Unit 1

ITPM CSBS Sem VIII

Project Identification

- The purpose of project identification is to develop a preliminary proposal for the most appropriate set of interventions and course of action, within specific time and budget .

Identification involves:

- a review of alternative approaches or options for addressing a set of development problems and opportunities;
- the definition of project objectives and scope of work at the degree of detail necessary to justify commitment of the resources for detailed formulation and respective preparatory studies; and
- the identification of the major issues that must be tackled and the questions to be addressed before a project based on the concept can be implemented.

Market and demand analysis

- Market and demand analysis are carried out by the project manager in the process of evaluating a project idea
- Six steps :
- situational analysis and objectives specification,
- collection of data,
- market survey,
- market description,
- demand forecasting
- market planning.

Market and demand analysis

1. situational analysis and objectives specification :

- In order to get a “feel” of the relationship between the product and its market, the project analyst may informally talk to customers, competitors, middlemen, and others in the industry.

2. collection of data

- partly from secondary sources and partly through a market survey
- For secondary sources reliability, accuracy, and relevance for the purpose under consideration must be carefully examined

Market and demand analysis

- The market analyst should seek to know:
  - Who gathered the information? What was the objective?
  - When was the information gathered? When was it published?
  - How representative was the period for which the information was gathered?
  - Have the terms in the study been carefully and unambiguously defined?
  - What was the target population?
  - How was the sample chosen?
  - How representative was the sample?
  - How satisfactory was the process of information gathering?
  - What was the degree of sampling bias and non-response bias in the information gathered?
  - What was the degree of misrepresentation by respondents?

Market and demand analysis

3. Conduct of market survey:

For getting primary and secondary information market survey is needed to be done the market survey may be a census survey or a sample survey. In a census survey entire population is covered. On the other hand in a simple survey, a sample of the population is contracted or observed.

Market and demand analysis

- 4. ***Market description:***
- Based on the information gathered from secondary sources and through the market survey, the market for the product or service may be described in terms of the following –
- Effective demand in the past and present;
- Breakdown of demand,
- Price,
- Methods of distribution and sales promotion;
- Consumers;
- Supply and competition;
- Government policy.

Market and demand analysis

5. **Demand Forecasting** :

After gathering information about various aspects of the market and demand from primary and secondary sources, an attempt may be made to estimate future demand. A wide manage of forecasting methods is available to the market analyst.

- ***Uncertainties in demand forecasting:*** Demand forecasts are subject to error and uncertainty which arise from three principal sources:-
- Data about past and present market;
- Methods of forecasting;
- Environmental change.

Market and demand analysis

6. **Market Planning**

- A market planning usually has the following components.
- Current marketing situation;
- Opportunity and issue analysis;
- Objective;
- Marketing strategy;
- Action programmed.

Project estimation technique

- An estimate is a rough calculation of something.
- Key areas that benefit use of project estimating technique:

1. Cost
2. Time
3. Scope
4. Risk
5. Resources
6. Quality

Project estimation technique

- Types :
- Top-down estimate – Work Breakdown Structure
- Bottom-up estimate
- Expert judgement
- Comparative estimation
- Parametric modeling estimation
- Three-point estimation

Project cost estimation

- Software size estimation :

Essential part of SPM

helps the project manager to further predict the effort and time which will be needed to build the project

Project cost estimation

1. **Line of Code**

- count the total number of lines of source code in a project. The units of LOC are:

- KLOC- Thousand lines of code
- NLOC- Non-comment lines of code
- KDSI- Thousands of delivered source instruction

Project cost estimation

2. **Number of entities in ER diagram**

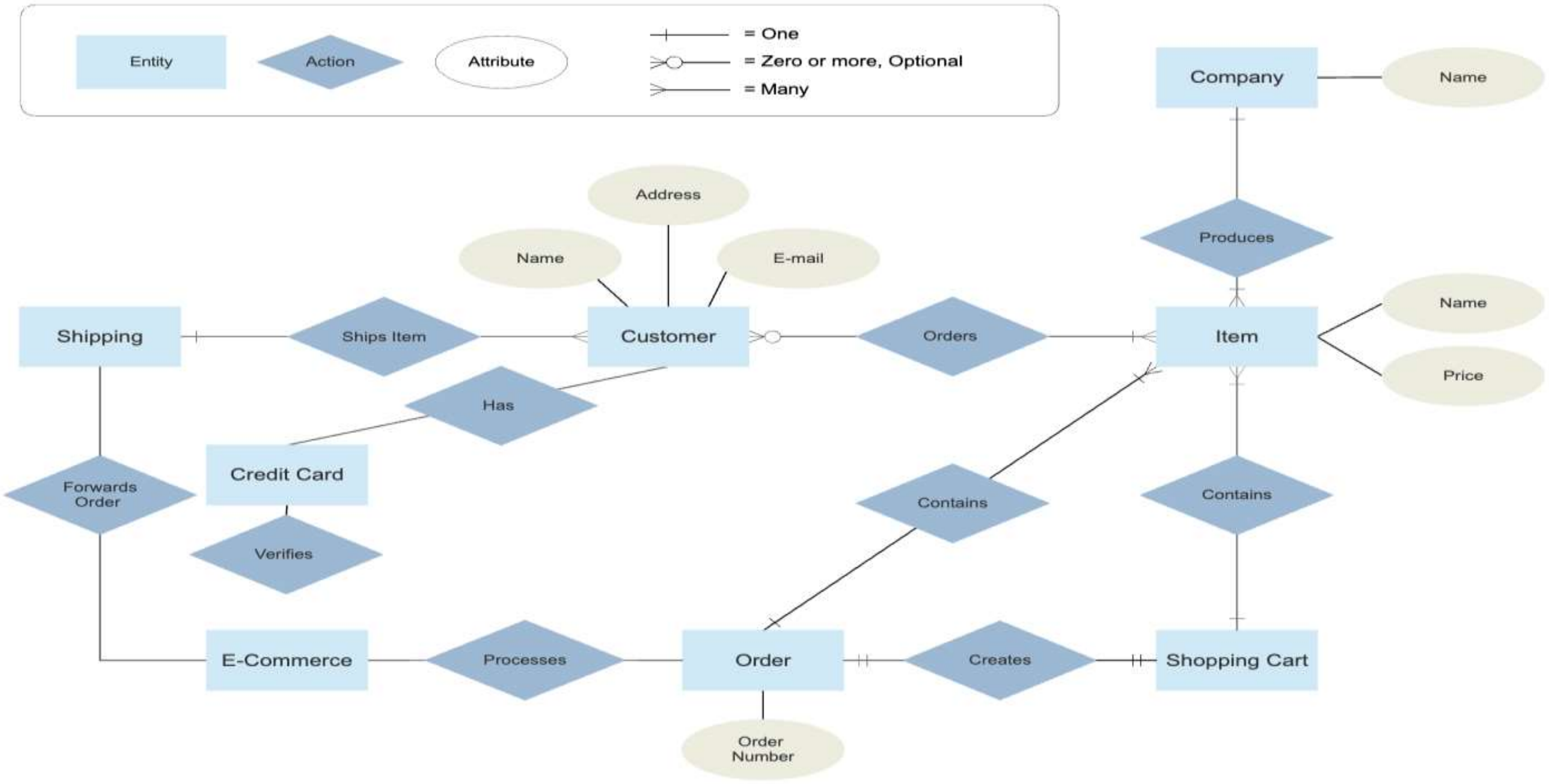
ER model provides a static view of the project.

It describes the entities and their relationships.

The number of entities in ER model can be used to measure the estimation of the size of the project.

The number of entities depends on the size of the project.

Entity Relationship Diagram - Internet Sales Model

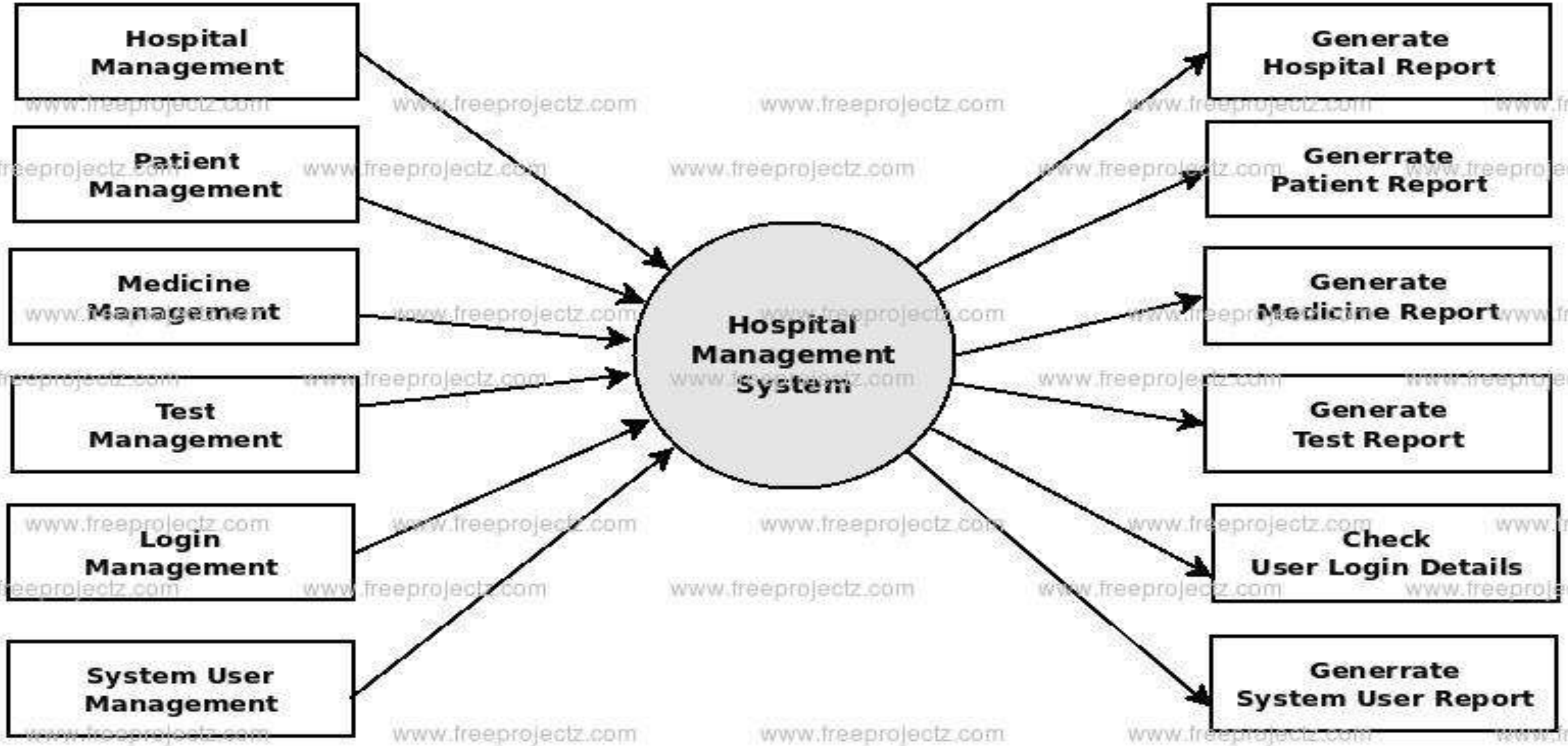


Project cost estimation

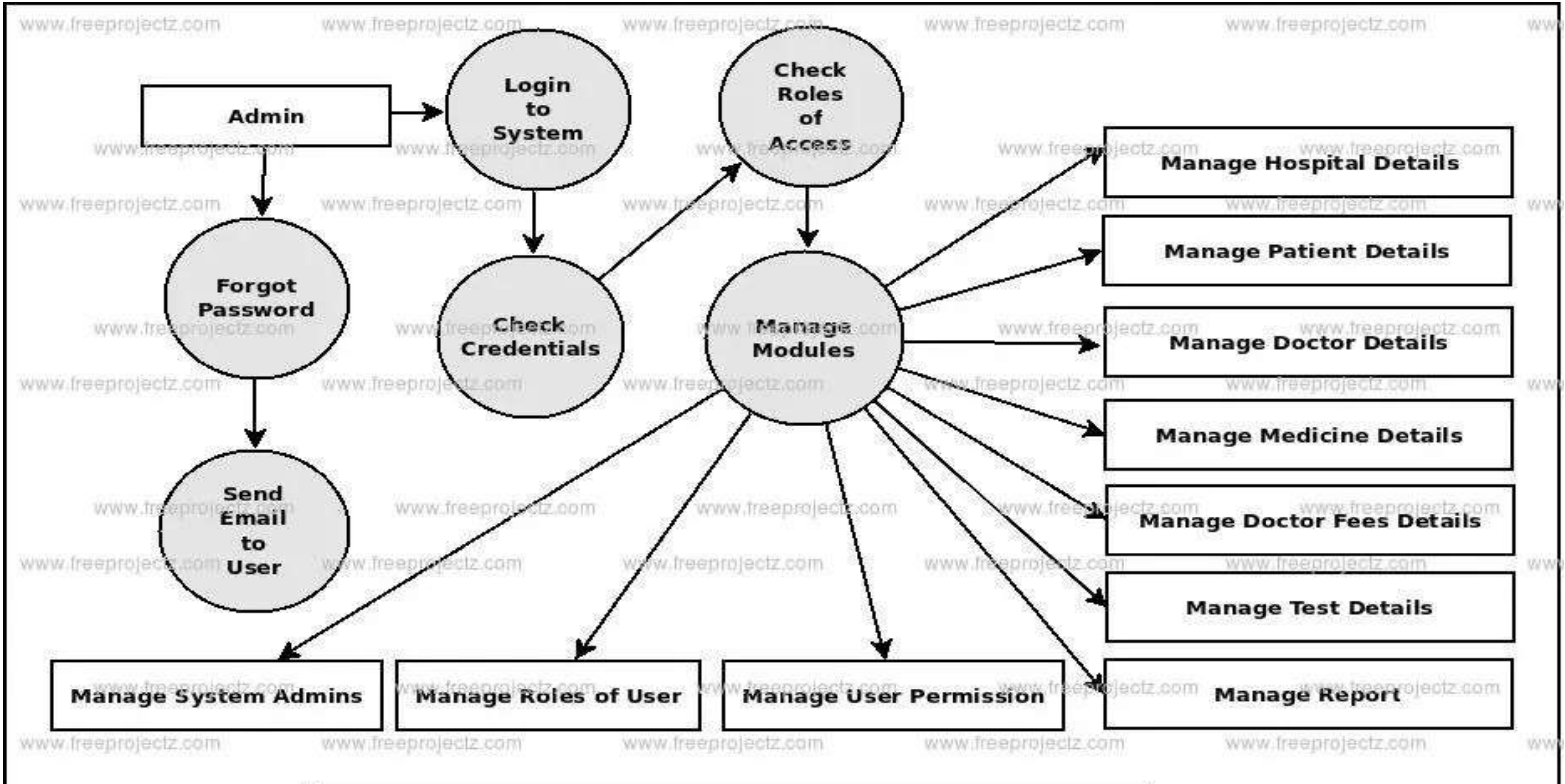
3. **Total number of processes in detailed data flow diagram:**

Data Flow Diagram(DFD) represents the functional view of software.

Already existing processes of similar type are studied and used to estimate the size of the process.



First Level DFD - Hospital Management System



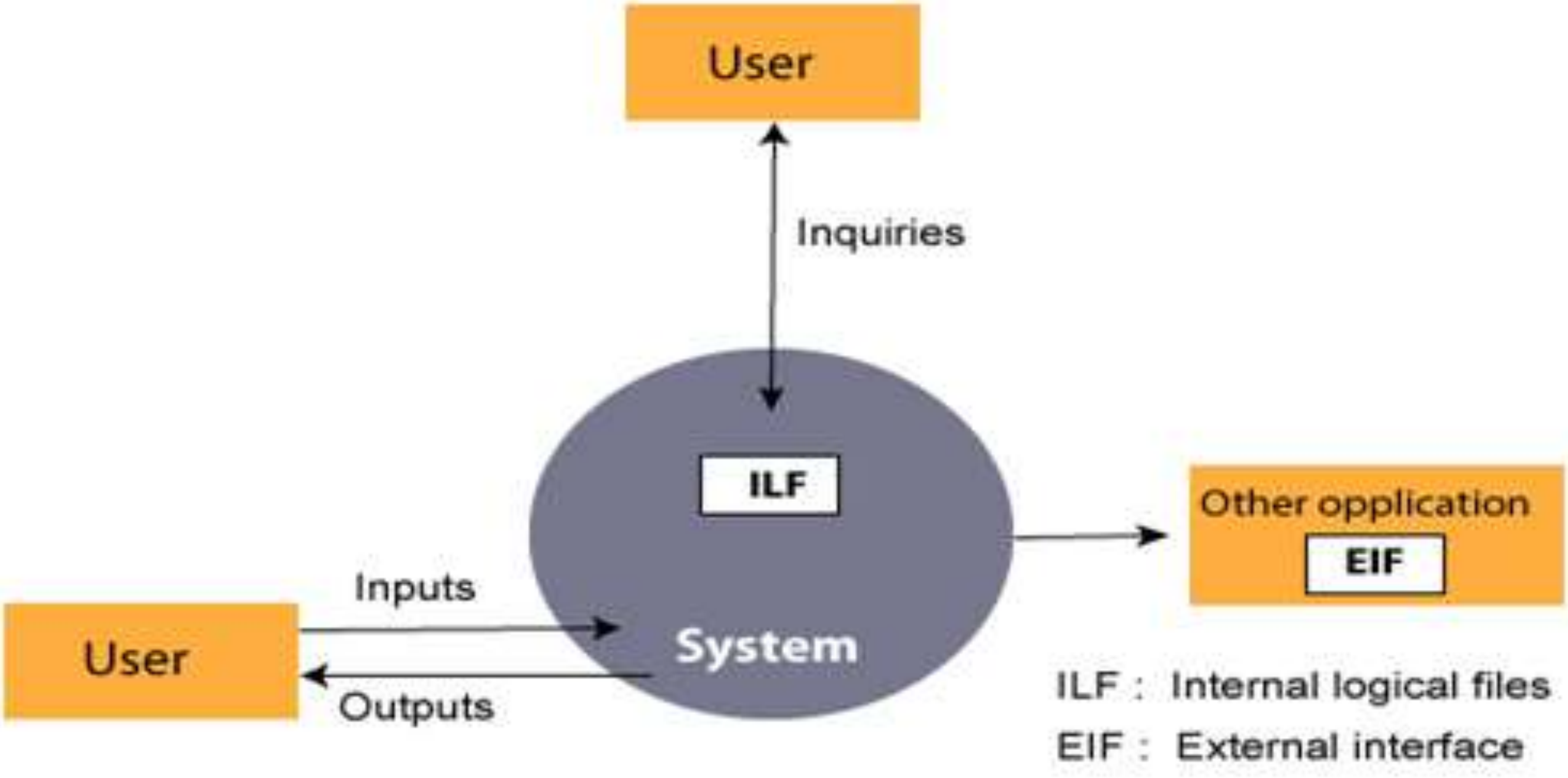
Second Level DFD - Hospital Management System

Project cost estimation

- 4. **Function Point Analysis:**

The steps in function point analysis are:

- Count the number of functions of each proposed type.
- Compute the Unadjusted Function Points(UFP).
- Find Total Degree of Influence (TDI).
- Compute Value Adjustment Factor (VAF).
- Find the Function Point Count (FPC).



FPAs Functional Units System

Project cost estimation

- **Count the number of functions of each proposed type:** Find the number of functions belonging to the following types:
    - External Inputs: Functions related to data entering the system.
    - External outputs: Functions related to data exiting the system.
    - External Inquiries: They lead to data retrieval from the system but don’t change the system.
    - Internal Files: Logical files maintained within the system. Log files are not included here.
    - External interface Files: These are logical files for other applications which are used by our system.

Project cost estimation

- **Compute the Unadjusted Function Points(UFP):** Categorise each of the five function types like simple, average, or complex based on their complexity. Multiply the count of each function type with its weighting factor and find the weighted sum. The weighting factors for each type based on their complexity are as follows:

Project cost estimation

- Example:

Function type	Simple	Average	Complex
External Inputs	3	4	6
External Output	4	5	7
External Inquiries	3	4	6
Internal Logical Files	7	10	15
External Interface Files	5	7	10

Project cost estimation

- **Find Total Degree of Influence (TDI) :** Use the ’14 general characteristics’ of a system to find the degree of influence of each of them. (0-5 scale)
- Data Communications, Distributed Data Processing, Performance, Heavily Used Configuration, Transaction Rate, On-Line Data Entry, End-user Efficiency, Online Update, Complex Processing Reusability, Installation Ease, Operational Ease, Multiple Sites and Facilitate Change.

Project cost estimation

- **Compute Value Adjustment Factor(VAF):** Use the following formula to calculate VAF
  VAF = (TDI * 0.01) + 0.65

Project cost estimation

- **Find the Function Point Count:** Use the following formula to calculate FPC
  FPC = UFP * VAF

Project cost estimation

- Based on the FP measure of software many other metrics can be computed:
- Errors/FP
- Function cost = $/FP.
- Defects/FP
- Pages of documentation/FP
- Errors/PM.
- Productivity = FP/PM (effort is measured in person-months).
- $/Page of Documentation.

Project cost estimation

- Example of function point :
- Given the following values, compute function point when all complexity adjustment factor (CAF) and weighting factors are average.
- User Input = 50
- User Output = 40
- User Inquiries = 35
- User Files = 6
- External Interface = 4

Project cost estimation

- **Step-1:** As complexity adjustment factor is average (given in question), hence,scale = 3.
- F = 14 * 3 = 42
- **Step-2:**CAF = 0.65 + (0.01 * 42) = 1.07
- **Step-3:** As weighting factors are also average (given in question) hence we will multiply each individual function point to corresponding values in TABLE.UFP = (50*4) + (40*5) + (35*4) + (6*10) + (4*7) = 628
- **Step-4:**Function Point = 628 * 1.07 = 671.96

Project cost estimation

- Calculate the function point, productivity, documentation, and cost per function for software application with multiple Processing Factors 5, 1, 0, 4, 3, 5, 4, 3, 4, 5, 2, 3, 4, 2 by using following given Date: The number of EI(Avg): 22,The number of EO(Low): 45,The number of EI(High): 06, The number of ILF(Avg): 05, The number of ELF(Low): 02, Effort:37 MM, Software technical documents: 250 pages, User related documents: 120 pages and Budgeting/Cost: $7520 per month.

Example of function point

Parameters	**Weight Factors**		
	Low	**Average**	**High**
External Inputs (EI)	3	4	6
External Outputs (EO)	4	5	7
External Inquiries (EI)	3	4	6
Internal Logic Files (ILF)	7	10	15
External Logic Files(ELF)	5	7	10

Example of function point

- Productivity (P) = FP/Effort
- Total Page of Documentation (PD) = Software Technical Documents + User related documents
- Documentation (D) = PD/FP
- Cost of each Functionalities = COST/Productivity

Example of function point

Example: Compute the function point, productivity, documentation, cost per function for the following data:

- Number of user inputs = 24 (Average)
- Number of user outputs = 46 (Simple)
- Number of inquiries = 8 (Complex)
- Number of files = 4 (Average)
- Number of external interfaces = 2 (Simple)
- Effort = 36.9 p-m
- Technical documents = 265 pages
- User documents = 122 pages
- Cost = $7744/ month
- Various processing complexity factors are: 4, 1, 0, 3, 3, 5, 4, 4, 3, 3, 2, 2, 4, 5.

Computing FPs

Measurement Parameter	Count		Weighing factor			
			Simple	Average	Complex	
1. Number of external inputs (EI)	—	*	3	4	6 =	—
2. Number of external Output (EO)	—	*	4	5	7 =	—
3. Number of external Inquiries (EQ)	—	*	3	4	6 =	—
4. Number of internal Files (ILF)	—	*	7	10	15 =	—
5. Number of external interfaces(EIF)	—	*	5	7	10 =	—
Count-total →						

- So sum of all fi (i ← 1 to 14) = 4 + 1 + 0 + 3 + 5 + 4 + 4 + 3 + 3 + 2 + 2 + 4 + 5 = 43

- FP = Count-total * [0.65 + 0.01 *∑(fi)]
- = 378 * [0.65 + 0.01 * 43]
- = 378 * [0.65 + 0.43]
- = 378 * 1.08 = 408

- Functional Point (FP) Analysis
- Total pages of documentation = technical document + user document
- = 265 + 122 = 387pages

- Documentation = Pages of documentation/FP
- = 387/408 = 0.94

- Functional Point (FP) Analysis

Financial Appraisal

- Financial appraisal is a method used to evaluate the viability of a proposed project by assessing the value of net cash flows that result from its implementation.

Financial Appraisal

1. Return on Investment (ROI). ROI is a direct measure of the return of capital produced by a project relative to the amount of capital spent on or invested in a project. ROI is calculated with the following equation:

- ROI = (Gain from Investment – Investment Cost) / Investment Cost
- The higher the return on investment, the more desirable the project.

ROI examples

- A person bought a house that needed significant work for $100,000. During the course of a year, they invested an additional $100,000 to renovate the house to make it sellable. They are able to sell the renovated house for $250,000. Calculate ROI

Financial Appraisal

- 2. Payback Period :

The payback period of a project examines how long a project will take in order to recover the amount of capital invested. It asks the question; how long will it take for a project to generate enough income to pay for itself? The simplest calculation for payback period is to divide the amount of capital invested in the project by the amount generated (or saved) by the project per period of time (months, years, etc.).

Payback period = amount of capital invested / amount generated per period of time

Using payback period, the project with the shortest time to recover invested capital should be selected.

Financial Appraisal

NPV

- Net present value is a tool of Capital budgeting to analyze the profitability of a project or investment. It is calculated by **taking the difference between the present value of cash inflows and present value of cash outflows over a period of time**
- NPV=Cash flow/(1+i)^t −initial investment

where:

- i=Required return or discount rate
- t=Number of time periods

NPV Example

- **Company A ltd wanted to know their net present value of cash flow if they invest 100000 today. And their initial investment in the project is 80000 for the 3 years of time, and they are expecting the rate of return is 10 % yearly. From the above available information, calculate the NPV.**

NPV example

- NPV = Cash flows /(1- i)t – Initial investment
- = 100000/(1-10)^3-80000
- **NPV** = **57174.21**

Financial Appraisal

- Advantage of NPV :
- Better approach as it considers time value for money
- Gives importance to profitability and risk
- Helps in maximizing value of the company
- Considers changing discount rate

- Disadvantage:
- Complex to calculate
- Sensitive to fluctuations
- Fails to provide accurate result when the two projects have different life period

Financial Appraisal

- *IRR :*

- *NPV*=*t*=0∑*n* *CFt* / (1+*r*)*t*

- **where:***CFt*=net after-tax cash inflow-outflows during a single period t
- *r*=internal rate of return that could be earned in alternative investments
- *t*=time period cash flow is received
- *n*=number of individual cash flows

Financial Appraisal

- Advantage of IRR:
- Considers time value of money
- Considers cash flows thru the life span
- Consistent vth wealth maximization objective

- Disadvantage:
- Tedius and difficult calculation
- Produces multiple rate of return
- May not give valid result for unequal project span, unequal cash flow

Financial Appraisal

- The Cost Performance Index (CPI) is a method for calculating the cost efficiency and financial effectiveness of a specific project through the following formula:

- **CPI = earned value (EV) / actual cost (AC)**.

- A CPI ratio with a value higher than 1 indicates that a project is performing well budget-wise

Financial Appraisal

- **Accounting Rate of Return (ARR) is the percentage rate of return that is expected from an investment or asset compared to the initial cost of investment.** Typically, ARR is used to make capital budgeting decisions. For example, if your business needs to decide whether to continue with a particular investment, whether it’s a project or an acquisition, an ARR calculation can help to determine whether going ahead is the right move.

- The Accounting Rate of Return formula is as follows:
- **ARR = average annual profit / average investment**

Financial Appraisal

- Example
- A Company wants to invest in new set of vehicles for the business. The vehicles cost 350,000 and would increase the company's annual revenue by 100,000, as well as the company's annual expenses by 10,000. The vehicles are estimated to have a useful shelf life of 20 years, with no salvage value. So, the ARR calculation is as follows:

1. Average annual profit = 100,000 - 10,000 = 90,000
2. Depreciation expense = 350,000 / 20 = 17,500
3. True average annual profit = 90,000 - 17,500 = 72,500
4. ARR = 72,500 / 350,000 = 0.2071 = 20.71%

ARR example

- XYZ Company is looking to invest in some new machinery to replace its current malfunctioning one. The new machine, which costs $420,000, would increase annual revenue by $200,000 and annual expenses by $50,000. The machine is estimated to have a useful life of 12 years and zero salvage value.

ARR example

- **Calculate Average Annual Profit**
- inflows, Years 1-12 = (200,000*12) = 2400000
- **Annual Expenses**
- (50,000*12) = 600000
- **Depreciation**
- 420,000
- Total profit : 1380000
- **Average Annual Profit**
- (1,380,000/12) = **115,000**

ARR example

- **Calculate Average Investment**
- ($420,000 + $0)/2 = **$210,000**
- **Use ARR Formula**
- ARR = $115,000/$210,000 = **54.76%**

ARR example

2. XYZ Company is considering investing in a project that requires an initial investment of $100,000 for some machinery. There will be net inflows of $20,000 for the first two years, $10,000 in years three and four, and $30,000 in year five. Finally, the machine has a salvage value of $25,000.

Calculate Average Annual Profit

Inflows, Years 1 & 2

(20,000*2)   = 40,000

Inflows, Years 3 & 4

(10,000*2)   = 20,000

ARR example

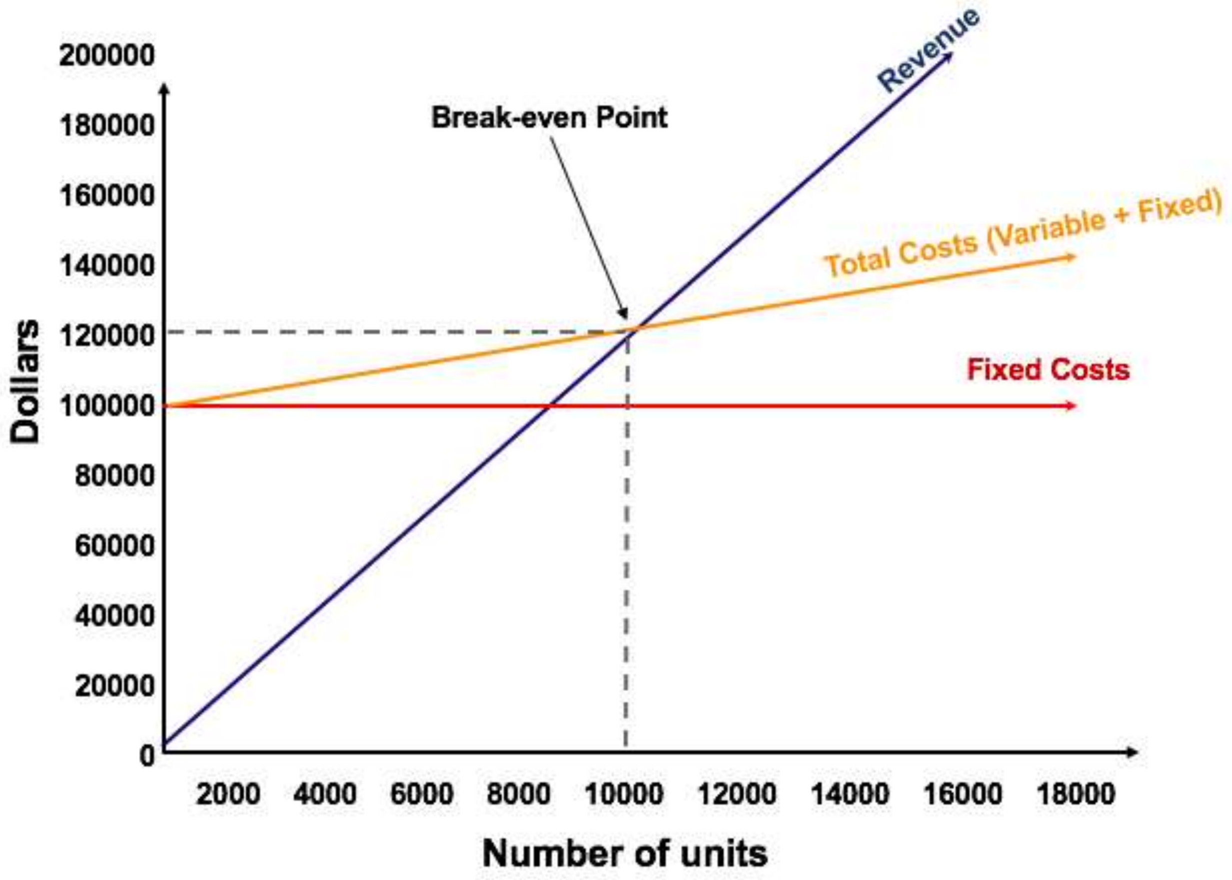
- Inflow, Year 5   - 30,000
- Depreciation
- (100,000-25,000)   - 75,000
- Total Profit   - 15,000
- **Average Annual Profit**
- (15,000/5)   - **3,000**
- **Calculate Average Investment**
- ($100,000 + $25,000) / 2 = **$62,500**
- **Use ARR Formula**
- ARR = $3,000/$62,500 = **4.8%**

Financial Appraisal

- **What is Break Even Analysis?**
- Break Even Analysis in economics, business, and cost accounting refers to the point in which total cost and total revenue are equal. A break even point analysis is used to determine the number of units or dollars of revenue needed to cover total costs

- **Break even quantity = Fixed costs / (Sales price per unit – Variable cost per unit)**
-
- Where:
- **Fixed costs** are costs that do not change with varying output (e.g., salary, rent, building machinery).
- **Sales price per unit** is the selling price (unit selling price) per unit.
- **Variable cost per unit** is the variable costs incurred to create a unit.

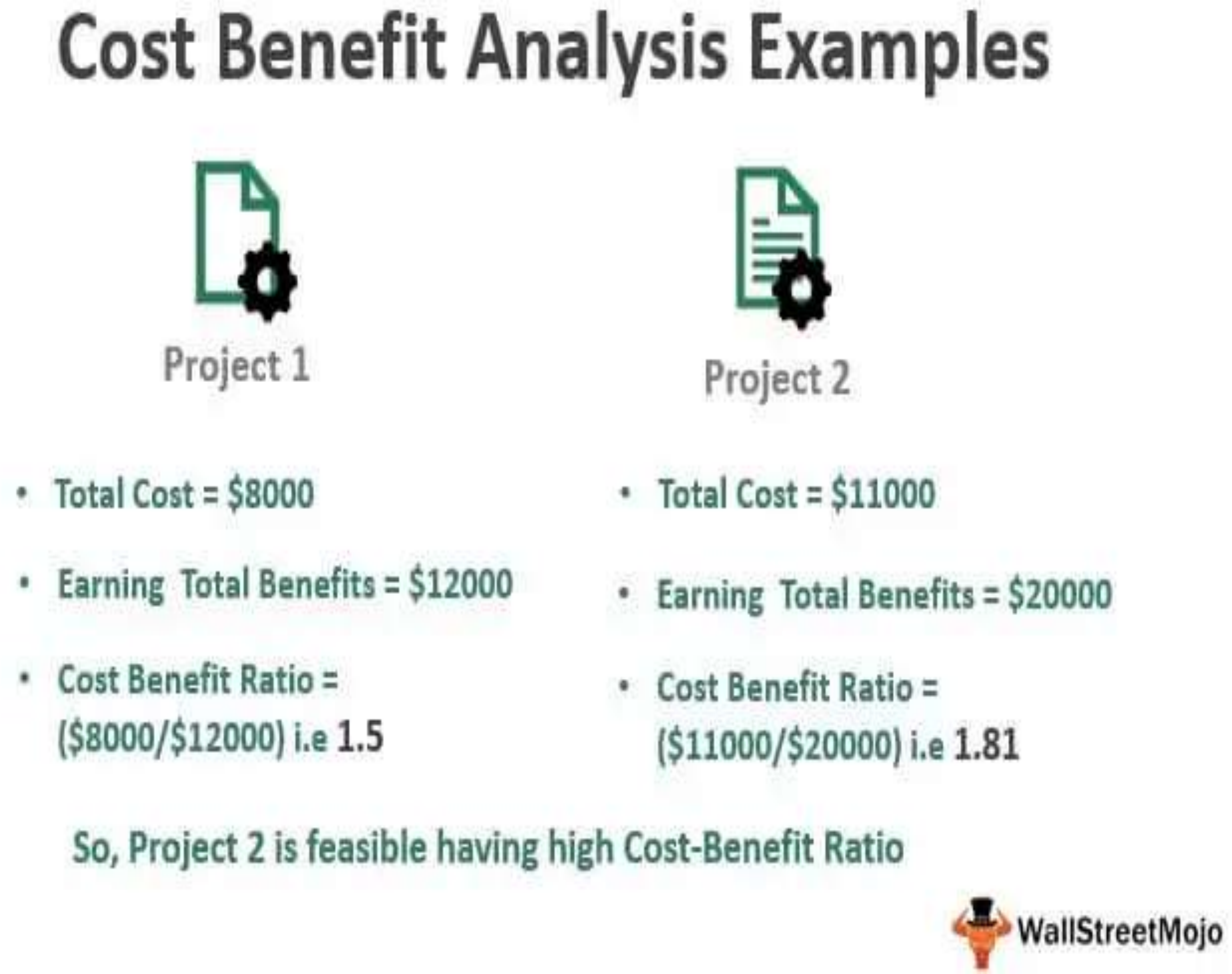
Financial Appraisal



Financial Appraisal

- **Example of Break Even Analysis**
- Colin is the managerial accountant in charge of Company A, which sells water bottles. He previously determined that the fixed costs of Company A consist of property taxes, a lease, and executive salaries, which add up to $100,000. The variable cost associated with producing one water bottle is $2 per unit. The water bottle is sold at a premium price of $12. To determine the break even point of Company A's premium water bottle:
- **Break even quantity = $100,000 / ($12 – $2) = 10,000**
- Therefore, given the fixed costs, variable costs, and selling price of the water bottles, Company A would need to sell 10,000 units of water bottles to break even.

Financial Appraisal



Unit 2

Project Scheduling

PERT

- PERT is a management technique used with responsibility accounting and to attain well defined objectives.
- It is designed for scheduling complex interrelated tasks of the projects.

❖ **PERT System of Three Time Estimate**

  - Optimistic Time
  - Most likely Time (t_m)
  - Pessimistic Time (t_p)

❖ PERT Algorithm

1. Develop a list of activities that made up the project including immediate predecessors.
2. For each activity, a rough PERT network is drawn on the basis of which activity precedes, which activity follows which one, which activity are concurrent with which one.
3. The network is sketched to conform to rules and conventions.
4. Events are numbered in ascending order from left to right.
5. Time estimates (Optimistic Estimate, Most Likely Estimate, Pessimistic Estimate)for each activity are obtained.
6. Then upon the assumption of beta distribution for the activity duration, the expected time t_e for each activity is computed using $t_e = 1(1+4m+b)/6$.

❖ **PERT Algorithm…(continued)**

7. Using the expected activity time estimates, determine the earliest start time and the earliest finish time for each activity, the earliest finish time for the complete project corresponds to the earliest finish time for the last activity.

8. After determining the latest start time and the latest finish time for each activity, compute the float associated with each activity, the critical path activities are the activities with zero float. Determine now the critical path through the given network.

9. Using the values for b and a, which were determined in step 5. calculate the variance (σ^2) of each activities time estimated by $\sigma^2 = [1(b-a)/6]^2$.

10. Use the variability in the activity times to estimate the variability of the project completion date, then using this estimate compute the probability of meeting a specified completion date by using the standard normal equation

– Z = Due date – Expected date of completion

– √ Project Variance

– where Z = no of standard deviations the due date or target date lies from the mean or expected date

CPM

- CPM method is developed by E. I. du Pont de Nemours Company (USA) in 1958.
- It is used to schedule and control the project.
- It is used to estimate the total project duration and to assign starting and finishing times to all activities involved in the project.

❖ **CPM Systems**

  - Activity-On-Arrow (AOA) Network
  - Activity-On-Node (AON) Network

❖ Steps

1. Break down the project into various activities systematically. Label all activities. Arrange all the activities in logical sequence. Construct the network diagram.
2. Number all the nodes (events) and activities. Find the time for each activity considering it to be deterministic. Indicate the activity times on the arrow diagram.
3. Calculate earliest start time, earliest finish time, latest start time and latest finish time. Tabulate activity normal times, earliest times and latest times.
4. Determine the total float for each activity by taking difference between the earliest time and latest time for each node.
5. Identify the critical activities and connect them with the beginning node and the ending node in the network diagram by double line arrow. This gives the critical path.
6. Calculates the total project duration.
7. Reduce the total project duration, crash the critical activities of the network.
8. Optimize the cost.
9. Update the network and smooth the network resource.

S.No.	PERT	CPM
1.	PERT is that technique of project management which is used to manage uncertain (i.e., time is not known) activities of any project.	CPM is that technique of project management which is used to manage only certain (i.e., time is known) activities of any project.
2.	It is event oriented technique which means that network is constructed on the basis of event.	It is activity oriented technique which means that network is constructed on the basis of activities.
3.	It is a probability model.	It is a deterministic model.
4.	It majorly focuses on time as meeting time target or estimation of percent completion is more important.	It majorly focuses on Time-cost trade off as minimizing cost is more important.

S.No.	PERT	CPM
5.	It is appropriate for high precision time estimation.	It is appropriate for reasonable time estimation.
6.	It has Non-repetitive nature of job.	It has repetitive nature of job.
7.	There is no chance of crashing as there is no certainty of time.	There may be crashing because of certain time boundation.
8.	It doesn’t use any dummy activities.	It uses dummy activities for representing sequence of activities.
9.	It is suitable for projects which required research and development.	It is suitable for construction projects.

Problems on PERT (Program Evaluation & Review Technique) & CPM (Critical Path Method)

PERT

- **Problem 1: A small project consisting of eight activities has the given characteristics:**

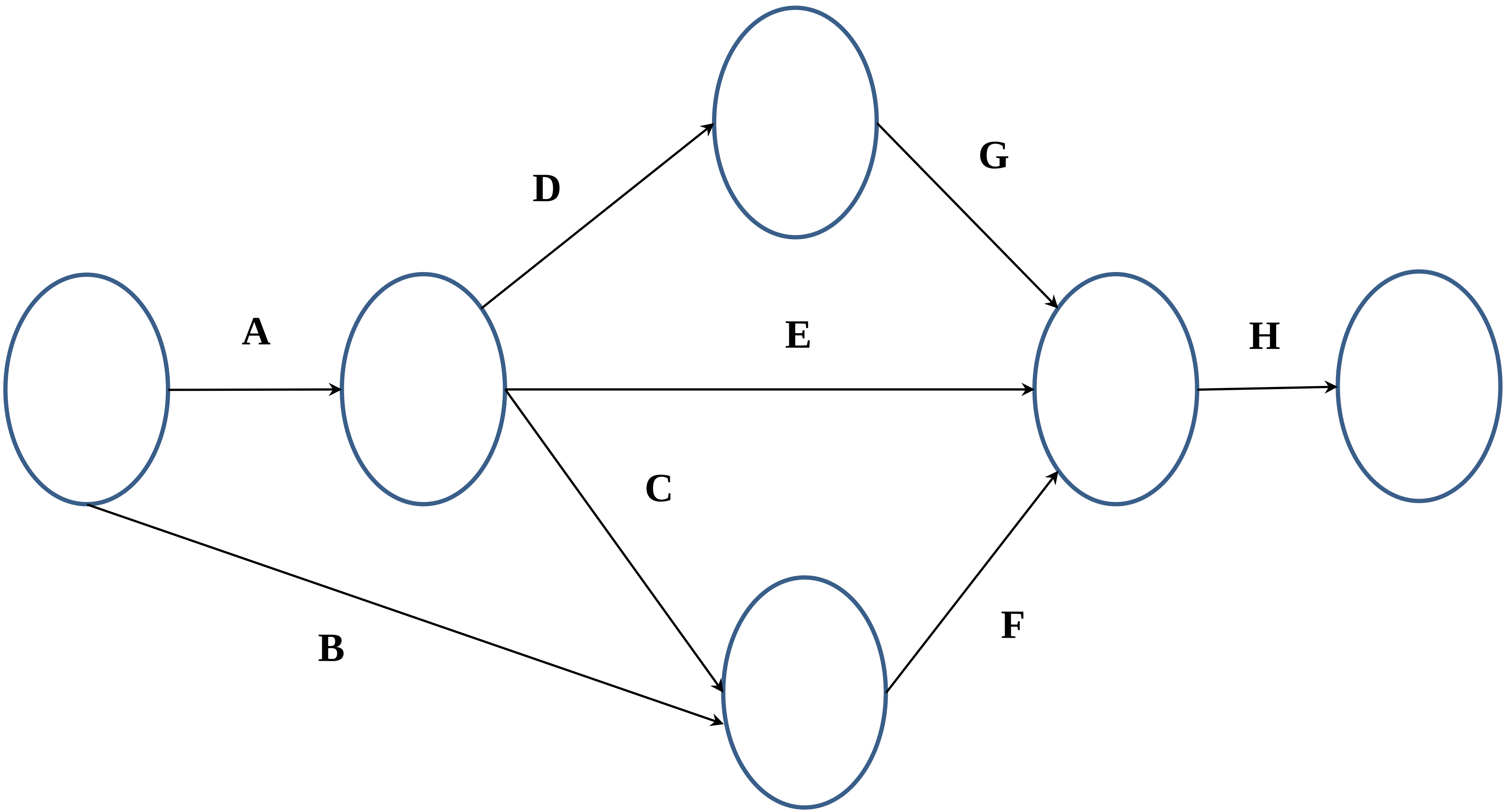
1. Draw the PERT network for the project.
2. Prepare the activity schedule for the project.
3. Determine the critical path.

PERT

Activity	Preceding Activity	Optimistic Time	Most Likely Time	Pessimestic Time
A	None	2	4	12
B	None	10	12	26
C	A	8	9	10
D	A	10	15	20
E	A	7	7.5	11
F	B, C	9	9	9
G	D	3	3.5	7
H	E, F, G	5	5	5

PERT

1. Draw the PERT network for the project.



PERT

2. Prepare the activity schedule for the project.

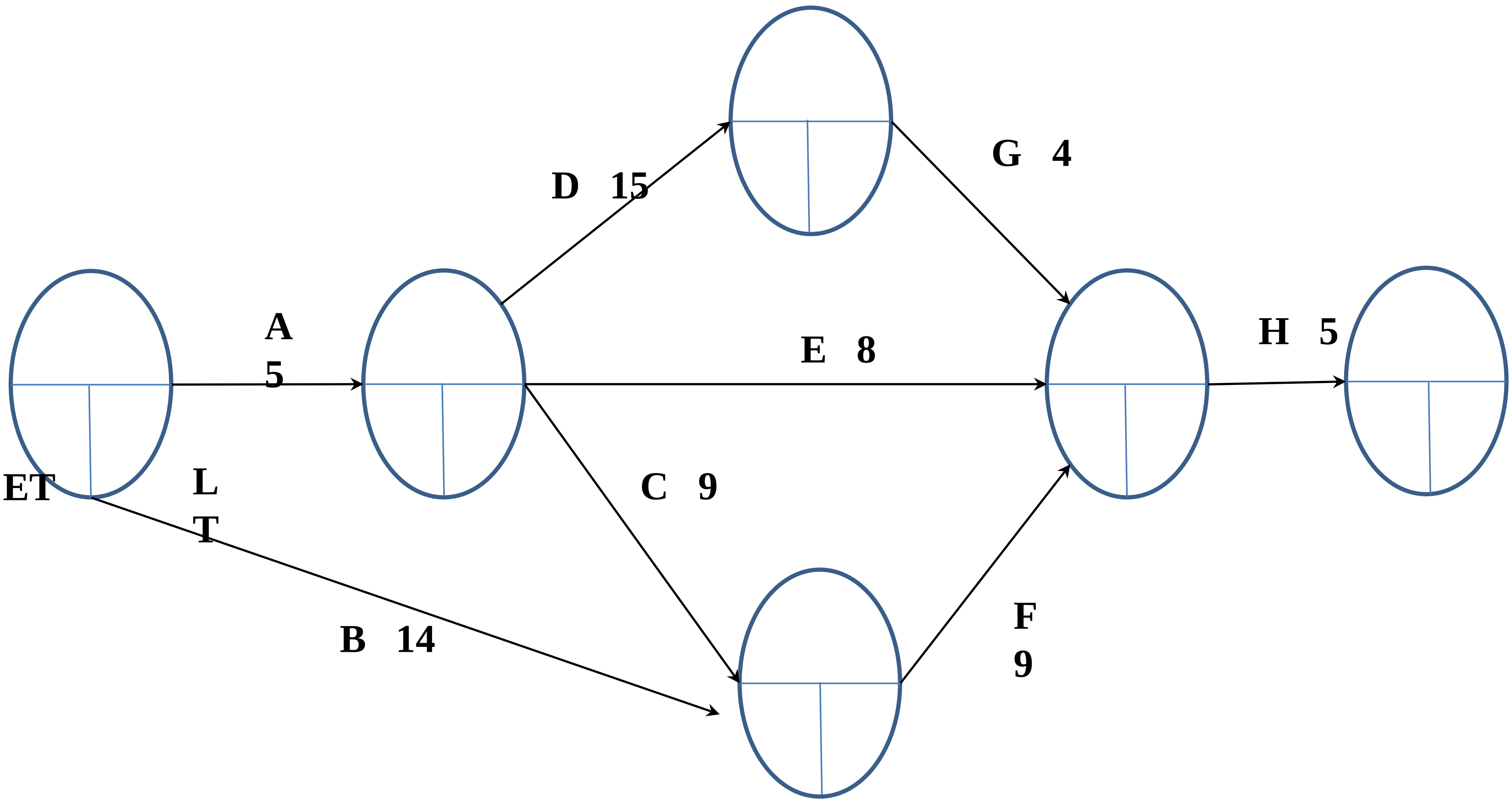
Activity	Preceding Activity	Optimistic Time (a)	Most Likely Time (m)	Pessimestic Time (b)	Expected Time $t_e = \frac{a+4m+b}{6}$	Variance $\sigma^2 t = ((b-a)/6)^2$
A	None	2	4	12		
B	None	10	12	26		
C	A	8	9	10		
D	A	10	15	20		
E	A	7	7.5	11		
F	B, C	9	9	9		
G	D	3	3.5	7		
H	E, F, G	5	5	5		

PERT

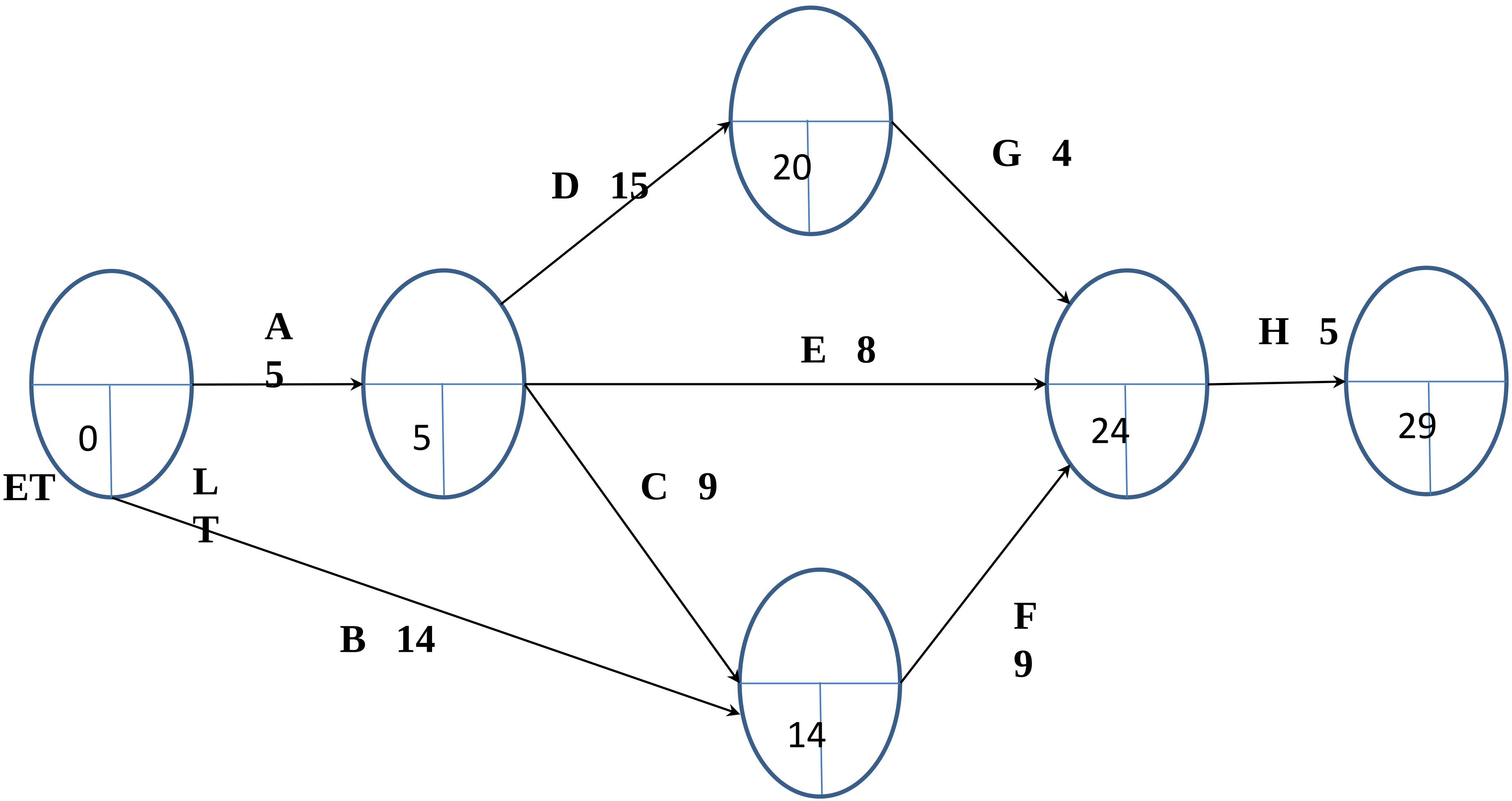
2. Prepare the activity schedule for the project.

Activity	Preceding Activity	Optimistic Time (a)	Most Likely Time (m)	Pessimestic Time (b)	Expected Time $t_e = \frac{a+4m+b}{6}$	Variance $\sigma^2 t = ((b-a)/6)^2$
A	None	2	4	12	5	25/9
B	None	10	12	26	14	64/9
C	A	8	9	10	9	1/9
D	A	10	15	20	15	25/9
E	A	7	7.5	11	8	4/9
F	B, C	9	9	9	9	0
G	D	3	3.5	7	4	4/9
H	E, F, G	5	5	5	5	0

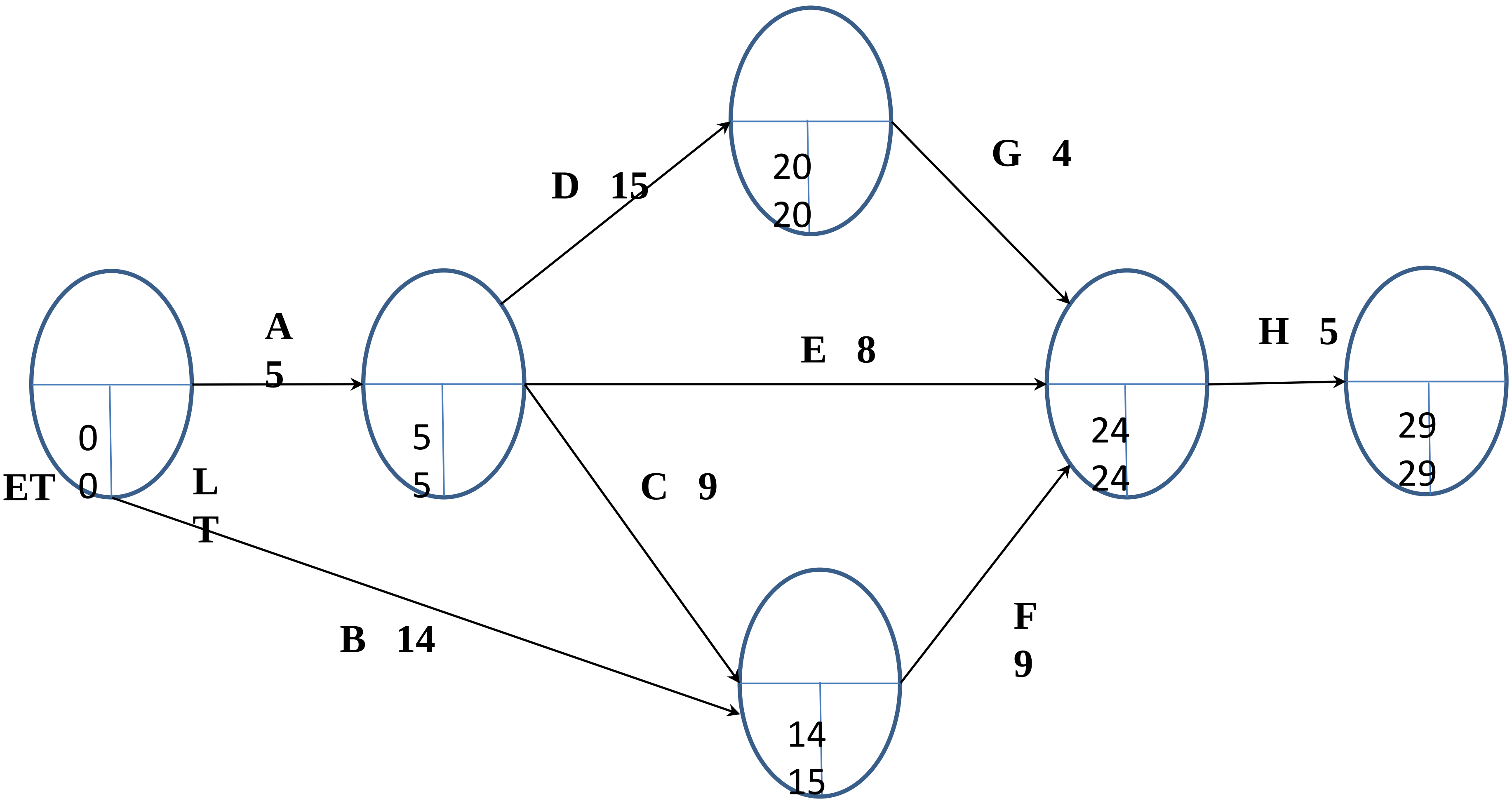
PERT



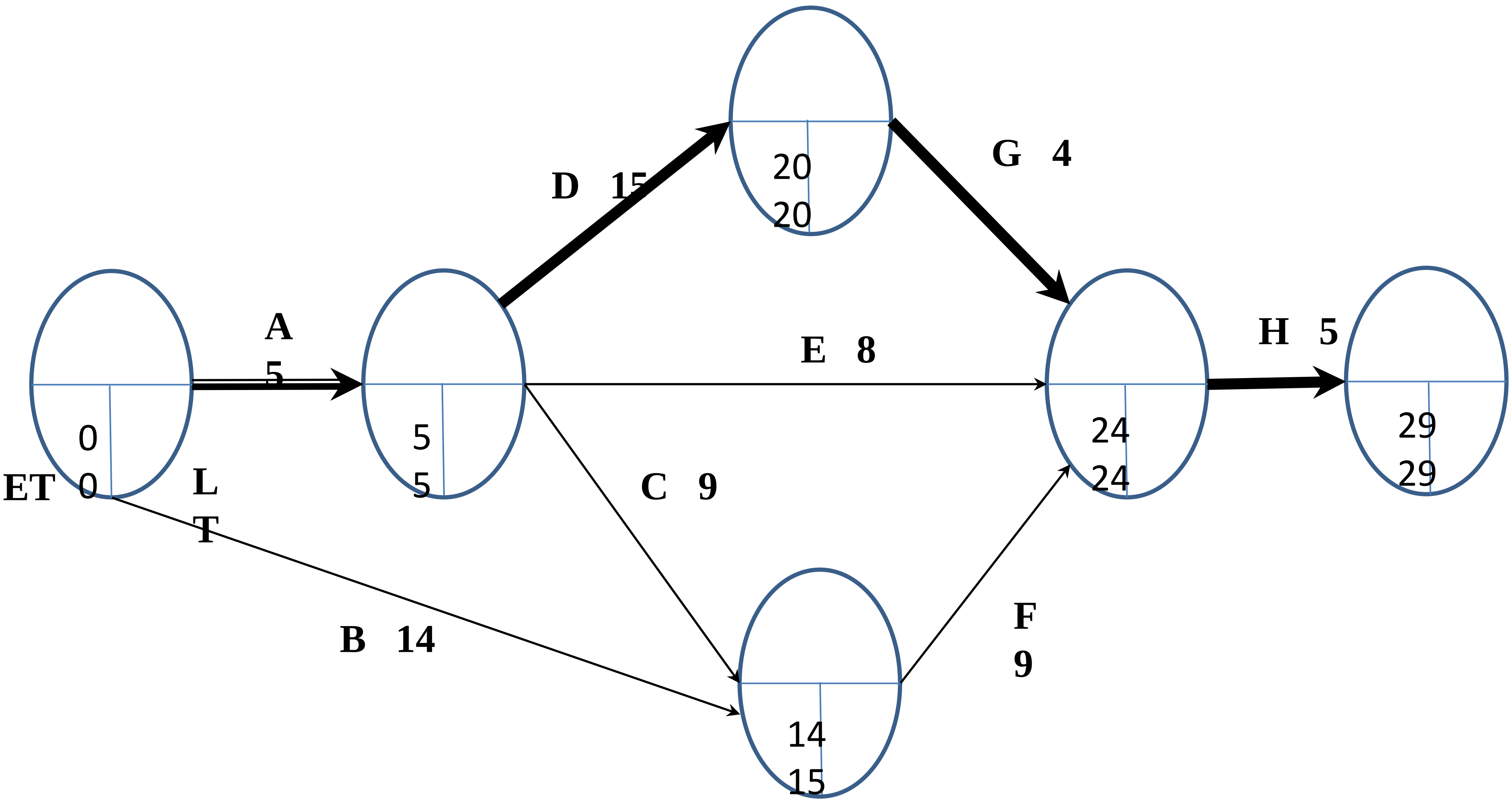
PERT



PERT



PERT



PERT

Activity	Preceding Activity	Optimistic Time (a)	Most Likely Time (m)	Pessimestic Time (b)	Expected Time Te	Variance $\sigma^2 t$	EST	EFT	LST	LFT
A	None	2	4	12	5	25/9	0	5	0	5
B	None	10	12	26	14	64/9	0	14	1	15
C	A	8	9	10	9	1/9	5	14	6	15
D	A	10	15	20	15	25/9	5	20	5	20
E	A	7	7.5	11	8	4/9	5	13	16	24
F	B, C	9	9	9	9	0	14	23	15	24
G	D	3	3.5	7	4	4/9	20	24	20	24
H	E, F, G	5	5	5	5	0	24	29	24	29

PERT

- Critical Path:
- A - D - G - H = 5+15+4+5 = 29
- A - E – H = 5+8+5 = 18
- Therefore, Project Completion Time = 29 weeks
- Project Variance = 25/9 + 25/9 +4/9 + 0 = 6

PERT

- **Problem 2: A small project consisting of eight activities has the given characteristics:**

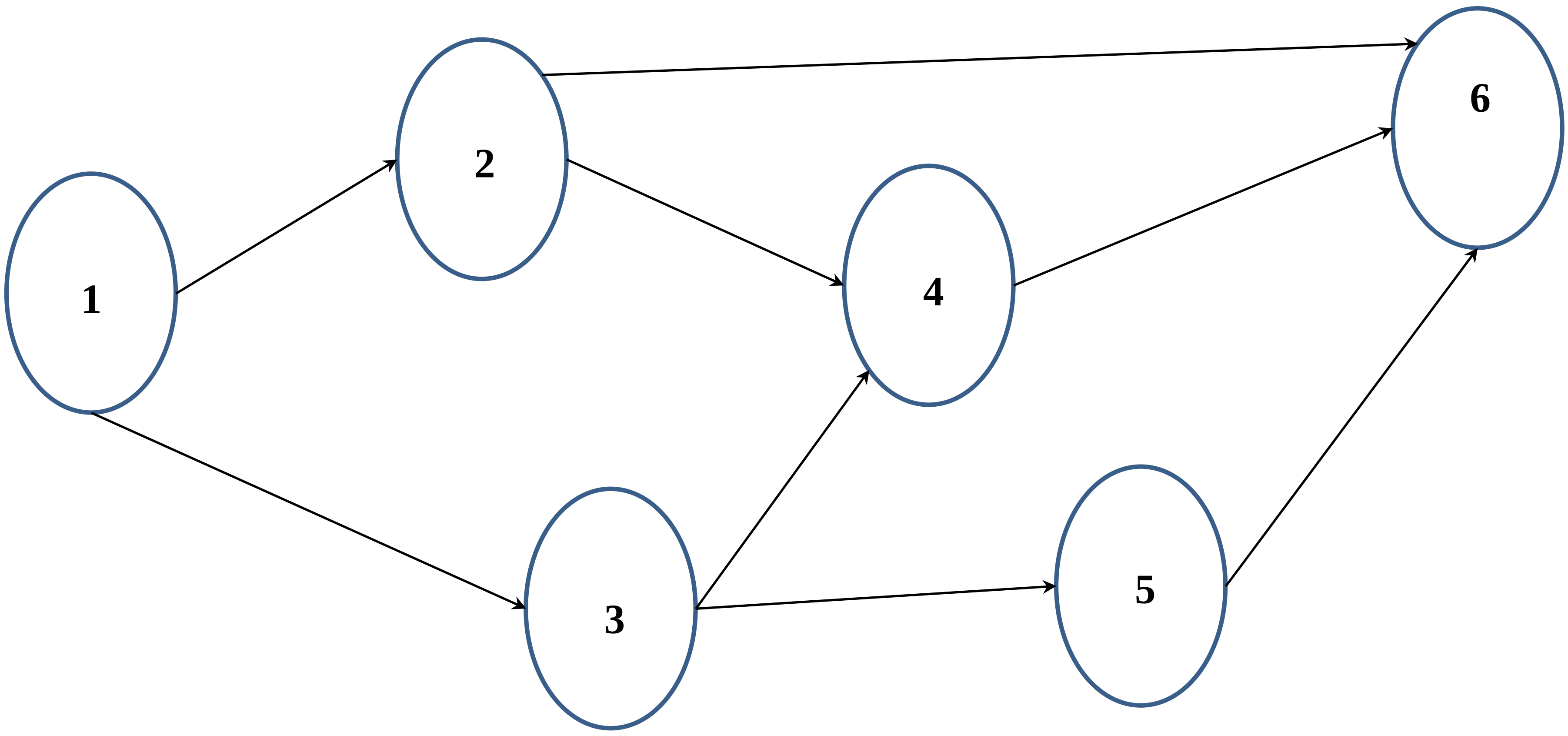
1. Draw the PERT network for the project.
2. Prepare the activity schedule for the project.
3. Determine the critical path.

PERT

Preceding Activity	Activity	Optimistic Time	Most Likely Time	Pessimestic Time
1	2	6	9	12
1	3	3	4	11
2	4	2	5	14
3	4	4	6	8
3	5	1	1.5	5
2	6	5	6	7
4	6	7	8	15
5	6	1	2	3

PERT

1. Draw the PERT network for the project.



PERT

2. Prepare the activity schedule for the project.

Preceding Activity	**Activity**	**Optimistic Time (a)**	**Most Likely Time (m)**	**Pessimestic Time (b)**	**Expected Time te = $\frac{a+4m+b}{6}$**	**Variance $\sigma^2 t = ((b-a)/6)^2$**
1	2	6	9	12		
1	3	3	4	11		
2	4	2	5	14		
3	4	4	6	8		
3	5	1	1.5	5		
2	6	5	6	7		
4	6	7	8	15		
5	6	1	2	3		

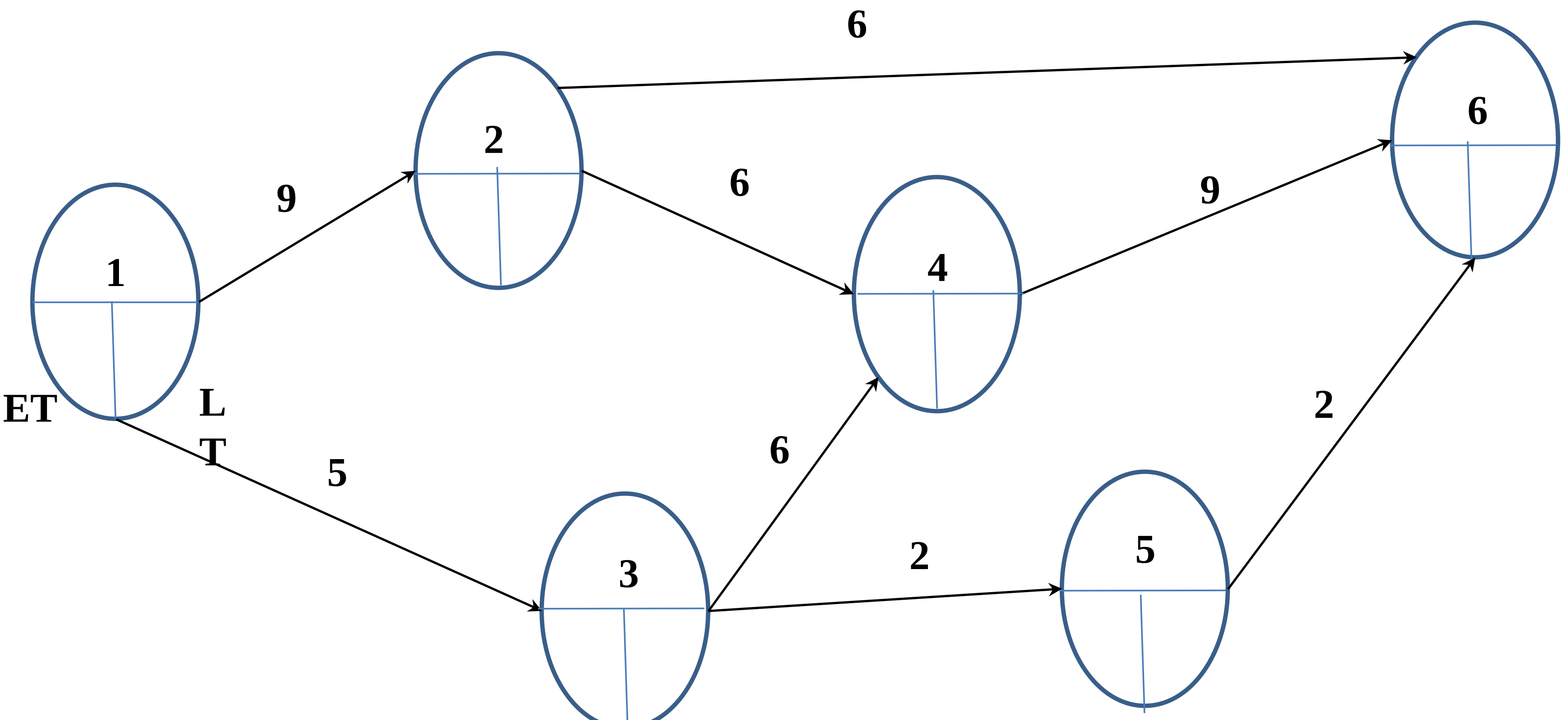
PERT

2. Prepare the activity schedule for the project.

Preceding Activity	Activity	Optimistic Time (a)	Most Likely Time (m)	Pessimestic Time (b)	Expected Time $t_e = \frac{a+4m+b}{6}$	Variance $\sigma^2 t = ((b-a)/6)^2$
1	2	6	9	12	9	1
1	3	3	4	11	5	16/9
2	4	2	5	14	6	4
3	4	4	6	8	6	4/9
3	5	1	1.5	5	2	4/9
2	6	5	6	7	6	1/9
4	6	7	8	15	9	16/9
5	6	1	2	3	2	1/9

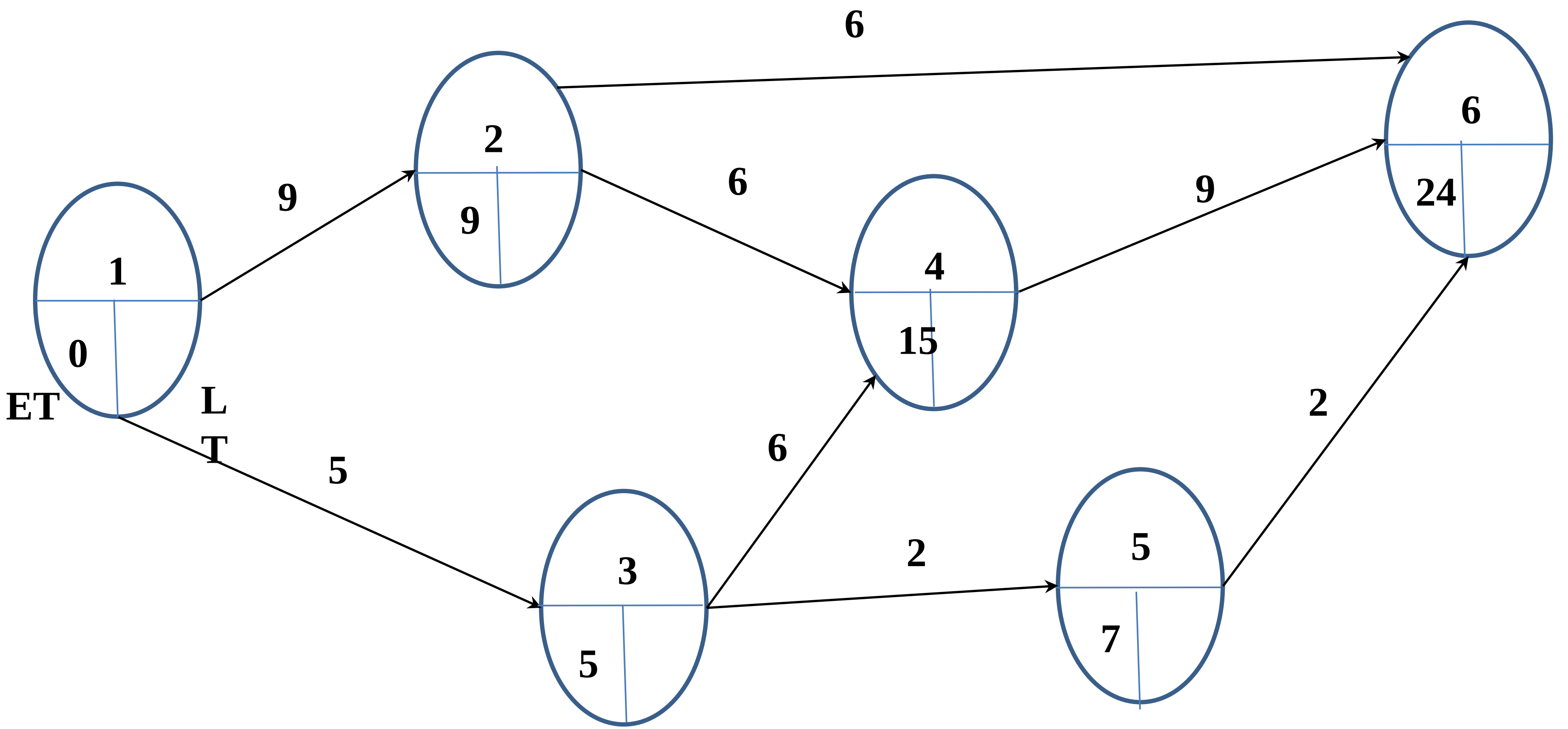
PERT

1. Draw the PERT network for the project.



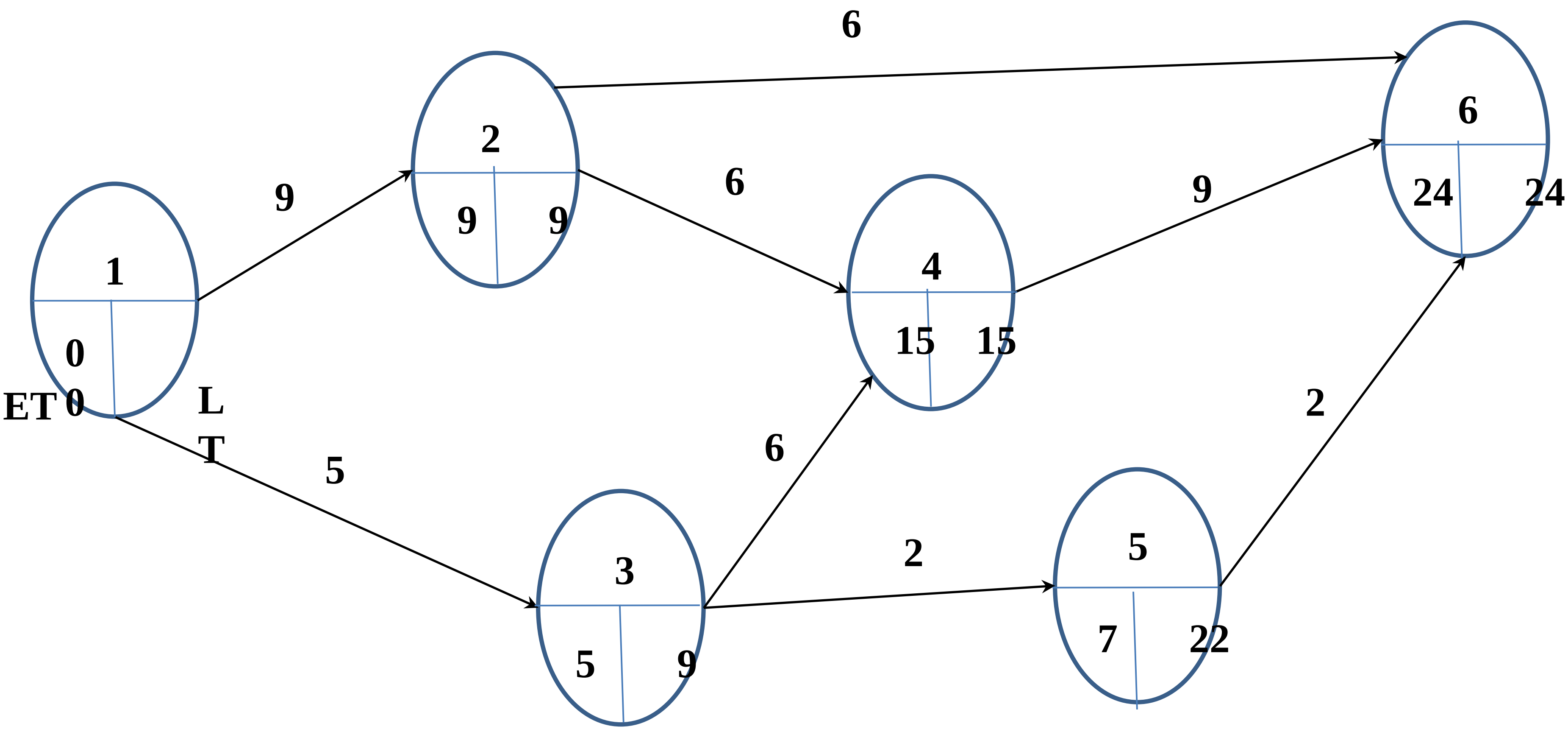
PERT

1. Draw the PERT network for the project.



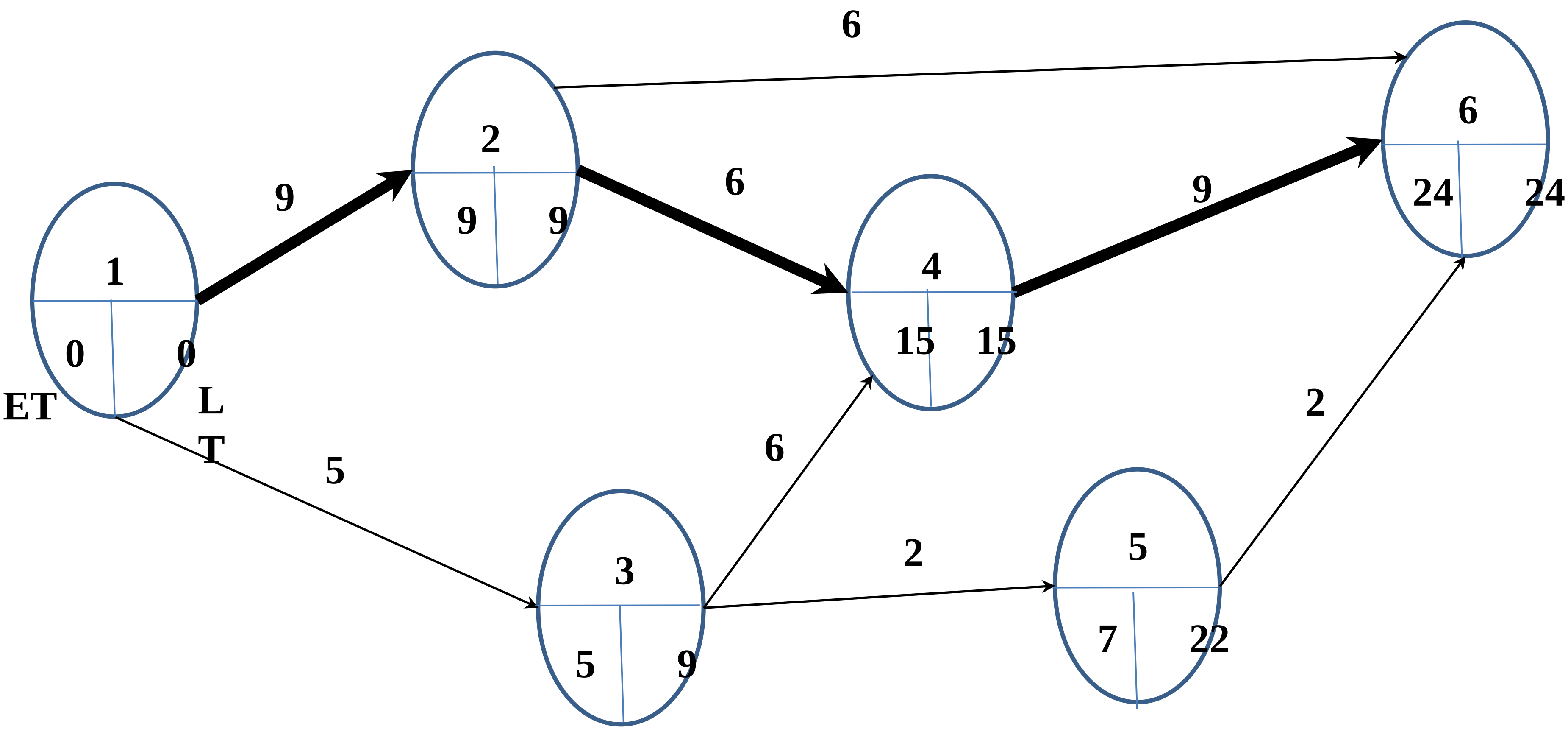
PERT

1. Draw the PERT network for the project.



PERT

1. Draw the PERT network for the project.



PERT

- Critical Path:
- 1-2-4-6
- Therefore, Project Completion Time = 24 days
- Project Variance = 1+4+16/9= 6.78

A small project consisting of eight activities has the following characteristics:

Time – Estimates (in weeks)

Activity	Preceding activity	Most optimistic time (a)	Most likely time (m)	Most Pessimestic time (b)
A	None	2	4	12
B	None	10	12	26
C	A	8	9	10
D	A	10	15	20
E	A	7	7.5	11
F	B,C	9	9	9
G	D	3	3.5	7
H	E, F, G	5	5	5

- (i) Draw the PERT network for the project.
- (ii) Prepare the activity schedule for the project.
- (iii) Determine the critical path.

Float

- Project management float is the amount of time a given task can be delayed without causing a delay in the entire project
- **Types of Float**
- The different **types of float** are
- **Total Float** or **Float**
- **Free Float**
- **Project Float**
- **Interfering Float (INTF)**
- **Independent Float (INDF)**

Float Calculation

- **Total float**
- The total amount of time a task can be delayed without affecting the final project delivery date
- To calculate **total float**, subtract the task's earliest finish (EF) date from its latest finish (LF) date. It looks like this: LF - EF = total float

Float Calculation

- **Free float**
- The amount of time a task can be delayed without impacting other tasks in the path
- **Free float**, on the other hand, is calculated by subtracting the task's earliest finish date from its earliest start date. That formula looks like this: ES - EF = free float

- It is the amount of time a **Project can be delayed** without delaying the externally imposed project finish date by the customer, or the project finish date previously committed to by the Project Manager.
- Free & Total Floats are about the time an **activity** can be delayed, while Project float is the amount of time a **Project** can be delayed.

- **<u>Interfering Float (INTF)</u>**
- Interfering Float is the amount of time a schedule activity can be delayed or extended from its early start date without delaying the project finish date.
- If an activity is delayed for the amount of the Free and Interfering Float, then its successor activities are critical.
- **Interfering Float = Total Float – Free Float**

- **Independent Float (INDF)**
- Interfering Float is the maximum amount of time an activity can be delayed without delaying the early start of the succeeding activities and without being affected by the allowable delay of any predecessor activity.
- ***Independent Float Formula***
- **Independent Float (INDF) = Earliest Successors' Early Start – Earliest Predecessors' Late Finish – Activity's duration**

- **Total Float** or **Float = LF -EF**
- **Free Float = ES - EF**
- **Interfering Float (INTF) = Total Float – Free Float**
- **Independent Float (INDF) = Earliest Successors’ Early Start – Earliest Predecessors’ Late Finish – Activity’s duration**

Thank you

Module 3
Project Planning & Scheduling

Points to be Covered…

1. Work Breakdown Structure (WBS)
2. Linear Responsibility Chart
3. Interface Coordination
4. Concurrent Engineering
5. Project Cost Estimation and Budgeting
6. Top down and Bottom up Budgeting
7. Networking and Scheduling Techniques
8. PERT
9. CPM
10. GANTT Chart
11. Introduction to Project Management Information System (PMIS)

1. Work Breakdown Structure

- Work Breakdown Structure is a hierarchical tree structure that outlines project and breaks it down into a smaller and more manageable units.

❖ Characteristics

- Definable
- Manageable
- Estimated
- Independent
- Integration
- Measurable
- Adaptable

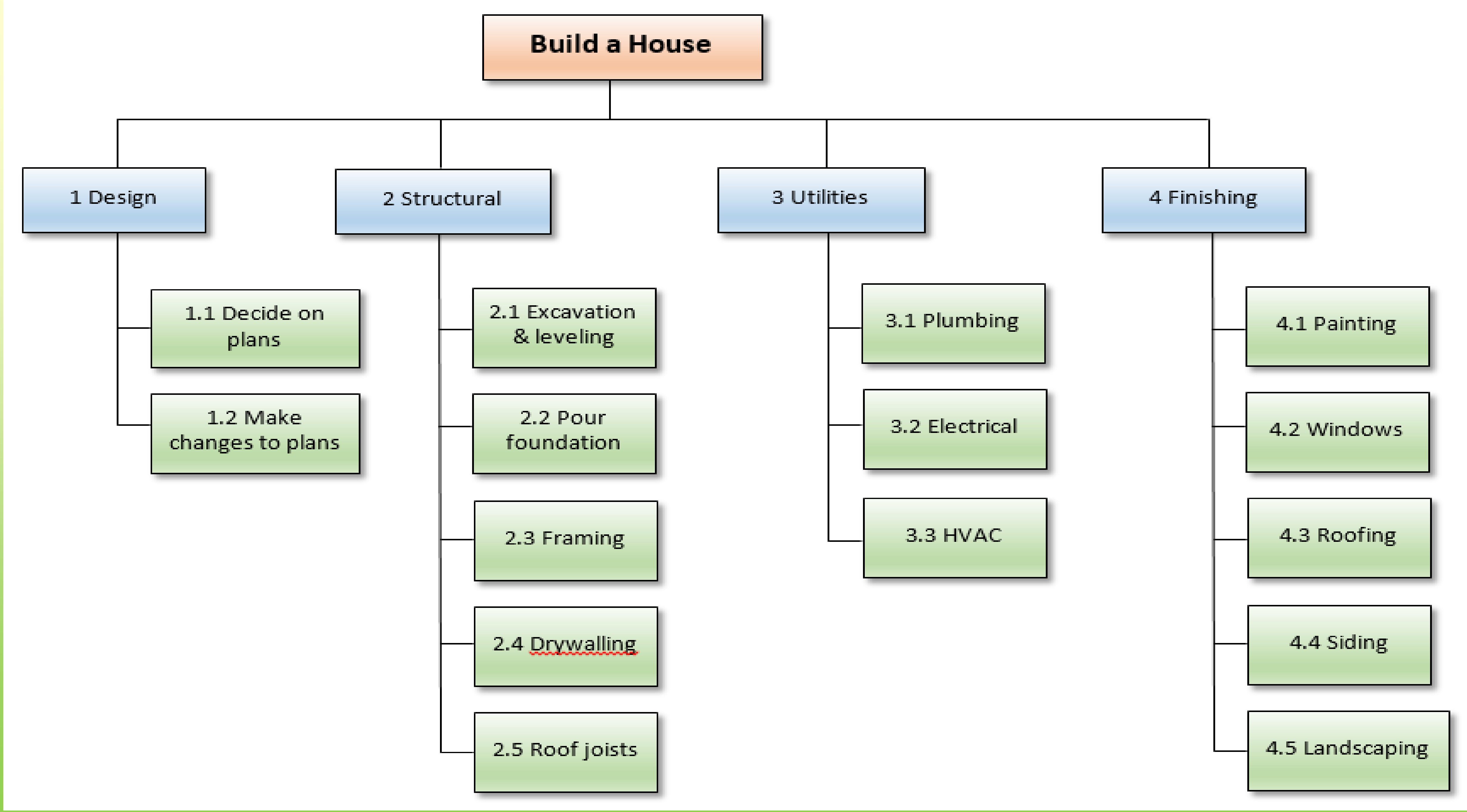
❖ Rules

- The 100% Rule
- Mutually Exclusive
- Focus on Outcomes
- The 8/80 Rule

Work Breakdown Structure

- 100 % rule : **the sum of the work at the “child” level must equal 100% of the work represented by the “parent”**

- “8 – 80” rule - **the lowest level of work should be not less than 8 hours and not more than 80 hours**.

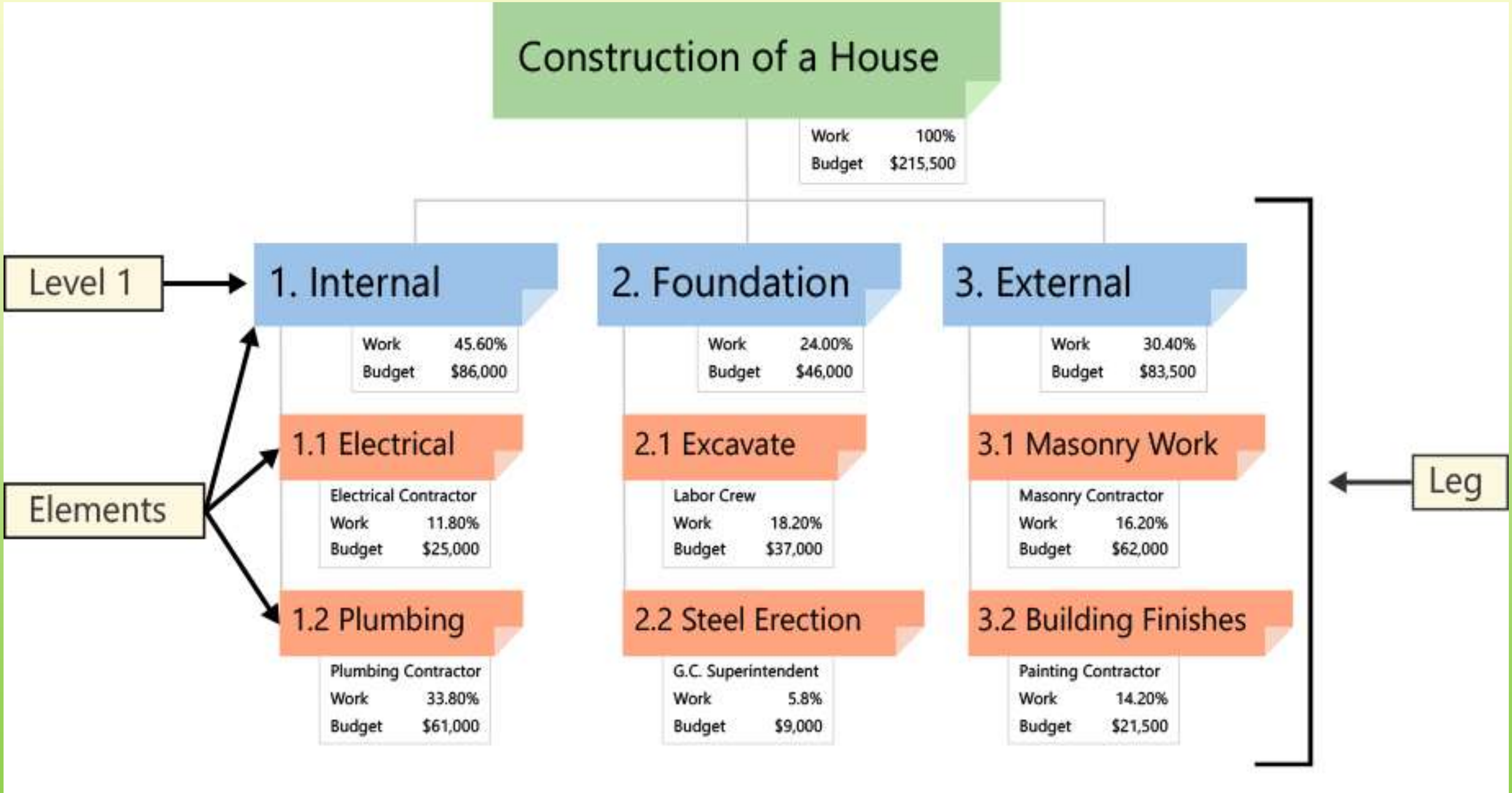

Build a House
1 Design
2 Structural
3 Utilities
4 Finishing
1.1 Decide on plans
1.2 Make changes to plans
2.1 Excavation & leveling
2.2 Pour foundation
2.3 Framing
2.4 Drywalling
2.5 Roof joists
3.1 Plumbing
3.2 Electrical
3.3 HVAC
4.1 Painting
4.2 Windows
4.3 Roofing
4.4 Siding
4.5 Landscaping

1. Work Breakdown Structure

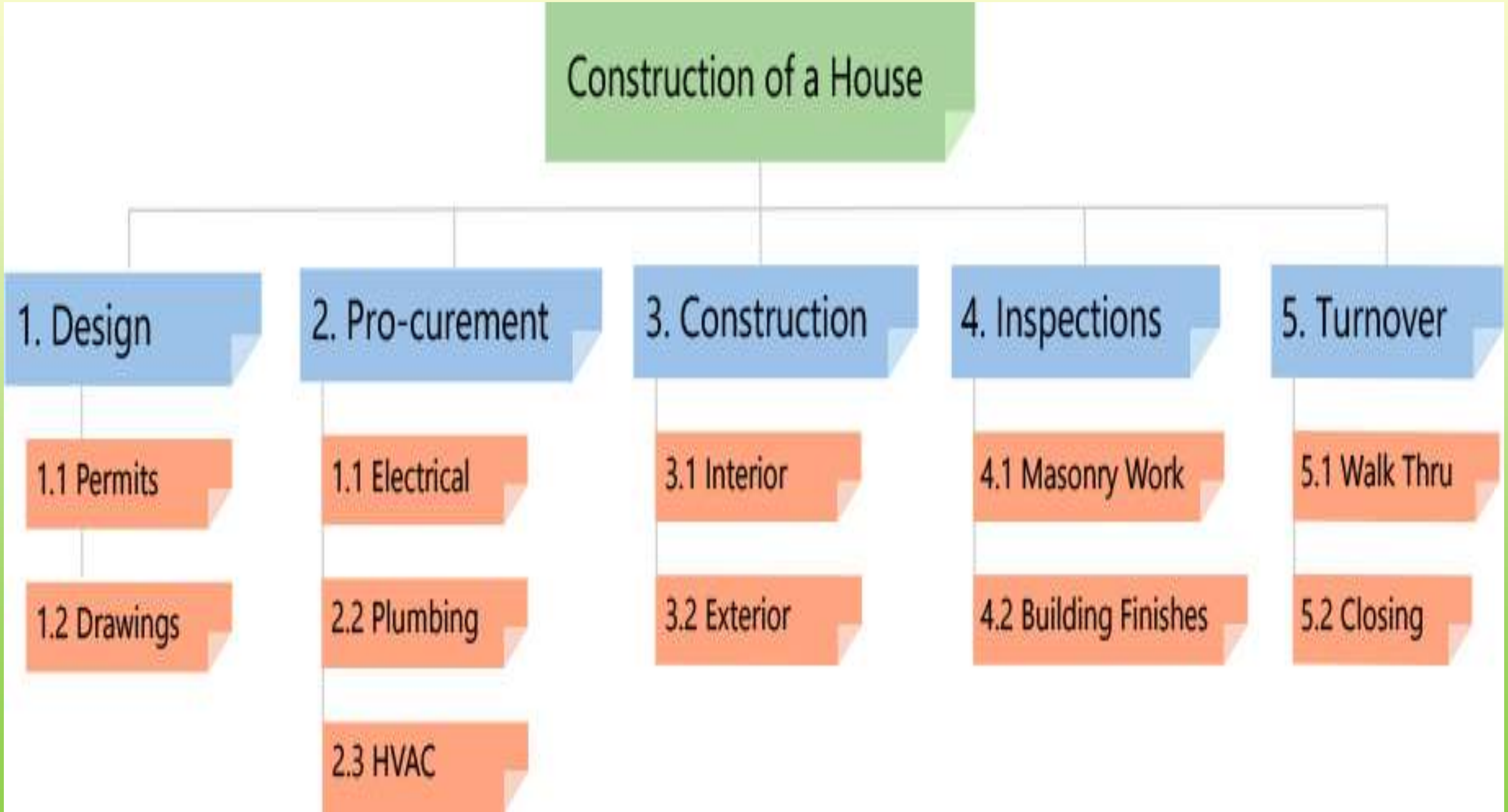
- **Different Forms of WBS**
  - Phase-based Structure
  - Deliverable-based Structure
  - Responsibility-based Structure
  - Resource Breakdown Structure

- **Process to create WBS**
  - Step 1: List high-level deliverables
  - Step 2: Think about tasks
  - Step 3: Prepare Minute Details
  - Step 4: Format and Estimate

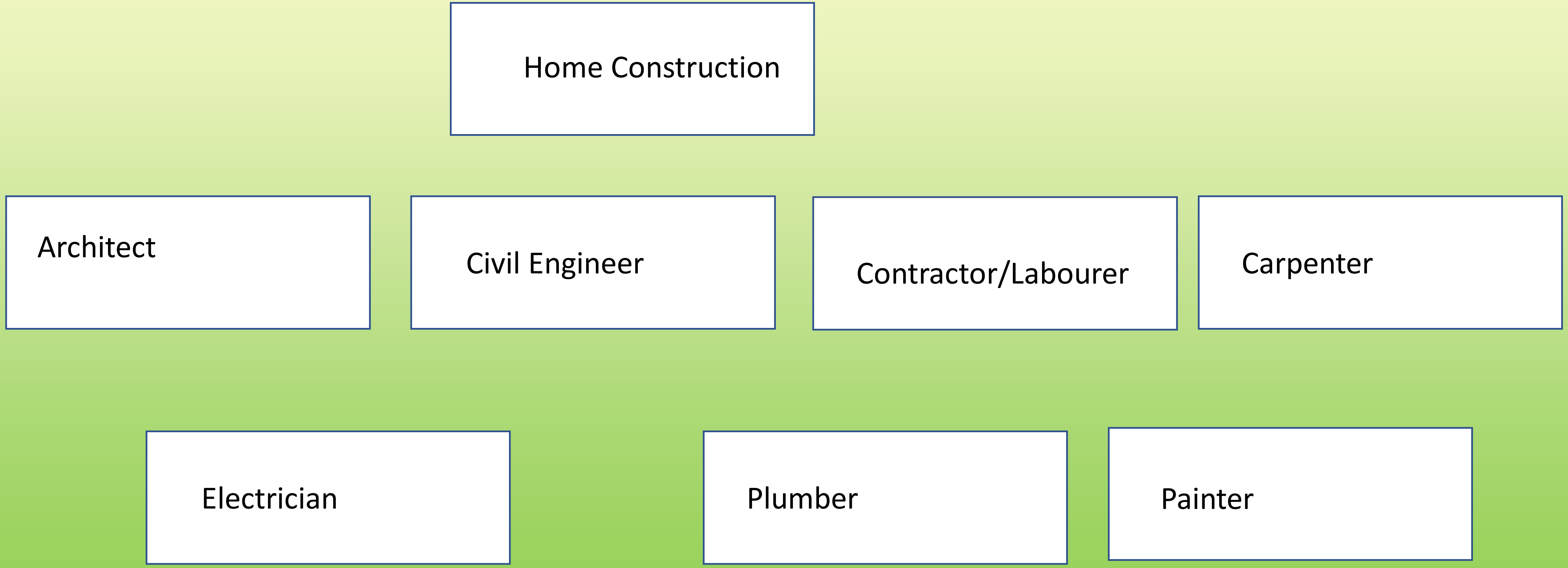
Deliverable based WBS



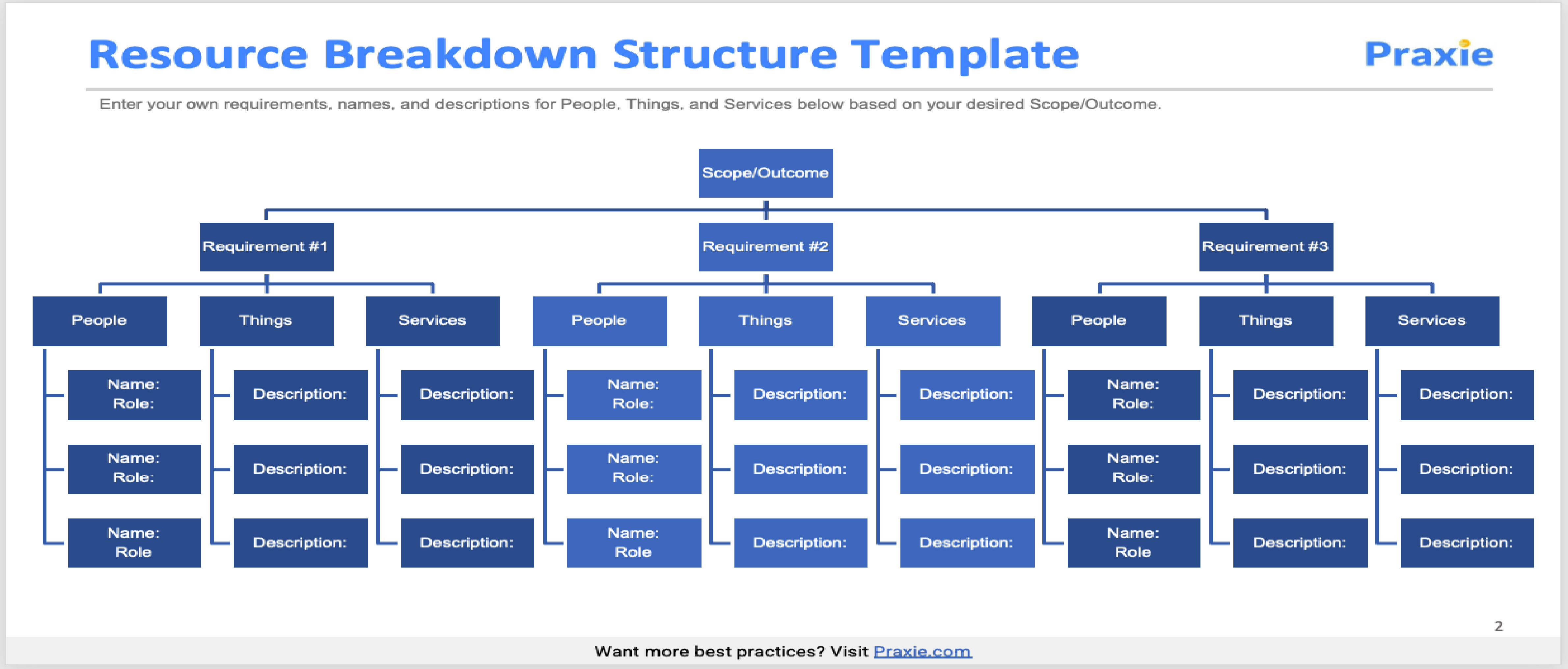
Phase based WBS



Responsibility based WBS



Resource based WBS



1. Work Breakdown Structure…

1. Phase-based work breakdown structure

The first level of a phase-based work breakdown structure will be elements that are typical phases of a project.

The second phase will usually be elements that are distinctive deliverables in each of the phases highlighted.

The lower level of both phase-based and deliverable-based work breakdown structures are elements that are deliverables.

For a phase-based work breakdown structure, work associated with different elements will be divided into work unique to the element in the first level of your work breakdown structure.

2. Deliverable-based work breakdown structure

A work breakdown structure based on the deliverables identifies connections between the project's deliverables and the scope.

1. Work Breakdown Structure…

3. Responsibility-based work breakdown structure

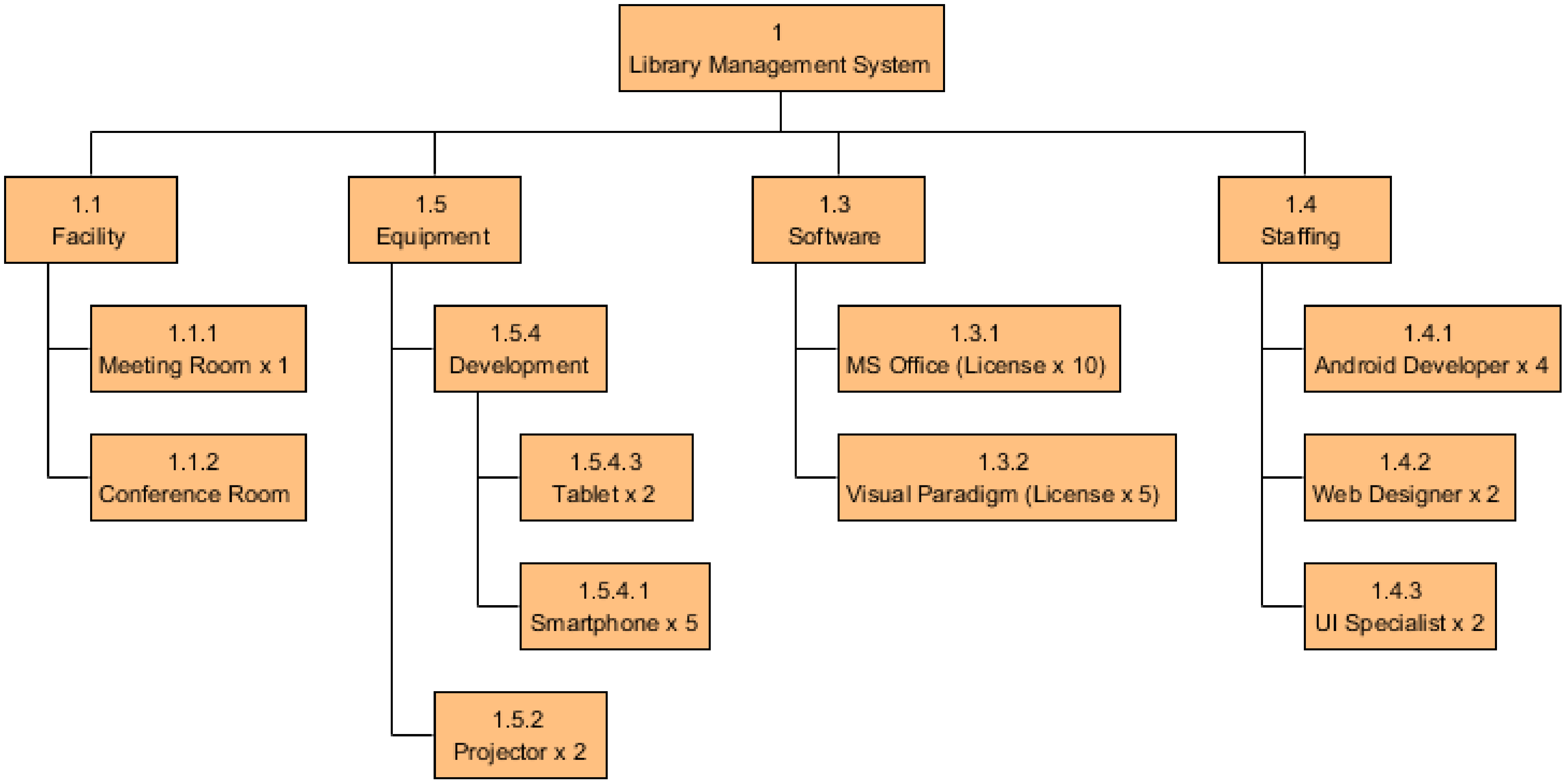
The responsibility-based work breakdown structure defines the project's elements by the organizational units that will work on the project.

The first level of the structure in a responsibility-based work breakdown structure will be the organization units, the rest of the levels will often follow the same format as the other two work breakdown structures.

4. Resource Breakdown Structure

Resource Breakdown Structure (RBS) is a project management tool that provides a hierarchical decomposition of resources, either structured by resource category, types or by IT/business function that has resource needs.

Example of Resource Breakdown Structure



2. Linear Responsibility Chart

- Linear Responsibility Chart is the chart of responsibility which defines the project participants and shows authority and responsibility relationships among them.
- It is also called as Linear Chart, Matrix Responsibility Chart (MRC), Responsibility Interface Matrix (RIM), Responsibility and Accountability (RAM).

3. Interface Coordination

- Interface Coordination is a process that facilitates agreements with other stakeholders regarding roles and responsibilities, timing for providing interface information and identification of critical interfaces early in the project through a structured process.
- Interface is defined as a point of connect between entities working on a common project.

❖ **Interfaces are**

- Physical
- Functional
- Contractual
- Organizational
- Knowledge
- Resource

3. Interface Coordination…

- **Objectives**
  - Identify the appropriate personnel who will be responsible for each interface request and for the resolution of interface request.
  - Provide a system that will facilitate the identification of interfaces and address the specific interface request requirements.
  - Establish a procedure that promotes efficient management of interface issues from initiation to close out.
  - Define methods for communication and coordination of interface requests between various parties.
  - Facilitate clear and frequent communications amongst parties.
  - Facilitate the agreement of a schedule for interface request resolution and close-out.
  - Define a means for the control, expediting, and reporting of progress on the transfer of interface requests.
  - Define processes of assurance that interface requests are effectively identified and managed.

3. Interface Coordination…

- **Process**
  - Identification and recording an interface.
  - Creating an interface agreeing.
  - Agreeing/ Resolving Conflict.
  - Monitoring the Status.
  - Reporting the Status.
  - Closing the Interface Agreement.

3. Interface Coordination…

- **Roles and Responsibility of Interface Coordinators**
  - Participants in interface meetings with involved parties are required to manage interfaces.
  - Review outgoing interface requests and serve as interface requests.
  - Ensure resolution of inbound interface requests.
  - Actively monitor interface request register to expediting requests and open/update/close requests on behalf of their team.
  - Provide collaborate interface resolution support.
  - Serve as PMT liaison between contractor and operating plant point of contract. Project liaisons communicate effectively between multiple team members and stakeholders. The job will require persuasiveness, approachability, likeability, adaptability, and skills in project management.
  - Inform Interface Manager of potential impacts due to unsatisfactory resolution response.

4. Concurrent Engineering

- Concurrent Engineering is a method of designing and developing products, in which the different stages run simultaneously.
- It is a systematic approach to integrated product development that emphasizes the response to customer expectations.

❖ **Methods to implement Concurrent Engineering**

  - Project Methods
  - Problem Solving Methods

4. Concurrent Engineering…

❖ Advantages

- Encourage multi-disciplinary collaboration.
- Reduces product cycle time.
- Reduces cost.
- Increase quality by supporting the entire project cycle – enhanced quality.
- Increases productivity by stopping the mistakes in their trends.
- Gives the competitive edge advantage.

❖ Disadvantages

- Complex to manage.
- Relies on everyone working together hence communication is critical.
- Room for mistakes are small as it impacts all the electrical, mechanical, software departments or disciplines.

5. Project Cost Estimation and Budgeting

- Project Cost Estimation is the process of determining the total expenditure of the project.

❖ **Project Cost Management**

  - Plan Cost Management
  - Estimate Costs
  - Determine Budget
  - Control Costs

5. Project Cost Estimation and Budgeting…

- **Plan Cost Management**
  - Plan Cost Management is the process that establishes the policies, procedures, and documentation for planning, managing, expending, and controlling project costs.

Inputs

1. Project management plan
2. Project charter
3. Enterprise environmental factors
4. Organizational process assets

Tools and Techniques

1. Expert judgment
2. Analytical techniques
3. Meetings

Outputs

1. Cost management plan

5. Project Cost Estimation and Budgeting…

❖ Estimate Cost

- Estimate Costs is the process of developing an approximation of the monetary resources needed to complete project activities.

❑ Inputs

1. Cost management plan
2. Human resource management plan
3. Scope baseline
4. Project schedule
5. Risk register
6. Enterprise environmental factors
7. Organizational process assets

❑ Tools and Techniques

1. Expert judgment
2. Analogous estimating
3. Parametric estimating
4. Bottom-up estimating
5. Three-point estimating
6. Reserve analysis
7. Cost of quality
8. Project management software
9. Vendor bid analysis
10. Group decision-making techniques

❑ Outputs

1. Activity cost estimates
2. Basis of estimates
3. Project documents updates

Tools and technique for cost estimation

- **Expert Judgement**

While estimating the project cost, the first step is to take the comments from the experts. The experts are the people who have prior knowledge on similar kind of projects. So they can suggest valuable insight based on their experience. You can also take their advice on various tools and techniques that can be used to estimate similar kind of project.

- **Analogous Estimation**

Normally, at the early stages of your project, you do not have much detail, so taking into account of similar projects previously completed by your organization, the cost of the project can be estimated. Analogous estimation technique uses the parameters such as scope, budget, duration, size, weight and complexity of previous projects having similar nature of works. It measures the current project on that basis and does the estimation.

Tools and technique for cost estimation

- **Analogous Estimation Continues**
- The technique is less costly and less time-consuming. But the accuracy of this estimation is lower than the other estimation techniques as it is purely based on historical data. It can be applied to the whole project or some part of the project in combination with other techniques.
- For example, if the budget of a particular activity in the previous project has X amount, and by measuring the same activity in your current project looks identical, then the same X amount can be applied to that.

- **Parametric Estimation**
- This technique uses an algorithm to calculate the cost of the activity considering the historical data and other project variables. A statistical relationship needs to be evaluated between the historical data and other variables. This technique can be used for the complete project or for some of the activities in conjunction with other estimation techniques.

Tools and technique for cost estimation

- Parametric estimation continues

For example, in an industrial project, one of the activities is to make 10 valves in the first phase. So as part of historical data gathering, you got the information that construction of each valve requires $150.

Based on that information you can calculate as:

Total cost of making 10 valves = cost per valves * no. of valves

Total cost = 150*10 = 1500

- **Bottom-Up Estimation**
- Bottom-up estimation technique starts with the estimation from the lower level i.e. the work package level created as per WBS and then rolled up to higher-level. The accuracy of this estimation technique is high as you are doing the estimation from granular level

Tools and technique for cost estimation

- **Bottom-Up Estimation**
- Bottom-up estimation technique starts with the estimation from the lower level i.e. the work package level created as per WBS and then rolled up to higher-level. The accuracy of this estimation technique is high as you are doing the estimation from granular level

- **Three-Point Estimation**
- To deal with uncertainties and risk, you need to take the help of three-point estimation which is also referred as PERT- Program Evaluation and Review Technique.
- The Program Evaluation and Review Technique use three types of estimations:
- M – Most Likely: The realistic or ideal situation, all the required resources will be assigned and can achieve the expected productivity
- O – Optimistic: Estimation based on best case scenario
- P – Pessimistic: Estimation based on worst case scenario
- Based on the above assumptions, the expected duration can be calculated using two basic formulas.
- Triangular Distribution – (O+M+P)/3
- Beta distribution – (O+4M+P)/6

Tools and technique for cost estimation

- **Reserve Analysis**
- To deal with uncertainty, you need to allocate some funds called as the contingency reserve. That is the part of the cost baseline to mitigate the identified and accepted risks. Also for unknown risks, an amount needs to be estimated which is called management reserve. This is not included in the cost baseline but part of the overall project budget. It is important to keep the reserve budget to deal with uncertain events. The contingency reserve is under the project manager authority, while to use the management reserve the project manager need to take approval from the sponsors.

- **Cost of Quality**
- Basically, two types of costs are there to ensure the quality, one is called the cost of conformance which is the budget required for prevention and appraisals, and another one is cost of non-conformance that may be used up due to internal and external failures. Cost of quality means estimating the cost of both conformance and non-conformance expenses.

Tools and technique for cost estimation

- **Project Management Software**
- There are some tools which can be used to perform the project cost estimation, such as cost estimating software application, spreadsheets, simulation and statistical tools.

- **Vendor Analysis**
- This is another technique to estimate the cost by comparing the various bids proposed by the vendors. There may be differences in their bids but you can get an idea considering the average bid values.

Tools and technique for cost estimation

- **Group Decision Making Techniques**
- This technique emphasizes the involvement of a group of people who are going to perform the technical work. By involving those you will gain more details on the work and thus helpful to estimate more accurately. Also, it develops a commitment from the people who are involved in the discussion to complete the work as estimated.

- Depending upon the nature of your project, either you can apply these techniques together or in combinations of few techniques to estimate the project cost. Also, keep in mind that the estimations are never drawn to an exact figure; it is always in the probable ranges. In the initial phases, the preliminary estimate ranges between -15% to +50%, while the rough order of magnitude estimates in between -25% to +75%. And the budget estimate falls in -10% to +25% ranges.

5. Project Cost Estimation and Budgeting…

❖ **Determine Budget**

- Determine Budget is the process of aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline.

❑ **Inputs**

1. Cost management plan
2. Scope baseline
3. Activity cost estimates
4. Basis of estimates
5. Project schedule
6. Resource calendars
7. Risk register
8. Agreements
9. Organizational process assets

❑ **Tools and Techniques**

1. Cost aggregation
2. Reserve analysis
3. Expert judgment
4. Historical relationships
5. Funding limit reconciliation

❑ **Outputs**

1. Cost baseline
2. Project funding requirements
3. Project documents updates

5. Project Cost Estimation and Budgeting…

- **Control Cost**
  - Control Costs is the process of monitoring the status of the project to update the project costs and managing changes to the cost baseline.

Inputs

1. Project management plan
2. Project funding requirements
3. Work performance data
4. Organizational process assets

Tools and Techniques

1. Earned value management
2. Forecasting
3. To-complete performance index (TCPI)
4. Performance reviews
5. Project management software
6. Reserve analysis

Outputs

1. Work performance information
2. Cost forecasts
3. Change requests
4. Project management plan updates
5. Project documents updates
6. Organizational process assets updates

6. Top Down and Bottom Up Budgeting

- Top Down estimating is a project estimating technique in which the overall project is estimated first and then individual task are apportioned from it.
- Bottom Up estimating is a project estimating technique in which the individual task are estimated first and rolled up into overall project estimate.

7. Networking and Scheduling Techniques

- Network Planning is a technique used to plan, schedule and control the interrelated activities of the project.
- Network Diagram is a graphical representation of all the tasks, responsibilities and workflow for a project.

❖ **Types of Network Diagrams**

  - Arrow Diagram Method
  - Precedence Diagram Method

7. Networking and Scheduling Techniques…

❖ Concepts of Network Analysis

- Activity
  - Predecessor Activity
  - Successor Activity
  - Concurrent Activity
  - Dummy Activity
- Event
  - Merge Event
  - Burst Event
  - Merge and Burst Event

❖ Techniques of Network Analysis

- Critical Path Method (CPM)
- Programme Evaluation and Review Technique (PERT)

8. PERT

- PERT is a management technique used with responsibility accounting and to attain well defined objectives.
- It is designed for scheduling complex interrelated tasks of the projects.

❖ **PERT System of Three Time Estimate**

  - Optimistic Time
  - Most likely Time (t_m)
  - Pessimistic Time (t_p)

8. PERT…

❖ PERT Algorithm

1. Develop a list of activities that made up the project including immediate predecessors.
2. For each activity, a rough PERT network is drawn on the basis of which activity precedes, which activity follows which one, which activity are concurrent with which one.
3. The network is sketched to conform to rules and conventions.
4. Events are numbered in ascending order from left to right.
5. Time estimates (Optimistic Estimate, Most Likely Estimate, Pessimistic Estimate)for each activity are obtained.
6. Then upon the assumption of beta distribution for the activity duration, the expected time t_e for each activity is computed using $t_e = 1(1+4m+b)/6$.

8. PERT…

❖ PERT Algorithm…(continued)

7. Using the expected activity time estimates, determine the earliest start time and the earliest finish time for each activity, the earliest finish time for the complete project corresponds to the earliest finish time for the last activity.
8. After determining the latest start time and the latest finish time for each activity, compute the float associated with each activity, the critical path activities are the activities with zero float. Determine now the critical path through the given network.
9. Using the values for b and a, which were determined in step 5. calculate the variance (σ^2) of each activities time estimated by $\sigma^2 = [1(b-a)/6]^2$.
10. Use the variability in the activity times to estimate the variability of the project completion date, then using this estimate compute the probability of meeting a specified completion date by using the standard normal equation

$$Z = \text{Due date} - \frac{\text{Expected date of completion}}{\sqrt{\text{Project Variance}}}$$

where Z = no of standard deviations the due date or target date lies from the mean or expected date

9. CPM

- CPM method is developed by E. I. du Pont de Nemours Company (USA) in 1958.
- It is used to schedule and control the project.
- It is used to estimate the total project duration and to assign starting and finishing times to all activities involved in the project.

❖ **CPM Systems**

  - Activity-On-Arrow (AOA) Network
  - Activity-On-Node (AON) Network

9. CPM…

❖ Steps

1. Break down the project into various activities systematically. Label all activities. Arrange all the activities in logical sequence. Construct the network diagram.
2. Number all the nodes (events) and activities. Find the time for each activity considering it to be deterministic. Indicate the activity times on the arrow diagram.
3. Calculate earliest start time, earliest finish time, latest start time and latest finish time. Tabulate activity normal times, earliest times and latest times.
4. Determine the total float for each activity by taking difference between the earliest time and latest time for each node.
5. Identify the critical activities and connect them with the beginning node and the ending node in the network diagram by double line arrow. This gives the critical path.
6. Calculates the total project duration.
7. Reduce the total project duration, crash the critical activities of the network.
8. Optimize the cost.
9. Update the network and smooth the network resource.

10. GANTT Chart

- Gantt bar Chart is a horizontal bar chart that visually represents a project plan over time.
- It shows the status of each task and who’s responsible for each task in the project.

❖ **Key Parts of Gantt Chart**

  - Task List
  - Timeline
  - Dateline
  - Bars
  - Milestones
  - Dependencies
  - Progress
  - Resource assigned

10. GANTT Chart…

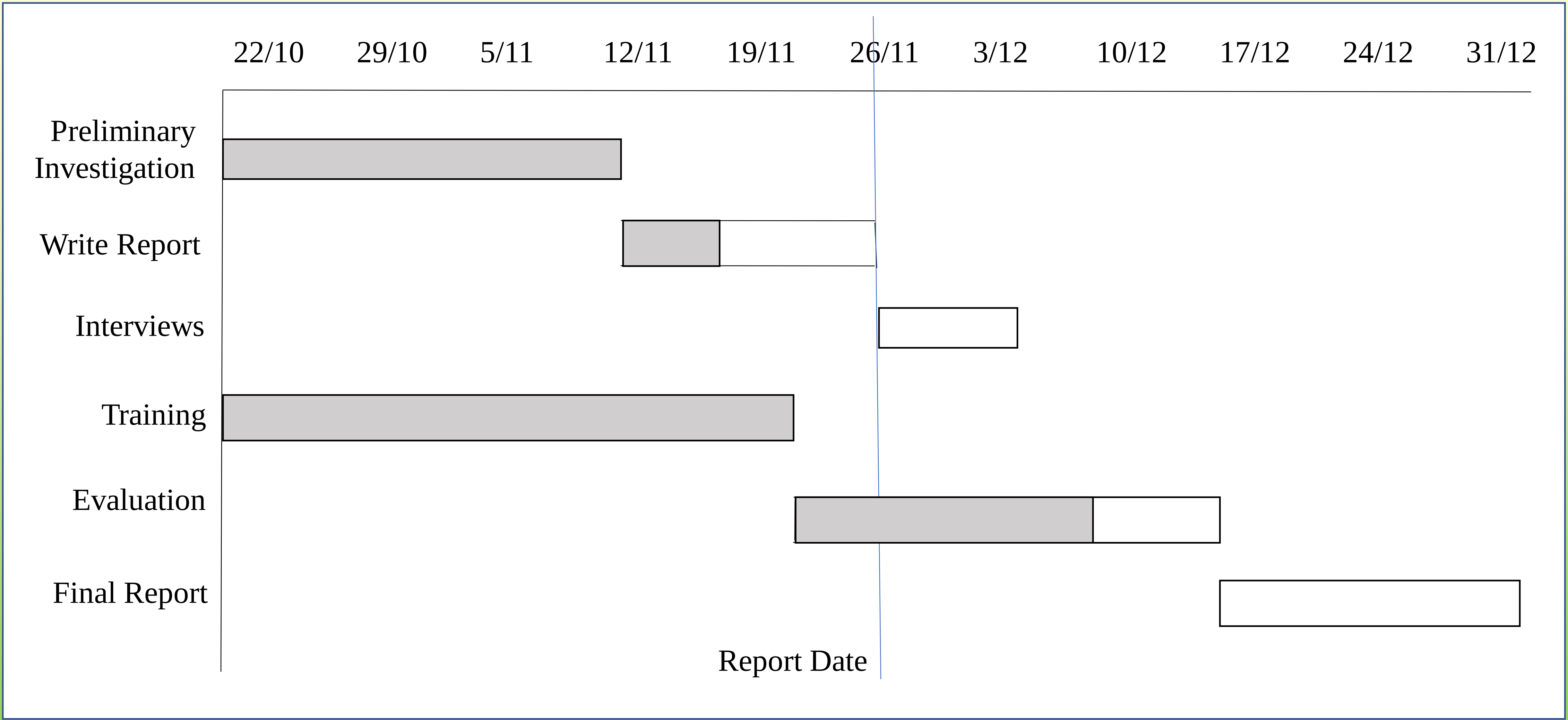


Fig: Gantt Chart of Project Schedule

10. GANTT Chart…

- **Functions of Gantt Chart**
  - Plan, schedule, manage and monitor the tasks involved in the projects.
  - Define the tasks that require completion.
  - The chart is displayed as a horizontal bar chart.
  - Horizontal bars of different length represent the project timeline.
  - This includes task sequence, task duration, task start date and task end dates.

10. GANTT Chart…

- **Benefits of Gantt Chart**
  - It identifies all the task, task which are executing in parallel and dependent tasks.
  - It organizes high level tasks and resource allocation.
  - It detects potential bottlenecks and identify tasks that may have been excluded from the project timeline.
  - The bars represents which tasks are completed.
  - It depicts the task slack time

11. Introduction to Project Management Information System (PMIS)

- PMIS is a computer based information system that efficiently stores and organized information needed to run a project.
- Project Management Book of Knowledge (PMBOK) is an information system consisting of the tools and techniques used to gather, integrate and disseminate the outputs of project management processes.

- **Objective:**
  - To reduce project duration
  - Minimize the cost of crashing

11. Introduction to Project Management Information System (PMIS)…

- **Tools used by PMIS**
  - Schedule and Planning
  - Resource Management
  - Budget
  - Control and Performance
  - Reporting and Communication
  - Integration and Ease of Use

11. Introduction to Project Management Information System (PMIS)…

❖ Functions

- During initiation phase, Project Manager uses PMIS to prepare preliminary budget including cost estimate and resource.
- It schedules the project.
- It define the scope of work, assists with preparing the bid and can be used when presenting the data to decision-makers.
- It supports cost management planning including WBS analysis and integration of control processes.
- It proves beneficial to the Project Manager when resource planning in terms of availability and level.
- It establishes a baseline for project scope, schedule and cost.
- Once the project has been executed, PMIS starts collecting, organizing and storing data as it comes in from the project team, which is then compared to the baseline projections.
- It uses cost and schedule forecasts to help if changes are required mid-project.
- It supports materials management, cost collect, performance measurement and reporting.
- During closing, it review requirements to make sure that project has met all its goals and objectives.
- It organizes all the collected information for performance review, productivity analysis, final reports and then keeps an archive with the historical data for future projects.

Thank you

Unit 3

- Pert Cost Control
- Cost reduction by crashing of activity
- Resource Scheduling
- Resource Levelling

PERT/Cost

- assists in planning and controlling program cost expenditures by employing several cost-estimating techniques as monitors to determine variances, i.e., where actual costs are different from planned costs.
- Developed by DoD and NASA
- a) assist project managers by assigning costs to the working levels of projects in the detail needed for planning schedules and costs,
- b) evaluate schedule and cost performance, and
- c) predict and control costs during the project's operational phases

PERT/Cost

PERT Cost Activity Cost Estimates

- 1) a single cost estimate of expected actual cost,
- 2) three cost estimates combined by formula into an expected cost (similar to determining expected time in PERT Time),
- 3) optimum time-cost curves (used in conjunction with the Resource Allocation Procedure supplement), and
- 4) three separate cost estimates (used in conjunction with the Time-Cost Option Procedure supplement).

PERT/Cost

- **Single Cost Estimate**: A single cost estimate of activity is based upon the sum of cost elements within each activity.
- These estimates are made by determining manpower, material, and other resources required to complete each activity.
- Direct and indirect cost

PERT/Cost

Direct Costs	Indirect Costs
Direct costs affect the product's price and are thus calculated per project or per item.	Indirect costs affect the whole business and are thus calculated monthly or annually.
The volume of products affects final product costs.	Changes in production volumes do not significantly affect indirect costs.
Highly variable mainly due to market factors.	Relatively stable.
Includes raw material, manufacturing, direct labor, and direct fuel costs.	Includes rents, leases, utilities, insurance, legal, financial fees, office expenses, maintenance, and telecommunications.
Included in the costs of goods sold section in the income statement.	Included in the operational expenses segment in the income statement.

PERT/Cost

Direct Costs		Indirect Costs	
Direct Labor	Highly variable	Rent	Fixed
Raw materials	Highly variable	Lease	Fixed
Production supplies	Highly variable	Utilities	Fixed
Fuel costs	Variable due to different fuel taxes per jurisdiction	Administration costs	Variable

PERT/Cost

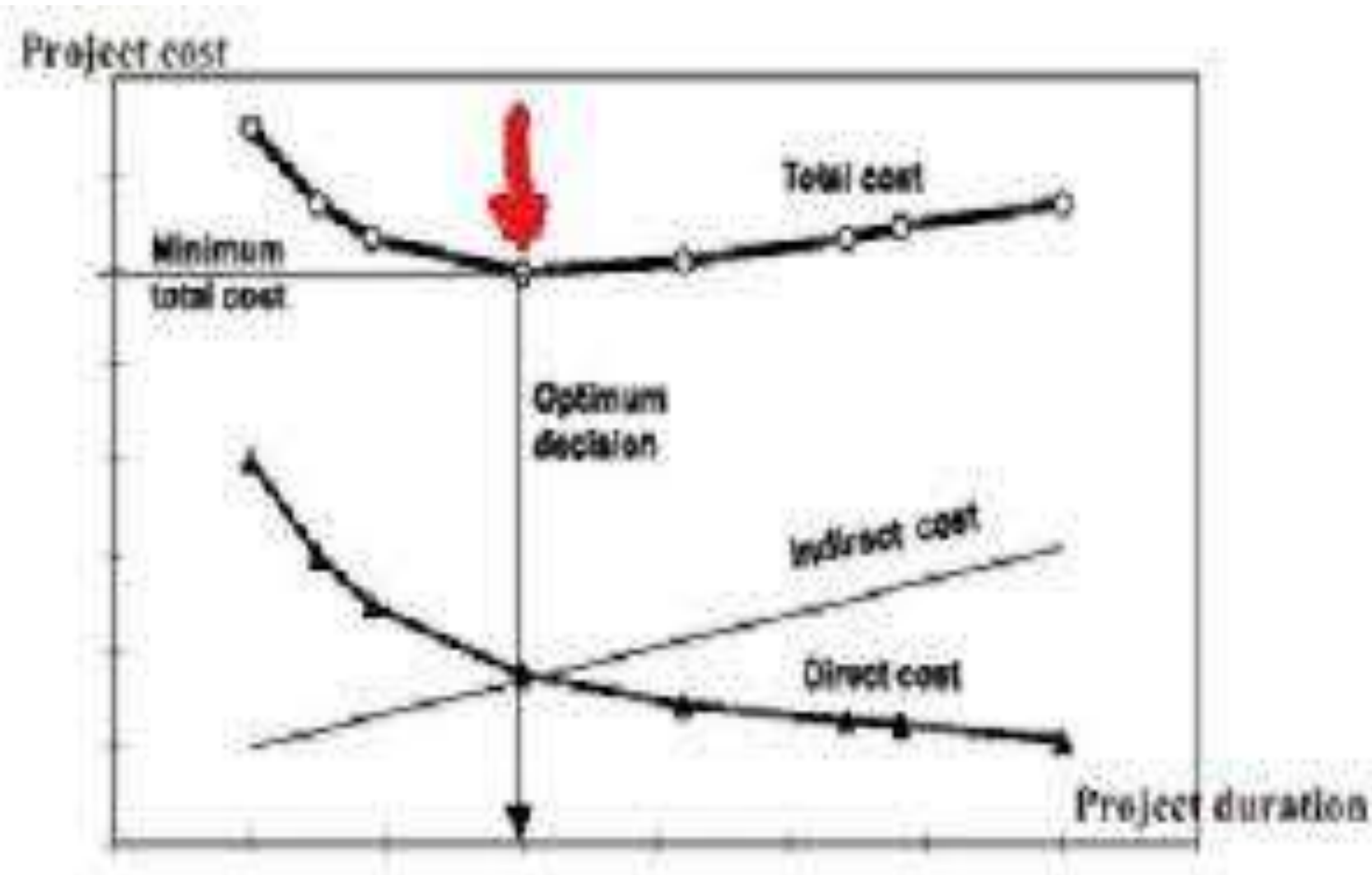
- **Three Cost Estimate**: The three cost estimate approach has as its goal determining an “expected activity cost.”
- subject to probability analysis.
- Ce = (Ca + 4Cm+Cb)/6
- if the cost estimates are realistic, the probabilities of achieving the expected cost can be used for project contract negotiations.

PERT/Cost

Optimum Time-Cost Curve Estimate:

- this concept is differential costing with time
- The intention of this approach is to optimize project time and costs by using optimum estimated activity costs
- It assumes the existence of a direct relationship between time and costs for each network activity.

PERT/Cost



Project cost
Total cost
Minimum
total cost
Optimum
decision
Indirect cost
Direct cost
Project duration

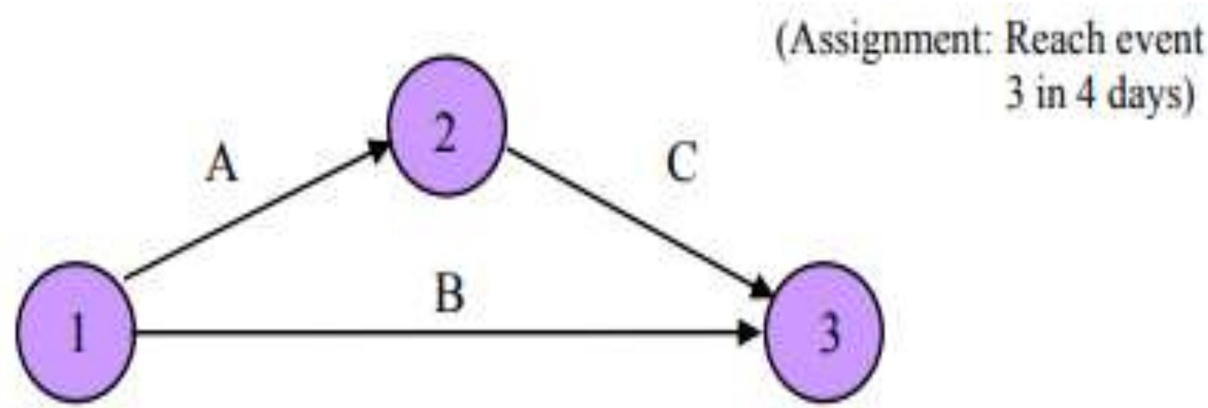
PERT/Cost

Resource Allocation Supplement:

This supplement is composed of a variation of continuous time-cost curves which can be used to plan and control a group of important activities representing only a minor portion of a project network.

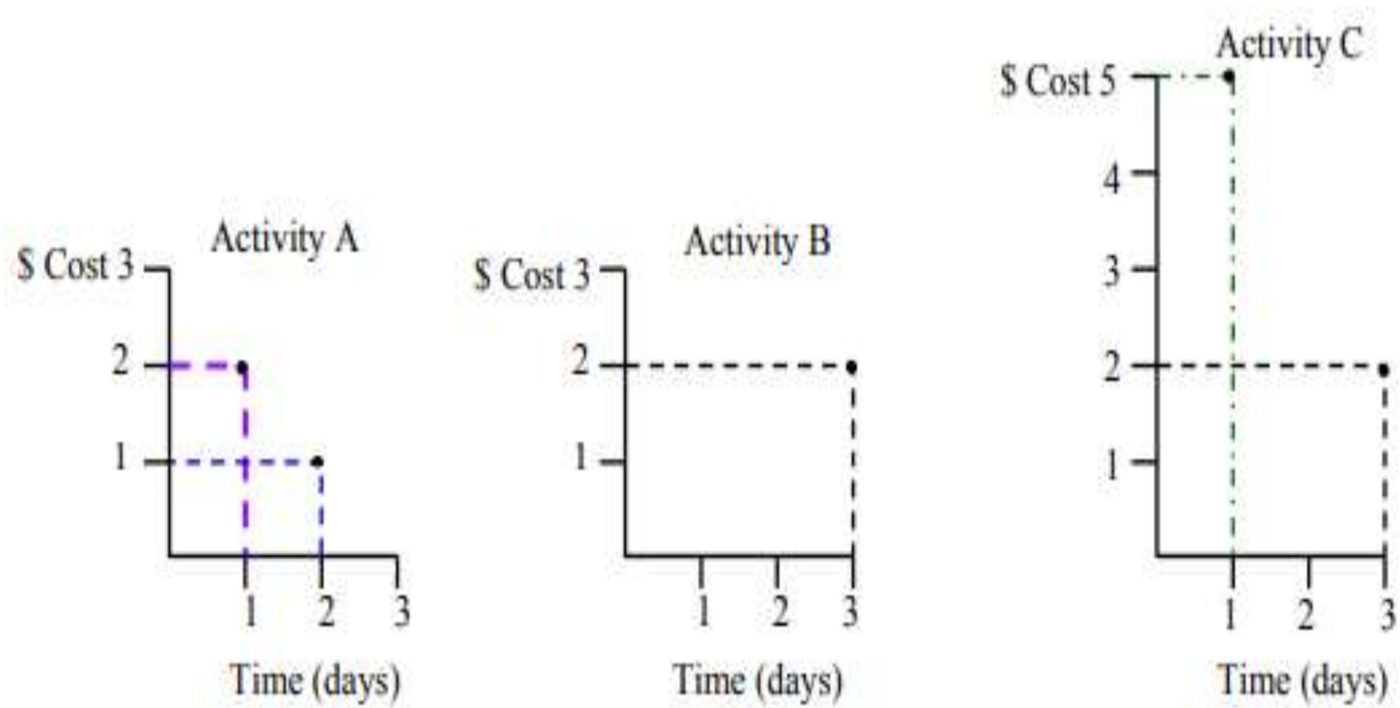
PERT/Cost

- Procedure of RAS :
- Step 1: Construct network of activities in which you are interested.



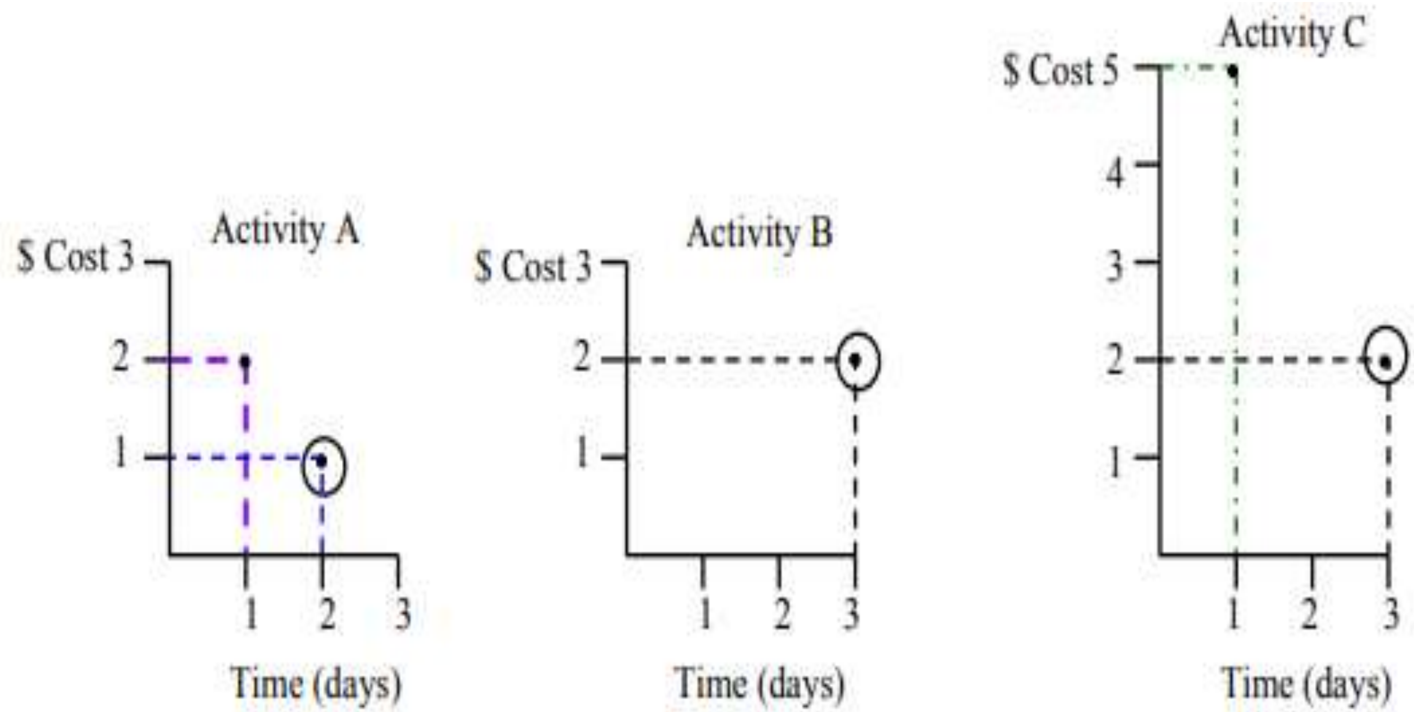
PERT/Cost

Step 2: Obtain alternative time-cost estimates for each activity.



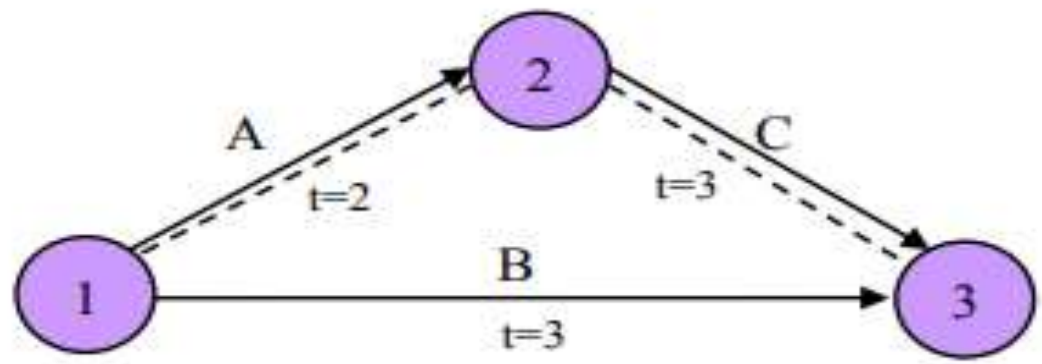
PERT/Cost

Step 3: Select the lowest cost activity for each activity.



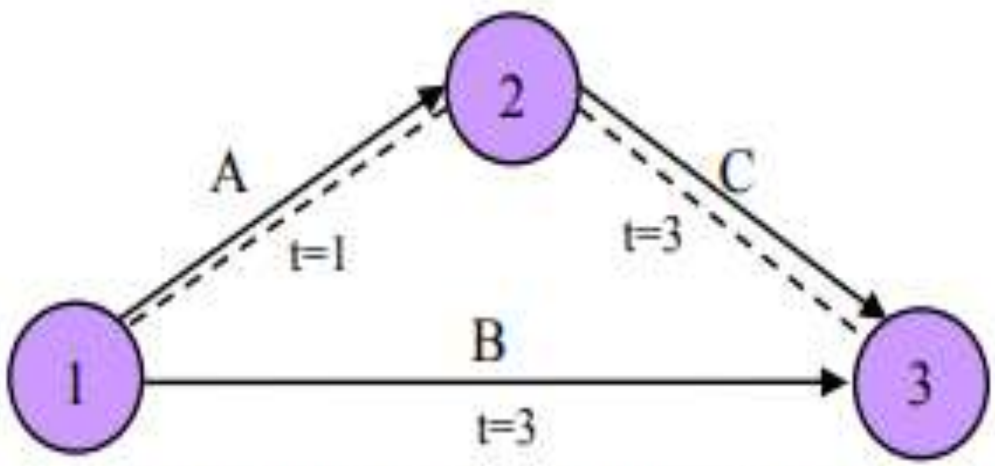
PERT/Cost

- Step 4: Calculate critical path and compare with directed completion date.



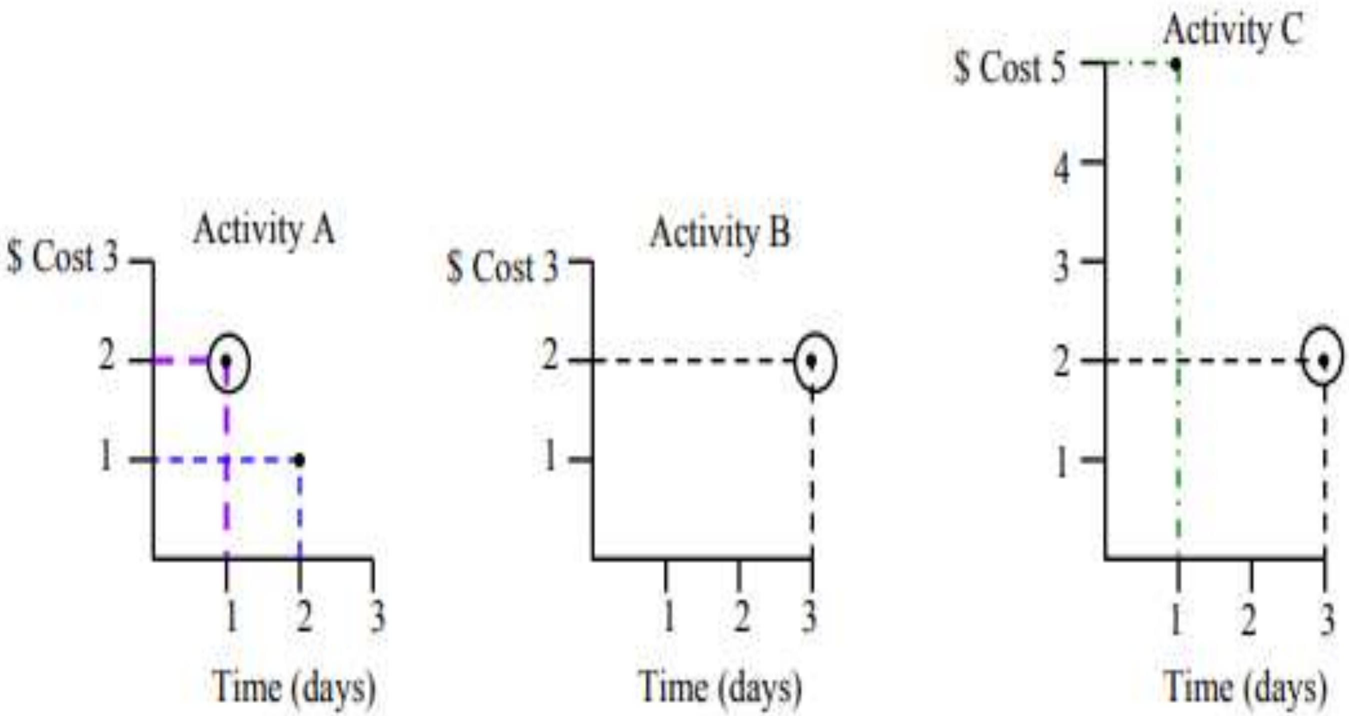
PERT/Cost

- Step 5: Adjust critical path to meet directed completion date at lowest possible costs.



(- - - - - - critical path takes 4 days, directed completion date is 4 days, scheduling change resulted in an increase in cost from $5 to $6.

PERT/Cost



Activity A
$ Cost 3
2
1
1
2
3
Time (days)
Activity B
$ Cost 3
2
1
1
2
3
Time (days)
Activity C
$ Cost 5
4
3
2
1
1
2
3
Time (days)

PERT/Cost

- In the Resource Allocation supplement procedure, one can determine how to accomplish a project by a specified date at minimum cost. The critical path is from event 1 to event 2 and from event 2 to event 3 since it requires 5 days at absolute minimum costs. However, our assigned completion date is 4 days from the beginning. From our activity time-cost charts, one finds that cutting activity A one day doubles its cost. However, since shortening the activity time for activity C would result in an even greater cost increase, we choose to shorten activity A's time.

Crashing of activity

- Cost reduction by crashing of activity
- Project crashing involves shortening the expected time taken for a project.
- This is primarily done by adding more resources to it.
- **Crashing in a project is an activity that will shorten the completion time of a project within the optimum cost increase.**

Crashing of activity

- **What are the problems a project may face?**
- A delay
- Lack of quality
- A problem with coordination
- Mismatch of expectations
- A poor plan
- Unforeseen circumstances
- External factors
- Change of scope

Crashing of activity

- **What Prompts Crashing in Project Management?**
- If there is a **heavy penalty** for failing to meet a project completion deadline, then the increased cost of crashing could be justified to an extent.
- If there is an external change where a competitor is working on a similar project, the cost of not speeding up the project would lead to the loss of a **competitive edge**.
- In case there is an activity that **delays a host of other activities**, crashing that activity could bring benefits across the project.

Crashing of activity

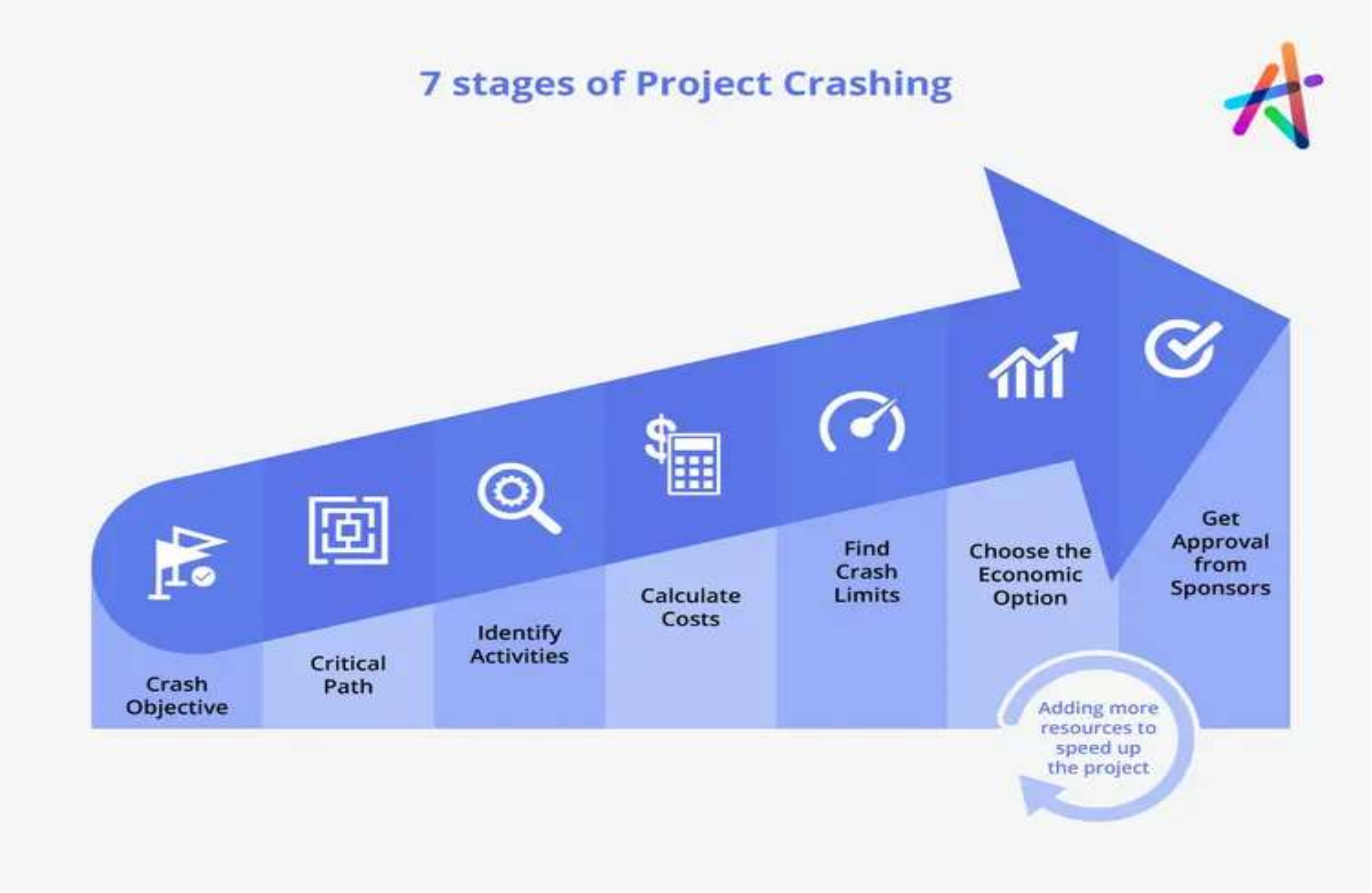
- **An Example of Crashing in Project Management – Covid case**

Crashing of activity

- While crashing into an activity in your project consider :
- **Critical Path**
- **Cost and Benefit**
- **Resource Availability**
- **Training Needs**

Crashing of activity

- **Project Crashing Management Stages**



Crashing of activity

- 1. **Crash Objective**
- The first stage of the project crashing is understanding the need for it and the objective in terms of what is to be accomplished. If the scope of the project has been reduced, then there may not be a need to add more resources to speed up the project.
- How to use the workforce or what amount of work can be outsourced etc. can be estimated at this stage.

Crashing of activity

2. Critical Path

- Each project will have a critical path identified at the beginning. This chain of activities is what needs to be crashed to speed up the project. Crashing an activity outside the critical path does not help in reducing the project time.

Crashing of activity

3. Identify Activities

- Not every activity can be crashed. There may be activities that need very specific skills that are not easily transferable. Hence adding resources to that might prove to be counterproductive. The list of activities that can be crashed and are part of the critical path should be the ones in focus.

Crashing of activity

4. Calculate Costs

- Crashing involves an increase in cost. This increase in cost will be different for each process. Comparing these costs with each other will help you arrive at a reasonable cost at which some activities can be crashed to sufficiently advance the project completion date.

Crashing of activity

5. Find Crash Limits

- Each activity will have a crash limit. This is the point beyond which an action cannot be crashed. Understanding this information will give you an idea of how much the project can potentially be crashed.

Crashing of activity

6. Choose the Economic Option

- Once you have an idea of how much each activity can be crashed and the cost associated with it, it becomes easy to identify how many activities to target and to what extent they need to be crashed to meet the objective at the most reasonable cost.

Crashing of activity

7. Get Approval from Sponsors

- Once you have identified the most reasonable or most viable crashing plan, then you can convince the key stakeholders of the project and get their approval to implement it.

Resource Scheduling

- Resource scheduling is a process used by teams to organize and structure their time, so tasks they need to complete are scheduled based on availability and capability.
- It determines the timeline and resources required to complete a project.
- Analyze how well resources are being utilized and reassign tasks to people who are not working to their full utilization rates.
- Track project estimations and outcomes to make future scheduling easier.

Need for Resource Scheduling

- **Reduces overallocation**: Team leaders can assign people tasks without over (or under) allocating their schedules. In return, team members are constantly working on an optimized schedule
- **Improves task allocation**: It makes it easy to identify who should be working on what and when and helps match people with tasks they're best suited for.
- **Provides accurate demand forecasts**: It gives team leaders a chance to fill gaps before they can derail a project. If you don't have a designer or engineer on your team to complete a specific task, you'll know ahead of time and can reallocate work or bring in extra help!

Types of Resource Scheduling

1. **Resource Constraint Scheduling:**

- Resource-constrained scheduling is a method used to complete a project with limited resources. It involves adjusting projects to align with resource capabilities.
- Say you have a project that ideally requires three people to complete, but you only have one person available. This process helps you maximize the use of your available team members or find a way to get the job done without missing the project deadline

Resource Scheduling

2. **Time constrained scheduling**

- Time-constrained scheduling is a method used to manage resources and schedule activities when there are strict deadlines to meet.
- For example, your team is working on a preorder website that has to be rolled out in two weeks. Halfway through the project, you realize that the team isn't moving fast enough to meet the deadline. So you hire a freelance developer to help speed things up.

Resource Scheduling

- **Resource scheduling in 5 steps**
- **Step 1. Break down tasks within a project**
- The first step to resource scheduling is figuring out what jobs you need to tackle on a project.
- Start by looking at the project as a whole and then breaking down each part into individual tasks.

Resource Scheduling

- **Step 2. Look at your resource capabilities**
- confirm who is available to take on tasks.
- This step goes beyond just looking at who has space on their calendar for a project.
- need to ensure people with space on their calendars also have the skills required to complete the work.

Resource Scheduling

- **Step 3. Schedule tasks to team members based on their availability**
- assigning tasks to your team based on their availability.
- Review past projects like the one you are scheduling to get an idea of how long you should allow each task on your team's calendars.

Resource Scheduling

- **Step 4. Manage and monitor resources as the project progresses**
- It's crucial to monitor individual tasks' progress so your project doesn't get knocked off course.
- If a team member calls in sick or takes some vacation time, you'll need a plan to reassign their tasks or move their deadlines backward.

Resource Scheduling

- **Step 5. Track the actual time spent on tasks and activities**
- Finally, track everything, so you make the project run even smoother.
- By tracking how many resources you used on each task and the time it took to complete them, you'll be able to use that data to tighten up your future schedules.
- Adding time tracking to your resource scheduling software is the easiest and most effective way. See if a project task is taking your team longer than expected or your resources are being used inefficiently.

Resource Levelling

- Resource leveling is a project management technique that involves resolving overallocation or scheduling conflicts to ensure a project can be completed with the available resources.
- Resources include the time, materials, or tools needed to complete a project.

Resource Levelling

- The purpose of resource leveling is to get the most out of available resources while working within the project’s time, cost, and scope constraints.
- Resource leveling can be challenging for project managers as it requires balancing the demand for the same resources across multiple projects.

Resource Levelling

Depending on your team needs, here are possible outcomes:

- If the goal is to keep the current project deadline, more resources may need to be made available.
- If the goal is to run the project with currently available resources, the deadline of the project may be extended.

Resource Levelling

- When to use resource leveling
- To optimize your resources
- To minimize deficits
- To prevent task overloading
- To ensure the quality of a project output

Resource Levelling

- Example of Obtaining additional resources

The IT team has been responding to a large number of IT requests to deal with a virus that infected company computers. Since the company's current antivirus software isn't robust enough to handle the virus, the team decides to invest in new antivirus software so they're able to fix the computers.

Resource Levelling

Example of Postponing a project end date :

- The marketing team is launching a new social media campaign and they're waiting for approval from the social media manager, who is currently out of the office due to illness. Since the campaign isn't time-sensitive, they decide to push the launch date back by a few days so the manager has time to review.
- Whether you lead a marketing, sales, or IT team, resource leveling can come in handy for resolving resource conflicts. Once you decide on a solution, let the rest of your team know your plan.

Unit 4

CSBS Sem VIII

- Risk Analysis
- Project Control
- Project Audit
- Project Termination

Risk Management

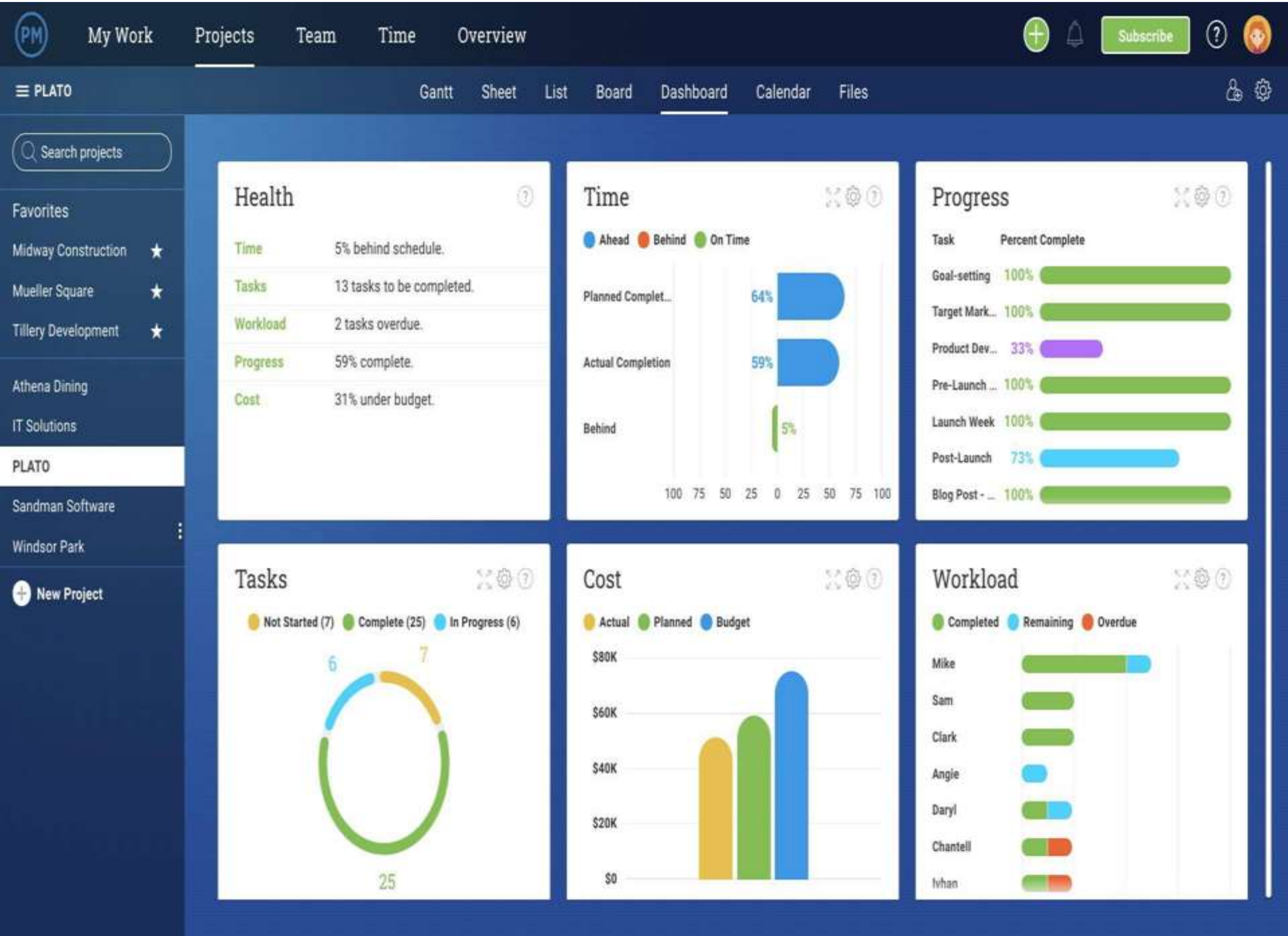
- Risk Management is the process of defining how to conduct risk management activities for a project.
- **Most Common Project Risks**
- **Cost risk**, typically escalation of project costs due to poor cost estimating accuracy and scope creep.
- **Schedule risk**, the risk that activities will take longer than expected. Slippages in schedule typically increase costs and, also, delay the receipt of project benefits, with a possible loss of competitive advantage.
- **Performance risk**, the risk that the project will fail to produce results consistent with project specifications.

Risk Management

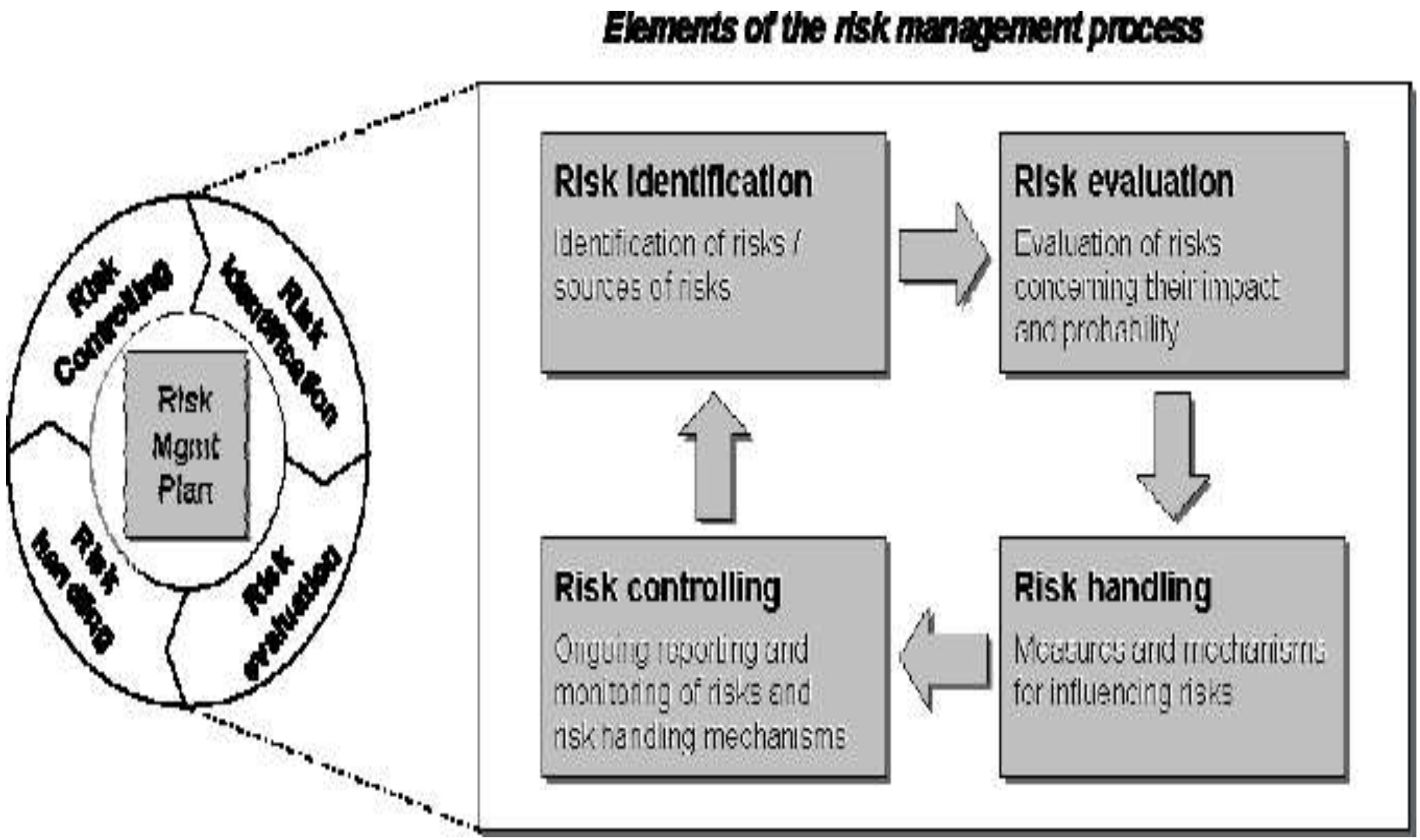
- **Other Types of Risks**
- There are many other types of risks of concern to projects. These risks can result in cost, schedule, or performance problems and create other types of adverse consequences for the organization. For example:
- **Governance risk** relates to board and management performance with regard to ethics, community stewardship, and company reputation.
- **Strategic risks** result from errors in strategy, such as choosing a technology that can't be made to work.

Risk Management

- **Operational risk** includes risks from poor implementation and process problems such as procurement, production, and distribution.
- **Market risks** include competition, foreign exchange, commodity markets, and interest rate risk, as well as liquidity and credit risks.
- **Legal risks** arise from legal and regulatory obligations, including contract risks and litigation brought against the organization.
- **Risks associated with external hazards**, including storms, floods, and earthquakes; vandalism, sabotage, and terrorism; labor strikes; and civil unrest.


PM
My Work
Projects
Team
Time
Overview
Subscribe
PLATO
Gantt
Sheet
List
Board
Dashboard
Calendar
Files
Search projects
Favorites
Midway Construction
Mueller Square
Tillery Development
Athena Dining
IT Solutions
PLATO
Sandman Software
Windsor Park
New Project
Health
Time
5% behind schedule.
Tasks
13 tasks to be completed.
Workload
2 tasks overdue.
Progress
59% complete.
Cost
31% under budget.
Time
Ahead
Behind
On Time
Planned Complet...
64%
Actual Completion
59%
Behind
5%
100 75 50 25 0 25 50 75 100
Progress
Task
Percent Complete
Goal-setting 100%
Target Mark... 100%
Product Dev... 33%
Pre-Launch ... 100%
Launch Week 100%
Post-Launch 73%
Blog Post - ... 100%
Tasks
Not Started (7)
Complete (25)
In Progress (6)
6
7
25
Cost
Actual
Planned
Budget
$80K
$60K
$40K
$20K
$0
Workload
Completed
Remaining
Overdue
Mike
Sam
Clark
Angie
Daryl
Chantell
Ivhan

Risk Management



Risk Management

1. Risk Identification

Risks are to be identified and dealt with as early as possible in the project.

Risk identification is done throughout the project life cycle

Risk identification is one of the key topics in the regular project status and reporting meetings.
Some risks may be readily apparent to the project team—known risks; others will take more rigor to uncover, but are still predictable.

Risk Management

- Risk Identification :
- Risk Sources

Risk Source	Description
Risk repository	The risk repository is the history data containing the list of risks identified for completed projects. The risk repository can be used to arrive at a list of potential risks for the project. This risk repository can also be filtered based on risk sources, categories, and projects.
Checklist analysis	The risk identification checklist is a questionnaire that helps identify gaps and potential risks. It is developed based on experience and project type.
Expert judgement	Risk identification is also done by brainstorming with or interviewing experienced project participants, stakeholders, and subject matter experts.
Project status	The project status includes project status meeting reports, status reports, progress reports, and quality reports. These reports provide the current project progress, issues faced, and threshold violations. These provide insight into the status of the project and potential new risks.

Risk Management

- 2. Risk Category

Risk category provides a list of areas that are prone to risk events. The organization recommends high-level, standard categories

Risk Category	Extended categories
Technical	Requirements, Technology, Interfaces, Performance, Quality, etc.
External	Customer, Contract, Market, Supplier, etc.
Organizational	Project Dependencies, Logistics, Resources, Budget, etc.
Project Management	Planning, Schedule, Estimation, Controlling, Communication, etc.

Risk Management

- Risk analysis involves examining how project outcomes and objectives might change due to the impact of the risk event.
- Once the risks are identified, they are analysed to identify the qualitative and quantitative impact of the risk on the project so that appropriate steps can be taken to mitigate them.

Risk Management

- Probability of Risk Occurrence

High probability – ($80\ \% \le x \le 100\%$)
Medium-high probability – ($60\ \% \le x < 80\%$)
Medium-Low probability – ($30\ \% \le x < 60\%$)
Low probability ($0\ \% < x < 30\%$)

- Risk Impact

High – Catastrophic (Rating A – 100)
Medium – Critical (Rating B – 50)
Low – Marginal (Rating C – 10)

Risk Management

Project Objective	C Rating 10	B Rating 50	A Rating 100
Cost	Cost increase > 0 % or > 0 €	Cost increase 5 - 10% or > 50.000 €.	Cost increase > 10 % or > 100.000 €.
Schedule	overall project schedule delay > 0 days	overall project schedule delay > 1 week	overall project schedule delay > 2 weeks *
Scope	Scope decrease barely noticeable	Minor areas of scope are affected	Major areas of scope are affected; scope reduction unacceptable to the client
Quality	Quality reduction barely noticeable	Quality reduction does not affect vital functionality	Quality reduction requires client approval

Risk Management

3. Risk Exposure

- Risk Exposure or Risk Score is the value determined by multiplying the Impact Rating with Risk Probability.

		Probability			
		1 = high (80% ≤ x ≤ 100%)	2 = medium high (60% ≤ x < 80%)	3 = medium low (30% ≤ x < 60%)	4 = low (0% < x < 30%)
Impact	A=high (Rating 100)	(Exposure – Very High) (Score 100)	(Exposure – Very High) (Score 80)	(Exposure – High) (Score 60)	(Exposure – Moderate) (Score 30)
	B=medium (Rating 50)	(Exposure – High) (Score 50)	(Exposure – Moderate) (Score 40)	(Exposure – Moderate) (Score 30)	(Exposure – Low) (Score 15)
	C=low (Rating 10)	(Exposure – Low) (Score 10)	(Exposure – Low) (Score 8)	(Exposure – Low) (Score 6)	(Exposure – Low) (Score 3)

Risk Management

- Risk Occurrence Timeframe

Timeframe	Description
Near	Now- until one month
Mid	next 2-6 months
Far	>6 months

Risk Management

- Risk Classification Examples:

Risk event	Probability	Impact rating	Score
The hardware will be delivered 10 days late, leading to an overall project delay of 10 days in a project that is of minor importance to the customer	100%	B (50)	50
The hardware will be delivered 10 days late, leading to an overall project delay of 10 days. Delivery on time is important to the customer. High penalties for each day of delayed delivery are agreed.	100%	B (50)	50, but because of special circumstances is upgraded to 100
The acceptance test scope of work is not confirmed by the customer by integration test completion. From experience, it may be expected that the customer will require a certain number of additional test cases, leading to schedule delay and additional costs.	70%	B (50), because a risk of 6% cost increase and 10 days project schedule delay are expected	40
At C130 the customer has confirmed half the features described in the R-Spec, but informs Nokia Siemens Networks that the other half, as well as some additional requirements, are still under discussion. The final scope of the project is therefore very unclear. Major changes are to be expected.	80%	A (100), because a risk of more than 10% cost increase and more than 2 weeks project schedule delay, as well as major changes in scope, are expected	100

Risk Management

4. Risk Response Planning

- There may not be quick solutions to reduce or eliminate all the risks facing a project. Some risks may need to be managed and reduced strategically over longer periods. Therefore, action plans should be worked out to reduce these risks. These action plans should include:
- Risk description with risk assessment
- Description of the action to reduce the risk
- Owner of the risk action
- Committed completion date of the risk action

Risk Management

Risk Response Plans

- For each risk, a risk response must be documented in the risk register in agreement with the stakeholders. This should be ensured by the project manager.
- Risk response plans are aimed at the following targets:
- Eliminating the risk
- Lowering the probability of risk occurrence
- Lowering the impact of the risk on the project objectives

Risk Management

Risk event	Risk Response
Schedule delay to be expected if the hardware is delivered late.	Agree on penalties with the hardware supplier for delayed delivery. • Evaluate ways to shorten the timeline for onsite activities like installation, commissioning, etc. • Shorten the acceptance phase by reducing acceptance test cases or inviting the customer to a joint system test before customer release.
Time, cost, and scope deviation to be expected if requirements not final at project kick-off.	• Make sure that the requirements specification has been internally reviewed by all concerned parties and is internally agreed as complete and feasible. • Inform the customer about the latest possible date for input into the final version of the requirements specification and about the version that is to be used as basis for the development if no further input is available until then. • Open a claim against the customer. • Agree with the customer that all issues not clarified until project kick-off will be treated as change requests with possible impacts on time and cost.

Risk Management

5. Risk Ownership:

- The ground rule is that responsibility for managing all risks in the project lies with the project manager.
- Based on this ground rule a Risk Owner (who is not necessarily the project manager) must be determined and named in the Risk Register.

Risk Management

Risk event	Risk owner
Schedule delay to be expected if the hardware is delivered late.	Technical Order Manager and Service Account Manager
Time, cost, and scope deviation to be expected if requirements will not be final at project kick-off.	Project Manager
Overall project schedule delay to be expected if customer release will not be reached in time.	System Test leader

Risk Management

6. Risk monitoring and control :

- Identifying new risks and planning for them
- Keeping track of existing risks to check if:
  - Reassessment of risks is necessary
  - Any of risk conditions have been triggered
  - Monitor any risks that could become more critical over time
  - Tackle the remaining risks that require a longer-term, planned, and managed approach with risk action plans

Risk Management

7. Risk reporting:

- The risk register is continuously updated, from risk identification through risk response planning and status update during risk monitoring and control. This project risk register is the primary risk reporting tool and is available in the central project server, which is accessible to all stakeholders.

Project Monitoring & Control

- Project controlling is the application of processes to measure performance against the plan.
- Controlling helps identify deviations from the plan.
- Project management helps manage different processes, while project control ensures they are performed as planned.
- Project Control focuses on the following:
- Project Budget
- Project Schedule
- Project Quality

Project Monitoring & Control

- Features:

1. It is Forward-Looking

Controlling helps organizations plan and manage their projects. It allows an organization to identify areas of risk and realize opportunities.

2. **It Exists at all Levels**

- Controlling is from the top management to the operational level. This ensures plans are aligned with operations and resources are used efficiently.

Project Monitoring & Control

3. It is a Continuous Process

- Controlling is not a one-time event; project managers continually monitor their progress and compare it with the planned progress.
- This allows organizations to be proactive rather than reactive when managing resources.

Project Monitoring & Control

4. It is a Preventive Mechanism

- Controlling helps organizations identify and address potential problems before they escalate. This allows organizations to take corrective action before it’s too late.

5. It Provides Feedback

- Feedback provides organizations with information about the effectiveness of their strategies and how to improve further.
- The controlling mechanism provides an organization with valuable feedback.

Project Monitoring & Control

6. It is Flexible

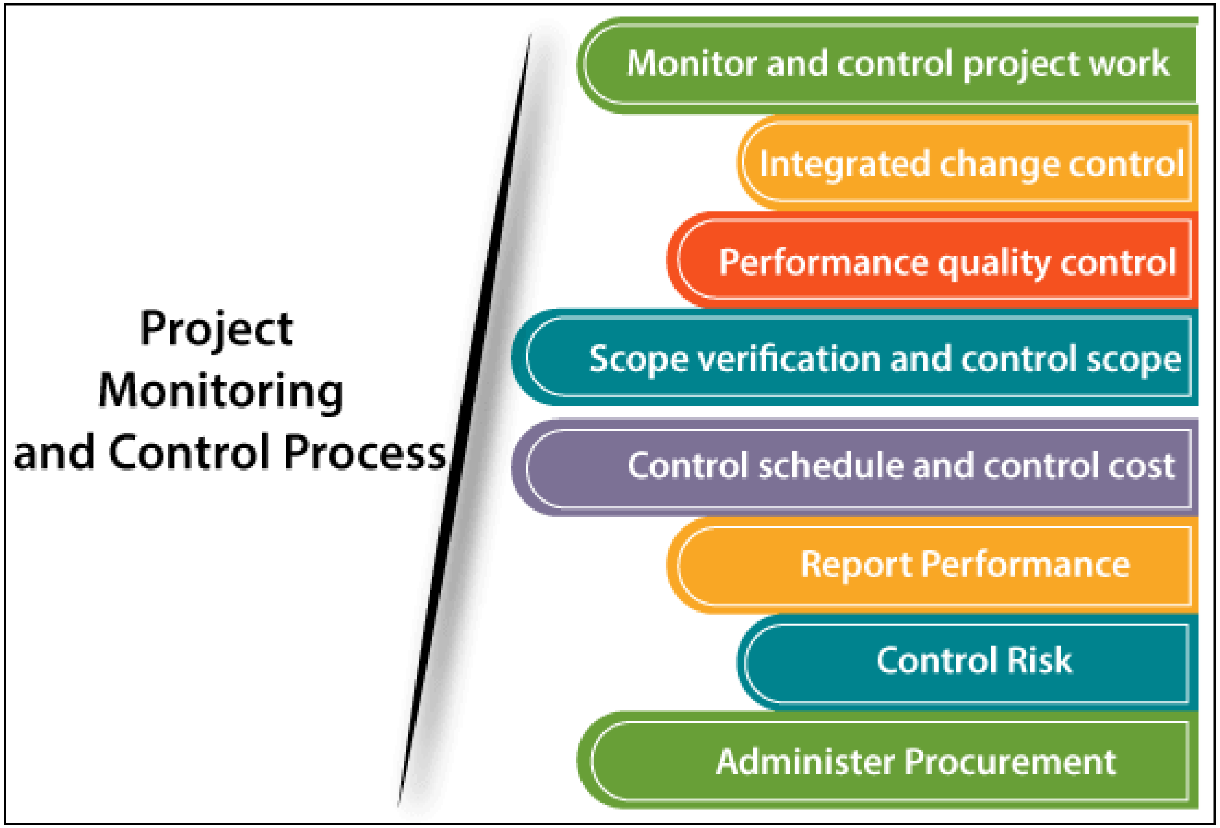
- Controlling can be adjusted according to the project needs, such as changes in market conditions or new government regulations.
- This allows organizations to adapt their controlling processes when necessary.

Project Monitoring & Control

- Project monitoring and control process includes procedures which are performed to observe project performance so that potential problems are identified, and appropriate action can be taken to meet the desired performance of the project.
- The goal of Project Monitoring and Control (PMC) is to ensure that whether the project proceeds according to the activities that are planned or not. It helps to develop an understanding of project progress, which helps in taking appropriate actions to control deviations of plans.

Project Monitoring & Control

- **There are several processes in Project Monitoring and Control as follows:-**



Project Monitoring & Control

- **Monitor and control project work -** It helps to check whether the team is working according to plan or not and able to complete the project on time. Project managers make performance measures or use previous performance measures to analyze project performance at regular intervals during the development of the project.

Project Monitoring & Control

- **Integrated change control -** Project manager, always try to avoid the changes and control them if changes occur. Change is required, but there is no compulsion. If it requires a change, the project manager discusses with the consultants, senior management, or other stakeholders, including customer and try to find out the solution.

Project Monitoring & Control

- **Activities during this change control:**
- Keeps a record of all the changes made to the previous baseline to reach a new baseline
- Identify all items to define the software configuration
- Monitor status of change requests
- Complete listing of all changes since the last baseline
- Allows tracking of progress to next baseline
- Allows to check previous releases/versions to be extracted for testing

Project Monitoring & Control

- **Scope verification and control scope -** The project manager controls the scope all over the development phases. The customer will verify the scope to check whether the developed product fulfills all the requirements of the customer’s or not. If it meets the requirements, then it is delivered to the customer's site, and if not, then it should again go back to the development stage.

Project Monitoring & Control

- **Control schedule and control cost -** With the help of Earned Value Management (EVM), the project manager controls the schedule and cost of the project. With the help of Earned Value Management (EVM), the project manager control the timing and cost of the project, and depending upon the results of CPI(Cost Performance Index) and SPI(Schedule Performance Index) project is monitored and controlled.

Project Monitoring & Control

- ❖ **Planned Value (PV)**
  - It is the planned expenditure of funds to the date of analysis.
  - PV = Planned Completion (%) * BAC
  - Where BAC = budget at completion
- ❖ **Earned Value (EV)**
  - It is the actual progress of the task to the date of analysis.
  - Earned Value = Actual Completion (%) * BAC
- ❖ **Actual Cost (AC)**
  - It is the actual expenditure of funds to the date of analysis.

Project Monitoring & Control

- **Cost Variance (CV)**
  - The amount that the project is above or below the budget at the point of analysis.
- **Cost Performance Index (CPI)**
  - The amount that the project is above or below budget, relative to the overall size of the project.
  - If CPI > 1, Project Cost is below Budget.
  - If CPI < 1, Project Cost is over Budget.

Project Monitoring & Control

- **Schedule Variance**
  - The amount that the project is ahead or behind schedule at the point of analysis.
- **Schedule Performance Index**
  - The amount that the project is ahead or behind schedule, relative to the overall size of the project.
  - If SPI > 1, Project is ahead its Schedule
  - If SPI < 1, Project is behind its Schedule

Project Monitoring & Control

- **Problem 1: Suppose you have a budgeted cost of a project at $900,000. The project is to be completed in 9 months. After a month, you have completed 10 percent of the project at a total expense of $100,000. The planned completion should have been 15 percent. Calculate Planned value and earned value.**

Project Monitoring & Control

- Given,
  - BAC = $ 900,000
  - AC = $ 100,000
- Calculate,
  - Planned Value
  - Earned Value
- We have,
  - planned completion (%) = 15 %
  - actual completion (%) = 10 %

Project Monitoring & Control

- PV = Planned Completion (%) * BAC
- = 15% * $900,000
- = $135,000
- EV = Actual Completion (%) * BAC
- = 10% * $900,000
- = $90,000

Project Monitoring & Control

- Calculate,
  - CPI
  - SPI
- CPI = EV/AC
- = 90,000/ 100,000
- = 0.90
- SPI = EV/PV
- = 90,000/ 135,000
- = 0.67
- CV = EV – AC
- SV = EV – PV

Project Monitoring & Control

- **Problem 2: Suppose you are managing a software development project. The project is expected to be completed in 8 months at a cost of $10,000 per month. After 2 months, you realize that the project is 30 percent completed at a cost of $40,000. You need to determine whether the project is on-time and on-budget after 2 months.**

Earned Value Analysis

- Given,
  - BAC = 8 * 10,000 = $ 80,000
  - AC = $ 40,000
- Calculate,
  - Planned Value, CV, SV
  - Earned Value
- We have,
  - planned completion (%) = 2/8 = 25 %
  - actual completion (%) = 30 %

- PV = Planned Completion (%) * BAC

  =

  =

- EV = Actual Completion (%) * BAC

  =

  =

- CV = EV – AC
- SV = EV - PV

Earned Value Analysis

- Given,
  - BAC = 8 * 10,000 = $ 80,000
  - AC = $ 40,000
- Calculate,
  - Planned Value
  - Earned Value
- We have,
  - planned completion (%) = 2/8 = 25 %
  - actual completion (%) = 30 %

- PV = Planned Completion (%) * BAC

  = 25 % * 80,000

  = 20,000
- EV = Actual Completion (%) * BAC

  = 30 % * 80,000

  = 24,000

Earned Value Analysis

- Calculate,
  - CPI
  - SPI
- CPI = EV/AC

  =

  =
- SPI = EV/PV

  =

  =
- CPI 1, Project is Budget.
- SPI 1, Project is Schedule.

Earned Value Analysis

- Calculate,
  - CPI
  - SPI
- CPI = EV/AC

  = 24,000/ 40,000

  = 0.6
- SPI = EV/PV

  = 24,000/ 20,000

  = 1.2
- CPI < 1, Project is Over Budget.
- SPI > 1, Project is Ahead Schedule.
- Calculate CV and SV

Project Monitoring & Control

- **Perform quality control -** Before delivering the product to the customer, the developed product is verified again to check that the product we are giving to the customer is delivered with the required quality. There are a lot of quality tools and processes to check the quality of the product, like test cases, Root Cause Analysis, Control chart, Histogram, etc.

Project Monitoring & Control

- **Report performance –** Large projects would have many stakeholders. The project manager will update the project performance to the stakeholders. This process collects performance information like status reports, progress reports, and forecasts.
- **Control risk –** Project managers also monitor the risks involved with the project. The project may have different types of risks, including process, people (internal, customer, vendor), tools, and technology.

Project Monitoring & Control

- **Administer Procurement -** If any process is handed over to the third-party, their performance should also be monitored. Based on their performance, the outcome of the project is decided. The project manager also needs to monitor the role and responsibility of the third-party.
- **Benefits of Process Monitoring and Control**
- It helps in the better control of the project
- It provides an in-depth knowledge of the progress of the project.
- It helps in maintaining coordination among team members.
- It helps in monitoring and managing the project process.

Project Audit

- **A project audit** is a **formal review of a project,** often intended to assess the extent to which project management standards are being upheld.
- **Audits** are generally carried out by a specially designated **audit department**, the **Project Management Office**, an **approved management committee** or an **external auditor**.

Project Audit

Objectives of project audit:

1. **Ensure the quality of products and services**

- A **project audit** acts as a **quality assurance tool**. It reviews the project life cycle evaluating the results yielded during the different stages, from the design phase to implementation.
- When reviewing the design phase, a project audit evaluates the thoroughness of the design concepts, including the analysis of alternative designs.
- **The identification of the errors during the process** contributes to the resolution of the problems and to understand if the project should continue through a go/no-go decision at each stage.

Project Audit

2. **Ensure the quality of project management**

A **project audit** ascertains that the project management satisfies the standards by assessing whether it complies with the organization's **policies, processes and procedures**.

It evaluates the methodology used to help identify gaps in order to introduce the required improvements.

Project Audit

3. Identify the business risk

- Project audits support the identification of business factors where **risks may reside**, which could affect **budget, time, environment and quality**.
- The project audit assesses the feasibility of the project in terms of affordability and performance by providing transparency and assessing costs, time and resources.

Project Audit

4. Improve project performance

- The monitoring of the various phases of the project life cycle can contribute to the **improvement of the project team's performance**.
- The audit also helps to improve the budget and resource allocation.
- Identifying priorities, corrective measures and preventive actions can lead to a positive project outcome.
- The troubleshooting process allows the project team to provide solutions and helps prevent similar problems from recurring in the future.

Project Audit

- **5. Learn**
- A project audit can deliver **learning opportunities** through assessments of project management expertise.
- Providing reviews and feedback allows individuals and project teams to ponder their own performance.

Project Audit

- Steps in Project Audit
- **1.** *Project Audit Initiation* This step involves starting the audit process, defining the purpose and scope of the audit, and gathering sufficient information to determine the proper audit methodology.

Project Audit

- **2.** *Project Baseline Definition* This phase of the cycle normally consists of identifying the performance areas to be evaluated, determining standards for each area through benchmarking or some other process, ascertaining management performance expectations for each area, and developing a program to measure and assemble the requisite information.

Project Audit

- **3.** *Establishing an Audit Database:* Once the baseline standards are established, execution of the audit begins. The next step is to create a database for use by the audit team.

Depending on the purpose and scope of the audit, the database might include information needed for assessment of project organization, management and control, past and current project status, schedule performance, cost performance, and output quality, as well as plans for the future of the project. The information may vary from a highly technical description of performance to a behaviorally based description of the interaction of project team members.

Project Audit

- **4.** *Preliminary Analysis of the Projec*t After standards are set and data collected, judgments are made. Some auditors do judgment on the grounds that such a delicate but weighty responsibility must be reserved to senior management.

The auditor must analyze the data and then present the analysis to managers in ways that communicate the real meaning of the audit's findings. It is the auditor's duty to brief the PM on all findings and judgments *before* releasing the audit report management.

Project Audit

- **5.** *Audit Report Preparation* This part of the audit life cycle includes the preparation of the audit report, organized by whatever format has been selected for use.

A set of recommendations, together with a plan for implementing them, is also a part of the audit report. If the recommendations go beyond normal practices of the organization, they will need support from the policy-making level of management.

Project Audit

Summary of Recommendations

Further development of VALID techniques:

- Make the method more field-friendly
- Increase accessibility and further verify usefulness of different tracers and doses
- Further establish guidelines for interpreting VALID techniques
- Further validate the method for different population groups, especially children and pregnant and lactating women
- Design studies with sufficient statistical power for specific conditions
- Determine how vitamin A status and other population characteristics influence vitamin A absorption, distribution, and metabolism
- Consider designs with paired comparisons and both positive and negative controls

Further application of VALID techniques to benefit public health:

- Monitor the safety and effectiveness of high dose supplementation to young children in developing countries
- Assess alternative vitamin A interventions
- Determine the effectiveness of routinely supplementing with or feeding β-carotene, rather than retinol
- Investigate the usefulness of VALID techniques to assess vitamin A status in populations affected by inflammation
- Improve understanding of the influence of iron or zinc deficiencies on vitamin A metabolism and status evaluation

Project Termination

A project can be said to be terminated when work on the substance of the project has ceased or slowed to the point that further progress on the project is no longer possible

- There are four fundamentally different ways to close out a project:
- extinction, addition, integration, and starvation.

Project Termination

- 1. **Termination by Extinction**
- The project is stopped. It may end because it has been successful and achieved its goals
- The new product has been developed and handed over to the client, or the software has been installed and is running.
- The project may also be stopped because it is unsuccessful or has been superseded:

e.g: The new drug failed its efficacy tests; there are better/faster/cheaper/prettier alternatives available;

or it will cost too much and take too long to get the desired performance.

Project Termination

- A special case of termination by extinction is "termination by murder."* There are all

sorts of murders. They range from political assassination to accidental projecticide. When senior executives vie for promotion, projects for which the loser is champion are apt to suffer. Corporate mergers often make certain projects redundant or irrelevant.

Project Termination

- When a decision is made to terminate a project by extinction, the most noticeable event is that all activity on the *substance* of the project ceases.
- A great deal of organizational activity, however, remains to be done. Arrangements must be made for the orderly release of project team members and their reassignment to other activities if they are to remain in the parent organization.

Project Termination

2. Termination by Addition

- Most projects are “in-house,” that is, carried out by the project team for use in the parent organization.
- If a project is a major success, it may be terminated by institutionalizing it as a formal part of the parent organization.
- When project success results in termination by addition, the transition is strikingly different from termination by extinction.

Project Termination

- Project personnel, property, and equipment are often simply transferred from the dying project to the newly born division.
- The metamorphosis from project to department,

to division, and even to subsidiary is accompanied by budgets and administrative practices that conform to standard procedure in the parent firm, by demands for contribution profits.

Project Termination

- **Termination by Integration**
- This method of terminating a project is the most common way of dealing with successful projects, and the most complex.
- The property, equipment, material, personnel, and functions of the project are distributed among the existing elements of the parent organization.
- The output of the project becomes a standard part of the operating systems of the parent, or client.

Project Termination

- Following is a list of a few of the more important aspects of the transition from project to integrated operation that must be considered when the project functions are distributed:
- 1. Personnel 2.Accounting/Finance
- 3. Information system/software 4. Marketing
- 5. Purchasing 6. Risk Identification& mgmt

Project Termination

- 4. **Termination by Starvation**
- It is “slow starvation by budget decrement.” Almost anyone who has been involved with projects over a sufficient period of time to have covered a business recession has had to cope with budget cuts.
- In some firms, for example, it is politically dangerous to admit that one has championed a failure, and terminating a project that has not accomplished its goals is an admission of failure.

Project Termination

- In such a case, the project budget might receive a deep cut—or a series of small cuts—large enough to prevent further progress on the project and
- to force the reassignment of many project team members.
- In effect, the project is terminated, but the project still exists as a legal entity complete with sufficient staff to maintain some sort of presence.

Project Termination

- **WHEN TO TERMINATE A PROJECT**
- Is the project still consistent with organizational goals?
- Is it practical? Useful?
- Is management sufficiently enthusiastic about the project to support its implementation?
- Is the scope of the project consistent with the organization’s financial strength?
- Is the project consistent with the notion of a “balanced” program in all areas of the organization’s technical interests? In “age”? In cost?
- Does the project have the support of all the departments (e.g., finance, manufacturing, marketing, IT, legal, etc.) needed to implement it?
- Is organizational project support being spread too thin?
- Is support of this individual project sufficient for success?
- Does this project represent too great an advance over current technology? Too small an advance?

Project Termination

- Is the project team still innovative, or has it gone stale?
- Can the new knowledge be protected by patent, copyright, or trade secret?
- Could the project be farmed out without loss of quality?
- Is the current project team properly qualified to continue the project?
- Does the organization have the required skills to achieve full implementation or exploitation of the project?
- Has the subject area of the project already been "thoroughly plowed"?
- Has the project lost its key person or champion?
- Is the project team enthusiastic about success?
- Can the potential results be purchased or subcontracted more efficiently than developed in-house?
- Does it seem likely that the project will achieve the minimum goals set for it? Is it still profiable? timely?

Case Study 1

- Tornado IPT Case Study
- Working with Tornado IPT
- The Tornado Integrated Project Team (Tornado IPT) is part of the UK Ministry of Defence's (MoD's) Defence Equipment and Support (DE&S) organisation. It is responsible for the provision of logistical support and capability development for the RAF Tornado F3 (Air Defence Variant) and the GR4 (Ground Reconnaissance) fleet until 2025, when it is due to be replaced by the Eurofighter Typhoon. Between now and then it is the task of the IPT to ensure the platform's capability is developed to meet the UK's changing defence requirements.
- The requirement to drive down defence costs whilst maintaining outputs to the end customer has led the IPT instigating a transformation programme which has resulted in the development of a series of availability-based contracting solutions with industry. The Tornado IPT draws Case study on the extensive aircraft design, development, operational and repair expertise of a team that includes the RAF, BAE Systems, Rolls Royce Defence Aerospace and QinetiQ.

Case study 2

- Working with LLW Repository Ltd
- LLW Repository Ltd (LLWR) is a waste management company that provides services to customers to treat and dispose of low-level radioactive waste (LLW). It manages the national Low-Level Waste Repository in West Cumbria on behalf of the Nuclear Decommissioning Authority (NDA), overseeing a National LLW Programme to ensure that lower activity waste is managed effectively across the UK.
- After a competitive evaluation, LLWR appointed Risk Decisions to implement an integrated risk database solution to embed risk management.
- **Challenge**
- Prior to 2007, when LLWR was established as an independent Site Licence Company, LLWR' s risk team had very little control over its shared systems. Moving away from spreadsheet-based methods towards more scalable solutions was part of the business's growth plans.
- LLWR's Project Controls Manager, Sarah Moore, explains, "A new parent body organisation taking ownership of **LLWR** in 2008 was the opportunity for change. To that point, risk management was something that had been done to the organisation as opposed to being embedded within it. We wanted to have a tool that the organisation could use to demonstrate the value of our risk processes."
- "We were looking for a tool that would integrate all of our risk data, and provide us with analytical capability – basically a one-stop-shop for risk management. Given the industry we work in, the tool also needed to have a robust audit trail."

Unit 5

- Agile Principles
- Agile Methodologies
- Relationship between Agile & Scrum
- Lean
- DevOps
- IT Service Management

Agile Values & Principles

- The Four Values of The Agile Manifesto
- The Agile Manifesto is comprised of four foundational values and 12 supporting principles which lead the Agile approach to software development.
- Each Agile methodology applies the four values in different ways, but all of them rely on them to guide the development and delivery of high-quality, working software.

Agile Values and Principles

- **1. Individuals and Interactions Over Processes and Tools**
  The first value in the Agile Manifesto is “Individuals and interactions over processes and tools.” Valuing people more highly than processes or tools is easy to understand because it is the people who respond to business needs and drive the development process. If the process or the tools drive development, the team is less responsive to change and less likely to meet customer needs. Communication is an example of the difference between valuing individuals versus process. In the case of individuals, communication is fluid and happens when a need arises. In the case of process, communication is scheduled and requires specific content.

Agile Values and Principles

- **2. Working Software Over Comprehensive Documentation** Historically, enormous amounts of time were spent on documenting the product for development and ultimate delivery. Technical specifications, technical requirements, technical prospectus, interface design documents, test plans, documentation plans, and approvals required for each.
- The list was extensive and was a cause for the long delays in development. Agile does not eliminate documentation, but it streamlines it in a form that gives the developer what is needed to do the work without getting bogged down in minutiae.
- Agile documents requirements as user stories, which are sufficient for a software developer to begin the task of building a new function.
  The Agile Manifesto values documentation, but it values working software more.

Agile Values and Principles

- **3. Customer Collaboration Over Contract Negotiation** Negotiation is the period when the customer and the product manager work out the details of a delivery, with points along the way where the details may be renegotiated. Collaboration is a different creature entirely.
- With development models such as Waterfall, customers negotiate the requirements for the product, often in great detail, prior to any work starting. This meant the customer was involved in the process of development before development began and after it was completed, but not during the process.
- The Agile Manifesto describes a customer who is engaged and collaborates throughout the development process, making. This makes it far easier for development to meet their needs of the customer. Agile methods may include the customer at intervals for periodic demos, but a project could just as easily have an end-user as a daily part of the team and attending all meetings, ensuring the product meets the business needs of the customer.

Agile Values and Principles

- **4. Responding to Change Over Following a Plan** Traditional software development regarded change as an expense, so it was to be avoided.
- The intention was to develop detailed, elaborate plans, with a defined set of features and with everything, generally, having as high a priority as everything else, and with a large number of many dependencies on delivering in a certain order so that the team can work on the next piece of the puzzle.
- With Agile, the shortness of an iteration means priorities can be shifted from iteration to iteration and new features can be added into the next iteration. Agile's view is that changes always improve a project; changes provide additional value.

Agile Values and Principles

- The Twelve Agile Manifesto Principles
- The Twelve Principles are the guiding principles for the methodologies that are included under the title "The Agile Movement."
- They describe a culture in which change is welcome, and the customer is the focus of the work. They also demonstrate the movement's intent as described by Alistair C, one of the signatories to the Agile Manifesto, which is to bring development into alignment with business needs.
- The twelve principles of agile development include:

Agile Values and Principles

- **Customer satisfaction through early and continuous software delivery** – Customers are happier when they receive working software at regular intervals, rather than waiting extended periods of time between releases.
- **Accommodate changing requirements throughout the development process** – The ability to avoid delays when a requirement or feature request changes.
- **Frequent delivery of working software** – Scrum accommodates this principle since the team operates in software sprints or iterations that ensure regular delivery of working software.
- **Collaboration between the business stakeholders and developers throughout the project** – Better decisions are made when the business and technical team are aligned.
- **Support, trust, and motivate the people involved** – Motivated teams are more likely to deliver their best work than unhappy teams.
- **Enable face-to-face interactions** – Communication is more successful when development teams are co-located.

Agile Values and Principles

- **Working software is the primary measure of progress** – Delivering functional software to the customer is the ultimate factor that measures progress.
- **Agile processes to support a consistent development pace** – Teams establish a repeatable and maintainable speed at which they can deliver working software, and they repeat it with each release.
- **Attention to technical detail and design enhances agility** – The right skills and good design ensures the team can maintain the pace, constantly improve the product, and sustain change.
- **Simplicity** – Develop just enough to get the job done for right now.
- **Self-organizing teams encourage great architectures, requirements, and designs** – Skilled and motivated team members who have decision-making power, take ownership, communicate regularly with other team members, and share ideas that deliver quality products.
- **Regular reflections on how to become more effective** – Self-improvement, process improvement, advancing skills, and techniques help team members work more efficiently.

Agile Methodologies

Toyota working model :

- Error prevention to eliminate mistake
- Stop production where action is required
- Identify and learn
- JIT
- Voice areas of improvement
- Understand the working environment
- Business information to be shared openly
- Kanban
- Actions and process must be transparent

Agile Methodologies

- Kanban for software teams:
- Agile software development teams today are able to leverage these same JIT principles by matching the amount of work in progress (WIP) to the team's capacity. This gives teams more flexible planning options, faster output, clearer focus, and transparency throughout the development cycle.
-

Agile Methodologies

- According to Kanban practices, big changes at the beginning of any process are discouraged. When you do begin to make changes, be sure to do so gradually to ensure your team is comfortable with the new process.
- Kanban principles also encourage team members to understand and respect everyone’s role within the organization. This means knowing everyone’s job title and understanding what that role entails. Kanban encourages collaboration when it comes to identifying any changes that are needed.
- Kanban also encourages equal contributions from all team members when it comes to offering ideas. Even entry-level employees can provide useful input that can help to improve overall efficiency.

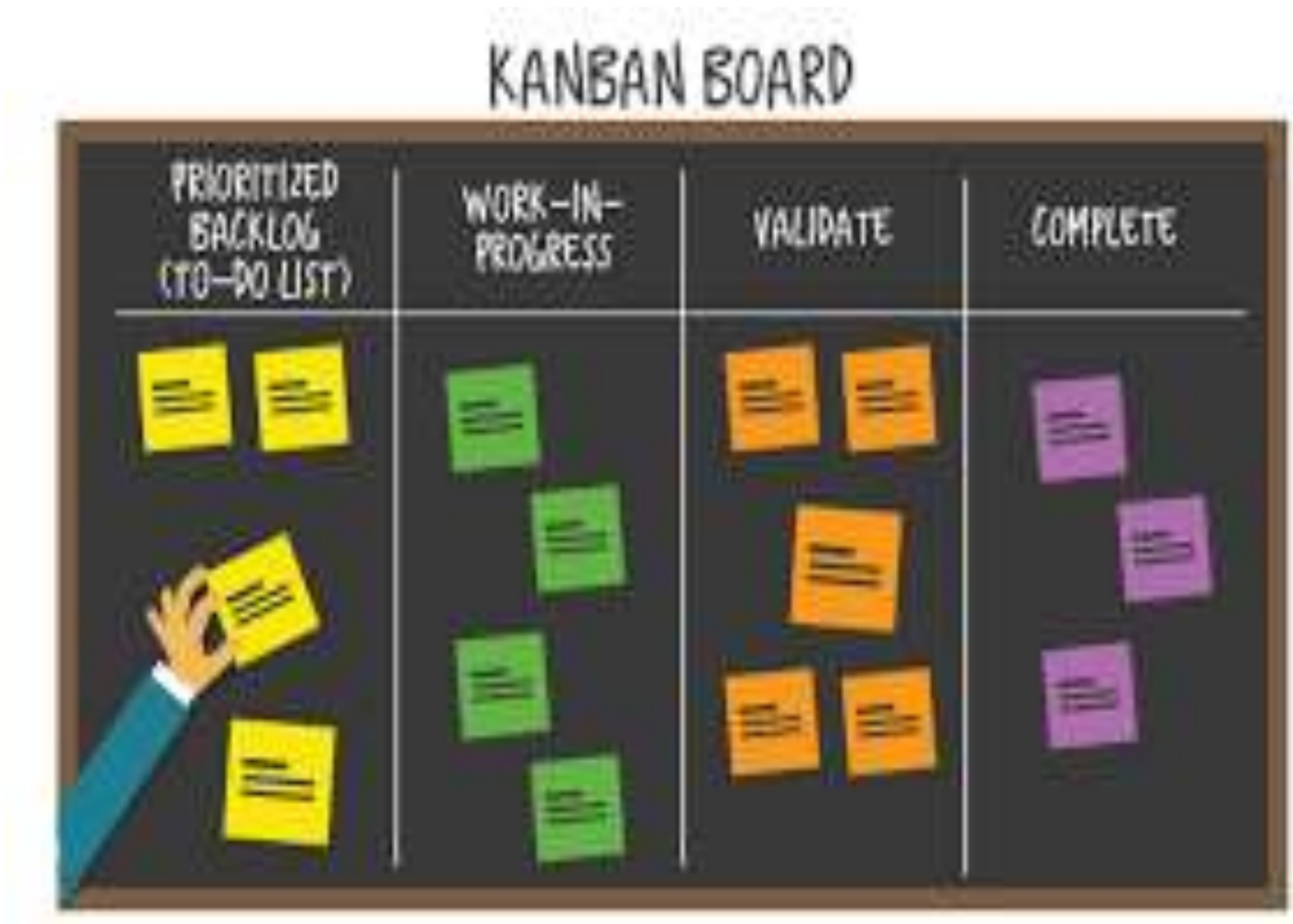
Agile Methodologies

- Kanban boards
- The work of all kanban teams revolves around a kanban board, a tool used to visualize work and optimize the flow of the work among the team.
- virtual boards are a crucial feature in any agile software development tool for their traceability, easier collaboration, and accessibility from multiple locations.

Agile Methodologies

- A basic kanban board has a three-step workflow: To Do, In Progress, and Done.
- The kanban methodology relies upon full transparency of work and real-time communication of capacity

Agile Methodologies



Agile Methodologies

- Lean : Lean is both a philosophy and a discipline which, at its core, increases access to information to ensure responsible decision making in the service of creating customer value.
- originally sprouted in Japan at Toyota Production System
- Lean methodology originated in the Japanese automobile industry in the late 1940s and 1950s, specifically at Toyota Motor Corporation.
- It was developed to respond to the inefficiencies and waste of traditional mass production methods. The goal of Lean was to eliminate waste and improve quality and efficiency.

Agile Methodologies

- 5 core principles:
- Value: Understand what customers value in a product or service
- Value Stream: What goes into maximizing value and eliminating waste throughout the entire process from design to production
- Flow: All product processes flow and synchronizes seamlessly with each other
- Pull: Flow is made possible by “pull,” or the idea that nothing is made before it is needed, thereby creating shorter delivery cycles
- Perfection: Relentlessly pursue perfection by constantly engaging the problem-solving process

Agile Methodologies

- Another key to lean is its definition of waste, of which there are eight types:
- Motion: Unnecessary movement of people or processes (equipment and manufacturing machinery, for example). Repetitive movements that do not add value translates to wasted time and resources.
- Over-processing: Doing unnecessary processes or steps than what is required to create a valuable product.
- Extra-processing: Products require more work or quality than necessary to deliver value to the customer.

Agile Methodologies

- Defects: Manufacturing processes create defective products — which becomes wasted materials.
- Transport: Like motion, but over greater distances to include the transport of tools, inventory, people, or products further than necessary.
- Human Potential: Underused skills and talent due to poor employee management and team structure lead to a lack of morale and productivity.
- Waiting: Idle equipment and waiting on materials or equipment can slow down processes and efficiency.
- Inventory: Excessive products and inventory take up space, reveal overproduction, and create backwork.

Agile Methodologies

- Pillars of Lean Methodology
- Elimination of waste: The aim is to eliminate anything that does not add value to the customer.
- Continuous improvement: Lean methodology stresses the importance of continuous improvement and encourages individuals to look for ways to improve processes constantly.
- Respect for people: Lean recognizes people's importance and ability to contribute to continuous improvement.
- Focus on the customer: Lean methodology places the customer at the center of everything and focuses on delivering value to the customer.
- Continuous flow: Lean aims to create a smooth and uninterrupted flow of work, from the customer's order to the delivery of the final product.
- Pull-based production: Lean methodology is based on "pull-based" production, where work is only started when there is customer demand.

SCRUM

Unit 6

Contents

- Various terminologies used in Scrum (Sprint, product backlog, sprint backlog, sprint review, retro perspective),
- various roles (Roles in Scrum),
- Best practices of Scrum (https://www.developer.com/project-management/scrum-best-practices/)

What is Scrum?

- Scrum is an agile framework for developing software applications.
- Scrum has been in use since the early 1990s. It is a flexible and holistic approach to project management.
- Scrum focuses on continuous improvement, learning, and adjusting to the changing market, user requirements, and technology.
- Scrum involves a set of events, tools, and roles that work together to help teams structure and manage a project.
- Within software development, requirements, market, technology, and other external factors change quite often.
- Scrum embraces the changes as the product is built in a series of iterations called sprints.

What is Scrum?

- Big projects are broken into smaller pieces that are delivered in several sprints, making the project easier to manage.
- Every sprint is released to users, and feedback is collected. Speed to market is also increased.
- Scrum is all about continuous learning and adapting to changes.
- a scrum team is a small team made of highly adaptive and flexible individuals.

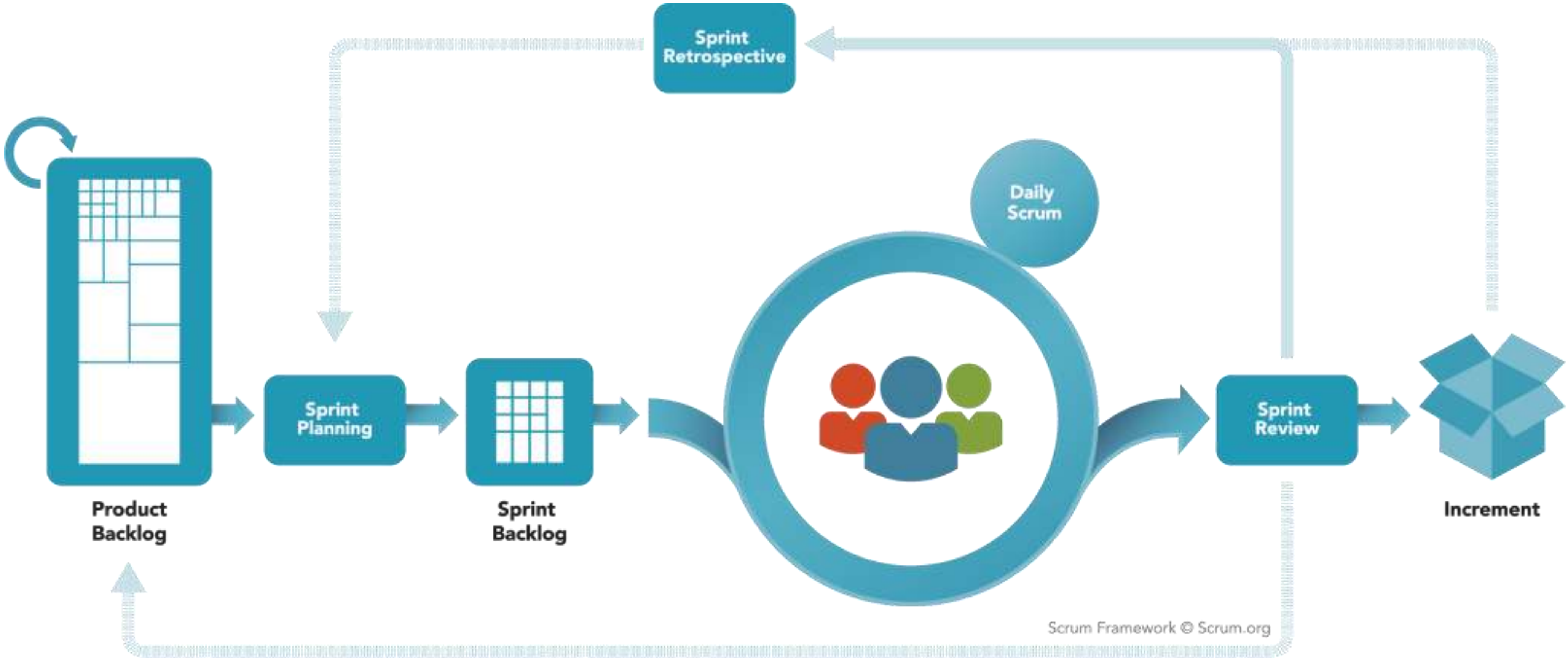
Scrum

- Scrum is an empirical process, where decisions are based on observation, experience and experimentation.
- **Scrum** has three pillars: **transparency**, **inspection** and **adaptation**.
- there are **accountabilities**, **events** and **artifacts** that make up the Scrum Framework

Scrum


SCRUM
Transparency
Inspection
Adaptation
TRUST
COURAGE
Scrum Team members have courage to do the right thing and work on tough problems
FOCUS
Everyone focuses on the work of the Sprint and the goals of the Scrum Team
COMMITMENT
People personally commit to achieving the goals of the Scrum Team
RESPECT
Scrum Team members respect each other to be capable, independent people
OPENNESS
The Scrum Team and its stakeholders agree to be open about all the work and the challenges with performing the work
Credit: ABN AMRO Bank N.V.

Scrum


Sprint
Retrospective
Daily
Scrum
Sprint
Planning
Sprint
Review
Product
Backlog
Sprint
Backlog
Increment
Scrum Framework © Scrum.org

Scrum events

- Each event is time-bound to a maximum duration.
- Strict scrum events reduces the need of meetings that are not defined in the scrum framework.
- The events are created to foster transparency and inspection within the scrum team.
  - Sprint
  - Sprint planning
  - Daily Scrum
  - Sprint review
  - Sprint Retrospective

Scrum events: Sprint

- The sprint is the backbone of scrum. A sprint takes 1 to 4 weeks.
- During this period, a potentially shippable product increment is created.
- A list of product backlog items, selected during sprint planning, are worked on during each sprint.
- A new sprint starts immediately after the end of the previous one.
- If a sprint took more than a month, the definition or market of what is being developed might change, increasing complexity and risk.
- Each successful sprint constitutes an increment in the final product.

Scrum events: Sprint Planning

- The scrum team discuss the items to be worked on during the sprint and creates a sprint goal.
- Top priority product backlog items to be worked on during the sprint are selected.
- The primary purpose of Sprint Planning is to address “What can be done during the next sprint?” and “How to do the work required to provide the increment?”
- Sprint planning takes at most eight hours for a four weeks Sprint.

Scrum events: Daily scrum

- It is a fifteen-minute Stand-up event for the development team held daily.
- Preferably, it should be held at the same venue and time.
- The team discusses what they have completed in the last 24 hours and plan for the next 24 hours' work.
- A check on the progress towards the sprint goals is also done in the stand-up meeting.

Scrum events: Sprint Review

- Sprint Review is held towards the end of the Sprint.
- This is an opportunity for the team to showcase the completed work to the product owner and partners.
- This review process is meant to encourage collaboration and to get feedback.
- It takes at most four hours for a one-month sprint.
- The development team discuss what worked out during the sprint, the challenges encountered, and how they were addressed.
- They also discuss how they will improve the process in the future.
- Sprint review provides important input to the upcoming sprint planning.
- The deliverable of a Sprint Review is an updated product backlog items for the coming sprint.

Scrum events: Sprint Retrospective

- This event happens before the next sprint planning.
- It takes at most three hours for a one-month Sprint. The scrum team discusses the following:
- What worked well?
- What could be improved?
- What will the team commit in the next sprint?
- Scrum Team members make actionable commitments. The deliverables of this meeting are improvements to be implemented in the next sprint by the Scrum Team.

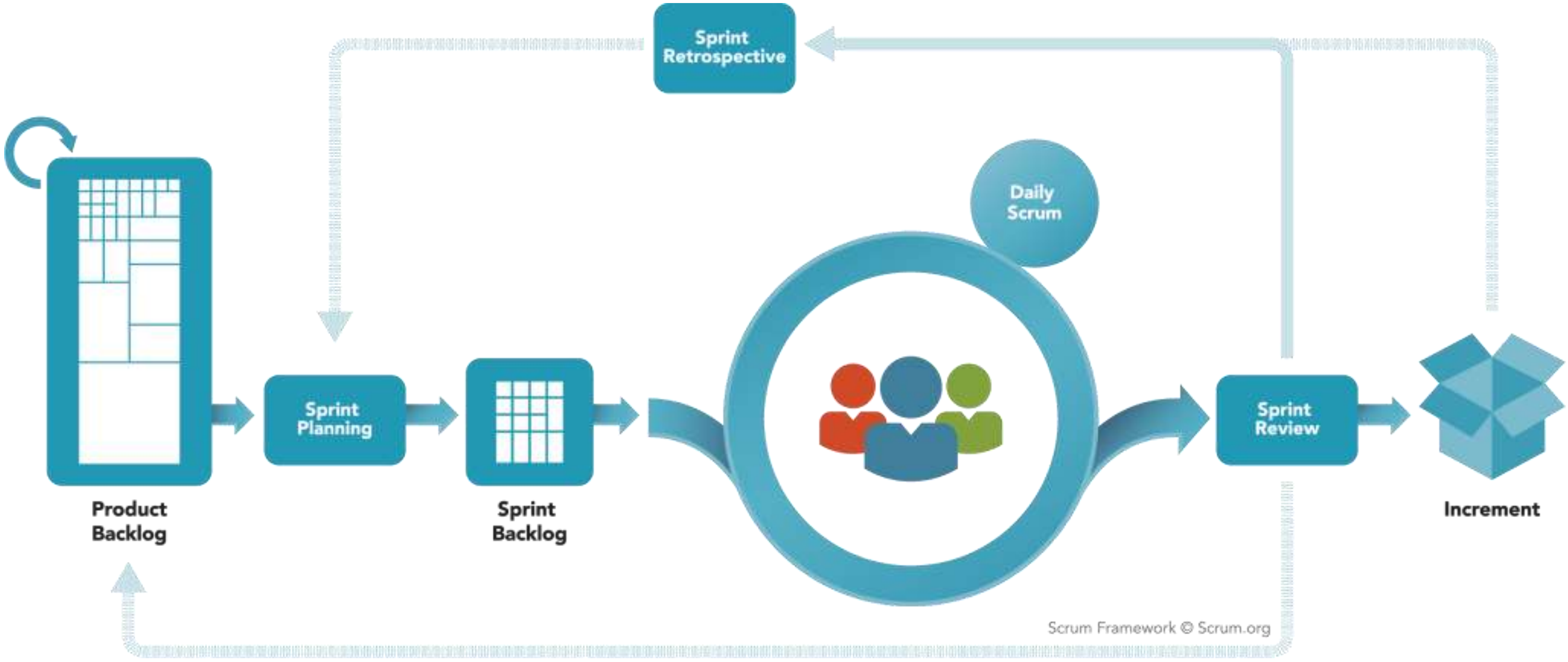
Scrum Artifacts

- Artifacts are there to ensure and maximize the transparency of information.
- Every team member must have the same interpretation of an artifact.
- The **product backlog** consists of a list of features, functions, enhancements, and fixes needed.
- It is the only source of requirements for the Scrum Team.
- The product owner is responsible for its content, availability, and ordering. Since the requirement never stops changing, so does the product backlog. All the requirements are broken down, with the most prioritized at the top.

Scrum Artifacts

- The current **sprint backlog** items are selected from high priority features in the product backlog. It is the output of the sprint planning event. The sprint backlog is modified throughout the sprint. Burndown charts are used to monitor sprint progress.
- **Increment**
- The sum of all product backlog completed and “done” during a sprint is referred to as an increment. Each Scrum Team has a definition of “done.” “Done” means in a usable condition as per the Scrum Team definition.

Scrum



Sprint Retrospective
Daily Scrum
Sprint Planning
Sprint Review
Product Backlog
Sprint Backlog
Increment
Scrum Framework © Scrum.org

Scrum Roles

- The team is cross-functional and self-organizing. The team decides how best to accomplish the work and has all the necessary expertise to do it.

- Product Owner
- Scrum Master
- The Development Team

Scrum Roles

- **Product Owner**:
- The product owner plays in the part of a client or stakeholder.
- He/She is one person and not a group of people.
- He or she is responsible for managing the product backlog by clearly expressing items that need to be addressed.
- The product owner ensures that the product backlog items are clear for the development team.

Scrum Roles

- **Scrum Master**:
- The scrum master is a “servant leader” responsible for protecting the team and the process. The scrum master helps everyone understands the scrum framework as defined in the scrum guide. Other responsibilities include:
- Ensuring a good working bond between the development team and the product owner
- Protecting the team from outside interactions and disruptions
- Facilitating scrum events
- Providing optimal techniques for optimal product backlog management
- Removing any obstacle that may affect the development team progress

Scrum Roles

- **The Development Team**:
- It is a team with the necessary skills to create a product increment by itself.
- That is why it is said to be cross-functional and self-organizing. Members lay multiple roles such as design, business analysis, operations, programming, and testing.
- Thus, the team recognizes no title for any of its members. Team members may have some particular competencies and areas of specialization, but they are accountable as one.
- The team size can consist from three to nine members.

Benefits of Scrum

Disadvantages of Scrum

Case study#1

- Mayden is a small and successful U.K. company that develops managed Web applications for the health care sector. They specialize in flexible, cloud-based software, delivered by a team of 44 from two locations in England
- Mayden has built a track record of delivering value to its customers
- The company did have a reputation for being responsive to customer needs, but it tried to execute within a traditional project management environment
- CEO Chris May explains the problems that surfaced as a result of trying to be flexible in a Waterfall environment: "Our best-laid plans were continually being hijacked for short-priority developments. The end result was that we reached a point where we had started lots of things but were finishing very little."

Case study

- projects were frequently assigned to only one person, so the work "often took months to complete." From a development team standpoint, this approach created individual expertise and worked against a team environment.
- People were seen as specialists, and some developers had a large backlog of work while others had insufficient work — but they were unable to assist their colleagues because they didn't have that specialist knowledge.
- This created individual silos and led to lack of variety as well as boredom and low morale.
- From a company standpoint, it also led to poor skills coverage, with multiple "single points of failure" in the development team.

Case study

- Transition:
- Reduced lead time for delivery of new features to the customer
- Increased skill coverage across the development team, creating a more consistent work flow
- More frequent deadlines, keeping the development team alert and focused
- Empowered staff who now all contribute and comment on the best way to approach stories
- Increased quality of coding due to ongoing assessment from teammates

Case study

- Advice:
- Even though they were told in training that while Scrum concepts were easy, putting them into practice could be difficult.
- If you do choose to implement Scrum, you can't do it halfheartedly; you have to commit to it. Embrace it company-wide and you'll be amazed by the results.
- the dynamics of the team may change, which requires an open mind and trust. "The quiet person in the corner who doesn't say much may just well surprise you and become the star of the team, if given the opportunity and environment in which to flourish. We've experienced that firsthand, and Scrum was the catalyst.“
- https://resources.scrumalliance.org/Article/case-study-maydens-transformation-waterfall-scrum

Case study#2

- **How can you build a truck with innovative unique selling propositions in just 18 months, if the regular development cycle is at least five years? MAN Truck & Bus was confronted with this challenge at the end of 2016.**
- The answer was a cross-functional team and a new way of working for MAN: Scrum. Thanks to the consistent establishment of the agile framework, a 100% dedicated development team including Scrum Master and Product Owner could be set up very quickly.

Case study

- When asking the team about the decisive success factors, especially the following points were mentioned: 100% availability of the team members and their co-location, daily coordination with colleagues in the workshop, full support and regular and pragmatic involvement of stakeholders, as well as transparency and communication with related departments.
- The most important point, how-ever, is openness and the courage to try something new.

- https://www.agile-academy.com/en/organizational-development/case-study-man/

Best Practices of Scrum

- Teamwork and collaboration are essential for the scrum framework to work and help agile software developers create quality products.
  - Integrate the scrum framework within the development process from beginning to end. You can ensure desired results if the scrum framework guides every development stage.
  - Get the assistance of a scrum expert to use the framework effectively.
  - Avoid creating too many scrum teams to avoid confusion and miscommunication.
  - Make sure every team member knows and understands the product goal.
  - Prepare the team for new requirements based on the changing project requirements every day.
  - Test the product every day and implement product owner feedback.
  - Keep the whole team and investors/stakeholders on the same page about the project direction.
  - Make sure the meetings and feedback are face-to-face to avoid miscommunications.
  - Confirm the absence of micromanagement in every scrum team.
  - Avoid burnout in team members by giving them a small break between sprints

What would you do?

- You work with a scrum team that has sprints of a week. Upto this point, you have been doing an hour long weekly sprint retrospective as part of this cycle. the product owner isn’t always present due to scheduling conflicts. Also the development team suggests doing a sprint retrospective every other sprint. Their experience is that the weekly sprint retrospective doesn't really result in anything useful anyways.
- As a scrum master , would you go along with the suggestion of the development team? If yes, why? If no, why?

What would you do?

- Several important customers of your product are unhappy. Users are running into lots of bugs, performance is low and features are delivered well beyond set release dates
- Henry, the product owner of your team, agrees with this assessment. He asks you as the scrum master- to resolve this with the development team.
- How would you respond to this request? How would you connect this with the scrum values?

Useful links

- https://www.ailoitte.com/blog/software-development-scrum/

Unit 7&8

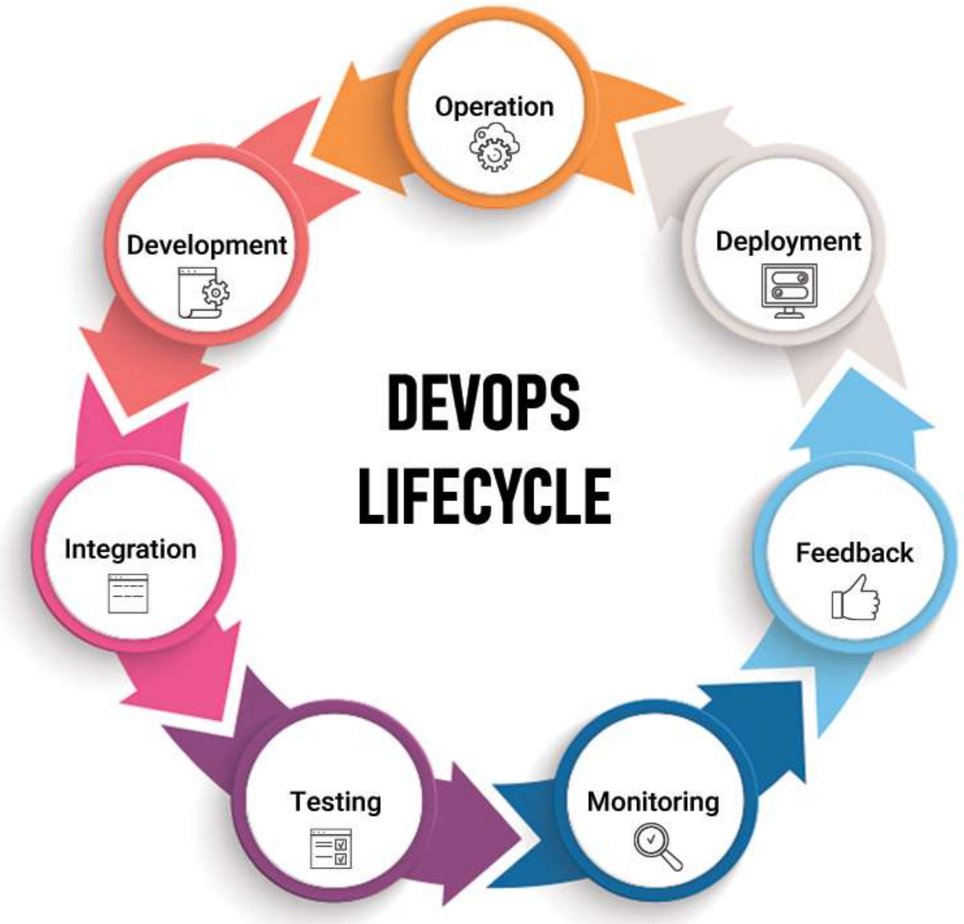
ITPM CSBS Sem VIII

Devops & its components

- **DevOps lifecycle is a combination of different phases of continuous software development, integration, testing, deployment, and monitoring. A competent DevOps lifecycle is necessary to leverage the full benefits of the DevOps methodology.**
- The DevOps approach embraces continuous innovation, agility, and scalability to build, test, consume, and evolve software products. It promotes a culture of experimentation, feedback, and constant learning to reinvent products, services, and processes. However, to implement DevOps, a proper understanding of different phases of the DevOps lifecycle is crucial.

Devops & its components

- **DevOps Lifecycle: Key Components**



Devops & its components

- 1. **Continuous development**
- **2. Continuous integration**
- **3. Continuous testing**
- **4. Continuous deployment**
- **5. Continuous monitoring**
- **6. Continuous feedback**
- **7. Continuous operations**

Containerization using Docker

- **Containerization is a technology that allows a developer to package an application and its dependencies into a single container.**
- To give you an analogy, containerization is kind of like packing all the stuff you need for a road trip into a single suitcase. You can put all your clothes, personal care items, and other essentials into the suitcase. Then you just grab it and go. It doesn't matter where you're going or what kind of car you're taking. As long as you have your suitcase, you have everything you need.

Analogous wrt putting all the all the application related packages in one container

Containerization using Docker

- Benefits:
- **Portability**
- **Isolation**
- **Resource efficiency**
- **Easy to package, ship, and deploy**
- **Ease of scaling**
- **Enhanced security**

Containerization using Docker

- **Docker is a popular containerization platform that allows developers to easily build, deploy, and run applications using containers.** Note that Docker is both the name of the company and the name of the technology.
- he Docker Ecosystem
- One of the key strengths of Docker is the ecosystem of tools and resources that have been built up around it. There are a wide variety of tools available that can be used to build, deploy, and manage Docker containers. Some of the key tools include:
- **Docker Engine:** The core component of the Docker platform, responsible for building and running Docker containers.
- **Docker Hub:** A cloud-based registry (a storage location) for Docker images, allowing developers to share and discover Docker images.
- **Docker Compose:** A tool for building and running applications that are *composed* of multiple containers.
- **Docker Swarm:** A tool for orchestrating Docker containers across a cluster of servers.

Managing Source Code and Automating Builds

- **Build automation** is the process of automating the retrieval of source code, compiling it into binary code, executing automated tests, and publishing it into a shared, centralized repository. Build automation is critical to successful **DevOps** processes.

Managing Source Code and Automating Builds

- **5 Benefits of Build Automation**
- There are five main benefits of build automation.
- **Increases Productivity**
- Build automation ensures fast feedback. This means your developers increase productivity. They'll spend less time dealing with tools and processes — and more time delivering value.
- **Accelerates Delivery**
- Build automation helps you accelerate delivery. That's because it eliminates redundant tasks and ensures you find issues faster, so you can release faster.
- **Improves Quality**
- Build automation helps your team move faster. That means you'll be able to find issues faster and resolve them to improve the overall quality of your product — and avoid bad builds.
- **Maintains a Complete History**
- Build automation maintains a complete history of files and changes. That means you'll be able to track issues back to their source.
- **Saves Time and Money**
- Build automation saves time and money. That's because build automation sets you up for CI/CD, increases productivity, accelerates delivery, and improves quality.

Managing Source Code and Automating Builds

How to Automate the Build Process

- **Write the code.**
- **Commit code to a shared, centralized repository — such as Perforce Helix Code.**
- **Scan the code using tools such as static analysis.**
- **Start a code review.**
- **Compile code and files.**
- **Run automated testing.**
- **Notify contributors to resolve issues.**

Managing Source Code and Automating Builds

- **Automated Build Tools**
- Automated build tools will help you ensure build automation.
- **Build runners** in particular, are critical for automation. These tools help you automate the process of building, testing, and deploying code.
- Example : Jenkins

Automated Testing & Test Driven Development

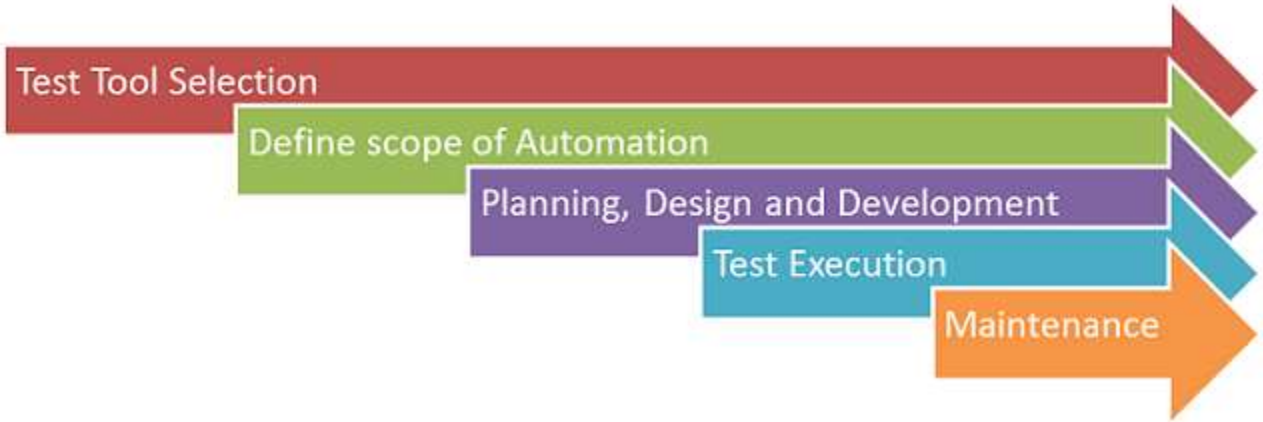
- **What is Automation Testing?**
- **Automation Testing** is a software testing technique that performs using special automated testing software tools to execute a test case suite. On the contrary, Manual Testing is performed by a human sitting in front of a computer carefully executing the test steps.
- The automation testing software can also enter test data into the System Under Test, compare expected and actual results and generate detailed test reports. Software Test Automation demands considerable investments of money and resources.

Automated Testing & Test Driven Development

- **Test Automation** is the best way to increase the effectiveness, test coverage, and execution speed in software testing. Automated software testing is important due to the following reasons:
- Manual Testing of all workflows, all fields, all negative scenarios is time and money consuming
- It is difficult to test for multilingual sites manually
- Test Automation in software testing does not require Human intervention. You can run automated test unattended (overnight)
- Test Automation increases the speed of test execution
- Automation helps increase Test Coverage
- Manual Testing can become boring and hence error-prone.

Automated Testing & Test Driven Development

- **Automated Testing Process:**

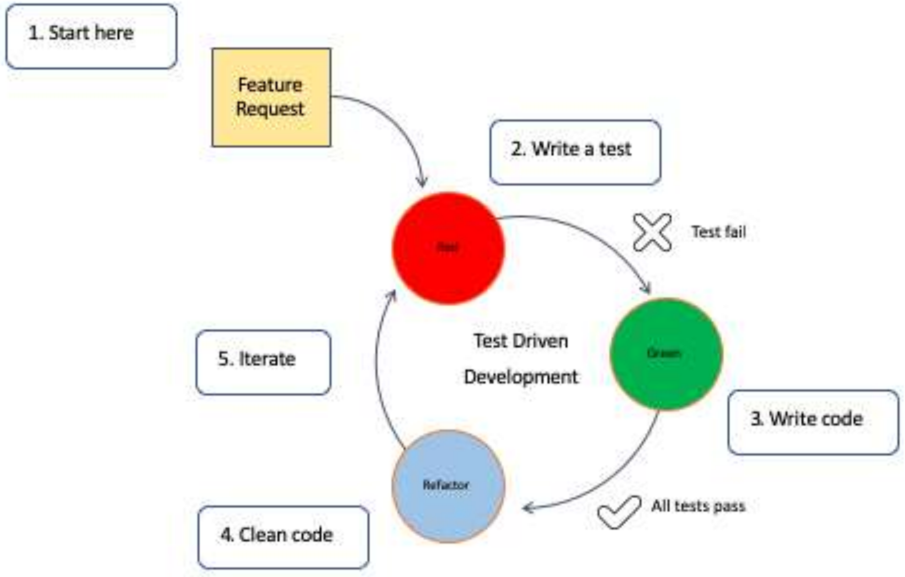


Automated Testing & Test Driven Development

- What is test-driven development?
- Test-driven development reverses traditional development and testing. So, instead of writing your code first and then retroactively fitting a test to validate the piece of code you just wrote, test-driven development dictates that you write the test first and then implement code changes until your code passes the test you already wrote.

Automated Testing & Test Driven Development

- Steps of test-driven development



Continuous integration in DevOps

- A developer develops or writes some form of code, often called as patches representing a change to the project's codebase [for example, a fix or bug].
- Merges the change to the centralized repository of that project like git, SVN, and bitbucket vary with the project.
- If the codes present in the centralized repos are needed later or while composing the application, i.e. building can be referred later at any point in time. Then these builds are deployed and can be manipulated or called at any point in time, often termed as packages or artifacts.

Continuous integration in DevOps

- Continuous Delivery and Continuous Deployment are part of Continuous Integration, which has helped to come automation so far by dividing and distributing all commits and patches into all new versions of different software.
- Continuous Delivery means the simultaneous commits being made into the repository, and then it is the responsibility of the human to decide whether to take it further for deployment or not, which means human effort is being involved somehow because of which companies don't prefer and thinks twice before deployment.
- On the other hand, many companies put more emphasis on continuous deployment in a sense they will directly put the commits and changes as it is a direct and simple approach. But again, it involves a lot of risks and can hamper or create bugs when a product goes for production. Thus, some new approaches must be introduced to mitigate the bug risk and make the Continuous deployment process with continuous delivery and continuous integration more enhanced and powerful.

Continuous integration in DevOps

- How does continuous integration work?
- Continuous integration is generally achieved and completed in six steps. These steps are:
- Manual process identification
- Frequency and duration definition
- Sub-process selection for automation
- Automation script creation
- Artifact trigger scheduling
- Iterate, improve, and repeat

Continuous integration in DevOps

- Importance of continuous integration in software development
- **Reduction in code changes**
- **Issues isolation**
- **Faster mean time to resolution**
- **Smaller Backlogs**

- Example Jenkins, Azure DevOps

Continuous integration in DevOps

Continuous Integration	**Continuous Development**
Continuous integration is an automated approach to test each change to the codebase.	Continuous development is an approach to develop software in shorter cycles.
The process of continuous integration refers to the versioning of source code.	Continuous development refers to automated source code implementations.
Continuous integration focuses on automation testing to determine that the software has no errors or bugs.	Continuous development emphasizes the change in all stages of your production pipeline.
Continuous integration is performed immediately after the developer check-in.	In continuous development, developers deploy the code directly to the production stage when it is developed.
The development team sends continuous code merging requests in continuous integration even when the testing process is running.	The development team deploys the codes using an automated process in continuous development.

Configuration Management in DevOps

- Configuration management occurs when a configuration platform is used to automate, monitor, design and manage otherwise manual configuration processes.
- An important function of configuration management is defining the state of each system. By orchestrating these processes with a platform, organizations can ensure consistency across integrated systems and increase efficiency.

Configuration Management in DevOps

- Components:
- **Identification:**
  The process of finding and cataloging system-wide configuration needs.
- **Control:**
  During configuration control, we see the importance of change management at work. It’s highly likely that configuration needs will change over time, and configuration control allows this to happen in a controlled way as to not destabilize integrations and existing infrastructure.
- **Audit:**
  Like most audit processes, a configuration audit is a review of the existing systems to ensure that it stands up to compliance regulation and validations.
- Like DevOps, configuration management is spread across both operational and development buckets within an organization. This is by design. There are primary components that go into the comprehensive configuration management required for DevOps:
- Artifact repository
- Source code repository
- Configuration management data architecture

Configuration Management in DevOps

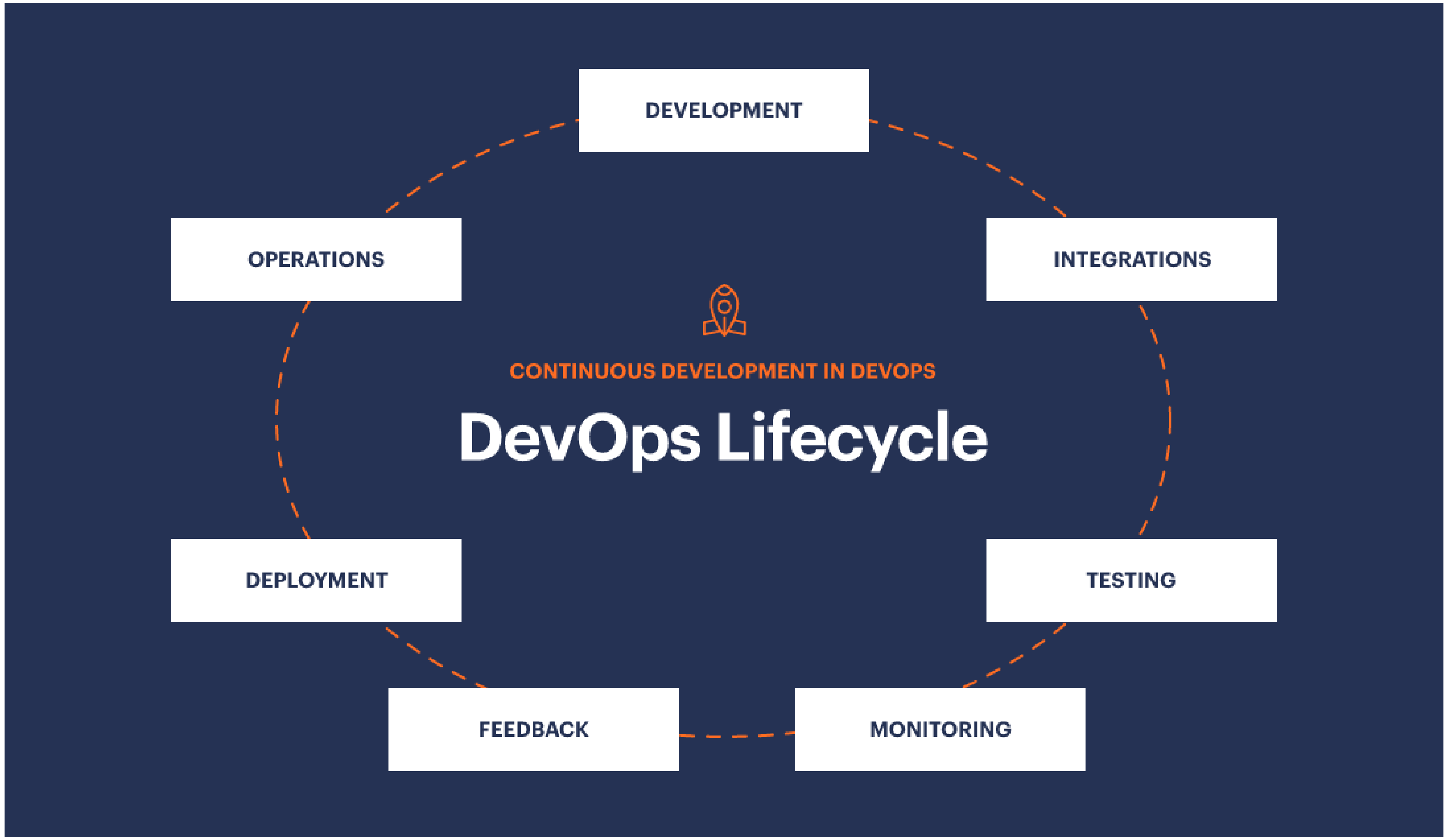
- Outcomes of Properly Managed Configurations:

- **Infrastructure-as-a-Code**
- **Configuration-as-a-Code**

Continuous Development in DevOps

- Various DevOps strategies are referred to as “Continuous Development.” Continuous Development’s sole purpose is to keep track of constant improvements, plan, test, and collect feedback to improve the product. As a result, understanding Continuous Development is crucial for ensuring that all your DevOps processes work correctly.

Continuous Development in DevOps



Continuous Development in DevOps

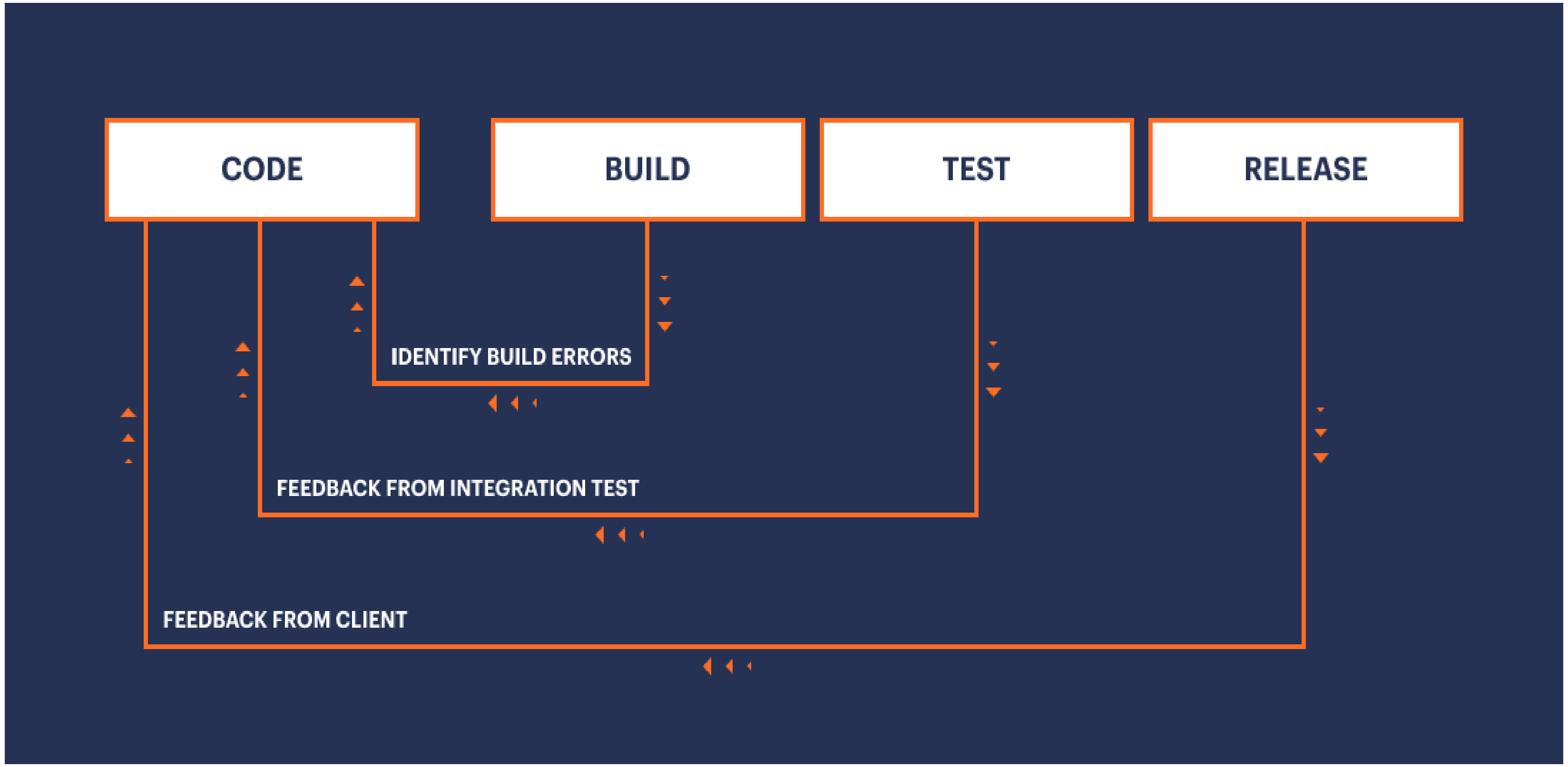
- Benefits of Continuous Development:
- **1. Good quality software**
- **2. Swift transitions**
- **3. Lesser Risks**
- **4. Lesser Resources**
- **5. More Productivity**

Continuous Development in DevOps

- Factors of Continuous Development:
- **Continuous integration**
- **Continuous delivery**
- **Continuous deployment**
- **Continuous testing**

Continuous Development in DevOps

- Process of Continuous Development



Continuous deployment in DevOps

- Continuous deployment vs. continuous delivery
- Continuous delivery is a software development practice where software is built in such a way that it can be released into production at any given time. To accomplish this, a continuous delivery model involves production-like test environments. New builds performed in a continuous delivery solution are automatically deployed into an automatic quality-assurance testing environment that tests for any number of errors and inconsistencies. After the code passes all tests, continuous delivery requires human intervention to approve deployments into production. The deployment itself is then performed by automation.
- Continuous deployment takes automation a step further and removes the need for manual intervention. The tests and developers are considered trustworthy enough that an approval for production release is not required. If the tests pass, the new code is considered to be approved, and the deployment to production just happens.

Continuous deployment in DevOps

- Continuous deployment vs. continuous integration
- In order for automation of deployment processes to work, all the developers working on a project need an efficient way of communicating the changes that take place. Continuous integration makes this possible.
- Typically, when working on the same software development project, developers work off of individual copies of a master branch of code. However, functionality issues and bugs can occur after developers merge their changes onto the main codebase, especially when developers work independently from each other. The longer they work independently, the higher the risk.
- With CI, everyone merges their code changes into a repository at least once per day. As updates occur, automated build tests run to ensure that any changes remain compatible with the master branch. This acts as a fail-safe to catch integration problems as quickly as possible.

Continuous deployment in DevOps

Continuous deployment tools:

- **Version control**
- **Code review**
- **Continuous integration (CI)**
- **Configuration management**
- **Release automation**
- **Infrastructure monitoring**

Automated Monitoring in DevOps

DevOps automation is the practice of automating repetitive and manual DevOps tasks to be carried out without any human interaction. Automation can be applied throughout the DevOps lifecycle, spanning:

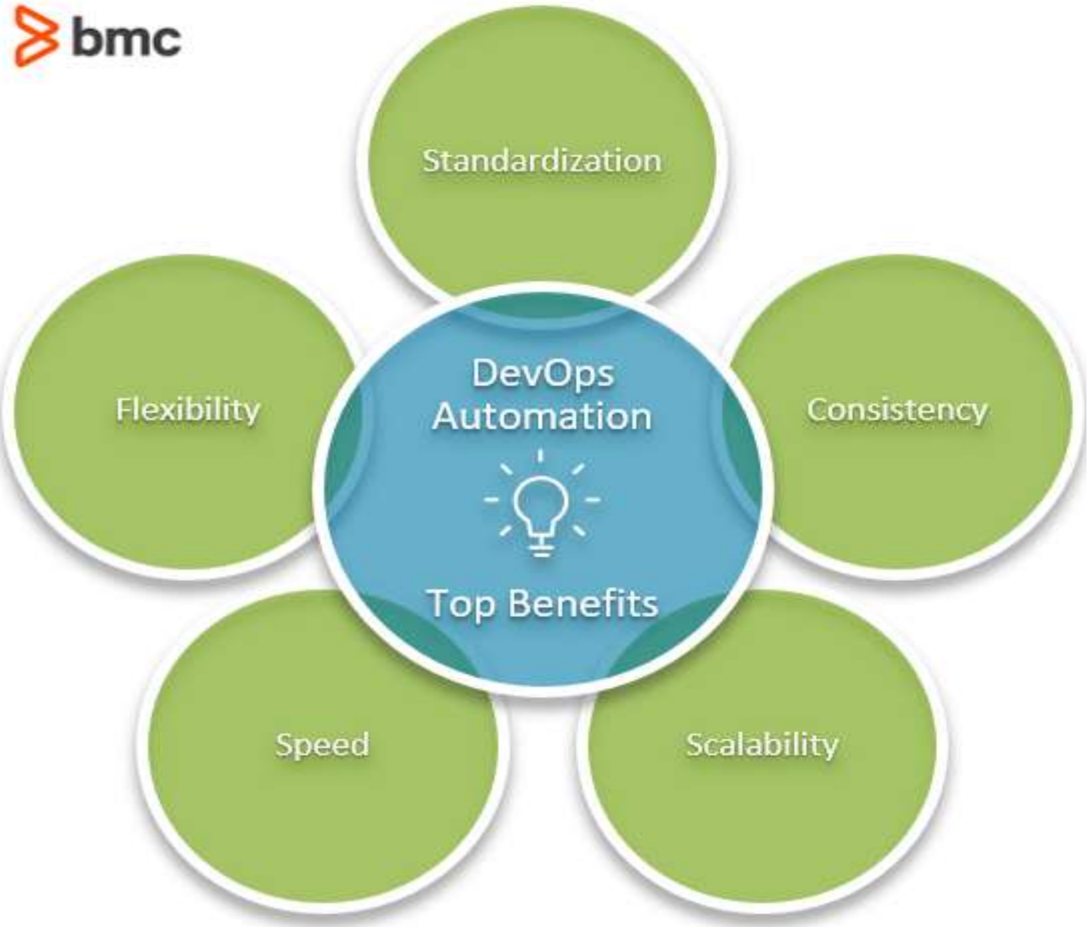
- Design and development
- Software deployment and release
- Monitoring

The goal of DevOps automation is to streamline the DevOps lifecycle by reducing manual workload. This automation results in several key improvements:

- Eliminates the need for large teams
- Drastically reduces human errors
- Increases team productivity
- Creates a fast-moving DevOps lifecycle

Automated Monitoring in DevOps

- Features :



Automated Monitoring in DevOps

Benefits:

- Consistency
- Scalability
- Speed
- Flexibility

Other Agile Methodologies

- Introduction to XP
- FDD
- DSDM
- Crystal

Introduction to XP

- Extreme Programming (XP) is an agile software development framework that aims to produce higher quality software, and higher quality of life for the development team. XP is the most specific of the agile frameworks regarding appropriate engineering practices for software development.

Introduction to XP

5 Values:

Communication

- Software development is inherently a team sport that relies on communication to transfer knowledge from one team member to everyone else on the team. XP stresses the importance of the appropriate kind of communication – face to face discussion with the aid of a white board or other drawing mechanism.

Simplicity

- Simplicity means “what is the simplest thing that will work?” The purpose of this is to avoid waste and do only absolutely necessary things such as keep the design of the system as simple as possible so that it is easier to maintain, support, and revise. Simplicity also means address only the requirements that you know about; don’t try to predict the future.

Feedback

- Through constant feedback about their previous efforts, teams can identify areas for improvement and revise their practices. Feedback also supports simple design. Your team builds something, gathers feedback on your design and implementation, and then adjust your product going forward.

Courage

- Kent Beck defined courage as “effective action in the face of fear” (Extreme Programming Explained P. 20). This definition shows a preference for action based on other principles so that the results aren’t harmful to the team. You need courage to raise organizational issues that reduce your team’s effectiveness. You need courage to stop doing something that doesn’t work and try something else. You need courage to accept and act on feedback, even when it’s difficult to accept.

Respect

- The members of your team need to respect each other in order to communicate with each other, provide and accept feedback that honors your relationship, and to work together to identify simple designs and solutions.

Introduction to XP

Practices

- The core of XP is the interconnected set of software development practices listed below.
- The Planning Game
- Small Releases
- Metaphor
- Simple Design
- Testing
- Refactoring
- Pair Programming
- Collective Ownership
- Continuous Integration
- 40-hour week
- On-site Customer
- Coding Standard

FDD (Feature Driven Development)

- Feature Driven Development (FDD) is an agile framework that, as its name suggests, organizes software development around making progress on fe
- FDD was designed to follow a five-step development process, built largely around discrete “feature” projects. That project lifecycle looks like this:
- Develop an overall model
- Build a features list
- Plan by feature
- Design by feature
- Build by feature
- atures.

FDD (Feature Driven Development)

FDD (Feature Driven Development)

FDD's strengths include:

- Simple five-step process allows for more rapid development
- Allows larger teams to move products forward with continuous success
- Leverages pre-defined development standards, so teams are able to move quickly

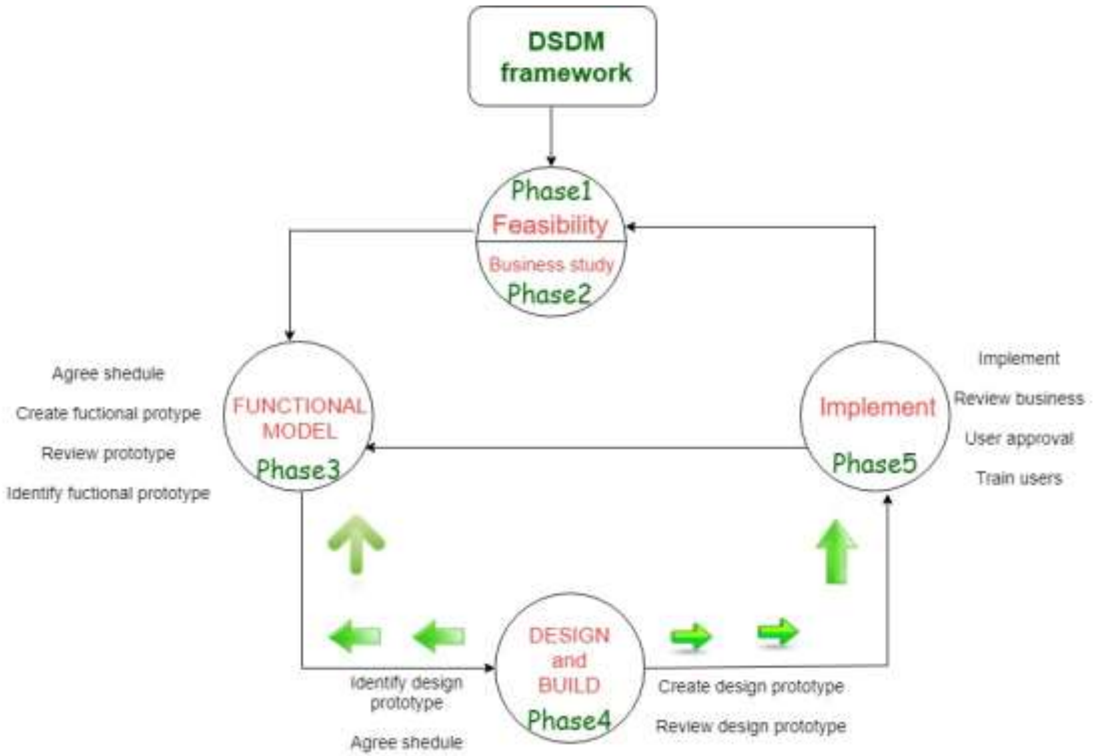
FDD's weaknesses include:

- Does not work efficiently for smaller projects
- Less written documentation, which can lead to confusion
- Highly dependent on lead developers or programmers

DSDM (Dynamic System Development Method)

- The Dynamic Systems Development Method (DSDM) is an agile framework that addresses the entire project lifecycle and its impact on the business. Like the broader agile philosophy, DSDM is an iterative approach to software development, and this framework explicitly states “any project must be aligned to clearly defined strategic goals and focus upon early deliver of real benefits to the business.” The framework is built on four principles: feasibility and business study, functional model and prototype iteration, design and build iteration, and implementation.

DSDM (Dynamic System Development Method)



Dynamic Systems Development Method life cycle

DSDM (Dynamic System Development Method)

Like other agile methods, the DSDM method is based on an **incremental process**, with frequent releases and testing. It describes **7 project phases**:

- **Pre-project**: preparatory work to define a vision and set goals,
- **Feasibility**: checking whether the project is realistic and objectives are attainable,
- **Foundations**: defining the solutions and methods that will be used for the project,
- **Exploration**: prioritising and iterative definition and testing of features,
- **Engineering**: developing the project incrementally,
- **Deployment**: implementing each iteration of the project,
- **Post project**: assessing the benefits obtained from the project.

Crystal

- The crystal method is an agile framework that is considered a lightweight or agile methodology that focuses on individuals and their interactions. The methods are color-coded to significant risk to human life. It is mainly for short-term projects by a team of developers working out of a single workspace.

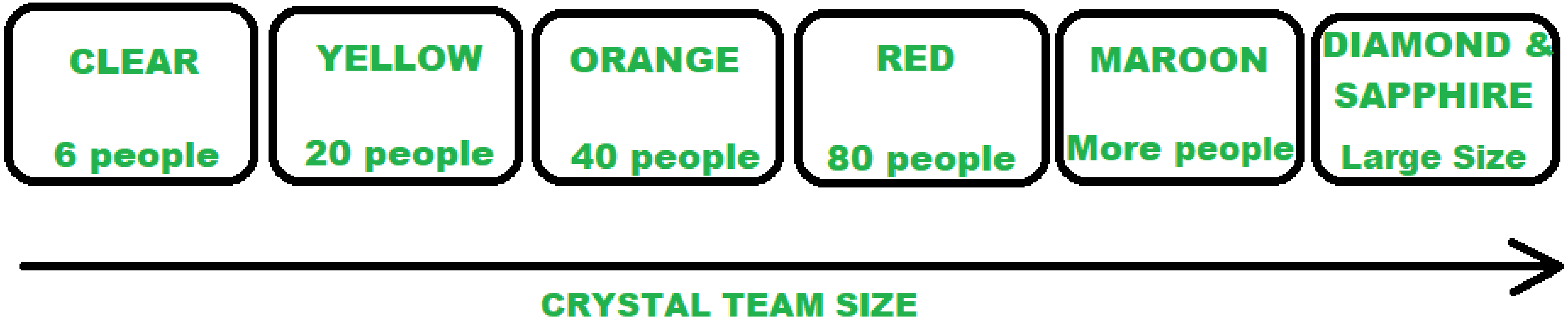
Crystal

- **Properties of Crystal Agile Framework :**
- **Frequent Delivery-** It allows you regularly deliver the products and test code to real users. Without this, you might build a product that nobody needs.
- **Reflective Improvement-** No matter how good you have done or how bad you have done. Since there are always areas where the product can be improved, so the teams can implement to improve their future practices.
- **Osmotic Communication-** Alistair stated that having the teams in the same physical phase is very much important as it allows information to flow in between members of a team as in osmosis.
- **Personal Safety-** There are no bad suggestions in a crystal team, team members should feel safe to discuss ideas openly without any fear.
- **Focus-** Each member of the team knows exactly what to do, which enables them to focus their attention. This boosts team interaction and works towards the same goal.
- **Easy access to expert users-** It enhances team communication with users and gets regular feedback from real users.
- **Technical tooling-** It contains very specific technical tools which to be used by the software development team during testing, management, and configuration. These tools make it enable the team to identify any error within less time.

Crystal

- How does it function?
- Crystal family consists of many variants like Crystal Clear, Crystal Yellow, Crystal Red, Crystal Sapphire, Crystal Red, Crystal Orange Web, and Crystal Diamond.
- **Crystal Clear-** The team consists of only 1-6 members that is suitable for short-term projects where members work out in a single workspace.
- **Crystal Yellow-** It has a small team size of 7-20 members, where feedback is taken from Real Users. This variant involves automated testing which resolves bugs faster and reduces the use of too much documentation.
- **Crystal Orange-** It has a team size of 21-40 members, where the team is split according to their functional skills. Here the project generally lasts for 1-2 years and the release is required every 3 to 4 months.
- **Crystal Orange Web-** It has also a team size of 21-40 members were the projects that have a continually evolving code base that is being used by the public. It is also similar to Crystal Orange but here they do not deal with a single project but a series of initiatives that required programming.
- **Crystal Red-** The software development is led by 40-80 members where the teams can be formed and divided according to requirements.
- **Crystal Maroon-** It involves large-sized projects where the team size is 80-200 members and where methods are different and as per the requirement of the software.
- **Crystal Diamond & Sapphire-** This variant is used in large projects where there is a potential risk to human life.

Crystal


CLEAR
6 people
YELLOW
20 people
ORANGE
40 people
RED
80 people
MAROON
More people
DIAMOND &
SAPPHIRE
Large Size
CRYSTAL TEAM SIZE

Crystal

Benefits of using the Crystal Agile Framework :

- Facilitate and enhance team communication and accountability.
- The adaptive approach lets the team respond well to the demanding requirements.
- Allows team to work with the one they see as the most effective.
- Teams talk directly with each other, which reduces management overhead.

Drawbacks of using the Crystal Agile Framework :

- A lack of pre-defined plans may lead to confusion and loss of focus.
- Lack of structure may slow down inexperienced teams.
- Not clear on how a remote team can share knowledge informally.