Unit 4:
Project Evaluation and Estimation

ER. RAJAN KARMACHARYA
DEPARTMENT OFEAEC
CSIT
ST. XAVIER'S COLLEGE, MAITIGHAR

Includes…

1. Cost Benefit Analysis, Cash flow forecasting, cost benefit evaluation technique, risk evaluation
2. Selection of an appropriate project : Choosing technologies, choice of process model
3. Structured methods, rapid application development, water fall model, V-process model, Spiral Model, Prototyping

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Cost Benefit Analysis

Decision making is about choices

- For an individual
  - They might rely on **intuition, a "gut feel" for the right choice**. They decide to do an analysis of the choices or it may be a combination of both of these.

- For a company
  - Being **concerned with the profit earning capacity and income flow**, they may undertake a cashflow analysis or a full financial appraisal of the project.

- For the Government
  - Decision making for governments is **much harder**. Not only are they expected to consider **the profitability** (or at least neutrality) **of the costing** but must also include **consideration of the social cost and benefits** of their choices. They are also expected to act within the **political environment to satisfy the political agenda set by the government of the day** and finally, must also comply with environmental considerations.

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Cost Benefit Analysis

- The most common way of carrying out **an economic assessment of a proposed information system** is by **comparing the expected costs** of development and operation of the system **with the benefits of having it in place**.
- CBA measures **costs and benefits to the community of adopting a particular course of action** e.g. Constructing a dam, by-pass etc.
- CBA is a **decision making device** for evaluating activities that are not priced by the market.
- CBA **attempts to simulate a market result** in areas where the market does not operate to establish prices

Cost Benefit Analysis : Issues

- Is the project worthwhile financially?
- Is it the best option?
- Should it be undertaken at all?

- *There might be more candidate projects that can be undertaken at any one time and in any case, projects will need to be prioritized so that any scarce resource may be allocated effectively.*

Steps in Cost Benefit Analysis

- **Identifying and estimating all of the costs and benefits of carrying out the project and operating the system**
  - These include the **developmental costs**, **the operating costs** and **the benefits** that are expected to accrue from the new system

- **Expressing these costs and benefits in common units**
  - We need to evaluate the **net benefit** (difference between the total benefit accruing from the system and the total cost of creating and operating it)
  - The fundamental common unit of measurement is **money.**

Types of Costs

Costs are relatively easy to quantify in approximate monetary terms.

- **Developmental Cost**
  - Include the **salaries** and **other employment costs** of the staff involved in the development project and all associated costs.

- **Setup Cost**
  - Include the costs of putting the system into place.
  - These consists mainly of the **costs of any new hardware** and **additional equipment**, but will also include **costs of file conversion**, **recruitment and staff training**.

- **Operational Cost**
  - Consists of the **costs of operating the system once it has been installed**.

Types of Benefits

Benefits are often quite difficult to quantify in approximate monetary terms.

- **Direct Benefits**
  - These **accrue directly** from the operation of the proposed system.
  - Eg. **Reduction in salary bills through the introduction of new computerized system**

- **Assessable Indirect Benefits**
  - These are generally secondary benefits such as **increased accuracy** through the introduction of a more user friendly screen design where we might be able to estimate the reduction in errors, and hence costs, of the proposed system.

- **Intangible Benefits**
  - These are generally longer term or benefits that are considered very difficult to quantify.
  - Eg. **Increased organizational transparency and responsibility**
  - **Improved customer response**

Exercise

Brightmouth College are considering the replacement of the existing payroll service operated by a third party, with a tailored, off the shelf computer based system. List some of the costs and benefits they might consider under each of the six headings above. For each cost or benefit, explain how, in principle, it might be measured in monetary terms.

Table F.1 *Costs and benefits for the Brightmouth College payroll system*

Category	*Cost/benefit*
Development costs	software purchase – software cost plus selection and purchasing cost
	project team employment costs
Setup costs	training include costs of trainers and operational staff time lost while training
	staff recruitment
	computer hardware and other equipment which might have a residual value at end of projected life
	accommodation – any new/refurbished accommodation and furniture required to house new system.
	initial systems supplies – purchase of stationery, disks and other consumables
Operational costs	operations staff – full employment costs
	stationery – purchase and storage*
	maintenance and standby – contract or estimation of occurrence costs
	accommodation including heating, power, insurance etc.*
Direct benefits	saving on local authority fees
	later payment – increase interest income through paying salaries later in the month
Indirect benefits	improved accuracy – assumes that direct costs of correcting current errors that should not occur with a computerized system are known (for example, takes one person one day per week) Note: benefit should measure what can be done with that additional time
Intangible benefits	improved management information – this should lead to improved decision making but it is very difficult to quantify the potential benefits

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Cash Flow Forecasting

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Cash Flow Forecasting

- A cash flow forecast indicates **when expenditure and income will take place**.

Typically products generate a negative cash flow during their development followed by a positive cash flow over their operating life. There might be decommission-ing costs at the end of a product's life

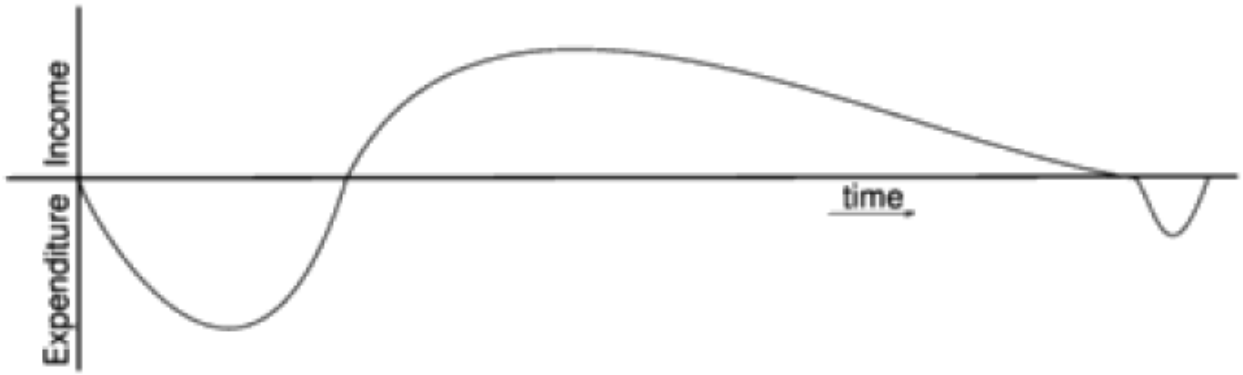

Figure *Typical product life cycle cash flow.*

- It is vital to have some forecast of when expenditure such as the payment of salaries and bank interest will take place and when any income is to be expected, such as payment on completion or possibly stage payments.
- **Accurate** cash flow **forecasting is not easy** as it generally **needs to be done early in the project's life cycle**.
- While estimating future cash flows, it is usual to **ignore the effects of inflation** as **this increases the uncertainty of forecasts**.

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Cash Flow Forecasting

Table A: *Four project cash flow projections – figures are end of year totals (£)*

Year	*Project 1*	*Project 2*	*Project 3*	*Project 4*
0	−100,000	−1,000,000	−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

Cash flows take place at the end of each year. The year 0 figure represents the initial investment made at the start of the project.

- The table illustrates cash flow forecasts for four projects. **In each case it is assumed that the cash flows take place at end of each year.**
- For short term projects or where candidate projects demonstrate significant seasonal cash flow patterns, it can be advisable to produce quarterly or even monthly cash flow forecasts

Cash Flow Forecasting

- *If We Could Get It Right*
  - Liquidity Management:

    Having Funds Available To Meet All Known and Unknown Commitment
  - Minimise Cost of Funds
  - Maximise Interest Earnings
  - Budgeting and Control
  - Currency Risk Management
  - Working Capital Management

Cost Benefit Evaluation Technique

Cost Benefit Evaluation Technique

- We would consider **proceeding with a project** only where the **benefits outweigh the cost**.
- **The timing** of costs and benefits (how many years???)
- Benefits **relative to the size** of investment.

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Exercise

- **Consider the project cash flow estimates for four projects shown below. Negative values represent expenditure and positive values income.**
- **Rank the four projects in order of financial desirability and make a note of your reasons for ranking them in that way.**

Table *Four project cash flow projections – figures are end of year totals (£)*

Year	*Project 1*	*Project 2*	*Project 3*	*Project 4*
0	−100,000	−1,000,000	−100,000	−120,000
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- **A PROBABLE ANSWER !!!**

Table *Four project cash flow projections – figures are end of year totals (£)*

Year	*Project 1*	*Project 2*	*Project 3*	*Project 4*
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Net profit	50,000	100,000	50,000	75,000

- **One way of consideration would be**
- Project 2 requires a very large investment compared to its gain – in fact we could obtain 100,000 by undertaking both projects 1 and 3 for a lower cost than project 2. Both projects 1 and 4 produce the bulk of their incomes relatively late in their lives compared with project 3, which produces a steady income over its life.

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Cost Benefit Evaluation Technique : **Net Profit**

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Cost Benefit Evaluation Technique : Net Profit

- The net profit of a project is the **difference between the total cost and the total income** over the life of the project.

Table *Four project cash flow projections – figures are end of year totals (£)*

Year	*Project 1*	*Project 2*	*Project 3*	*Project 4*
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Net profit	50,000	100,000	50,000	75,000

- Project 2 shows the greatest net profit but at the expense of large investment
- If we had £1m to invest, we might undertake all of the other three projects and obtain an even greater net profit. **(A Wiser Idea to Avail)**
- The simple **net profit takes no account of the timing of the cash flows**.
- Project 1 and 3 each have a net profit of 50,000 and would be equally preferable according to this selection criterion

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Cost Benefit Evaluation Technique : Net Profit

- The bulk of income occurs late in the life of project 1 whereas project 3 returns a steady income throughout its life.
- Having to wait for a return has the disadvantage that the investment must be funded for longer.
- Added to the fact that, other things being equal, estimates in the more distant future are less reliable than short term estimates and we can see that the two projects are not equally preferable.

Table *Four project cash flow projections – figures are end of year totals (£)*

Year	*Project 1*	*Project 2*	*Project 3*	*Project 4*
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Cost Benefit Evaluation Technique : **Pay Back Period**

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Cost Benefit Evaluation Technique : Pay Back Period

- The payback period **is the time taken to break even or pay back the initial investment.**
- Normally, the project with the shortest payback period will be chosen on the basis that an organization will wish to minimize the time that a project is in debt.
- The **advantage** of the payback period is that **it is simple to calculate** and is **not particularly sensitive to small forecasting errors**.
- Its **disadvantage** as a selection technique is that **it ignores the overall profitability of the project** – in fact, it totally ignores any income or expenditure once the project has broken even.
- Thus the fact that projects 2 and 4 are, overall, more profitable than project 3, **they are ignored**.

Consider the four project cash flows given in the table above and calculate the payback period for each of them.

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Cost Benefit Evaluation Technique : Pay Back Period

- The payback periods for each of the projects will occur during the year indicated:
  - **Project 1 year 5**
  - **Project 2 year 5**
  - **Project 3 year 4**
  - **Project 4 year 4**
- We would therefore favour project 3 or 4 over the other two.

Table *Four project cash flow projections – figures are end of year totals (£)*

Year	*Project 1*	*Project 2*	*Project 3*	*Project 4*
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Net profit	50,000	100,000	50,000	75,000

Cost Benefit Evaluation Technique : **Return on Investment**

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Cost Benefit Evaluation Technique : Return on Investment

- The ROI also known as accounting rate of return (ARR) provides **a way of comparing the net profitability to the investment required**.
- A straight forward common formula for calculation is

$$ROI = \frac{AverageAnnualprofit}{TotalInvestment} \times 100$$

Calculating the ROI for project 1, the net profit is 50,000 and the total investment is 100,000. The return on investment is therefore calculated as

$$ROI = \frac{10{,}000}{100{,}000} \times 100 = 10\%$$

On the basis of ROI criterion, determine which project is the most worthwhile listed in Table A above.

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Cost Benefit Evaluation Technique : **Return on Investment**

- **The ROI for each project is :**
  - Project 1: 10%
  - Project 2: 2%
  - Project 3: 10%
  - Project 4: 12.5%
  - Project 4 therefore stands out as being the most beneficial as it earns the highest return

Cost Benefit Evaluation Technique : Return on Investment

- The ROI **provides a simple, easy to calculate measure of return on capital** and is therefore quite popular.
- **Two Severe Drawbacks**
  - **Takes no account of the timing of the cash flows**
  - **It is tempting to compare the rate of return with current interest rates. (no compound interest calculated)**

Cost Benefit Evaluation Technique : **Net Present Value**

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Cost Benefit Evaluation Technique : Net Present Value

- The Net Present Value (NPV) **take into account the profitability of a project and the timing of the cash flows** that are produced.
- It does so by discounting future cash flows by a percentage known as discount rate.
- ***Based on the view that receiving Rs 100 today is better than having to wait until next year as the Rs 100 next year is worth less than Rs 100 now.***
- the present value of any future cash flow may be obtained by using the following formula.

$$presentValue = \frac{ValueInYearT}{(1+r)^T} \qquad DiscountFactor = \frac{1}{(1+r)^T}$$

- Where
- r = discount rate expressedd as a decimal value
- T = is the number of years into the future that the cash flow occurs.

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Cost Benefit Evaluation Technique : Net Present Value

- **Assuming a 10% discount rate, the NPV for project 1 would be calculated as in the following table. Using a 10% discount rate, calculate the net present values for projects 2,3 and 4 and decide which, on the basis of this, is the most beneficial to pursue.**

Table *Applying the discount factors to project 1*

Year	*Project 1 cash flow (£)*	*Discount factor @ 10%*	*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
Net Profit:	£50,000		NPV: £618

$$DiscountFactor = \frac{1}{(1+r)^T}$$

The net present value for each of the projects is calculated in the following table. On the basis of the net present value, **project 4 clearly provides the greatest return** and **project 2 is clearly not worth considering.**

Table *Calculating the net present value of projects 2, 3 and 4*

Year	*Discount factor*	*Discounted cash flow (£)*		
		Project 2	*Project 3*	*Project 4*
0	1.0000	−1,000,000	−100,000	−120,000
1	0.9091	181,820	27,273	27,273
2	0.8264	165,280	24,792	24,792
3	0.7513	150,260	22,539	22,539
4	0.6830	136,600	20,490	20,490
5	0.6209	186,270	18,627	46,568
NPV		−179,770	13,721	21,662

Cost Benefit Evaluation Technique : Net Present Value

- **The main DIFFICULTY**
  - **Selecting an appropriate discount rate.**
  - **Some organizations have a standard rate but where this is not the case, the discount rate should be chosen to reflect available interest rates plus some premium to reflect the fact that software projects are inherently more risky than lending money to a bank.**

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Cost Benefit Evaluation Technique : Net Present Value

- **Calculate the NPV for each of the projects A,B adn C shown in the table below using each of the discount rates 8%, 10% and 12 %.**
- **For each of the discount rates, decide which is the best project. What can vou conclude from this result?**

Year	*Cash flow values (£)*		
	Project A	*Project B*	*Project C*
0	–8,000	–8,000	–10,000
1	4,000	1,000	2,000
2	4,000	2,000	2,000
3	2,000	4,000	6,000
4	1,000	3,000	2,000
5	500	9,000	2,000
6	500	–6,000	2,000
Net Profit	£ 4,000	£ 5,000	£ 6,000

Table F.3 *The effect on net present value of varying the discount rate*

Year	*Cash flow values (£)*		
	Project A	*Project B*	*Project C*
0	–8,000	–8,000	–10,000
1	4,000	1,000	2,000
2	4,000	2,000	2,000
3	2,000	4,000	6,000
4	1,000	3,000	2,000
5	500	9,000	2,000
6	500	–6,000	2,000
Net Profit	£ 4,000	£ 5,000	£ 6,000
NPV @ 8%	£ 2,111	£ 2,365	**£ 2,421**
NPV @ 10%	£ 1,720	**£ 1,818**	£ 1,716
NPV @ 12%	**£ 1,356**	£ 1,308	£ 1,070

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Cost Benefit Evaluation Technique : **Internal Rate of return**

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Cost Benefit Evaluation Technique : **Internal Rate of return**

- One disadvantage of NPV is, it might not be directly comparable with earnings from other investments or the costs of borrowing capital. Such costs are usually quoted as a percentage of interest rate.
- The internal rate of return attempts to provide a profitability measure as a percentage return that is directly comparable with interest rates.
- Thus, a project that showed estimated IRR of 10% would be worthwhile f the capital could be borrowed for less than 10% or of the capital could not be invested elsewhere for a return greater than 10%
- The IRR is calculated as that percentage discount rate that would produce an NPV of zero.
- It is most easily calculated using a spreadsheet that provides functions for calculating IRR

Risk Evaluation

Risk Evaluation

- Every project involves risk of some form.
- When accessing and planning a project, we are concerned with the risk of the project's not meeting its objectives.
- **Here**
- Concerned with taking risk into account when deciding **whether to proceed with a proposed project.**

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Risk Evaluation : Risk identification and Ranking

- In any project evaluation we should attempt to identify the risks and quantify their potential effects.
- One common approach >> **construct a project risk matrix** utilizing a checklist of possible risks and to classify each risk according to **its relative importance and likelihood.**
- **Importance and likelihood need to be separately accessed** >>>>>>
- we might be less concerned with something that, although serious, is very unlikely to occur than with something less serious that is almost certain.

A fragment of a basic project risk matrix

Risk	*Importance*	*Likelihood*
Software never completed or delivered	H	—
Project cancelled after design stage	H	—
Software delivered late	M	M
Development budget exceeded ≤ 20%	L	M
Development budget exceeded > 20%	M	L
Maintenance costs higher than estimated	L	L
Response time targets not met	L	H

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Risk Evaluation : Risk and Net Present Value

- Where a project is relatively risky it is common practice to **use a higher discount rate to calculate NPV**.
- This addition or risk premium, might for example, be an additional 2% for a reasonably safe project or 5% for a fairly risky one.
- **Projects may be categorized as high, medium or low risk using a scoring method** and risk premiums designated for each category.

Selection of an appropriate project approach

Choosing Technologies

- **An outcome of project analysis** will be the selection of the **most appropriate methodologies and technologies**
- Methodologies include techniques like various flavours of object-oriented development or SSADM
- The chosen technology will influence the following aspects of a project.
  - **The training requirement for development staff;**
  - **The types of staff to be recruited;**
  - **The development environment – both hardware and software;**
  - **System maintenance arrangement**

Choosing Technologies : Analyze Project Characteristics

- **Is a data oriented or process oriented system to be implemented?**
- **Will the software that is to be produced be a general package or application specific?**
- **Is the system to be implemented of a particular type for which specific tools have been developed?**
- **Is the system to be created safety critical?**
- **What is the nature of the hardware/software environment in which the system will operate?**

Choosing Technologies : Analyze Project Characteristics

How would you categorize each of the following systems according to the classification above?

(a) a payroll system
(b) a system to control a bottling plant
(c) a system that holds details of the plans of plant used by a water company to supply water to consumers
(d) a software application to support project managers
(e) a system used by lawyers to get hold of case law relating to company taxation.

- **A payroll system is a data oriented or information system that is application specific.**
- **The bottling plant system is an industrial system which contains embedded software.**
- **It is an IS that will make heavy use of computer graphics. The plant itself might use control software which might be safety critical.**
- **Project management software tools are often categorized as general packages. There would be a considerable information systems element to them.**
- **This could be an information retrieval package that is a general package. It is also a strong candidate for a knowledge based system.**

Choosing Technologies : Analyze high level project risks

- **Uncertainty >>>> the greater the uncertainties at the beginning of the project, the greater the risk that the project will be unsuccessful.**
- **Product Uncertainty>>>>**
  - **How well the requirements are understood?**
  - **The users themselves could be uncertain about what a proposed Information System is to do.**
- **Process Uncertainty>>>>**
  - **It might be that the project under consideration is the first where an organization has tried to use a method that is new to them.**
  - **Any changes in the way that the systems are developed is going to introduce uncertainty.**
- **Resource Uncertainty>>>>**
  - **Main issue----unavailability of staff of the right ability and experience.**
  - **The larger the number of resources need or the longer the duration of the project, the more inherently risky it is likely to be.**

Choice of process model

- Process >> the system in action
- In order to achieve an outcome, the system will have to execute one or more activities: that is its process
- During the development of computer based information system, **a number of interrelated activities have to be undertaken to create a final product.**
- These activities called process models can be organized in different ways.

St. Xavier's College

Department Of Computer Science and Information Technology

Any Queries?