Lesson 2-2 – Decision Framework and Current Cost Models

The Role of Engineering Economic Analysis

The problems should:

- be important enough to justify serious thought and effort
- be not easily worked out in one's head—organization required
- economic issues are a significant component of the analysis leading to a decision
- require that the decision variables be carefully organized and the consequences be understood

Not all problems

Problems can be classified by levels of difficulty:

- Simple (not much effort):
  - If we use a machine three items per week, how many should we buy at a time?
- Intermediate (primarily economic):
  - Which machine should be purchased? Low-cost, requiring three operators or high-cost, requiring only two operators?
- Complex:
  - The annual budget of a corporation. All projects are evaluated economically but may also include non-economic factors such as political or national concerns, individual concerns, and other corporation-wide impacts.

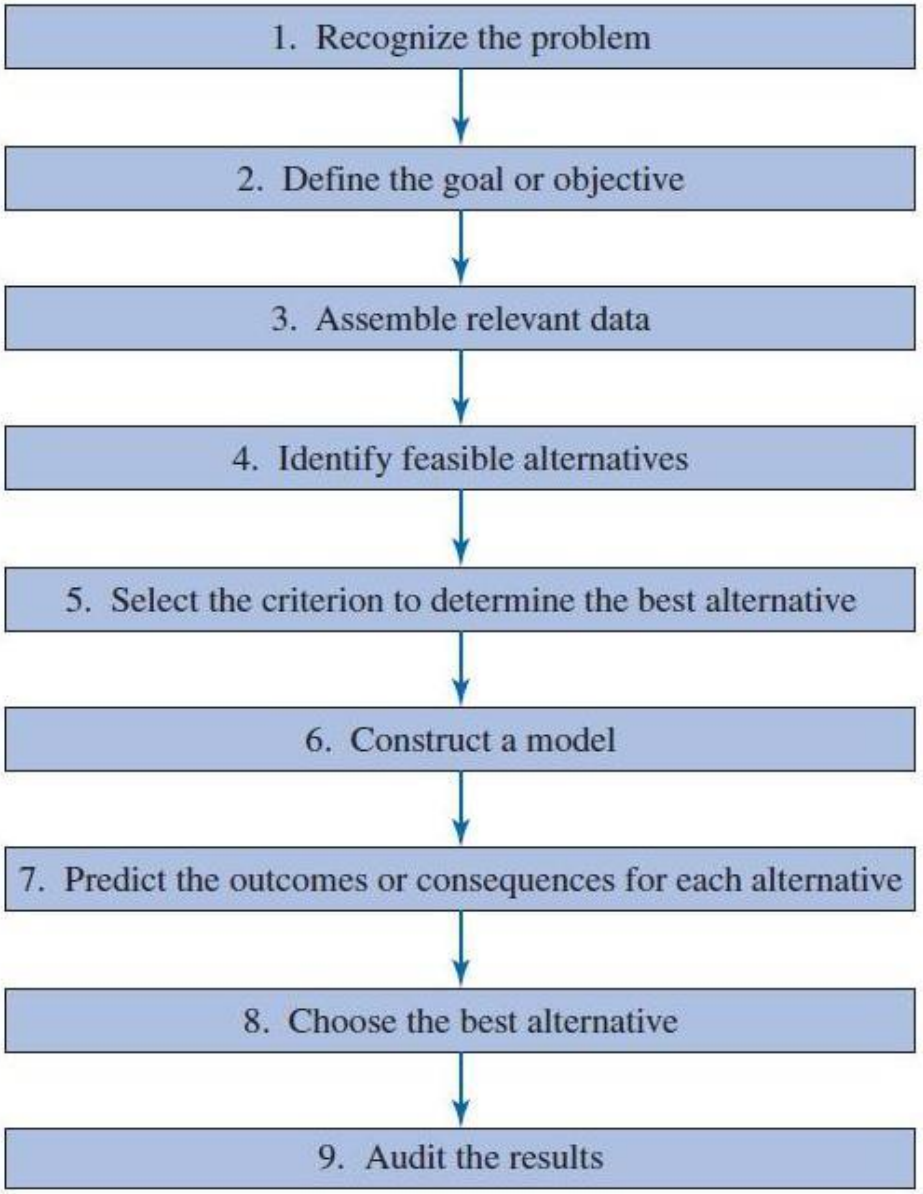
Examples of Engineering Economic Analysis

- Focus on costs, revenues, and benefits that occur at different times
- Engineering questions:
  - Which projects are worthwhile?
  - How should projects be designed?
- Questions or issues for engineers as individuals
  - How to achieve goals?
  - Making the best investment decisions

Decision Making

- Decision making is a major aspect of everyday life
- Engineers need tools to analyze and solve the economic problems they face
- Complex problems can be broken down to produce sensible solutions.
- We make better decisions when:
  - We know the decision making process
  - We know how to use the appropriate tools to make comparisons between competing alternatives.

The Decision-Making Process



1. Recognize the Problem

- The starting point in rational decision-making is recognizing that a problem exists.
- A problem exists when:
  - a standard or expectation is not being met.
  - a new standard or expectation is established and needs to be achieved (an opportunity).
- Problems can b  ized or may only become appar situation.
- To determine a ve to analyze information pr

2. Define the Goal or Objective

- A goal or objective is the standard or expectation we wish to meet.
- A goal or objective can be wide or narrow in scope:
  - Wide scope: “Make the business more profitable.”
  - Narrow scope: “Determine the most economical machines to purchase.”
- Defining the objective describes the goal.

Current Costs

Simple economic problems can often be addressed by simply comparing anticipated costs and benefits, if those occur in a short period of time

- Why only for a short time?

Examples of simple current cost models

- Generally arithmetic
- Costs and revenues per unit
  - Revenue is $50 - $0.10x where x is # of units produced
  - Cost is $5x + $20,000
  - Maximize profit
- Options or choices
  - Assemble product with one worker at $30 per hour taking 3 hours, or
  - Assemble product with three workers at $15 per hour taking 1.5 hours
- Any problem where the costs and revenues can be modeled with basic math and occur over a short timeframe

Current Costs: Problem 1

You want to travel to Calgary to visit your Grandmother.

You can drive. You estimate the trip will be approximately 2,100 km, and 11 hours each way, and your car uses 9.2 l/100km in gas. Gas prices are currently $1.55/litre

You can fly at a price of $340 return, taxes included.

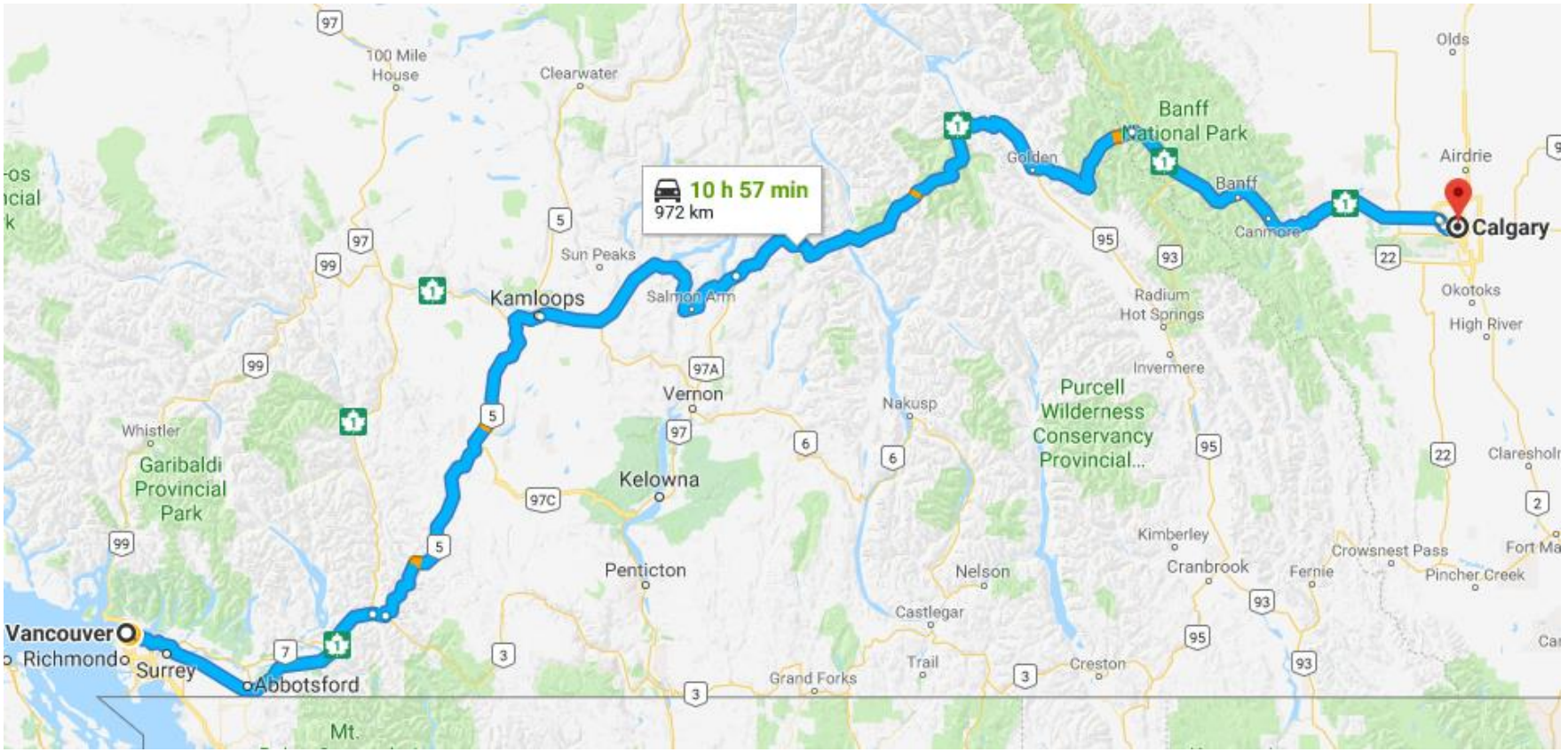
Which options is more economical?

Which option would you choose?

Current Costs: Solution 1

Price to fly: $340

Price to drive: 2100 km * 9.2 l/100km * $1.55/litre = $299.46



Current Costs: Problem 2

John, an auto mechanic, suddenly inherited a sum of $1,000,000 when both of his parents died in a crash. He is making about $15 an hour and works about 50 hours a week for 52 weeks a year (10 hour overtime per week). He gets two weeks of paid vacation. The overtime wage is at time-and-a-half of the regular wages.

He would like to get an income from his inheritance equivalent to his job so that he can quit his job. He found that he could invest the money safely to get an interest of 5% year for the rest of his life.

Will John make enough money with his investments to quit his job?

Current Costs: Solution 2

John's yearly earnings

$= 15(40)(52) + 15(1.5)(10)(52) = \$42,900$

John's investment income

$= 0.05(1,000,000) = \$50,000$

Since John will be able to make more money from his investment, he should certainly consider quitting his job.

Other considerations: Cost, Quality, and Functionality

- The potential trade-offs between:
  - Cost
  - Quality
  - Functionality

- How do you treat this?
- What does this depend on?

Ethical Dimensions in Engineering Decision Making

- Ethics distinguishes between right and wrong with respect to decision making
- Often, decision-making requires more “context” than simple economical efficiency
- Ethical codes of conduct exist for Professional Engineers (PEng)
  - Canadian Council of Professional Engineers (CCPE), known more recently as “Engineers Canada”
    - www.engineerscanada.ca
  - APEGBC

Gaining Knowledge and Building Trust versus Favours for Influence

- Sales tactics can include a mix of business and pleasure activities.
- Some of these activities can be considered business opportunities (networking) and can also bring up ethical questions.
  - Are these kinds of sales tactics providing “favour”?

- How can we separate “favours” from “appropriate evaluation”?

The Environment We Live In

- Large-scale projects typically involve some environmental impact.
- How do you account for these impacts?
- You must deal with opposing viewpoints and minimum standards.
- How do you decide?

- Can you think of any examples of this in real life?

Safety and Cost

- There are often trade-offs between safety and cost.
  - Is it only just ‘safe enough’?
  - It is “too safe,” therefore too expensive?
  - What is the ‘cost’ of someone being killed due to unsafe product or processes?

Emerging Global Issues

- Governments have started to prevent, limit, and expose financial and ethical wrong-doing within corporations.
- Globalization is an important part of ethical discussions:
  - Different countries have different ethical expectations
  - When working for a multinational company, which standard do you follow: the local standard, or perhaps the higher international (and more expensive) standard? Which is more culturally relevant?

Importance of Ethics in Engineering Economic Analysis

- Ethics in Engineering Economic Analysis (and in Engineering in general) focuses on how well and how honestly decision making is conducted.
  - You must recognize that ethical issues exist and make them part of your decision making
  - Be open and transparent about how these issues affect your decisions
  - Potential professional consequences

Suggested Textbook Practice Problems

- Practice problems and self assessment on Canvas

- Chapter 1:
  - 3, 4, 6, 11, 16, 17, 18, 21, 26, 42, 47, 51 (then read http://www.newyorker.com/magazine/2015/05/04/the-engineers-lament and reconsider your answers), 57, 65, 68.