

NET PRESENT VALUE AND OTHER INVESTMENT CRITERIA

Chapter 9

OUTLINE

1. Capital Budgeting
2. Evaluating Investments and Investing Criteria
 1. Net Present Value (NPV)
 2. Internal Rate of Return (IRR)
 3. Payback Rule
 4. Discounted Payback Rule
3. Advantages and Disadvantages of Investing Criteria
4. The Practice of Capital Budgeting

CAPITAL BUDGETING

THE CAPITAL BUDGETING DECISION

Recall that **CAPITAL BUDGETING** is the process of planning and managing a firm's long-term investments.

Investments are acquisition of fixed assets, properties, or cash flow rights, spending on research and development, expanding factories, launching and marketing new products.

EXAMPLES OF CAPITAL BUDGETING

Tesla building a factory in China.

Disney expanding theme parks in Paris.

Microsoft acquiring Minecraft.

With all decisions, the goal of the manager is to maximize value per share.

CAPITAL BUDGETING CONSIDERATIONS

Regardless of the nature of the investment opportunity, financial managers need to understand the

- Size
- Timing
- Risk

of the future cash flows.

Note that these correspond to inputs of the PV calculation.

EVALUATING INVESTMENTS

Given that firms have a large number of opportunities for investing, they need tools for evaluating these possibilities.

The NPV, IRR, Payback Rule, and Discounted Payback Rule are ways firms evaluate investments.

THE NET PRESENT VALUE

NET PRESENT VALUE EXAMPLE

You want to start a grass cutting business in Lexington to make some money during the 4 years you attend UK. It costs \$3,000 to buy all the equipment you need, which you will buy today. You estimate that you will be able to make \$2,000 a year for each of the next 4 years (starting in one year), but buying gas and maintaining your equipment costs \$800 a year. At the end of 4 years you will graduate and sell your equipment for an estimated \$1,000. You think your discount rate should be around 15% because there are other investment opportunities that could yield similar returns at a similar level of risk. Should you start this business?

NPV EXAMPLE

To determine if it is a good idea to start this business, we should calculate the PV of the future cash flows. Let's start by organizing the information we have.

Initial Cost = \$3,000

Time Periods = 4

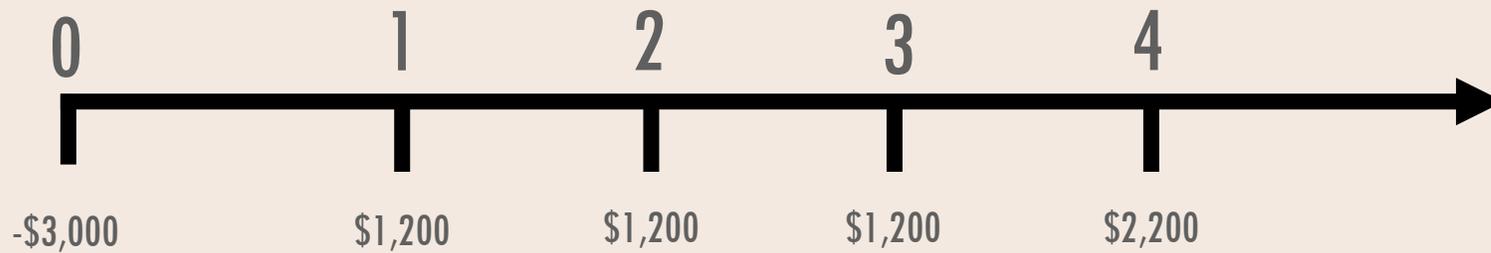
Cash Flow Years 1 through 3 = \$2,000 revenue - \$800 costs = \$1,200

Cash Flow in Year 4 = \$2,000 revenue - \$800 costs + \$1,000 equipment = \$2,200

Discount Rate = 15%

NPV EXAMPLE

Now, draw a timeline



$CF_0 = -3000$, $CF_1 = 1200$, $F_01 = 1$, ..., $CF_3 = 1200$, $F_03 = 1$, $CF_4 = 2200$, $F_04 = 1$

(or $CF_0 = -3000$, $CF_1 = 1200$, $F_01 = 3$, $CF_2 = 2200$, $F_02 = 1$)

$I = 15$, CPT NPV = **\$997.73**

NPV

NET PRESENT VALUE: the difference between an investment's market value and its cost. A measure of how much value is created or destroyed, taking into account cash inflows and outflows.

Here, the positive/negative sign is *very* important, but it is much clearer as to whether cash is an outflow or inflow.

BASED ON THE NPV RULE, AN INVESTMENT SHOULD BE ACCEPTED IF THE NPV IS POSITIVE AND REJECTED IF IT IS NEGATIVE.

Note: the NPV is only an estimate and quite sensitive to the discount rate!

BACK TO THE EXAMPLE

The NET PRESENT VALUE is the measure of how much value is created or destroyed, taking into account cash inflows and outflows.

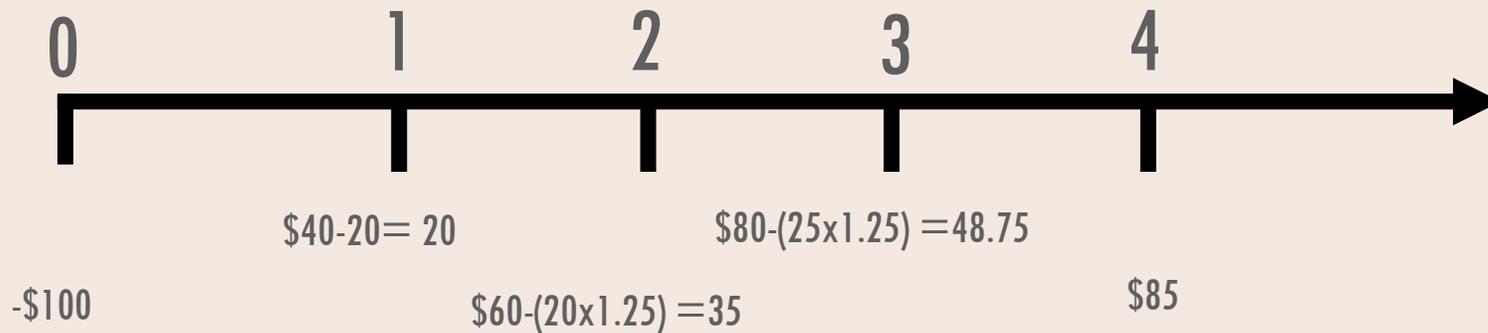
Here, the NPV is **+\$997.73**, therefore, your net worth increases by **+\$997.73** for investing in the lawn care business. You should make this investment!

NPV EXAMPLE 2

Snapchat is interested in developing its own phone to sell to consumers that focuses on photos and filters but doesn't make calls. The cost of development will be \$100 million. Sales in the first year 3 years are expected to be \$40 million, \$60 million, and \$80 million while costs are expected to be \$20 million in the first year and grow annually at 25%. One year after achieving \$80 million in sales, Snapchat expects to sell off its phone business for \$85 million. What is the NPV and should Snapchat pursue this project assuming the discount rate is 28% annually?

NPV EXAMPLE 2

First, draw a timeline:



$CF_0 = -100, CF_1 = 20, F_0 = 1, \dots, CF_4 = 85, F_0 = 1$

$I = 28, \text{CPT NPV} = -\8.10 million.

Snapchat should not pursue this project.

TO SUMMARIZE

We calculate the NPV by considering the PV of future cash flows with the cost of an investment. We should accept investments with a positive NPV and reject investments with a negative NPV. The NPV is only an estimate.

THE INTERNAL RATE OF RETURN

INTERNAL RATE OF RETURN EXAMPLE

American Airlines wants to update an old fleet of airplanes it no longer uses and sell them to other airlines. The cost to do so is \$435.44 million, and they project they can earn \$100 million in the first year, \$200 million in the second year and \$300 million in the third year by selling the updated fleet. Given the riskiness of this investment, AA requires a return of 18%. What is the IRR? Should AA undertake this investment?

In your calculator:

$C_{fo} = -435.44$, $CF_1 = 100$, $F_01 = 1$, ..., $CF_3 = 300$, $F_03 = 1$

IRR CPR = 15.00%

IRR < Required Return, therefore AA should *not* undertake this investment.

THE INTERNAL RATE OF RETURN (IRR)

IRR: The discount rate that makes the NPV of an investment zero. This rate is “internal” in that it depends only on the cash flows of the project, not on opportunity costs.

BASED ON THE IRR RULE AN INVESTMENT SHOULD BE
ACCEPTED IF THE IRR IS GREATER THAN THE REQUIRED
RETURN

INTERNAL RATE OF RETURN EXAMPLE REVISTED

American Airlines wants to update an old fleet of airplanes and sell them to other airlines. The cost to do so is \$435.44 million, and they project they can earn \$100 million in the first year, \$200 million in the second year and \$300 million in the third year by selling the updated fleet. What is the NPV of this project given a discount rate of 15%? (Note that 15% = IRR from before).

In your calculator:

$$C_{fo} = -435.44, CF_1 = 100, F_{01} = 1, \dots, CF_3 = 300, F_{03} = 1$$

$$NPV \rightarrow I = 15.00\%$$

$$CPT NPV = 0.000$$

IRR AND NPV

IRR is useful because we don't need to think about a discount rate, only a rate we require.

Using the IRR and NPV Rule always results in the same accept/reject decision *unless*:

- (1) The project's cash flows are *unconventional*
- (2) The projects are *mutually exclusive*, whereby undertaking one project means you cannot undertake the other.

(1) UNCONVENTIONAL CASH FLOWS

This generally exists when you have positive and negative cash flows over time.

Example: Mining gold requires an initial investment of \$60 million to set up the site. This yields cash flows of \$100 million then \$200 million over the next two years, but then another \$40 million investment is required to restore the mine.

There can be multiple IRRs in this case, and your calculator may just pick one, which isn't suitable.

Fortunately, the NPV method still works.

(2) MUTUALLY EXCLUSIVE PROJECTS

Two projects are mutually exclusive if taking one means you can't take the other.

Example: JCPenney's has a plot of land that they can either build a store or distribution center on, but not both.

We *cannot* use the IRR to compare two mutually exclusive projects: accept the one with the highest NPV.

This is in part due to the *timing* of the cash flows as well as the chosen *discount rates*.

(2) MUTUALLY EXCLUSIVE PROJECTS EXAMPLE

The Ford Motor Company must decide which of their classic cars, the Model T or the Model A, to reintroduce to its lineup. Whichever it chooses, it will be for a limited time only (4 years). The table of the investment and expected sales (net of expenses) are presented below. Calculate the IRR for each investment.



| Year | Model T | Model A |
|------|----------|----------|
| 0 | -\$100 M | -\$100 M |
| 1 | 50 M | 20 M |
| 2 | 40 M | 40 M |
| 3 | 40 M | 50 M |
| 4 | 30 M | 60 M |



(2) MUTUALLY EXCLUSIVE PROJECTS EXAMPLE

| Year | Model T | Model A |
|------|----------|----------|
| 0 | -\$100 M | -\$100 M |
| 1 | 50 M | 20 M |
| 2 | 40 M | 40 M |
| 3 | 40 M | 50 M |
| 4 | 30 M | 60 M |

For the Model T:

$C_{fo} = -100, CF_1 = 50, F_{01} = 1, \dots, CF_4 = 30, F_{04} = 1 \rightarrow \text{CPT IRR} = 24.00\%$

For the Model A:

$C_{fo} = -100, CF_1 = 20, F_{01} = 1, \dots, CF_4 = 60, F_{04} = 1 \rightarrow \text{CPT IRR} = 21.03\%$

(2) MUTUALLY EXCLUSIVE PROJECTS EXAMPLE

| Year | Model T | Model A |
|------|----------|----------|
| 0 | -\$100 M | -\$100 M |
| 1 | 50 M | 20 M |
| 2 | 40 M | 40 M |
| 3 | 40 M | 50 M |
| 4 | 30 M | 60 M |

Does this mean Ford should produce the Model T? What's the NPV of both projects assuming a discount rate of 5%?

For the Model T:

$C_{f0} = -100, CF_1 = 50, F_{01} = 1, \dots, CF_4 = 30, F_{04} = 1 \rightarrow I = 5, \text{CPT NPV} = 43.13$

For the Model A:

$C_{f0} = -100, CF_1 = 20, F_{01} = 1, \dots, CF_4 = 60, F_{04} = 1 \rightarrow I = 5, \text{CPT NPV} = 47.88$

(2) MUTUALLY EXCLUSIVE PROJECTS EXAMPLE

| Year | Model T | Model A |
|------|----------|----------|
| 0 | -\$100 M | -\$100 M |
| 1 | 50 M | 20 M |
| 2 | 40 M | 40 M |
| 3 | 40 M | 50 M |
| 4 | 30 M | 60 M |

What's the NPV of both projects assuming a discount rate of 15%?

For the Model T:

$C_0 = -100, C_1 = 50, F_1 = 1, \dots, C_4 = 30, F_4 = 1 \rightarrow I = 15, \text{CPT NPV} = 17.18$

For the Model A:

$C_0 = -100, C_1 = 20, F_1 = 1, \dots, C_4 = 60, F_4 = 1 \rightarrow I = 15, \text{CPT NPV} = 14.82$

MUTUALLY EXCLUSIVE PROJECTS

Never rank mutually exclusive projects on their returns. Think of it this way:

You have two investments. One has a 10% return and makes you \$1,000 richer immediately. The other has a 20% return and makes you \$500 richer immediately. You'd rather be \$1,000 richer regardless of return.

Use NPVs when comparing mutually exclusive projects.

Independent projects are those that can be pursued at the same time.

CONFLICTS BETWEEN IRR AND NPV

Due to the unreliable nature of IRR when it comes to unconventional cash flows and mutually exclusive projects, *always go with the NPV if there is a conflict with IRR.*

TO SUMMARIZE

The IRR is the rate at which the NPV is zero. If you calculate an IRR for a project that is greater than your required return, you should accept the project. Be mindful of mutually exclusive projects and projects with unconventional cash flows.

THE PAYBACK RULE

PAYBACK RULE EXAMPLE

Cedar Fair Entertainment Company is interested in building a new theme park in Lexington, KY. The cost of the park will be \$1.3 billion. Cash flows net of costs will be \$250 million, \$275 million, \$400 million, \$550 million, and \$600 million for the next 5 years, consisting of ticket and merchandise sales. How much time is needed until the original investment is paid off? Should they pursue this project if the Board of Directors wants it to be paid back within 5 years?

Year 1: 250

Not yet

Year 2: $250 + 275 = 525$

Not yet

Year 3: $250 + 275 + 400 = 925$

Not yet

Year 4: $250 + 275 + 400 + 550 = 1,475$

Paid back!

In the 4th year, you only need $1,300 - 925 = 375$ to be paid back. With 550 in total cash flow projected for year 4, we are paid back 68% of the way through the 4th year: $375/550 = 0.68$

This project pays back in $3 + 0.68 = 3.68$ years.

PAYBACK RULE

The **PAYBACK PERIOD** is the amount of time required for an investment to generate cash flows sufficient to cover its costs. Generally used for smaller projects.

**BASED ON THE PAYBACK RULE, AN INVESTMENT IS ACCEPTABLE
IF ITS CALCULATED PAYBACK PERIOD IS LESS THAN SOME
PRESPECIFIED PERIOD OF TIME.**

This is a type of “break even” measure, and time value of money is ignored.

PAYBACK RULE EXAMPLE (2)

Bass Pro Shops is interested in building a store Lexington, KY. The cost of the store will be \$65 million. Cash flows net of costs will be \$25 million, \$50 million, \$70 million, and -\$12.65 trillion, for the next 4 years. Should they pursue this project if the Board of Directors wants it to be paid back within 3 years?

Year 1: 25

Not yet

Year 2: $25 + 50 = 75$

Paid back!

In the 2nd year, you only need $65 - 25 = 40$ to be paid back. With 50 in total cash flow projected for year 2, we are paid back 80% of the way through the 2nd year, or $40/50 = 0.80$

This project pays back in $1 + 0.80 = 1.8$ years, which is less than 3 years.
Should they undertake this investment?

TO SUMMARIZE

The Payback Rule determines if an investment will be offset by future cash flows within a set number of periods.

THE DISCOUNTED PAYBACK RULE

THE DISCOUNTED PAYBACK RULE

Here, we determine the **PAYBACK PERIOD** as in the **PAYBACK RULE METHOD**, only now we consider the **Time Value of Money**.

BASED ON THE DISCOUNTED PAYBACK RULE, AN INVESTMENT IS ACCEPTABLE IF ITS CALCULATED PAYBACK PERIOD IS LESS THAN SOME PRESPECIFIED PERIOD OF TIME.

Not much simpler than just finding the NPV...

DISCOUNTED PAYBACK RULE EXAMPLE

Let's revisit the Cedar Fair Entertainment Company example. Assume now a discount rate of 12%. The cost of the park will be \$1.3 billion. Cash flows net of costs will be \$250 million, \$275 million, \$400 million, \$550 million, and \$600 million for the next 5 years. Should they pursue this project if the Board of Directors wants it to be paid back within 3 years?

| | |
|--|---------|
| Year 1: $250/(1.12)^1 = 223$ | Not yet |
| Year 2: $275/(1.12)^2 = 219$ and $223 + 219 = 442$ | Not yet |
| Year 3: $400/(1.12)^3 = 285$ and $223 + 219 + 285 = 727$ | Not yet |

No, this project does not pay back the original investment within 3 years assuming a discount rate of 12%.

TO SUMMARIZE

The Discounted Payback Rule determines if an investment will be offset by the present value of future cash flows within a set number of periods.

ADVANTAGES AND DISADVANTAGES OF INVESTING CRITERIA

PROS AND CONS OF NPV

The NPV is the preferred method of evaluating a project.

No major flaws, but it is important to note:

- (1) The NPV is only an estimate
- (2) The NPV is sensitive to the discount rate

PROS AND CONS OF IRR

Pros:

Easy to understand and communicate. A manager can say “this project would yield a return of 15%” where 15% is the IRR.

Cons:

Cannot be used to compare mutually exclusive projects

Cannot be used when there are unconventional cash flows

PROS AND CONS OF THE PAYBACK RULE

Pros:

Easy to calculate and has a straightforward interpretation

Cons:

Doesn't determine if value is created for the shareholders

Ignores risks and time value of money

Ignores cash flows after the payback period

The choice of payback period can be arbitrary

PROS AND CONS OF THE DISCOUNTED PAYBACK RULE

Pros:

Easy to calculate and has a straightforward interpretation

Cons:

Doesn't determine if value is created for the shareholders

No simpler to calculate than the NPV

Ignores cash flows after the payback period

The choice of payback period can be arbitrary

TO SUMMARIZE

Each of the methods we've covered has pros and cons. The NPV method is generally preferred.

THE PRACTICE OF CAPITAL INVESTMENTS

WHAT DO MANAGERS DO?

In practice, CFOs use a mix of the techniques we've discussed (and a few that we didn't).

Percentage of CFOs who Always or Almost Always use a Given Technique (1999):

| Capital Budgeting Technique | Percentage Always or Almost Always Using | Average Score [Scale is 4 (always) to 0 (never)] | | |
|-----------------------------|--|---|-------------|-------------|
| | | Overall | Large Firms | Small Firms |
| Internal rate of return | 76% | 3.09 | 3.41 | 2.87 |
| Net present value | 75 | 3.08 | 3.42 | 2.83 |
| Payback period | 57 | 2.53 | 2.25 | 2.72 |
| Discounted payback period | 29 | 1.56 | 1.55 | 1.58 |
| Accounting rate of return | 20 | 1.34 | 1.25 | 1.41 |
| Profitability index | 12 | .83 | .75 | .88 |

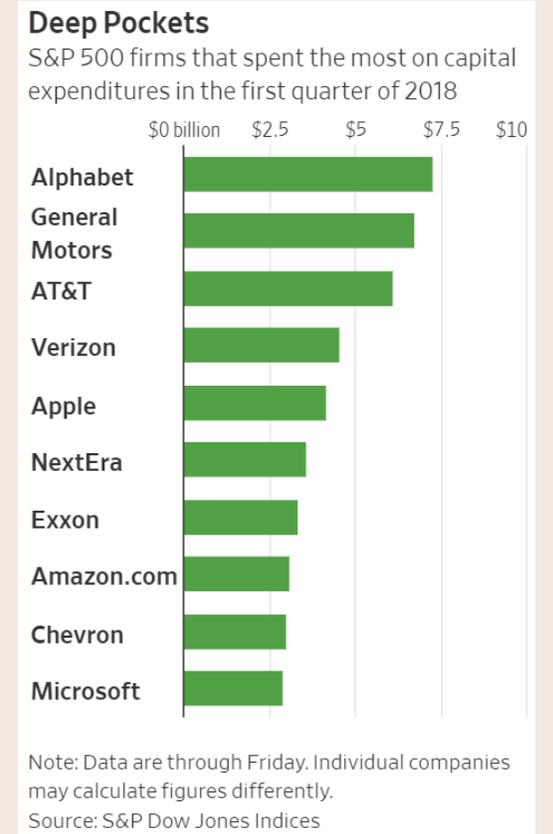
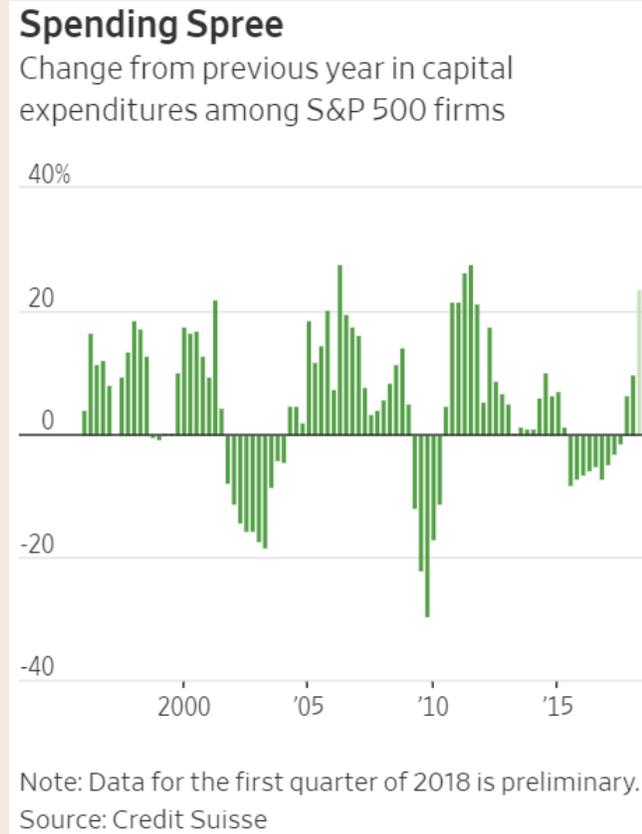
WHAT SHOULD MANAGERS DO?

Managers and CFOs should be focused on maximizing the value per share to existing shareholders. This is done by undertaking positive NPV projects and rejecting negative NPV projects.

INVESTING AND CAPITAL EXPENDITURES

Investments and projects are generally called CAPITAL EXPENDITURES in financial statements and in the financial press.

WSJ Capital Spending Boom



INVESTING AND CAPITAL EXPENDITURES: EXXONMOBIL

CONSOLIDATED STATEMENT OF CASH FLOWS

| | Note Reference Number | 2017 | 2016 | 2015 |
|---|-----------------------------|----------|----------|----------|
| <i>(millions of dollars)</i> | | | | |
| Cash flows from operating activities | | | | |
| Net income including noncontrolling interests | | 19,848 | 8,375 | 16,551 |
| Adjustments for noncash transactions | | | | |
| Depreciation and depletion | 9 | 19,893 | 22,308 | 18,048 |
| Deferred income tax charges/(credits) | | (8,577) | (4,386) | (1,832) |
| Postretirement benefits expense | | | | |
| in excess of/(less than) net payments | | 1,135 | (329) | 2,153 |
| Other long-term obligation provisions | | | | |
| in excess of/(less than) payments | | (610) | (19) | (380) |
| Dividends received greater than/(less than) equity in current earnings of equity companies | | 131 | (579) | (691) |
| Changes in operational working capital, excluding cash and debt | | | | |
| Reduction/(increase) - Notes and accounts receivable | | (3,954) | (2,090) | 4,692 |
| - Inventories | | (1,682) | (388) | (379) |
| - Other current assets | | (117) | 171 | 45 |
| Increase/(reduction) - Accounts and other payables | | 5,104 | 915 | (7,471) |
| Net (gain) on asset sales | 5 | (334) | (1,682) | (226) |
| All other items - net | 5 | (771) | (214) | (166) |
| Net cash provided by operating activities | | 30,066 | 22,082 | 30,344 |
| Cash flows from investing activities | | | | |
| Additions to property, plant and equipment | 5 | (15,402) | (16,163) | (26,490) |
| Proceeds associated with sales of subsidiaries, property, plant and equipment, and sales and returns of investments | 5 | 3,103 | 4,275 | 2,389 |
| Decrease/(increase) in restricted cash and cash equivalents | | - | - | 42 |
| Additional investments and advances | | (5,507) | (1,417) | (607) |
| Other investing activities including collection of advances | | 2,076 | 902 | 842 |
| Net cash used in investing activities | | (15,730) | (12,403) | (23,824) |



TAKEAWAYS

TAKEAWAYS

1. Capital Budgeting is the process of planning and managing a firm's long-term investments.
2. There are several ways managers evaluate projects, including the NPV, IRR, Payback Period, and Discounted Payback Period.
3. The NPV compares the present value of an investment's future cash flows to the cost of the investment.
4. The IRR can be calculated for a project and compared to a required rate of return.
5. Ultimately, the goal of the financial manager is to maximize the value per share for existing shareholders, which is done by selecting value-enhancing (positive NPV) projects.

END.

