JEPPIAAR INSTITUTE OF TECHNOLOGY

"Self-Belief | Self Discipline | Self Respect"

DEPARTMENT

OF

COMPUTER SCIENCE AND ENGINEERING

LECTURE NOTES

IT8075 – Software Project Management

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UNIT-I Project Evaluation and project planning

Importance of SPM - Activities Methodologies - Categorization of software projects - Setting objectives - Management principles - Management Control - project portfolio Management - Cost - benefit evaluation technology - Risk Evaluation - Strategic program Management - Stepwise Project planning

06, 12, 21, 27, 32, 35, 41, 46, 47, 50,

Importance of Software project Management

Art & science of planning & leading

SPM is the art and science of planning and leading software projects. It is a sub-discipline of project Management in which s/w projects are planned, implemented and Controlled.

planned, impl & controlled

Why is s/w project Management important?

Direct teams that solve problems and develop new ideas in info. & comm. Tech industry

* Large amount of money are spent on ICT. in info. & comm. Tech industry

eg: Uk goverment in 2002-03 spent $2-3 billions on contracts, for ICT and only $1-4 billions on road building

* The biggest department spender was the department for work and pensions, who spent over $800 million on ICT.

Telecomm., media, IT (s/wt h/w develop)

* Mismanagement of ICT projects means that there is less to spend on good things such as hospitals

* Unfortunately, projects are not always successful. In a report published in 2003, Standardize group only a third of ICT projects are successful. 82% were late and 43% exceeded their budget.

* The reason for these project short comings is often the management projects is "poor project Management"

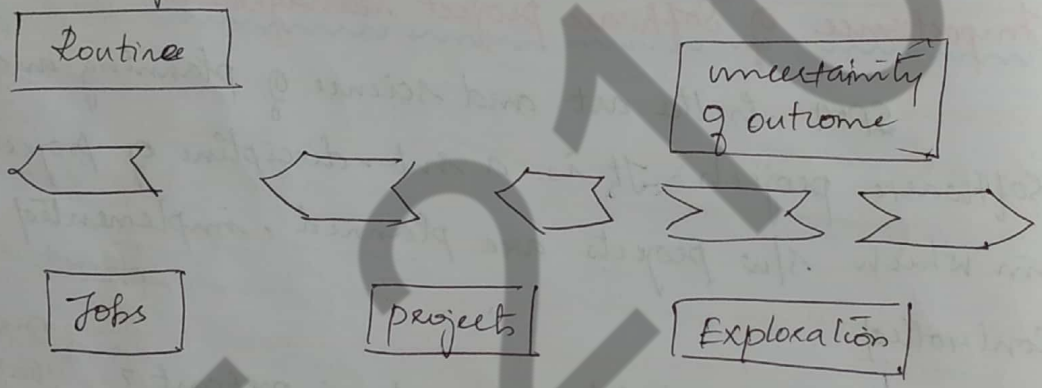
What is a project?

Some dictionary definitions

"A specific plan or design"
"A planned undertaking"
"planned activity"
"A large undertaking"
eg: public work scheme

program management is often used to coordinate activities on concurrent jobs

Jobs Vs Projects:



'Jobs': Repetition of very well defined and well understood tasks with very little (doubt) uncertainity

'Exploration' - eg: finding a cure for cancer: The outcome is very (doubt) uncertain

Projects - in the middle (time span, specialism, several phases)

The following characteristics distinguish projects:

*) Non-routine tasks are involved
*) Planning is required
*) Specific objectives are to be met or a specified product is to be created
*) The project has a predetermined time span
*) Work is carried out for someone other than yourself
*) Work involves several specialism

*) people are formed into a temporary work group to carry out the task

*) Work is carried out in several phases

People are formed into a temporary work group.

*) The resources that are available for use on the project are constrained

*) The project is large or complex

The more any of these facts apply to a task when the task is difficult.

Software projects Vs Other types of project

Some characteristics of s/w projects which make them particularly difficult

Invisibility - s/w project management can be seen as the process of making the invisible visible

Complexity - s/w products contain more complexity than other engineered artifacts / set of some activities

Conformity - Materials Vs internal communication

Flexibility - s/w is easy to change is seen as a strength

Contract management and technical project Management

projects can be

In-house - clients and developers are employed by the same Organization

Out-sourced - clients and developers employed by different Organizations

'project-manager' could be:

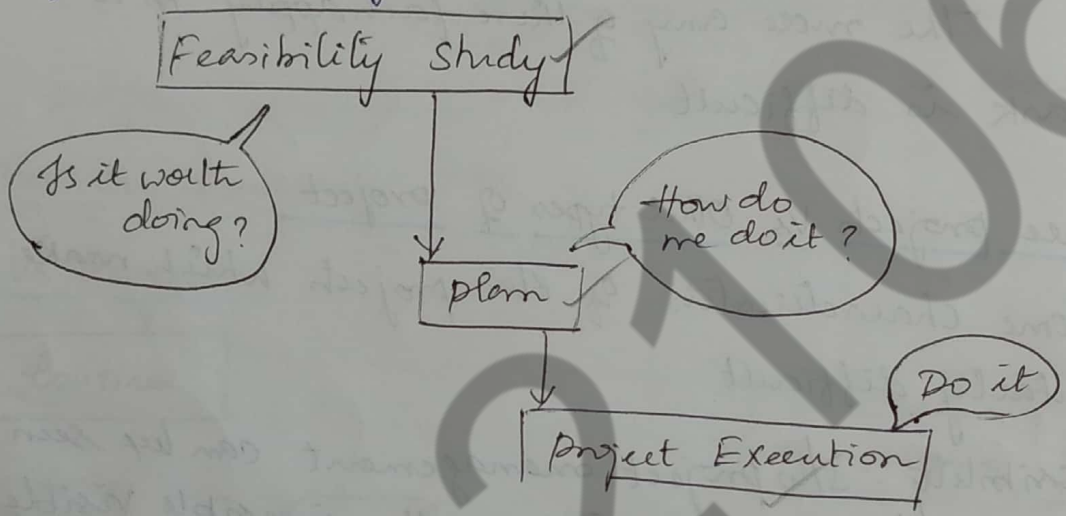
- a 'contract manager' in the client organization
- a technical project manager in the supplier/services Organization

Activities Methodologies

Activities covered by Software Project Management

A software project is not only concerned with the actual writing of s/w. Some other activities associated with s/w.

Usually there are 3 successive processes that bring a new system into being.

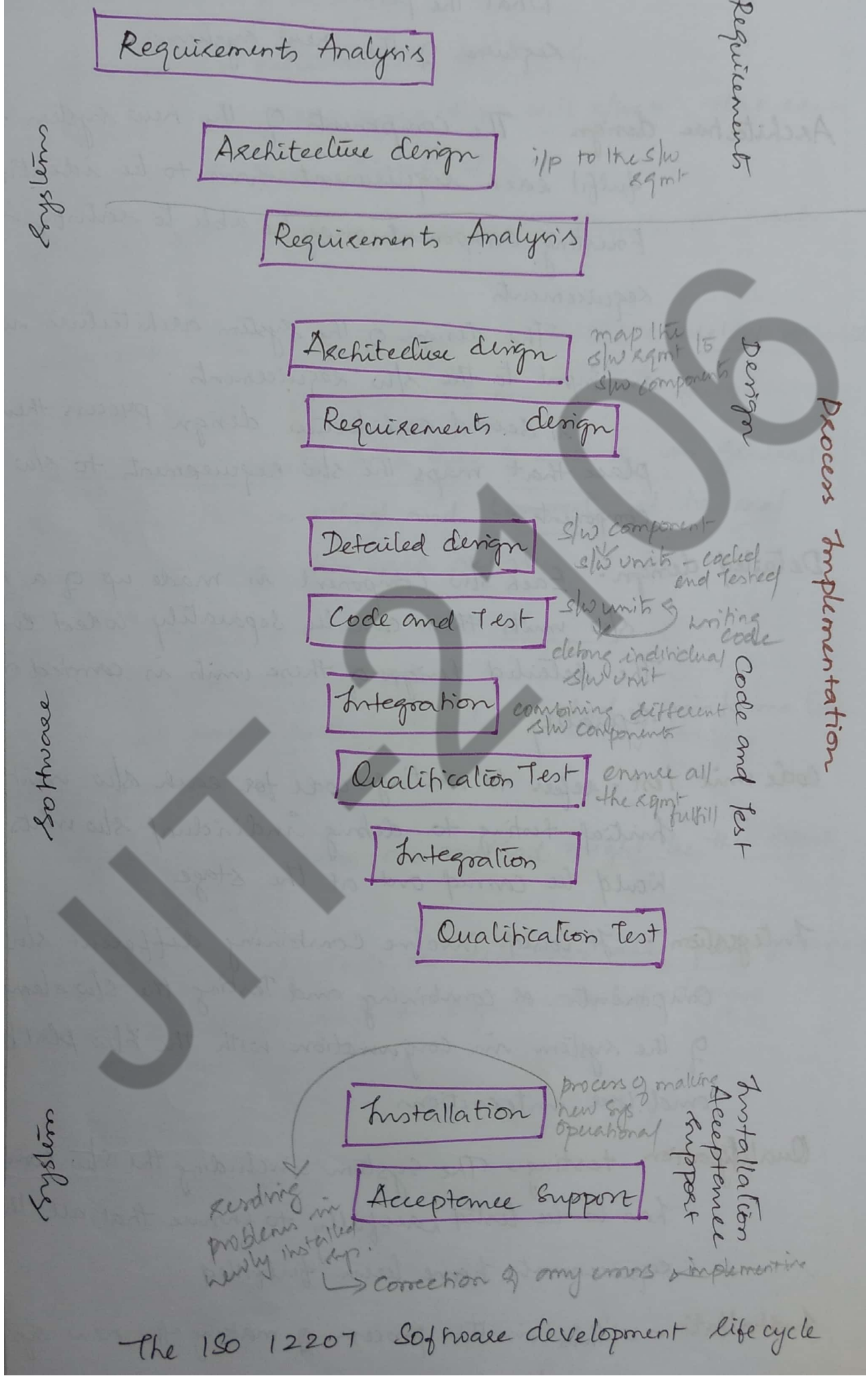


1. **The Feasibility Study** - Information is gathered about the requirements of the proposed Application

2. **planning** - Based on the feasibility study, to create an outline plan for the whole project and a detailed one for the first stage.

3. **project Execution** - The Execution of a project often contains design and Implementation sub-phases

The following diagram shows the typical sequence of software development activities recommended in the international standard ISO 12207. Some activities are concerned with the system while others relate to software



The ISO 12207 Software development life cycle

Requirements Analysis - Starts with requirements elicitation (or) requirements gathering which establishes what the potential users and their managers require of the new system.

Architecture design - The components of the new system that fulfil each requirement have to be identified. Existing components may be able to satisfy some requirements.

The design of the system architecture is thus an input to the s/w requirements.

A second architecture design process then takes place that maps the s/w requirements to s/w components.

Detailed design - Each s/w component is made up of a no. of s/w units that can be separately coded and tested. The detailed design of these units is carried out separately.

Code unit test - refers to writing code for each s/w unit. Initial testing to debug individual s/w units would be carried out at the stage

Integration - It could involve combining different s/w components, or combining and Testing the s/w element of the system in conjunction with the h/w platform and user interactions.

Qualification testing - The system including the s/w components has to be tested carefully to ensure that all the requirements have been fulfilled.

Installation - This is the process of making the new system operational.

Acceptance support - This is the resolving of problems with the newly installed system, including the correction of any errors and implementing agreed extensions and improvements

plans, Methods and Methodologies

*) A plan for an activity must be based on some idea of a method of work.

→ Analyze the requirements for the s/w.

→ Device & write test cases that will check, that each requirements has been satisfied

→ Create test scripts and expected results for each test case.

→ Compare the actual results and the expected results and identify discrepancies. (inconsistency btw facts, difference)

→ A method relates to a type of activity in general, a plan takes that method and converts it to real activities, identify for each activity:

- it start and end dates
- who will carry it out
- what tools and materials including information will be needed.

→ The output from one method might be the input, to another.

→ Groups of methods or techniques are often grouped into methodologies such as object-oriented design

Categoraization of Software projects

Compulsary Vs Voluntary users

* In workplaces there are systems that staff have to use if they want to do something. Such as recording a sale.

* However, use of a system is increasingly voluntary, as in the case of computer games.

Information Systems Vs Embedded Systems

↓ Which enable staff to carry out office processes
eg. Stock control system

↓ - which control machines.
eg. System might control the air conditioning equipment in a building.

Out Sourced projects :

While developing a large project, sometimes, it makes good comonercial sense for a company to outsource some parts of its work to other companies.

Objective - driven development:

- Projects may be distinguished by whether their aim is to produce a 'product' or to meet certain 'objectives'.

* A project might be to create a product, the details of which have been specified by the client. The client has the responsibility for testing the project.

* The project requirement might be met certain objectives which could meet in a no. of ways. An organization might have a problem and ask a specialist to recommend a solution.

- Many s/w projects have 2 stages.

1. An objective - driven project resulting in recommendations. It identify the need for a new system.
2. A project actually to create the s/w project.

Stake holders :

- There are people who have a stake or interest in the project. Stakeholders can be categorized as:

* Internal to the project team → they will be under the direct managerial control of the project leader.

* External to the project team → within the same organization → for eg. the project leader might need the assistance of the users to carry out systems testing.

* External to both the project team and the organization → External stakeholders may be customers (or users) who will benefit from the system that the project implements. The relationship here is usually based on a contract.

- Stakeholders are the people involved in or affected by the project activities.

- Stakeholders include :

* The project sponsor and project team
* Support staff
* Customers
* Users
* Suppliers.

Setting objectives

- The objectives should define what the project team must achieve for project success.
- Objectives focus on the desired outcomes of the project rather than the tasks within it - they are the 'post-conditions' of the project.
- Informally the objectives could be written as a set of statements following the opening words "the project will be a success if ...."
- 'project steering committee' (or project board or project management board) with overall responsibility for setting, monitoring and modifying objectives.

Sub-objectives and goals:

- Defining sub-objectives requires assumptions about how the main objective is to be achieved.
- The mnemonic SMART is sometimes used to describe well-defined objectives:

* **Specific** → Effective objectives are concrete and well defined.
* **Measurable** → Ideally there should be measures of effectiveness which tell us how successful the project has been.
* **Achievable** → It must be within the power of the individual or group to achieve the objective.
* **Relevant** → The objective must be relevant to the true purpose of the project.
* **Time constrained** → There should be a defined point in time by which the objective should have been achieved.

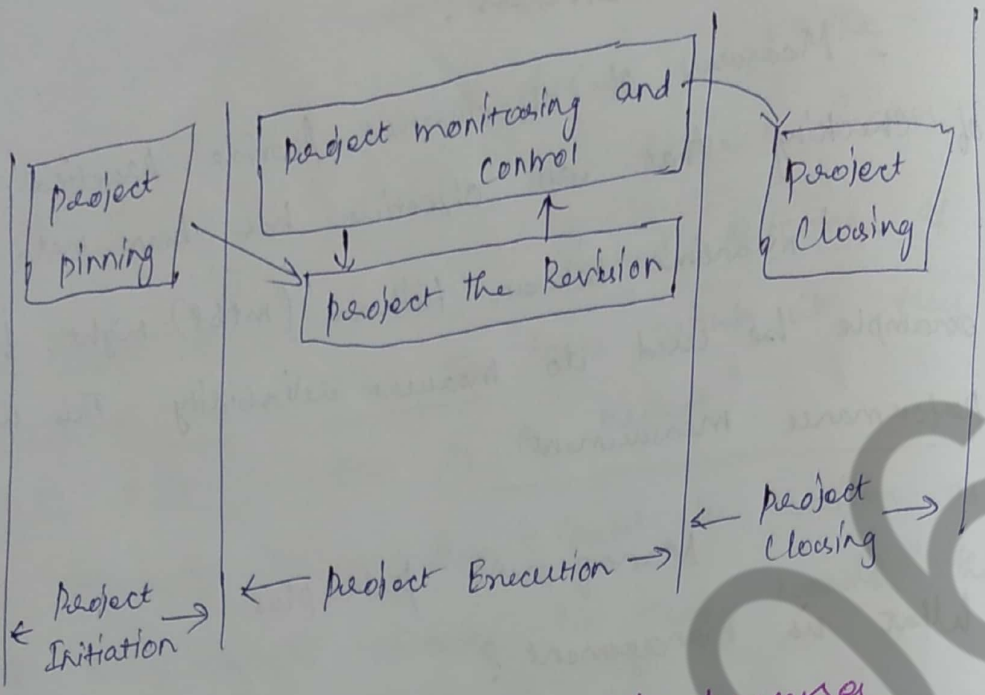
Measures of effectiveness:

- Measures of effectiveness provide practical methods of checking that an objective has been met.
- 'meantime between failures' (mtbf) might, for example be used to measure reliability. This is a performance measurement.

Management principles

What is management?

- Management can be defined as all activities and tasks undertaken by one or more persons for the purpose of planning and controlling the activities of others in order to achieve objectives or complete an activity that could not be achieved by others acting independently.
- Management involves the following activities.
  - # planning → deciding what is to be done
  - # organizing → making arrangements.
  - # staffing → selecting the right people for the job.
  - # directing → giving instructions.
  - # monitoring → checking on progress.
  - # controlling → taking action to remedy hold-ups.
  - # innovating → coming up with new solutions.
  - # representing → liasing with clients, users, developers, suppliers and other stakeholders.
- Much of the project manager's time is spent on only three of the 8 identified activities, viz, project planning, monitoring and control
- The time period during which these activities are carried out is indicated in the following figure.



Principal Project management processes

* Project Planning - is an important responsibility of the project manager.
  - It carried out before development starts.
  - important activities:

* Estimation → The following project attributes are estimated,
  1. Cost → how much is it going to cost to complete the project?
  2. Duration → How long is it going to take to complete the project?
  3. Effort → How much effort would be necessary for completing the project?

* Scheduling → Based on estimations of effort and duration, the schedules for manpower and other resources are developed.

* Staffing → Staff organization and staffing plans are made

* Risk management → This activity includes risk identification, analysis and abatement planning.

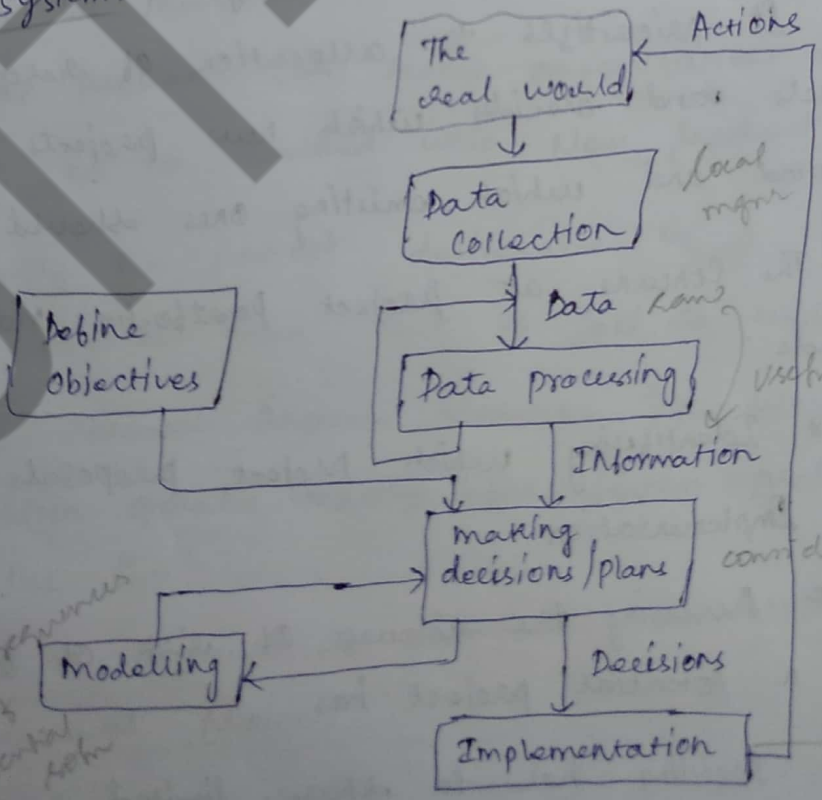
* miscellaneous plans → This includes making several other plans such as quality assurance plan, configuration management plan, etc.

Project monitoring and control → These activities are undertaken after the initiation of development activities.

- The aim of these activities is to ensure that the software development proceeds as planned.

Management control.

- Management, in general, involves setting objectives for a system and then monitoring the performance of the system.



The Project control cycle

- This will involve the local managers in data collection.

- Data processing will be needed to transform this raw data into useful information.

Data → eg. 6000 documents processed at location X.

Information → eg. Productivity is 100 documents a day.

- making decisions - Consider what to do.
- modelling - the consequences of potential solution.
- Implementation - Implementing the decision.

Project portfolio management

- Portfolio Project management provides an overview of all the Projects that an organization is undertaking or is considering.

- It prioritizes the allocation of resources to projects and decides which new projects should be accepted and which existing ones should be dropped.

- The concerns of Project portfolio management include:

* Identifying which project proposals are worth Implementation.
* Assessing the amount of risk of failure that a potential project has.
* Deciding how to share limited resources, including staff time and finance between projects.

* Being aware of the dependencies between projects, when several projects needs to be completed.
* Ensuring that projects do not duplicate work.
* Ensuring that necessary developments have not been inadvertently been missed.

- The 3 key aspects of project portfolio management are

1. portfolio definition
2. Portfolio Management
3. Portfolio optimization

1. project portfolio definition

- An organization should record in a single repository details of all current projects. A decision will be needed about whether projects of all types are to be included.
- One problem for many organizations is that projects can be divided into New product Developments (NPD).
- Mostly the project deliverable is a product, such as a computer game, that is sold to customers.
- The renewal projects improves the way an organization operates, mostly info. system projects are often like this.
- It is difficult to distinguish b/w NPD projects and renewal projects.
- Information system could be used to provide a customer service such as recording the details of people buying a new insurance product.

- NPD projects are often more frequent in organizations which have a continuous development of new goods and services.

- Renewal projects may be less frequent and thus inherently more risky as there is less experience of these types of project.

2. Project Portfolio management:

- once the portfolio has been established, more detailed costings of projects can be recorded.

- Actual performance of project on these Performance Indicators can then be tracked.

- This information can be the basis for the more rigorous screening of new projects.

3. Project Portfolio optimization:

- The performance of the portfolio can be tracked by high level managers on a regular basis.

- A better balance of project may be achieved. Some project potentially be very profitable but could also be risky.

- In the case of an e-commerce site, for example. Sales may not be as great as hoped because established competitors reduce prices.

- Other projects could have more benefits, such as those cutting costs by automatically process, but have fewer risks.

Some problems with project portfolio management:

- Problem in sharing resources b/w projects.
- The official portfolio may not accurately reflect organizational activity if some projects are excluded.
- The 'below the line' projects could in fact consume substained staff effort and bleed away effort from the official projects.
- Instead of allocating full time staff to a project, they may effectively be part time staffs as they have routine works
- This is also applicable to users, developers who may on occasion be called away from project work to deal with support tasks.

Advantages of project portfolio management

- It allows small adhoc tasks to be done.
- Quick fixes to systems to deal with externally imposed changes is carried out.
- The work burden on higher management is reduced.
- Developers may find these small tasks rewarding.
- Developing with small requests is an easy way to keep users happy.
- The first line manager is allowed to make some judgement in accepting planned works, while allocating resources to a project.

Cost - benefit evaluation technology.

- It is very important to known the various evaluation methods of projects
- One of the technique to evaluate the project is cost benefit analysis.

Evaluation of Individual projects :

The feasibility of an individual project can be evaluated using many methods.

1. Technical Assessment
2. Cost - Benefit Analysis
3. Cash flow forecasting

1. Technical Assessment

- Technical assessment of a proposal system consists of evaluating whether the required functionality can be achieved with current affordable technologies.
- organization policy, aimed at providing a consistent b/w s/w infrastructure is likely to limit the technical solutions considered.
- The cost of the technology adopted must be taken into account in the cost benefit analysis.

2. Cost - benefit analysis :

- The estimate benefits will exceed the estimated cost, if it necessary to decide if the proposed project is the best of several options.
- The project manager should ensure that the most valuable projects should get most resources.
- The cost benefit analysis done in 2 steps :

1. Identifying all the costs and benefits
2. Expressing these costs and benefits in common units.

1. Identifying all the costs of benefits of carrying out the project and operating the delivered application

- These includes the development costs, the operating costs and benefits expected from the new system.

- Where the proposed system is a replacement, these estimates should reflect the change in cost and benefits due to the new system.

- A new sales order processing system could only claim to benefit an organization by the increase in sales due to the use of the new system.

2. Expressing the costs and benefits in common units

- Each cost and benefit and the net benefit is expressed in money.

Net benefit / Profit = Benefit - Cost.

- Most direct costs are easy to quantify in monetary terms and categorized as.

* Development costs → This includes the development staff costs

* Setup costs → Consisting of the costs of putting the system into place, mainly of any new hardware but also including the costs of file conversion, recruitment and staff training.

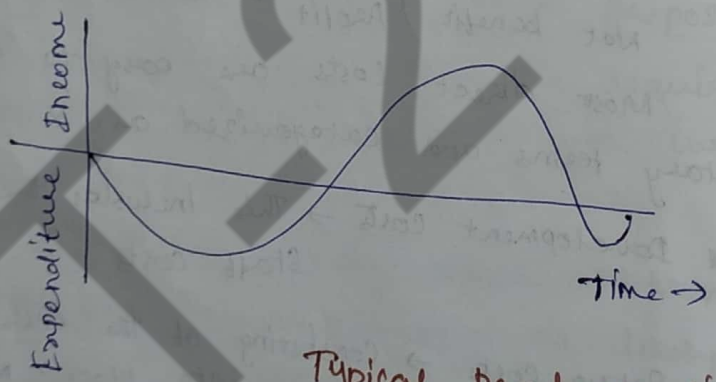
* Operational costs → This relates to operating the system after installation

3. Cash Flow Forecasting.

- It is important to estimate the overall costs and benefits of a project.

- The cashflow forecast is done to perform this analysis, which indicates when expenditure and income will take place.

- During a project's development, there is a need to spend money, such as staff wages.
- Such expenditure cannot wait until income is received.
- We need to know that we can find this development expenditure either from the company's own resources or by borrowing.
- A forecast is needed of when expenditure, such as the payment of salaries and any other income are to be expected.
- Accurate cash flow forecasting is difficult, as it is done early in the project's lifecycle and many items to be estimated might be some years in the future.



Typical product life cycle cash flow

Cost- benefit Evaluation Techniques:

- While carrying out the cost benefit evaluation, it is important to consider the following terminologies:
  * Net profile
  * Payback period
  * Return On Investment (ROI)
  * Net Present Value
  * Internal rate of return.

Consider the Cash below forecasts for 4 projects in the table given below.

Year	project-1	project-2	project-3	project-4
0	-1,00,000	-10,00,000	-100,000	-120000
1	10,000	200000	30000	30000
2	10,000	200000	30000	30000
3	10,000	200000	30000	30000
4	20000	200000	30000	30000
5	1000000	3000000	75000	50000
Net Profit	50000	100000	50000	75000
	Cashflow projections for 4 projects			

- In each case it is assumed that the cash flows take place at the end of each year.

For short term projects or where there are significant seasonal cashflow patterns, quarterly or even monthly cash flow forecasts could be appropriate

1. Net profit:

- It is the difference between the total costs and the total income over the life of the project.
- Cash flows take place at the end of each year. The year 0 represents the initial investment made at the start of the project as the above table.
- In the above table, Negative values represent expenditure and positive values represent income.

Consider project-1 in the above table.

The initial investment = Rs. 100000

The total income (1 to 5 yrs) = Rs. 1,50,000

Hence the Net Profit = Total income - Total costs

= 1,50,000 - 100000

∴ Net profit = 50,000

2. Payback period

- The payback period is the time taken to break even or payback 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 ~~probably~~ particularly sensitive to small forecasting errors.
- The disadvantage is that it ignores the overall profitability of the project.
- Even though the projects 2 and 4 in the above table are more profitable than project-3 since their payback period is more may be ignored / rejected.
- The payback period of project-3 is by 4th year, whereas for project-2 and 4 are by 5th year.

3. Return on Investment (ROI)

- It is also known as the Accounting Rate of Return (ARR)
- It provides a way of comparing the net profitability to the investment required.
- Formula is $ROI = \frac{\text{average annual profit}}{\text{Total Investment}} \times 100$
- The ROI provides a simple, easy to calculate Return on Capital. Calculating the ROI for project-1, the net profit is Rs. 50000/- and the total investment is Rs. 100000/-.

$$\therefore ROI = \frac{\text{average amount profit}}{\text{total investment}} \times 100$$

$$= \frac{50000/5}{100000} \times 100$$

$$\boxed{ROI = 10\%}$$

- disadvantages of ROI:

* it does not consider the timing of the cash flows.
* it doesn't have any relationship to the interest rates offered or charged by banks.

4. Net Present Value (NPV)

- It is project evaluation technique that takes into account the profitability of a project and the timing of the cash flows that are produced.
- This is based on the view that receiving Rs. 100 today is better than having to wait until next year to receive it.
- We could invest the Rs. 100 in a bank today and have Rs. 100 plus the interest in a year's time.
- NPV and IRR are collectively known as discounted cash flow (DCF) techniques.
- The present value of any future cash flow may be obtained by applying the following formula.

$$\text{Present Values} = \frac{\text{Value in Year}(t)}{(1+r)^t}$$

where, r is the discount rate expressed as a decimal value. t is the no. of years into the future that the cash flow occurs.

$$\text{Discount Rate} = \frac{1}{(1+r)^r}$$

where,

$r \rightarrow$ Discount rate
$t \rightarrow$ No. of years

5. Internal Rate of Return (IRR)

- it attempts to provide a profitability measure as a percentage return that is directly comparable with interest rates.

- It a project that showed an estimated IRR of 10.1. would be worthwhile if the capital could be borrowed for less than 10.1. or if the capital could not be invested elsewhere for a return greater than 10.1..

- The IRR is calculated as that percentage discount rate would produce an NPV of zero.

- it is most easily calculated using a Spreadsheet or other Computer program that provides functions for calculating the IRR.

- One deficiency of the IRR is that it does not indicate the absolute size of the return.

- A project with an NPV of Rs. 100000 and an IRR of 15.1. can be more attractive than one with an NPV of Rs 10.000 and an IRR of 18.1. The return on capital is lower but the net benefits are greater.

Risk Evaluation

- Almost every project may involve risk. Project risks prevent the project from being completed successfully.

- The business risks are sometimes not profitable even through the product is delivered successfully and it is different from project risks.

- The evaluation involves the following steps:

1. Risk Identification and ranking
2. Risk and Net present value (NPV)
3. Cost benefit analysis
4. Risk Profit analysis
5. Using decision trees

Risk Identification and Ranking

In any project evaluation, we should identify the risks and quantify their effects.

One approach is to construct a project risk matrix utilizing a checklist of possible risks and classifying risks according to their relative importance and likelihood.

Importance and likelihood need to be separately accessed.

We may ignore a serious risk which is very unlikely to occur.

We cannot ignore something that is less serious risk, but that is almost certain to occur.

Projects risk matrix may be used as a way of evaluating projects or as a means of identifying and ranking the risks for a specific project.

The risks can be classified as High(H), medium(M) low(L) or exceedingly unlikely(–)

Consider the basic project risk matrix with some busines risk for a project

Business Risk matrix for an e-commerce applⁿ

Risk	Importance	likelihood
Client reject proposed look and feel of site	H	–
Competitors undercut prices	H	M
Warehouse unable to deal with increased demand	M	L
Online payment has security problems	M	M
Maintenance costs higher than estimated	L	L
Purchasers	M	M

Strategic programme Management

* A group of projects that are managed in a coordinated way to gain benefits that would not be possible were the projects to be managed independently.

Business cycle programmes
Strategic programmes
Infrastructure programmes
Research & Development programmes
Innovative partnerships

Programme manager	Project Manager
* Deals with many simultaneous projects	Deals with only one project at a time
* personals relationship with skilled resources	Impersonal relationship with resource type.
* Need to maximize utilization of resources	Need to minimize demand for resources
* project tend to be similar	Projects tend to be dissimila

* A difference from a programme management is where a portfolio of projects all contribute to a common objective

Eg: Consider a business which carries out maintenance work for clients.

* A customer experience of the organization might be found to be very variable & inconsistent

* Sometimes the customer has to explain about a problem with the employees of the organization multiple times.

* A business objective might be to present a consistent and uniform front to the client.

Stepwise project planning

The major principle of project planning is to plan in outline first and then carrying out more detailed activities