# Feasibility and Cost-Benefit Analysis

## Feasibility

### Operational Feasibility

- centred on human factors (ie. ergonomics, desire to have a new computer system)
- Is the problem worth solving?
- How do the clients feel about the problem?
- Are there unused computer terminals in the company now?
- Are there unread reports being generated?

### Technical Feasibility

- often computer-oriented
- is the solution practical?
- do we have the technology now?
- do we have the technical expertise and time?

### Economic Feasibility

- costs and benefits
- early estimates based on rule of thumb
- refined successively until we have a complete Cost-Benefit Analysis

**BUT**:

- often all three feasibility measures will not point to the same alternative
- i.e. a GUI system is operationally desirable, but the technology may not exist or is too costly to implement

- clients and the analysts must evaluate the results of the feasibility study and make decisions together based on the results

## Cost-Benefit Analysis

- the process of isolating and estimating costs and benefits
- in order to do a cost-benefit analysis, two sides of the ledger must be considered
- system ***costs***
- ***benefits*** from the system
- if a system is economically feasible, then the benefits should outweigh the system costs within a defined period of time acceptable to the user/client

## System Costs

### Development Costs

- one time expenses for the project
- estimates improve as more detail is given
- Personnel Costs

  salaries of all individuals who develop the system

  also includes benefits
- User Time
- Training Costs
- Equipment Costs

  cost of acquiring all new hardware/software for project

  if the equipment is shared, then divide the total cost or compute it proportional to its usage

  also cost of new furniture, chairs, etc. if needed
- Computer Usage Costs
- Supply and Materials Costs

  hardware, software and office supplies consumed

  costs of manuals and other documentation too
- Facility Costs

  expenditures necessary to prepare the site for the new system
- Overhead and Miscellaneous Expenses

  rent, utilities, training course fees, etc.

  cost of running two parallel systems

**Ongoing Operating Costs**

- recurring costs for the operation of the system
- all of the development costs required on an ongoing basis: personnel, equipment, maintenance, overhead, etc.

**Fixed Costs**

- occur at regular intervals
- costs are not dependent upon the operation of the system
- constant, no matter how much or little the system is used
- eg. property taxes, lease payments must be paid monthly
- also, company benefit plans (ie hospital coverage)

**Variable Costs**

- occur in proportion to the usage of the system
- CPU costs
- supply costs
- wage costs
- some maintenance costs

## Benefits

- normally increase profits or decrease costs

### Performance Benefits

- to improve the quality of work or to permit new activities to be undertaken
- common performance benefits might be error reduction, increased speed of activity, and access to information that was not previously available

### Cost-Avoidance Benefits

- clerical errors will be avoided with new system, and now costing the company $10,000 annually
- firm will not have to hire two additional employees with new system

### Tangible Benefits

- can be estimated quite accurately
- usually measured in terms of monthly or annual savings or profit

  Staff Reductions

  Savings on Production

  Faster Cycle Time

  Manufacture a new Part

**Intangible Benefits**

- difficult or impossible to quantify

  Goodwill

  Environmentally Friendly

- three different methods to quantify intangible benefits

**Method 1: Subjective Estimation**

- users make estimates based on gut feel or experience
- no way to validate
- analyst should document and append to Cost-Benefit Report

**Method 2: Decision Theory (ie. Expected Values)**

- assign probabilities to various outcomes
- better working conditions will reduce employee turnover
- requires estimation of the extent of the reduction
- estimate savings since retraining not required

1) By what percentage will turnover be reduced?

   20% chance of 5% reduction

   50% chance of 4% reduction

   30% chance of 3% reduction

   Turnover reduced by .2(.05)+.5(.04)+.3(.03)=3.9%

   Current turnover is 100 people/year

   New system only 96.1 people/year leave

2) Determine how much this will save:

Termination Pay = $1,200

Recruitment Costs = $2,000

Replacement Salary and Overhead = $12,500

Training Costs = $3,000

TOTAL = $18,700

Therefore benefit of better working conditions is

3.9 x $18,700 = $72,930

**Method 3: Working Backwards from Desired Results**

- using Method 2 example:

  savings of a person *not* leaving is $18,700

  company requires an annual benefit of $100,000

  then must be able to reduce turnover by 5.35 people

## Cost-Benefit Terminology

### Spending vs Investment

- spending is the purchase of what is needed to keep the operation viable
- investments are monies spent which should generate revenue - a new system is an investment in most situations
- if benefits are less than costs, then system is not worth doing!
- the goal is to maximize revenue

### Direct versus Indirect Costs and Benefits

- direct costs and benefits can be specifically attributable to the system
- indirect costs and benefits are expenses or revenue that are shared with other components of the organization (corporate management would generally allocate such costs and benefits)

### Economic Life

- period of time the investment is expected to yield benefits
- projects into the future
- after the economic life is determined, can classify costs as fixed or variable
- costs of existing facilities present during economic life of investment are fixed - all other costs are variable

**Residual Value**

- value of the parts of the existing system that can be salvaged
- results in reduced cost of the replacement system
- usually estimated as a percent of the new system's development cost

**Sunk Costs**

- costs related to an investment which have already been paid out
- Example 1: the use of an empty factory cannot be justification for making a project cost effective because the costs are already *sunk*
- Example 2: just because $20,000 has already been invested in a project, you cannot justify proceeding with the project. The $20,000 is sunk costs.

**Discount Rate**

- opportunity cost of being able to invest money in other projects (or investments) expressed as a percentage
- could also be the acceptable return on its investments

**Required Rate of Return**

- minimum rate of return that a company can accept
- theoretically, the cost of raising capital (or discount rate)

**Present Value**

- all cost-benefit data should be converted into today's dollars
- because we can invest a dollar today and gain interest on that dollar, a dollar today is worth more than one dollar a year from now
- benefits realized in the future must be brought back to today's value
- ie. when doing a cost-benefit analysis, if I had the money in my hand today, would I be better to invest it or to build the new system?
- this also allows us to compare projects with different lifetimes

**Let:**

F = Future Value of Investment

P = Present Value of Investment

i = Interest Rate per Compounding Period

n = Number of Compounding Periods

**Then:**

$F = P(1 + i)^n$

$$P = \frac{F}{(1 + i)^n}$$

**Partial Table for Present Value of a Dollar**

- the present value can be calculated using this formula
- tables are also produced where combinations of interest and compounding periods are already calculated

## Techniques Used to Determine Economic Feasibility

Four different measures:

1) payback analysis
2) return on investment
3) net present value
4) profitability index

In order to do a thorough cost-benefit analysis, need to know:

1) Development Costs
2) Annual Operating Costs
3) Annual Benefits
4) Economic Life of the System (ie. expected to last 5 years)
5) Required Rate of Return (ie. 15%)

**Technique 1: Payback Analysis**

- determines how much time will lapse before accrued benefits overtake accrued and continuing costs
- time required for investment to break even
- very important when company is 'cash poor' - shows when company will get its money back
- does not consider the 'time value' of money!
- a new project continues to go into debt until it is implemented and benefits begin to be realized
- breakeven point is when debts have been cancelled by benefits

- payback is very useful when a project is very time sensitive - a project may be cost justifiable during its economic life, but due to some external constraint (ie bank loans coming due), "net profit" from the project must be realized in a defined period of time. Payback determines if the project is capable of doing this.
- show on the overhead that the difference between the cumulated benefits and costs indicates when the project moves out of the "red" into the "black" or the breakeven point occurs

$$\text{Payback Period (T)} = \frac{\text{Development Costs (D)}}{\text{Annual Revenues - Annual Operating Costs (P)}}$$

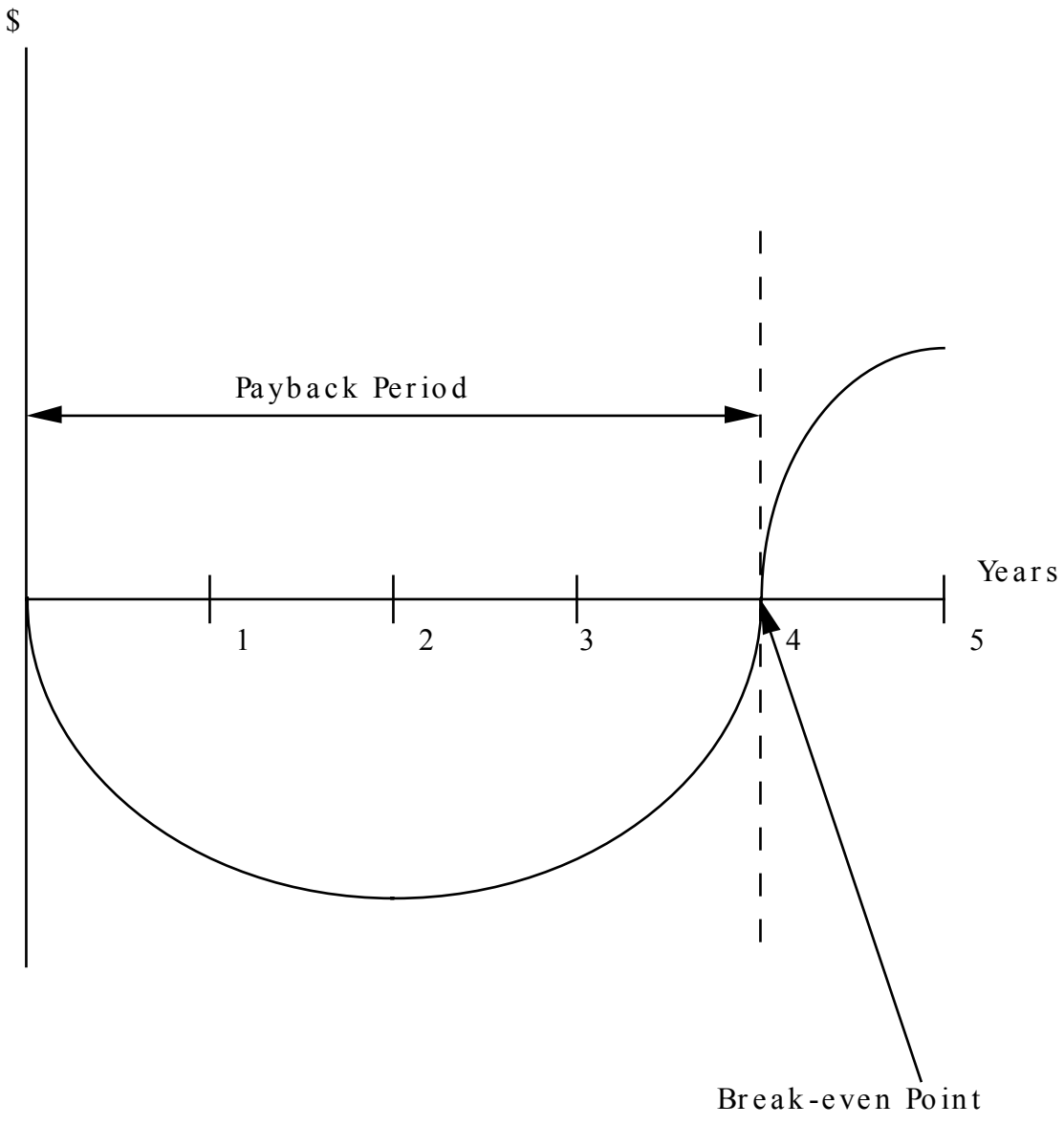
**Insert Two Overheads Here!**

**Example**:

Investment A costs $40,000 to develop and reduces costs by $20,000 annually. Payback period is D/P = $40,000/$20,000 = 2 years.

Investment B costs $50,000 to develop and reduces costs by $30,000 annually. Payback period is D/P = $50,000/$30,000 = 1.67 years.

# Payback Period



**Technique 2: Internal Rate of Return (IRR)**

- *a measure of the relationship between what is invested in a project and the net benefits from the project*
- an expression of benefits returned by an investment in terms of a *rate per year*
- the IRR can be compared with the IRR of alternate solutions
- the company may also have a stated minimum IRR for its projects
- usually want it to be better than interest rates (or one would simply invest the money rather than risk a project)

$$\text{IRR} = \frac{\text{estimated lifetime benefits-estimated lifetime costs}}{\text{estimated lifetime costs}}$$

- note this is a lifetime IRR, so divide by the economic life of the system to calculate the yearly IRR

**Examples on Overheads**

Example A

$$\frac{\$100{,}000 - \$40{,}000}{\$40{,}000} = \frac{\$60{,}000}{\$40{,}000} = 1.5 \text{ over project lifetime}$$

1.5/5 year lifetime = 0.3 = 30% annual IRR

Example B

$$\frac{\$90{,}000 - \$50{,}000}{\$50{,}000} = \frac{\$40{,}000}{\$50{,}000} = 0.8 \text{ over project lifetime}$$

0.8/3 year lifetime = 26.7% annual IRR

# Internal Rate of Return (IRR)

$$\text{IRR} = \frac{\text{lifetime benefits - lifetime costs}}{\text{lifetime costs}}$$

**NOTE: This is a lifetime IRR, so divide by the economic life of the system to calculate the yearly IRR.**

**Technique 3: Present Value & Net Present Value**

- costs and benefits of the system are calculated in terms of today's dollars (ie. the value of the investment in today's dollars)
- takes into account the time value of money
- eg. at 10% annual interest, $1 today is worth $1.10 at the end of one year, then $1.10 x 1.1 = $1.21 at the end of two years, etc.

For the overhead example, look up figures on Present Value table to come up with the following:

**Present Value of Annual Benefits**

| | Example A | Example B |
|---|---|---|
| Year 1 | $17,400 | $26,100 |
| Year 2 | $15,120 | $22,680 |
| Year 3 | $13,160 | $19,740 |
| Year 4 | $ 11,440 | |
| Year 5 | $ 9,940 | |
| Total | $67,060 | $68,520 |

NPV = Present Value of Total Benefits - Present Value of Total Costs

- if NPV is > 0, then the project is economically feasible

**Technique 4: Profitability Index**

- attempts to measure *risk* by determining ratio of PV of benefits (Present Value) to the Development Costs
- ie. PV of benefits for two projects may be the same, but if development costs of one is five times that of another, then you would want to choose the project with the lower risk

PI = Present Value of Benefits / Present Value of Development Costs

- if PI > 1 then the project is profitable

## Cost-Benefit Example

A new automated premium billing system has been recommended by outside consultants. The requirements have been defined and we are now ready to perform the cost benefit analysis.

The system will cost $50,000 to build. It has been determined that the economic life of the new system will be 5 years, after its installation one year from now. At the end of the period, the data base can still be used in the replacement system, saving approximately $10,000.

The current system's operating costs are estimated to be $100,000 per year but the operating costs for the new system are only $75,000 per year. The new system has additional intangible benefits of $10,000 per year.

All estimates of costs and benefits are increasing at a rate of 10% per year for both the current and new systems. The required rate of return for the company is 15%.

## Solution

| **Year** | **0** | **1** | **2** | **3** | **4** | **5** | **6....** |
|---|---|---|---|---|---|---|---|
| **Costs** | | | | | | | |
| Analysis, design, implementation | -50 | | | | | | |
| Operation and Maintenance | | -75 | -83 | -91 | -100 | -110 | |
| **Total Costs** | **-50** | **-75** | **-83** | **-91** | **-100** | **-110** | |
| Discount Factor (15) | 1 | .87 | .756 | .658 | .572 | .497 | |
| Present Value of Costs | -50 | -65.25 | -62.75 | -59.88 | -57.2 | -54.67 | |
| Cumulative PV Costs | -50 | -115.25 | -178 | -237.88 | -295.08 | -349.75 | -349.75 |
| **Benefits** | | | | | | | |
| Tangible Benefits from new System | | 110 | 121 | 133 | 146 | 161 | |
| Intangible Benefits from new System | | 10 | 11 | 12 | 13 | 15 | 10 |
| **Total Benefits** | | **120** | **132** | **145** | **159** | **176** | **10** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Discount Factor (15) | 1 | .87 | .756 | .658 | .572 | .497 | .432 |
| Present Value of Benefits | | 104.4 | 99.79 | 95.41 | 90.95 | 87.47 | 4.32 |
| Cumulative PV Benefits | | 104.4 | 204.19 | 299.60 | 390.55 | 478.02 | 482.34 |
| | | | | | | | |
| Cumulative PV Benefits+Costs | -50 | -10.85 | 26.19 | 61.72 | 95.47 | 128.27 | 132.59 |

Payback = Sometime in the first year of the system's operation

IRR = estimated lifetime benefits - estimated lifetime costs

estimated lifetime costs

= 132.59 = .379 or 37.9% over lifetime or 7.58% per year

342.75

NPV = 132.59 since >0, feasible

PV = 182.59

PI = 182.59 / 50 = 3.65 since >1, feasible