



Prepared by
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Objective of
this lecture

This Lecture Covers:

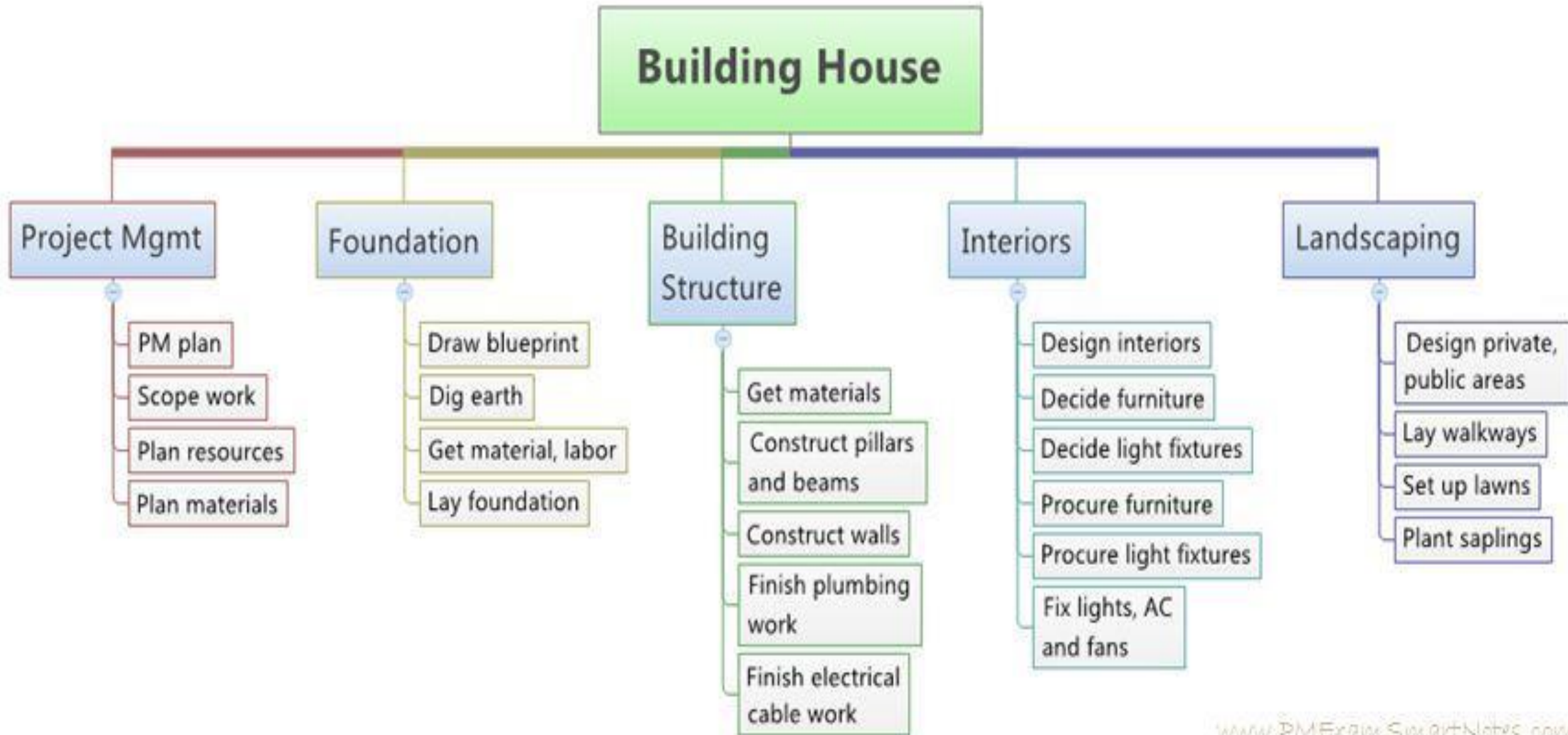
- Sources of Finance
- The Four Steps in Project Cost Management



Introduction

- Organizations aim for their projects to be successful and to meet client expectations as well as their internal objectives. But what is the reality on the ground? In a **PMI report**, 14% of the surveyed IT projects were deemed as failures. Only 57% of the projects finished within their initial budgets, with the others exceeding the target they had set for themselves.
- This is certainly not good news for enterprises as **cost overruns** not only impact their margins, but also hinder the ability to execute future projects. Understanding what project cost management is and how to be effective at it can be beneficial for organizations to stay on course.

Work Breakdown Structure



The Four Steps in Project Cost Management

- While cost management is viewed as a continuous process, it helps to split the function into four steps: resource planning, estimation, budgeting and control. They are mostly sequential, but it's possible that some resource changes happen midway through the project, forcing the budgets to be adjusted. Or, the variances observed during the control process can call for estimate revisions.
- Let us look at each of these four steps in detail.

1. Project Resource Planning

- **Resource planning** is the process of identifying the resources required to execute a project and take it to completion. Examples of resources are people (such as employees and contractors) and equipment (such as infrastructure, large construction vehicles and other specialized equipment in limited supply).
- Resource planning is done at the beginning of a project, before any actual work begins.
- To get started, project managers first need to have the work-breakdown structure (WBS) ready. They need to look at each subtask in the WBS and ask how many people, with what kind of skills are needed to finish this task, and what sort of equipment or material is required to finish this task?
- By adopting this task-level approach, it becomes possible for project managers to come up with an accurate and complete inventory of all resources, which is then fed as an input into the next step of estimating costs.

1. Project Resource Planning

A few tips to consider during the process:

- Consider historical data—past schedules and effort—before determining sub-tasks and the corresponding resources.
- Take feedback from SMEs and team members—a collaborative approach works well especially in projects that do not have past data to use.
- Assess the impact of time on resource requirements. For instance, a resource may be available only after a few months, dragging the project's schedule. This could have an impact on cost estimation.
- Although this step happens at the planning stage, project managers need to account for ground realities. For example, you may identify the need for a resource with certain expertise, but if such a resource is not available within the organization, you have to consider hiring a contractor or training your team to get them up to speed. All these real variables impact cost management.

2. Cost Estimation

- **Cost estimation** is the process of quantifying the costs associated with all the resources required to execute the project. To perform cost calculations, we need the following information:
- Resource requirements (output from the previous step)
- Price of each resource (e.g., staffing cost per hour, vendor hiring costs, server procurement costs, material rates per unit, etc.)
- Duration that each resource is required
- List of assumptions
- Potential risks
- Past project costs and industry benchmarks, if any
- Insight into the company's financial health and reporting structures
- Estimation is arguably the most difficult of the steps involved in cost management as accuracy is the key here. Also, project managers have to consider factors such as fixed and variable costs, overheads, inflation and the time value of money.

2. Cost Estimation

- The greater the deviation between estimation and actual costs, the less likely it is for a project to succeed. However, there are many estimation models to choose from. Analogous estimation is a good choice if you have plenty of historical cost data from similar projects. Some organizations prefer mathematical approaches such as parametric modeling or program evaluation and review technique (PERT).
- Then there is the choice between employing a **top-down** versus **bottom-up approach**. Top-down typically works when past costing data are available. In this, project managers usually have experience executing similar projects and can therefore take a good call. Bottom-up works for projects in which organizations do not have a lot of experience with, and, therefore, it makes sense to calculate a cost estimate at a task-level and then roll it up to the top.

Estimation of future cashflow

OPERATING REVENUES AND COSTS

Taking a process plant as an example, the main elements of **operating cash flow** may include:

Operating revenues from sales of products

minus

- Cost of fuel or raw materials
- The Project Company's own operating costs (personnel, office, etc.)
- Operation and Maintenance (O&M) Contract costs
- Insurance

OPERATING REVENUES AND COSTS

The first stage in projecting the operating revenues, and the cost of fuel or raw materials, in the model is to identify the key **operating assumptions**— e.g., for a process plant:

- What is the initial output?
- How does this output change over time?
- How much time is needed for maintenance?
- How much time should also be allowed for unexpected downtime?
- What is the rate of consumption of fuel or raw materials?
- How does this consumption change over time?

OPERATING REVENUES AND COSTS

The revenues from sales and the costs of fuel or raw materials are the product of:

- These operating assumptions
- The terms of any Project Agreements, such as an Input Supply Contract or Off-take Contract
- Assumptions about market prices in the absence of such contracts.

The projections also have to take into account.

EQUITY RETURNS

The standard measurements of return on equity for investors in a project are calculated on a cash flow basis. For most managers financial criteria are the preferred method to evaluate projects.

These models are appropriate when there is a high level of confidence associated with estimates of future cash flows. Two models and examples are demonstrated here: **payback model** and **net present value (NPV) model.**

- **Example:** **(Even Cash inflows)**
- Project A has an initial investment (cash outflows) of \$700,000 and projected cash inflows of \$225,000 for 5 years.
- Project B has an initial investment of \$400,000 and projected cash inflows of \$110,000 for 5 years.

The payback model

It measures the time it will take to recover the project investment. Shorter paybacks are more desirable. Payback is the simplest and most widely used model. Payback emphasizes cash flows, a key factor in business. Some managers use the payback model to eliminate unusually risky projects (those with lengthy payback periods). The major limitations of payback are that it ignores the time value of money, assumes cash inflows for the investment period (and not beyond), and does not consider profitability.

$$\text{Payback period (yrs)} = \text{Estimated Project Cost} / \text{Annual Savings}$$

$$\text{Rate of return} = \text{Annual savings} / \text{Estimated Project Cost}$$

Payback period (yrs) for project A = $700,000 / 225,000 = 3.1$ years.

Payback period (yrs) for project B = $400,000 / 110,000 = 3.6$ years.

Rate of return of project A = $225,000 / 700,000 = 32.1\%$

Rate of return of project B = $110,000 / 400,000 = 27.5\%$

The payback for Project A is 3.1 years and for Project B is 3.6 years. Using the payback method both projects are acceptable since both return the initial investment in less than five years and have returns on the investment of 32.1 and 27.5 percent.

The net present value (NPV) model

It uses management's minimum desired rate-of-return (discount rate, for example, 15 percent) to compute the present value of all net cash inflows. If the result is positive (the project meets the minimum desired rate of return), it is eligible for further consideration. If the result is negative, the project is rejected. Thus, higher positive NPV's are desirable.

$$\text{Project NPV} = I_0 + \sum_{t=1}^n \frac{F_t}{(1 + k)^t} \quad \text{where}$$

$$\sum_{t=1}^n \frac{F_t}{(1+k)^t} = \frac{F_1}{(1+k)^1} + \frac{F_2}{(1+k)^2} + \frac{F_3}{(1+k)^3} + \dots + \frac{F_t}{(1+k)^t}$$

I_0 = Initial investment (since it is an outflow, the number will be negative)

F_t = Net cash inflow for period t

k = Required rate of return (nominal)

$$\begin{aligned} \text{Net present value for project A} &= -700,000 + \frac{225,000}{(1+.15)^1} + \frac{225,000}{(1+.15)^2} + \frac{225,000}{(1+.15)^3} + \frac{225,000}{(1+.15)^4} + \frac{225,000}{(1+.15)^5} \\ &= \$ 54,235 \end{aligned}$$

$$\begin{aligned} \text{Net present value for project B} &= -400,000 + \frac{110,000}{(1+.15)^1} + \frac{110,000}{(1+.15)^2} + \frac{110,000}{(1+.15)^3} + \frac{110,000}{(1+.15)^4} + \frac{110,000}{(1+.15)^5} \\ &= - \$ 31,263 \end{aligned}$$

The NPV model accepts project A, which has a *positive* NPV of \$54,235. Project B is rejected since the NPV is *negative* \$31,263. Compare the NPV results with the payback results. The NPV model is more realistic because it considers the time value of money, cash flows, and profitability.

When using the NPV model, the discount rate (return on investment hurdle rate) can differ for different projects. For example, the expected ROI on strategic projects is frequently set higher than operational projects. Similarly, ROI's can differ for riskier versus safer projects. The criteria for setting the ROI hurdle rate should be clear and applied consistently.

Unfortunately, pure financial models fail to include many projects where financial return is impossible to measure and/or other factors are vital to the accept or reject decision.

EQUITY RETURNS

When cash inflows are uneven, we need to calculate the cumulative net cash flow for each period and then use the following formula:

$$\text{Payback Period} = A + \frac{B}{C}$$

Where,

A is the last period number with a negative cumulative cash flow;

B is the absolute value (i.e. value without negative sign) of cumulative net cash flow at the end of the period *A*; and

C is the total cash inflow during the period following period *A*

Cumulative net cash flow is the sum of inflows to date, minus the initial outflow.

EQUITY RETURNS

- **Example : Uneven Cash Flows**

Company C is planning to undertake another project requiring initial investment of \$50 million and is expected to generate \$10 million net cash flow in Year 1, \$13 million in Year 2, \$16 million in year 3, \$19 million in Year 4 and \$22 million in Year 5. Calculate the payback value of the project.

Solution

Year	<i>(cash flows in millions)</i>	
	Annual Cash Flow	Cumulative Cash Flow
0	(50)	(50)
1	10	(40)
2	13	(27)
3	16	(11)
4	19	8
5	22	30

Payback Period = $3 + 11/19 = 3 + 0.58 \approx 3.6$ years

EQUITY RETURNS

Inflation is usually defined as the general rise in the price of the goods and services. So, it has huge impact over the Net Present Value analysis because we use nominal rate of return in discounting cash flows to the present value.

Nominal rate of return is the rate which your investment yields without taking into accounts factor of inflation.

In order to take into account inflation rate, we need to calculate real rate of return RR. Usually, it is obtained by subtracting inflation rate from the nominal rate.

- **Formula**

- $$RR = \{ (1 + MR) / (1 + IR) \} - 1$$

- Where:

- RR = Real rate of return

- MR = Nominal rate of return

- IR = Inflation rate

EQUITY RETURNS

- **Example**

- DCF is considering investing in a long term project of 5 years of \$ 100,000 which will generate \$ 25,000 each year. The nominal rate of return is 15 % and inflation rate is 10 %. Calculate the real rate of return.

- **Solution**

- As we know that:
- $RR = \{ (1 + MR) / (1 + IR) \} - 1$
- $RR = \{ (1 + 0.15) / (1 + 0.10) \} - 1$
- $RR = (1.15 / 1.10) - 1$
- **RR = 4.6 %**

EQUITY RETURNS

Net present value (NPV) does not take into account the size of the project. For example, say Project A requires initial investment of \$4 million to generate NPV of \$1 million while a competing Project B requires \$2 million investment to generate an NPV of \$0.8 million. If we base our decision on NPV alone, we will prefer Project A because it has higher NPV, but Project B has generated more shareholders' wealth per dollar of initial investment (\$0.8 million/\$2 million vs \$1 million/\$4 million).

EQUITY RETURNS

Internal rate of return is a method of calculating an investment's rate of return. The term internal refers to the fact that the calculation excludes external factors, such as the risk-free rate, inflation, the cost of capital, or financial risk.

The internal rate of return (IRR) is a metric used in financial analysis to estimate the profitability of potential investments. IRR is a [discount rate](#) that makes the net present value (NPV) of all cash flows equal to zero in a discounted cash flow analysis.

IRR calculations rely on the same formula as NPV does. Keep in mind that IRR is not the actual dollar value of the project. It is the annual return that makes the NPV equal to zero.

Generally speaking, the higher an internal rate of return, the more desirable an investment is to undertake. IRR is uniform for investments of varying types and, as such, can be used to rank multiple prospective investments or projects on a relatively even basis. In general, when comparing investment options with other similar characteristics, the investment with the highest IRR probably would be considered the best.

EQUITY RETURNS

IRR is calculated using the same concept as net present value (NPV), except it sets the NPV equal to zero.

Formula and Calculation for IRR

The formula and calculation used to determine this figure are as follows:

$$0 = NPV = \sum_{t=1}^T \frac{C_t}{(1 + IRR)^t} - C_0$$

where:

C_t = Net cash inflow during the period t

C_0 = Total initial investment costs

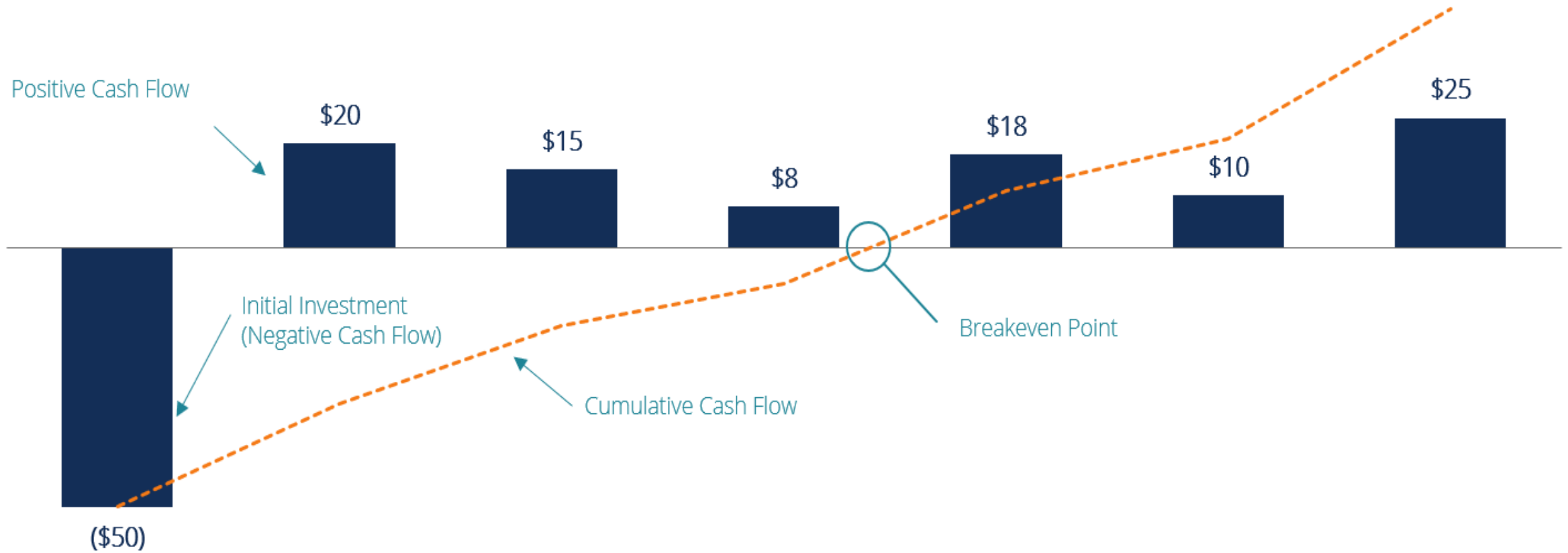
IRR = The internal rate of return

t = The number of time periods

EQUITY RETURNS

Internal Rate of Return

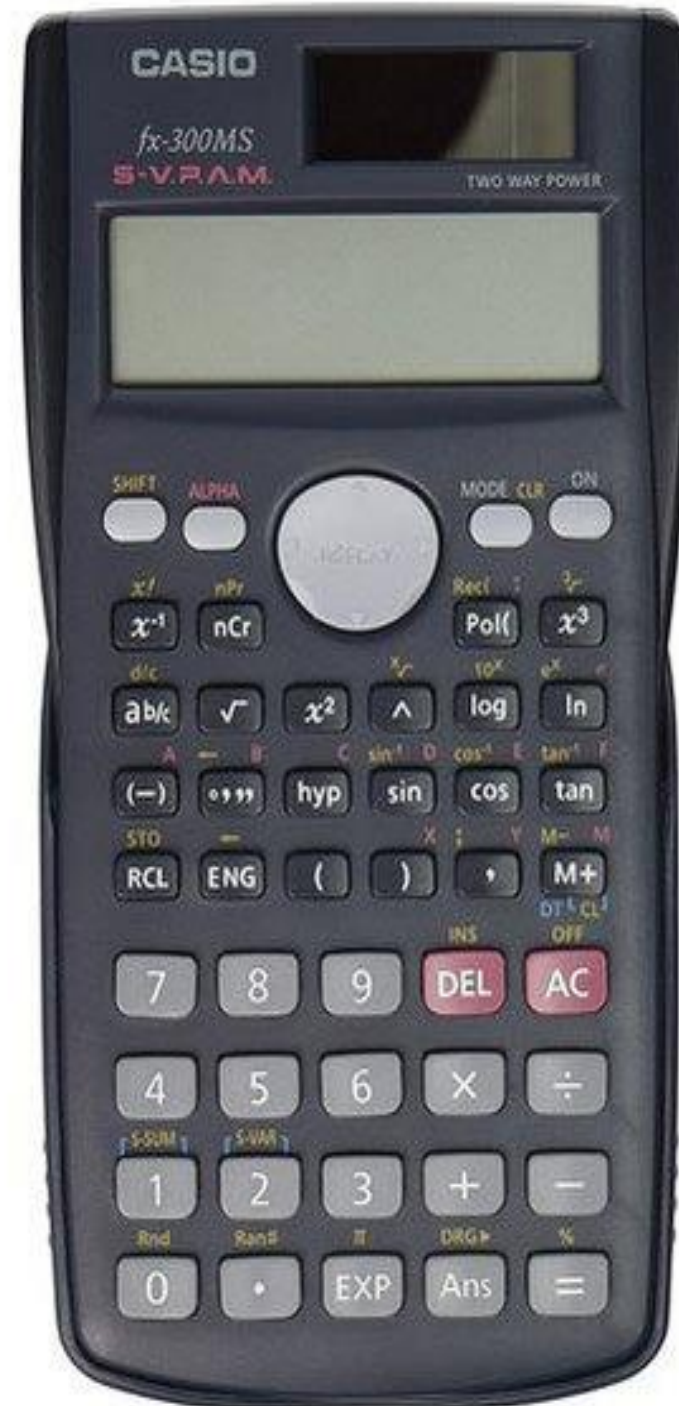
IRR = 22%



EQUITY RETURNS

- The IRR of an investment is the discount rate at which the net present value of costs (negative cash flows) of the investment equals the net present value of the benefits (positive cash flows) of the investment.
- The higher a project's IRR, the more desirable it is to undertake the project.
- A firm (or individual) should, in theory, undertake all projects or investments available with IRRs that exceed the cost of capital. Investment may be limited by availability of funds to the firm and/or by the firm's capacity or ability to manage numerous projects.
- Based on IRR, a company will decide to either accept or reject a project. If the IRR of a new project exceeds a company's required rate of return, that project will most likely be accepted. If IRR falls below the required rate of return, the project should be rejected.

Scientific Calculator



[illegible]

J3													
	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2				Exhibit 2.3B									
3													
4				Example Comparing Two Projects Using NPV									
5	Project A		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total		Formulas		
6	Required	15%											
7	Outflows		-\$700,000						-\$700,000				
8	Inflows			\$225,000	\$225,000	\$225,000	\$225,000	\$225,000	\$1,125,000				
9	Net inflows			\$225,000	\$225,000	\$225,000	\$225,000	\$225,000	\$425,000	Project A: =C7+NPV(B6,D9:H9)			
10	NPV	\$54,235											
11													
12													
13	Project B												
14	Required	15%											
15	Outflows		-\$400,000						-\$400,000				
16	Inflows			\$110,000	\$110,000	\$110,000	\$110,000	\$110,000	\$550,000				
17	Net inflows			\$110,000	\$110,000	\$110,000	\$110,000	\$110,000	\$150,000	Project B: =C15+NPV(B14,D17:H17)			
18	NPV	-\$31,263											
19													
20													
21													
22	NPV comparison: Accept Project A---NPV is positive.												
23	Reject Project B---NPV is negative.												

3. Cost Budgeting

- Cost budgeting can be viewed as part of estimation or as its own separate process. Budgeting is the process of allocating costs to a certain chunk of the project, such as individual tasks or modules, for a specific time period. Budgets include contingency reserves allocated to manage unexpected costs.
- For example, let's say the total costs estimated for a project that runs over three years is \$2 million. However, since the budget allocation is a function of time, the project manager decides to consider just the first two quarters for now. They identify the work items to be completed and allocate a budget of, say, \$35,000 for this time period, and these work items. The project manager uses the WBS and some of the estimation methods discussed in the previous section to arrive at this number.

3. Cost Budgeting

- Budgeting creates a cost baseline against which we can continue to measure and evaluate the project cost performance. If not for the budget, the total estimated cost would remain an abstract figure, and it would be difficult to measure midway. Evaluation of project performance gives an opportunity to assess how much budget needs to be released for future phases of the project.
- Another reason to firm up budgets is that organizations often rely on expected future cash flows for their funding. During the initial phases, the project manager has a limited financial pool and has to set targets accordingly. It's similar to building the foundation and one floor of the house in the initial few months and later completing the rest of the project, as you save more.

3. Cost Budgeting

Contingency reserves are established to cover project risks that are identified and unknown. When, where, and how much money will be spent is not known until the risk event occurs.

Project “owners” are often reluctant to set up project contingency funds that seem to imply the project plan might be a poor one. Some perceive the contingency fund as an add-on slush fund. Others say they will face the risk when it materializes. Usually, such reluctance to establish contingency reserves can be overcome with documented risk identification, assessment, contingency plans, and plans for when and how funds will be disbursed.

3. Cost Budgeting

- **Contingency funding**
- In practice, contingencies run from 1 to 10 percent in projects similar to past projects. However, in unique and high-technology projects it is not uncommon to find contingencies running in the 20 to 60 percent range. Use and rate of consumption of reserves must be closely monitored and controlled.
- In practice, the contingency reserve fund is typically divided into **budget** and **management reserve funds** for control purposes. Budget reserves are set up to cover identified risks; these reserves are those allocated to specific segments or deliverables of the project. Management reserves are set up to cover unidentified risks and are allocated to risks associated with the total project.

3. Cost Budgeting

1. Budget reserves

- These reserves are identified for specific work packages or segments of a project found in the baseline budget or work breakdown structure. **For example,** a reserve amount might be added to “computer coding” to cover the risk of “testing” showing a coding problem.
- The budget reserve should be communicated to the project team. This openness suggests trust and encourages good cost performance. However, distributing budget reserves should be the responsibility of both the project manager and the team members responsible for implementing the specific segment of the project. If the risk does not materialize, the funds are removed from the budget reserve. Thus, budget reserves decrease as the project progresses.

3. Cost Budgeting

2. Management Reserves

- These reserve funds are needed to cover major unforeseen risks and, hence, are applied to the total project. For example, a major scope change may appear necessary midway in the project. Because this change was not anticipated or identified, it is covered from the management reserve. Management reserves are established *after* budget reserves are identified and funds established.
- These reserves are independent of budget reserves and are controlled by the project manager and the “owner” of the project. The “owner” can be internal (top management) or external to the project organization. Most management reserves are set using historical data and judgments concerning the uniqueness and complexity of the project.

3. Cost Budgeting

2. Management Reserves

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3. Cost Budgeting

Table 7.1 shows the development of a contingency fund estimate for a hypothetical project. Note how budget and management reserves are kept separate; control is easily tracked using this format.

TABLE 7.1
Contingency Fund
Estimate (Thousands
of Dollars)

Activity	Budget Baseline	Budget Reserve	Project Budget
Design	\$500	\$15	\$515
Code	900	80	980
Test	20	2	22
Subtotal	\$1,420	\$97	\$1,517
Management reserve	—	—	50
Total	\$1,420	\$97	\$1,567

4. Cost Control

Cost control is the process of measuring cost variances from the baseline and taking appropriate action, such as increasing the budget allocated or reducing the scope of work, to correct that gap.

Cost control is a **continuous process** done throughout the project lifecycle. The emphasis here is as much on timely and clear reporting as measuring.

Along with the cost baseline, the cost management plan is an essential input for cost control. This plan contains details such as how project performance will be measured, what is the threshold for deviations, what actions will be done if the threshold is breached, and the list of people and roles who have the executive authority to make decisions.

How to Calculate Earned Value in Project Management

Earned value management (EVM) is one of the most popular approaches to measuring cost performance.

Earned value (EV) is a way to measure and monitor the level of work completed on a project against the plan. Simply put, it's a quick way to tell if you're behind schedule or over budget on your project. You can calculate the EV of a project by multiplying the percentage complete by the total project budget.

For example, let's say you're 60% done, and your project budget is \$100,000 — your earned value is then \$60,000. However, to properly use earned value, a few additional calculations must be considered. The largest benefits of earned value result from completing both cost and schedule variance analyses.

Earned value calculations in project management

1.Schedule Variance (SV): Schedule variance is the difference between your planned progress and your actual progress to date. The SV calculation is EV (earned value) - PV (planned value). Let's assume you have a four-month-long project, and you're two months in, but the project is only 25% complete. In this case, your EV = 1 months (25% of four months), and your PV = 2 months. Therefore, your SV is $1 - 2 = -1$. Since the number is negative, **it indicates you're behind schedule.** (يشير إلى أنك متأخر عن الجدول الزمني)

Earned value calculations in project management

2. Cost Variance (CV): Similar to SV, cost variance is the difference between how much you planned on spending thus far and your actual costs to date. The CV calculation is: $CV = EV - AC$ (actual cost). Let's use the earlier example. Your project budget is \$100,000 and you're 60% done, which means your EV is \$60,000. If you've spent \$70,000 so far to get to this point in the project, your CV is **-\$10,000**. **You can tell you're over budget because the number is negative, which may indicate a problem with the project or that the project could go over budget or run out of money.**

Earned value calculations in project management

3. Schedule Performance Index (SPI): This measure is similar to SV but is often preferred as it translates the numbers into a value that is easily compared across tasks or projects. The SPI calculation is: $SPI = EV/PV$. When SPI is above 1.00, you're ahead of schedule (قبل الموعد المحدد). **If it's below 1.00, you're behind.** To take the example from above, SPI would be $1/2 = 0.5$.

Using SPI is different than simply comparing your progress against your baseline. Comparing your actual schedule against your plan may indicate you're behind on two tasks. So, you know where your immediate problem is, but not necessarily how it impacts the overall project or your expected completion date. Using earned value, you can calculate your SPI both by task and for the project as a whole. When you take the SPI for each task and look at the bigger picture, you can see that your project is ahead of schedule, even with two late tasks. This helps you better understand the overall impact of the late tasks on the project.

Earned value calculations in project management

4. Cost Performance Index (CPI): As with SPI, CPI allows you to simplify the answer for better analysis. The CPI calculation is: $CPI = EV/AC$. When CPI is over 1.00, you're under budget, and when it's under 1.00, you're overspending. **In the scenario above, $CPI = 60,000/70,000 = 0.86$, indicating an overspend.** CPI can be used to forecast your project's completion.

For example, you can divide your total project budget by your current CPI to get the expected total cost at completion. **The formula is Estimate at Completion (EAC) = Budget/ CPI. In the above example, this would be $\$100,000/ 0.86 = \$116,279.07$. Meaning, that at this point in the project, based on current trends, you will likely end up overspending your budget by $\$16,279.07$.** Knowing this early allows you the time to either find ways to cut costs or secure more funding.