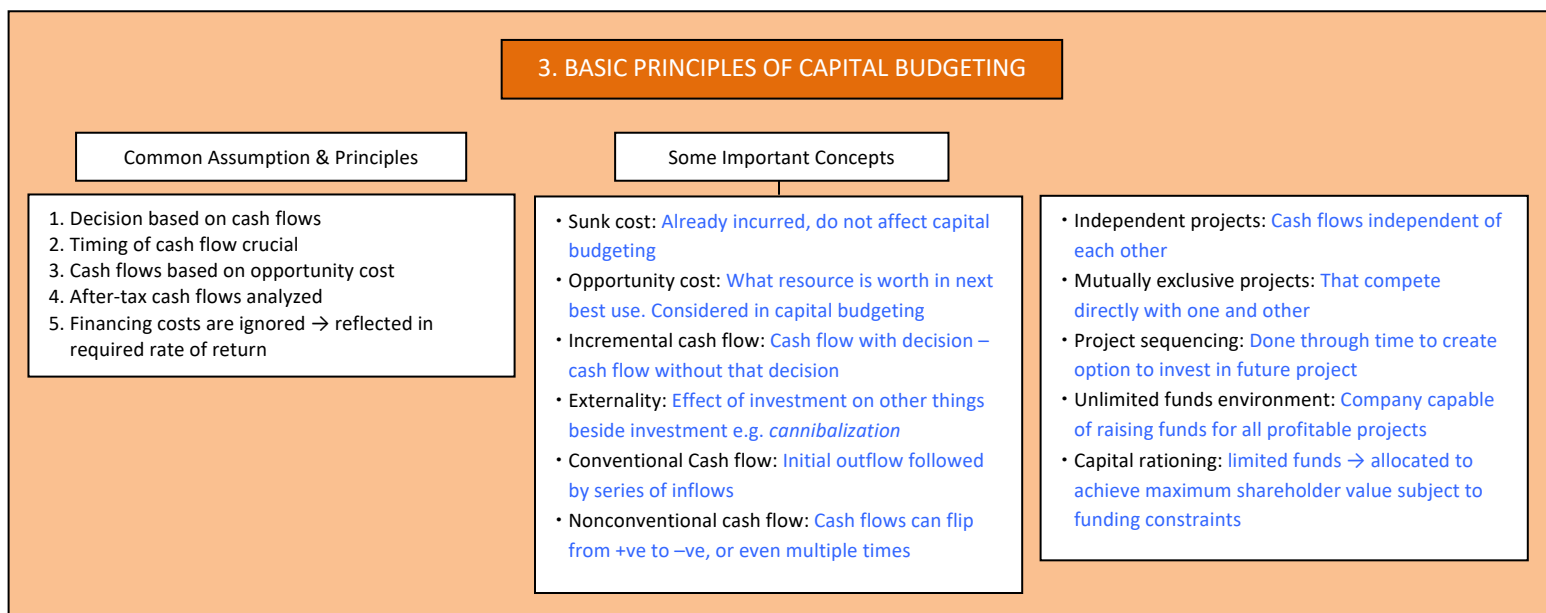
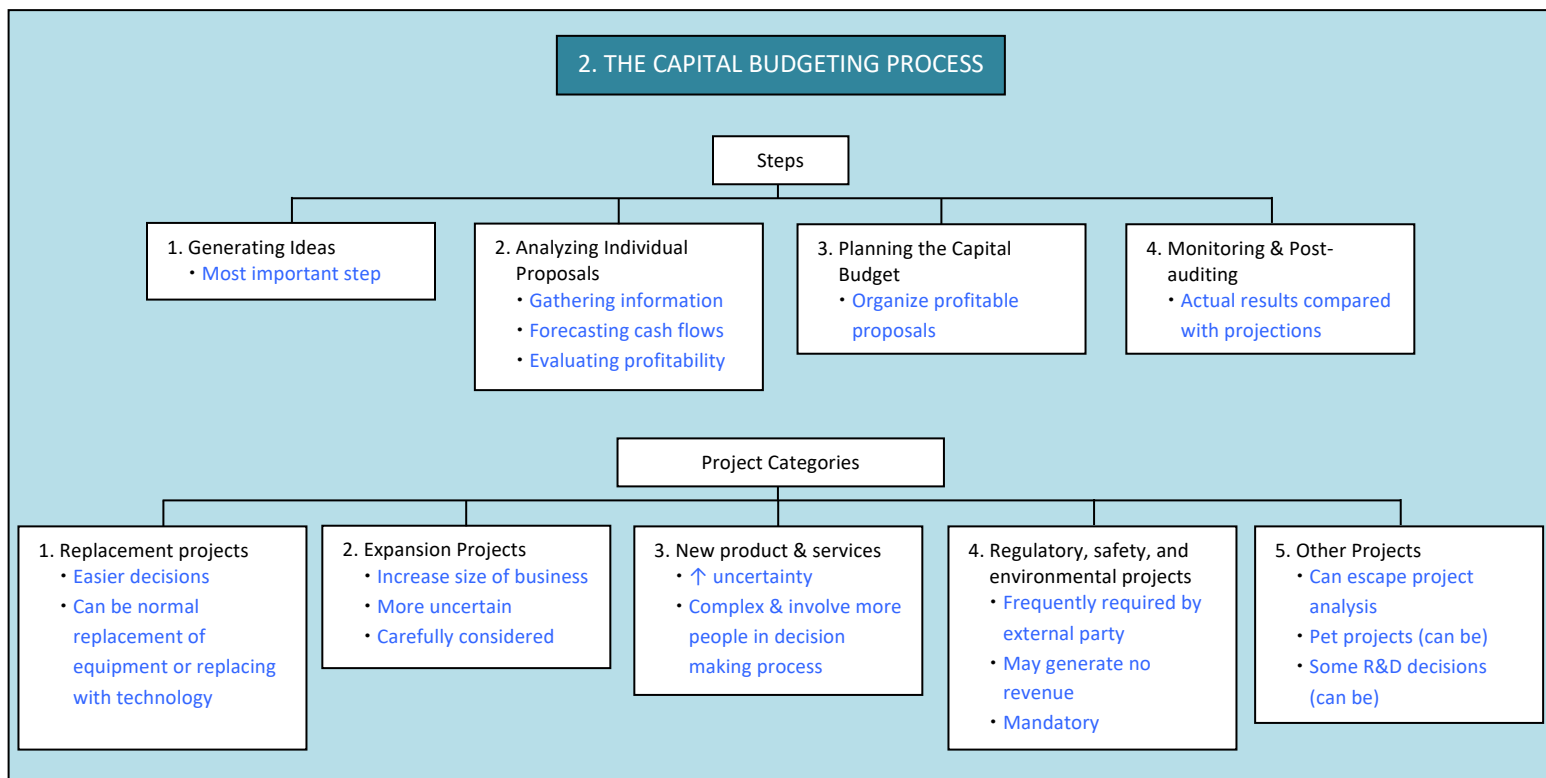
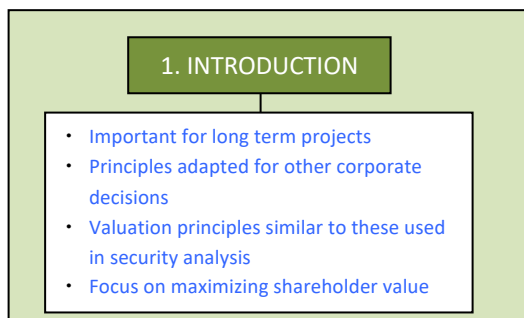


Capital Budgeting

r	= Required rate of return
NPV	= Net Present Value
IRR	= Internal Rate of Return
TVM	= Time Value of Money
Sa_T	= Cash proceeds from sale of fixed capital at Termination date
B_T	= Book value at Termination date
FCInv	= Fixed Capital Investment
NWCInv	= Net Working Capital Investment
S	= Sales
C	= Cash operating expenses
TNOCF	= Terminal year after tax non-op cash flow

T	= Tax rate.
CF	= after tax operating Cash Flow
EAA	= Equal Annual Annuity
CAPM	= Capital Asset Pricing Model
APT	= Arbitrage Pricing Theory
MRP	= Market Risk Premium
MV	= Market Value
PV	= Present Value
NOPAT	= Net Operating Profit After tax
MVA	= Market Value Added
D	= Depreciation



4. Investment Decision Criteria

4.1 Net Present Value (NPV)

$$NPV = \sum_{t=1}^n \frac{CF_t}{(1+r)^t} - outlay$$

- Invest if NPV > 0
- Do not Invest if NPV < 0

4.2 Internal Rate of Return

$$\sum_{t=1}^n \frac{CF_t}{(1+IRR)^t} = outlay$$

- Invest if IRR > r
- Do not invest if IRR < r

4.3 Payback Period

- No. of years required to cover the original investment
- Cash flows are not discounted → major drawback
- Does not measure profitability
- Indicator of project liquidity
- No decision rule due to lack of economic viability

4.4 Discounted Payback Period

- No. of years taken by cumulative discounted cash flows to equal the original investment
- ↑ than payback period
- Usually – NPV projects → No discounted payback period
- Ignores cash flows after payback period reached
- – NPV but + discounted cash flow can happen

4.5 Average Accounting Rate of Return (AAR)

- $AAR = \frac{PAvg.net\ income}{Avg.book\ value}$
- Easy to understand & calculate
- Based on accounting not on cash flow → practical limitation
- TVM not accounted for
- No conceptual criterion of distinguishing between profitable & non-profitable project investments

4.6 Profitability Index (PI)

- $PI = \frac{PV\ of\ future\ cash\ flows}{initial\ investment} = 1 + \frac{NPV}{initial\ investment}$
- Invest if PI > 1.0
- Do not invest if PI < 1.0
- PI → indicates value received against 1 unit invested
- Used as guide in capital rationing
- Also known as *benefit-cost ratio*

4.7 NPV Profile

- Shows NPV as function of discount rates
- y-axis ⇒ NPV, x-axis ⇒ Discount rates in %

4.8 Ranking Conflicts between NPV and IRR

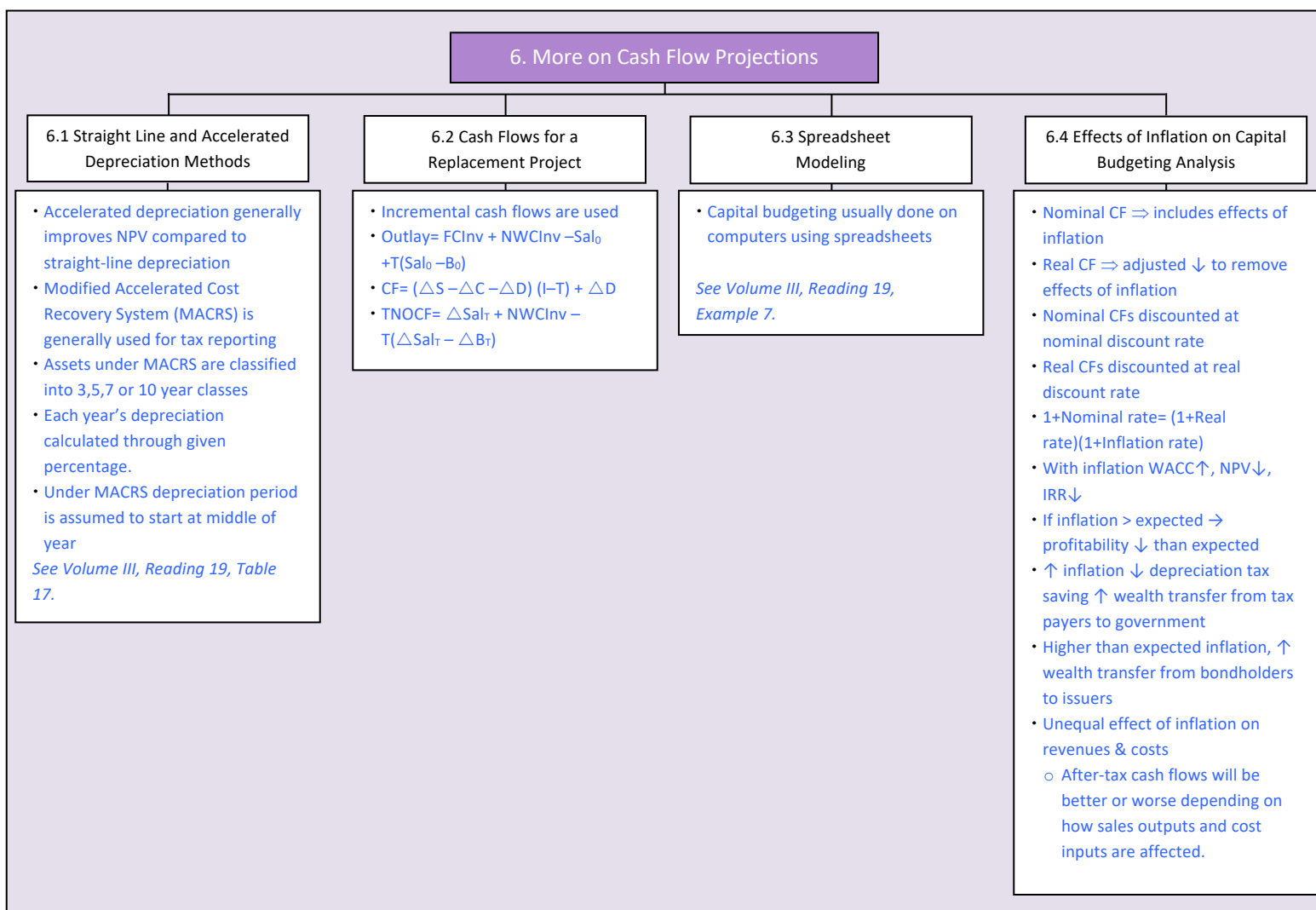
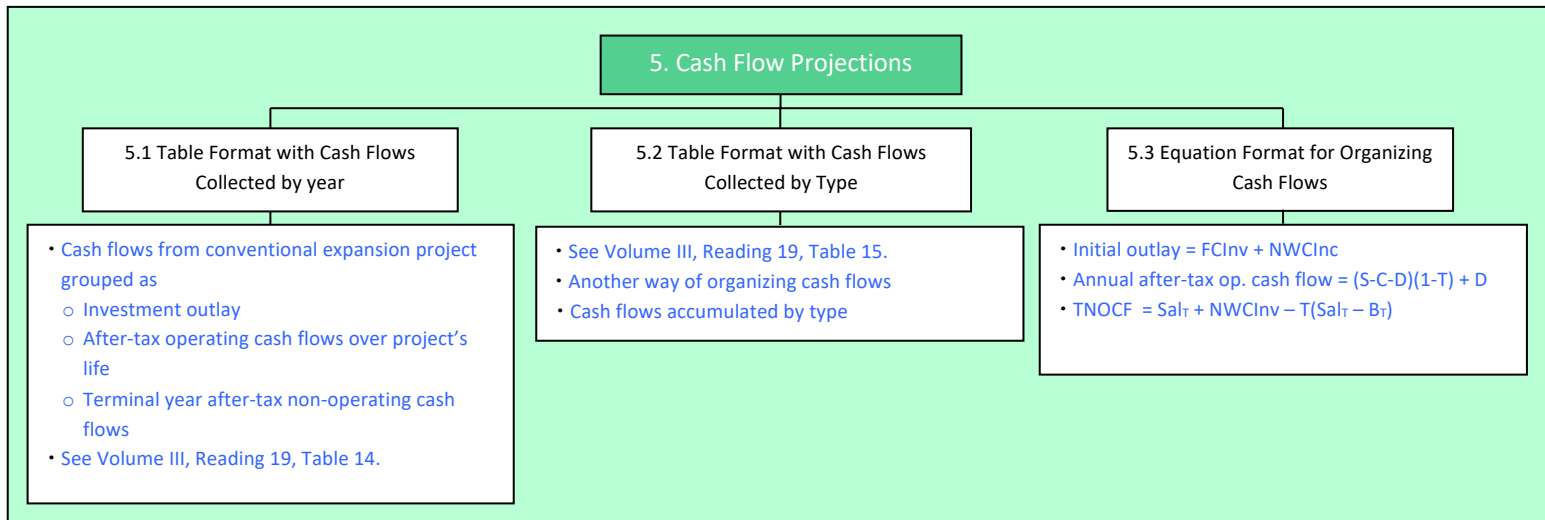
- Conflicts arise in mutually exclusive projects
- Choose project based on ↑ NPV
- Projects with different scale can also create conflicts

4.9 The Multiple IRR Problem and the No IRR Problem

- Unconventional cash flows can cause multiple IRR problem
- No IRR problem → No discount rate at which NPV is 0
- No IRR project → good investment

4.10 Popularity and Usage of the Capital Budgeting Methods

- Larger companies usually use NPV/IRR techniques
- European countries usually use payback period
- MBA's prefer using discounted cash flow techniques
- NPV criterion most directly related to stock prices
- Typically value of company = Existing investment + NPV of future investments
- Impact of investment on stock price is based on expectations
- Management's capital budgeting process can demonstrate quality of management and degree to which management ↑ shareholders' wealth.



7. Project Analysis & Evaluation

7.1 Mutually Exclusive Projects with Unequal Lives

7.1.1 Least common multiple of lives approach

- Life of projects with unequal lives is made equal using LCM
- Project with ↑ NPV is selected

7.1.2 Equivalent annual annuity approach

- Annuity payment = NPV is calculated for each project
- Project with ↑ EAA is chosen
- Project with -EAA is chosen if - NPV (pet projects)

7.2 Capital Rationing

- Done when company has constrained budget
- Allocation is done in choosing projects that ↑ shareholders' wealth
- Projects chosen within budget with ↑ NPV.
- Individual ↑ NPV projects → not necessarily chosen
- PI is used, IRR is not used
- Misallocation of resources; potential disadvantage of capital rationing
- Hard Capital Rationing: fixed budget, managers cannot go beyond it.
- Soft capital rationing: fixed budget but managers are allowed to overspend it under profitable opportunities.

7.3 Risk Analysis of Capital Investments – Stand-Alone Methods

7.3.1 Sensitivity Analysis

- 1 variable is changed at a time to check Δ in NPV
- Useful in analyzing most influential variable
- Variables are plotted on graphs
- This analysis is used to establish the most influential variables on project's success or failure.

7.3.2 Scenario Analysis

- Several variables changed at a time to gauge Δ in NPV.
- Three scenarios may be used

7.3.3 Simulation (Monte Carlo) Analysis

- Procedure of estimating probability distribution of outcomes.
- Good estimate built by simulating results hundreds/thousand of times.

See Volume III Reading 19, Example 8.

Pessimistic

- ↑ Costs
- ↓ revenues
- ↑ r (used to calc. NPV).

Optimistic

- ↑ revenues
- ↓ costs
- ↓ r (used to calc. NPV).

Most likely

- Base case scenario
- Project inputs costs, revenues & r are used to calc. NPV

7.4 Risk Analysis of Capital Investments – Market Risk Methods

- Discount rate should be adjusted for market risk
- Market risk measure depends on how projected cash flows correlate with market returns
- CAPM & APT are used to estimate MRP

CAPM divides total risk into

Systematic risk

- Related to market
- Can't be diversified

Unsystematic risk

- Unrelated to market
- Can be diversified

7.5 Real Options

- Capital budgeting options allow flexibility regarding future decisions
- Like financial options but with underlying real assets
- Contingent on future events, option not compulsion

Timing options: option to delay the investment timing

- Abandonment option: opportunity to abandon project when profitable to do

- Growth/ Expansion option: ability to undertake additional investments when profitable

Sizing option

Flexibility options

- Price setting option to ↑ price when demand > supply (capacity)

- Production Flexibility option to add more shifts, working overtime when demand ↑ in production

Fundamental Options

- Whole investment is an option
- R&D projects are most likely fundamental options
- Whole venture decision is based on underlying assets

7.6 Common Capital Budgeting Pitfalls

- Failure to incorporate economic response into investment analysis
- Using standardized capital budgeting templates for unique projects
- Using normal analysis for pet projects, overly estimating forecasts or undertaking no analysis
- Using short term profitability measures like ROE, NI, EPS instead of NPV, (long term measure)
- Using IRR for mutually exclusive projects
- Bad accounting for cash flows
- Over estimating overhead costs
- Using WACC instead of r for project with risk different than company's avg. risk
- Spending entire capital budget just because it is available
- Not focusing on alternative projects which could be profitable
- Mishandling opportunity and sunk costs

Approaches to evaluate capital budgeting projects with

- NPV +ve without real options → go ahead no need to value option, they add value
- Project NPV = NPV (without options) + value of options – cost of option
- Use decision trees
- Use option pricing models to evaluate the options

8. OTHER INCOME MEASURES & VALUATION MODELS

8.1 The Basic Capital Budgeting Model

See Volume III, Reading 19, Table 28.

8.2 Economic & Accounting Income

Economic Income = Cash flow + Δ in MV
 Δ in MV = Ending MV – Beg. MV
 Δ in MV is also termed as economic depreciation
 • MV at any point in time= PV of future CF
 • Interest is ignored
 • Economic rate of return is used to calculate MV

Accounting Income
 • Measured as Revenue - Expense
 • Depreciation based on original cost not MV
 • Interest is adjusted while calculating it

8.3 Economic Profit, Residual Income & Claims Valuation

8.3.1 Economic Profit
 • EP = NOPAT - \$ WACC
 • NOPAT = EBIT (1 – TAX)
 • \$WACC = Capital x WACC
 • $NPV = \sum_{t=1}^{\infty} \frac{EP_t}{(1+WACC)^t}$
 • NPV = MVA

8.3.2 Residual Income
 • $RI_t = NI_t - EC_{t-1}$
 • $EC_t = r \times B_{t-1}$
 • $NPV = \sum_{t=1}^{\infty} \frac{RI_t}{(1+r_e)^t}$
 • Value of company = Original BV of debt & equity + PV of RI

8.3.3 Claim Valuation
 • Estimates value of liabilities / equity claims against assets.
 • Value of company = Liabilities value + equity value
 • Value of liabilities = PV of interest & principal proceeds at r_d
 • Value of equity = PV of cash flows at r_e
 • In principal EP, RI and claim valuation results in same valuation
 • Only measure value of company

Real world complications
 • Pension liability adjustments
 • Financial instruments MV
 • Gains/losses (exchange rate)
 • Adjustments → deferred tax, goodwill, inventories, lease