Announcements

- Assignment 7 due this week
- Journal check the week
- Exams nearly graded
“Every engineering decision is a business decision.”

- Jean Sweeney, VP, 3M Corp.
Engineering and Economics are inextricably linked

- Can the user afford to buy it?
- Can the builder afford to make it?
- Can the client afford the product?

- Engineering is supposed to benefit society
  - by increasing our well-being
  - by fueling the economic engine
“Engineering is the art of doing that well with one dollar than any bungler can do with two.”

- Arthur Wellington
Key Economic Concepts

- Fixed versus variable costs
- Time value of money
- Cost estimation
- Costing versus pricing
Invest now for future benefit

Most engineering projects have upfront costs with expected later benefits.
Fixed Costs

• Costs not proportional to amount of product made. Examples:
  – facilities construction
  – purchased equipment
  – equipment installation
  – engineering costs
  – working capital
Variable costs

- Costs that are proportional to amount of product made. Examples:
  - raw materials / purchased components
  - direct labor
  - maintenance
  - utilities
Overhead costs

• Costs not attributable to a specific product or project. Examples:
  – administrative costs
  – janitorial services
Exercise

In your teams:

• Make a list of the fixed costs of your designed system
• Make a list of the variable costs.
• Project out to full implementation / market introduction
Time Value of Money

• A dollar today is worth more than a dollar tomorrow.
• $100 a year from now is worth $91 today, at 10% discount rate.
  – to compensate for opportunity cost
• Therefore, we must account for:
  – Amount of expense, and
  – Timing of the expense
Basic Economic Analysis Equation

\[ F = P \left(1 + i\right)^n \]

where:
- \( F \) = future value
- \( P \) = present value
- \( i \) = discount rate per time period
- \( n \) = number of time periods
Alternatively

\[ P = F \left(1 + i\right)^{-n} \]

Simply discount all future cash flows to present value, and sum.

If comparing alternatives, projected usable life must be the same.
Return on Investment

• Interest rate at which benefits = costs
Exercise

For your project, create a timeline of projected expenses for implementation / market introduction.

Label the cash flows (don’t worry about values for now).

0 1 2 3 4 5 … n
Estimating Costs

• Bill of Materials
  – specifies all the parts for the system
  – quantities
  – hierarchical by subsystems

• Labor
  – direct
  – indirect

• Overhead
Estimating costs, cont.

- Economies of scale
- Rules of thumb
  - discipline specific
  - e.g., cost per pound or cost per ft²
Costing versus Pricing

- Pricing is determined more by market value than product cost.
- Profit = Revenue - cost
Exercise

• With your team, plan out what information you need to gather to complete a cost analysis of your project

• Note: a cost analysis is required in the final notebook submission.