Software Economics

Metrics of Business Case Analysis Part 1
Today

- Last Session we covered FV, PV and NPV
- We started with setting up the financials of a Business Case
- We talked about measurements to compare investment options and talked about NPV, now we continue with
  - Baseline or alternative scenarios
  - ROI (Return on Investment)
  - IRR (Internal Rate of Return)
  - Payback Period
Opportunity Cost

When deciding to invest or not, you always have an alternative to compare with.

If no other investment alternatives, the alternative is to do nothing, no-action, not to invest.

Investing should be compared to at least the alternative of not doing anything.
You always have at least two scenarios – to invest or not to.

If you continue business as usual (not to invest), that is your baseline scenario.

If you invest, hopefully you will get a better scenario, the upside scenario.

We are interested in the added value of investing, i.e. what we get more if we invest as compared to not investing (increment).

Sometimes, you have two options for investment and want to find the best one.
Return on Investment

Return on Investment – Simple ROI

\[
\text{ROI} = \frac{\text{Gain from investment} - \text{Cost of investment}}{\text{Cost of Investment}}
\]

Or ROI = Net profit / Cost of investment

Simple and flexible tool to measure profit in relation to cost.
### An example

<table>
<thead>
<tr>
<th></th>
<th>Initial</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Sum Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Costs</strong></td>
<td>10,000</td>
<td>2,500</td>
<td>2,500</td>
<td>2,500</td>
<td><strong>17,500</strong></td>
</tr>
<tr>
<td><strong>Total Benefits</strong></td>
<td>0</td>
<td>20,000</td>
<td>20,000</td>
<td>20,000</td>
<td><strong>60,000</strong></td>
</tr>
<tr>
<td><strong>Net Benefits</strong></td>
<td>-10,000</td>
<td>17,500</td>
<td>17,500</td>
<td>17,500</td>
<td><strong>42,500</strong></td>
</tr>
</tbody>
</table>

**ROI** 243%  
\[
\text{ROI} = \frac{42,500}{17,500}
\]
A company thinks it can improve performance if they invest in a software package.

The investment is 1 000 000 $.

The benefit of the investment is estimated to be 1 000 000 $ in year 1 and 3 000 000 $ in year 2 and 3.

What is the ROI after year 1, 2 and 3?
Solution

ROI = Net benefit / Cost

Year 1: \((1 \text{ million} - 1 \text{ million}) / 1 \text{ million} = 0 \%\)

Year 2: \((1 + 3 - 1) / 1 = 300 \%\)

Year 3: \((1 + 3 + 3 - 1) = 600 \%\)

Do you see any issues with the ROI measurement?
Weakness of ROI

- ROI is very flexible and easy to use, but the flexibility make it easy to manipulate to suit your purpose. There is no “correct” calculation.

- When presenting ROI, for which year will you choose?
- What benefits and what costs do you include?

For example, an Investment will generate a revenue of 5000 and will cost 1500 to implement.

\[
ROI = \frac{(5000 - 1500)}{1500} = 233\%
\]

What if we take the gross profit or the net profit?
Risk Adjusted ROI

- Simple ROI does not consider time value of money.
  - Profits in the future has same value as today
  - Simple ROI better for short term investments

- Risk Adjusted ROI considers the time value of money

Risk Adjusted ROI =

\[
\frac{\text{Net Present Value of Cumulative Net Benefit}}{\text{Net Present Value of Total Costs}}
\]
Calculating ROI

- ROI is basically a cost-benefit analysis
  - Looks at positive (benefits) and negative (costs) cash flows.

Calculating the ROI in a Business Case

1. Put the Baseline Scenario down
2. Put the Investment (Upside) Scenario down
3. Calculate the Incremental Cash Flows
4. Divide the net gains of the investment with the costs of the investment
Exercise: Open the Selver Case we did last week and calculate the ROI in groups of 4-5.
What is the ROI?

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>430 000</th>
<th>860 000</th>
<th>1 290 000</th>
<th>1 290 000</th>
<th>3 870 000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Gain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Costs</td>
<td>350 000</td>
<td>410 000</td>
<td>660 000</td>
<td>630 000</td>
<td>630 000</td>
<td>2 680 000</td>
</tr>
<tr>
<td>Total Net Gain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 190 000</td>
</tr>
</tbody>
</table>

ROI 44%
## Interpreting ROI

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Interpretation</th>
<th>Impact on Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROI &gt; 0</td>
<td>The investment will add value (positive return).</td>
<td>If its inline with strategy, choose the one with highest ROI (regard how large the ROI is)</td>
</tr>
<tr>
<td>ROI = 0</td>
<td>The investment neither adds nor decreases value.</td>
<td>Use other criteria to decide.</td>
</tr>
<tr>
<td>ROI &lt; 0</td>
<td>The Investment decreases the value (negative return)</td>
<td>Do not invest unless other benefits (intangible) justify the investment.</td>
</tr>
</tbody>
</table>
When considering ROI

- ROI states only relative gains, not absolute gains.
- Be aware of the assumptions behind the ROI number.
- Don’t use only ROI, combine it with other measures for a better understanding and better decision.
Risks

- You have 10 000$. You can either
  - Save it in your bank account for 3% interest rate
  - Or invest it with a 3% return on your investment.
  - Which do you choose and why?

- If you invest, and take a risk, you want more return than the risk free rate.

- How much return do you want?
  - Depends on how much risk you are taking.
Discount Rate

Expected Return (Discount Rate) = Risk-free rate + Risk Premium

[Cost of Capital is also used to determine discount rate]
Recap of NPV

- Calculate NPV for the following cash flows:

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash flow</td>
<td>-45000</td>
<td>20000</td>
<td>20000</td>
<td>15000</td>
</tr>
</tbody>
</table>

with discount rate of 0, 5, 10, 15 and 20 %.

- Then make a simple graph.

- What does these numbers and the graph tell you about the profitability of the investment?

- At what rate does this investment have zero value for the investor?
Internal Rate of Return

IRR gives you the rate at which your investment NPV is 0.

It gives you the discount rate at which your investment will have a NPV of zero, i.e. your investment does not add value.

\[ \text{Set NPV as 0, } IRR = i \text{ when } \]

\[ 0 = FV_0 + FV_1 / (1+i)^1 + FV_2 / (1+i)^2 + FV_n / (1+i)^n \]

Therefore it is a measure of the risk sensitivity of your investment.

The higher IRR is, the more things can go wrong before your NPV becomes 0.
Some say IRR is an objective measurement as compared to NPV. Why?

Answer: The discount rate is not chosen.
Calculating IRR

1. Calculate the NPV and then change the discount rate until the NPV gets to zero

2. Use the IRR function of Excel

Open the Sangar Case and calculate the IRR.

What do you get?

What does it mean?
Limitations of IRR

Calculate the IRR of the following cash flows:

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash flow</td>
<td>-30,000</td>
<td>50,000</td>
<td>-10,000</td>
</tr>
</tbody>
</table>

You should get 43 % but also close to -76.75 %

If your investment has shift in net cash flows from for example negative to positive to negative, the IRR can return multiple values.

When we have multiples IRRs, it’s better to choose another measure.
Payback Period

- Payback period tells you how long it takes for the investments net cash flows to be positive (recover the initial investment).

- Usually expressed in years and months.

- Calculate the payback time of the following cash flows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Cash Flows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 0</td>
<td>-5000</td>
</tr>
<tr>
<td>Year 1</td>
<td>1000</td>
</tr>
<tr>
<td>Year 2</td>
<td>3000</td>
</tr>
<tr>
<td>Year 3</td>
<td>3400</td>
</tr>
</tbody>
</table>
Calculating the Payback Period

Before the end of year 3, we cover the investment. We need to cover 1000 and we will get 3400 during year 3 so =1000/3400 = 0.29 *12 = 3.5 months.

Payback Period is therefore 2 years and 3.5 months

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Cash Flows</th>
<th>Ack Cash Flows</th>
<th>Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 0</td>
<td>-5000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 1</td>
<td>1000</td>
<td>-4000</td>
<td></td>
</tr>
<tr>
<td>Year 2</td>
<td>3000</td>
<td>-1000</td>
<td></td>
</tr>
<tr>
<td>Year 3</td>
<td>3400</td>
<td>2400</td>
<td>0.29</td>
</tr>
</tbody>
</table>

Net CF of Year 0 (-5000) + Net CF of Year 1 (1000)
## Discounted Payback Period

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Cash Flow</th>
<th>PV</th>
<th>Ack CF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 0</td>
<td>-10000</td>
<td>-10000</td>
<td></td>
</tr>
<tr>
<td>Year 1</td>
<td>6500</td>
<td>5702</td>
<td>-4298</td>
</tr>
<tr>
<td>Year 2</td>
<td>7000</td>
<td>5386</td>
<td>11088</td>
</tr>
<tr>
<td>Year 3</td>
<td>7500</td>
<td>5062</td>
<td>0.80</td>
</tr>
<tr>
<td>Year 4</td>
<td>8000</td>
<td>4737</td>
<td></td>
</tr>
</tbody>
</table>

Payback Period is 1 year 10 months
# Quick Summary

<table>
<thead>
<tr>
<th>How much profit will my investment give?</th>
<th>What is the Risk of my Investment?</th>
<th>When do I get benefit from my investment?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Present Value (NPV)</td>
<td>Internal Rate of Return (IRR)</td>
<td>Payback Period</td>
</tr>
<tr>
<td>Return on Investment (ROI)</td>
<td>Modified Internal Rate of Return (MIRR)</td>
<td>Discounted Payback</td>
</tr>
<tr>
<td>Risk Adjusted ROI</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
“WHAT’S THE ROI OF THE TIME WE SPEND FIGURING OUT ROI?”
Practice Business Case

1. Read the Sangar case
2. List the assumptions
3. Do the baseline
4. Do the upside
5. Calculate NPV, ROI, IRR and Payback Period
6. Interpret the results