



**A T M E**  
College of Engineering



---

**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - AI & ML**

---

# **MODULE-4**

## DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - AI & ML

**Introduction to Project Management:** Introduction, Project and Importance of Project Management, Contract Management, Activities Covered by Software Project Management, Plans, Methods and Methodologies, Some ways of categorizing Software Projects, Stakeholders, Setting Objectives, Business Case, Project Success and Failure, Management and Management Control, Project Management life cycle, Traditional versus Modern Project Management Practices.

**Project Evaluation:** Evaluation of Individual projects, Cost-benefit Evaluation Techniques, Risk Evaluation

## 1.1 Introduction

- The first question is whether the management of software projects is really that different from that of other projects.
- To answer this, we need to look at some key ideas about the planning, monitoring and control of software projects.
- We will see that all projects are about meeting objectives. Like any other project, a software project must satisfy real needs.
- To do this we must identify the project's stakeholders and their objectives.
- Ensuring that their objectives are met is the aim of project management. However, we cannot know that a project will meet its objectives in the future unless we know the present state of the project.

## **1.2 Why is Software Project Management Important?**

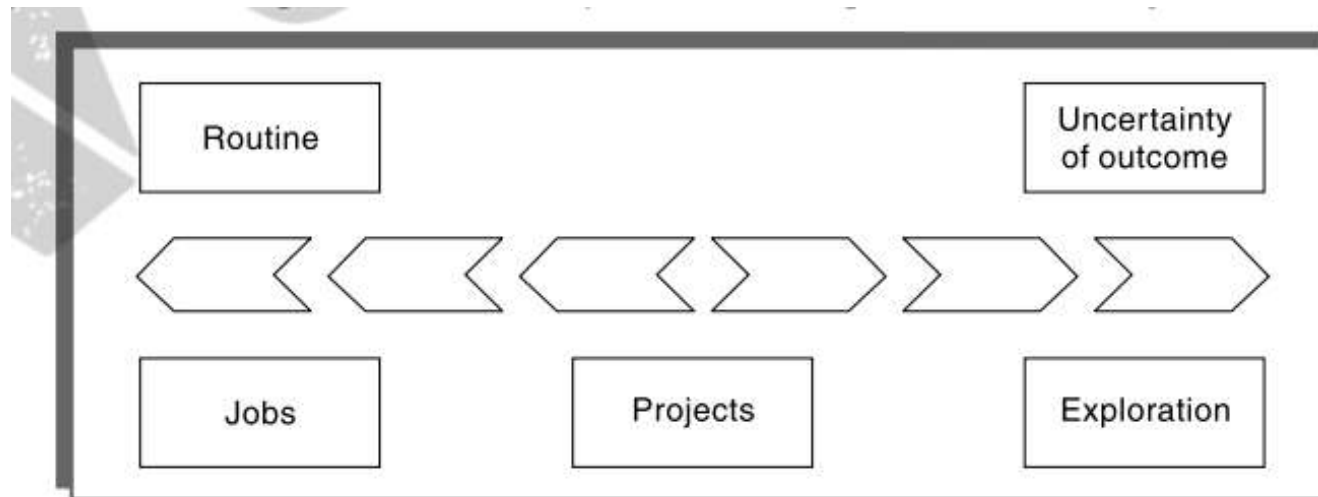
1. There is the question of money. A lot of money is at stake with ICT projects. In the United Kingdom during the financial year 2002–2003, the central government spent more on contracts for ICT projects than on contracts related to roads .
2. The biggest departmental spender was the Department for Work and Pensions, who spent over £800 million on ICT.
3. Unfortunately, projects are not always successful. In a report published in 2003, the Standish Group in the United States analysed 13,522 projects and concluded that only a third of projects were successful; 82% of projects were late and 43% exceeded their budget.
4. The National Audit Office in the UK, for example, among other factors causing project failure identified ‘lack of skills and proven approach to project management and risk management

## 1.3 What is a Project?

- The dictionary definitions put a clear emphasis on the project being a planned activity.
- The emphasis on being planned assumes we can determine how to carry out a task before we start. Yet with exploratory projects this might be difficult. Planning is in essence thinking carefully about something before you do it – even with uncertain projects this is worth doing as long as the resulting plans are seen as provisional.
- Other activities, such as routine maintenance, will have been performed so many times that everyone knows exactly what to do. In these cases, planning hardly seems necessary, although procedures might be documented to ensure consistency and to help newcomers.

## DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - AI & ML

The activities that benefit most from conventional project management are likely to lie between these two extremes. A hazy boundary exists between the non-routine project and the routine job. The first time you do a routine task it will be like a project. On the other hand, a project to develop a system similar to previous ones that you have developed will have a large element of routine.



l Activities most likely to benefit from project management

## **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's;
- People are formed into a temporary work group to carry out the task; work is carried out in several phases;
- The resources that are available for use on the project are constrained; the project is large or complex.

## 1.4 Software Projects versus Other Types of Projects

- **Fred Brooks** identified some characteristics of software projects which make them particularly difficult:

**1. *Invisibility*** : When a physical artefact such as a bridge is constructed the progress can actually be seen. With software, progress is not immediately visible. Software project management can be seen as the process of making the invisible visible.

**2. *Complexity***: Per dollar, pound or euro spent, software products contain more complexity than other engineered artefacts.

**3. *Conformity*:** The ‘traditional’ engineer usually works with physical systems and materials like cement and steel. These physical systems have complexity, but are governed by consistent physical laws. Software developers have to conform to the requirements of human clients. It is not just that individuals can be inconsistent. Organizations, because of lapses in collective memory, in internal communication or in effective decision making, can exhibit remarkable ‘organizational stupidity’.

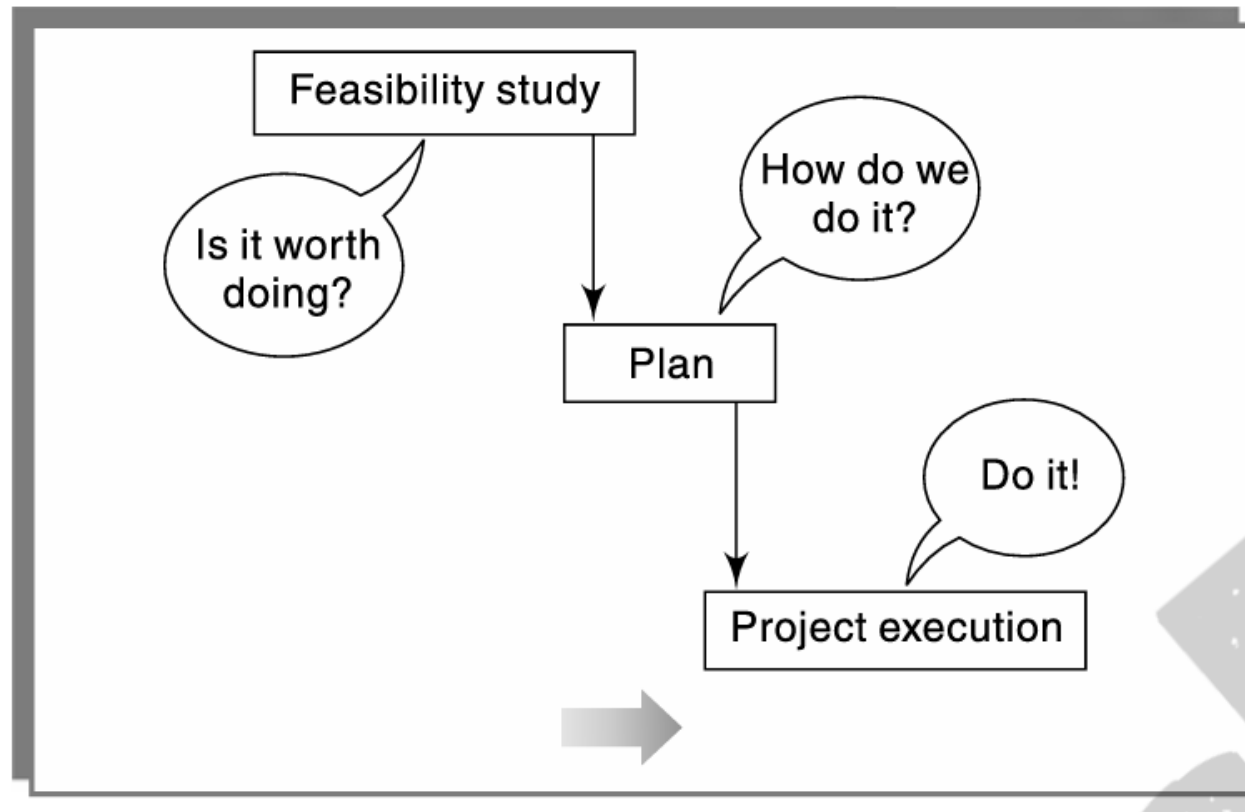
**4. *Flexibility*:** That software is easy to change is seen as a strength. However, where the software system interfaces with a physical or organizational system, it is expected that the software will change to accommodate the other components rather than vice versa. Thus software systems are particularly subject to change.

## 1.5 Contract Management and Technical Project Management

- In-house projects are where the users and the developers of new software work for the same organization.
- However, increasingly organizations contract out ICT development to outside developers.
- Here, the client organization will often appoint a ‘project manager’ to supervise the contract who will delegate many technically oriented decisions to the contractors. Thus, the project manager will not worry about estimating the effort needed to write individual software components as long as the overall project is within budget and on time.
- On the supplier side, there will need to be project managers who deal with the more technical issues.

# 1.6 Activities Covered by Software Project Management

The feasibility study/plan/execution cycle



# Usually there are three successive processes that bring a new system into being

### 1. *The feasibility study*

- ❖ Assesses whether a project is worth starting – that it has a valid business case.
- ❖ Information is gathered about the requirements of the proposed application.
- ❖ The stakeholders may know the aims they wish pursue, but not be sure about the means of achievement.
- ❖ The developmental and operational costs, and the value of the benefits of the new system, will also have to be estimated.
- ❖ The study could be part of a strategic planning exercise examining a range of potential software developments. Sometimes an organization assesses a *programme* of development made up of a number of projects.

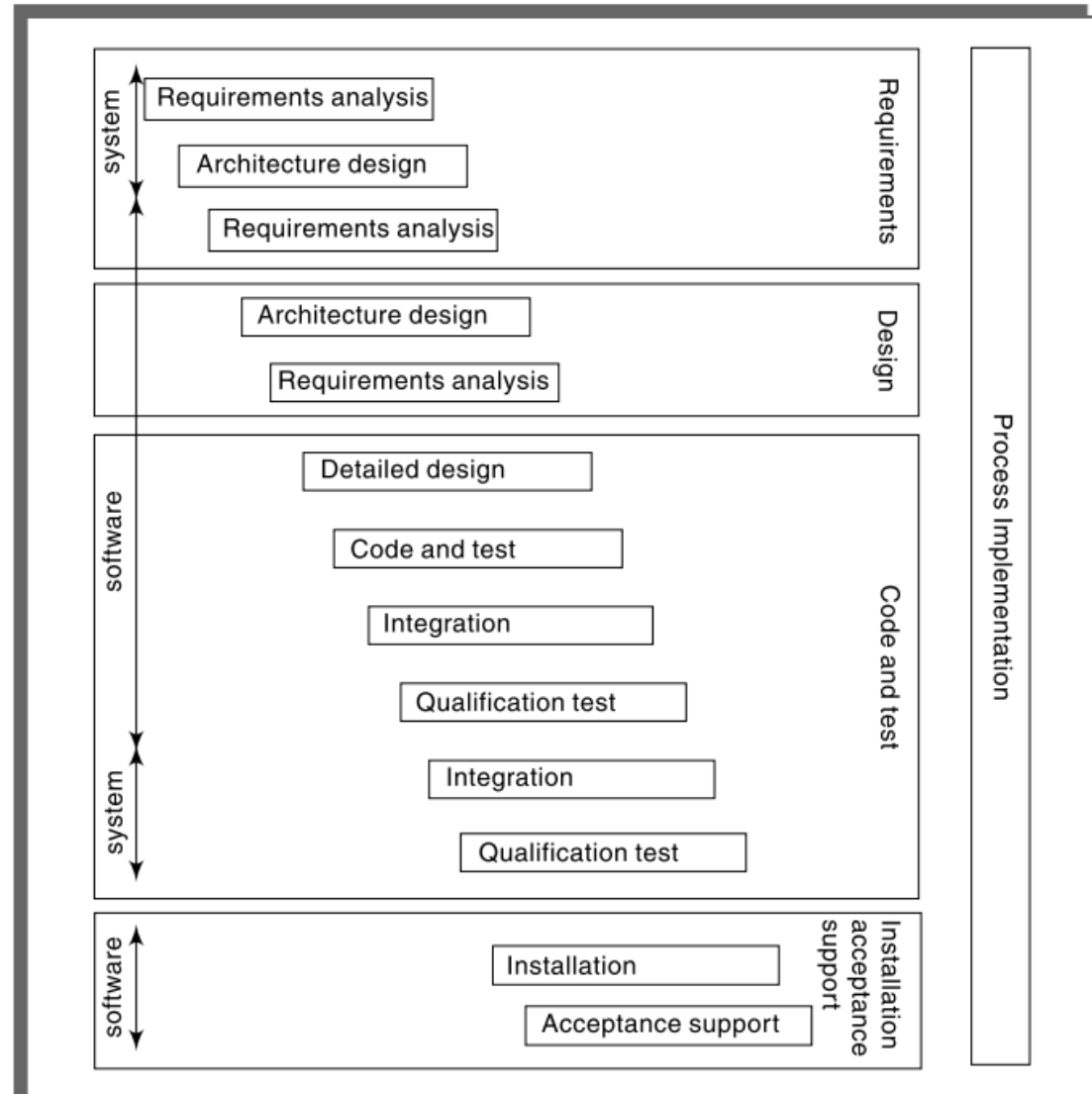
## ***2.Planning***

- ❖ If the feasibility study indicates that the prospective project appears viable, then project planning can start.
- ❖ For larger projects, we would not do all our detailed planning at the beginning.
- ❖ We create an outline plan for the whole project and a detailed one for the first stage.
- ❖ Because we will have more detailed and accurate project information after the earlier stages of the project have been completed, planning of the later stages is left to nearer their start

### ***3. Project execution***

- ❖ The execution of a project often contains design and implementation sub-phases.
- ❖ Students new to project planning often find that the boundary between design and planning can be hazy.
- ❖ Design is making decisions about the form of the products to be created.
- ❖ This could relate to the external appearance of the software, that is, the user interface, or the internal architecture.
- ❖ The plan details the activities to be carried out to create these products.
- ❖ Planning and design can be confused because at the most detailed level, planning decisions are influenced by design decisions.
- ❖ Thus a software product with five major components is likely to require five sets of activities to create them.

**Figure shows the typical sequence of software development activities recommended in the international standard ISO 12207**



# 1.Requirements analysis

- Starts with requirements elicitation or requirements gathering which establishes what the potential users and their managers require of the new system.
- It could relate to a function— that the system should do something. It could be a quality requirement – how well the functions must work.

- An example
  - dispatching an ambulance in response to an emergency telephone call. In this case transaction time would be affected by hardware and software performance as well as the speed of human operation. Training to ensure that operators use the computer system efficiently is an example of a system requirement for the project, as opposed to a specifically software requirement. There would also be resource requirements that relate to application development costs.

## 2. Architecture design

- The components of the new system that fulfill each requirement have to be identified.
- Existing components may be able to satisfy some requirements.
- In other cases, a new component will have to be made.
- These components are not only software: they could be new hardware or work processes.

- Example,
  - Have to take account of existing legacy systems with which they will interoperate. The design of the system architecture is thus an input to the software requirements. A second architecture design process then takes place that maps the software requirements to software components.

### 3.Detailed design

- ❖ Each software component is made up of a number of software units that can be separately coded and tested. The detailed design of these units is carried out separately.

### 4. Code and test

- ❖ Refers to writing code for each software unit. Initial testing to debug individual software units would be carried out at this stage.

### 5.Integration

- ❖ The components are tested together to see if they meet the overall requirements. Integration could involve combining different software components, or combining and testing the software element of the system in conjunction with the hardware platforms and user interactions.

## **6. Qualification testing**

- ❖ The system, including the software components, has to be tested carefully to ensure that all the requirements have been fulfilled.

## **7. Installation**

- ❖ This is the process of making the new system operational. It would include activities such as setting up standing data (for example, the details for employees in a payroll system), setting system parameters, installing the software onto the hardware platforms and user training.

## **8. 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. Software maintenance can be seen as a series of minor software projects. In many environments, most software development is in fact maintenance

## 1.7 Plans, Methods and Methodologies

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

For example, if you were asked to test some software, you may know nothing about the software to be tested, but you could assume that you would need to:

- Analyse the requirements for the software;
- Devise and write test cases that will check that each requirement has been satisfied
- Create test scripts and expected results for each test case;
- Compare the actual results and the expected results and identify discrepancies.

## DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - AI & ML

- While a method relates to a type of activity in general, a plan takes that method and converts it to real activities, identifying for each activity:
  - Its 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

## **1.8 Some Ways of Categorizing Software Projects**

- Projects may differ because of the different technical products to be created. Thus we need to identify the characteristics of a project which could affect the way in which it should be planned and managed. Other factors are discussed below.
  - Compulsory versus voluntary users
  - Information systems versus embedded systems
  - Outsourced projects
  - Objective-driven development

# 1. Compulsory versus 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.
- Here it is difficult to elicit precise requirements from potential users as we could with a business system.
- What the game will do will thus depend much on the informed ingenuity of the developers, along with techniques such as market surveys, focus groups and prototype evaluation.

## **2.Information systems versus embedded systems**

- A traditional distinction has been between information systems which enable staff to carry out office processes and embedded systems which control machines.
- A stock control system would be an information system. An embedded, or process control, system might control the air conditioning equipment in a building.
- Some systems may have elements of both where, for example, the stock control system also controls an automated warehouse.

### 3.Outsourced projects

- While developing a large project, sometimes, it makes good commercial sense for a company to outsource some parts of its work to other companies.
- There can be several reasons behind such a decision.
  - For example,

A company may consider outsourcing as a good option, if it feels that it does not have **sufficient expertise** to develop some specific parts of the product or if it determines that some parts can be developed **cost-effectively** by another company. Since an outsourced project is a small part of some project, it is usually small in size and needs to be completed within a few months. Considering these differences between an outsourced project and a conventional project, managing an outsourced project entails special challenges.

# 4.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 justifying the product.
- On the other hand, the project requirement might be to meet certain objectives which could be met in a number of ways. An **organization might have a problem and ask a specialist to recommend a solution**.
- Many software projects have **two stages**. First is an **objective-driven project** resulting in recommendations. This might identify the need for a new software system. The next stage is a project actually to **create the software product**.
- This is useful where the technical work is being done by an external group and the user needs are unclear at the outset. The external group can produce a preliminary design at a fixed fee. If the design is acceptable the developers can then quote a price for the second, implementation, stage based on an agreed requirement.

## 1.9 Stakeholders

- These are people who have a stake or interest in the project
- Their early identification is important as you need to set up adequate communication channels with them.
- Stakeholders can be categorized as:

### **1. Internal to the project team**

- This means that they will be under the direct managerial control of the project leader.

### **2. External to the project team but within the same organization**

- For example, the project leader might need the assistance of the users to carry out systems testing. Here the commitment of the people involved has to be negotiated.

### **3. 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. They may be contractors who will carry out work for the project. The relationship here is usually based on a contract.

### 1.10 Setting Objectives

- Among all these stakeholders are those who actually own the project. They control the financing of the project. They also set the objectives of the project. The objectives should define what the project team must achieve for project success. Although different stakeholders have different motivations, the project objectives identify the shared intentions for the project.
- 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. . . .’
- Example: Thus one statement in a set of objectives might be ‘customers can order our products online’ rather than ‘to build an e-commerce website’.
- There is often more than one way to meet an objective and the more possible routes to success the better

## **Sub-objectives and goals**

- Appropriate goal or sub-objective for the software developers would be to keep development costs within a certain budget.
- We can say that in order to achieve the objective we must achieve certain goals or sub-objectives first.

# The mnemonic SMART is sometimes used to describe well-defined objectives:

## 1. Specific

- ❖ Effective objectives are concrete and well defined.
- ❖ Vague aspirations such as ‘to improve customer relations’ are unsatisfactory.
- ❖ Objectives should be defined so that it is obvious to all whether the project has been successful.

## 2. Measurable

- ❖ Ideally there should be measures of effectiveness which tell us how successful the project has been.
- ❖ For example, ‘to reduce customer complaints’ would be more satisfactory as an objective than ‘to improve customer relations’.
- ❖ The measure can, in some cases, be an answer to simple yes/no question, e.g. ‘Did we install the new software by 1 June?’

*.....continue*

### 3. **A**chievable

It must be within the power of the individual or group to achieve the objective.

### 4. **R**elevant

The objective must be relevant to the true purpose of the project.

### 5. **T**ime constrained

There should be a defined point in time by which the objective should have been achieved

## **1.11 The Business Case**

Any project plan must ensure that the business case is kept intact.

For example:

- That development costs are not allowed to rise to a level which threatens to exceed the value of benefits;
- That the features of the system are not reduced to a level where the expected benefits cannot be realized;
- That the delivery date is not delayed so that there is an unacceptable loss of benefits.

## 1.12 Project Success and Failure

- The project plan should be designed to ensure project success by preserving the business case for the project.
- We can distinguish between project objectives and business objectives.

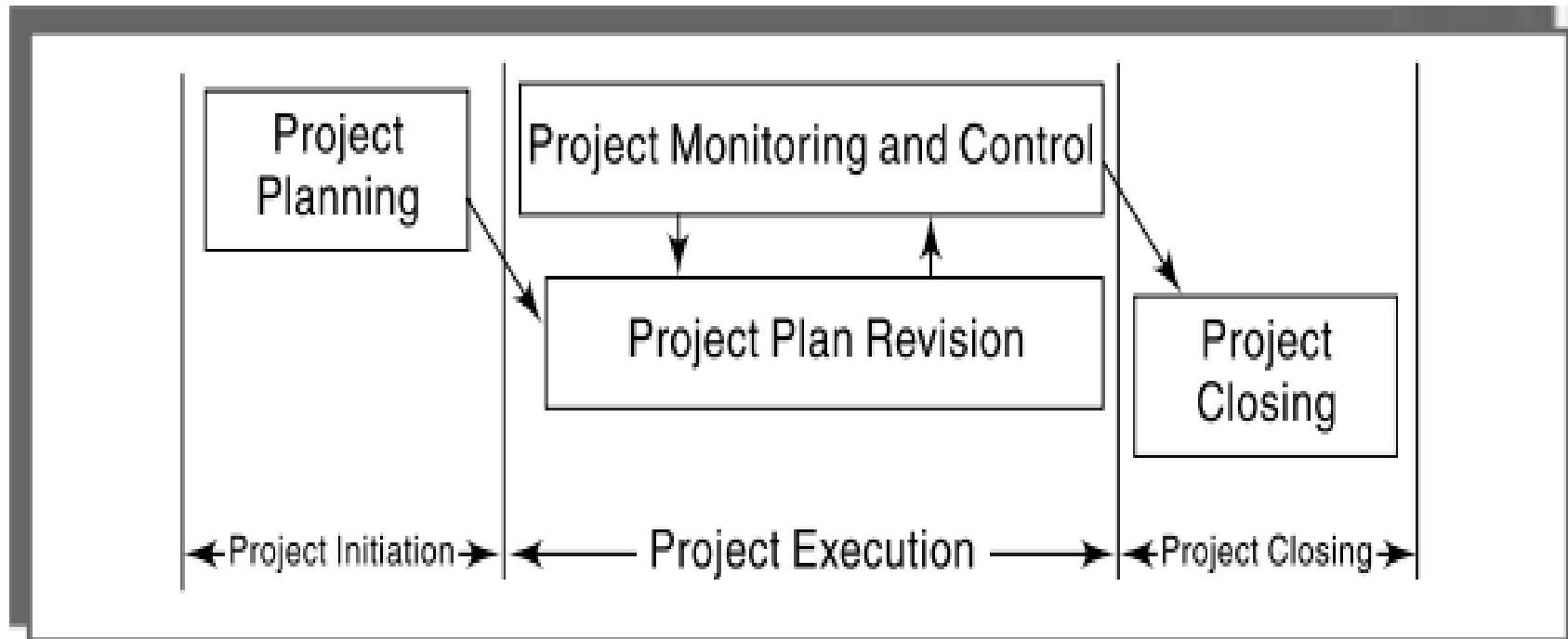
# Project objectives

- The project objectives are the targets that the project team is expected to achieve. In the case of software projects, they can usually be summarized as delivering:
  - The agreed functionality
  - To the required level of quality
  - On time
  - Within budget

## 1.13 What is Management?

- It has been suggested that management involves the following activities:
  - planning – deciding what is to be done;
  - organizing – making arrangements;
  - staffing – selecting the right people for the job etc.;
  - directing – giving instructions;
  - monitoring – checking on progress;
  - controlling – taking action to remedy hold-ups;
  - innovating – coming up with new solutions;
  - representing – liaising with clients, users, developer, suppliers and other stakeholders

- Principal project management processes



## DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - AI & ML

- ❖ It shows that project management is carried out over three well-defined stages or processes, irrespective of the methodology used
- ❖ In the project initiation stage, an initial plan is made.
- ❖ As the project starts, the project is monitored and controlled to proceed as planned.
- ❖ However, the initial plan is revised periodically to accommodate additional details and constraints about the project as they become available.
- ❖ Finally, the project is closed. In the project closing stage, all activities are logically completed and all contracts are formally closed.

## DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - AI & ML

- Initial project planning is undertaken immediately after the feasibility study phase and before starting the requirements analysis and specification process.
- Figure shows this project initiation period. Initial project planning involves estimating several characteristics of a project.
- Based on these estimates, all subsequent project activities are planned.
- The initial project plans are revised periodically as the project progresses and more project data becomes available.
- Once the project execution starts, monitoring and control activities are taken up to ensure that the project execution proceeds as planned.
- The monitoring activity involves monitoring the progress of the project.
- Control activities are initiated to minimize any significant variation in the plan

## DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - AI & ML

- Project planning is an important responsibility of the project manager. During project planning, the project manager needs to perform a few well-defined activities that have been outlined below.
- Estimation The following project attributes are estimated.
- Cost How much is it going to cost to complete the project?
- Duration How long is it going to take to complete the project?
- Effort How much effort would be necessary for completing the project

## DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - AI & ML

The effectiveness of all activities such as scheduling and staffing, which are planned at a later stage, depends on the accuracy with which the above three project parameters have been estimated.

### **1.Scheduling**

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

### **2.Staffing**

Staff organization and staffing plans are made.

### **3.Risk Management**

This activity includes risk identification, analysis, and abatement planning.

### **4.Miscellaneous Plans**

This includes making several other plans such as quality assurance plan, configuration management plan, etc

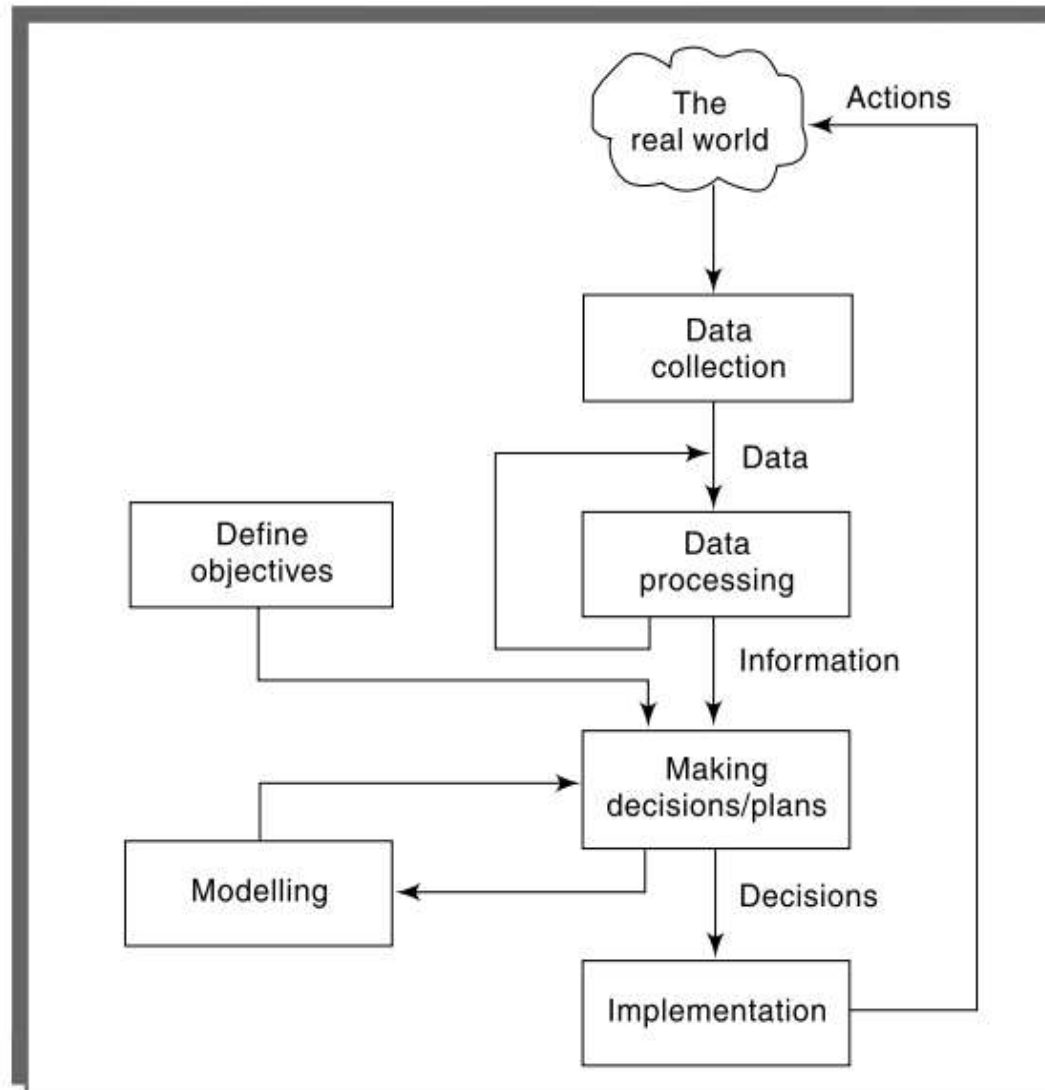
- ***Project monitoring and control activities*** are undertaken after the initiation of development activities.
- The aim of project monitoring and control activities is to ensure that the software development proceeds as planned.
- While carrying out project monitoring and control activities, a project manager may sometimes find it necessary to change the plan to cope with specific situations and make the plan more accurate as more project data becomes available.

## 1.14 Management Control

- Management, in general, involves setting objectives for a system and then monitoring the performance of the system
- This will involve the local managers in data collection.
- data processing will be needed to transform this raw data into useful information.
- The project manager would need to calculate carefully what the impact would be in moving staff from particular branches. This is modeling the consequences of a potential solution. Several different proposals could be modelled in this way before one was chosen for implementation.
- Having implemented the decision, the situation needs to be kept under review by collecting and processing further progress details.

FIGURE 1.5 The project control cycle

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - AI & ML



## DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - AI & ML

- It can be seen that a project plan is dynamic and will need constant adjustment during the execution of the project.
- While this is to be expected, with nearly all projects much more time is spent actually doing the project rather than planning it.
- A good plan provides a foundation for a good project, but is nothing without intelligent execution.
- The original plan will not be set in stone but will be modified to take account of changing circumstances.

## **1.15 Traditional versus Modern Project Management Practices**

**Some important differences between modern project management practices and traditional practices.**

### ***1. Planning Incremental***

- Delivery Few decades ago, projects were much simpler and therefore more predictable than the present day projects. In those days, projects were planned with sufficient detail, much before the actual project execution started. After the project initiation, monitoring and control activities were carried out to ensure that the project execution proceeded as per plan.

## DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - AI & ML

- Now, projects are required to be completed over a much shorter duration, and rapid application development and deployment are considered key strategies. The traditional long-term planning has given way to adaptive short-term planning.
- Instead of making a long-term project completion plan, the project manager now plans all incremental deliveries with evolving functionalities. This type of project management is often called extreme project management. Extreme project management is a highly flexible approach to project management that concentrates on the human side of project management rather than formal and complex planning and monitoring techniques.

## ***2. Quality Management***

- ❖ Of late, customer awareness about product quality has increased significantly.
- ❖ Tasks associated with quality management have become an important responsibility of the project manager.
- ❖ The key responsibilities of a project manager now include assessment of project progress and tracking the quality of all intermediate artifacts.

## ***3.Change Management***

- Earlier, when the requirements were signed off by the customer, any changes to the requirements were rarely entertained.
- Customer suggestions are now actively being solicited and incorporated throughout the development process. To facilitate customer feedback, incremental delivery models are popularly being used.
- Product development is being carried out through a series of product versions implementing increasingly greater functionalities. Also customer feedback is solicited on each version for incorporation.

## DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - AI & ML

- This has made it necessary for an organization to keep track of the various versions and revisions through which the product develops.
- Another reason for the increased importance of keeping track of the versions and revisions is the following. Application development through customization has become a popular business model. Therefore, existence of a large number of versions of a product and the need to support these by a development organization has become common. In this context, the project manager plays a key role in product base lining and version control. This has made change management a crucial responsibility of the project manager. Change management is also known as configuration management.

## Project Evaluation:

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - AI & ML

### Technical assessment

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

### Cost-benefit analysis

Even where the estimated benefits will exceed the estimated costs, it is often necessary to decide if the proposed project is the best of several options. Not all projects can be undertaken at any one time and, in any case, the most valuable projects should get most resources.

## Cost-benefit analysis comprises two steps:

*Identifying all of the costs and benefits of carrying out the project and operating the delivered application* These include the development costs, the operating costs, and the benefits expected from the new system. Where the proposed system is a replacement, these estimates should reflect the change in costs and benefits due to the new system. A new sales order processing system, for example, could only claim to benefit an organization by the increase in sales due to the use of the new system.

*Expressing these costs and benefits in common units* We must express each cost and benefit – and the net benefit which is the difference between the two – in money.

Most direct costs are easy to quantify in monetary terms and can be categorized as:

- Development cost
  - Staff cost
- Set up cost
  - File conversion, recruitment , staff training
- Set up cost
  - Related to operating after installation