Software Project Management

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Project Evaluation and Programme Management cont…

Contents

- Cost-benefit evaluation techniques

Cost-benefit analysis – Detailed Steps

1. Identify the cost and benefits pertaining to the project
2. Categorize the various costs and benefits
3. Select cost-benefit evaluation technique
4. Interpret the results of the analysis
5. Take appropriate action.

Select cost-benefit evaluation technique

Different cost-benefit evaluation techniques are:

1. Net benefit (profit) analysis
2. Payback period
3. Return on investment
4. Present value analysis
5. Net present value (NPV)
6. Internal rate of return (IRR)
7. Break-even analysis

Net Profit

- Net profit of a project is the difference between the total costs and the total income over the life of the project.

Net Profit - Example

Year	Cash-flow
0	-100,000
1	10,000
2	10,000
3	10,000
4	20,000
5	100,000
Net profit	50,000

- In this example, 'Year 0' represents all the costs before system is operation.
- 'Cash-flow' is the value of income less outgoing.
- Net profit is the value of all the cash-flows for the lifetime of the application.
- For this example, net profit is $50,000.
- Cons: Does not take into account the timing of the cash flows.

Another Example: Four project cash-flow projections

Year	Cash-flow Project 1 ($)	Cash-flow Project 2($)	Cash-flow Project 3($)	Cash-flow Project 4($)
0	-100,000	-1000,000	-100,000	-120,000
1	10,000	200,000	30,000	30,000
2	10,000	200,000	30,000	30,000
3	10,000	200,000	30,000	30,000
4	20,000	200,000	30,000	30,000
5	100,000	300,000	30,000	75,000
Net profit($)	50,000	100,000	50,000	75,000

So, project 2 shows largest net profit, but, at the expense of huge investment

Pay back period

Year	Cash-flow ($)	Accumulated ($)
0	-100,000	-100,000
1	10,000	-90,000
2	10,000	-80,000
3	10,000	-70,000
4	20,000	-50,000
5	100,000	50,000

- It is the time taken to break even or pay back the initial investment.
- This is the time it takes to start generating a surplus of income over the expenditure.
- The project with shortest payback period is preferred, as the owner wishes to minimize the time that a project is "in debt".
- For this example, payback period is year 5.

Another Example: Four project cash-flow projections

Year	Cash-flow Project 1 ($)	Cash-flow Project 2($)	Cash-flow Project 3($)	Cash-flow Project 4($)
0	-100,000	-1000,000	-100,000	-120,000
1	10,000	200,000	30,000	30,000
2	10,000	200,000	30,000	30,000
3	10,000	200,000	30,000	30,000
4	20,000	200,000	30,000	30,000
5	100,000	300,000	30,000	75,000
Net profit	50,000	100,000	50,000	75,000
PB period	Year 5	Year 5	Year 4	At end of Year 4

So, project 3 is the most beneficial Project

Pay back period cont...

Pros:

- Simple to calculate
- Not particularly sensitive to small forecasting errors

Cons:

- Ignores the overall profitability of the project
- Ignores any income (expenditure) once the project has broken-even
- So, the fact that Projects 2 and 4 are, overall, more profitable than Project 3, is ignored

Return on investment (ROI)

- Provides a way of comparing the net profitability to the investment period.
- Provides a simple and easy-to-calculate measure of return on capital.

Return on investment (ROI) cont...

$$ROI = \frac{\text{Average annual profit}}{\text{Total investment}} \times 100$$

In the previous example

- Average annual profit
  = 50,000/5
  = 10,000
- So, ROI = 10,000/100,000 X 100
  = 10%

Another Example: Four project cash-flow projections

Year	Cash-flow Project 1 ($)	Cash-flow Project 2($)	Cash-flow Project 3($)	Cash-flow Project 4($)
0	-100,000	-1000,000	-100,000	-120,000
1	10,000	200,000	30,000	30,000
2	10,000	200,000	30,000	30,000
3	10,000	200,000	30,000	30,000
4	20,000	200,000	30,000	30,000
5	100,000	300,000	30,000	75,000
Net profit	50,000	100,000	50,000	75,000
ROI	10%	2%	10%	12.5%

So, Project 4 is the most beneficial project

Return on investment (ROI) cont...

Cons:

- Like the net profitability, it does not take into account the timing of the cash flows.
- Bears no relationship to the interest rates charged by banks since it takes no account of the timing of the cash flows.
- It is therefore, potentially, very misleading.

Present value (PV) analysis

- In developing long-term projects, it is often difficult to compare today's costs with the full value of tomorrow's benefits.
- The time value of money allows for interest rates, inflation, and other factors that alter the value of the investment.
- So, PV analysis is important. It controls the above problems by calculating the costs & benefits of the system in terms of today's value of the investment and then comparing across alternatives.
- A critical factor to consider in computing present value is a discount rate equivalent to the forgone amount that the money could earn if it were invested in a different project.

Present value analysis cont…

- In other words, the annual rate by which we discount the future earnings is known as discount rate.
- Discount Factor (DF) is calculated as follows:

$$DF = \frac{1}{(1+r)^t}$$

where r= discount rate, t= number of years into the future that the cash flow occurs.

Present value analysis cont…

- In the case of 10% rate and one year

  Discount Factor = 1/(1+0.10) = 0.9091

- In the case of 10% rate and two years

$$DiscountFactor = \frac{1}{(1+0.10)^2}$$

$$=0.8264$$

Similarly, the discount factor can be computed for any given year and discount rate.

NPV discount factors

Year	Discount rate (%)					
	5	6	8	10	12	15
1	0.9524	0.9434	0.9259	0.9091	0.8929	0.8696
2	0.9070	0.8900	0.8573	0.8264	0.7972	0.7561
3	0.8638	0.8396	0.7938	0.7513	0.7118	0.6575
4	0.8227	0.7921	0.7350	0.6830	0.6355	0.5718
5	0.7835	0.7473	0.6806	0.6209	0.5674	0.4972
6	0.7462	0.7050	0.6302	0.5645	0.5066	0.4323
7	0.7107	0.6651	0.5835	0.5132	0.4523	0.3759
8	0.6768	0.6274	0.5403	0.4665	0.4039	0.3269
9	0.6446	0.5919	0.5002	0.4241	0.3606	0.2843
10	0.6139	0.5584	0.4632	0.3855	0.3220	0.2472
15	0.4810	0.4173	0.3152	0.2394	0.1827	0.1229
20	0.3769	0.3118	0.2145	0.1486	0.1037	0.0611
25	0.2953	0.2330	0.1460	0.0923	0.0588	0.0304

Present value analysis cont…

- Suppose that $3000 is to be invested in a project, and the average annual benefit is $1500 for the four-years life of the project. The investment has to be made today, whereas the benefits are in the future.
- We compare present values to future values by considering the time value of money to be invested.
- The amount that we are willing to invest today is determined by the value of the benefits at the end of a given period (year).
- The amount is called the present value of the benefit.

Present value analysis cont…

To compute the present value, we use the formula for future value as given below

$$F = \frac{P}{(1+r)^t}$$

where,

F = future value

P = present value

r = discount rate

t = number of years into the future that the cash flow occurs.

Present value analysis cont…

On solving the above equation, we obtain the formula for present value (P) as follows :

$$P = \frac{F}{(1+r)^{t}}$$

where,

F = future value

P = present value

r = discount rate

t = number of years into the future that the cash flow occurs.

Present value analysis cont…

So the present value of $1,500 invested at 10% interest at the end of 4th year is:

$$P = \frac{1500}{(1+0.10)^4}$$

$$= \frac{1500}{1.61} = 1027.39$$

That is, if we invest $1,027.39 today at 10 percent interest, we can expect to have $1,500 in four years.

This calculation can be represented for each year where a benefit is expected.

Net Present Value (NPV) analysis

- NPV is a project evaluation technique that takes into account the profitability of a project and the timing of the cash flows that are produced.
- The net present value is obtained by discounting each cash flow (both negative & positive) and summing the discounted values.

Net Present Value (NPV) analysis - Example (project 1)

Year	Cash-flow ($)	Discount factor	Discounted cash flow ($)
0	-100,000	1.0000	-100,000
1	10,000	0.9091	9,091
2	10,000	0.8264	8,264
3	10,000	0.7513	7,513
4	20,000	0.6830	13,660
5	100,000	0.6209	62,090
		NPV	618

Net Present Value (NPV) analysis - cont…

Cons:

- The main difficulty with NPV for deciding between projects is selecting an appropriate discount rate.
- Using NPV, it might not be directly comparable with earnings from other investments or the costs of borrowing capital.

Exercise:

Calculate the NPV values for Projects 2, 3 and 4 and draw the inference.

Internal Rate of Return (IRR)

- IRR provides a profitability measure as a percentage return that is directly comparable with interest rates. So, a project that shows an IRR of 10% would be worth if the capital could be borrowed for less than 10% or the capital could not be invested elsewhere for a return greater than 10%.
- IRR is the discount rate that would produce an NPV of 0 for the project.
- Can be used to compare different investment opportunities.
- Can be calculated using a spread sheet. Also, Microsoft Excel provides functions, such as IRR(), which take a value and an initial guess as input and return an IRR as the output.

Internal Rate of Return (IRR) cont ...

Cons:

- It does not indicate the absolute size of the return.
- A project with an NPV of $100,000 with an IRR of 15% can be more attractive than one with an NPV of $10,000 with an IRR of 18%.
- Under certain conditions, it is possible to find more than one rate that will produce zero NPV. In these cases, take the lowest value and ignore the others.

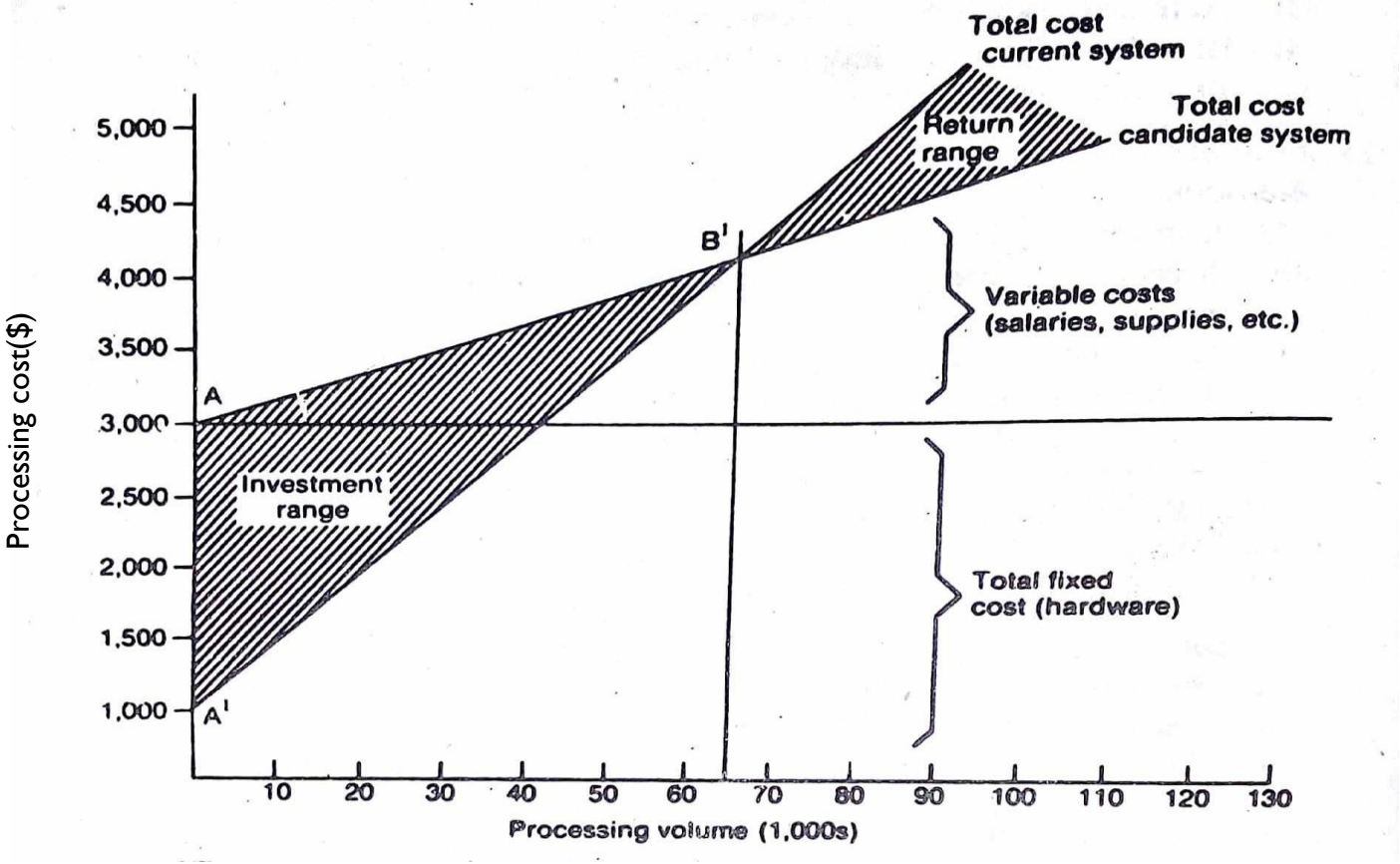
Break-even Analysis

- Break-even is the point where the cost of the candidate (proposed) system and that of the current one are equal.
- Unlike the payback method that compares costs and benefits of the candidate system , break-even analysis compares the costs of the current and candidate systems.

Break-even Analysis cont ...

- When a candidate system is developed, the initial costs usually exceed those of the current system. This is an investment period.
- When both costs are equal, it is break-even.
- Beyond that point, the candidate system provides greater benefit (profit) than the old one. This is the return period.

Break-even analysis



Break- even chart [Awad, 2009]

Break-even Analysis cont ...

- Straight lines are used to show the model's relationships in terms of the variable, fixed, and total costs of the two processing methods and their economic benefits.
- Intersection B' indicates the point where the total cost of processing 65,000 transactions by the current system is equal to the total cost of using the candidate system.

Break-even Analysis cont …

- The shaded area beyond that point is the return period.
- The shaded area AB'A' is the investment period.
- According to the chart, then, it would be more economical to process manually when volume is below 65,000 transactions during a given time period.
- Processing volume above B' favours the candidate system.

Summary

- Discussed different cost-benefit evaluation techniques with suitable examples.
- Also, described the advantages and disadvantages of each technique.
- Presented which technique will be best suitable in which circumstances.

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Thank you