

Chapter 1

Introduction to Financial Decision Making

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1.1 Introduction

- Consider the following scenarios or cases:

Case I: ISEM Electronics Project Bidding Problem: To continue R&D and bid for project or not?

ISEM Electronics Company is interested in bidding for a \$10-million project that involves the production, installation and commissioning of an advanced security system for the new National Stadium. For several years, the company has been developing a new technology that can be used in a critical component of future security systems that would be superior to any product currently in the market. Several millions of dollars have already been spent to date, and there is still uncertainty as to whether the R&D will be successful or not. If R&D is successful, there is a very high chance that the company will be able to win the contract due to the new technology. However, if the R&D is not successful, the company can still bid for the project using existing technology at a much lower chance of winning the contract.

The company can either continue with its R&D or terminate it immediately. If it chooses to continue with R&D, it must invest another sum of money to complete it. If the company submits a bid for the project, it will need to build a demonstration system at some uncertain costs. Finally, if the company wins the contract, the final cost to build, deliver and install the system is also uncertain. The new technology developed also has the potential to be exploited in other future projects by the company.

What should ISEM Electronics do?

Case II. HomeSmart Hair Dryer Heater Problem: Outsource, Self-develop manufacturing technology, or Acquire a company?

HomeSmart is an electrical home appliance manufacturing company. A few years ago, the company introduced a smart hairdryer to the market and gained unprecedented success. The company is confident that the product will remain popular in the market for a while.

The most critical and expensive part of the hair dryer is the heater which requires a sophisticated manufacturing process using advanced materials. The company currently outsources the production of the heater to a contractor which accounts for a substantial part of the total product cost and the current yield rate is not very satisfactory.

The company management is now thinking of ways to improve this product's yield rate and profitability. The company has the following alternatives:

- A. Continue with outsourcing until the end of product life, and live with the current yield rates and cost.
- B. Continue with outsourcing for two years while trying to self-develop the technology. This will require a large financial investment and a delicate R&D team working on the project. At the end of two years, the company will know the product yield rate and production cost. It will then decide if it is feasible to adopt the self-developed technology or continue to outsource the heater manufacturing.
- C. Acquire a company that is capable of manufacturing the heater. This will include all the company's intellectual properties and manufacturing facilities. This option requires a very huge financial investment, takes only six months to complete but will have less uncertainty on the future product yield rates and production costs. It will also benefit other products of the company.

What should HomeSmart Company do?

Case III. Biotechno's Computer Replacement Problem

Biotechno is a leading company performing cutting-edge R&D in bio-technology areas. Three years ago, the company purchased a computer for \$50,000 for its R&D Department. Today, this computer has reached its maximum capacity though it has another two years of useful life. There is a need to double its capacity to meet the anticipated computational needs of new R&D projects that the company is expecting to launch in the coming year.

Biotechno can expand its existing computer by purchasing a second computer at \$30,000 to double the capacity of the entire computing system in its R&D Department. Alternatively, the company can replace the existing computer complete with a new model at a cost of \$80,000. The old computer has a current market value of \$30,000 if re-exported to a third-world country.

The annual operating and maintenance cost for the computers in the next few years are: \$10,000 for the existing computer and is expected to increase as the equipment ages, \$5,000 for the secondary computer, and \$8,000 for the new model.

What should Biotechno do?

Case IV. Mr. K.C. Chen (Personal Investment Decision)

K.C. Chen is a recent engineering graduate who desires to invest a portion of his annual income every year. He is unsure about the kind of investments he should make – stocks, bonds, properties, etc. He is also undecided about how much of his annual income he should set aside for investment. He also does not know what annual return he should expect to earn on his investments. Finally, he wonders how long it will take for him to achieve his financial goals.

What should Mr. Chen do?

Financial Decision Making in Engineering, Business and Operations Management

- What do the preceding problems or cases have in common?
- We noted that in each of the cases, the respective organization or individual has to make **complex decisions** that have **financial** implications.
- Most, if not all of the cases involve
 1. Multiple **Alternatives** or **Courses of action** to decide on
 2. Current and future **Goals** to be met
 3. **Constraints** such as limited **Capital** and **Budgets**
 4. **Money** or **Cash flows** occurring at different **Time**
 5. **Uncertainty** and **Risk** are involved
- In short, they all involved making complex and difficult financial decisions over time, under risk and subject to various technological or business constraints, to achieve some objectives and goals.

What Does this Course Offer?

- This course is concerned with the principles and practice of financial analysis and decision-making in engineering, operations management, and business investment projects that involve **Capital Investments** and **Cash Flows** over time possibly under **Uncertainty** and **Risk**.
- This course teaches you the fundamental knowledge of **Financial Analysis** and equips you with the **Conceptual Frameworks**, **Analytical Techniques** and **Computational Tools** for understanding and performing **Decision-Making** that involves alternatives with **Cash Flows** over time.
- A cash flow occurs when money changes hands from one individual or organization to another.
 - Money received is called a cash *inflow*.
 - Money dispensed (spent or paid) is called a cash *outflow*.

Examples of Engineering, Business and Management Decision

1. Choosing the best design for a consumer's product considering production costs, reliability, maintainability, performance, aesthetics, and marketability.

E.g., Car, Computer, Smart TV, Coffee maker, etc.

2. Choosing the best design for a public infrastructure development project considering construction costs, operation & maintenance costs, and benefits & dis-benefits to different stakeholders and users.

E.g., Transportation systems, Power stations, Waste-to-Energy plants, Recreation & Public parks, etc.

3. Deciding between different production technologies or methods to manufacture a product for the mass market.

E.g., Fully automated (robots) production line vs. manual (labor intensive) process.

4. Deciding if an existing asset should be replaced with a new one now, or continued to be used?

E.g., Aircraft (commercial and military), Public buses, MRT trains, Computers, Photocopiers, etc.

5. Deciding how often an asset should be replaced with a new one if the service it provides is required for N more years.

E.g., Same as above.

6. Deciding if resources for business operations should be purchased or leased.

E.g. Factory/office space, production machines, photocopiers, warehouses, etc.

7. etc.

Topics Covered

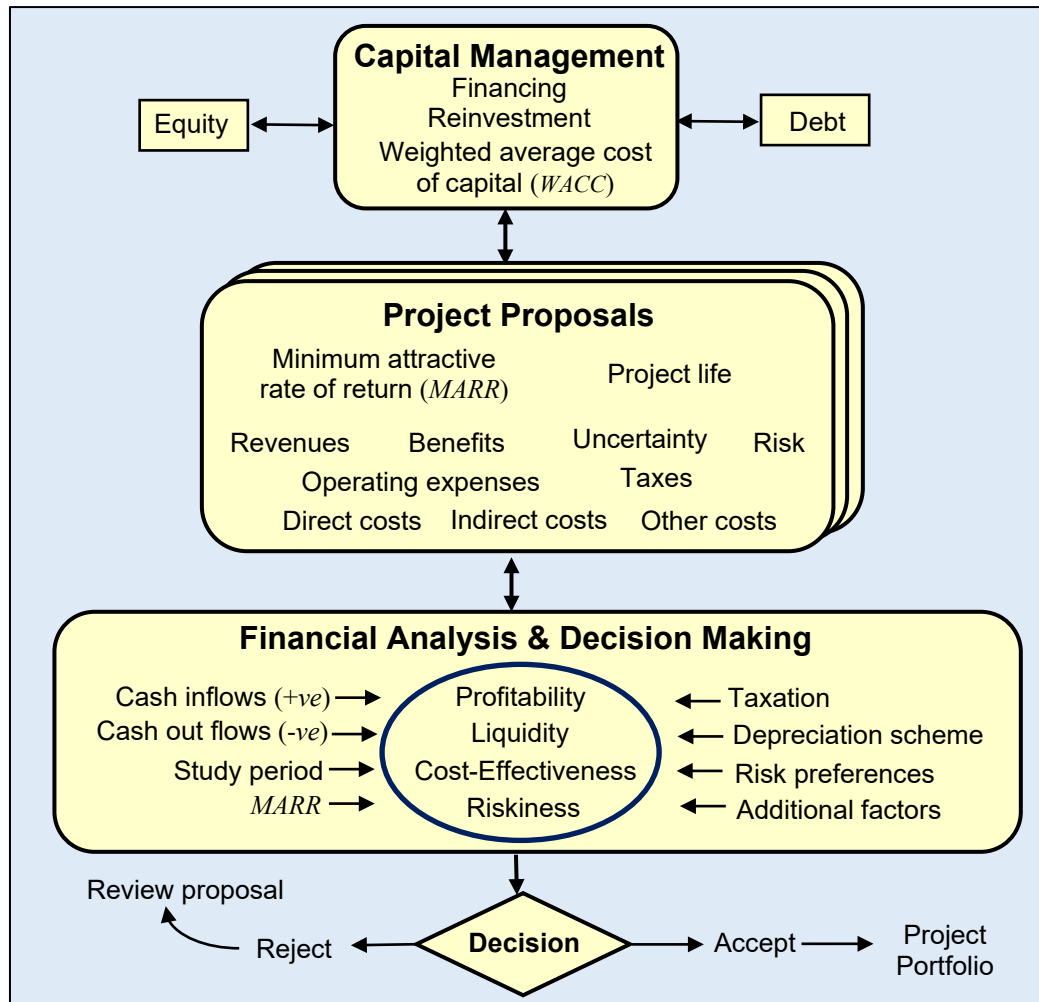
1. Introduction to Financial Decision Making
2. The Time Value of Money
3. Financial Analysis of Single Project
4. Financial Decision on Multiple Projects
5. Understanding Key Uncertainties in Projects
6. Probabilistic Risk Analysis
7. Financial Analysis with Capital Asset Depreciations and Taxes
8. Capital Assets Replacement Analysis
9. Basic Cost Estimation Techniques
10. Project Capital Financing

Course Learning Outcomes

- Upon completion of this course, you will be able to:
 1. Perform cash flow modeling and financial analysis involving the time value of money.
 2. Analyze, compare and select financial investment alternatives using appropriate criteria.
 3. Deal with risk and uncertainty in projects using sensitivity analysis, probabilistic analysis, and Monte Carlo simulation.
 4. Perform financial analysis on projects with capital asset depreciation and taxes under Singapore corporate tax system.
 5. Perform replacement analysis for depreciable capital assets.
 6. Develop and analyze cash flow models for complex scenarios that require the use of a combination of the methods listed above (c/o group projects).
 7. Use computing tools such as Excel to model and analyze engineering financial decision problems.

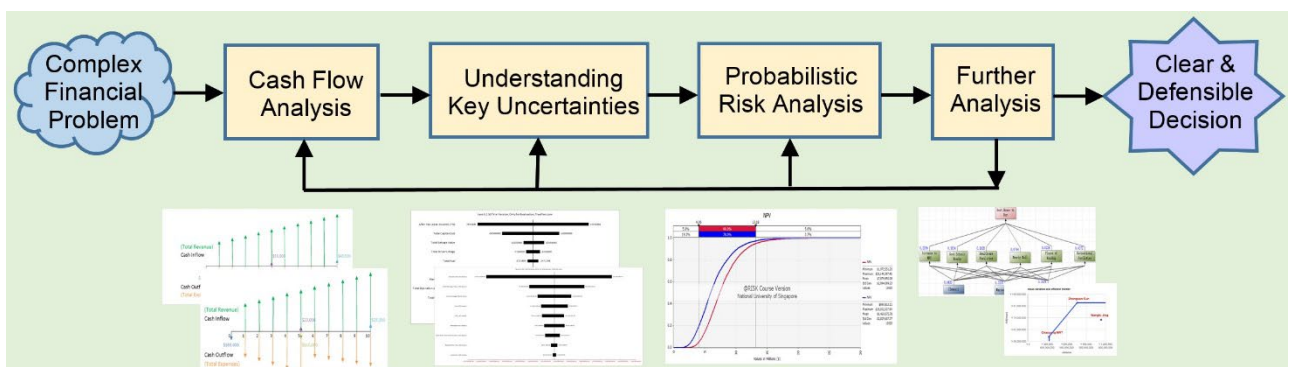
1.2 Overview of Financial Analysis and Decision Making

- An overview of the financial analysis and decision making on investment projects in an organization is shown below.



An overview of the Financial Decision Analysis Process

- The financial decision analysis is an iterative process that provides a systematic approach to ensure that all relevant factors and data are taken into consideration so that a clear, justifiable, and defensible decision is obtained.



- You will learn to perform each of the steps above by the end of Chapter 6.

1.3 Cost Concepts and Behaviors

1.3.1 Understanding Cost Concepts

- Financial decision analysis involves mainly the consideration of financial investment, business, and operational cash flows over time.
- Cash flows may include costs that are incurred in the operations and activities.
- There are many forms of costs and an understanding of them and how they behave is essential for proper financial analysis.
- In this section, we will study the different types of cost and their behaviors.

1.3.2 Fixed, Variable and Incremental Costs

Fixed Costs

- **Fixed Costs** are those unaffected by changes in activity level over a feasible range of operations for the capacity or capability available.

Examples

1. In setting up a manufacturing system, the initial costs of the machines and tools are fixed costs. They do not depend on the total number of units subsequently manufactured.
 2. In a retail store, the monthly rental, insurance premium, and utility costs for the premise are fixed costs. They do not depend on the actual sales volume.
 3. In a company (manufacturing or service), the salaries of the general manager and administrative staff are fixed costs. They do not depend on the manufacturing or service outputs of the company.
- Note that when large changes in usage of resources occur, or when plant or shop expansion or shutdown is involved, fixed costs may be affected. Hence in all the above examples, fixed costs are “fixed” only over a specific operating range.

Variable Costs

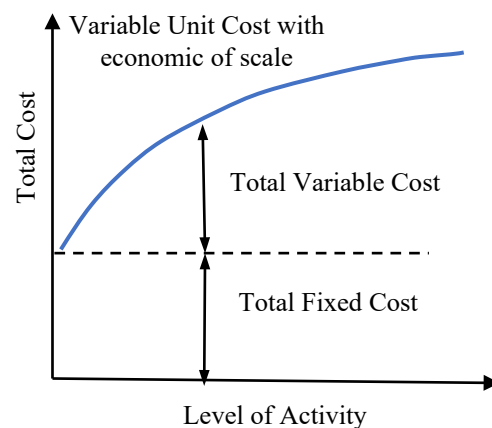
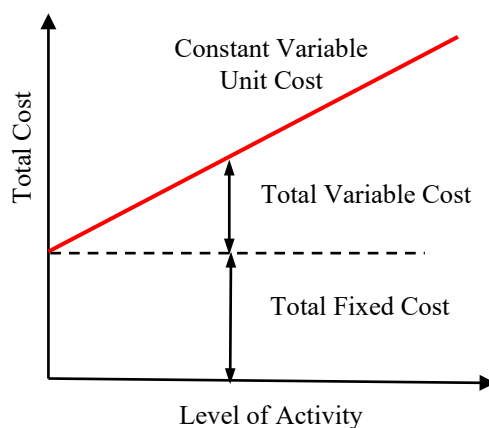
- **Variable Costs** are those associated with an operation that varies in total with the quantity of output or other measures of activity level.

Examples

1. In a manufacturing plant, the material and labor costs of the manufactured products are variable costs. They depend on the production quantity.
 2. In a retail operation, the costs of goods sold are variable costs. They depend on the number of goods sold.
- Variable Costs may be expressed as cost per unit of activity or service. It is also known as variable unit cost and may change with the level of activity or service such as for example due to economics of scale, large quantity discounts, etc.

Total Cost

- Total Cost = Total Fixed Cost + Total Variable Cost
= Total Fixed Cost + Level of activity \times Variable unit cost



Incremental Cost

- An **Incremental Cost** is the additional cost that results from increasing the output of a system by one (or more) units.

Example

- If a student joins an existing group tuition class, the incremental cost to the tuition center would be the additional cost due to the additional facility and teaching resources consumed by this student.

1.3.3 Recurring and Non-recurring Costs

Recurring Costs

- **Recurring Costs** are repetitive and occur when a firm produces similar goods and services on a continuing basis.

Examples

1. Monthly rental cost for office or factory space is a recurring cost
 2. Monthly salaries of administrative and support staff are recurring costs
- Note a recurring cost can be either a fixed cost or a variable cost.

Non-Recurring Costs

- **Non-recurring Costs** are those that are not repetitive, even though the total expenditure may be cumulative over a relatively short period of time.
- They typically involve developing or establishing a capability or capacity to operate, and are “one-off” in nature.

Examples

1. The purchase cost of a piece of land on which a plant will be built, and the construction costs of the plant itself.
2. The initial purchase cost of a machine or equipment for the production of goods or services.
3. The acquisition cost of intellectual property.

1.3.4 Direct, Indirect and Standard Costs

Direct Costs

- **Direct Costs** are those which can be reasonably measured and directly associated with a specific output or work activity.

Examples

1. The cost of materials and labor used to make a product.
2. The salary of a worker that provided a service.

Indirect or Overhead Costs

- **Indirect or Overhead Costs** are those that are incurred indirectly to a specific output or work activity.
- They are often difficult to allocate because it involves costs that are shared by different products or activities.

Examples

1. Costs of common equipment for maintenance of machines.
2. The rental and utility cost for an office space that is shared by different business activities.
3. The salaries of marketing and administrative staff of a company that manufactured many different products.

Standard Cost

- **Standard Costs** are planned costs per unit of output that are established in advance of actual production or service delivery.
- They are developed from anticipated direct labor hours, materials, and overhead costs.
- Standard costs are important for cost control and management.
- Examples of the use of Standard Costs
 1. Estimation of future costs
 2. Measuring operating performance by comparing actual and standard per-unit costs
 3. Preparing bids on products and services requested by customers
 4. Establishing the value of work in progress and finished inventories

1.3.5 Cash Cost versus Book Cost

- **Cash Costs** are those that involve real or actual cash flows. i.e., money actually changed hands.

Examples

1. Costs of goods sold to customers
2. Salaries of workers
3. Costs of services provided by third parties to your business operation.

- **Book Costs** (Non-cash Costs) are those that do not involve real cash flows, i.e. no money changed hands. It is often only reflected in the accounting system for income tax purposes or financial analysis.

Example

- **Depreciation** (Capital Allowances) are costs charged for the utilization of assets in business operations in computing taxable income for a company.

1.3.6 Sunk Costs

- **Sunk Costs** are monies or expenditures that are *already spent* and are *non-refundable* under all available options now.
- Understanding sunk costs is important when considering what to do with an old asset that was purchased previously.

Example

- Daisy purchased a notebook computer a year ago for \$1,500. Today she found that the computer is too lagging due to increasing requirements from school work, and she needs more RAM and storage space.
- Daisy is considering upgrading her current computer which is estimated to have another two years of useful life with more RAM and storage space. She could also purchase a new computer and sell off the older one.
- The \$1,500 she paid a year ago is a *Sunk Cost*. It should not be included in the analysis.
- Relevant data for this asset replacement problem includes:
 - How long more does Daisy need a computer?
 - Cost of new notebook computer meeting Daisy's new requirements
 - Resale value of the old computer
 - Cost of upgrading the old computer to meet the new requirements
 - Future maintenance and operating costs of both old and new computers.
 - Future resale value of the new computer.

1.3.7 Opportunity Costs

- An **Opportunity Cost** is incurred when the use of limited resources for one purpose means forgoing the alternative use of the same resources for other monetary gains.

Examples

1. In considering whether to start running a business on your own, the salary that you might earn by looking for a job instead, is an opportunity cost and should be considered in the analysis.
2. In the above example, suppose, in addition, you intend to set up the business in a premise that you owned then the rental income that you might have received should you rent out the space to somebody else is an opportunity cost, and should be considered in the analysis.

Readings

- Sullivan et al (2020), Sections 1.1, 1.2, 1.4, and 2.1.