

Wollo University
College of Informatics
Department Of software engineering

Software Project management

BY: shambel D.

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Learnings outcome

- This course should provide you basic understanding of software product, software design and development process, software project management and design complexities etc.
- At the end of the course you should be equipped with well understanding of software engineering project management concepts

Introduction

- Many organizations today have a new or renewed interest in project management and it is a **back-bone & critical** field in software related project.
- Project management may be the most important aspect of systems development.
- Effective PM helps to ensure that meeting of customer expectations and satisfying of budget and time constraints.
- Computer hardware, software, networks, and the use of interdisciplinary and global work teams have radically changed the work environment.

Cont...

- Let us first understand what software engineering stands for. The term is made of two words, software and engineering.
- **Software** is more than just a program code. A program is an executable code, which serves some computational purpose. Software is considered to be collection of executable programming code, associated libraries and documentations. Software, when made for a specific requirement is called **software product**.
- **Engineering** on the other hand, is all about developing products, using well-defined, scientific principles and methods.

Cont...

- Software engineering is an engineering branch associated with development of software product using well-defined scientific principles, methods and procedures.
- The outcome of software engineering is an efficient and reliable software product.
- Software project management has wider scope than software engineering process as it involves communication, pre and post delivery support etc.
- A Software Project is the complete procedure of software development from requirement gathering to testing and maintenance, carried out according to the execution methodologies, in a specified period of time to achieve intended software product.



Software engineering is an engineering branch associated with development of software product using well-defined scientific principles, methods and procedures. The outcome of software engineering is an efficient and reliable software product.

- The goal of software project management is to understand, plan, measure and control the project such that it is delivered on time and on budget. This involves gathering requirements, managing risk, monitoring and controlling progress, and following a software development process.
- Software project management requires trained and experienced Software Engineers in order to increase the likelihood of project success because software development for large projects is extremely complex and following strict engineering principles will help reduce the risks associated with the project.

- Software project management is extremely important for the following reasons:
- Software development is highly unpredictable: only about 10% of projects are delivered within initial budget and on schedule.
- Management has a greater effect on the success or failure of a project than technology advances.
- Too often there is too much scrap and rework. The entire process is very immature, not enough reuse

- Another problem which distinguishes software engineering from other engineering fields is the fact that software is not concrete. There is a common misconception that software can be easily changed to do anything no matter which stage the project is currently at. If construction on a building or bridge is nearly complete, people understand that it is too late to make significant changes to the architecture or design. However with software, clients tend to have the impression that making changes are always easy even though the end result could be the equivalent to tearing down a nearly completed building!

- So why does software fail anyways? Here is the list from the IEEE Spectrum :
- Unrealistic or unarticulated project goals
- Inaccurate estimates of needed resources
- Badly defined system requirements
- Poor reporting of the project's status
- Unmanaged risks
- Poor communication among customers, developers, and users
- Use of immature technology
- Inability to handle the project's complexity
- Sloppy development practices
- Poor project management
- Stakeholder politics
- Commercial pressures

- A common misconception is that developing software means writing code, which is definitely not the case. Code writing itself only counts for about 40% of software development. There are many other important steps such as requirements, configuration, deployment and maintenance.
- The main goal of software project management is to try and reduce the risks involved with a project such that the project can then finish on budget and on time with all of the features desired by the clients..

- Project management helps us achieve the following [1]:
- Estimate the budget needed to complete the project before it starts and to monitor the progress so that at any given time we know how much a project has cost and how much more it will cost.
- Estimate the time needed to complete at project before it starts and to monitor the progress so that at any given time we know how much time is left before completion.
- Estimate which features can be developed in the given time and cost frame.
- Monitors the project progress and so we know which features have been completed and which ones will be completed before the end of the project.
- Software delivered must provide all the features specified in the requirements (feature complete). Project management therefore helps project managers re-negotiate features and requirements.

SDLC Activities

- SDLC provides a series of steps to be followed to design and develop a software product efficiently. SDLC framework includes the following steps:

What Is a Project?

- A **project** is a **temporary** endeavour designed to produce a **unique** product, service or result with a **defined beginning and end** undertaken to meet **unique goals and objectives**, typically to bring about beneficial change or added value.

Examples:

- Development of software for an improved business process,
- Construction of a building or bridge,
- Relief effort after a natural disaster,
- Expansion of sales into a new geographic market
- Developing a new product or service.
- Effecting a change in structure, staffing, or style of an organization.
- Designing a new transportation vehicle.
- Developing or acquiring a new or modified information system.
- Running a campaign for political office.

CHARACTERISTICS OF PROJECT

- Projects differ in size, scope cost and time, but all have the following characteristics:
 - A **start** and a **finish**
 - A **life cycle** involving a series of phases in between the beginning and end
 - A **budget**
 - A set of **activities** which are sequential, unique and non-repetitive
 - Use of **resources** which may require coordinating
 - Centralised **responsibilities** for management and implementation
 - Defined **roles** and **relationships** for participants in the project

Project management

- Is the application of **knowledge, skills, tools, and techniques** to project activities in order to meet or exceed stakeholder needs and expectations from a project.
- Is an attempt to accomplish a specific objective through a unique set of interrelated tasks and the effective utilization of resources..
- It is the **planning and allocating** of resource to **develop a quality software** on time and with in budget.

- **Software project management** refers to the branch of project management dedicated to the **planning**, **scheduling**, resource **allocation**, **execution**, tracking and delivery of software and web projects.
- Project management in software engineering is distinct from traditional project management in that software projects have a **unique lifecycle process** that requires multiple rounds of **testing**, **updating**, and **customer** feedback.
- Most IT-related projects are managed in the **agile style**, in order to keep up with the increasing pace of **business**, and **iterate** based on **customer** and **stakeholder** feedback.

Project Management Knowledge Areas

- **Project Management Knowledge Areas** describe the key competencies that project managers must develop
- **There are ten Project Management Knowledge Areas**
 - Four **core** knowledge areas lead to specific project objectives (**scope, time, cost, and quality**)
 - Five **facilitating** knowledge areas are the means through which the project objectives are achieved (**human resources, communication, stakeholder ,risk and procurement management**)
 - One **knowledge** area (**project integration management**) affects and is affected by all of the other knowledge areas
 - All knowledge areas are important!

Core Knowledge Areas of Project Management

- **Project Scope management** involves defining and managing all the work required to successfully complete the project
- **Project Time management** includes estimating how long it will take to complete the work
- **Project Cost management** consists of preparing and managing the budget for the project
- **Project Quality management** ensures that project will satisfy the stated or implied needs for which it was undertaken

Facilitating Knowledge Areas of Project Management

- **Project Human Resource Management** is concerned with making effective use of the people involved with the project
- **Project Communications management** involves generating, collecting, disseminating, and storing project information
- **Project Risk management** includes identifying, analyzing, and responding to risks related to the project
- **Project Stakeholder Management** involves identification of stakeholders, analysis of their expectations and influences, development of appropriate strategies to work with the stakeholders and executing the process

Software project managers may have to do any of the following tasks:

- **Planning:** A software project manager will need to putting together the blueprint for the entire project. It will define the scope, allocate resources, estimate timeline, communication strategy, and indicate the steps for testing and maintenance.
- **Leading:** A software project manager will need to assemble and lead the project team, which likely will consist of developers, analysts, testers, graphic designers, and technical writers. This requires excellent communication, people and leadership skills.
- **Execution:** The project manager will participate in and supervise the successful execution of each stage of the project. This includes monitoring progress, frequent team check-ins and creating status reports.

- **Time management:** Staying on schedule is crucial to the successful completion of any project. Software project managers must be experts in risk management and contingency planning to ensure forward progress when roadblocks or changes occur.
- **Budget:** Like traditional project managers, software project managers are tasked with creating a budget for a project, and then sticking to it as closely as possible, moderating spend and re-allocating funds when necessary.
- **Maintenance:** Software project management typically encourages constant product testing in order to discover and fix bugs early, adjust the end product to the customer's needs, and keep the project on target. The software project manager is responsible for ensuring proper and consistent testing, evaluation and fixes are being made.

Important Skills for good project manager

- **What skills make the best project managers so good?**
 - **Communication:** listening, persuading, negotiating
 - **Organizational:** planning, goal-setting, analyzing
 - **Team building:** empathy, motivation, team spirit
 - **Leadership:** sets example, energetic, vision, delegates, positive attitude
 - **Coping:** flexibility, creativity, patience, persistence
 - **Technical:** experience, project knowledge

SPMP Document

- Software project manager prepare a document on the basis of decision finalized during the project planning. This document is known as Software Project Management Plan Document or SPMP document.
- SPMP document is a well organized document that contains the project planning in detail. It would have details about project objective, project estimates, project schedules, project resources, project staffing, risk management plans, project monitoring, project control and other miscellaneous activities.

A SPMP document is organized as shown below:

Introduction

- Objectives
- Functions
- Performance issues
- Constraints

Project estimates

- Historical data used
- Estimation techniques details
- Cost, duration, effort estimates

Project Schedule

- Work breakdown
- Gantt and PERT chart

Project resource

- Manpower
- Hardware and Software
- Highly skilled professionals

Staff organization

- Team formation and structure
- Management reporting

Risk Management

- Risk analysis
- Risk identification
- Risk abatement methods

Project tracking

Project Control

Miscellaneous activities

All the above activities are documented in SPMP document by project manager

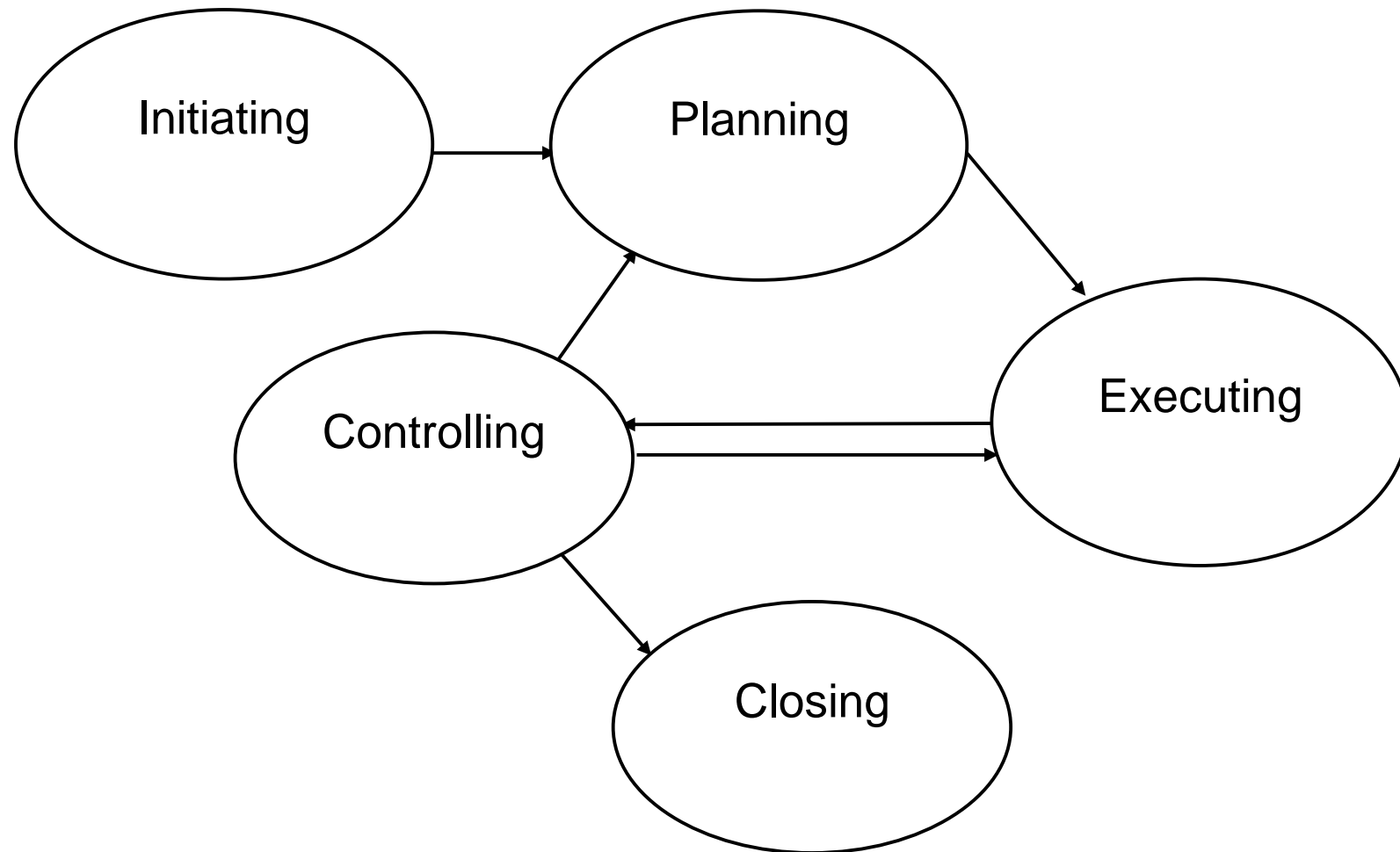
why software project management important?

- **Strategic alignment:**-it ensures what is being delivered, is right, and will deliver real value against the business opportunity
- **Leadership:**-it brings leadership and direction to software project. It allows and enables a team to do their best work.
- **Clear focus & objectives:**-it ensures best plan for executing on strategic goal.
- **Realistic project planning:**-it ensures proper expectations are set around what can be delivered, by when and for how much.
- **Quality control:**-it ensures the quality of whatever is being delivered.

Project management Lifecycles

- **Project life cycle:** Is the natural grouping of ideas, decisions, and actions into Project phases, from Project conception to operations to Project phase-out.
- The generic project life cycle has four phases:
 - **Initiating the project,**
 - **Planning the project,**
 - **Executing and controlling the project,**
 - **Closing the project.**

Project managment Lifecycles



Initiating Phase

- Initiation is successfully beginning the project to create success in the end
- In the initiating phase, projects are **identified** and **selected**, and then authorized using a document referred to as a **project charter**.
 - Involves the identification of a need, problem, or opportunity and can result in the sponsor's authorizing a project to address the identified need or solve the problem
 - May take several months to identify the need, gather data, and define the project objective
 - Important to define the right need
 - Needs are often defined as part of an organization's strategic planning process

CONTD...

- Organizations must have a project selection process to determine what projects to be effective.
- Project charter includes:-
 - ✓ Rationale or justification for the project
 - ✓ Project objective and expected benefits
 - ✓ General requirements and conditions such as amount of funds authorized, required completion date, major deliverables, and required reviews and approvals, and key assumptions

Planning Phase

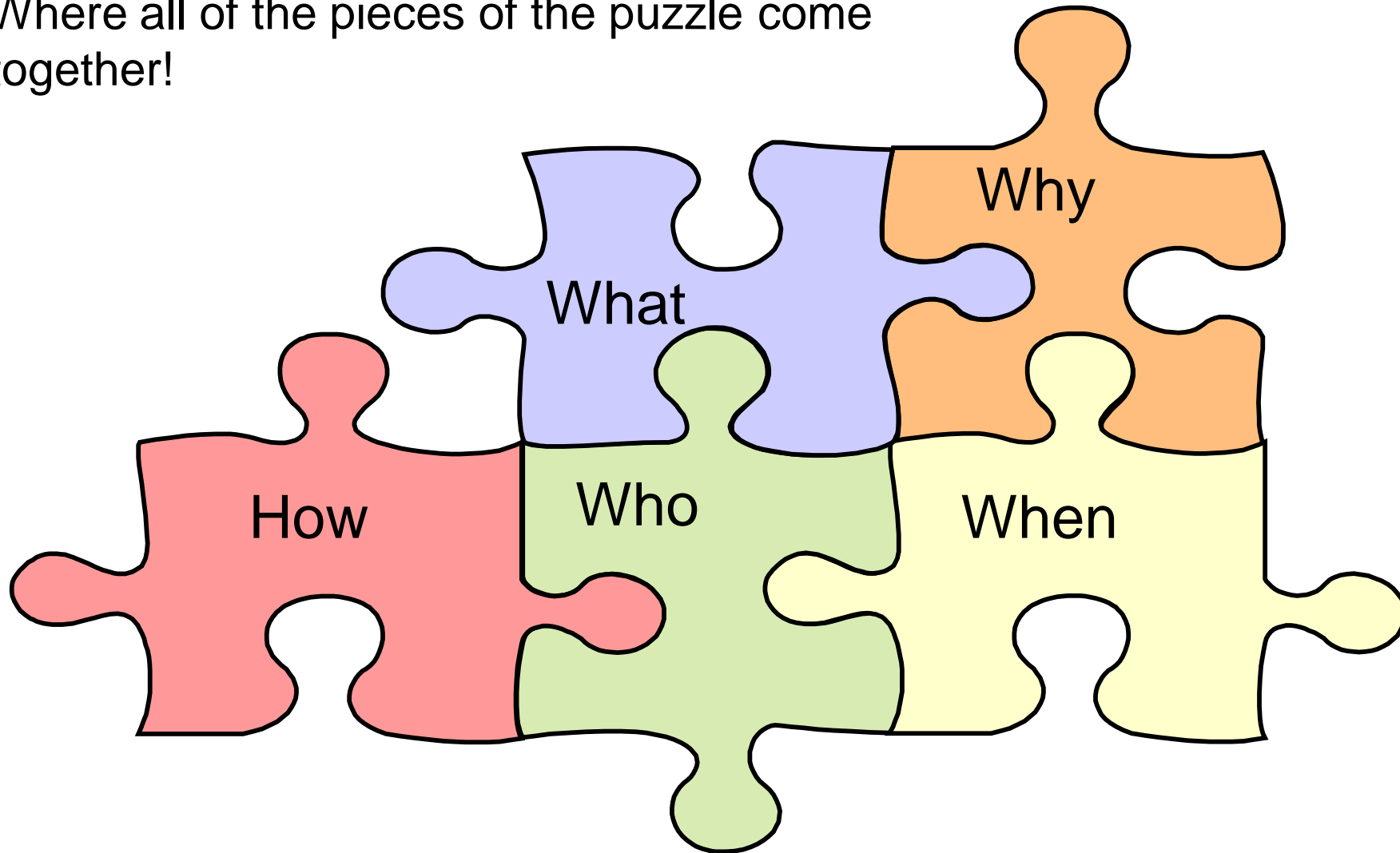
Goal: Introduce the Project Management skills for planning projects focusing on **critical areas** for software projects

Purpose of Planning Process

- Perform a work breakdown
- Perform activity analysis
- Project schedule development
- Project Risk analysis
- Develop a Project Budget

The Project Plan is...

Where all of the pieces of the puzzle come together!



CONTD...

- The planning phase includes defining the project activity, identifying resources, developing a schedule and budget, and identifying risks, all of which make up the baseline plan for doing the project work.
- Show how the project scope will be accomplished within budget and on schedule.
- Plan the work and work the plan

CONTD...

- Detailed plan results in a baseline plan
 - What needs to be done -- scope, deliverable
 - How it will get done -- activities, sequence
 - Who will do it -- resources, responsibilities
 - How long it will take -- durations, schedule
 - How much it will cost -- budget
 - What the risks are
- Include the people that will actually do the work in the planning process
 - They have knowledge of detailed activities to be done
 - Participation builds commitment

CONTD...

- Project Planning probably the most **time consuming** project management activity
- Project Planning is **continuous activity from initial** concept through to system delivery
- Plans must be regularly revised as new information becomes available
- Various different types of plan may be developed to support the main software project plan that is concerned with schedule and budget

Project executing and controlling phase

- In the performing phase, the project plan is executed and work tasks are carried out to produce all the project deliverables and to accomplish the project objective.
- The project progress is monitored and controlled to ensure the work remains on schedule and within budget, the scope is fully completed according to specifications, and all deliverables meet acceptance criteria.
- Changes are managed and controlled through documentation, approval, and communication with agreement between the sponsor and the contractor

Project Execution

- The process of coordinating the people and other resources to carry out the plan.
- The focus of this phase is:
 - Project plan execution
 - Quality assurance
 - Team development
 - Information distribution

Project Control

- The process of ensuring that the project objectives are met by monitoring and measuring progress and taking corrective action when needed.
- The focus of this phase is to:
 - Measure **project performance against the plan** to identify variances/deviations and take corrective action as necessary.
 - It includes
 - Overall change control
 - Scope change control
 - Schedule control
 - Cost control
 - Quality control
 - Performance reporting

Project Closing phase

Goal: Introduce the final PMI process group necessary for successful project management implementation

Project Closing – Elements:

- **Administrative Close Out** – Generating, gathering, disseminating information to formalize phase or project completion, including evaluating the project, compiling lessons learned for use in planning future phases or projects
- **Contract Close Out** – Completion and settlement of the contract including resolution of any open items

CONT...

- In the closing phase, project evaluations are conducted, **lessons learned** are identified and documented to help improve performance on future projects, and project documents are organized and archived
- Includes a variety of **actions** such as:
 - ❖ Collecting and making final payments
 - ❖ Recognizing and evaluating staff
 - ❖ Conducting a post project evaluation
 - ❖ Documenting lessons learned
 - ❖ Record project documents
- Using a knowledge base to record lessons learned and post-project evaluation is helpful to retrieve the lessons and information that could support future business with the customer or other customers

- A **software life cycle model** defines the different activities in sequence which needs to be carried out to develop a software product.
- It can also be seen as series of identifiable stages through which product pass through as its development progress.
- Software life cycle is also known as Systems Development Life Cycle (SDLC).

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- There are various models available which can be followed depending upon the suitability of the product to be developed. Whichever model is followed the product will go through the below phases in sequence:
- Feasibility study
- Requirement analysis
- Requirement specification
- Software Design
- Software Coding
- Software Testing
- Software Maintenance
- A software development process covers all the activities starting from product conception to delivery and finally retirement.

- Software life cycle is necessary for:
 - developing good quality products
 - economically cost effective product development
 - on time delivery of software product

Assignment

- **What are the popular SDLC Models**
- **Which model to select for the project?**
- We are going to study about some popular life cycle models adopted by industry. All the software development life cycle (SDLC) model is explained in [SDLC tutorial](#).
 - **Waterfall model**
 - **Iterative waterfall model**
 - **Prototyping model**
 - **Evolutionary model**
 - **Spiral model**

Benefits of software Project Management plan

- Meeting/Exceeding Customer Expectations
- Meeting Project Deadlines
- Meeting Projects Costs
- Efficient Resource Utilization
- Improved Communications
- Better control of financial, physical, and human resources
- Improved customer relations
- Higher quality and increased reliability
- Improved productivity

what is software quality metrics?

- Simply, a **software metric** is a measure that allows getting a quantitative value of software features or specifications.
- The objective of measuring the software quality is to use the received results for planning the budget and schedule, estimating costs, testing and QA, debugging, etc.
- The main goal is to **measure quality of software products**.
- “You cannot control what you cannot measure”. (Tom DeMarco)

Project size estimation techniques

- Estimation of the size of software is an essential part of Software Project Management.
- It helps the project manager to further predict the effort and time which will be needed to build the project. Various measures are used in project size estimation.
- Some of these are:
 - Lines of Code:-
 - Number of entities in ER diagram
 - Total number of processes in detailed data flow diagram
 - Function points

- Here are the most popular methods of measuring quality
- **Agile Metrics**
 - Agile metrics are used to find out ways to enhance the process of software development. Usually, lead time, cycle time, team velocity, open and close rates are taken into account.
- **Production Metrics**
 - This type of metric assesses the scope of assignments done and measures the productivity of software development teams. Typically, it estimates the operation speed and productivity.

- **Security Responses Metrics**

- This type of quality measurement is used to understand how security responsive software is. Every software may face different dangers on various devices, that's why the metrics are used to detect how much time is needed to find out an issue, fix it, or develop a remedy.

- **Size-Oriented Measurements**

- Size-oriented metrics are used to analyze the quality of software with the help of a KLOC quantifier. KLOC is an abbreviation for kilo (1000) lines of code that are used to determine bugs, errors, and costs per 1000 lines.

- **Function-Oriented Methods**

- A function point is here a core quantifier. It is a measure that demonstrates how much functionality, business functionality mainly, a product gives. This methodology considers user inputs, error reports, and messages, user inquiries, etc

- **QA Metrics**

- What are quality metrics in software testing? Testing is an integral part of any development process. Basic metrics include test cases executed and test cases written. Calculated metrics are usually executed by a QA Lead and are used to determine the progress of the project. The reports of calculated metrics can help improve the whole software development lifecycle (SDLC).

- **Customers Satisfaction**

- The metric estimates a level of customer's satisfaction with the product that varies from very satisfied to very dissatisfied. The data about a level of quality under these terms is obtained from customer surveys and calculated in percent

Project estimation technique

- There are many different types of estimation techniques used in Project Management with various streams like Engineering, IT, Construction, Agriculture, Accounting, etc. A Project manager is often challenged to align mainly six project constraints - Scope, Time, Cost, Quality, Resources and Risk in order to accurately estimate the project.

- The common questions that come into the mind of a project manager at the start of the project are—
- How much work is to be estimated (scope).
- How to estimate the project (techniques).
- How much time it will require to complete the project (Schedule).
- Who will be doing the project (resources).
- What is the budget required to deliver the project (cost).
- Any intermediary dependencies that may delay or impact the project (Risks)

Some Project Estimation Techniques or tools

- Top-Down Estimate
- Bottom-Up Estimate
- Analogous Estimating
- Parametric Estimate
- Three-point Estimating

Chapter two

Project integration management

Project Integration Management?

- **Project integration management** involves coordinating all the other project management knowledge areas throughout a project's life cycle.
- includes the processes and activities to identify, define, combine, unify, and coordinate the various processes and project management activities within the Project Management Process Groups.
- **Integration** ensures that all the elements of a project come together at the right times to complete a project successfully.

Project Integration Management Overview

4.1 Develop Project Charter

- .1 Inputs
 - .1 Business documents
 - .2 Agreements
 - .3 Enterprise environmental factors
 - .4 Organizational process assets
- .2 Tools & Techniques
 - .1 Expert judgment
 - .2 Data gathering
 - .3 Interpersonal and team skills
 - .4 Meetings
- .3 Outputs
 - .1 Project charter
 - .2 Assumption log

4.2 Develop Project Management Plan

- .1 Inputs
 - .1 Project charter
 - .2 Outputs from other processes
 - .3 Enterprise environmental factors
 - .4 Organizational process assets
- .2 Tools & Techniques
 - .1 Expert judgment
 - .2 Data gathering
 - .3 Interpersonal and team skills
 - .4 Meetings
- .3 Outputs
 - .1 Project management plan

4.3 Direct and Manage Project Work

- .1 Inputs
 - .1 Project management plan
 - .2 Project documents
 - .3 Approved change requests
 - .4 Enterprise environmental factors
 - .5 Organizational process assets
- .2 Tools & Techniques
 - .1 Expert judgment
 - .2 Project management information system
 - .3 Meetings
- .3 Outputs
 - .1 Deliverables
 - .2 Work performance data
 - .3 Issue log
 - .4 Change requests
 - .5 Project management plan updates
 - .6 Project documents updates
 - .7 Organizational process assets updates

4.4 Manage Project Knowledge

- .1 Inputs
 - .1 Project management plan
 - .2 Project documents
 - .3 Deliverables
 - .4 Enterprise environmental factors
 - .5 Organizational process assets
- .2 Tools & Techniques
 - .1 Expert judgment
 - .2 Knowledge management
 - .3 Information management
 - .4 Interpersonal and team skills
- .3 Outputs
 - .1 Lessons learned register
 - .2 Project management plan updates
 - .3 Organizational process assets updates

4.5 Monitor and Control Project Work

- .1 Inputs
 - .1 Project management plan
 - .2 Project documents
 - .3 Work performance information
 - .4 Agreements
 - .5 Enterprise environmental factors
 - .6 Organizational process assets
- .2 Tools & Techniques
 - .1 Expert judgment
 - .2 Data analysis
 - .3 Decision making
 - .4 Meetings
- .3 Outputs
 - .1 Work performance reports
 - .2 Change requests
 - .3 Project management plan updates
 - .4 Project documents updates

4.6 Perform Integrated Change Control

- .1 Inputs
 - .1 Project management plan
 - .2 Project documents
 - .3 Work performance reports
 - .4 Change requests
 - .5 Enterprise environmental factors
 - .6 Organizational process assets
- .2 Tools & Techniques
 - .1 Expert judgment
 - .2 Change control tools
 - .3 Data analysis
 - .4 Decision making
 - .5 Meetings
- .3 Outputs
 - .1 Approved change requests
 - .2 Project management plan updates
 - .3 Project documents updates

4.7 Close Project or Phase

- .1 Inputs
 - .1 Project charter
 - .2 Project management plan
 - .3 Project documents
 - .4 Accepted deliverables
 - .5 Business documents
 - .6 Agreements
 - .7 Procurement documentation
 - .8 Organizational process assets
- .2 Tools & Techniques
 - .1 Expert judgment
 - .2 Data analysis
 - .3 Meetings
- .3 Outputs
 - .1 Project documents updates
 - .2 Final product, service, or result transition
 - .3 Final report
 - .4 Organizational process assets updates

Project Integration Management Processes

The Project Integration Management Processes includes:-

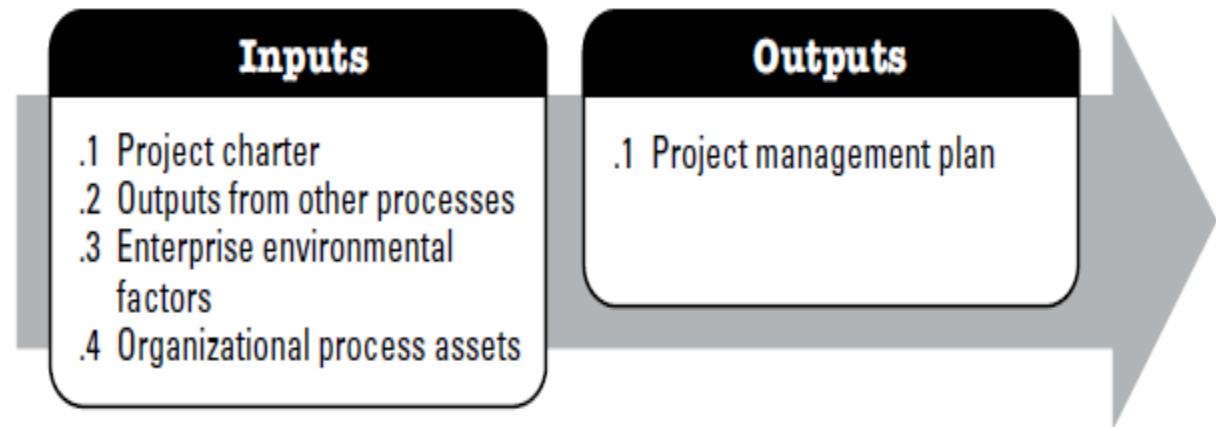
- **Develop the project charter:** Work with stakeholders to create the document that formally authorizes a project—the charter.
- **Develop the preliminary project scope statement:** Work with stakeholders, especially users of the project's products, services, or results, to develop the high-level scope requirements and create a preliminary project scope statement.
- **Develop the project management plan:** Coordinate all planning efforts to create a consistent, coherent (Rational) document—the project management plan.

Project Integration Management Processes(Contd..)

- **Direct and manage project execution:** Carry out the project management plan by performing the activities included in it.
- **Monitor and control the project work:** Oversee project work to meet the performance objectives of the project.
- **Perform integrated change control:** Coordinate changes that affect the project's deliverables and organizational process assets.
- **Close the project:** Finalize all project activities to formally close the project.

DEVELOP PROJECT MANAGEMENT PLAN.

Develop Project Management Plan is the process of defining, preparing, and coordinating all plan components and consolidating them into an integrated project management plan. The key benefit of this process is the production of a comprehensive document that defines the basis of all project work and how the work will be performed. This process is performed once or at predefined points in the project. The inputs and outputs of this process are depicted in the following Figure



- **Project Charter.** A document issued by the project initiator or sponsor that formally authorizes the existence of a project and provides the project manager with the authority to apply organizational resources to project activities.
- **Enterprise Environmental Factors.** Conditions, not under the immediate control of the team, that influence, constrain, or direct the project, program, or portfolio.
- **Organizational Process Assets.** Plans, processes, policies, procedures, and knowledge bases that are specific to and used by the performing organization.

PROJECT SCOPE MANAGEMENT

- Project Scope Management includes the processes required to ensure that the project includes all the **work required**, and **only the work required**, to complete the project successfully. Managing the project scope is primarily concerned with **defining and controlling** what is and is not included in the project.

- The Project Scope Management processes groups are:

Plan Scope Management—The process of creating a scope management plan that documents how the project and product scope will be defined, validated, and controlled.

Collect Requirements—The process of determining, documenting, and managing stakeholder needs and requirements to meet project objectives.

Define Scope—The process of developing a detailed description of the project and product.

Create WBS—The process of subdividing project deliverables and project work into smaller, more manageable components.

Validate Scope—The process of formalizing acceptance of the completed project deliverables.

Control Scope—The process of monitoring the status of the project and product scope and managing changes to the scope baseline.

Project Scope Management Overview

5.1 Plan Scope Management

- .1 Inputs
 - .1 Project charter
 - .2 Project management plan
 - .3 Enterprise environmental factors
 - .4 Organizational process assets
- .2 Tools & Techniques
 - .1 Expert judgment
 - .2 Data analysis
 - .3 Meetings
- .3 Outputs
 - .1 Scope management plan
 - .2 Requirements management plan

5.4 Create WBS

- .1 Inputs
 - .1 Project management plan
 - .2 Project documents
 - .3 Enterprise environmental factors
 - .4 Organizational process assets
- .2 Tools & Techniques
 - .1 Expert judgment
 - .2 Decomposition
- .3 Outputs
 - .1 Scope baseline
 - .2 Project documents updates

5.2 Collect Requirements

- .1 Inputs
 - .1 Project charter
 - .2 Project management plan
 - .3 Project documents
 - .4 Business documents
 - .5 Agreements
 - .6 Enterprise environmental factors
 - .7 Organizational process assets
- .2 Tools & Techniques
 - .1 Expert judgment
 - .2 Data gathering
 - .3 Data analysis
 - .4 Decision making
 - .5 Data representation
 - .6 Interpersonal and team skills
 - .7 Context diagram
 - .8 Prototypes
- .3 Outputs
 - .1 Requirements documentation
 - .2 Requirements traceability matrix

5.5 Validate Scope

- .1 Inputs
 - .1 Project management plan
 - .2 Project documents
 - .3 Verified deliverables
 - .4 Work performance data
- .2 Tools & Techniques
 - .1 Inspection
 - .2 Decision making
- .3 Outputs
 - .1 Accepted deliverables
 - .2 Work performance information
 - .3 Change requests
 - .4 Project documents updates

5.3 Define Scope

- .1 Inputs
 - .1 Project charter
 - .2 Project management plan
 - .3 Project documents
 - .4 Enterprise environmental factors
 - .5 Organizational process assets
- .2 Tools & Techniques
 - .1 Expert judgment
 - .2 Data analysis
 - .3 Decision making
 - .4 Interpersonal and team skills
 - .5 Product analysis
- .3 Outputs
 - .1 Project scope statement
 - .2 Project documents updates

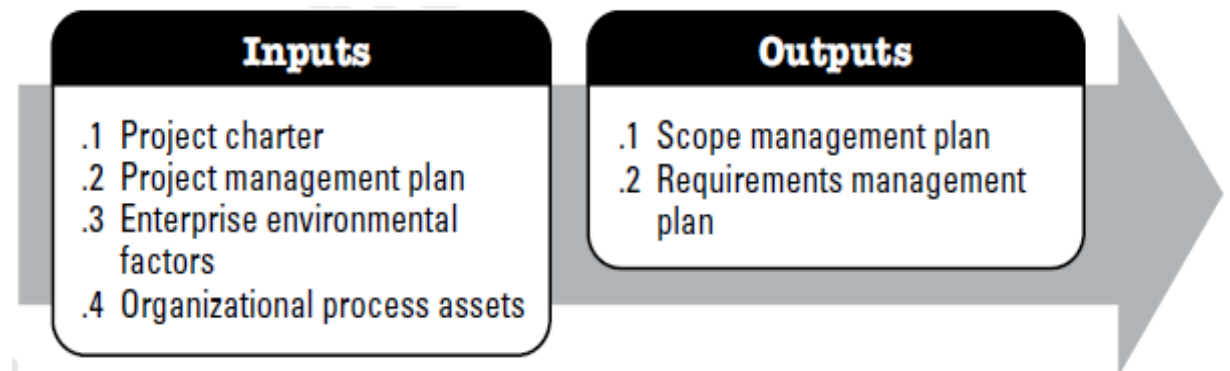
5.6 Control Scope

- .1 Inputs
 - .1 Project management plan
 - .2 Project documents
 - .3 Work performance data
 - .4 Organizational process assets
- .2 Tools & Techniques
 - .1 Data analysis
- .3 Outputs
 - .1 Work performance information
 - .2 Change requests
 - .3 Project management plan updates
 - .4 Project documents updates

The Scope Planning Process Group

PLAN SCOPE MANAGEMENT

Plan Scope Management is the process of creating a scope management plan that documents how the project and product scope will be defined, validated, and controlled. The key benefit of this process is that it **provides guidance and direction on how scope will be managed throughout the project**. This process is performed once or at predefined points in the project. The inputs and outputs of this process are depicted in the following Figure.



The Scope Planning Process Group tools and techniques

- Expert judgment
 - Expertise should be considered from individuals or groups with specialized knowledge or training in the following topics:
 - Previous similar projects, and
 - Information in the industry, discipline, and application area.
- Data analysis
 - A data analysis technique that can be used for this process includes but is not limited to alternatives analysis. Various ways of collecting requirements, elaborating the project and product scope, creating the product, validating the scope, and controlling the scope are evaluated.
- Meetings :-project teams may attend project meetings to develop the scope management plan.

The Scope Planning Process Group output

- **Requirements Management Plan.** A component of the project or program management plan that describes how requirements will be analyzed, documented, and managed.

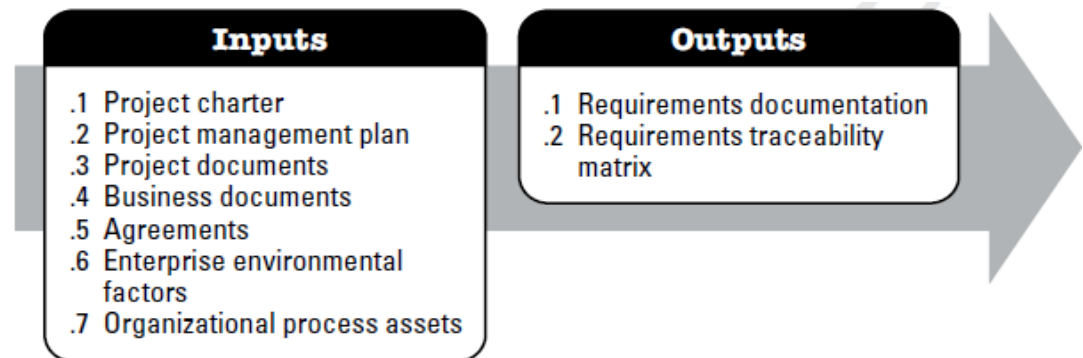
Examples of project management plan components that may be inputs for this process include but are not limited to:

1. Quality management plan,
 2. Project life cycle description, and
 3. Development approach.
- **Scope Management Plan.** A component of the project or program management plan that describes how the scope will be defined, developed, monitored, controlled, and validated.

The Scope Planning Process Group

COLLECT REQUIREMENTS

Collect Requirements is the process of determining, documenting, and managing stakeholder needs and requirements to meet objectives. The key benefit of this process is that it **provides the basis for defining the product scope and project scope**. This process is performed once or at predefined points in the project. The inputs and outputs of this process are depicted in the following Figure.



The Scope Planning Process Group

- **PROJECT MANAGEMENT PLAN COMPONENTS:-**Examples of project management plan components that may be inputs for this process include but are not limited to:
 1. Scope management plan,
 2. Requirements management plan, and
 3. Stakeholder engagement plan.
- **Procurement Documents.** The documents utilized in bid and proposal activities, which include the buyer's Invitation for bid, invitation for negotiations, request for information, request for quotation, request for proposal, and seller's responses. Examples of project documents that may be inputs for this process include but are not limited to:
 1. Assumption log,
 2. Lessons learned register, and
 3. Stakeholder register.

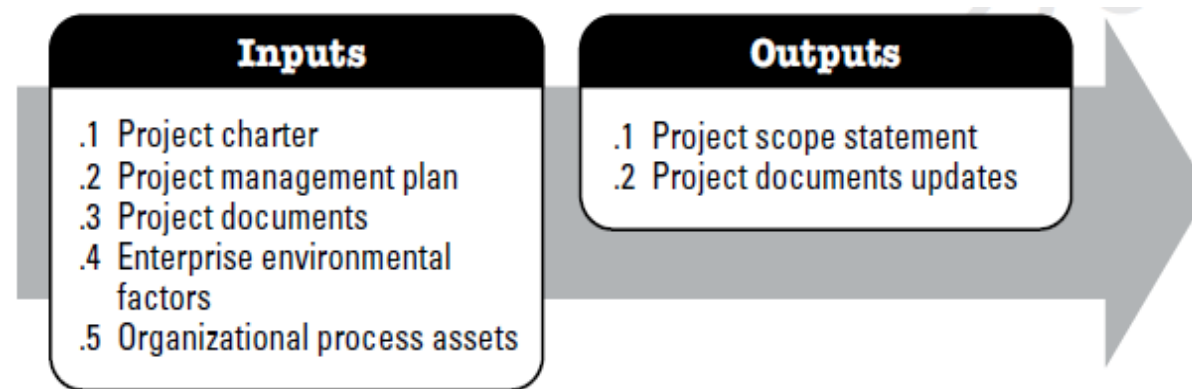
The Scope Planning Process Group

- **Agreements.** Any document or communication that defines the initial intentions of a project. This can take the form of a contract, memorandum of understanding (MOU), letters of agreement, verbal agreements, email, etc.
- **Requirements Documentation.** A description of how individual requirements meet the business need for the project.
- **Requirements Traceability Matrix.** A grid that links product requirements from their origin to the deliverables that satisfy them.

The Scope Planning Process Group

DEFINE SCOPE

- Define Scope is the process of developing a detailed description of the project and product. The key benefit of this process is that **it describes the product, service, or result boundaries** and acceptance criteria. This process is performed once or at predefined points in the project. The inputs and outputs of this process are depicted in the following Figure:-



The Scope Planning Process Group

PROJECT MANAGEMENT PLAN COMPONENTS

An example of a project management plan component that may be an input for this process includes but is not limited to the scope management plan.

PROJECT DOCUMENTS EXAMPLES

Examples of project documents that may be inputs for this process include but are not limited to:

1. Assumption log,
2. Requirements documentation, and
3. Risk register.

The Scope Planning Process Group

PROJECT DOCUMENTS UPDATES

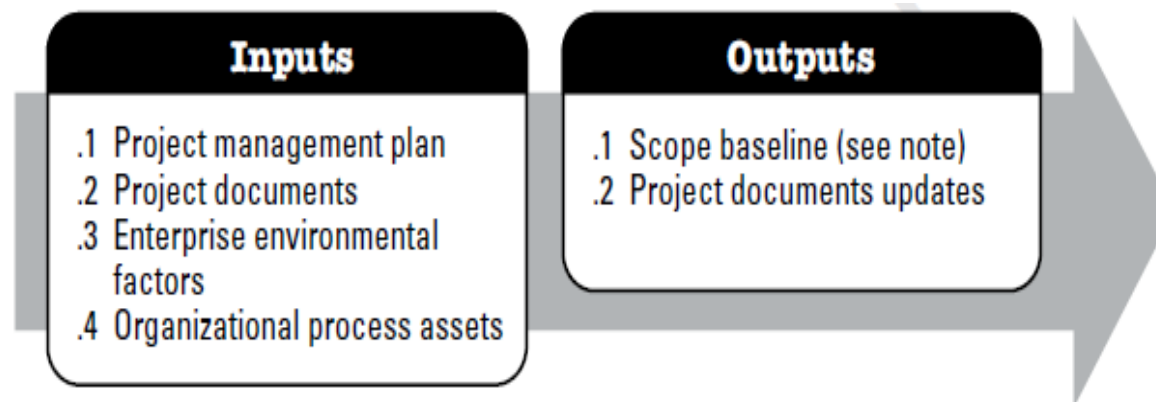
Project documents that may be updated as a result of this process include but are not limited to:

1. Assumption log,
2. Requirements documentation,
3. Requirements traceability matrix, and
4. Stakeholder register.
5. **Project Scope Statement.** The description of the project scope, major deliverables, assumptions, and constraints.

The Scope Planning Process Group

CREATE WBS

- Create Work Breakdown Structure (WBS) is the process of subdividing project deliverables and project work into smaller, more manageable components. The key benefit of this process is that it **provides a framework of what has to be delivered**. This process is performed once or at predefined points in the project. The inputs and outputs of this process are depicted in the following Figure.



The Scope Planning Process Group

- **Scope Baseline.** The approved version of a scope statement, work breakdown structure (WBS), and its associated WBS dictionary, that can be changed using formal change control procedures and is used as a basis for comparison to actual results. **Components of the scope baseline include:**

1. Project scope statement.
2. WBS.
3. Work package.
4. Planning package.
5. WBS dictionary.

- **PROJECT MANAGEMENT PLAN COMPONENTS**

An example of a project management plan component that may be an input for this process includes but is not limited to the scope management plan.

The Scope Planning Process Group

- **PROJECT DOCUMENTS EXAMPLES**

Examples of project documents that may be inputs for this process include but are not limited to:

- Project scope statement, and
- Requirements documentation.

- **PROJECT DOCUMENTS UPDATES**

- Project document that may be updated as a result of this process include but is not limited to:
- Assumption log, and
- Requirements documentation.

VALIDATE SCOPE

- Validate Scope is the process of formalizing acceptance of the completed project deliverables.
- The key benefit of this process is that it brings objectivity to the acceptance process and increases the probability of final product, service, or result acceptance by validating each deliverable. This process is performed periodically throughout the project as needed
-

CONTROL SCOPE

- Control Scope is the process of controlling the status of the project and product scope and managing changes to the scope baseline.
- The key benefit of this process is that the scope baseline is maintained throughout the project. This process is performed throughout the project

Chapter three

project schedule management

project schedule management



Project Schedule Management

Project Schedule Management includes the processes required to manage the timely completion of the project. The Project Schedule Management processes are:

1 Plan Schedule Management—The process of establishing the policies, procedures, and documentation for planning, developing, managing, executing, and controlling the project schedule.

2 Define Activities—The process of identifying and documenting the specific actions to be performed to produce the project deliverables.

3 Sequence Activities—The process of identifying and documenting relationships among the project activities.

An Overview of Project Schedule Management

4 Estimate Activity Durations—The process of estimating the number of work periods needed to complete individual activities with the estimated resources.

5 Develop Schedule—The process of analyzing activity sequences, durations, resource requirements, and schedule constraints to create the project schedule model for project execution and monitoring and controlling.

6 Control Schedule—The process of monitoring the status of the project to update the project schedule and manage changes to the schedule baseline.

Project Schedule Management Overview

6.1 Plan Schedule Management

- .1 Inputs
 - .1 Project charter
 - .2 Project management plan
 - .3 Enterprise environmental factors
 - .4 Organizational process assets
- .2 Tools & Techniques
 - .1 Expert judgment
 - .2 Data analysis
 - .3 Meetings
- .3 Outputs
 - .1 Schedule management plan

6.4 Estimate Activity Durations

- .1 Inputs
 - .1 Project management plan
 - .2 Project documents
 - .3 Enterprise environmental factors
 - .4 Organizational process assets
- .2 Tools & Techniques
 - .1 Expert judgment
 - .2 Analogous estimating
 - .3 Parametric estimating
 - .4 Three-point estimating
 - .5 Bottom-up estimating
 - .6 Data analysis
 - .7 Decision making
 - .8 Meetings
- .3 Outputs
 - .1 Duration estimates
 - .2 Basis of estimates
 - .3 Project documents updates

6.2 Define Activities

- .1 Inputs
 - .1 Project management plan
 - .2 Enterprise environmental factors
 - .3 Organizational process assets
- .2 Tools & Techniques
 - .1 Expert judgment
 - .2 Decomposition
 - .3 Rolling wave planning
 - .4 Meetings
- .3 Outputs
 - .1 Activity list
 - .2 Activity attributes
 - .3 Milestone list
 - .4 Change requests
 - .5 Project management plan updates

6.5 Develop Schedule

- .1 Inputs
 - .1 Project management plan
 - .2 Project documents
 - .3 Agreements
 - .4 Enterprise environmental factors
 - .5 Organizational process assets
- .2 Tools & Techniques
 - .1 Schedule network analysis
 - .2 Critical path method
 - .3 Resource optimization
 - .4 Data analysis
 - .5 Leads and lags
 - .6 Schedule compression
 - .7 Project management information system
 - .8 Agile release planning
- .3 Outputs
 - .1 Schedule baseline
 - .2 Project schedule
 - .3 Schedule data
 - .4 Project calendars
 - .5 Change requests
 - .6 Project management plan updates
 - .7 Project documents updates

6.3 Sequence Activities

- .1 Inputs
 - .1 Project management plan
 - .2 Project documents
 - .3 Enterprise environmental factors
 - .4 Organizational process assets
- .2 Tools & Techniques
 - .1 Precedence diagramming method
 - .2 Dependency determination and integration
 - .3 Leads and lags
 - .4 Project management information system
- .3 Outputs
 - .1 Project schedule network diagrams
 - .2 Project documents updates

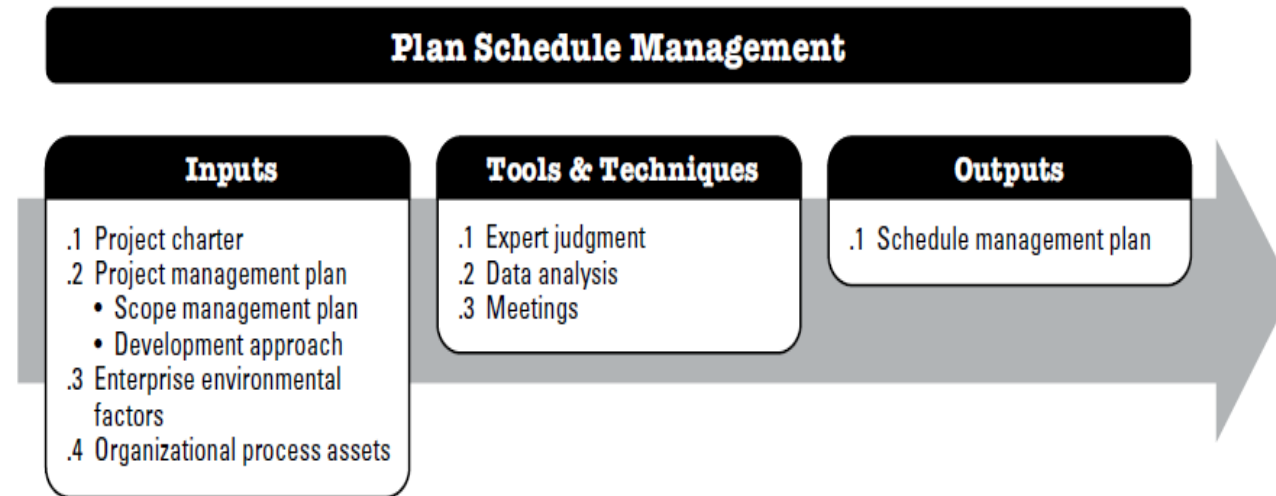
6.6 Control Schedule

- .1 Inputs
 - .1 Project management plan
 - .2 Project documents
 - .3 Work performance data
 - .4 Organizational process assets
- .2 Tools & Techniques
 - .1 Data analysis
 - .2 Critical path method
 - .3 Project management information system
 - .4 Resource optimization
 - .5 Leads and lags
 - .6 Schedule compression
- .3 Outputs
 - .1 Work performance information
 - .2 Schedule forecasts
 - .3 Change requests
 - .4 Project management plan updates
 - .5 Project documents updates

Plan Schedule Management

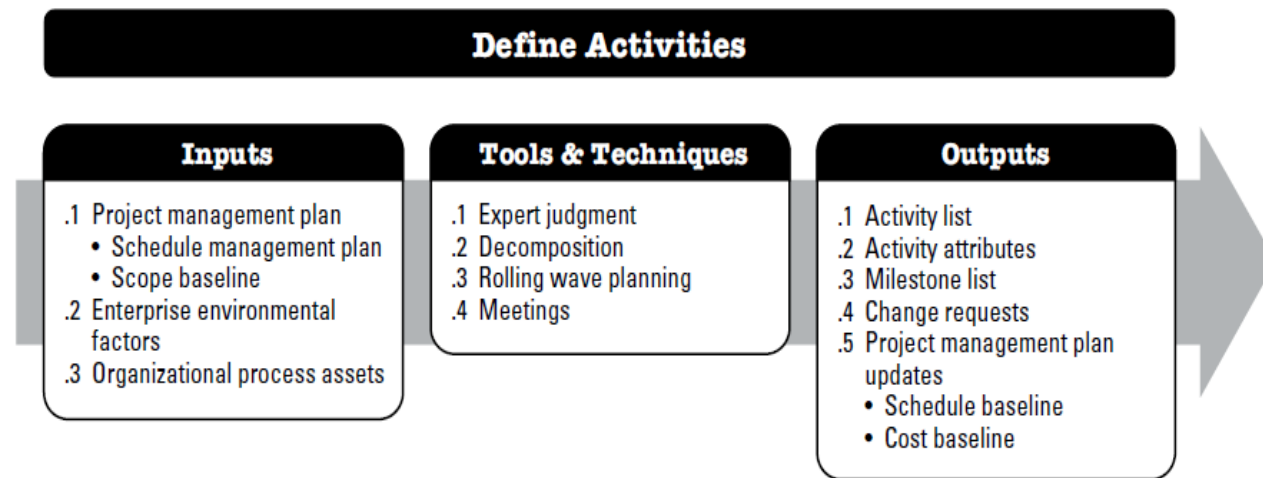
Plan Schedule Management is the process of establishing the policies, procedures, and documentation for planning, developing, managing, executing, and controlling the project schedule.

The key benefit of this process is that it provides guidance and direction on how the project schedule will be managed throughout the project. This process is performed once or at predefined points in the project. The inputs, tools and techniques, and outputs of the process are depicted in the following figure:-



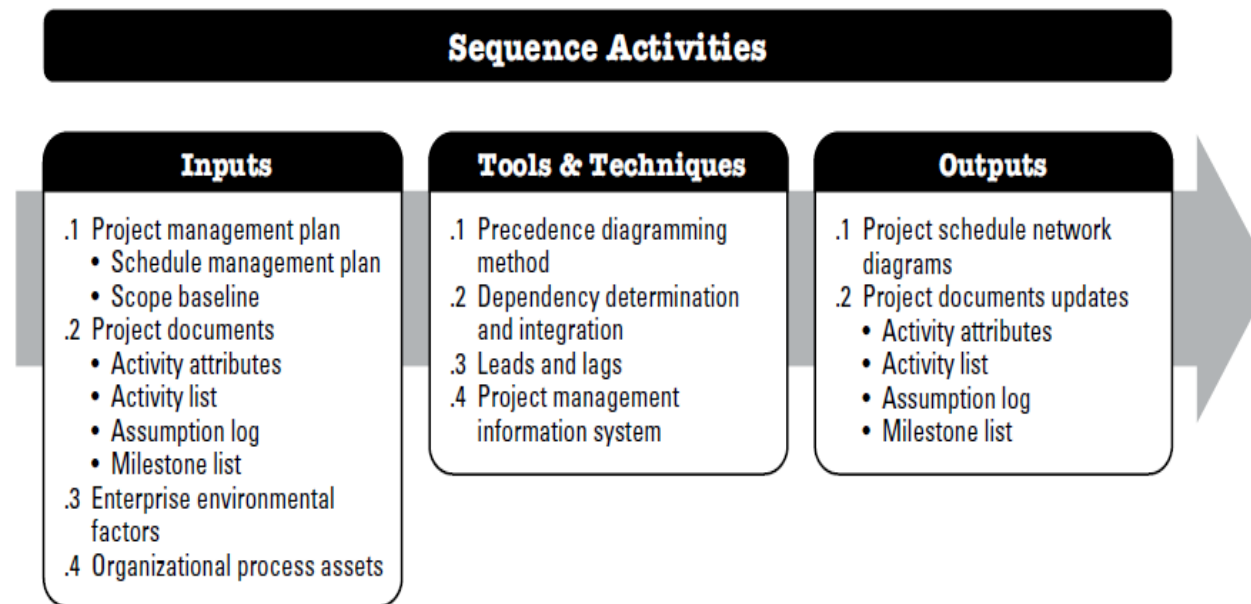
Define Activities

Define Activities is the process of identifying and documenting the specific actions to be performed to produce the project deliverables. The key benefit of this process is that it decomposes work packages into schedule activities that provide a basis for estimating, scheduling, executing, monitoring, and controlling the project work. This process is performed throughout the project. The inputs, tools and techniques, and outputs of this process are depicted in the following figure:-



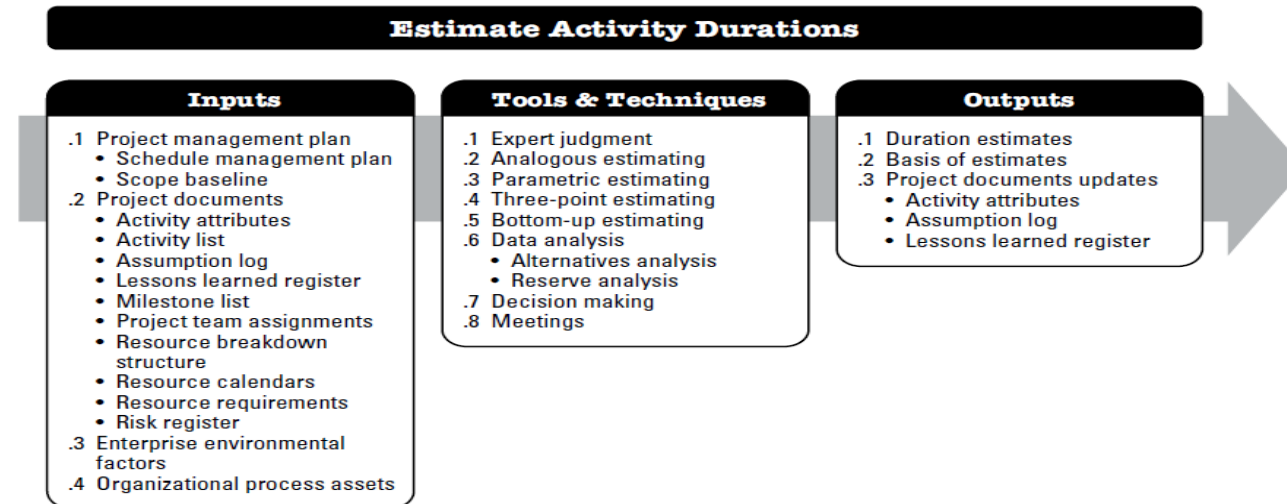
Sequence Activities

Sequence Activities is the process of identifying and documenting relationships among the project activities. The **key benefit** of this process is that it defines the logical sequence of work to obtain the greatest efficiency given all project constraints. This process is performed throughout the project. The inputs, tools and techniques, and outputs of this process are depicted in the following figure:-



ESTIMATE ACTIVITY DURATIONS

Estimate Activity Durations is the process of estimating the number of work periods needed to complete individual activities with estimated resources. The **key benefit** of this process is that it provides the amount of time each activity will take to complete. This process is performed throughout the project. The inputs, tools and techniques, and outputs of this process are depicted in the following figure:-



Estimate Activity Durations: Tools And Techniques

1. EXPERT JUDGMENT

Expertise should be considered from individuals or groups with specialized knowledge or training in the following topics:

- Schedule development, management, and control;
- Expertise in estimating; and
- Discipline or application knowledge.

2. ANALOGOUS ESTIMATING

Analogous estimating is a technique for estimating the duration or cost of an activity or a project using historical data from a similar activity or project. Analogous estimating uses parameters from a previous, similar project, such as duration, budget, size, weight, and complexity, as the basis for estimating the same parameter or measure for a future project. When estimating durations, this technique relies on the actual duration of previous, similar projects as the basis for estimating the duration of the current project.

Estimate Activity Durations: Tools And Techniques

It is a gross value estimating approach, sometimes adjusted for known differences in project complexity. Analogous duration estimating is frequently used to estimate project duration when there is a limited amount of detailed information about the project.

Analogous estimating is generally less costly and less time-consuming than other techniques, but it is also less accurate. Analogous duration estimates can be applied to a total project or to segments of a project and may be used in conjunction with other estimating methods. Analogous estimating is most reliable when the previous activities are similar in fact and not just in appearance, and the project team members preparing the estimates have the needed expertise.

Estimate Activity Durations: Tools And Techniques

3. THREE-POINT ESTIMATING

The accuracy of single-point duration estimates may be improved by considering estimation uncertainty and risk. Using three-point estimates helps define an approximate range for an activity's duration:

- **Most likely (tM).** This estimate is based on the duration of the activity, given the resources likely to be assigned, their productivity, realistic expectations of availability for the activity, dependencies on other participants, and interruptions.
- **Optimistic (tO).** The activity duration based on analysis of the best-case scenario for the activity.
- **Pessimistic (tP).** The duration based on analysis of the worst-case scenario for the activity.

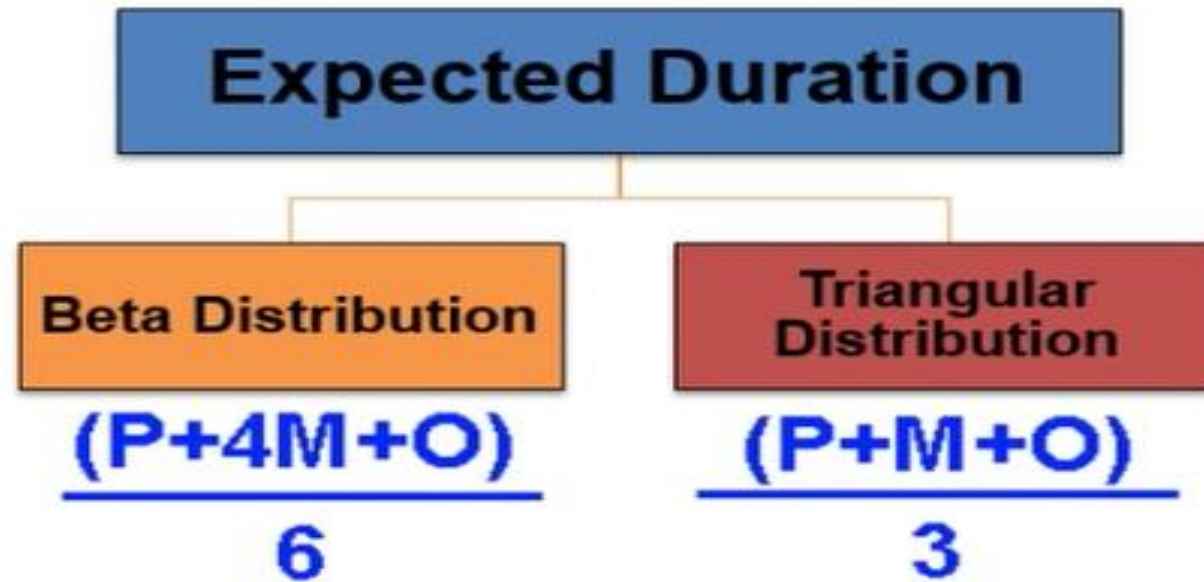
Estimate Activity Durations: Tools And Techniques

THREE-POINT ESTIMATING

Depending on the assumed distribution of values within the range of the three estimates, the expected duration, tE , can be calculated. One commonly used formula is triangular distribution: $tE = (tO + tM + tP) / 3$.

Triangular distribution is used when there is insufficient historical data or when using judgmental data. Duration estimates based on three points with an assumed distribution provide an expected duration and clarify the range of uncertainty around the expected duration.

THREE-POINT ESTIMATING



THREE-POINT ESTIMATING

Mulgeta is a risk manager in construction project, ha have an activity has an optimistic estimate 10 days, pessimistic estimate 16 days, and most likely estimate 13 days, according to Triangular Distribution, What is the estimated duration for the activity.

- A. 13 days
- B. 78 days
- C. 88 days
- D. 19 days

Estimate Activity Durations: Tools And Techniques

4. BOTTOM-UP ESTIMATING

Bottom-up estimating is a method of estimating project duration or cost by aggregating the estimates of the lower level components of the WBS. When an activity's duration cannot be estimated with a reasonable degree of confidence, the work within the activity is decomposed into more detail. The detail durations are estimated. These estimates are then aggregated into a total quantity for each of the activity's durations. Activities may or may not have dependencies between them that can affect the application and use of resources. If there are dependencies, this pattern of resource usage is reflected and documented in the estimated requirements of the activity.

Estimate Activity Durations: Tools And Techniques

5. DECISION MAKING

Decision-making techniques that can be used in this process include but are not limited to voting. One variation of the voting method that is often used in agile-based projects is called the fist of five (also called fist to five). In this technique, the project manager asks the team to show their level of support for a decision by holding up a closed fist (indicating no support) up to five fingers (indicating full support). If a team member holds up fewer than three fingers, the team member is given the opportunity to discuss any objections with the team. The project manager continues the fist-of-five process until the team achieves consensus (everyone holds up three or more fingers) or agrees to move on to the next decision.

Fist to Five



I completely understand
(can teach it).



I mostly understand
(can show it).



I understand pretty well.



I need more practice
and examples.



I need help.



I don't understand at all.

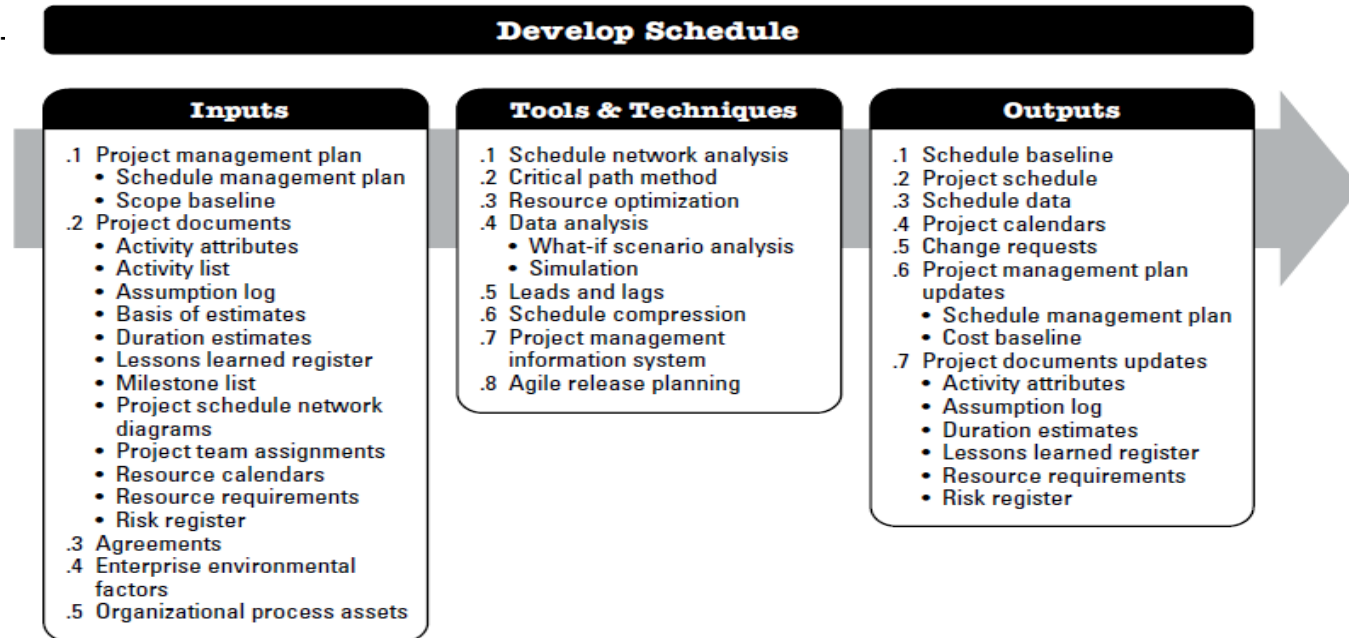
Estimate Activity Durations: Tools And Techniques

6. MEETINGS

The project team may hold meetings to estimate activity durations. When using an agile approach, it is necessary to conduct sprint or iteration planning meetings to discuss prioritized product backlog items (user stories) and decide which of these items the team will commit to work on in the upcoming iteration. The team breaks down user stories to low-level tasks, with estimates in hours, and then validates that the estimates are achievable based on team capacity over the duration (iteration). This meeting is usually held on the first day of the iteration and is attended by the product owner, the Scrum team, and the project manager. The outcome of the meeting includes an iteration backlog, as well as assumptions, concerns, risks, dependencies, decisions, and actions.

Develop Schedule

Develop Schedule is the process of analyzing activity sequences, durations, resource requirements, and schedule constraints to create a schedule model for project execution and monitoring and controlling. The key benefit of this process is that it generates a schedule model with planned dates for completing project activities. This process is performed throughout the project. The inputs, tools and techniques, and outputs of this process are depicted in following figure:-



Estimate Activity Durations: Tools And Techniques

SCHEDULE NETWORK ANALYSIS

Schedule network analysis is the overarching technique used to generate the project schedule model. It employs several other techniques such as critical path method, resource optimization techniques, and modeling techniques. Additional analysis includes but is not limited to:

- Assessing the need to aggregate schedule reserves to reduce the probability of a schedule slip when multiple paths converge at a single point in time or when multiple paths diverge from a single point in time, to reduce the probability of a schedule slip.
- Reviewing the network to see if the critical path has high-risk activities or long lead items that would necessitate use of schedule reserves or the implementation of risk responses to reduce the risk on the critical path.

Estimate Activity Durations: Tools And Techniques

CRITICAL PATH METHOD

The critical path method is used to estimate the minimum project duration and determine the amount of schedule flexibility on the logical network paths within the schedule model. This schedule network analysis technique calculates the early start, early finish, late start, and late finish dates for all activities without regard for any resource limitations by performing a forward and backward pass analysis through the schedule network.

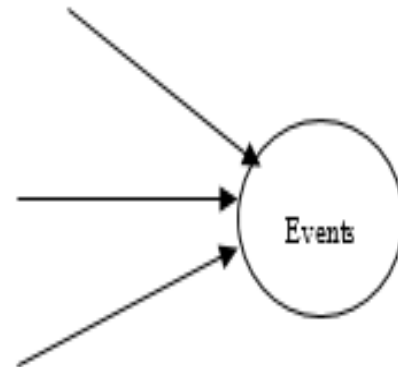
The critical path method is used to calculate the critical path(s) and the amount of total and free float or schedule flexibility on the logical network paths within the schedule model.

- A *network* is a graphical plan consisting of a certain configuration of arrow and nodes which indicates the logical sequence of various activities to be performed to achieve the objectives of a project.

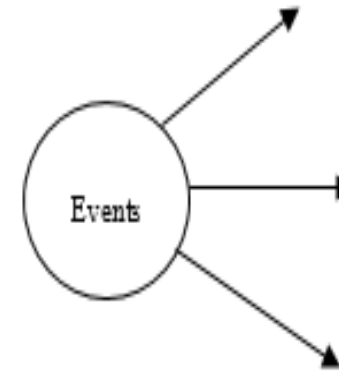
Network Components and Precedence Relationships

- CPM/PERT network diagram consists of two major components: **events** and **activities**.
- **Events**
- *Events* are commonly represented by circles (nodes) in the network diagram. The events can be further classified into the following two categories:
 - **Merge Event**: it is an event which represents the joint completion of more than one activity.
 - **Burst Event**: it is an event which represents the initiation (beginning) of more than one activity.

The two types of events are described in a network diagram as

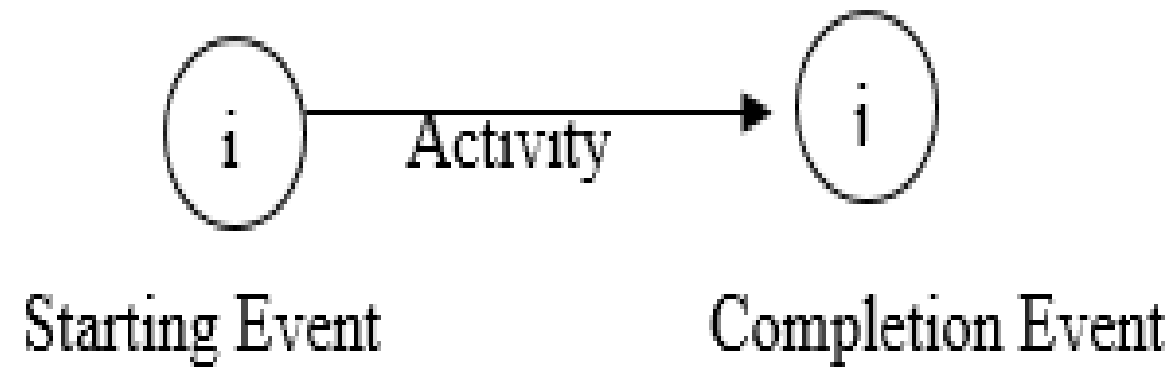


(a) Merge event



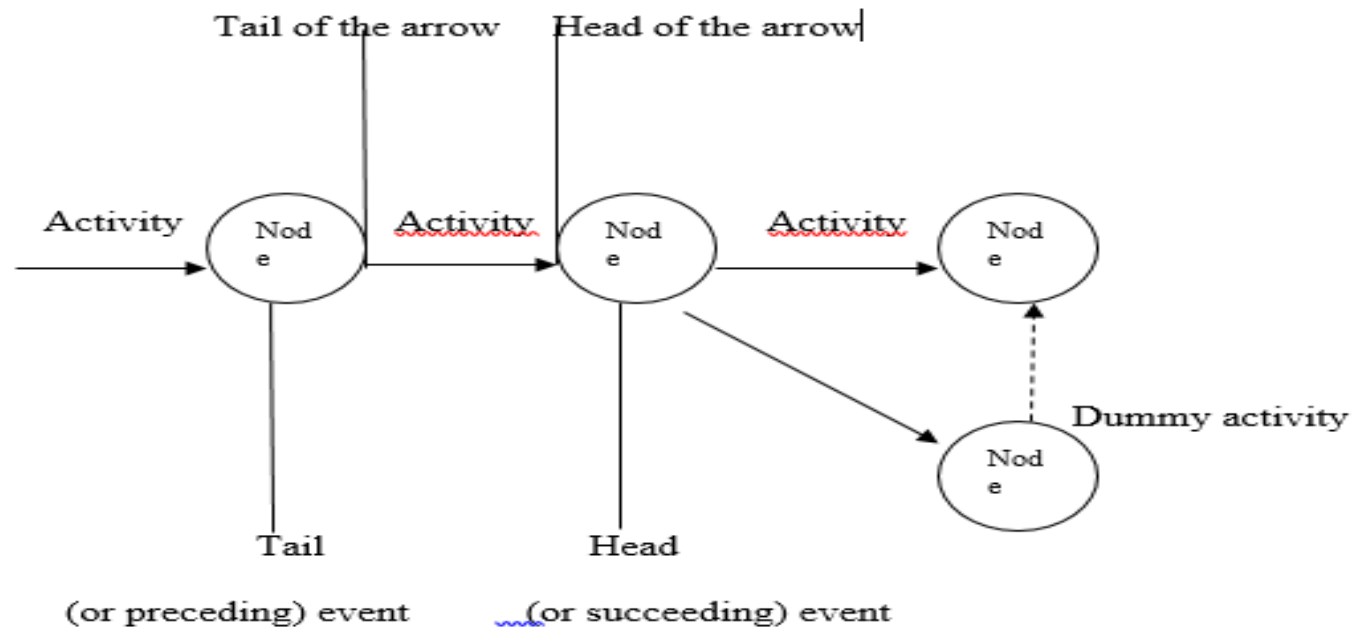
(b) Burst event

- **Activities**
- ***Activities*** in the network diagram represent project operations or tasks to be conducted.
- As such each activity consumes time and resources and incur costs.
- An arrow is commonly used to represent an activity with its head indicating the direction of progress in the project.



The activities can be further classified into the following three categories:

- (i) **Predecessor Activity:** it is an activity which must be completed before the start of one or more other activities.
- (ii) **Successor Activity:** it is an activity which started immediately after one or more of other activities are completed.
- (iii) **Dummy activity:** it is an activity which does not consume either any resource and/or time. A dummy activity in the network is added only to establish the given precedence relationship among activities of the project



- Network models use the following two types of precedence network to show precedence requirements of the activities in the project.
- **1. Activity-on-Node (AON) Network:**
 - each node (or circle) represents a specific task while the arcs represent the ordering between tasks.
 - A-O-N network diagrams place the activities within the nodes, and the arrows are used to indicate sequencing requirements.
 - Lacks of dummy activities in these diagrams always make them easier to draw and to interpret.

2. Activity-on-Arrow (AOA) network:

- In this type of precedence network, at each end of the activity arrow there is a node (or circle).
- These nodes represent points in time or instants, when an activity is starting or ending.
- The arrow itself represents the passage of time required for that activity to be performed.

Rules of AOA Network Construction

- The following are some of the rules which have to be followed while constructing a network:
 1. In network diagram, arrows represent activities and circles the events. The length of an arrow is of no significance.
 2. Each activity should be represented by only one arrow and must start and end in a circle called *event*. The tail of an activity represents the start, and head the completion of work.
 3. The event numbered 1 denotes start of the project and is called *initial event*. All activities emerging (or taking off) from event 1 should not be preceded by any other activity or activities. Event carrying the highest number denotes the completion event. A network should have only one initial event and only one terminal event.
 4. The general rule for numbering the event is that the head event should always be numbered larger than that at its tail. That is, events should be numbered such that for each activity (i,j), $i < j$.

5. An activity must be uniquely identified by its starting and completion event which implies that

- a. An event number should not get repeated or duplicated.
- b. Two activities should not be identified by the same completion event.
- c. Activities must be represented either by their symbols or by the corresponding ordered pair of starting-completion events.

6. The logical sequence (or inter-relationship) between activities must follow these rules:

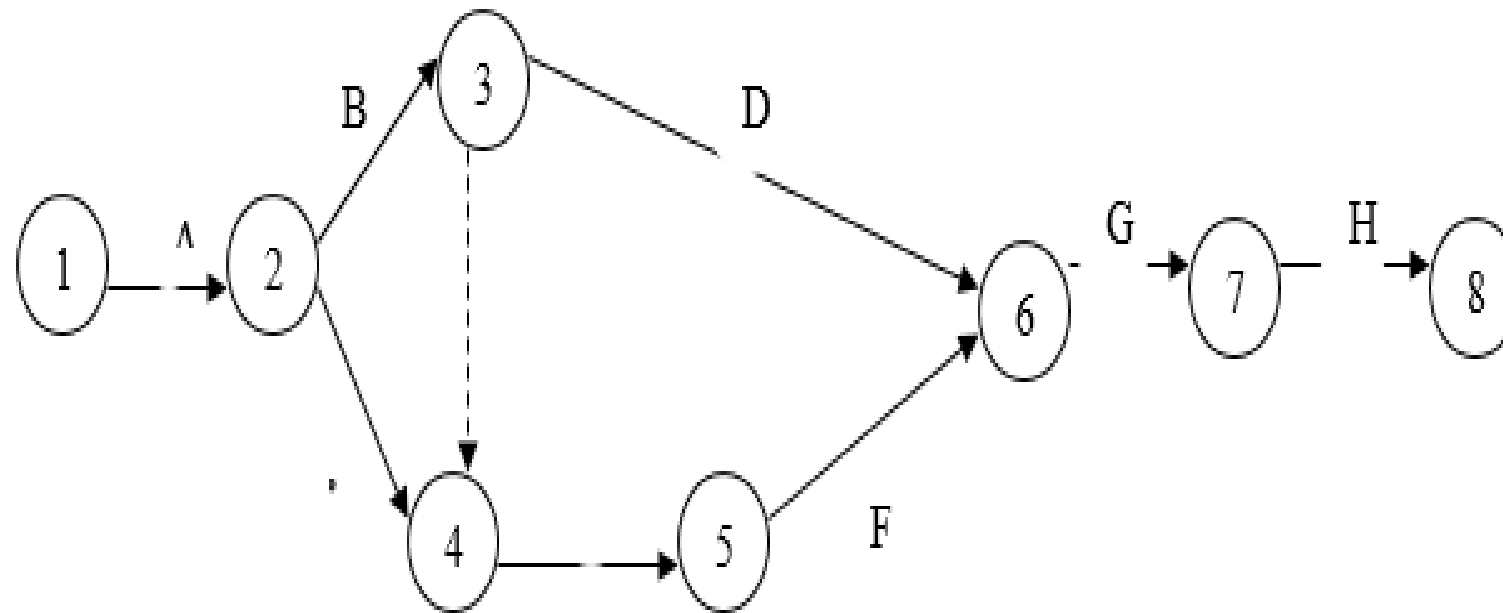
- a) An event cannot occur until all the incoming activities into it have been completed.
- b) An activity cannot start unless all the preceding activities on which it depends have been completed.
- c) A dummy activity does not consume either any resource of time, even then it has to follow the rules 6 (a) and 6(b).

Example: 1

<i>Activity</i>	<i>Description</i>	<i>Predecessor Activity</i>
<i>A</i>	Open work order	-
<i>B</i>	Get material for <i>X</i>	<i>A</i>
<i>C</i>	Get material for <i>y</i>	<i>A</i>
<i>D</i>	<u>Turn <i>X</i> on lathe</u>	<i>B</i>
<i>E</i>	Turn <i>Y</i> on lathe	<u><i>B,C</i></u>
<i>F</i>	Polish <i>Y</i>	<i>E</i>
<i>G</i>	<u>Assemble <i>X</i> and <i>Y</i></u>	<u><i>D,F</i></u>
<i>H</i>	pack	<i>G</i>

Draw a network diagram for the project.

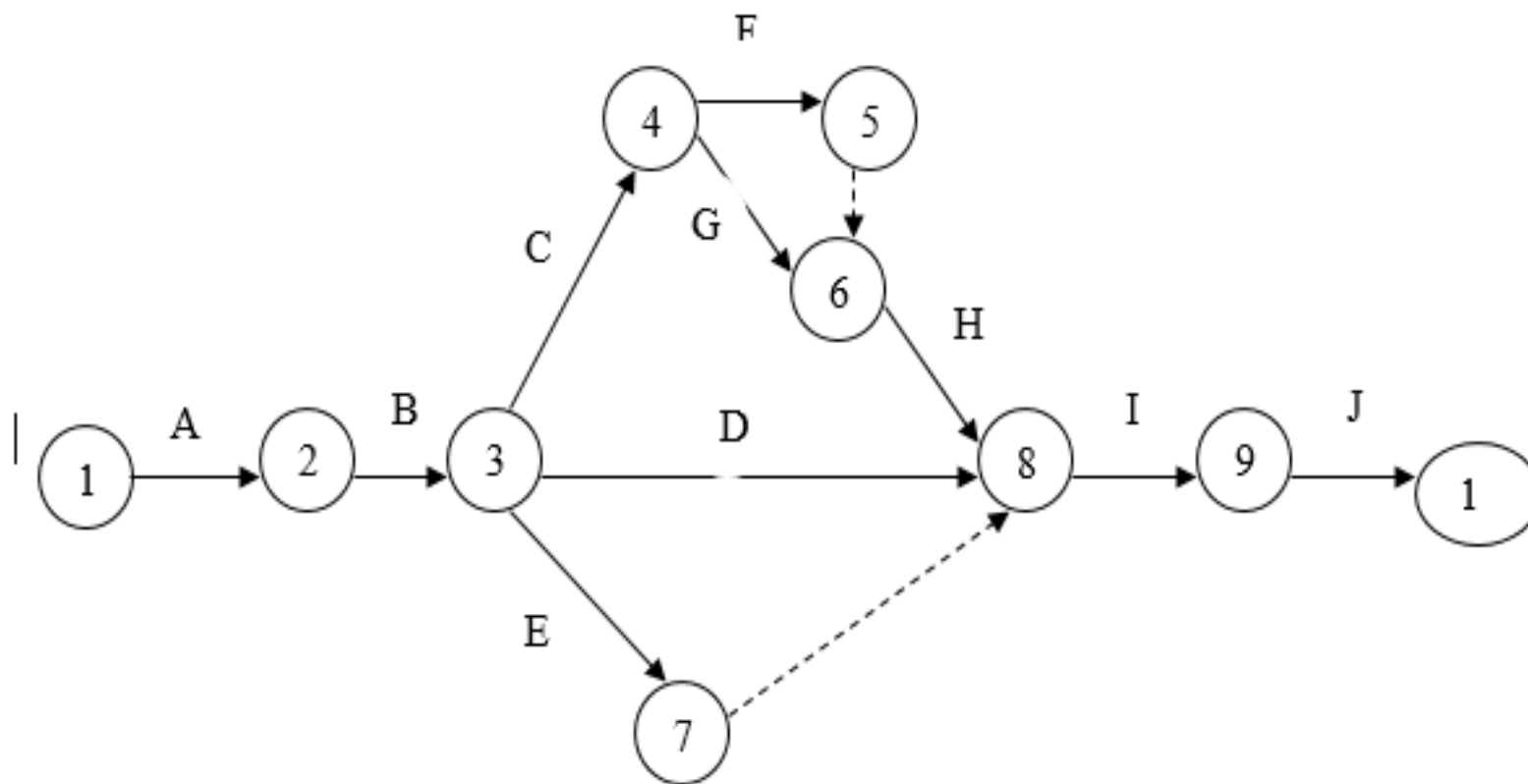
Solution: The network diagram for the project is shown in the following figure:



Example 2:

Draw a network diagram for the project.

<i>Activity</i>	<i>Description</i>	<i>Predecessor Activity</i>
<i>A</i>	Dismantle pipe connections	-
<i>B</i>	Dismantle heater, closure, and floating front	<i>A</i>
<i>C</i>	Remove tube bundle	<i>B</i>
<i>D</i>	Clean bolts	<i>B</i>
<i>E</i>	Clean heater and floating head front	<i>B</i>
<i>F</i>	Clean tube bundle	<i>C</i>
<i>G</i>	Clean shell	<i>C</i>
<i>H</i>	Replace tube bundle	<u><i>F, G</i></u>
<i>I</i>	Prepare shell pressure test	<u><i>D, E, H</i></u>
<i>J</i>	Prepare tube pressure test and reassemble	<i>I</i>



Critical Path Method (CPM) Analysis

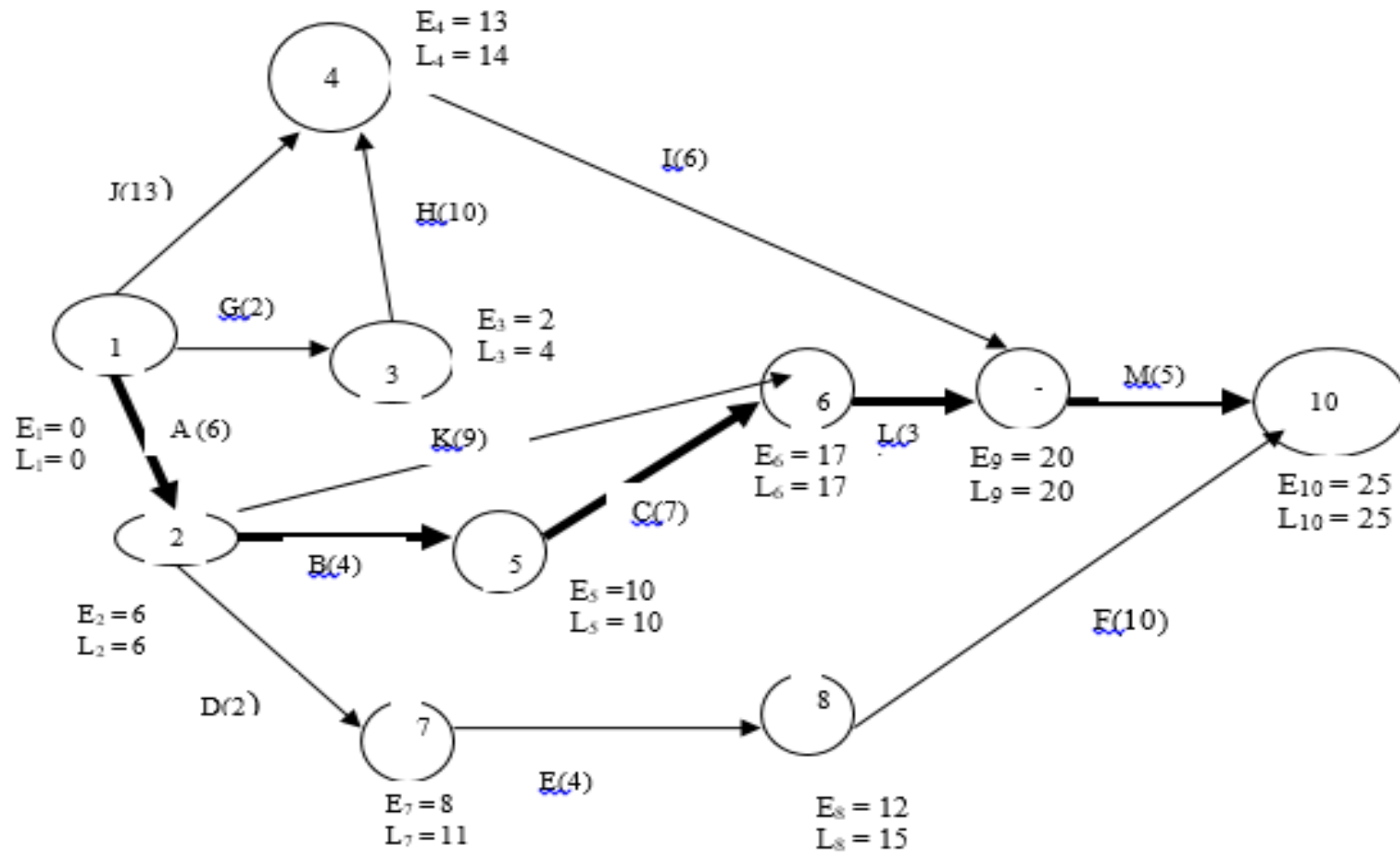
- **Steps involved in CPM**

The procedure of determining the critical path in CPM involves the following steps:

- Draw the network diagram including numbers for all events and put the time assigned for each activity on its respective arrow in the network diagram.
- Calculate earliest start time, latest start time, earliest finish time, latest finish time and total float for each activity.
- Identify the critical activities and connect them with bold or double arrow. This gives the critical path.
- Calculate the total duration of the project. It is the sum of the allotted times for each critical activities or critical path.

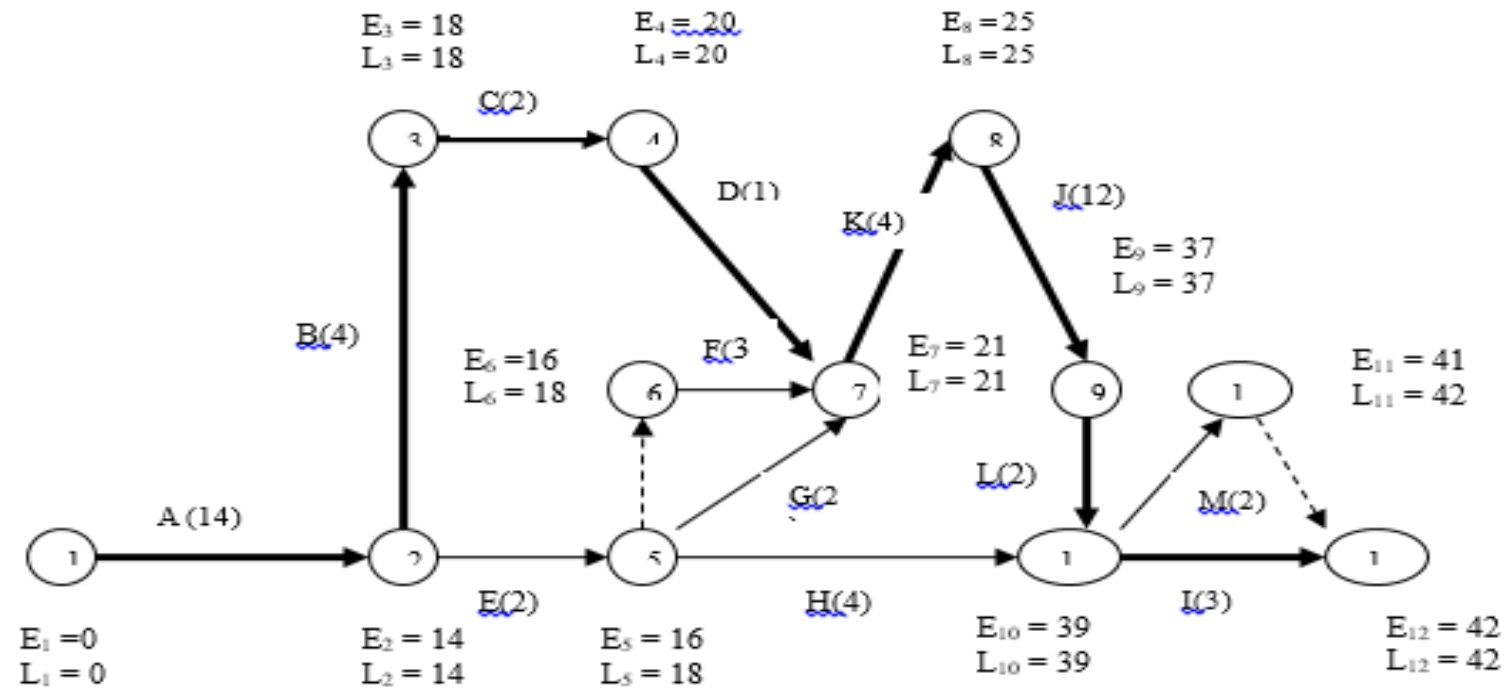
Example 3:

Activity	Description	Predecessors	Duration (weeks)
A	Organize sales office	-	6
B	Hire salesmen	A	4
C	Train salesmen	B	7
D	Select advertising agency	A	2
E	Plan advertising campaign	D	4
F	Conduct advertising campaign	E	10
G	Design package	--	2
H	Set-up package	G	10
I	Package initial stocks	J, H	6
J	Order stock from manufacturer	-	13
K	Select distributors	A	9
L	Sell to distributors	C, K	3
M	Ship stocks to distributors	I, L	5



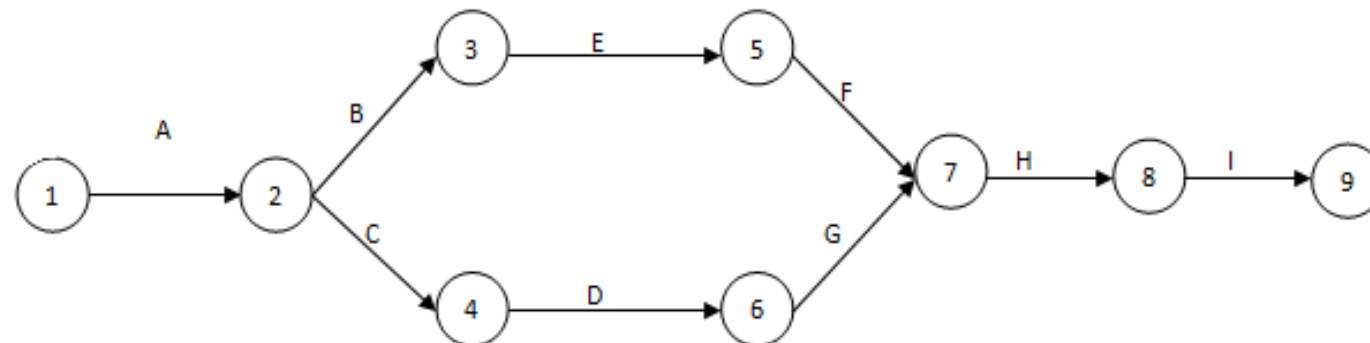
Example 4:

Activity	Description	Duration (weeks)	Immediate Predecessors
A	Design new premises	14	-
B	Obtain tenders from the contractors	4	A
C	Select the contractor	2	B
D	Arrange details with selected contractor	1	C
E	Decide which equipment is to be used	2	A
F	Arrange storage of equipment	3	E
G	Arrange disposal of other equipment	2	E
H	Order new equipment	4	E
I	Take delivery of new equipment	3	H, L
J	Renovations take place	12	K
K	Remove old equipment for storage or disposal	4	D, F, G



Example 3

ACTIVITY	DESCRIPTION	PRECEDED BY
A	Need Assessment	-
B	Environment Study	A
C	Requirement Study	A
D	System Analysis	C
E	Environment Match	B
F	Economic Feasibility Study	E
G	Technical Feasibility Study	D
H	Software Design	E,F
I	Software Development	H



Control Schedule

Control Schedule is the process of monitoring the status of the project to update the project schedule and managing changes to the schedule baseline. The key benefit of this process is that the schedule baseline is maintained throughout the project. This process is performed throughout the project. The inputs, tools and techniques, and outputs of this process are depicted in the following figure:-

