

Introduction to Operations Management

Chapter 1

These slides are based in part on slides that come with Cachon & Terwiesch book *Matching Supply with Demand* <http://cachon-terwiesch.net/3e/>. If you want to use these in your course, you may have to adopt the book as a textbook or obtain permission from the authors Cachon & Terwiesch.

Learning Objectives

- ◆ Operations Management Introduction.
- ◆ Manufacturing and Service Operations.
- ◆ How can Operations Management help?

OM = Operations Management

- ◆ Management of ANY activities/process that create goods and provide services
 - » Exemplary Activities:
 - ◆ Forecasting
 - ◆ Scheduling,
 - ◆ Quality management

- ◆ Why to study **OM**
 - » Cost and profit breakdown at a typical manufacturing company
 - » How to make more profit?
 - ◆ Cost cutting.
 - ◆ Which costs affect the revenue?
 - » Management of operations is critical to create and maintain competitive advantages

| |
|-------------------------------|
| Profit 10% |
| <i>OM Cost 20%</i> |
| Marketing Cost 25% |
| Manufacturing Cost 45% |

Operations Management

- ◆ Operations management: The management of the efficient transformation of inputs into outputs to effectively satisfy customers.
- ◆ The active role of operations:
 - **Inputs** become **Outputs** after some **Transformation** (Process or Operation)
 - Food processing example:

| Inputs | Transformation | Outputs |
|---------------------------------|-------------------------|-------------------|
| Energy, Raw vegetables | Cleaning | Clean vegetables |
| Energy, Metal sheets | Cutting/Rolling/Welding | Cans |
| Energy, Vegetables | Cutting/Chopping | Cut vegetables |
| Energy, Water, Vegetables | Cooking | Boiled vegetables |
| Energy, Cans, Boiled vegetables | Placing | Can food |

Operations in services: Health care

| Inputs | Processes | Outputs |
|------------------|-------------|------------------|
| Doctors, nurses | Examination | Healthy patients |
| Hospital | Surgery | |
| Medical Supplies | Monitoring | |
| Equipment | Medication | |
| Laboratories | Therapy | |

SOM offers medical management MBA and Master of Science
See <http://som.utdallas.edu/amme/index.html>.

Question: What are Inputs, Processes and Outputs in education?
Who is the customer?

Operations are everywhere !

| Operations | Examples |
|------------------------|--|
| Goods producing | Farming, mining, construction |
| Storage/transportation | Warehousing, trucking, mail, taxis, buses, hotels |
| Exchange | Trade, retailing, wholesaling, renting, leasing, loans |
| Entertainment | Radio, movies, TV, concerts, recording |
| Communication | Newspapers, journals, radio, TV, telephones, satellite |

OM at the core of Businesses



◆ Three basic functions

– Operations/Production

- » Goods oriented (manufacturing and assembly)
- » Service oriented (health care, transportation and retailing)
- » Value-added (the essence of the operations functions)

– Finance-Accounting

- » Budgets (plan financial requirements), Provision of funds

– Marketing

- » Selling, Promoting, Assessing customer wants and needs



Systems (Holistic) Approach

- ◆ Emphasize interrelations among subsystems.
- ◆ A systems approach is essential whenever something is being designed, redesigned, implemented, or improved. It is important to take into account the impact on all parts of the system.
- ◆ Example: A new feature is added to a product.
 - Designer must take into account how customers will view the change, instructions for using new feature, the cost, training of workers, production schedule, quality standard, advertising must be informed about the new feature.
 - A new feature: Suitcase wheels

“The whole is greater than the sum of the parts.”

Who has the D(ecision)?

- ◆ Global vs. Local decision makers
 - How much authority local businesses should have to tailor products to the local tastes / market conditions?
- ◆ Center vs. Business unit
 - Should a parent company have a say in a subsidiary's capital investment?
- ◆ Function vs. Function
 - Does product development or marketing decide on the standard features of a car?
- ◆ Inside vs. Outside partners
 - Should the U.S. apparel manufacturers supervise hiring practices and monitor working conditions at their foreign suppliers?

◆ Based on Who has the D? By Rogers and Blenko. HBR January 2006.

Degree of Standardization !

◆ Standardized output

– Take advantage of

- » standardized methods,
- » less skilled workers,
- » standard materials.

◆ Example: Iron, Wheat, most of commodities

◆ Customized output

– Each job is different

– Workers must be skilled

◆ Example: Hair cut, outputs of most service operations.

Manufacturing vs. Service Operations

◆ Production of goods

– Tangible products

- » Automobiles, Refrigerators, Aircrafts, Coats, Books, Sodas

◆ Services

– Repairs, Improvements, Transportation, Regulation

- » Regulatory bodies: Government, Judicial system, FAA, FDA
- » Entertainment services: Theaters, Sport activities
- » Exchange services: Wholesale/retail
- » Appraisal services: Valuation, House appraisal
- » Security services: Police force, Army
- » Education: Universities, K-12 schools
- » Financial services: Retail banks, Rating agencies, Investment banks

Manufacturing vs. Service Operations

◆ Differences with respect to

1. Customer contact
2. Uniformity of input
3. Labor content of jobs
4. Uniformity of output
5. Measurement of productivity
6. Production and delivery
7. Quality assurance
8. Amount of inventory

Manufacturing vs. Services

| Characteristic | Manufacturing | Service |
|---|---------------|------------|
| Output | Tangible | Intangible |
| Customer contact | Low | High |
| Uniformity of output | High | Low |
| Labor content | Low | High |
| Uniformity of input | High | Low |
| Measurement of productivity | Easy | Difficult |
| Opportunity to correct quality problems | Easy | Difficult |



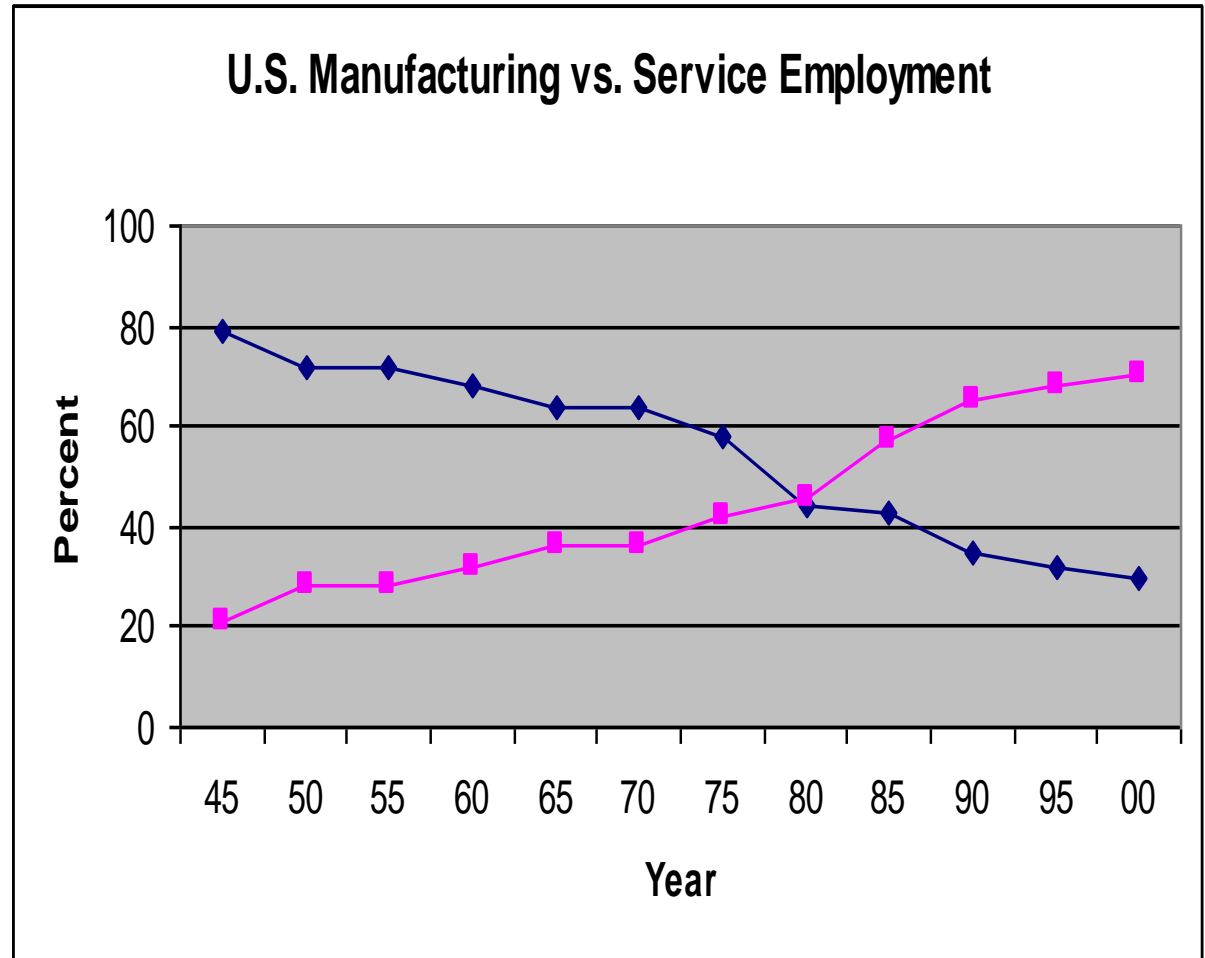
High percentage goods



Low percentage goods

Manufacturing vs. Service Industries in the U.S.

| Year | Mfg. | Service |
|------|------|---------|
| 45 | 79 | 21 |
| 50 | 72 | 28 |
| 55 | 72 | 28 |
| 60 | 68 | 32 |
| 65 | 64 | 36 |
| 70 | 64 | 36 |
| 75 | 58 | 42 |
| 80 | 44 | 46 |
| 85 | 43 | 57 |
| 90 | 35 | 65 |
| 95 | 32 | 68 |
| 00 | 30 | 70 |



Responsibilities of Operations Management

◆ Planning

- Capacity, utilization
- Location
- Choosing products or services
- Make or buy
- Layout
- Projects
- Scheduling
- Market share
- Plan for risk reduction, plan B?
- Forecasting

◆ Controlling

- Inventory
- Quality
- Costs

◆ Organization

- Degree of standardization
- Subcontracting
- Process selection

◆ Staffing

- Hiring/lay off
- Use of overtime
- Incentive plans

In a nutshell, the challenge is

“Matching the Supply with Demand”



SUPPLY SIDE



DEMAND SIDE

Supply Does Not Naturally Match Demand

- ◆ Inventory results from a mismatch between supply and demand
- ◆ Mismatch can take one of the following two forms
 - **Supply** waits for **Demand**
 - » Inventory = Finished goods and resources
 - **Demand** waits for **Supply**
 - » Inventory is negative or said to be backordered in manufacturing
 - » Inventory = Waiting customers in services
- ◆ Mismatch happens because
 - the demand varies
 - the capacity is rigid and finite.
 - » If the capacity is infinite, products (or services) can be provided at an infinite rate and instantaneously as the demand happens. Then there is no mismatch.

Consequences of the Mismatch are Severe

| | Air travel | Emergency room | Retailing | Iron ore plant | Pacemakers |
|---|---|--|--|---|--|
| Supply | Seats on specific flight | Medical service | Consumer electronics | Iron ore | Medical equipment |
| Demand | Travel for specific time and destination | Urgent need for medical service | Consumers buying a new video system | Steel mills | Heart surgeon requires pacemaker at exact time and location |
| Supply exceeds demand | Empty seat | Doctors, nurses, and infrastructure are under-utilized | High inventory costs; few inventory turns | Prices fall | Pacemaker sits in inventory |
| Demand exceeds supply | Overbooking; customer has to take different flight (profit loss) | Crowding and delays in the ER, potential diversion of ambulances | Foregone profit opportunity; consumer dissatisfaction | Prices rise | Foregone profit (typically not associated with medical risk) |
| Actions to match supply and demand | Dynamic pricing; booking policies | Staffing to predicted demand; priorities | Forecasting; quick response | If prices fall too low, production facility is shut down | Distribution system holding pacemakers at various locations |
| Managerial importance | About 30% of all seats fly empty; a 1-2% increase in seat utilization makes difference between profits and losses | Delays in treatment or transfer have been linked to death; | Per unit inventory costs for consumer electronics retailing commonly exceed net profits. | Prices are so competitive that the primary emphasis is on reducing the cost of supply | Most products (valued \$20k) spend 4-5 months waiting in a trunk of a sales person before being used |

More Examples of Demand-Supply Mismatch

- ◆ **Compaq** estimated that it lost \$0.5 B to \$1 B in sales in 1995 because laptops were not available when and where needed
- ◆ In 02-03 flu season, 12 M of 95 M doses of **flu vaccines** were not used in the US. For 03-04 season, 83=95-12 M doses were produced. In 03-04 season, there were widespread vaccine shortages causing flu-related deaths.
- ◆ **British Airways** had seat utilization of 70.3% in the early 2000s. If it could increase utilization by 0.33% (by flying one more person on a 300 seat aircraft), it would create additional revenues equal to quarter 2 profits of 2001, which was \$65 M.
- ◆ In 2000, **Playstation 2 of Sony** were backordered by several weeks due to high demand. But **X-Box of Microsoft** did not sell well and was discounted by \$100 per unit.
 - Discounting is a symptom of a problem in operations rather than being a usual practice.
- ◆ In 2009, **AT&T's telecommunication network capacity** does not suffice for 3G phone data flow demands. Calls cannot be made and are dropped.

Who Cares About Inventory in Manufacturing?



There is \$1.16 trillion (\$1,160,000,000,000) of inventory in the US economy.

The Economic Impact is Worse in Services



In service, waiting customers are even more important, but this inventory never shows up on the financial records.

How can OM Help?

Step 1: Help Making Operational Trade-Offs

Call center of Deutsche Bahn

Objective: 80% of incoming calls wait less than 20 seconds

Early 2003: 30% of incoming calls wait less than 20 seconds

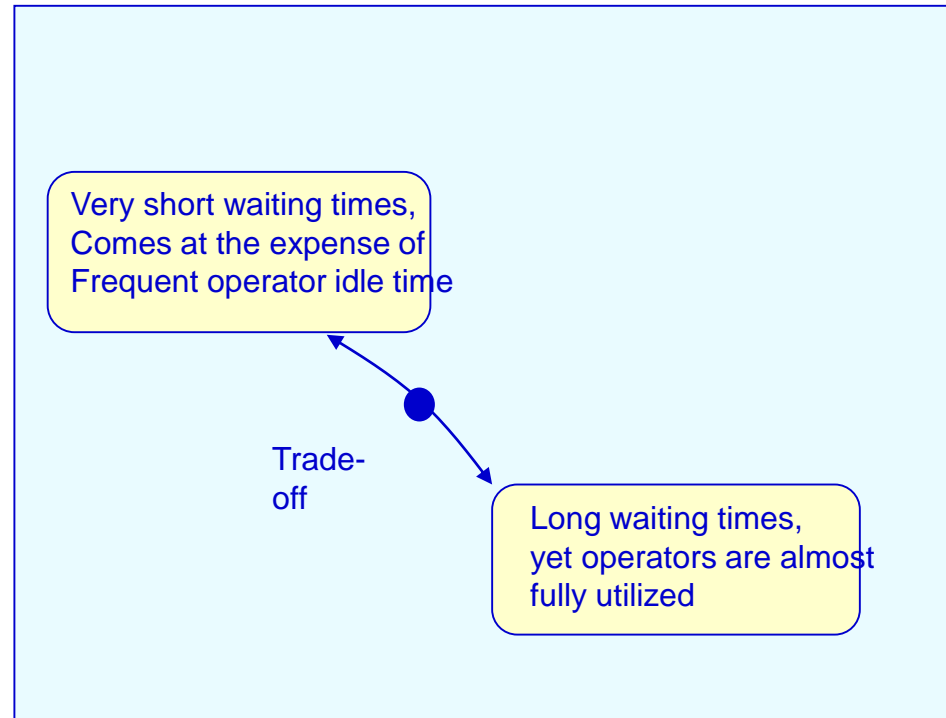
Problem: Staffing levels of call centers / impact on efficiency

OM Provides **tools** to balance responsiveness with efficiency

Responsiveness

High

Low



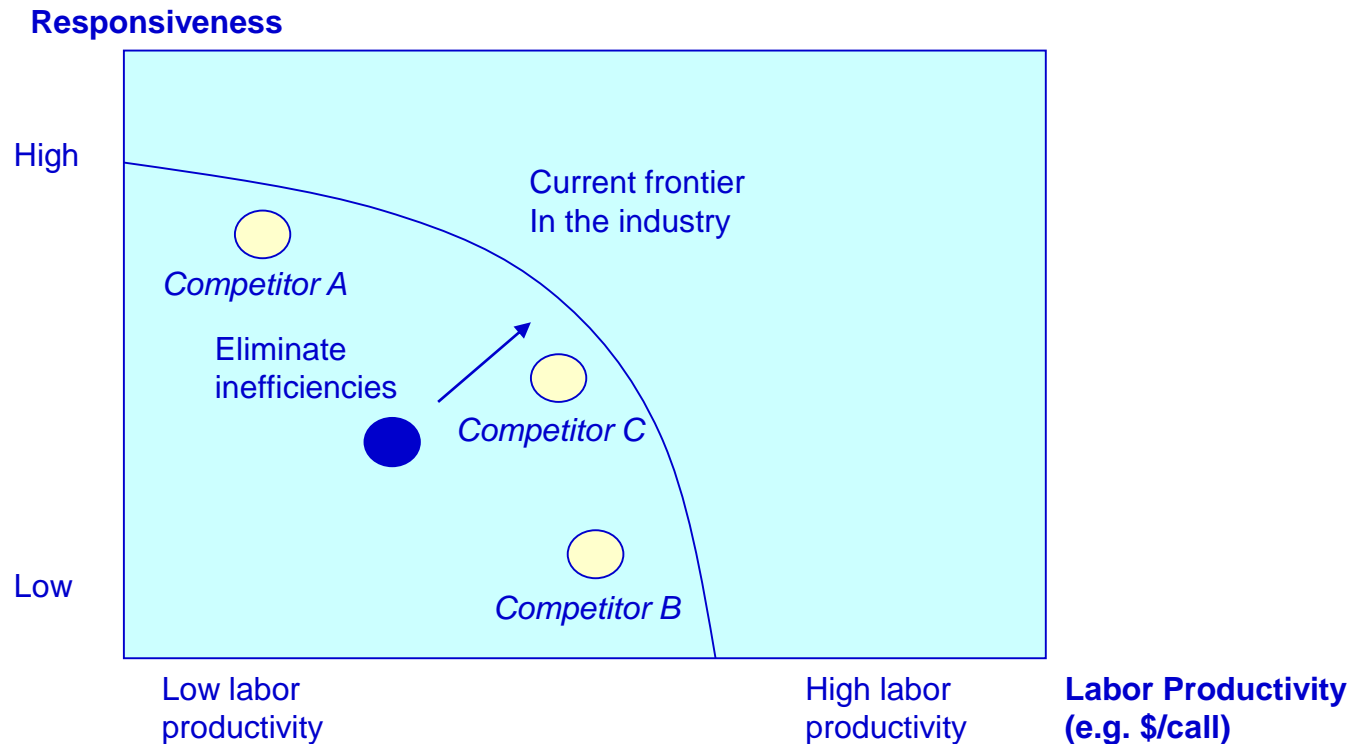
Low labor productivity

High labor productivity

Labor Productivity
(e.g. \$/call)

How can OM Help?

Step 2: Overcome Inefficiencies



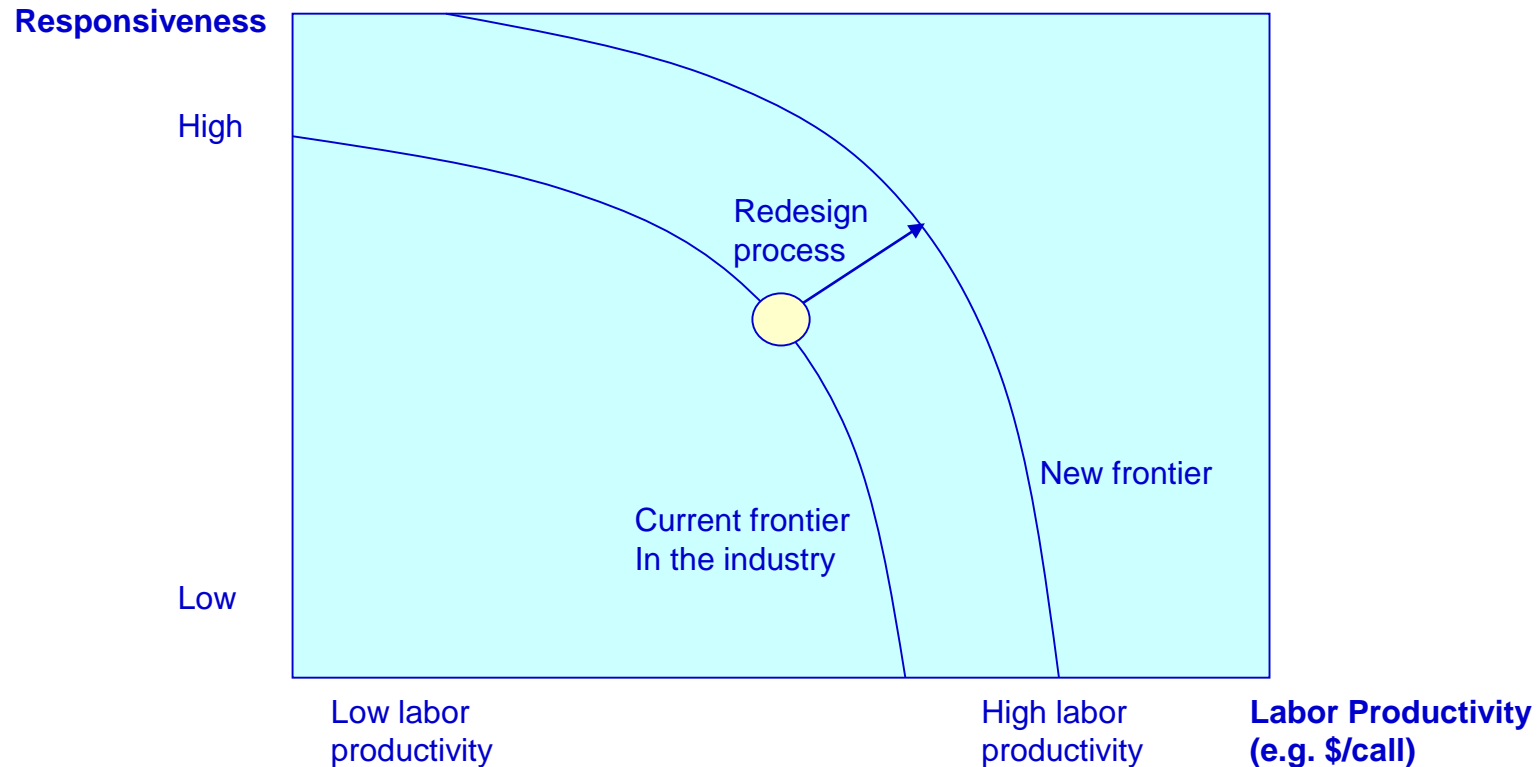
Example:

- Benchmarking shows the pattern above
- Do not just manage the current system... Change it!

OM Provides **tools** to identify and eliminate inefficiencies

How can OM Help?

Step 3: Evaluate Redesigns/New Technologies



Example:

- What will happen if we develop / purchase technology X?
 - Technology X keeps a database of customers and routes them quickly to specialized operators.
- Better technologies are always (?) nice to have, but will they pay for themselves?

OM provides **tools** to evaluate system designs before implementation

- What are the Tools?

- They are the Models

- ◆ **Model:** A structure which has been built purposefully to exhibit features and characteristics of another object.
 - A **map** is a model of
 - A **toy car** is a model of
 - A **movie** is a model of
 - An **OM course** is a model of
- ◆ **For**
 - Improved understanding and communication
 - » Easy to use, less expensive
 - Experimentation
 - » Analysis of tradeoffs
 - » Enable “what if” questions
 - Standardization and organization for analysis
 - » Increase understanding of the problem
 - » Consistent tool
 - » Standardized format
 - » Specific objectives
- ◆ **Abstraction vs. computability**

Types of Models

- ◆ Physical models (prototypes)
- ◆ Schematic models (Graphs, charts, pictures)
- ◆ Mathematical models, by application area
 - » Statistical models
 - ◆ Linear regression
 - » Linear programming
 - » Queuing techniques
 - » Inventory models
 - ◆ EOQ model
 - » Project management models
 - » Networks

Types of Mathematical Models by Employed Technique

- ◆ Simulation models : to test a proposed idea
 - Monte Carlo Simulation
- ◆ Optimization models : to create an optimal idea
 - Linear programming
- ◆ Pattern recognition models : to recognize a pattern
 - Statistics, Forecasting, data mining

Summary

- ◆ Operations Management Introduction.
- ◆ Manufacturing and Service Operations.
- ◆ How can Operations Management help?