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# APSC 221 - Lecture Notes

## Engineering Economics and Business Practice

Prof. Matthew Lee • Summer 2025 • Queen's University

## Contents

# 1 L1 APSC 221 - Cost Concepts

## 1.1 Cost Types

**Fixed Costs**

- Unaffected by changes
- Insurance, licenses, administrative salary

**Variables Costs**

- Will vary depending on quantity of output or activity level of operation
- Labour costs, materials

**Incremental Costs/Revenues**

- Additional cost/revenue form increasing output of a system
- Not associated with quantity of output, but rather a step change
- Overtime shift

**Direct Costs**

- Costs that can be reasonably measured and allocated to specific work/output
- Production labour, production materials

**Indirect or Overhead Costs**

- Costs that are difficult to allocate to specific work
- Utilities, rent, taxes

**Cash Costs**

- Costs paid in cash and have associated cash flow
- What we actually pay, like groceries

**Book Costs**

- Not involved in actual transaction, used for accounting purposes
- Recorded in the financial statements of a business
- Depreciation, interest on loans, insurance premiums

**Life Cycle Costs**

- Sum of all costs related to the life span of a product
- From purchasing to selling/using

**Sunk Costs**

- Costs from the past that has no relevance to a future decision

**Opportunity Cost**

- Costs incurred due to directing limited resources to a specific course of action
- Every action or inaction has costs in terms of what you could have done instead
- Every action is a trade-off, because there is always an opportunity cost

## 1.2 Life Cycle Phases and Costs

Two phases: acquisition phase and operation phase

Lines: Cumulative committed life-cycle cost, and cumulative life-cycle cost

**Cumulative Committed Life-Cycle Cost**

The decision to spend money is under the acquisition phase, which increases cumulative committed life-cycle cost

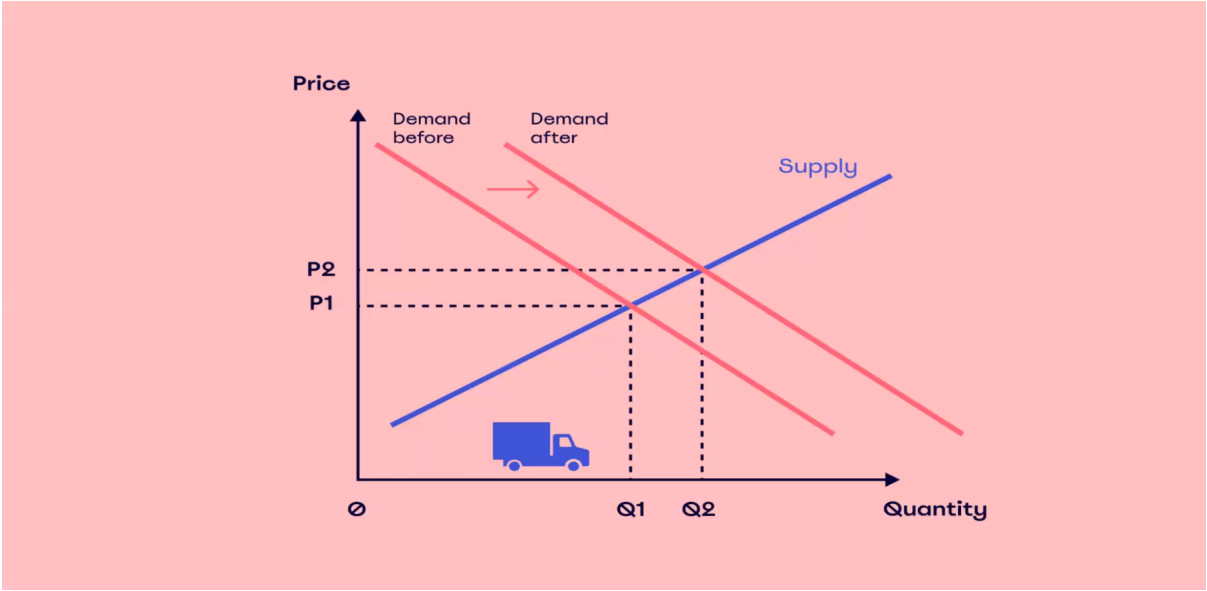
**Cumulative Life-Cycle Cost**

Construction and operating costs is under the operation phase, which increase the cumulative life-cycle cost

## 1.3 Supply/Demand

Naturally, as price decreases on y-axis, the quantity of demand increases on x-axis.

Relationship (blue line, supply): more production = more price



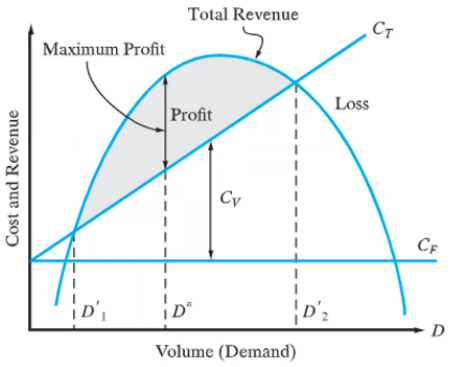

## 1.4 Ultimate Business Goal

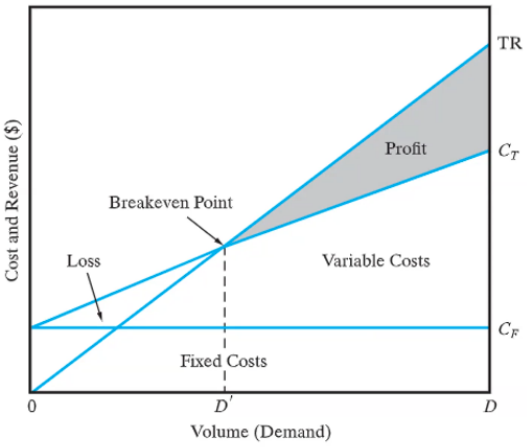
The ultimate goal is to make profits

These graphs have: Total revenue (TR): price x quantity Fixed costs (CF) and total costs (CT) = CF + CV

When TR < CT, the business is operating at a loss When TR > CT, the business is earning a profit, represented by the shaded grey region

Left: Revenue has a peak, and does not improve with more demand Right: Fixed revenue stream


Total Revenue
$C_T$
Maximum Profit
Profit
Loss
$C_V$
$C_F$
Cost and Revenue
$D'_1$
$D^*$
$D'_2$
$D$
Volume (Demand)


TR
Profit
$C_T$
Breakeven Point
Loss
Variable Costs
$C_F$
Cost and Revenue ($)
Fixed Costs
0
$D'$
$D$
Volume (Demand)

# 2 L2 APSC221 - Cost Estimation Techniques

## 2.1 Cost Estimation Techniques

In engineering economic studies, there are categories of costs and revenues used, such as:

- capital investments
- types of costs
- taxes and insurance
- revenues

This data can be found internally, in accounting/finance and within the corporation, or externally, through R&D programs, consultants, or the internet.

Estimates in studies are classified in three categories:

- Order of magnitude estimate
- Semi-detailed/Budgetary Estimate
- Definitive/Detailed Estimate

Through a graph, it is understood that order-of-magnitude estimates are low-cost, high-uncertainty estimates for early project phases. Detailed estimates are high-cost and typically used in the final stages of a project. It has a high WBS, meaning more detailed breakdowns of tasks and costs.

Order of magnitude & budgetary level accuracy estimates are high-level and techniques consist of:

- **Indexes**

They are dimensionless values used to estimate relationships of the past or future relative to a defined reference point. As things change over time, we need a baseline to compare all of our information to.

A common index is the Consumer Price Index (CPI) This makes an estimate on past data to how much revenue you can make today.

$$Cn = Ck(In/Ik)$$

k is the reference year n is the target year c is the cost i is the index value

**Unit Techniques**

Used when you have a known and reliable average per unit costs / revenues, allows for scalability

**Parametric cost estimation**

Based on historical data and statistical methods to develop a model, like a line of best fit. Models focus on key independent variables or cost drivers to model budget level costs.

## 2.2 Power-Sizing Technique

A model based on economies of scale Fixed costs are fixed, while variable costs are variable

$$Ca = Cb(Sa/Sb)^X$$

X is the cost-capacity factor A is the project being estimated B is the known project C is the cost S is the project size

## 2.3 Learning Curve Model

Modelling based on assumption that there is a constant percentage reduction in input resources as the output double.

$$Zu = k(u^(logs/log2))$$

U is the uth unit of production K is the resource value needed for first unit S is the learning curve parameter (decimal value) Zu is the resource value needed for the uth unit

# 3 L3 APSC221 - Time Value of Money

How to make comparisons and decisions on tradeoff that occur at different times fairly? ## Interest

Interest is compensation to the lender of money for their inconvenience. The inconvenience is the loss of productivity when lending money in the present.

Interest is expressed as a percentage rate for a given period of time.

| Notation | |
|---|---|
| Present Value / Present Worth / Principal | $P$ |
| Future Value | $F$ |
| Interest | $I$ |
| Interest rate | $i$ |
| Total Number of Interest Periods | $N$ |
| Nominal Interest Rate | $r$ |
| Effective Interest Rate per Period | $i_e$ |
| Annuity Amount | $A$ |
| Discrete Payment at the end of an Interest Period | $A_n$ |

The base unit of time for interest calculation is known as the interest period. Periods include annually, semiannually, quarterly, monthly, weekly, daily, etc. Continuous interest period is theoretical, but not practical. This rate limit approaches zero, and the function is exponential.

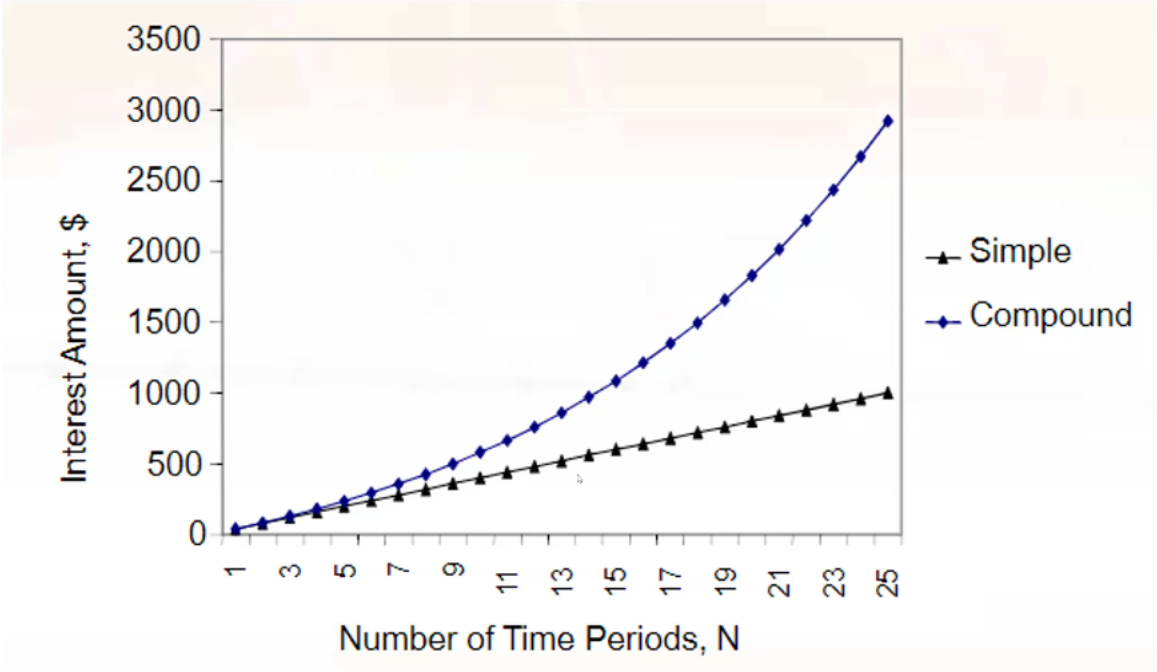
$$F = P + I$$
$$F = P + PI$$
$$F = P(1 + i)$$

Interest is payed for every period. Simple interest is constant for every period and is payed on the principal. This is basically inapplicable.

$$I = PiN$$

Compound interest is paying interest on the principal and accrued interest value. This interest compounds on itself, over each period.

$$F = P(1 + i)^N$$




## 3.1 Nominal and Effective Interest Rates

Interest rates are stated for a given period of time. The "stated" rate is the nominal interest rate, and is assumed to be **annual**. The effective interest rate can be found through conversion.

Suppose that: r is the nominal state rate for the period (annual) m is the equal compounding sub-periods (target period) the compound interest rate per sub period is is = r/m

$$F = P(1 + i_s)^m$$

The effective annual interest rate ie :

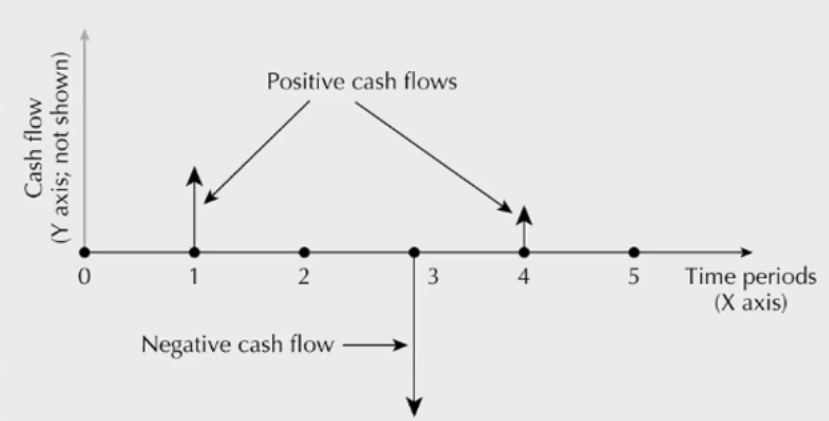
$$F = P(1 + i_s)^m = P(1 + i_e)$$

$$i_e = (1 + i_s)^m - 1$$

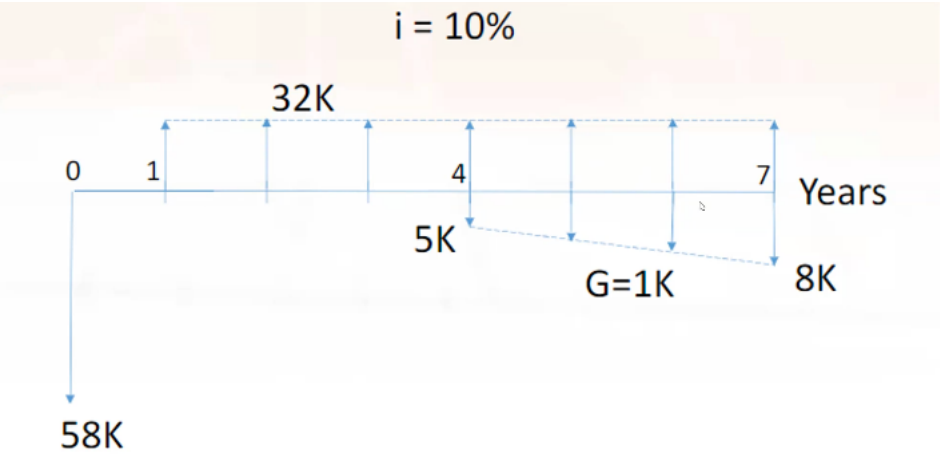
$$\text{or } i_e = (1 + r/m)^m - 1$$

## 3.2 Cash Flow Diagrams

Graphical representation to summarize the timing and magnitude of cash flows




Cash transactions occur at the end of a period The magnitude of the arrow is also important and should be measurable.




## 3.3 Equivalence

This is the idea that different sums of money at different points in time can be considered equal in value if adjusted properly using interest rates.

**Mathematical Equivalency** Calculations we are conducting that equates present and future values.

**Decisional and Market Equivalency** These assumptions must hold true for the mathematical equivalence to be meaningful.

1. Decision maker is indifferent between money now or in the future
2. Decision maker can exchange cash flows at zero cost (ignore admin costs)

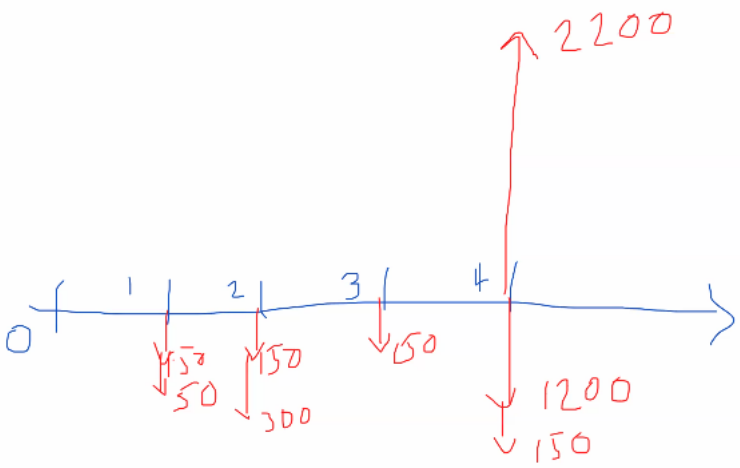
# 4 L4 APSC221 - Cash Flow Analysis

## 4.1 Drawing a Cash Flow Diagram

How to draw a cash flow diagram based on personal expenses:

- monthly income +2200
- rent -1200
- food per week -150
- cell phone bill -50
- credit card payment -300

1. Determine time period The most logical time period is weeks.
2. Draw line and hash marks for each period
3. Draw inflow lines up, downflow lines down
4. Don't subtract inflows and downflows




In cash flow diagrams, mathematical equivalency is used to compare different cash flows from an apples to apples basis.

Steps: 1. Draw a cash flow diagram for each options we are evaluating 2. Use mathematical equivalence to transfer all cash flows to a common point in time 3. Compare the options based on their equivalent values at the common point in time

For many cash flows, we can reduce the tediousness of transferring each cash flow by using **Compound Interest Factors**. This is a formulae defining the mathematical equivalence between common cash flow patterns, such as Single Cash Flows, Annuity Cash Flow Series, and Gradient Cash Flow series.

## 4.2 Types of Cash Flows

For a **Single Cash Flow**, use equation F = P(1+i)^n or rearrange to move backwards

General form: F = P(F/P, i, N)

Values of all compound interest factors have been calculated and presented in table format in **Interest Factor Tables**

**Find interest factor using accurate n and F values from table. Always keep to 4 decimal places until rounding the final solution.**

For a **Annuity Cash Flow Series**, use:

**Future Value of an Annuity**: F = A(F/A, i, N)

An **annuity** is a **series of equal payments** (cash flows) made at **regular time intervals** for a **fixed number of periods**.

### 4.2.1 Types of Factors

**Sinking Fund Factor** converts a future amount into an annuity: (A/F, i, N)

**Capital Recovery Factor** converts a present amount into an annuity: (A/P, i, N)

**Uniform Series Factor** converts an annuity into a future amount: (F/A, i, N)

**Series Present Worth Factor** converts an annuity into a present amount: (P/A, i, N)

If N goes to infinity only applies to annuities because it could go on forever. **Capitalized Value** is the P value of an infinite series of cash flows

Apply lim -> inf to get P = i/A

## 4.3 Arithmetic Gradient Cash Flow

This cash flows series **starts at zero** and increases at a constant amount, G, from period to period.

**Arithmetic Gradient to Annuity Factor** converts an arithmetic gradient into an annuity: (A/G, i, N)

**Arithmetic Gradient to Present Value** converts an arithmetic gradient into a present value: (P/G, i, N)

## 4.4 Geometric Gradient Cash Flow

This cash flow series increases at a constant rate or percentage, into an exponential function. We can compute the mathematical equivalence using a **spreadsheet, not formulas**.

## 4.5 Non-Standard Cash Flows

If the compounding period is not the same as the payment period, we use spreadsheets to convert the sub-periods into an equivalent cash flows.

How do we deal with a cash flow which does not match to any of the cash flow series we know?

We can convert each individually or calculate them in chunks while finding known patterns (i.e. uniform series, linear gradient) within them.

## Summary and Rules to Follow

Rules to Follow:

1. The present amount, $P$, of a future amount, $F$, occurs $N$ periods earlier than $F$.
2. The future amount, $F$, of an annuity or gradient occurs at the last cash flow of the annuity or gradient.

- $P$ denotes the present amount at the beginning of Period 1 (ie, Time Zero)
- Annuities have their first non-zero cash flow at the end of Period 1.
- Arithmetic gradients have their first non-zero cash flow at the end of Period 2.

# 5 L5 APSC221 - Comparison Methods 1

Present Worth, Future Worth, Annual Worth, and Payback Period

Determining the feasibility of a project based on the costs and benefits, aka Resources vs Investments.

## 5.1 Key Assumptions in Comparison Methods

1. Costs and benefits are measurable
2. Future cash flows are known in certainty
3. Cash flows are not affected by inflation (for now)
4. Taxes are not applicable (for now)
5. There are sufficient funds available unless specified
6. All investments have a first cost / cash outflow to start (not zero)

## 5.2 Project Relationships

An independent project's expected cost/benefits do not depend on if another project is chosen.

Mutually exclusive (ME) projects are more realistic. Choosing one project from a pool of projects excludes the others.

Related, but not ME project's expected cost/benefits depend on if another project is chosen.

## 5.3 Minimum Acceptable Rate of Return (MARR)

A minimum threshold to determine if a project is worth our time.

### 5.3.1 How to determine this rate?

- Weighted Average Cost of Capital (debt and equity) aka WACC
- Internal and External Rate of Return
- Risk Free Rates

## 5.4 Comparison Methods

Take cash flows for project, shift to a common point, and determine, based on common-point value, if we want to take on this project or which project.

Because we are equating cash flows, all projects compared must have the same lifespan.

### 5.4.1 Present Worth Method (PW) and Future Worth Method (FW)

Shift cash flows to present or end time. PW $< 0$, costs are higher than benefits PW $= 0$, this is the break-even point PW $> 0$, benefits are outweighing costs

Projects are ME, and the goal is to maximize PW/FW.

### 5.4.2 Annual Worth/Annual Cost Method (AW/AC)

For profits, maximize AW For costs, minimize AC

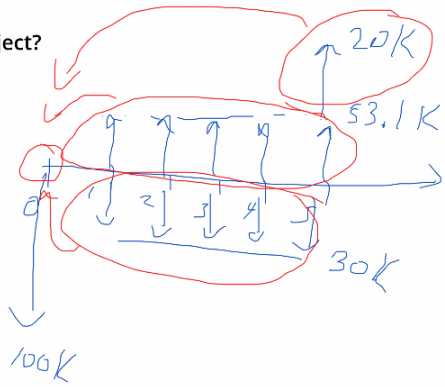
## 5.5 Independent PW Example

### Example – Independent PW

Aurora Air wants to open a temporary base in Sweden. The initial startup costs are expected to be $100,000 and will yield $53,100 annual revenues for 5 years. Maintaining the base will cost $30,000 per year and they expect to recover $20,000 when they close the base.

**If Aurora Air requires a 10% per year return, is this a desirable project?**

$$PW = -100K + 20k(P/F, 10\%, 5) + 53.1K(P/A, 10\%, 5) - 30k(P/A, 10\%, 5)$$



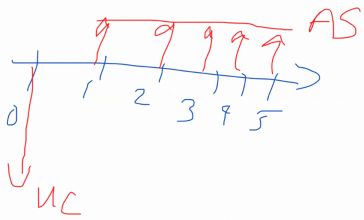

## 5.6 Mutually Exclusive PW Example

Aurora Air wants to replace its fleet of aircraft at the temporary base. The following 3 options were provided to them:

| Aircraft | Unit Cost | Annual Savings |
|---|---|---|
| 737 MAX 7 | $90 M | $24.0M |
| A320neo | $108M | $28.5M |
| CS300 | $87M | $23.0M |

**Assuming the same required return and time period as the temporary base, which aircraft should they choose?**

$$PW = -UC + AS(P/A, 10\%, 5)$$



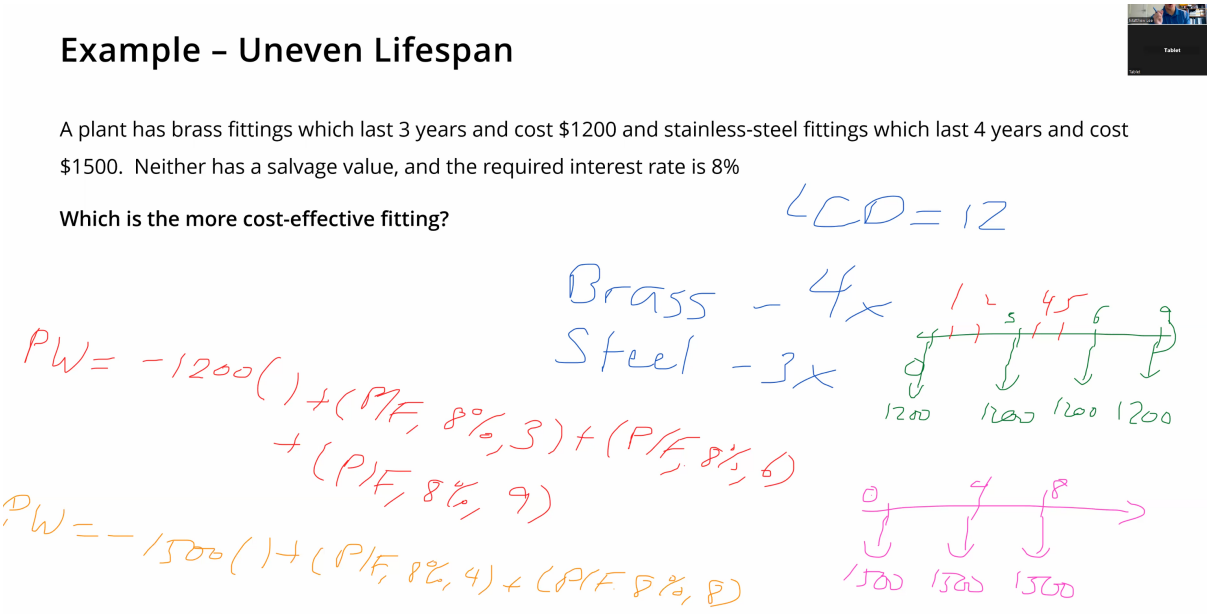

## 5.7 Uneven Lifespan

When comparing alternatives with unequal lifespans, we need a common basis for economic comparison:

1. **Repeated Lives Approach** Repeat each alternative's cash flow until they both span the **Least Common Multiple** of their lifespans.

2. **Study Period Approach** Determine a specific study period and realize a salvage value at the end of the study. Requires that the costs/benefits are reasonably well distributed.
3. **Do an AW/AC Method** Convert the PW of each alternative to an equivalent uniform annual cost over its own lifespan. Use: AW = Pw(A/P, i, n) This simplifies the comparison to an annualized basis, regardless of lifespan.

### 5.7.1 Uneven Lifespan Example




## 5.8 Payback Period

Simplest method in judging a project's viability. **Number of years for the first cost to be recovered.**

Period = First Cost / Annual Benefit.

If annual benefits are non constant, we can simplify the period: First Cost = sum of Annual Benefits.

**This method is very crude and ignores the time value of money.**

We commonly use a hurdle period of 2-4 years. If payback period exceeds, the project is not viable.

### 5.8.1 Payback Period Example

Of the 2 opportunities below, what is the payback period for each and what would be the recommendation?

| | Machine A | Machine B |
|---|---|---|
| First cost | $15 000 | $20 000 |
| Annual revenues | 9000 | 11000 |
| Annual costs | 6000 | 8000 |
| Scrap value | 1000 | 2000 |
| Service life | 5 years | 10 years |

$$PB = \frac{FC}{AB} = \frac{15K}{(9K-6K)} = 5$$

$$\frac{20K}{(11K-8K)} = 6.67$$

# 6 L6 APSC221 - Comparison Methods 2 - IRR

## 6.1 Internal Rate of Return

Underlying: What is the required profit?

The return of an investment in a project is known as the internal rate of return (IRR)

IRR: PW and AW = 0 1. Is internal, meaning it only covers the project's cash flow; not other things 2. For the IRR to exist, both the benefits and costs must be defined

### 6.1.1 IRR Calculation

Determine interest rate i s.t. the PW of the cash flows is zero

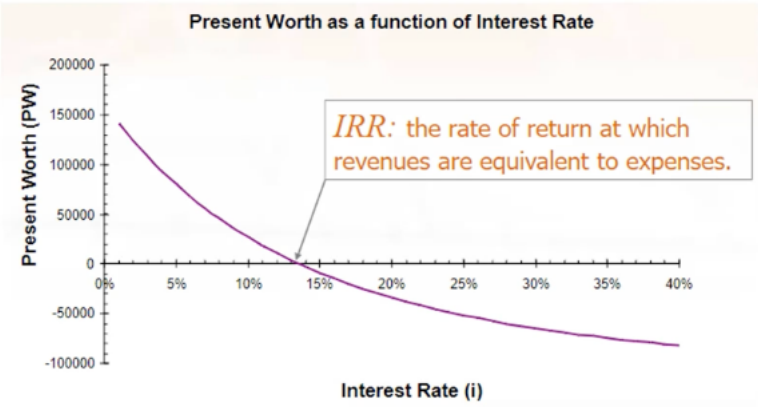
$$PW = 0 = \Sigma(R_t - D_t)/(1+i)^t$$

with limits t = 0 to T

s.t. R = Receipts (positive CF) D = Dispersements (negative CF)

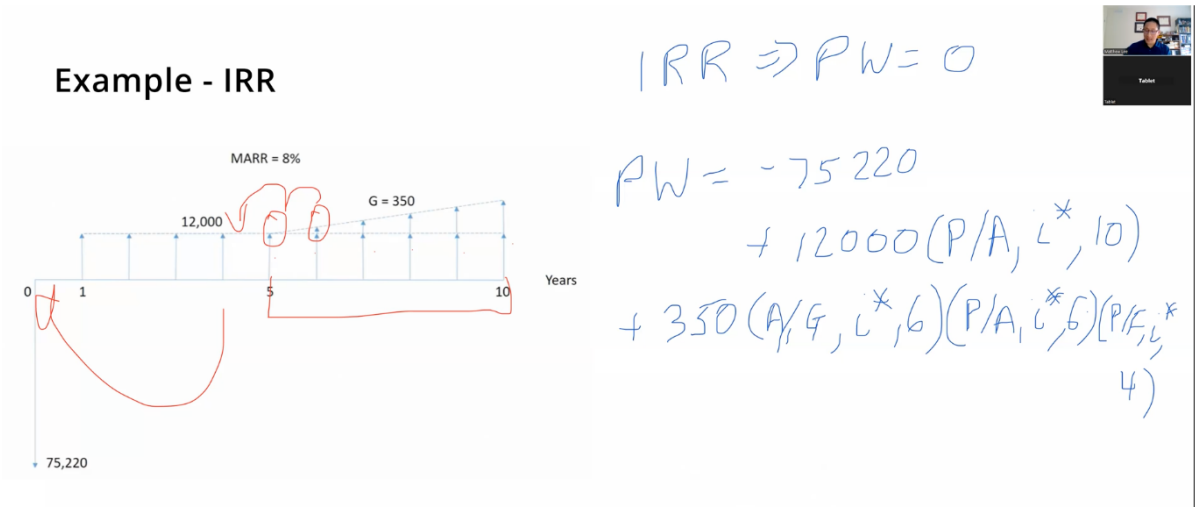
When graphed, IRR is a function, and its y-intercept is when PW = 0 (PW is on the

$$PW = 0 = \sum_{t=0}^{T} \frac{R_t - D_t}{(1+i^*)^t}$$




y-axis)

In practice, IRR is solved on excel.




If IRR is higher than MARR, then the cash flow is viable rather than do-nothing option.

## 6.2 Multiple IRRs

But, calculating IRR with an even-number polynomial will result in two asymptotes, thus two IRRs.

If cash flows change from positive to negative often, calculating IRR will be impossible due to multiple IRR results.

This adds one more assumption:

The sequence of cash flows can have only 1 sign change between positive and negative cash flows.

## 6.3 Evaluation for ME Projects

Highest IRR is not as simple to determine.

Process: 1. Sort the projects from the lowest to highest **first cost** and start with it as your current best option 2. Challenge the current best option with the next costlier project from the list 3. Determine if the incremental investment has an IRR $>$ or equal to MARR a. If yes, replace the current best option with the challenger b. If no, repeat Step 2

# 7 L7 APSC221 - Comparison Methods 2 - ERR

## 7.1 External Rates of Return

Combines internal and external investments to determine the viability of a complex project (defined based on CF).

We convert a non-standard CF into standard by assuming we can invest cash at the MARR rather than invest it in the project (do nothing).

If we do not convert to standard, we will have multiple IRRs.

### 7.1.1 Precise ERR (need a rate of return)

1. convert non-standard to standard
2. then conduct IRR

### 7.1.2 Approximate ERR (just need a decision)

1. cash inflows are moved to the future at the MARR
2. discount outflows by an ERR to calculate
3. FW = 0, solve for ERR

| Method | Advantages | Disadvantages |
|---|---|---|
| **IRR** | Facilitates comparisons of projects of different sizes<br>Commonly used | Relatively difficult to calculate<br>Multiple IRRs may exist |
| **Present worth** | Gives explicit measure of profit contribution | Difficult to compare projects of different sizes |
| **Annual worth** | Annual cash flows may have familiar meanings to decision makers | Difficult to compare projects of different sizes |
| **Payback period** | Very easy to calculate<br>Commonly used<br>Takes into account the need to have capital recovered quickly | Discriminates against long-term projects<br>Ignores time value of money<br>Ignores the expected service life |

- Precise ERR tracks the project's cash balance at every period, using trial and error to find the rate that makes the future value of all cash flows zero. It applies the MARR to positive balances and the trial ERR to negative balances, requiring careful calculation for each period.
- Approximate ERR is simpler. It moves all net receipts forward to the end at the MARR, and all net disbursements forward at an unknown rate. Then it solves for the rate that makes these two totals equal. This method does not track the actual timing of positive and negative balances, so it is less accurate but much faster.

# 8 L8 APSC221 - Inflation

## 8.1 Descriptions

**Inflation:** the increase in average price paid for goods and services; results in reduction of purchasing power

**Deflation:** decrease in average price paid for goods and services; results in increase of purchasing power

Inflation in measured as a rate of increase of price over a specified period, as a percentage.

CPI = 100 * (current cost / base year cost)

While CPI is a snapshot of price levels, inflation is the rate of change in those prices. So, when CPI rises, it's a sign of inflation.

## 8.2 Prices indices boil down to:

### 8.2.1 Contract Escalation

Inflation forecasts are used to escalate contracts.

Ex: inflation estimates are used for a contract of 10,000 over 50 years, because in 50 years, 10,000 is worthless.

Ex: minimum wage is tied to CPI and inflation.

Each industry has industry-specific price indices that tie future price increases to those indices.

### 8.2.2 Tracking Selling Prices

Companies can compare price changes for its products with those of the industry as a whole.

Used to compare price trends and get a sense of their own competitiveness.

## 8.3 Economic Evaluation with Inflation

### 8.3.1 Actual Dollars (or Current or Nominal)

The value of a dollar at the time of the CF.

These dollars' purchasing power changes due to inflation/deflation.

### 8.3.2 Real Dollars (or Constant)

Value of dollars assuming a constant purchasing power.

### 8.3.3 Converting between the two

$$R = \frac{A}{(1+f)^N}$$

R_0,N: Real dollars equivalent to A relative to year 0 A_N: Actual dollars in year N f: inflation rate per year

**Inflation affects MARR.** If inflation is expected, actual dollars returned does not reflect the actual purchasing power of the future CF.

Purchasing power depends on the **real** dollar of the CF.

## 8.4 Real Interest Rate Calculation

Find i' based on i and f.

$$F = M(1+i)$$

$$P = \frac{M(1+i)}{1+f}$$

$$M(1+i') = M\frac{1+i}{1+f}$$

$$i' = \frac{1+i}{1+f} - 1$$

Find IRR' based on IRR and f

$$\Sigma \frac{R_t}{(1+i')^t} = 0$$

$$IRR_{real} = \frac{1+IRR_{actual}}{1+f} - 1$$

$$IRR_{actual} = IRR_{real} + f + IRR_{real} * f$$

or

$$MARR_{actual} = MARR_{real} + f + MARR_{real} * f$$

The actual MARR and actual IRR are related in the same way to the real MARR and real IRR.

Actual incorporates inflation, while real does not.

If inflation is accurately used, PW is:

1. PW of actual dollars at actual MARR; or
2. PW of real dollars at real MARR

Projected cash flows are often stated in real dollars. The challenge is recognizing that we have an actual MARR but real cash flows.

## 8.5 Evaluation Methods

1. Work with real CFs and find the real MARR using an estimated inflation
2. Adjust the real CFs for inflation and apply the actual MARR; or
3. Work with mixed cash flows, use both real and actual rates (MARR or IRR) using equation; **requires a clear delineation in your mind of real vs actual CFs**

# 9 L9 APSC221 - Depreciation

## 9.1 Depreciation

Physical assets lose value or depreciate over time.

Depreciation comes from: 1. Use-related physical loss (wear and tear) 2. Time-related loss 3. Functional loss

### 9.1.1 Modeling

Depreciation models are used to estimate the valuation of assets at a given point in time.

Common terms include: **Market value** is the value of an asset on the open market (sale value). **Book value** is the value of an asset for accounting purposes.

### 9.1.2 Estimating Market Value

**Salvage value** is the actual or estimated value at the end of its useful life.

**Scrap value** is the actual or estimated value at the end of its physical life.

Estimating asset values is important to support business transactions (i.e. loans), planning replacement decisions, and for taxes paid on net income (revenue - expenses)

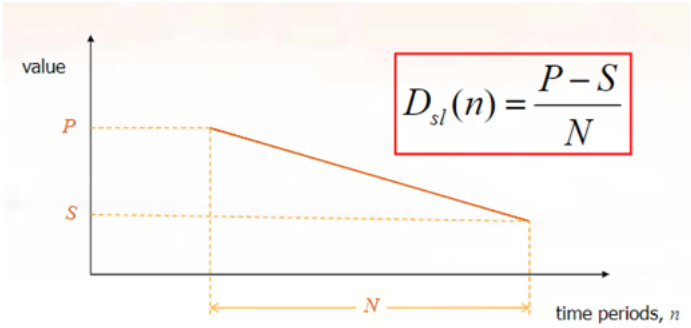
## 9.2 Depreciation Models

2 are used in Canada: **Straight Line Depreciation** and **Declining Balance Depreciation**

### 9.2.1 Straight Line Depreciation

SLD assumes a constant rate of value loss over the life cycle.

Not very realistic.




$$D_{sl}(n) = \frac{P - S}{N}$$

P rep. purchase price S rep. salvage value at time N N rep. useful life of N periods

**Example**

An asset purchased 7 years ago for $10,000 has a service life of 10 years. It can be sold at the end of its service life for $2,000.

What is the book value today using SLD?

$BV(7) = P - D(7)$

$= P - 7 \times \left(\frac{P-S}{N}\right)$

$D_{(n)} = \frac{P-S}{N}$ $= 4400$

### 9.2.2 Declining Balance Depreciation

DBD models loss at a constant **proportion of value (%)** loss over the life cycle.

More realistic. This is the mandated deprecation model by the CRA.

$$D_{db}(n) = BV_{db}(n-1) * d$$

BV(n) rep. book value at time n d rep. fixed depreciation percentage rate

If the percentage rate of DBD is not specified, we need to determine the appropriate depreciation rate.

$$BV_{db}(N) = S = P(1-d)^N$$

$$d = 1 - \sqrt[N]{\frac{S}{P}}$$

# 10 L10 APSC221 - Taxes

Taxes have a significant impact on the economic viability of a project.

Corporations are taxed at a **flat rate**, while individuals are taxed on a **progressive system** based on income.

## 10.1 Tax Effect on MARR

Taxes effectively reduce the profit of a project.

MARR after tax can be calculated:

$$MARR_{\text{after-tax}} = MARR_{\text{before-tax}}(1 - t)$$

Where (1-t) reflects the reduction in profit due to taxes, and profit is defined as revenue minus expenses.

## 10.2 Tax Loopholes (Bending Rules Around Expenses)

The **Capital Cost Allowance (CCA)** captures the value loss of assets held by corporations. Some companies work hard to maximize the depreciation expensed through operations.

CCA allows corporations to expense depreciation **instead of the full initial purchase price** of an asset. Maximizing depreciation reduces taxable profit.

CCA uses the **Declining Balance Depreciation (DBD)** method and specifies a maximum annual **CCA rate**.

## 10.3 Undepreciated Capital Cost (UCC)

- UCC is the **tax book value** for a class of assets.
- Used **only** for taxation purposes.
- **Does not reflect market value.**

### 10.3.1 Half-Year Rule

A condition for calculating depreciation for tax purposes:

- Only **half** of the asset's capital cost can be added to UCC in the year of acquisition.
- Prevents manipulation (e.g., buying at year-end and selling in the new year).

Formulas:

$$UCC_{\text{reduced}}(n) = UCC_{\text{end}}(n-1) + \frac{1}{2}\text{purchases} - \text{dispositions}$$

$$CCA(n) = UCC_{\text{reduced}}(n) \times \text{CCA rate}$$

$$UCC_{\text{end}}(n) = UCC_{\text{reduced}}(n) - CCA + \frac{1}{2}\text{purchases}$$

Only theoretical on the exam (edit: we got asked on the exam to define the half year rule)

## 10.4 Tax Savings from CCA

### 10.4.1 Capital Tax Factor (CTF)

The CCA generates tax savings, which reduce the present worth (PW) of the initial cost.

$$CTF = 1 - \frac{td\left(1 + \frac{i}{2}\right)}{(i+d)(1+i)}$$

Assumes the asset has **infinite life**.

### 10.4.2 Capital Salvage Factor (CSF)

Applies when the asset's useful life **ends** and it's sold:

$$CSF = 1 - \frac{td}{i+d}$$

- Applies a **cutoff** to the infinite tax savings assumed by CTF.
- Assumes **no tax implications** from capital gains/losses (not covered in the course).
- If salvage value = 0, CSF has no effect.

## 10.5 The Components of a Complete Tax Calculation

1. **First Cost** → Multiply by **CTF**
2. **Savings or Expenses** → Multiply by **(1 - t)**
3. **Salvage Value** → Multiply by **CSF**

# 11 L11 APSC221 - Replacement Decisions

## 11.1 When Do We Replace an Asset?

### 11.1.1 Options

Physical assets should be periodically evaluated as they age. The main options are:

1. **Keep** the asset (do nothing)
2. **Overhaul** the asset to improve efficiency
3. **Dispose** of the asset without replacement
4. **Replace** the asset with a new one

### 11.1.2 Reasons for Replacement or Retirement

- **Replacement**: Due to declining efficiency or loss of market competitiveness
- **Retirement**: When the asset's service is no longer needed

### 11.1.3 How Long Should We Keep an Asset?

- Relevant costs are not always obvious
- Understanding the asset's **economic life** is critical - distinct from its physical or service life
- **Economic life**: The point at which the cost of keeping the asset outweighs the economic benefit it provides

## 11.2 Asset Costs

### 11.2.1 Capital Costs

- Purchase cost - Salvage value (adjusted for time value of money)

### 11.2.2 Installation Costs

- One-time, non-recoverable, sunk costs

### 11.2.3 Operating & Maintenance (O&M) Costs

- Ongoing costs of using the asset
- Typically increase over time

## 11.3 Equivalent Annual Cost (EAC)

EAC provides a way to compare costs that vary over time.
Unlike regular annual cost, EAC changes each year based on time and cost structure.

### 11.3.1 Formulas:

- **Capital Cost EAC**

$$EAC_{capital} = (P - S)(A/P, i, N) - S * i$$

- **Operating & Maintenance EAC**

$$EAC_{O\&M} = \sum \text{Annualized cash flows}$$

- **Total EAC**

$$EAC_{total} = EAC_{capital} + EAC_{O\&M}$$

## 11.4 Replacement Scenarios

- **Defender**: The current asset
- **Challenger**: The potential replacement asset

### 11.4.1 Scenario 1: *Identical Defender and Challenger*

- Asset need is indefinite
- Life cycle repeats (e.g., software, electronics)
- Assumes stable tech, prices, and interest rates

**Decision Rule:**

- Replace when **EAC_capital is minimized** (i.e., at economic life)

### 11.4.2 Scenario 2: *Different Defender and Challenger (same challenger continues indefinitely)*

- Example: Flip phone vs. smartphone
- Assumes stable external conditions

**Decision Process:**

1. Determine economic life and **EAC_c** of challenger
2. Determine remaining life and **EAC_d** of defender
    - If **EAC_d** $>$ **EAC_c**, replace now
    - Else, monitor until EAC_d $>$ EAC_c at year $n$, and replace at year **n - 1**

**Notes:**

- **Sunk costs are excluded**
- **Defender's initial cost (P)** = present opportunity cost
- **One-Year Principle**:

- If capital costs are small and O&M costs increase steadily, economic life of the defender = 1 year

$$EAC_{total} = EAC_{O\&M}(n = 1)$$

### 11.4.3 Scenario 3: *Different Defender, Different Future Challengers*

- **Not covered in this course**

# 12 L12 APSC221 - Risk & Uncertainty

## 12.1 Overview

- Economic analysis often assumes all future cash flows (CFs) occur with certainty.
- In reality, projects face risks and uncertainties.
- Qualitative methods help understand and manage these uncertainties.

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## 12.2 Key Points

- Sensitivity analysis and break-even analysis address uncertainty (no probabilities).
- Decision trees address risk (with probabilities).
- Each method helps inform better decision-making under imperfect information.

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## 12.3 Brief Description

- **Sensitivity Analysis:** Examines how changes in one parameter affect project outcomes.
- **Break-even Analysis:** Identifies parameter values where a project just meets a threshold.
- **Decision Trees:** Models sequential decisions and chance events, incorporating probabilities.

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## 12.4 Intuition

### 12.4.1 Why It Matters

- Real-world projects rarely unfold exactly as planned.
- Understanding which variables most affect outcomes helps prioritize attention and resources.

### 12.4.2 Underlying Logic

- Sensitivity and break-even analyses reveal which assumptions are most critical.
- Decision trees break complex, uncertain decisions into manageable steps.

### 12.4.3 Analogies

- Sensitivity analysis is like testing how a car's speed changes with different amounts of fuel.
- Break-even analysis is like finding the minimum number of tickets you must sell to cover concert costs.
- Decision trees are like flowcharts for "choose your own adventure" stories, but with probabilities.

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## 12.5 Options/Frameworks

### 12.5.1 1. Sensitivity Analysis

- **Approach:** Change one parameter at a time, observe effect on outcome (e.g., Present Worth (PW), Annual Cost (AC)).
- **Tools:** Sensitivity graphs (plot outcome vs. parameter).
- **Pros:** Simple, highlights key variables.
- **Cons:** Ignores interdependencies, only two variables at a time.

### 12.5.2 2. Break-even Analysis

- **Approach:** Vary a parameter to find the value where the outcome meets a threshold (e.g., PW = \$10,000).
- **Pros:** Answers specific "what if" questions, useful for scenario planning.
- **Cons:** Cannot capture variable interdependencies.

### 12.5.3 3. Decision Trees

- **Approach:** Map out decisions and chance events in sequence, assign probabilities, calculate expected values.
- **Components:**
  - *Decision node (square):* Choice to be made.
  - *Chance node (circle):* Uncertain event.
  - *Branches (lines):* Sequence of decisions/events.
  - *Leaves:* Final outcomes/payoffs.
- **Pros:** Handles complex, multi-stage decisions; incorporates risk.
- **Cons:** Can become complex; requires probability estimates.

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## 12.6 Formulas

- **Expected Value of Random Variable:**

$$E(X) = \Sigma x_i p(x_i)$$

  - $x_i$: Possible outcome
  - $p(x_i)$: Probability of outcome $x_i$
  - *Example:* If PW can be $5k$ (20%), $10k$ (50%), $15k$ (30%): $E(PW) = 0.2 \times 5k + 0.5 \times 10k + 0.3 \times 15k$

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## 12.7 Scenarios

- *Sensitivity Graph:* Vary MARR (Minimum Attractive Rate of Return) to see how PW changes.
- *Break-even:* Find utility cost where PW = \$10,000.

- *Decision Tree:* Choose between Machine A and B, each with different probabilities for high/medium/low returns.

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## 12.8 Assumptions & Common Pitfalls

- **Assumptions:**
  - Sensitivity and break-even analyses assume only one variable changes at a time.
  - Decision trees assume probabilities are known and outcomes are discrete.
- **Pitfalls:**
  - Ignoring variable interdependencies.
  - Overconfidence in estimated probabilities.
  - Oversimplifying complex scenarios.

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## 12.9 Summary & Key Takeaways

- **Sensitivity and break-even analyses** help identify critical variables and thresholds under uncertainty (no probabilities).
- **Decision trees** provide a structured way to analyze decisions under risk (with probabilities).
- Use **sensitivity analysis** to prioritize variables for further study.
- Use **break-even analysis** to answer "how much is enough?" questions.
- Use **decision trees** for multi-stage, probabilistic decisions.

### 12.9.1 *When to Use*

- Use sensitivity and break-even analyses early in project evaluation to understand uncertainty.
- Use decision trees when decisions depend on sequential events and probabilities are available.

# 13 L13 APSC221 - Risk Management

## 13.1 Four Stage Process

1. Identification - determining which risks are likely to affect the project and documenting the characteristics of each
2. Analysis of Probability and Impact - evaluating risks and risk interactions to assess the range of possible project outcomes
3. Mitigation Strategies - defining enhancement steps for opportunities and responses to threats
4. Control and Documentation - responding to changes in risk over the course of the project and creating a knowledge base for future projects

**Risk Management** recognizes the capacity of any project to run into trouble

**Project Risk** is any possible event that can negatively impact the viability of a project

## 13.2 Risks and Sources of Risk

Events within the organization or outside its control that can negatively impact the success of a project

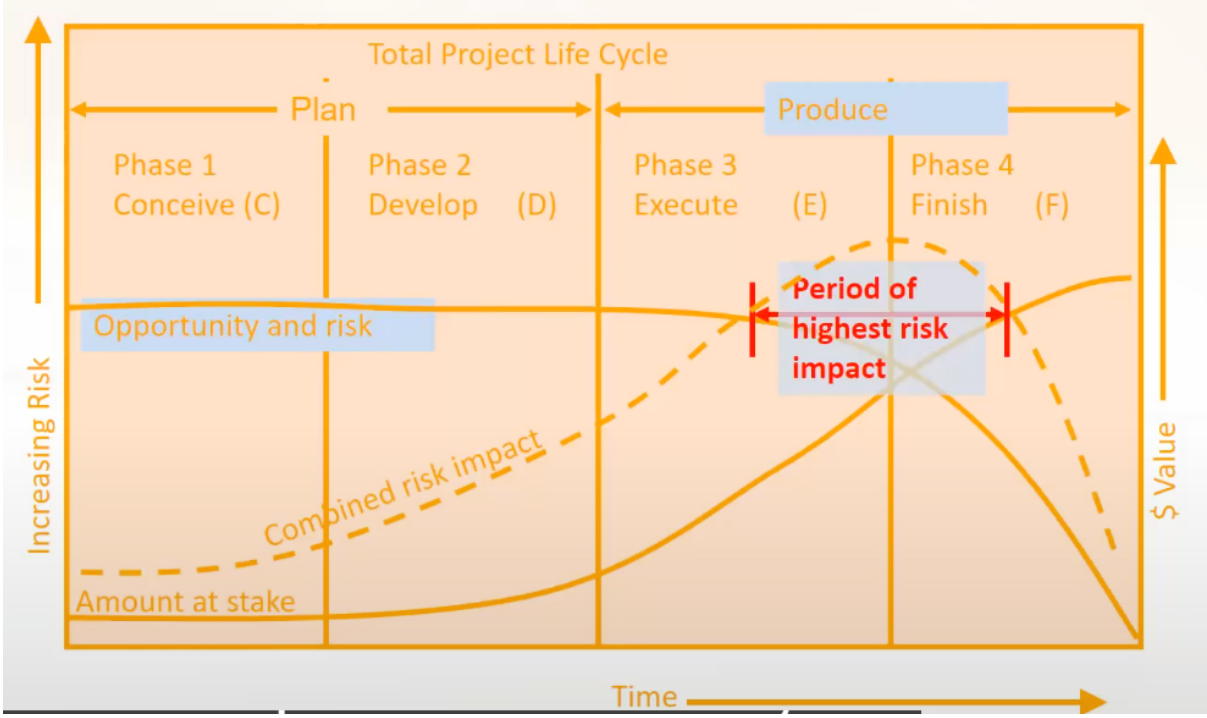
Risk = (Probability of Event)(Impact of Event)

**Sources:** * software * scope * quality * time * cost * procurement * human resources * project integration * communications

### 13.2.1 Process of Risk Management

We need to ask ourselves: * what is likely to happen * what can be done to minimize impact * what will signal the need to act * what are the likely outcomes of these problems and our anticipated reactions

## 13.3 Project Life Cycle and Risk




Edit: we got asked this on our exam ^

## 13.4 Other Notes on Risk

### 13.4.1 Risk Characteristics

- Risks are situational - no textbook answers exist
- Risks are interdependent - one risk can affect another
- Tolerance to risk depends on corporate values which themselves depend on personal values
- The greater the reward, the greater the acceptable risk
- Timing/quantity of risks can affect perceptions

### 13.4.2 Nine Phases of Risk Management (on S25 exam)

1. Define
2. Focus
3. Identify
4. Structure
5. Clarify ownership of risks
6. Estimate
7. Evaluate
8. Plan
9. Manage

### 13.4.3 Risk Quantification

Evaluate risks to assess the range of possible project outcomes

Seeks to determine which risks warrant response... - opportunities to pursue - opportunities to ignore - threats to respond to - threats to accept

Methods: * expected value * decision trees * monte carlo simulation

### 13.4.4 Risk Mitigation Strategies

Accept the risk - decision to "do nothing" is a reasoned calculation - a risk with low probability and low impact

Minimize the risk * methods to reduce probability and/or impact

Share the risk - contractually

Transfer the risk - where a risk cannot be reduced - dependent on types of risk and relationships with partners/stakeholders

### 13.4.5 Risk Response Control and Documentation

Need to capture and track risks for any given project

Required to... - access historical information about past projects - document data about each potential risk - assign responsibility - re-assess risk and mitigation strategies periodically - identify and document new risks as they may arise - communicate risks to all stakeholders

# 14 L14 APSC221 - Recognizing Opportunities and Generating Ideas

## 14.1 Terms

**Entrepreneur** is an individual who, rather than working as an employee, runs a small business and assumes all the risk and reward of a given business venture, idea, or good or service offered for sale. The entrepreneur is commonly seen as a business leader and innovator of new ideas and business processes.

Good entrepreneur: - prior experience - cognitive factors - entrepreneurial alertness - social network - social and professional contacts - creative

Weak-tie relationships are important to spark new ideas from casual acquaintances. Strong-tie relationships tend to reinforce insights and ideas that people already have.

**Intrapreneur** is an inside entrepreneur, or an entrepreneur within a large firm, who uses entrepreneurial skills without incurring the risks associated with those activities. Intrapreneur are usually employees within a company who are assigned a special idea or project, and are instructed to develop the project like an entrepreneur would. Intrapreneurs usually have the resources and capabilities of the firm at their disposal. The intrapreneur's main job is to turn that special idea or project into a profitable venture for the company.

## 14.2 Opportunities

An **opportunity** is a favourable set of circumstances that creates a need for a new product, service, or business

Both entrepreneurs and intrapreneurs seek to recognize a problem or an opportunity gap for which they can create a business model that will address the problem or fill the identified gap.

They need to be: - attractive - timely - durable - creates or adds value

## 14.3 Identifying Opportunities

They can be identified by: - solving a problem - notice a problem, find a way to solve - observing trends - economic forces, social forces, tech advances, political changes - finding gaps in the marketplace - fragmented market, or find a specific niche

### 14.3.1 Ideas

Ideas are great, we need them, but... - they might not meet the definition of an opportunity - idea has emphasis on creating or adding value

There are many ideas, but few are opportunities.

**Idea Generation** 1. Preparation - background, experience, rough idea, make connections 2. Incubation - small refinements, ideas flesh out 3. Insight - turn the idea into a viable solution, recognize the opportunity 4. Evaluation - analyze if the idea is viable 5. Elaboration - fine details, business, case, sales pitch

The idea generation should include a focus group of 5-10 people with unique participants and different perspectives.

### 14.3.2 Research

Libraries are often used for idea generation and research.

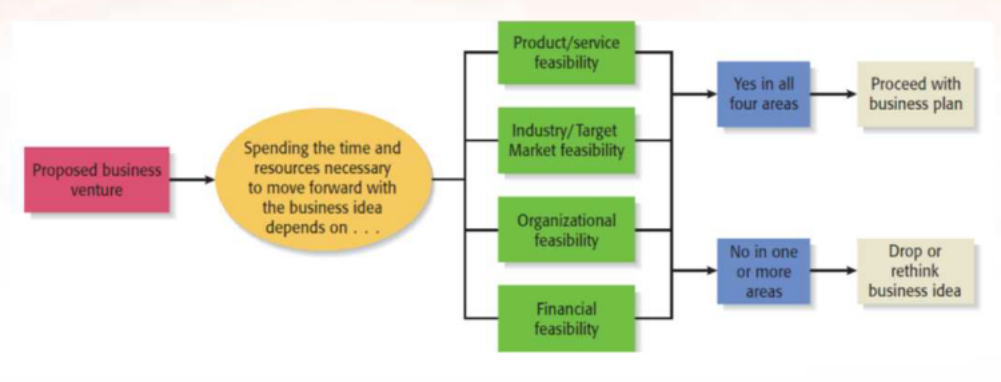
Internet can be used, but one should be weary of credibility.

### 14.3.3 Encouraging New Ideas

Establish a focal point for ideas, and encourage creativity at the firm

# 15 L15 APSC221 - Feasibility Analysis

Feasibility analysis is the process of determining whether a business opportunity is viable, if an idea is worth pursuing




## 15.1 Product/Service

- an assessment of the overall appeal of the product or service being proposed
- the product/service should be what prospective customers want

**Questions to ask:** - does it make sense? is it reasonable? - does it take advantage of market trends or gaps? - is this a good time to introduce the product/service to the market?

**Concept test** - concept statement: a one-page description distributed to people for feedback - feedback should give a sense of the viability of the product/service - sections: product, target market, benefits of the product, market positioning, management team

Demand should also be evaluated with potential customers through forms, ads, or surveys

## 15.2 Industry/Target Market

An assessment of the overall appeal of the industry and the target market for the proposed business A firm's **target market** is the limited portion of the industry it plans to go after.

**Characteristics** of attractive industries: - young rather than old, early rather than late in their life cycle - fragmented - growing, not crowded - selling "needs", not "wants" - high operating margins

Challenge: find a market that's large enough for the proposed business but is yet small enough to avoid attracting larger competitors

## 15.3 Organizational Feasibility

Conducted to determine whether a proposed business has sufficient management expertise, organizational competence, and resources to successfully launch a business **Focuses on non-financial resources**

The team must have passion for the business idea, and a strong understanding of the markets in which it will operate in

A firm should also list the 6-12 most critical non-financial resources that will be needed to move the business idea forward successfully, such as: - office/lab/manufacturing space - contractors or service providers - management employees and support personnel - ability to obtain intellectual property protection - ability to form favorable business partnerships

## 15.4 Financial Feasibility

A total start-up cash number should be determined by listing all anticipated capital purchases and operating expenses to generate the first dollar in revenue.

Estimate the proposed start-up's financial performance by comparing it to similar, already established businesses.

**Financial factors associated with promising business opportunities:** - steady and rapid growth in sales during the first 5-7 years in clearly defined market niche - high percentage of recurring revenue - ability to forecast income and expenses with a reasonable degree of certainty - internally generated funds to finance and sustain growth - availability of an exit opportunity for investors to convert equity to cash

# 16 L16 APSC221 - Assessing Financial Strength

**Financial management** is the raising of money and managing company finances to achieve the highest rate of return

## 16.1 Financial Objectives

1. Profitability - ability to make a profit
2. Liquidity - ability to meet short-term financial obligations
3. Efficiency - ability to utilize assets and equity productively to generate revenues and profits
4. Stability - Company's overall financial health and posture

## 16.2 Financial Management Process

Each step has different documents This process is cyclical, not linear

### 16.2.1 1. Preparation of Historic Financial Statements - income statement, balance sheet, statement of Cash Flows

**Income Statement** - reflects the result of business operations for a given period of time - records all revenues and expenses - shows the net result in profit or less

**Balance Sheet** - outlines a company's assets, liabilities, and equity at a **specific point in time** - limited use due to its time constraint

**Statement of Cash Flows** - summarizes the change in a company's cash position for a given period of time and **why it changed**

### 16.2.2 2. Preparation of Forecasts - income, expenses, capital expenditures

### 16.2.3 3. Preparation of Pro Forma Financial Statements

**pro forma** means into the future

**Historical Statements** - reflect past performance - typically, reported on a quarterly and fiscal year basis - publicly traded companies are required by securities laws to prepare these statements for shareholders and to make them public

**Pro Forma Statements** - projections of future periods - typically, prepared for an annual period for 2-3 years into the future - strictly planning tools and have no legislated requirements, nor are binding

### 16.2.4 4. Ongoing Analysis of Financial Results - ratio analysis, measuring results versus plans and/or industry norms

## 16.3 Income Statement

### Income Statement

| | December 31, 2014 | December 31, 2013 | December 31, 2012 |
|---|---|---|---|
| Net sales | $586,600 | $463,100 | $368,900 |
| Cost of sales | 268,900 | 225,500 | 201,500 |
| Gross profit | 317,700 | 237,600 | 167,400 |
| Operating expenses | | | |
| Selling, general, and administrative expenses | 117,800 | 104,700 | 90,200 |
| Depreciation | 13,500 | 5,900 | 5,100 |
| Operating income | 186,400 | 127,000 | 72,100 |
| Other income | | | |
| Interest income | 1,900 | 800 | 1,100 |
| Interest expense | (15,000) | (6,900) | (6,400) |
| Other income (expense), net | 10,900 | (1,300) | 1,200 |
| Income before income taxes | 184,200 | 119,600 | 68,000 |
| Income tax expense | 53,200 | 36,600 | 18,000 |
| Net income | 131,000 | 83,000 | 50,000 |
| Earnings per share | 1.31 | 0.83 | 0.50 |

**Net sales or revenues** is the amount of money brought in from sales **Cost of sales** is the cost of goods sold **Gross profit** Revenue - cost **Operating expenses (selling, general, admin)** are the overhead costs of the company **Depreciation** shows the amount of depreciation reduces from revenues **Operating income** is the income in the operation (running) of the company **Other income (expense), net** is interests, investments, financing expenses etc. **Income before income taxes** how much you have to pay before taxes **Income tax expense** taxes paid **Net income** bottom line, how much the company can keep **Earnings per share** if company is public

## 16.4 Balance Sheet

Assets = Liabilities + Equity ### Assets

## Balance Sheet - Assets

Assets = Liabilities + Equity

| Assets | December 31, 2014 | December 31, 2013 | December 31, 2012 |
|---|---|---|---|
| **Current assets** | | | |
| Cash and cash equivalents | $63,800 | $54,600 | $56,500 |
| Accounts receivable, less allowance for doubtful accounts | 39,600 | 48,900 | 50,200 |
| Inventories | 19,200 | 20,400 | 21,400 |
| Total current assets | 122,600 | 123,900 | 128,100 |
| Property, plant, and equipment | | | |
| Land | 260,000 | 160,000 | 160,000 |
| Buildings and equipment | 412,000 | 261,500 | 149,000 |
| Total property, plant, and equipment | 672,000 | 421,500 | 309,000 |
| Less: accumulated depreciation | 65,000 | 51,500 | 45,600 |
| Net property, plant, and equipment | 607,000 | 370,000 | 263,400 |
| Total assets | 729,600 | 493,900 | 391,500 |

#### 16.4.0.1 Current Assets

Quick to become cash. Use to make payments on debts, liabilities, etc.

**Cash and cash equivalents** are immediately cash (GIC) **Accounts receivable, less allowance for doubtful accounts** money expected to receive from invoices. **Inventories** is what we have prepared and ready to sell

#### 16.4.0.2 Long Term Assets

Land, buildings, equipment

### 16.4.1 Liabilities + Equity

Assets = Liabilities + Equity

| | | | |
|---|---|---|---|
| **Liabilities and shareholders' equity** | | | |
| **Current liabilities** | | | |
| Accounts payable | 30,200 | 46,900 | 50,400 |
| Accrued expenses | 9,900 | 8,000 | 4,100 |
| Total current liabilities | 40,100 | 54,900 | 54,500 |
| Long-term liabilities | | | |
| Long-term debt | 249,500 | 130,000 | 111,000 |
| Long-term liabilities | 249,500 | 130,000 | 111,000 |
| Total liabilities | 289,600 | 184,900 | 165,500 |
| **Shareholders' equity** | | | |
| Common stock (100,000 shares) | 10,000 | 10,000 | 10,000 |
| Retained earnings | 430,000 | 299,000 | 216,000 |
| Total shareholders' equity | 440,000 | 309,000 | 226,000 |
| Total liabilities and shareholders' equity | 729,600 | 493,900 | 391,500 |

#### 16.4.1.1 Current Liabilities

Debts or bills to pay in the short-term (1-2 months)

**Accounts payable** to be invoiced out **Accrued expenses** are things like insurance or utilities (paid after its use) #### Long Term Liabilities

**Long-term debt and liabilities** long term loans (mortgages, business loans)

**16.4.1.2 Shareholders' equity** **Owner equity** is related to those who have ownership in the company (stocks) **Retained earnings** is all the past profits not paid out to investors

## 16.5 Statement of Cash Flows

| | December 31, 2014 | December 31, 2013 |
|---|---|---|
| Cash flows from operating activities | | |
| Net income | $131,000 | $83,000 |
| Additions (sources of cash) | | |
| Depreciation | 13,500 | 5,900 |
| Decreases in accounts receivable | 9,300 | 1,300 |
| Increase in accrued expenses | 1,900 | 3,900 |
| Decrease in inventory | 1,200 | 1,000 |
| Subtractions (uses of cash) | | |
| Decrease in accounts payable | (16,700) | (3,500) |
| Total adjustments | 9,200 | 8,600 |
| Net cash provided by operating activities | 140,200 | 91,600 |
| Cash flows from investing activities | | |
| Purchase of building and equipment | (250,500) | (112,500) |
| Net cash flows provided by investing activities | (250,500) | (112,500) |
| Cash flows from financing activities | | |
| Proceeds from increase in long-term debt | 119,500 | 19,000 |
| Net cash flows provided by financing activities | | 19,000 |
| Increase in cash | 9,200 | (1,900) |
| Cash and cash equivalents at the beginning of each year | 54,600 | 56,500 |
| Cash and cash equivalents at the end of each year | 63,800 | 54,600 |

Shows what the change in cash is depending on the activity

**Cash flows from operating activities** from running the business or operating itself

**Cash flows from investing activities** from the company doing investing

**Cash flows from financing activities** taking out loans or receiving capital from investors

The final result will indicate an increase or decrease in cash. And, it shows the cash and cash equivalents at the beginning vs. the end of each year

## 16.6 Ratio Analysis

Edit: necessary to understand the drivers behind these ratios

Find a practical way to interpret a company's financial statements

You can: - compare company performance between years on a relativistic basis - compare company performance to other company's or the industry norms

### 16.6.1 Liquidity

$$\text{Working Capital Ratio} = CurrentAssets - CurrentLiabilities$$

$$\text{Current Ratio} = \frac{CurrentAssets}{CurrentLiabilities}$$

$$\text{Acid-Test Ratio} = \frac{QuickAssets}{CurrentLiabilities}$$

$$\text{Inventory Turnover Ratio} = \frac{Sales}{Inventory}$$

1. Goal: bigger than 1
2. Relativistic equivalent of WCR. Greater than 1
3. This uses quick assets, things we can turn to cash immediately
4. Telling us if we have too much inventory sitting around vs. sales

### 16.6.2 Profitability

$$\text{Profit Margin} = \frac{NetIncome}{Sales} = \frac{BottomLine}{TopLine}$$

$$\text{Return on Assets Ratio} = \frac{NetIncome}{TotalAssets}$$

$$\text{Return on Equity Ratio} = \frac{NetIncome}{TotalEquity}$$

1. Bottom line / top line. How much a company is keeping relative to its sales
2. Determines how efficient total assets are in creating income.
3. Tell us how efficient company is in making money depending on equity

### 16.6.3 Stability

$$\text{Debt Ratio} = \frac{TotalDebt}{TotalAssets}$$

$$\text{Debt to Equity Ratio} = \frac{TotalDebt}{Owner'sEquity}$$

$$\text{Equity Ratio} = \frac{TotalEquity}{TotalAssets}$$

1. Tells us if we are heavily using debt to run company. Small = good. Large = we have assets due to debt
2. Tells investors how much debt "they are in". Large = stockholder's will not receive money in bankruptcy
3. How much our assets are financed in equity

### 16.6.4 Ratio Analysis Comparison

Intuition-based comparison through ratio analysis

Good Examples: - rising profit margin per year - stable current and quick ratios - decreasing debt ratios

Bad Examples: - low pro forma ratios - low return on assets

### 16.6.5 Rules of Thumb

Targets: - current ratio = 2 - acid test ratio = 1

In general, specific ratio values are themselves netiher good nor bad - it is what they **imply** that is important

# 17 L17 APSC221 - How to Write a Business Plan

## 17.1 What is a business plan?

25-35 pages long, that describes what a new business plans to accomplish

It helps employees of a firm operate in sync and move forward in consistency It also makes the case for stakeholders that the firm is a good use of an investor's funds

## 17.2 Structure and Content

The business plan should be structured properly, and could use software packages for boilerplate templates

The plan should give clear and concise information on all the important aspects of the proposed venture, yet still long enough

### 17.2.1 Types of Business Plans

1. Summary Business Plan - 10-15 pages, best for new ventures in the early stages
2. Full Business Plan - 20-35 pages, best for new ventures in need of funding or financing
3. Operational Business Plan - 40-100 pages, primarily meant for an internal audience and for creating an operations blueprint

## 17.3 Elements of a Business Plan

### 17.3.1 Executive Summary

- Short overview, tl;dr for a busy reader
- Should not exceed two single-spaced pages
- It should be written last, but appears first

### 17.3.2 Industry Analysis

- Describe the industry entered in terms of size, growth rate, and sales projections
- Also include: industry structure, nature of participants, key success factors, industry trends, and long-term prospects

### 17.3.3 Company Description

- This section begins with a general description of the company
- Include: company description, company history, mission statement, products and services, current status, legal status and ownership, and key partnerships

### 17.3.4 Market Analysis

- This breaks the industry into segments and zeros in on the specific segment or target market to which the firm will try to appeal
- Include: market segmentation, target market selection, buyer behaviour, competitor analysis

### 17.3.5 Economics of the Business

- This section addresses the basic logic of how profits are earned in the business and how many units of a business's profits must be sold for the business to "break-even" and then start earning a profit
- Include: revenue drivers, profit margins, fixed and variable costs, operating leverage and its implications, start-up costs, and break-even charts and calculations
- A company may make profits as a high-margin low volume business, or a low-margin high-volume business
- Completing a sensitivity and a break-even analysis is an extremely useful exercise for any proposed or existing business

### 17.3.6 Marketing Plan

- This focuses on how the business will market and sell its product or service
- Include: overall marketing strategy, product, price, promotions, distribution, sales process or cycle, and sales tactics
- Start by articulating its strategy, positioning, and points of differentiation, then talk about how the plan will be supported with price, promotions, and distribution
- It's also important to discuss the company sales process

### 17.3.7 Design and Development Plan

- Include if the company is developing a new product or service, focusing on the status of development efforts
- Include: development status and tasks, challenges and risks, and projected development costs
- Include proprietary issues such as: patents, trademarks, copyrights, licenses, and brand names

### 17.3.8 Operations Plan

- Outlines how your business will be run and how your product or service will be produced
- Describe the business in terms of back stage and front stage
- Include: general approach to operations, business location, facilities, and equipment
- Keep this section short and crisp, as you should not provide too much detail

### 17.3.9 Management Team and Company Structure

- Team typically consists of the founder(s) and a handful of key management personnel
- Include: management team, board of directors, board of advisors, and company structure
- This section is critical and could be viewed right after the executive summary by readers to assess strength of the people starting the firm

### 17.3.10 Overall Schedule

- Schedule showing the major events required to launch the business, in format of milestones critical to the business's success

- Examples of milestones: incorporating the venture, completion of prototypes, rental of facilities, obtaining critical financing, starting production, and obtaining the first sale
- This can be very convincing to potential investors that the team is aware of what needs to take place to launch the venture

### 17.3.11 Financial Projections

- The final section presents a firm's pro forma financial projections
- Include: sources and uses of funds statement, assumptions sheet, pro forma income statements, pro forma balance sheets, pro forma cash flows, ratio analysis

### 17.3.12 Presenting the Business Plan

- Presentation should be smooth, well-rehearsed, with sharp slides
- Expect questions and feedback from investors, and try to have a good idea and preparation of what these questions might be

## 17.4 Slides to include in a business plan

1. Title Slide
2. Problem
3. Solution
4. Opportunity and target market
5. Technology
6. Competition
7. Marketing and sales
8. Management team
9. Financial projections
10. Current status
11. Financing sought
12. Summary

# 18 L18 APSC221 - Managing the Business Enterprise

## 18.1 Business Organization

The org chart typically has a: * CEO * Other C-Suites (COO, CTO, CFO), or VPs (marketing, operations, finance, research)

Organizations describe themselves based on: 1. Mission - purpose of the org, what they are achieving its vision 2. Vision - future focus, defining the future state of the org 3. Values - shared beliefs amongst shareholders, org culture and decision making

## 18.2 Organizational Systems

1. Resource inputs - money, people, facilities, equipment, tech, materials
2. Transformation process - work activity
3. Product outputs - finished, goods and services
4. Customer feedback, and iterate

### 18.2.1 Types of Organizations

**18.2.1.1 Profit** Includes publicly traded companies and private sector

**18.2.1.2 Non-Profit** Non-government organizations (NGOs), charitable orgs, and special interest groups representing a profession, religion, sport, etc.

## 18.3 Management Process

The process of determining the firm's goals and developing a strategy to achieve them Goals, Gaps, Plans, Actions, then Evaluation & Iterate

Plans: **Strategic** (3-10+ years), **tactical** (1-5 years), **operational** (0-2 years)

**Leading**

Involves interactions between people, often between managers and their subordinates, but can also involve peers,

Guiding, motivating and coaching employees, not just giving orders

**Organizing**

Determining how to use the resources to implement the plan Arranging jobs in a structure to create an efficient task system

**Controlling**

Establishing standards and measuring performance

### 18.3.1 Types & Areas Management

- Top Management (C-suite, overall performance, decision-making)
- Middle Management (VPs and EDs, implementing decisions)

- First-line Management (Managers and Supervisors, responsible for supervising employees)

As management goes from large-scale to small-scale, more technical expertise is required. In opposite order, more conceptual expertise is required.

Regardless, all managers must have **time management** and **decision-making** skills

Areas of Management: * Marketing * Financial * Engineering * Operations * Human Resources * Information

### 18.3.2 Strategic Management

Strategic management is the process of aligning the organization with its external environment Goals are the starting point of successfully managing a business, and the planned method of reaching a goal is the "strategy"

Formulating a strategy is based on goals, and mission, vision, and value statements.

### 18.3.3 SWOT Analysis

Strengths, weaknesses, opportunities, threats

An evaluation technique that analyses an organization and its environment by identifying internal strengths and weaknesses and extern opportunities and threats

## 18.4 Levels of Strategy

### 18.4.1 Corporate-level strategy (large)

Focus on one product, market penetration, improving products for current markets, expanding operations in new geographic areas

External activities that result in growth, acquisition of competitors, controlling inputs of the firm's processes or distribution channels

### 18.4.2 Business-level strategy (medium)

Produce at the lowest cost, target market segments, cost focus in a specific niche, differentiation focus

### 18.4.3 Functional strategy (small)

What actions can our department pursue to reach the overall goals?

## 18.5 Other Notes

### 18.5.1 Contingency Planning and Crisis Management

Business environments can be unpredictable, orgs need to be able to deal with the unknown and unforeseen through contingency planning and crisis management

### 18.5.2 Culture

Culture affects employee's attitudes and work efforts.

Forces shaping corporate culture: * top management values * history, shared experience * stories and legends * strong behavioural norms

Culture should be communicated to new managers and employees should be rewarded for continuous culture practice. If a culture change is required, new systems must be established to enforce new values.

# 19 L19 APSC221 - Change Management

## 19.1 What is Change Management?

A project is a dynamic process, and project change management is the process to manage/accommodate change during the project lifecycle

Organizational change management is carried out throughout an organization to transition from a current state to a desired future state, **we focus on this type for this course**

The goals are: * understanding the changes and associated implementation risks * implementing the desired change * ensuring transition from current to future state * minimizing unplanned operational disruptions * achieving the desired performance improvements * sustaining change over the long term

Change is made by people, not systems, but it is **people's adoption of these that is the change**

Change at the organizational level also achieves results But organizations are complex entities and change in one area may have farther reaching impacts than anticipated

## 19.2 Types of Change

edit: good mcq to study

**Transformational**

Organizational, major shifts in corporate vision, such as a new CEO introduces a strategic shift to boost performance

**Bounded**

Departmental, limited to one group, like a manager changing structures to realize new efficiencies

**Deliverable-Led**

Projects, focus is on the deliverable and less on the change, like new products or processes

## 19.3 Risks of Change - Four Change Outcomes

edit: good mcq to study

**The Disaster**

An organization undertakes an irreversible change, is not compatible with the wider business operations, and results in devastating reduction in performance, possibly leads to bankruptcy.

**The Lost Investment**

Performance declines over time once change is implemented, maybe because people revert to the "old ways" and the change is not sustained

**The Partial Success**

The change sees sustained improvement but full potential is not realized

**The Ideal**

This optimal result is rare but change is implemented and sustained with minimal short-term performance impact

## 19.4 Costs & Benefits of Change

Change management is necessary, but risks associated like short-term disruption and unexpected outcomes need to be managed.

### 19.4.1 Costs

- direct cost of change team
- consultants and advisers
- time away from the rest of the organization
- investments to facilitate change
- longer-term costs ### Benefits
- significant rewards can be realized
- need to manage and measure potential rewards

## 19.5 Other Notes

### 19.5.1 Why Change?

Change is necessary due to economic shifts, competition, new products opportunities, shareholder demands, M&A, etc.

The drive for change stems from external pressures and internal management foresight Internal drivers include new leadership, re-organization, changing tech, changing culture

Change is also important because organizations constantly have to assess their position within their environment (SWOT)

### 19.5.2 Effective Change Management and Failure

Change management requires vision, persistence, and empathy to fellow workers since humans have a resistance to change

Failure can come from: * a lack of initiative * unforeseen operational problems * the cost of the change is higher than expected * changes are never embedded (IT systems) * benefits never justify the true costs