

**Process Choice and Layout
Decisions in Manufacturing and
Services**

Chapter 3

3 Chapter Objectives

Be able to:

- Describe the characteristics of the five classic types of manufacturing processes.
- Discuss how different manufacturing process choices support different market requirements.
- Explain how different manufacturing processes can be linked together via the supply chain.
- Describe the critical role of customization in manufacturing, including the degree and point of customization, as well as upstream versus downstream activities.
- Discuss the three dimensions that differentiate services from one another - the service package, customization, and customer contact - and explain the different managerial challenges driven by these dimensions.
- Position a service on a conceptual model and explain the underlying managerial challenges.
- Explain how different service processes support different market requirements.
- Develop a product-based layout using line balancing, and calculate basic performance measures for the line.
- Develop a functional layout based on total distance traveled.

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3 Manufacturing Process Decisions

- Consider the impact of people, facilities and physical layouts, and information systems working together.
- Consider the effect of the manufacturing processes on the overall business strategy.
- Consider the impact of many different types of manufacturing processes working together.

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3 Selecting a Manufacturing Process

- What are the physical requirements of the company's product?
- How similar to one another are the products the company makes?
- What are the company's production volumes?
- Where in the value chain does customization take place (if at all)?

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3 Types of Manufacturing Processes

- Continuous Flow
- Production Line
- Batch
- Job Shop
- Fixed Position Layout

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3 Continuous Flow

- Large production volumes
- High level of automation
- Basic material passed along, converted as it moves
- Usually cannot be broken into discrete units
- Usually very high fixed costs and inflexible

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3 Production Line

- High-volume production of standard items with identical or highly similar designs
- Processes arranged by product flow
- Often “paced”
- Highly efficient, but not too flexible
- Resources are arranged sequentially

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3 Batch Manufacturing

- Items are moved through the different manufacturing steps in groups, or batches
- Moderate volumes, multiple products
- Sequence of steps is not as tightly linked as a production line
- Strikes a balance between the flexibility of a job shop and the efficiency of a production line

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Job Shops

- General-purpose equipment and broadly skilled workers
- Functional layout: Work areas are arranged by function
- Requirements can change dramatically from one job to the next
- Highly flexible but not very efficient

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Fixed-Position Layout

- The position of the product is fixed.
- Materials, equipment, and workers are transported to and from the product.
- Used in industries where the products are very bulky, massive, or heavy and movement is problematic

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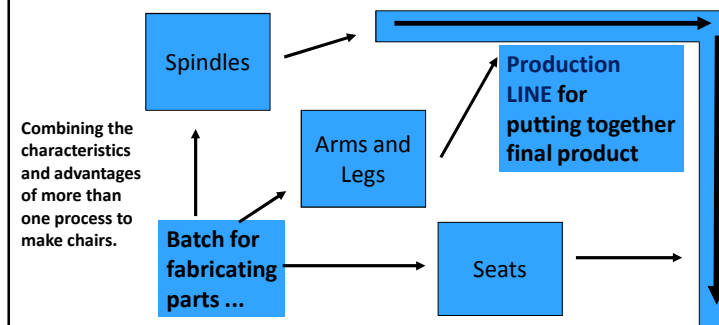
Hybrid Manufacturing Processes

- A manufacturing process that seeks to combine the characteristics and advantages of more than one classic process.
 - Machining centers
 - Group technology
 - Flexible manufacturing systems

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Hybrid Manufacturing Processes



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3 Linking Manufacturing Processes Across the Supply Chain

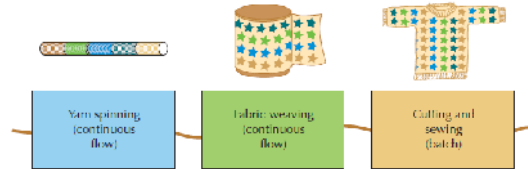


Figure 3.4

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3 The Product-Process Matrix

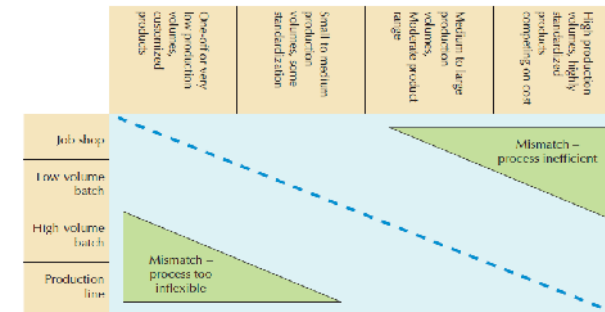
Based on R. Hayes and S. Wheelwright, *Restoring Our Competitive Edge: Competing through Manufacturing* (New York: Wiley, 1984)

Figure 3.5

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3 Four Levels of Customization

- **Make-to-stock (MTS)** – Products that require no customization.
- **Assemble-to-order (ATO)** – Products that are customized only at the very end of the manufacturing process.
- **Make-to-order (MTO)** – Products that use standard components but have customer-specific final configuration of those components.
- **Engineer-to-order (ETO)** – Products that are designed and produced from the start to meet unusual customer needs or requirements.

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3 Customization in the Supply Chain

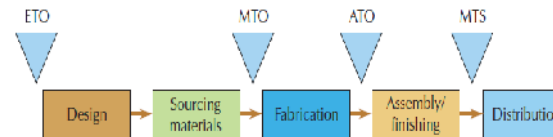


Figure 3.6

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3 Law of Variability

The greater the random variability either demanded of the process or inherent in the process itself or in the items processed, the less productive the process is.

© Schmenner and Swink (1998)

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3 Customization in the Supply Chain

- **When customization occurs early in the supply chain:**
 - Flexibility in response to unique customer needs will be greater.
 - Lead times to the customer will tend to be longer.
 - Products will tend to be more costly.

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3 Customization in the Supply Chain

- **When customization occurs late in the supply chain:**
 - Flexibility in response to unique customer needs will be limited.
 - Lead times to the customer will tend to be shorter.
 - Products will tend to be less costly.

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3 How different services are organized and managed

- **The service package**
- **The degree of customization**
- **The level of customer contact**

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3 The service package

- **Includes all value-added physical and intangible activities that a service organization provides to the customer.**
 - The greater the emphasis on physical activities, the more attention will be directed to capital expenditures, material costs, and other tangible assets.
 - The greater the emphasis on intangible activities, the more critical are the training and retention of skilled employees and the development of the firm's knowledge assets.

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3 Service customization

- **Ranges from highly customized to standardized.**
 - As the degree of customization increases, the service package becomes less predictable and more variable.

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3 Customer contact

- **Differs from customization – relates to the importance of front-room or back-room operations.**
 - Front Room – The physical or virtual point where the customer interfaces directly with the service organization.
 - Back Room – The part of a service operation that is completed without direct customer contact.

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3 Front Room vs. Back Room

- | | |
|---|---|
| ▪ Front room – what the customer can see | ▪ Back room – what the customer does not see |
| ▪ Managed for flexibility and customer service | ▪ Managed for efficiency and productivity |

Customer lobbies, bank teller, receptionist

Package sorting, car repair, blood test analysis, accounting department

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3 Managerial Challenges in Service Environments

Nature of the service package	Primarily physical activities → Greater emphasis on managing physical assets. (Airline, trucking firm)	Primarily intangible activities → Greater emphasis on managing people and knowledge assets. (Law firm, software developer)
Degree of customization	Lower customization → Greater emphasis on closely controlling the process and improving productivity. (Quick-change oil shop)	Higher customization → Greater emphasis on being flexible and responsive to customers' needs. (Full-service car repair shop)
Degree of customer contact	Lower contact → More of the service package can be performed in the back room. Service layout, location, and hours will be based more on cost and productivity concerns. (Mail sorting)	Higher contact → More of the service package must be performed in the front room. Service layout, location, and hours must be designed with customer convenience in mind. (Physical therapist)

Table 3.2

3 - 25

3 Service Blueprinting

- **Service Blueprinting - A specialized form of business process mapping that lays out the service process from the viewpoint of the customer and parses out the organization's service actions based on:**
 - The extent to which an action involves direct interaction with the customer.
 - Whether an action takes place as a direct response to a customer's needs.

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3 Service Blueprinting Template

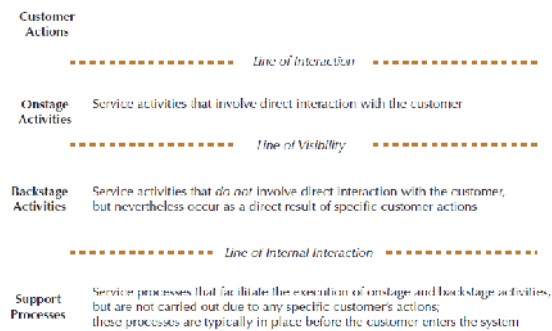


Figure 3.9

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3 Service Blueprinting

- | | |
|------------------------|--------------------------------|
| Processes | Separations |
| ▪ Customer actions | ▪ Line of interaction |
| ▪ Onstage activities | ▪ Line of visibility |
| ▪ Backstage activities | ▪ Line of internal interaction |
| ▪ Support | |

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A Conceptual Model of a Service Process

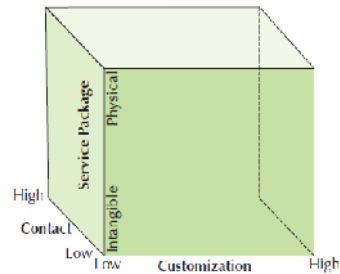


Figure 3.12

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Positioning a Typical Community Hospital

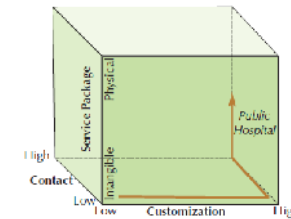


Figure 3.13

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Positioning a Birthing Center

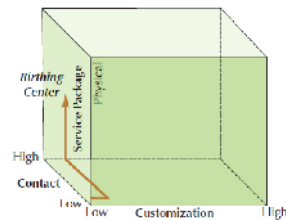


Figure 3.14

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Layout Decisions

- **Product-based layout** – Arranges resources sequentially, according to the steps required to make a product or provide a service.
- **Functional layout** – Physically groups resources by function.
- **Cellular layout** – Production resources are dedicated to a subset of products with similar requirements.
- **Fixed position layout** – Productive resources are moved to where the product is being made or service is being provided.

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3 Line Balancing

- Line balancing – a technique used in developing product-based layouts.
- Improve takt time:
 - Minimizes number of workstations
 - Minimizes idle time

$$\text{Takt time} = \frac{\text{available production time}}{\text{required output rate}}$$

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3 Line Balancing

- Identify all steps, their relationships, and times required.
- Draw a precedence diagram.
- Determine takt time (time available divided by desired output rate).
- Determine minimum number of workstations required (total process time divided by takt time).
- Assign tasks to workstations according to precedence and total time for each to not exceed takt time.
- Evaluate solution for times per workstation, % idle time, and efficiency delay (100% - % idle time).

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3 Precedence Diagram Example (with workstation task assignments)

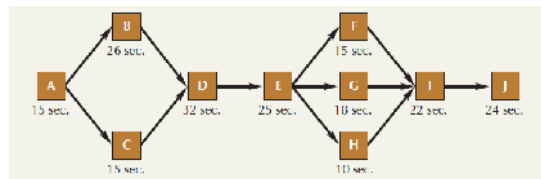


Figure 3.15

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3 Assigning Department Locations in Functional Layouts

- Minimize the total distance traveled
 - Determine distances between functional units
 - Determine numbers of interactions between units
 - Multiply distances times respective number of interactions
 - Revise original layout for minimum total distance after first locating functions best for process material flows

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Manufacturing and Services Case Study

Loganville Window Treatments

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