

Lecture No.1 Chapter 1

Engineering Economic Decisions

- Rational Decision- making Process
- The Engineer's Role in Business
- Types of Strategic Engineering Economic Decisions
- Fundamental Principles in Engineering Economics



Bose Corporation

CHAPTER OPENING STORY - BOSE CORPORATION

Dr. Amar Bose, a graduate of electrical engineering, an MIT professor, and Chairman of Bose Corporation.

He invented a directional home speaker system that reproduces the concert experience.

He formed Bose Corporation in 1964 and became the world's No.1 speaker maker.

He became the 288th wealthiest American in 2002 by Forbes magazine.

Engineering Economics Overview

- Rational Decision-Making Process
- Economic Decisions
- Predicting Future
- Role of Engineers in Business
- Large-scale engineering projects
- Types of strategic engineering economic decisions

RATIONAL DECISION- MAKING PROCESS

1. Recognize a decision problem
2. Define the goals or objectives
3. Collect all the relevant information
4. Identify a set of feasible decision alternatives
5. Select the decision criterion to use
6. Select the best alternative



WHICH CAR TO LEASE? SATURN VS. HONDA

1. Recognize a decision problem → Need a car
2. Define the goals or objectives → Want mechanical security
3. Collect all the relevant information → Gather technical as well as financial data
4. Identify a set of feasible decision alternatives → Choose between Saturn and Honda
5. Select the decision criterion to use → Want minimum total cash outlay
6. Select the best alternative → Select Honda

FINANCIAL DATA REQUIRED TO MAKE AN ECONOMIC DECISION

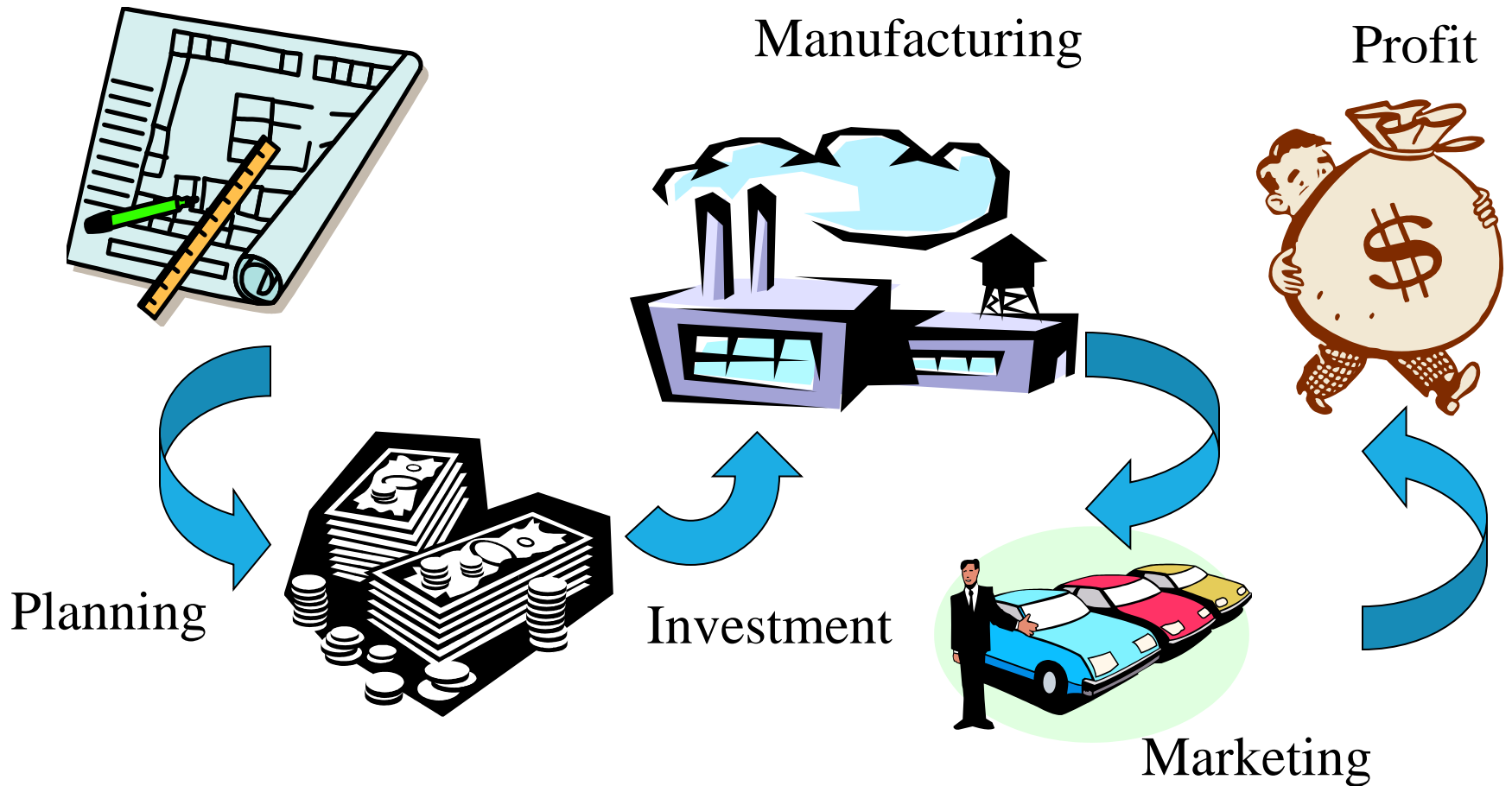
TABLE 11.1 Financial Data for Auto Leasing: Saturn versus Honda

Auto Leasing	Saturn	Honda	Difference Saturn – Honda
1. Manufacturer's suggested retail price (MSRP)	\$15,573	\$15,810	– \$273
2. Lease length	48 months	48 months	
3. Allowed mileage	48,000 miles	48,000 miles	
4. Monthly lease payment	\$219	\$248	– \$29
5. Mileage surcharge over 36,000 miles	\$0.20 per mile	\$0.15 per mile	+ \$0.05 per mile
6. Disposition fee at lease end	\$0	\$250	\$250
7. Total due at signing:			
• First month's lease payment	\$219	\$248	
• Down payment	\$1,100	\$800	
• Administrative fee	\$495	\$0	
• Refundable security deposit	<u>\$200</u>	<u>\$225</u>	
Total	\$2,014	\$1,273	+\$741

• Models compared: The 2003 Saturn ION3 with automatic transmission and A/C and the 2003 Honda Civic DX coupe with automatic transmission and A/C.

• Disposition fee: This is a paperwork charge for getting the vehicle ready for resale after the lease end.

ENGINEERING ECONOMIC DECISIONS



PREDICTING THE FUTURE

Estimating a Required investment

Forecasting a product demand

Estimating a selling price

Estimating a manufacturing cost

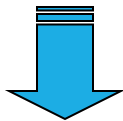
Estimating a product life



ROLE OF ENGINEERS IN BUSINESS

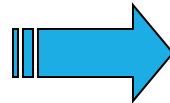
Create & Design

- Engineering Projects



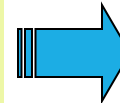
Analyze

- Production Methods
- Engineering Safety
- Environmental Impacts
- Market Assessment



Evaluate

- Expected Profitability
- Timing of Cash Flows
- Degree of Financial Risk



Evaluate

- Impact on Financial Statements
- Firm's Market Value
- Stock Price

ACCOUNTING VS. ACCOUNTING

Evaluating past performance



Accounting

Past

Evaluating and predicting future events



Engineering Economy

Future

Present

TWO FACTORS IN ENGINEERING ECONOMIC DECISIONS

The factors of **time** and **uncertainty** are the defining aspects of any engineering economic decisions

A LARGE-SCALE ENGINEERING PROJECT

Requires a large sum of investment

Takes a long time to see the financial outcomes

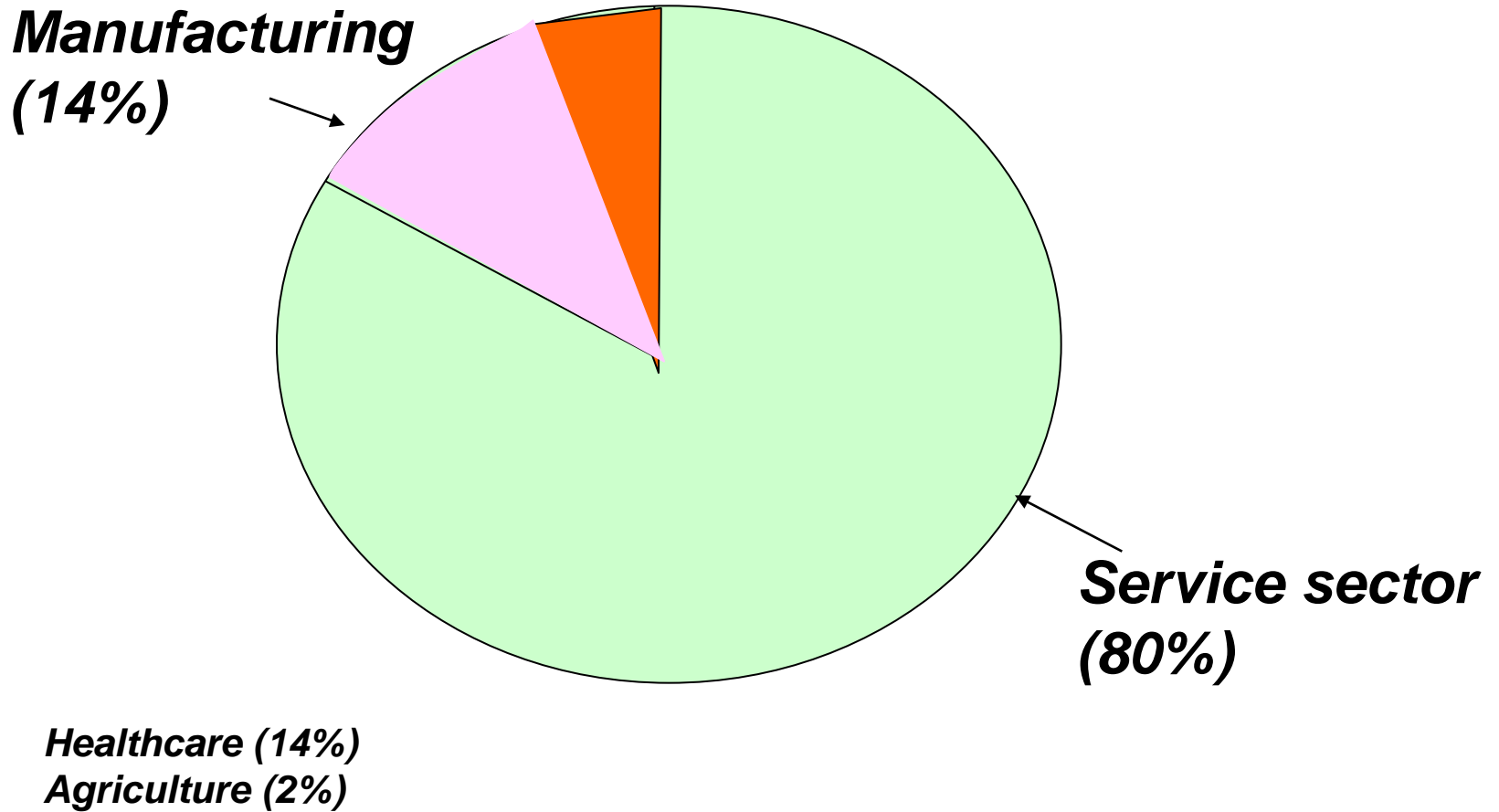
Difficult to predict the revenue and cost streams



TYPES OF STRATEGIC ENGINEERING ECONOMIC DECISIONS IN MANUFACTURING SECTOR

- ❑ Service Improvement
- ❑ Equipment and Process Selection
- ❑ Equipment Replacement
- ❑ New Product and Product Expansion
- ❑ Cost Reduction

U.S. GROSS DOMESTIC PRODUCTS (GDP)



Industrial Employment

Industry	1993 Employment distribution	1983-94 National Average	1994-2005 Projected Change
Manufacturing	12.6%	-0.70%	-7.2%
Services	30.5%	60.0%	39.0%
Retail trade	16.7%	31.1%	13.0%
Financial	8.0%	26.8%	6.3%

Source: Bureau of Economic Analysis/Bureau of Labor Statistics

Types of Strategic Engineering Economic Decisions in Service Sector

- ❑ Commercial Transportation
- ❑ Logistics and Distribution
- ❑ Healthcare Industry
- ❑ Electronic Markets and Auctions
- ❑ Financial Engineering
- ❑ Retails
- ❑ Hospitality and Entertainment
- ❑ Customer Service and Maintenance

Service Improvement

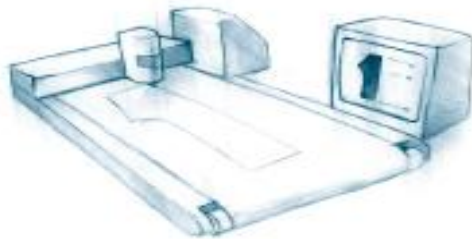
- How many more jeans would Levi need to sell to justify the cost of additional robotic tailors?



A sales clerk measures the customer using instructions from a computer as an aid.



The clerk enters the measurements and adjusts the data based on the customer's reaction to the samples.



The final measurements are relayed to a computerized fabric cutting machine at the factory.



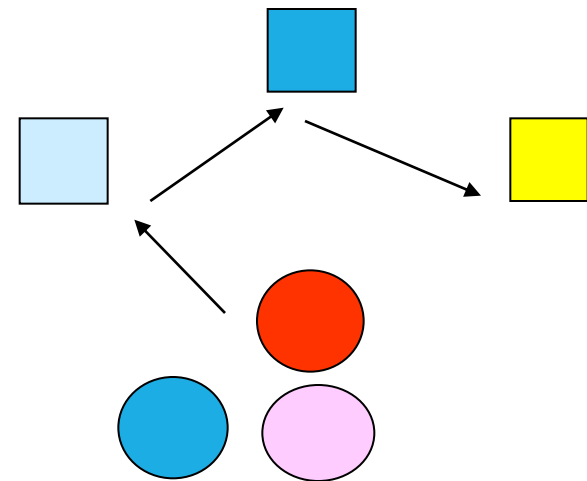
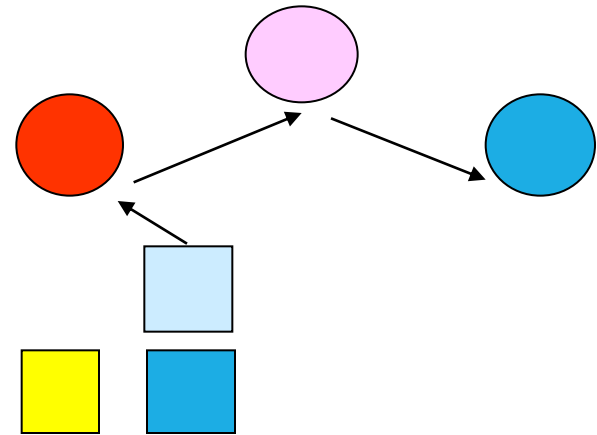
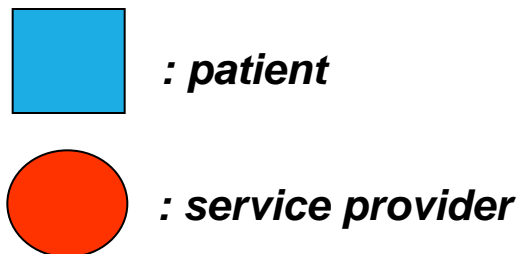
Bar codes are attached to the clothing to track it as it is assembled, washed, and prepared for shipment.

FIGURE 1.6 "From Data to Denim": Making customized blue jeans for women, a new computerized system being installed at some Original Levi's Stores allows women to order customized blue jeans

Example - Healthcare Delivery

Which plan is more economically viable?

- **Traditional Plan:** Patients visit each service provider.
- **New Plan:** Each service provider visits patients

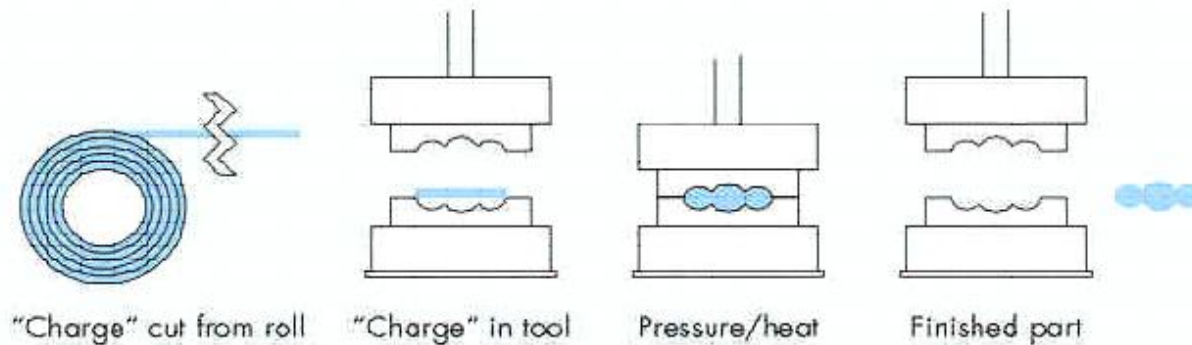


EQUIPMENT & PROCESS SELECTION

How do you choose between the Plastic SMC and the Steel sheet stock for an auto body panel?

The choice of material will dictate the manufacturing process for an automotive body panel as well as manufacturing costs.

WHICH MATERIAL TO CHOOSE?

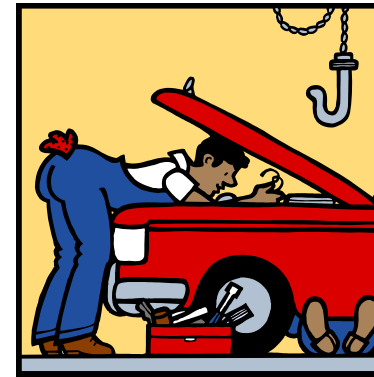


Description	Plastic SMC	Steel Sheet Stock
Material cost (\$/kg)	\$1.65	\$0.77
Machinery investment	\$2.1 million	\$24.2 million
Tooling investment	\$0.683 million	\$4 million
Cycle time (minute/part)	2.0	0.1

EQUIPMENT REPLACEMENT PROBLEM

Now is the time to replace
the old machine?

If not, when is the right
time to replace the old
equipment?



NEW PRODUCT AND PRODUCT EXPANSION

Shall we build or acquire
a new facility to meet the
increased demand?

Is it worth spending
money to market a new
product?



EXAMPLE - MACH 3 PROJECT

R&D investment: \$750 million

Product promotion through advertising: \$300 million

Priced to sell at 35% higher than Sensor Excel (about \$1.50 extra per shave).

Question 1: Would consumers pay \$1.50 extra for a shave with greater smoothness and less irritation?

Question 2: What would happen if the blade consumption dropped more than 10% due to the longer blade life of the new razor?



Gillette's MACH3 Project



**The
Gillette
Company**

COST REDUCTION

Should a company buy equipment to perform an operation now done manually?

Should spend money now in order to save more money later?



FUNDAMENTAL PRINCIPLES OF ENGINEERING ECONOMICS

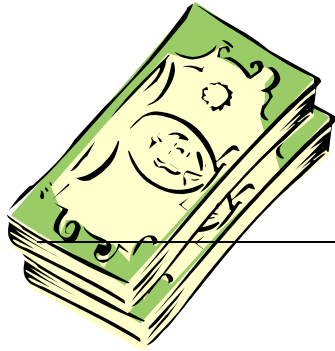
Principle 1: A nearby dollar is worth more than a distant dollar

Principle 2: All it counts is the differences among alternatives

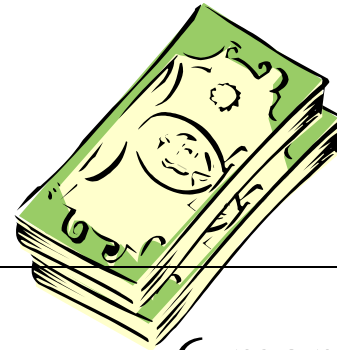
Principle 3: Marginal revenue must exceed marginal cost

Principle 4: Additional risk is not taken without the expected additional return

PRINCIPLE 1: A NEARBY DOLLAR IS WORTH MORE THAN A DISTANT DOLLAR



Today



6-month later

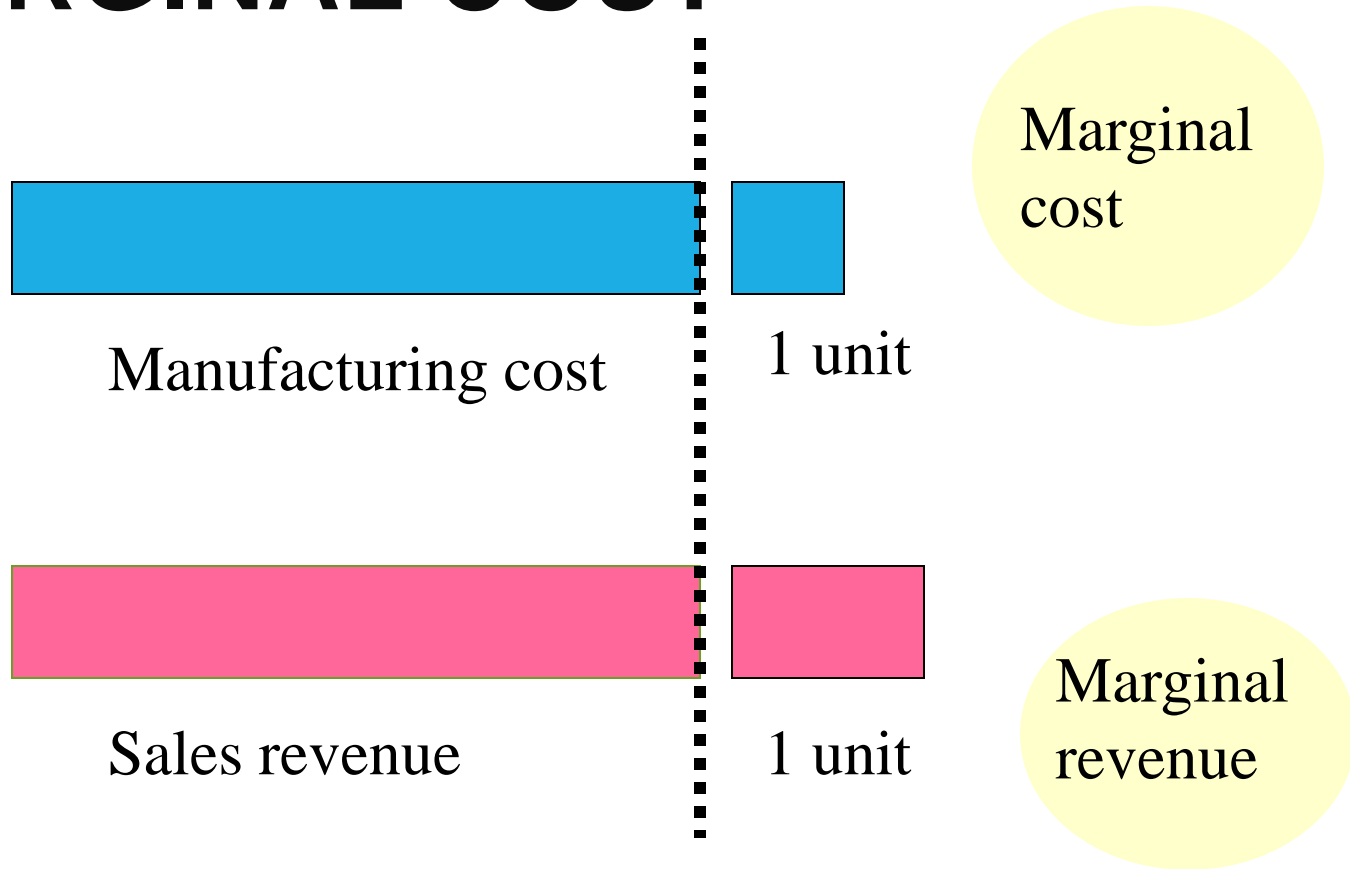
PRINCIPLE 2: ALL IT COUNTS IS THE DIFFERENCES AMONG ALTERNATIVES

Option	Monthly Fuel Cost	Monthly Maintenance	Cash outlay at signing	Monthly payment	Salvage Value at end of year 3
Buy	\$960	\$550	\$6,500	\$350	\$9,000
Lease	\$960	\$550	\$2,400	\$550	0

Irrelevant items in decision making

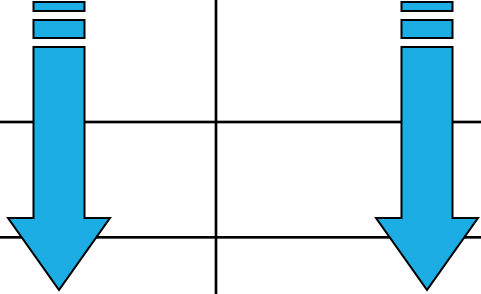


PRINCIPLE 3: MARGINAL REVENUE MUST EXCEED MARGINAL COST



PRINCIPLE 4: ADDITIONAL RISK IS NOT TAKEN WITHOUT THE EXPECTED ADDITIONAL RETURN

Investment Class	Potential Risk	Expected Return
Savings account (cash)	Low/None	1.5%
Bond (debt)	Moderate	4.8%
Stock (equity)	High	11.5%



SUMMARY

The term **engineering economic decision** refers to all investment decisions relating to engineering projects.

The five main types of engineering economic decisions are (1) **service improvement**, (2) **equipment and process selection**, (3) **equipment replacement**, (4) **new product and product expansion**, and (5) **cost reduction**.

The factors of **time** and **uncertainty** are the defining aspects of any investment project.