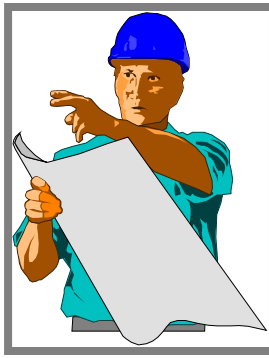
Department of Mechanical Engineering,
Pulchowk campus, Institute of Engineering,
Tribhuvan University

ENGINEERING ECONOMICS

Introduction

Dr. Shree Raj Shakya
2018



Course Objectives

This course aims to provide sound and comprehensive coverage of engineering economics especially the following:

- To **explain how business operates**, how **engineering project decisions are made** within the business, and how **engineering decisions can affect profit** of the firm.
- To **build a thorough understanding of** theoretical and conceptual basis of **financial analysis of project**.
- To **help engineer for making correct/informed financial decisions** when acting **as a team member or project manager** for an **engineering project**.
- To **introduce use of computer based critical decision-making tools** (software) so that engineers can make correct/informed decision under different constraints and uncertainty.

Course outline

- Introduction to engineering economics
- Cost concepts and behavior
- Understanding financial statements
- Time value of money
- Project Evaluation Techniques
- Depreciation
- Income Tax & Discounted Cash-flow models
- Project risk analysis
- Economic analysis in public sector
- Course Presentation

Text books and software

- **Chan S. Park. *"Contemporary Engineering Economics"*, Fifth Edition. Prentice Hall of India Pvt. Ltd., New Delhi. 2011**
- Other Related books
- Excel inbuilt financial analysis packages, Solver, Crystal ball Pro etc.

Evaluation Criteria

Internal Evaluation

Assessment :	**10**
Case Study Project + Presentation :	**8**
(3-4 students in one group)	
Attendance :	**2**
Total :	**20**

Engineering Economics

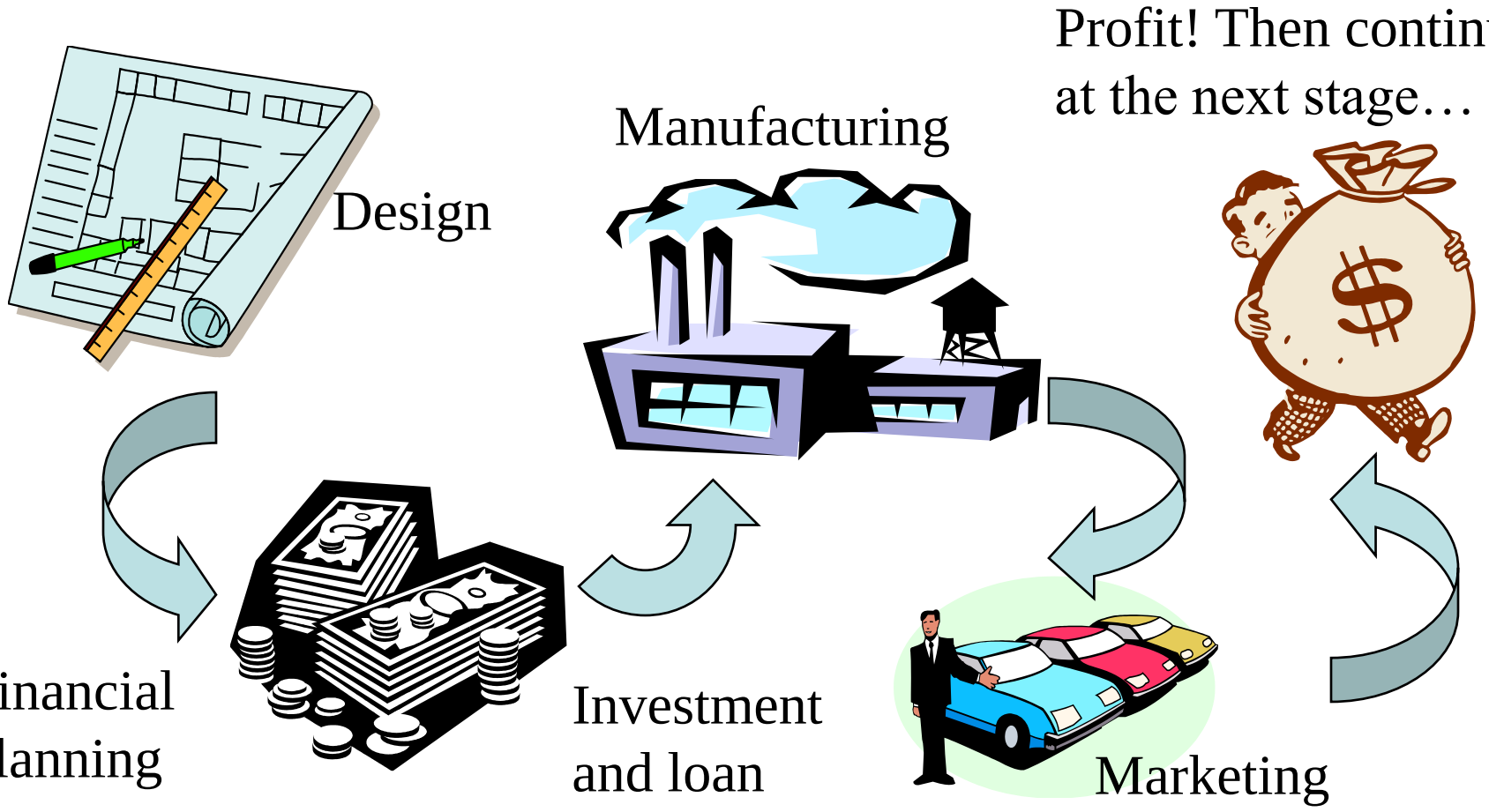
- Engineers **have to participate in various decision-making** process in a business firm or industry.
- They get **involved in various economic decisions** related to engineering projects such as development of a product, purchase of an equipment, construction of plant, dams, building etc.
- **Economics** is the study of **how people use their limited resources** to try **to satisfy unlimited wants**.
- **Engineering Economics** is the **study of how to make economic decisions in engineering projects.**

Rational Decision-Making Process: Example Car to Lease

▪ Recognize the decision problem	• Need to lease a car
▪ Collect all needed (relevant) information	• Gather technical and financial data
▪ Identify the set of feasible decision alternatives	• Select cars to consider
▪ Define the key objectives and constraints	• Wanted: small cash outlay, safety, good performance, aesthetics,…
▪ Select the best possible and implementable decision alternative	• Choice/ Select a car (i.e., Honda, Saturn or another brand)

Engineering Economic Decisions

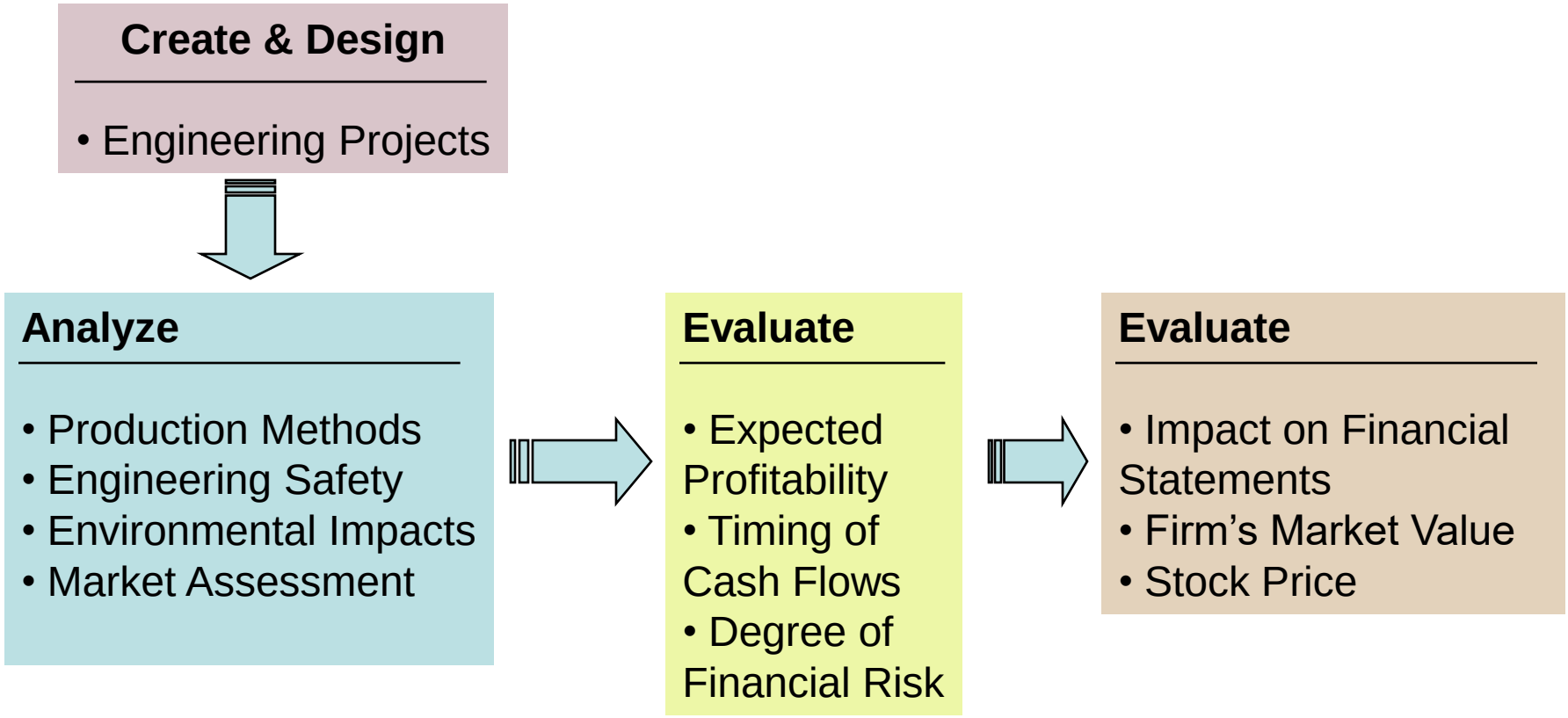
Needed e.g. in the following (connected) areas:



What Makes Engineering Economic Decisions Difficult? Predicting the Future

- Estimating the required investments
- Estimating product manufacturing costs
- Forecasting the demand for a brand new product
- Estimating a “good” selling price
- Estimating product life and the profitability of continuing production

The Role of Engineers in Business



Accounting vs. Engineering Economy

Evaluating past performance

Accounting

Evaluating and predicting future events

Engineering Economy

Past

Future

Present

Key Factors in Selecting Good Engineering Economic Decisions

- **Objectives** — **Profit Maximization, Cost Minimization**
- **Available Resources** — **Capital Investment, Human Resource, Raw materials, etc.**
- **Time** — **Short Term, Medium Term, Long Term**
- **Uncertainty** — **Cost (Investment, O&M cost), Revenue, other externalities**

Large-Scale Engineering Projects

These typically

- require **a large sum of investment**
- **can be very risky**
- take a **long time** to see the financial outcomes
- lead to revenue and cost streams that are **difficult to predict**

All the above aspects (and some others not listed here) point towards the importance of Engineering Economic Analysis

Types of Strategic Engineering Economic Decisions in the Manufacturing Sector

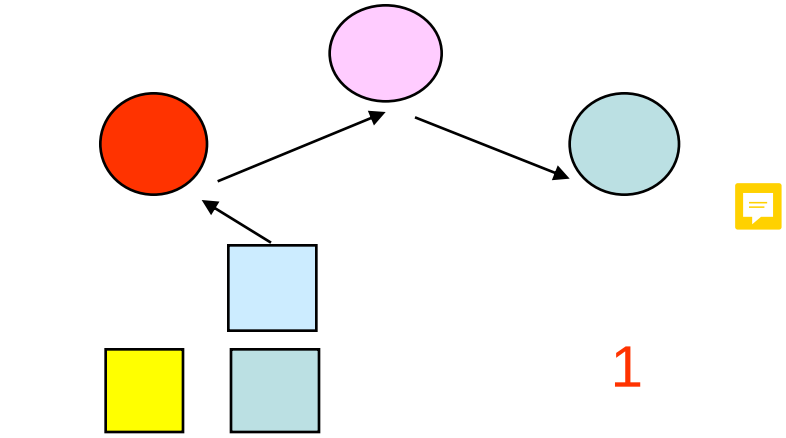
- **Service Improvement**
- **Equipment and Process Selection**
- **Equipment Replacement**
- **New Product and Product Expansion**
- **Cost reduction** or **profit maximization** can be seen as generic (common, eventual) objectives

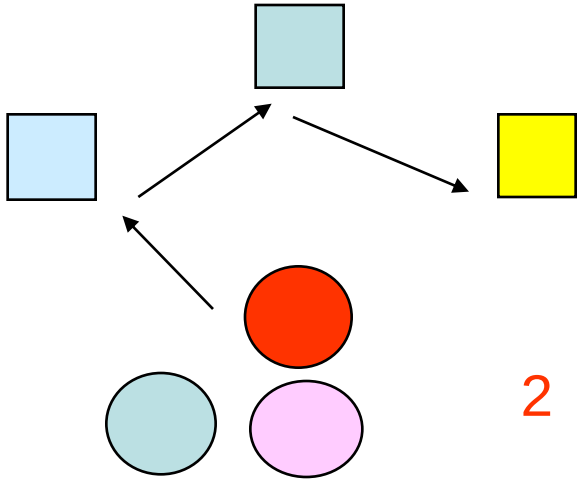
- In the most general sense, we have to **make decisions under resource constraints**, and in **presence of uncertainty**

Example 1: Healthcare Service Improvement

- 1 Traditional Plan: Patients visit the service providers
- 2 New Strategy: Service providers visit the patients

Which one of the two plans is more economical? The answer typically depends on the type of patients and the services offered. Examples?





Example 2:
Equipment and Process Selection

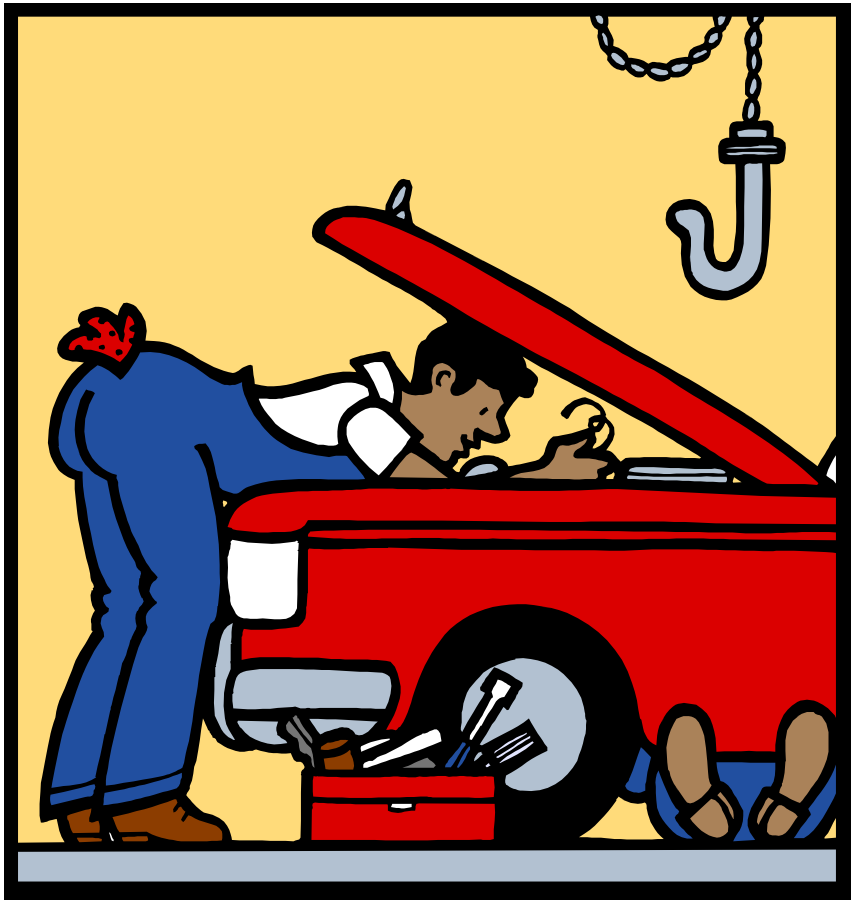
- How do you choose between using alternative materials for an auto body panel?

- The choice of material will dictate the manufacturing process and the associated manufacturing costs

Example 3:
Equipment Replacement Problem

- Key question:

  When is the right time to replace an old machine or equipment?



Example 4:
New Product and Product Expansion

- Shall we build or acquire a new facility to meet the increased (increasing forecasted) demand?
- Is it worth spending money to market a new product?

Example 5: MACH 3 Project

- R&D investment: $750 million(!)
- Product promotion through advertising: $300 million(!)
- Priced to sell at 35% higher than the preceding Sensor Excel model (i.e., about $1.50 extra per razor)
- Question 1: Would consumers pay $1.50 extra for a shave with greater smoothness and less irritation?
- Question 2: What happens if the blade consumption drops more than 10% – due to the longer blade life of the new razor?...

The Gillette Company

Example 6: Cost Reduction

- Should a company buy new equipment to perform an operation that is now done manually?
- Should we spend money now, in order to save more money later?
- The answer obviously depends on a number of factors.

Further Areas of Strategic Engineering Economic Decisions in the Service Sector

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

The Four Fundamental Principles of Engineering Economics

1: **An instant dollar** is **worth more** than a **distant dollar**…

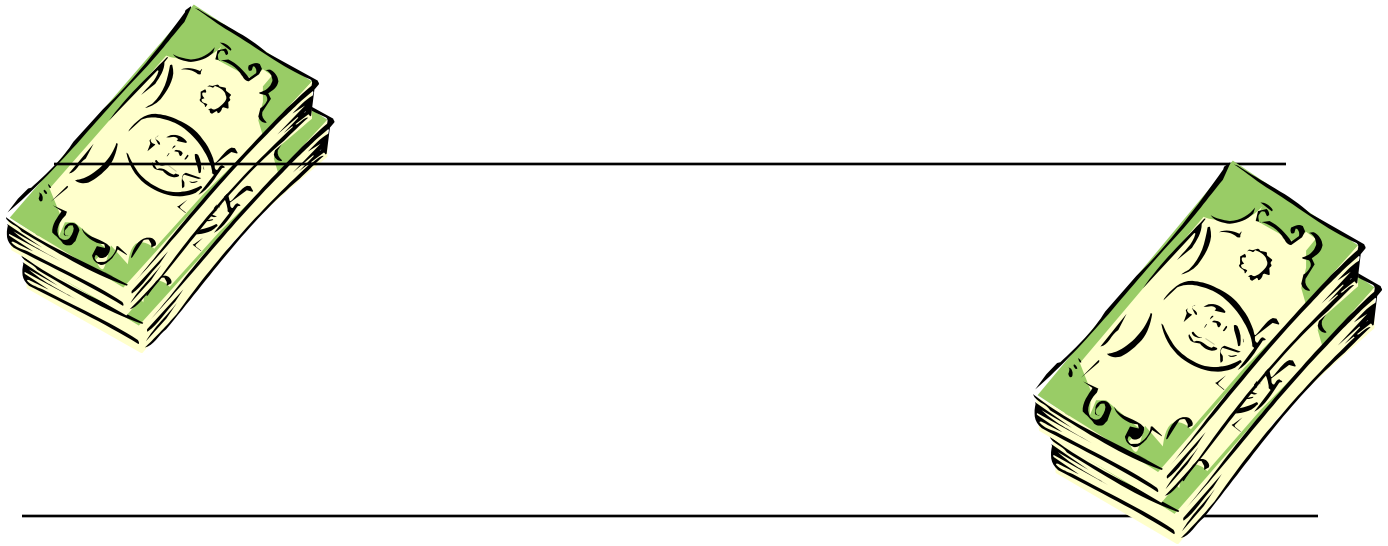
2: **Only the relative (pair-wise) difference** among the considered alternatives **counts**…

3: **Marginal revenue** must **exceed marginal cost**, in order to carry out a profitable increase of operations

4: **Additional risk** is **not taken without** an expected **additional return** of suitable magnitude

Principle 1

An instant dollar is worth more than a distant dollar…



Today

6 months later

Principle 2

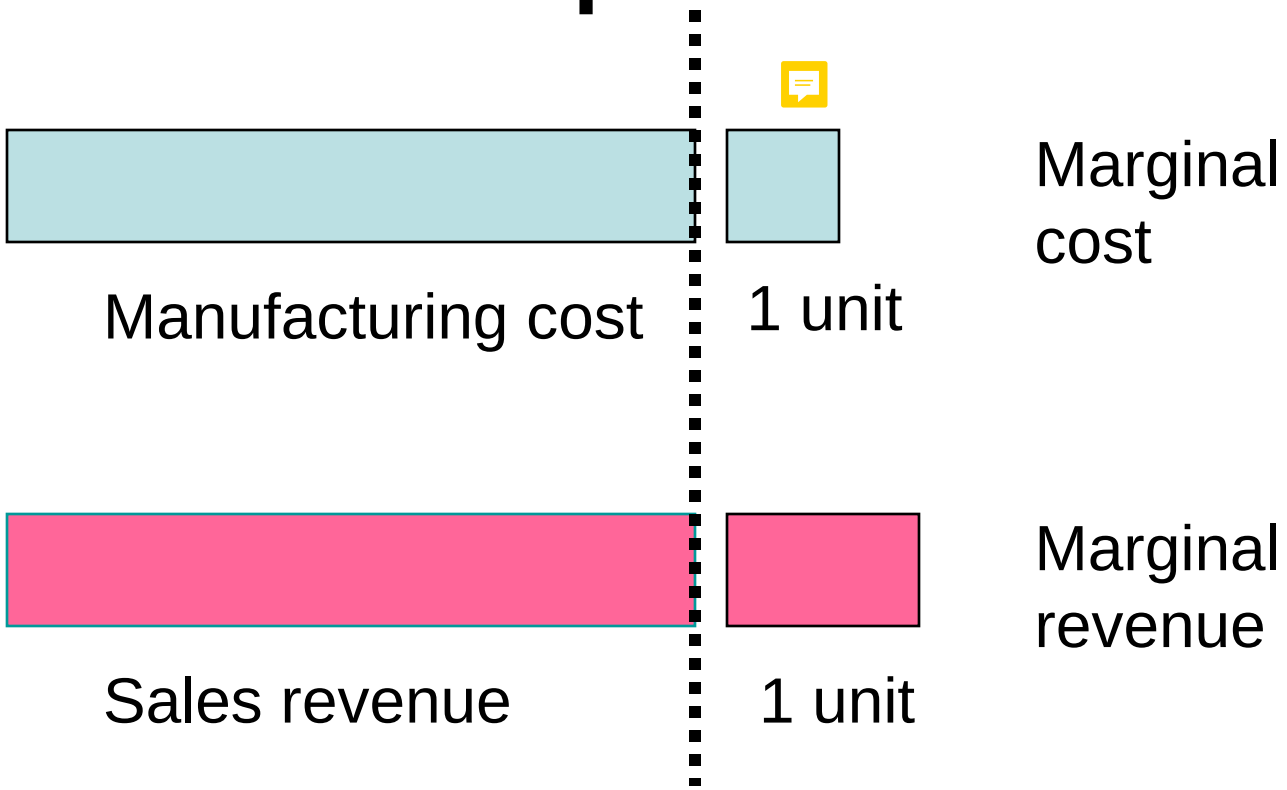
Only the cost (resource) difference among alternatives counts

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

The data shown in the green fields are irrelevant items for decision making, since their financial impact is identical in both cases

Principle 3

Marginal (unit) revenue has to exceed marginal cost, in order to increase production



Principle 4

Additional risk is not taken without a suitable expected additional return

Investment Class	Potential Risk	Expected Return
Savings account (cash)	Lowest	1.5%
Bond (debt)	Moderate	4.8%
Stock (equity)	Highest	11.5%

A simple illustrative example. Note that all investments imply some risk: portfolio management is a key issue in finance

Summary

- The term **engineering economic decision** refers to any investment or other decision related to an engineering project
- 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, resource limitations** and **uncertainty** are key defining aspects of any investment project
- All listed decision types can be seen and **modeled as a constrained decision (optimization) problem**

THANK YOU

Types of Business Organizations

- **Proprietorship**
- **Partnership**
- **Corporation**

- Their negative and positive sides ?