factories located next to each other:
  - mass production
  - mass customization
- High-end Panasonic bicycles are produced in *both* the MP and MC factories
  - MP factory employs more line workers
  - MC factory employs best skilled workers

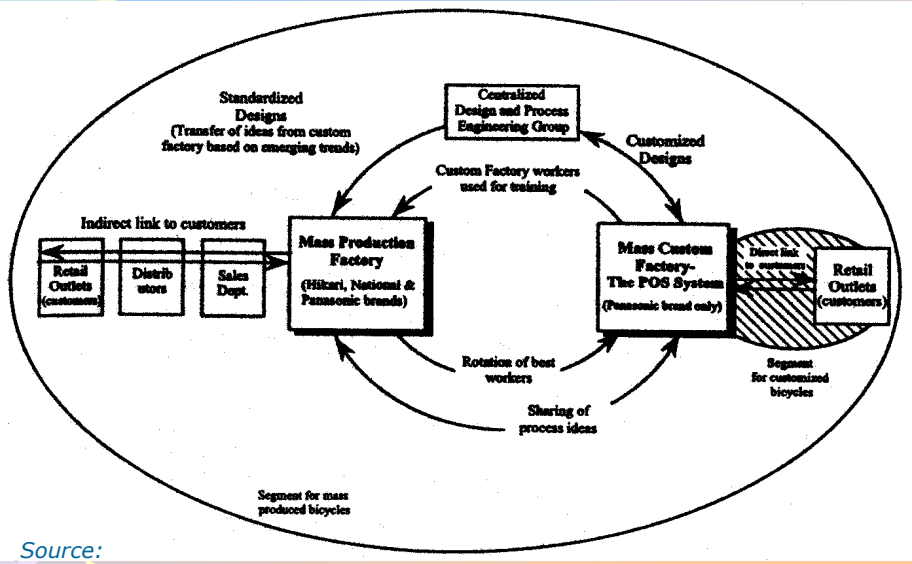
NBIC's Shift to MC

- MC idea originated after NBIC's president visited a famous department store in Osaka and noticed that women could custom order dresses which were delivered in 2 weeks
- Despite opposition, MC factory was fully operational 7 months after department store visit
- Panasonic Ordering System (POS)
  - choose from over 8 million possible variations based on model types, color, frame size, and other features
  - delivered in 2 weeks, not a day more or a day less
  - priced only 20-30% higher
  - production begins after arrival of customer order and specs

Production Process at MC Factory



Interaction Between MP and MC Factories



Source:

- Kotha, S., 1995, "Mass Customization: Implementing the Emerging Paradigm for Competitive Advantage," *Strategic Management Journal*, Vol. 16

Advantages of MC Factory at NBIC

- MC workers train MP workers, improving MP processes
- Innovation at MC firm adopted by MP firm
  - 3-D automated measuring machine
  - software for CAM systems
  - robots for painting
- Lot sizes in MP factory have decreased from 50 units to 20 units
- Customer feedback through MC process used by MP factory to create new and innovative designs (i.e., "fringe awareness")
- Enjoy first mover advantage: MC = Panasonic
- Since Panasonic = MC, Panasonic MP enjoys premium pricing due to brand "image"

Information Technology in Mass Customization

- There are several ways that IT can foster MC:
  - Value Chain Integration
    - connect entire value chain, both internal and external
  - Experience Warehouse
    - maintain electronic database of company knowledge
  - Embedded Customization
    - embed microprocessors to customize products
  - Segment-of-One Marketing
    - use electronic databases to store and track customer info
  - Precision Pricing
    - price products and services for individual customers

Step 5: Modularize

5. Modularize

- Design modular components that can be configured into a wide variety of end products and services

Step 5: Modularize

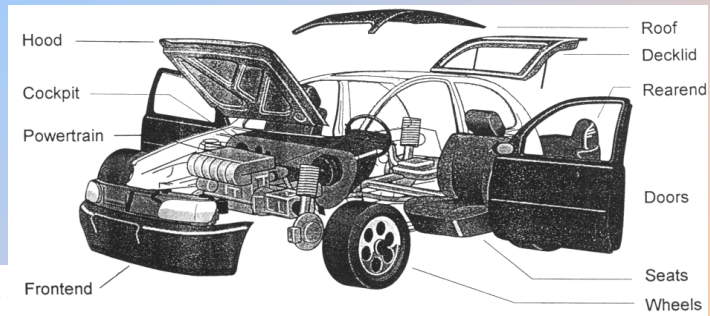
Notes:

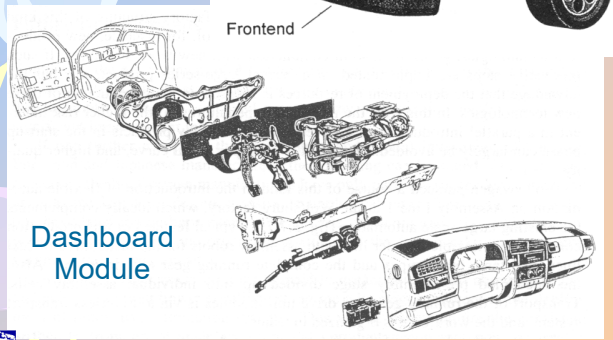
- Economies of scale maintained at component level
- Economies of scope at module level since they are used over and over again in different products
- Organization changes:
  - Marketing must figure out how to sell products without overwhelming customers with choices
  - Designers must modularize designs
  - Production must provide low cost manufacturing

Warnings:

- Modular products are much easier to reverse engineer
- Product is not optimized since competitor can lower cost by reducing modularity; however, this is only for a single product or service
- Modular designs can lead to less innovative solutions over time

Modularity in Automobiles



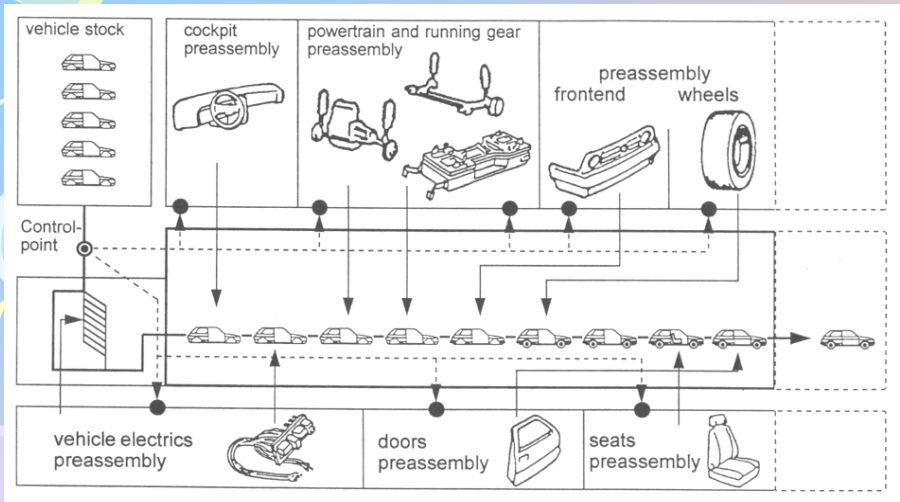


Different Modules in an Automobile

Source:

- Shimokawa, K., Jurgens, U., and Fujimoto, T. (Eds), 1997, Transforming Automobile Assembly, Springer, New York.

Modularity Facilitates Automated Assembly



Source:

- Shimokawa, K., Jurgens, U., and Fujimoto, T. (Eds), 1997, Transforming Automobile Assembly, Springer, New York.