



CHAPTER 1.

MAKING ECONOMIC DECISIONS

What is engineering economics? Engineering economic analysis basically deals with a *decision making process*. We are faced with many alternatives in business or personal environments, and it is important to have tools to analyze these alternatives and make rational decisions in a systematic way.

BOEING VS. AIRBUS (1)

- In early 2000, Boeing has been working on development of the *Sonic Cruiser*.
 - It is a lightweight plane that can fly near the speed of sound.
 - It is supposed to be about 15% faster than conventional jet.
 - However, demand for the plane was lukewarm. Why?
 - Boeing later switched to develop a slower, but more efficient 7E7 (later 787 *Dreamliner*) airplane.
- On the other hand, Airbus was betting on *size* rather than *speed*.
 - Its new model A380 is the largest passenger plane in the world.
 - By using new composite materials, Airbus could reduce the weight and the manufacturing cost by 20%.
 - The lighter plane will allow airlines to cut their operating cost by about 8%, and it is very popular.

BOEING VS. AIRBUS (2)



- How would airlines compare the two new planes?
- What economic criteria should airlines use?
 - Cost (efficiency); Size; Speed; Hub and spoke system.
- What economic factors should be included in the comparison?
 - Purchase cost; Operating cost; Durability; Technological development

1. WHAT IS ENGINEERING ECONOMICS?

- “The science that deals with techniques of quantitative analysis useful for selecting a preferable alternative from several technically viable ones.”
 - Can you get it?
- “The art of doing that well with one dollar what any bungler can do with two (Wellington, 1887).”
 - More intuitive?
- “The study of making a decision among several alternatives.”
 - In personal life, we always make decisions, even unconsciously.
 - In business environments, one’s decision has a significant impact on the survival of a firm.
 - Engineering economic analysis provides tools in comparing alternatives to make better decisions.

2. DECISION MAKING PROBLEMS

- We are surrounded by a sea of problems.
 - Simple (but important) problems: Should I pay cash or use my credit card?
 - Intermediate problems: Should I buy or lease my next car?
 - Complex problems: Is a new automobile plant feasible?
- We will focus on the second and third problems in this course.
- More complex problems require systematic analysis, because
 - they are *important* enough to justify serious analysis.
 - they involve various *economic aspects* in reaching a decision.
- In many business environments, costs, revenue and benefits occur at *different times*.
 - In a new automobile design, the development costs occur now.
 - However, the benefits (or revenues) from a new automobile begin only after the automobile is successfully manufactured.

2.1. ENGINEERING ECONOMIC ANALYSIS

- *Engineering economic analysis* can be defined the economic analysis of costs, benefits and revenues occurring over time.
 - This course develops the *tools* to properly analyze and solve the economic problems that are commonly faced by engineers.
- Questions of engineering economic analysis
 - Which engineering projects are *worthwhile*? Speedy plane or cost-efficient plane?
 - Which engineering projects should have a higher *priority*?
 - How should the engineering project be *designed*? Bigger plant now or staged construction?
 - How to achieve long-run *financial goals*? Do you buy stocks, bonds or real estates?
 - How to make short- and long-term *investment* decisions?

2.2. DECISION MAKING PROCESS

- Formulate a problem or project.
 - Recognize problem.
 - Define the goals or objectives.
 - Examples: material or process selection; equipment investment or replacement; new product development
- Identify *several* **technically** feasible alternatives for the project.
 - This used to be a *traditional* role of engineers!
- Choose *one* **economically** best alternative.
 - Collect data on costs and benefits for each alternative.
 - Rank each alternative based on a set of criteria, and choose the best one.
 - This is the *current and future* role of engineers.
 - This course focuses on this aspect of decision making process.

2.3. WHY STUDY ENGINEERING ECONOMICS?

- It is a required course of the Faculty of Engineering at UW.
- Engineers can get a professional engineering *certificate* (e.g. PEng), and this course is required by the Canadian Engineering Accreditation Board.

However:

- If you are a **manager** in a company, you should be able to make a judicious decision in a complex business environment (I call these “messes”).
- If you are a **CEO**, you should be able to evaluate managers’ decisions and performance.
- If you **own** your company, you are faced with endless situations of decision making.

3.1. CASE: SUPERSONIC AIRCRAFT (1)



3.1. CASE: SUPERSONIC AIRCRAFT (2)

- Development of supersonic aircraft
 - Supersonic aircraft were heavily developed in the 1950s and 1960s.
 - Boeing (US): Started to develop one in the 1960s, but soon scrapped the project due to low economic viability.
 - Tupolev TU-144 (Soviet): Developed ahead of Concorde, and commercially operated during 1977 – 1978.
- Concorde (Europe)
 - It was developed by a French-British government consortium in 1969.
 - Only 20 aircraft were produced.
 - Commercially operated from 1976 – 2003 by BA and Air France.
 - Air France 4590 crashed in 2000.
 - http://en.wikipedia.org/wiki/Air_France_Flight_4590



3.1. CASE: SUPERSONIC AIRCRAFT (3)

▪ Technical challenges

- Aerodynamics: Due to greater stress and temperatures at high speed, the plane will be *small* with *heavy duty* structure.
- *Sonic boom*: Serious noise occurs when breaking sonic barrier, which makes it difficult to fly over land.
- Requires large amounts of fuel/poor range.

▪ Economic issues

- Accommodates only 100 passengers, but uses same amount of fuel as Boeing 747 (which accommodates 400 passengers).
- High maintenance costs, especially after the 2000 crash.
- Depends on high-end market demand (\$10,000 per ticket), which decreased substantially post 2001.
- Ceased operation in 2003, mainly due to *economic reasons*.

3.2. CASE: IRIDIUM PHONE (1)

- Iridium company
 - Backed by Motorola and other firms in 1993, it provided a global *satellite-based* wireless phone system.
 - It sent 66 satellites in the orbit, enabling phone calls from anywhere.
 - It launched service on Nov. 1998, and was bankrupt on Aug. 1999.
 - It was re-launched in 2001 by another firm with different focus.



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3.2. CASE: IRIDIUM PHONE (2)

- **Technical** challenges
 - It was too expensive: \$3,000 per handset; \$7/min call charge
 - The handset was too bulky compared to cell phones.
 - Unreliable service: Low quality voice; High drop rate; No signal inside buildings or cars
- **Economic** issues
 - Investment cost: Nearly \$6 billion for launching 66 satellites.
 - Low demand
 - Initial forecast was 2 million subscribers in 5 years.
 - There were only 20,000 subscribers in the first year.
 - Unorganized marketing and mismanagement
- This failure had a negative effect on other satellite projects. ☹️
- Another example of good technology with bad economics...

EXAMPLE 3-1. WILL YOU BUY A HYBRID CAR? (1)

- Hybrid car is popular among car buyers.
 - Globally, more than 7 million hybrid vehicles were sold by 2013.
 - Toyota sold more than 5 million hybrid vehicles.
 - The share of hybrid vehicles in the United States was about 3% in 2012, but that in Japan was over 17%. (Less than 1% in Canada.)
- Suppose you now decide to buy a car. Will you buy a hybrid car? What factors do you need to consider?
 - Purchase price of car: Subsidy?
 - Gas price
 - KM per year travelled
 - Durability: Introduction of electric car
 - Environmentally conscious?



EXAMPLE 3-1. WILL YOU BUY A HYBRID CAR? (2)

- Let's compare Regular Camry LE with Hybrid Camry LE in 2014.

	Regular Camry LE	Hybrid Camry LE
Purchase price	\$23,700	\$27,700
Litres/100 km	7	4.7
Gas price/litres	\$1.30	\$1.30
Driving km per year	10,000	10,000
Useful life, years	8	8

- If annual driving distance is 20,000 km, will you buy it?
- If gas price increases to \$2.0 per litre, will you buy it?
- If you can use car only for 5 years, will you buy it?