Software Project Management

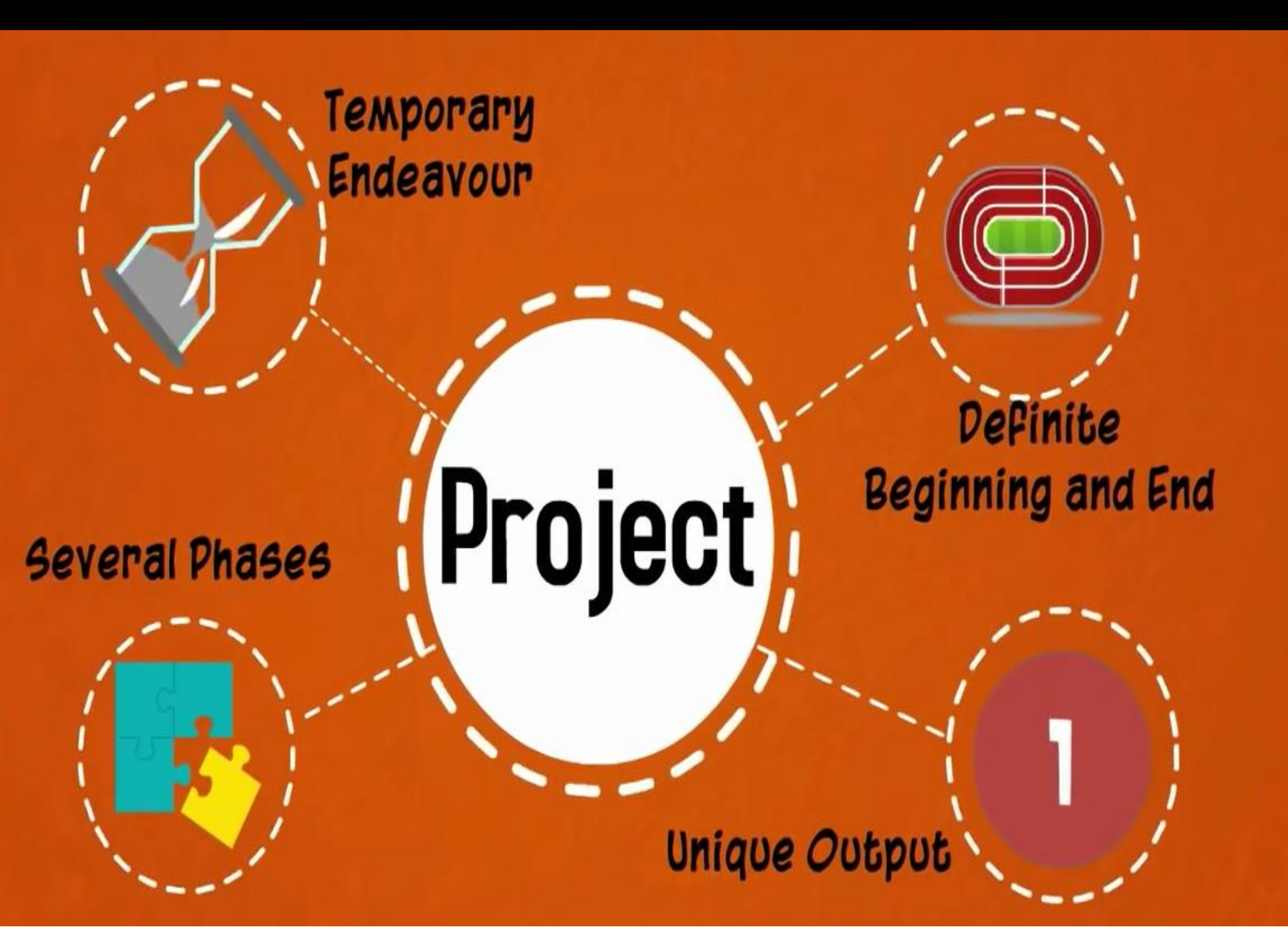
UNIT-4

SOFTWARE PROJECT MANAGEMENT

What is a Project ?

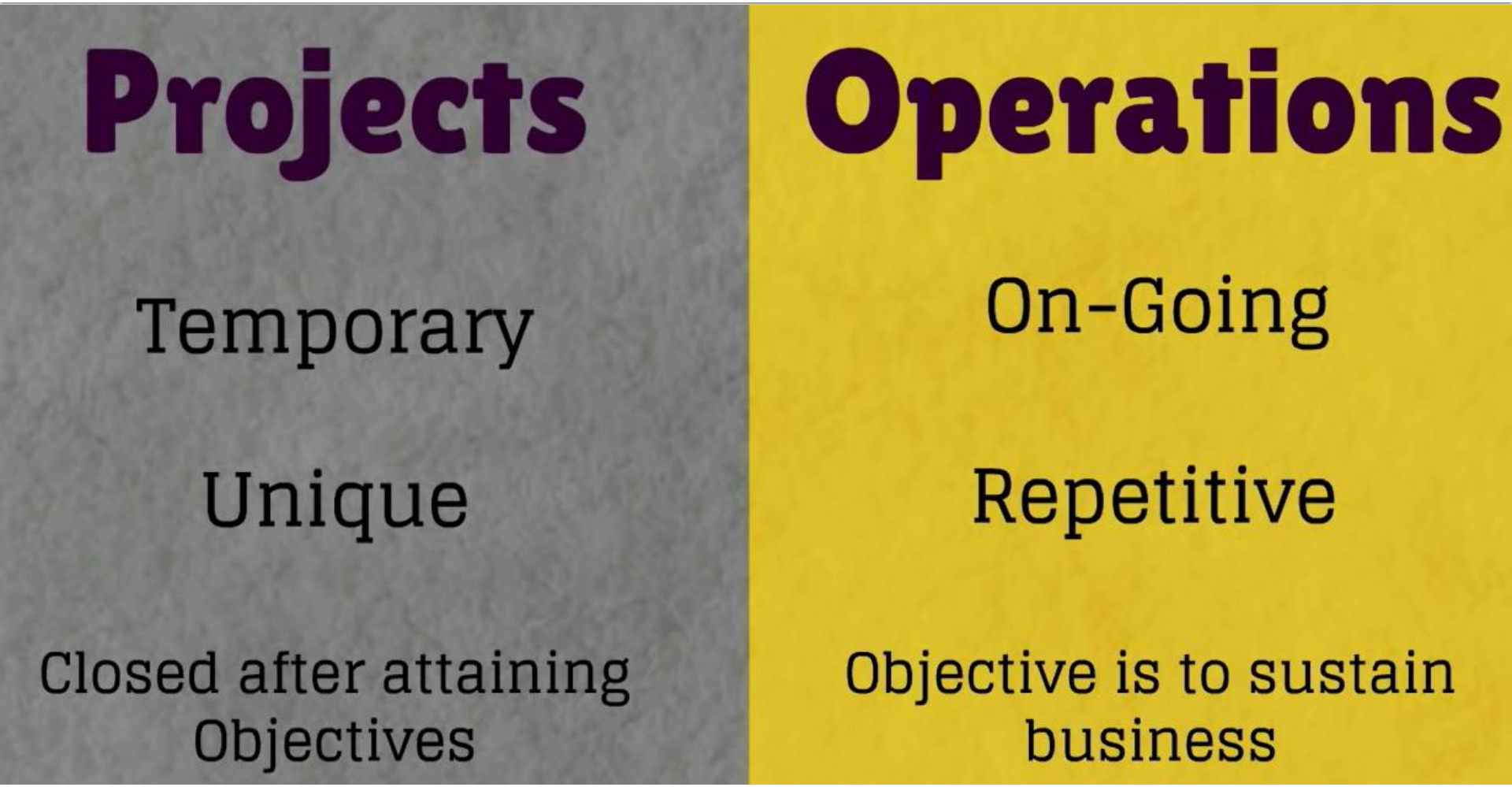
Contents

- **Software Project Management → Introduction**
- **An Overview of Project Planning → Step-wise Approach.**
- **Project Evaluation.**

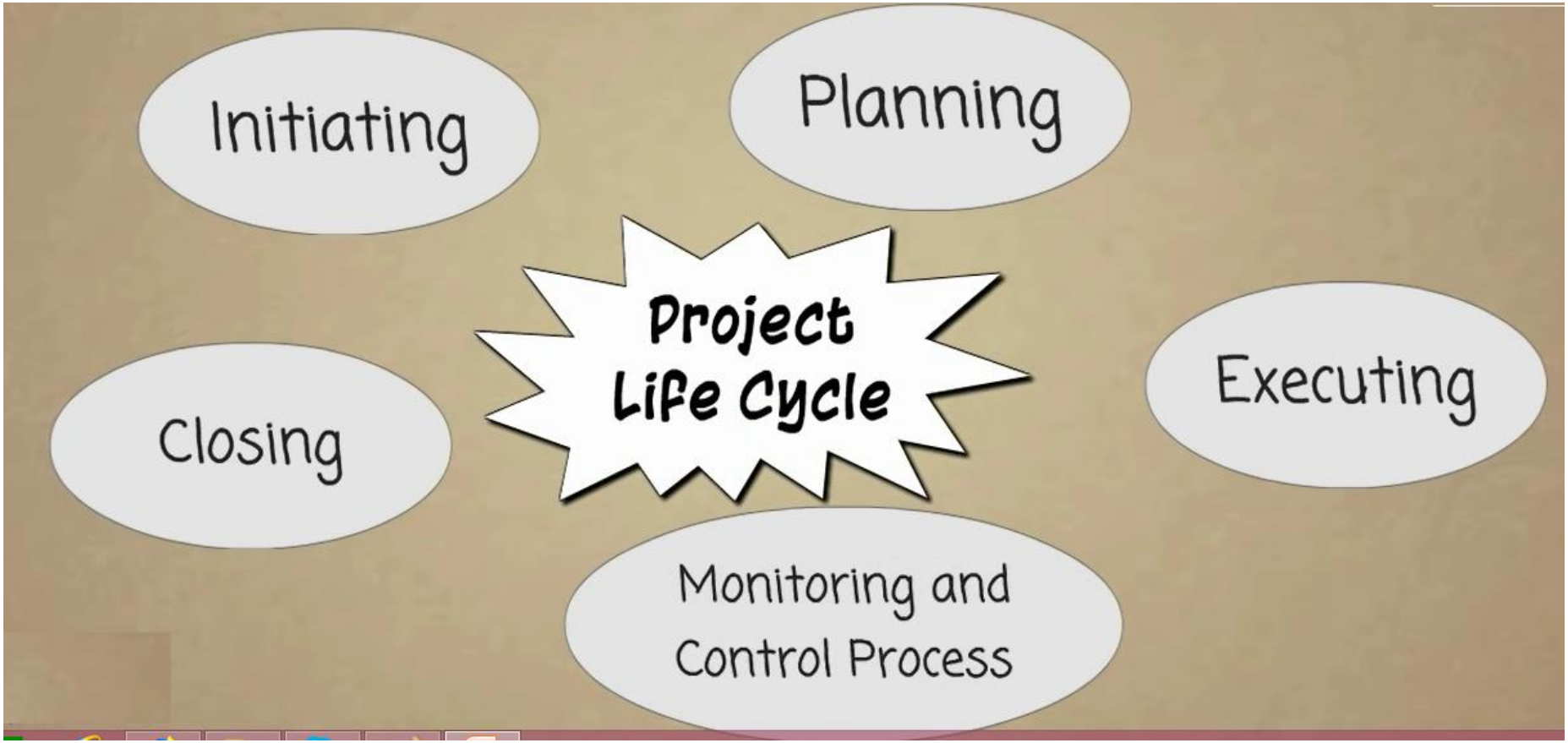

Temporary
Endeavour
Definite
Beginning and End
Project
Several Phases
Unique Output
1

Are Projects different from Operations ?

Project Vs Operations



Phases of Project Management



Why do project fail?

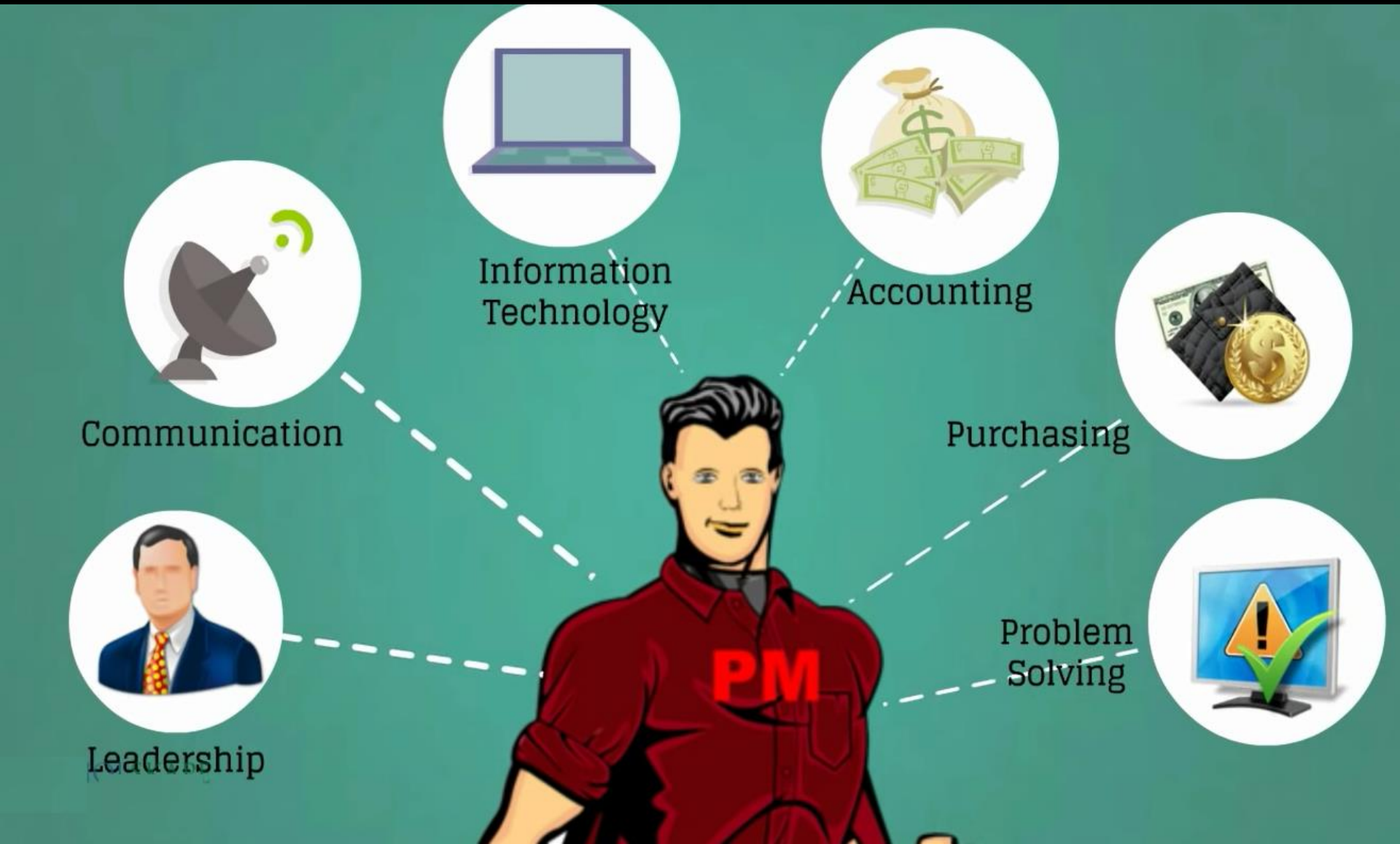
Following are the reasons for project failure:

- Failure in **time** management.
- Failure in **cost** management
- Failure in **scope** management
- Failure in **quality** management.

Who saves us from Project Failure?

It's a Project Manager!!

Skills of Project Manager




communication
deadlines
teamwork
analysis
goals
PROJECT
MANAGEMENT
budget
risks
planning
control
problem
solving
milestones

Project Management

- Project Management is the **art of managing** all the aspects of a project from inception to closure using a **scientific and structured** methodology.

- The project must create something **unique** whether it is a **product, service** or **result** and must be progressively elaborated.

What is Software Project Management?

- Software project management is the art and science of **planning** and **leading software projects.**

- It is a sub-discipline of project management in which software projects are **planned, implemented, monitored and controlled.**

What is SPM?...

- All projects are about meeting objectives.
- Like any other projects, a software project must satisfy real needs.
- To do this, identify the project's stakeholders and their objectives. Ensure that their **objectives are met** and this is the **aim of project management.**

Software Project Management

- **Plan**
- **Organize**
- **Monitor**
- **Control**

Effective Software project management focuses on 3 P's:

- People
- Problem
- Process

What is a project?

Some dictionary definitions:

"A specific plan or design"

"A planned undertaking"

"A large undertaking e.g. a public works scheme"

Longmans dictionary

Key points above are :
planning and ***size*** of task

What is a project?

- '**Unique process**, consisting of a set of coordinated and controlled **activities** with **start and finish dates**, undertaken to achieve an **objective** conforming to specific requirements, including **constraints** of **time**, **cost** and **resources**'

Project…

- A project is an **activity** to meet the **creation** of a **unique product or service.**

- The activities that are undertaken to accomplish **routine activities cannot be considered as projects** *(but can be considered as jobs).*

Jobs versus projects

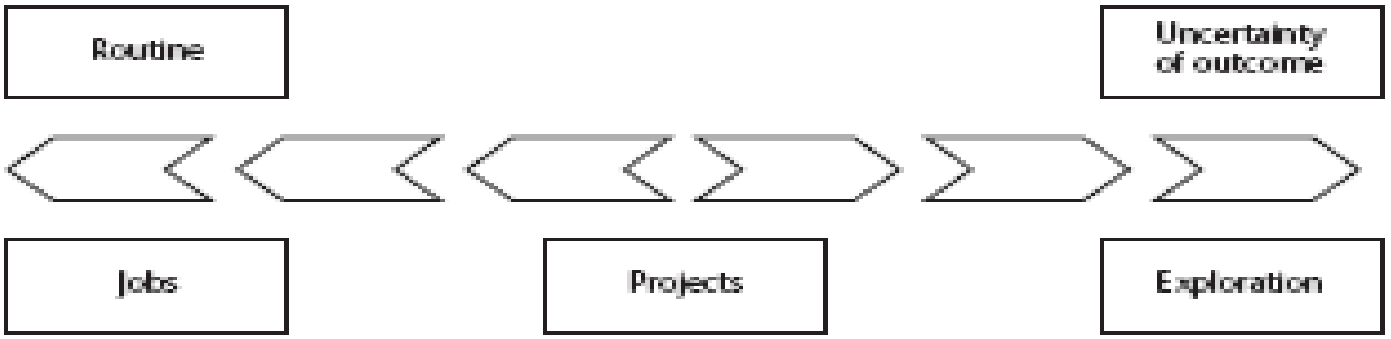


Figure 1.1 Activities most likely to benefit from project management

'**Jobs**' – repetition of very well-defined and well understood tasks with very little uncertainty.

'**Exploration**' – e.g. finding a cure for cancer: the outcome is very uncertain.(Some research projects)

'**Projects**' – in the middle!

Characteristics of projects

Following characteristics distinguish projects:

- Non-routine tasks are involved
- Planning is required
- Aiming at a specific target
- Predetermined time span
- Work carried out for a customer
- Work involves several specialism
- People are formed into a temporary work group to carry out the task
- Work is carried out in several different phases
- Constrained by time and resources
- Project is large and/or complex

Are Software projects different from other projects?

Not really! …but…

1. Invisibility—when a physical artefact such as bridge is constructed the progress can actually be seen where as with software , progress is **not immediately visible**.

2. Complexity—per dollar, pound, euro spent, Software product contain more complexity than other engineered artefacts.

3. Conformity -- the traditional engineer projects works with physical systems (materials like cement and steel). Whereas Software developers have to conform to the requirements of human clients.

4. Flexibility -- Software is easy to change, and is seen as a strength. Software will change to accommodate the other components rather than vice versa.

Contract management Vs Technical project management

Projects can be:

- **In-house**: clients and developers are employed by the same organization.
- **Out-sourced:** clients and developers employed by different organizations.
- 'Project manager' could be:
  - a '**contract manager**' in the client organization.
  - a **technical project manager** in the supplier/services organization.

NOTE—*We looks at things from the point of view of the technical software project manager*.

Activities covered by Project Management

There are **3 successive processes** that bring a new system.

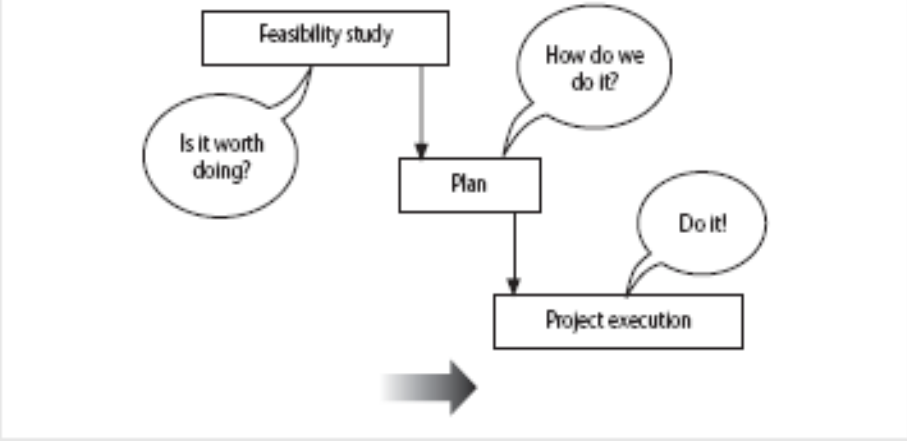


Figure 1.2 The feasibility study/plan/execution cycle

1. Feasibility study

Is project technically feasible and worthwhile from a business point of view?

2. Planning

Only done if project is feasible.

For large project create **Outline plan** and detailed only for first stage.

3. Execution -

Often contains design and implementation sub-phases.

Implement plan, but plan may be changed as we go along.

Activities covered by project management…

- Fig shows the typical sequence of **software development activities recommended** in the international standard **ISO 12207**.

- Some activities are concerned with the **system** while others relate to **software.**

The Software Development Life Cycle (ISO 12207)

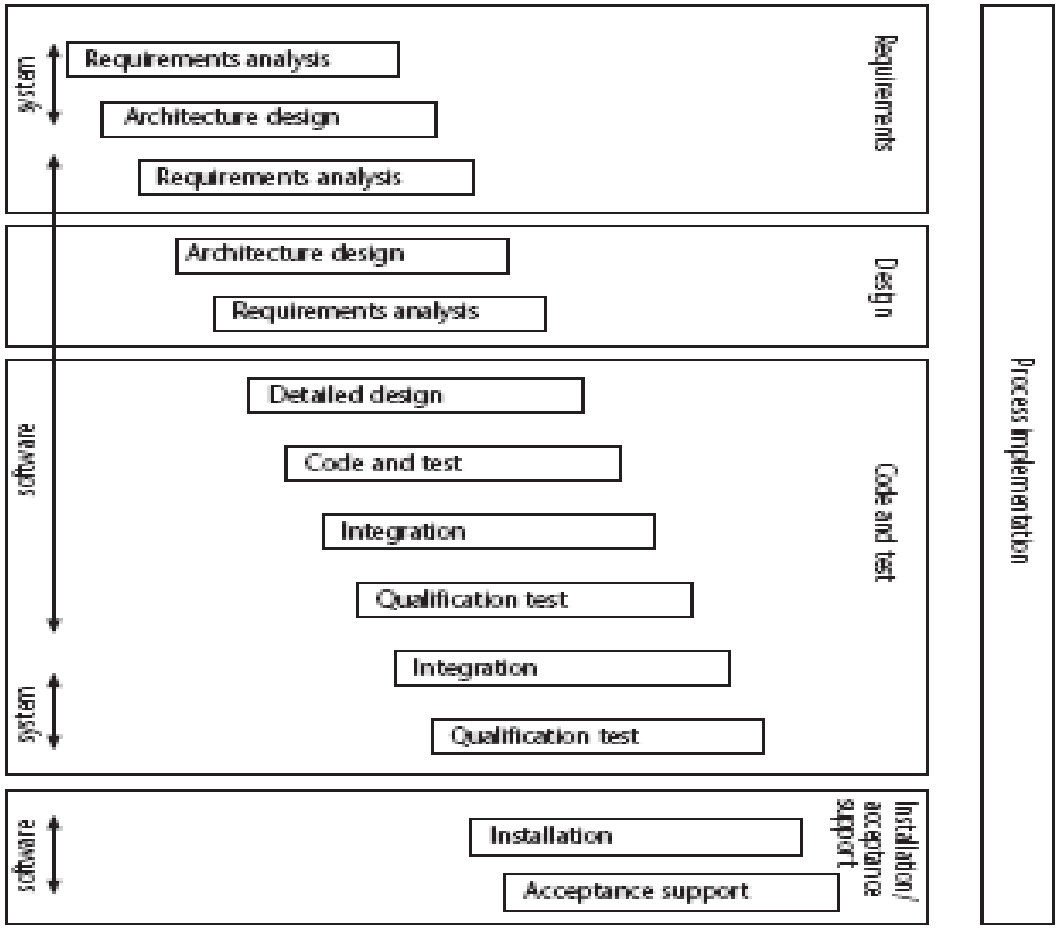


Figure 1.3 The ISO 12207 software development life cycle

ISO 12207 life-cycle

1. Requirements analysis

- **Requirements elicitation:** what does the client need?
- **Analysis:** converting ‘customer-facing’ requirements into equivalents that developers can understand
- Requirements will cover
  - Functions
  - Quality
  - Resource constraints i.e. costs

ISO 12207 life-cycle

2. Architecture design

- Based on *system requirements*
- Defines **components** of system. Components could be new hardware or work processes.

3. Detailed design

-software component is made up of a number of software units. The detailed design of these units are carried out separately.

ISO 12207 life-cycle

4.Code and test

- Writing code for each software unit. Initial testing to debug individual software units.

5.Integration

- Putting the components together.
- The components are tested together to check if they **meet the overall requirements.**

6.Qualification testing

- Testing the *system* (not just the *software*) ensure that all the requirements have been fulfilled

ISO12207 continued

7. Installation

- The **process of making the system operational**.
- Includes setting up standing data, setting system parameters, installing the software onto the hardware platforms and user training.

8. Acceptance support

- Including maintenance and enhancement.

--error corrections, improvements.

An Overview of Software Planning

Step Wise: An approach to planning Software projects

Activities within step

0 Select project

1 Identify project scope and objectives
- 1.1 Identify objectives and measures of effectiveness in meeting them
- 1.2 Establish a project authority
- 1.3 Identify all stakeholders in the project and their interests
- 1.4 Modify objectives in the light of stakeholder analysis
- 1.5 Establish methods of communications with all parties

2 Identify project infrastructure
- 2.1 Establish relationship between project and strategic planning
- 2.2 Identify installation standards and procedures
- 2.3 Identify project team organization

3 Analyse project characteristics
- 3.1 Distinguish the project as either objective- or product-driven
- 3.2 Analyse other project characteristics
- 3.3 Identify high level project risks
- 3.4 Take into account user requirements concerning implementation
- 3.5 Select general lifecycle approach
- 3.6 Review overall resource estimates

4 Identify project products and activities
- 4.1 Identify and describe project products (or deliverables)
- 4.2 Document generic product flows
- 4.3 Recognize product instances
- 4.4 Produce ideal activity network
- 4.5 Modify ideal to take into account need for stages and checkpoints

Activities within step

5 Estimate effort for each activity
- 5.1 Carry out bottom-up estimates
- 5.2 Revise plan to create controllable activities

6 Identify activity risks
- 6.1 Identify and quantify activity-based risks
- 6.2 Plan risk reduction and contingency measures where appropriate
- 6.3 Adjust plans and estimates to take account of risks

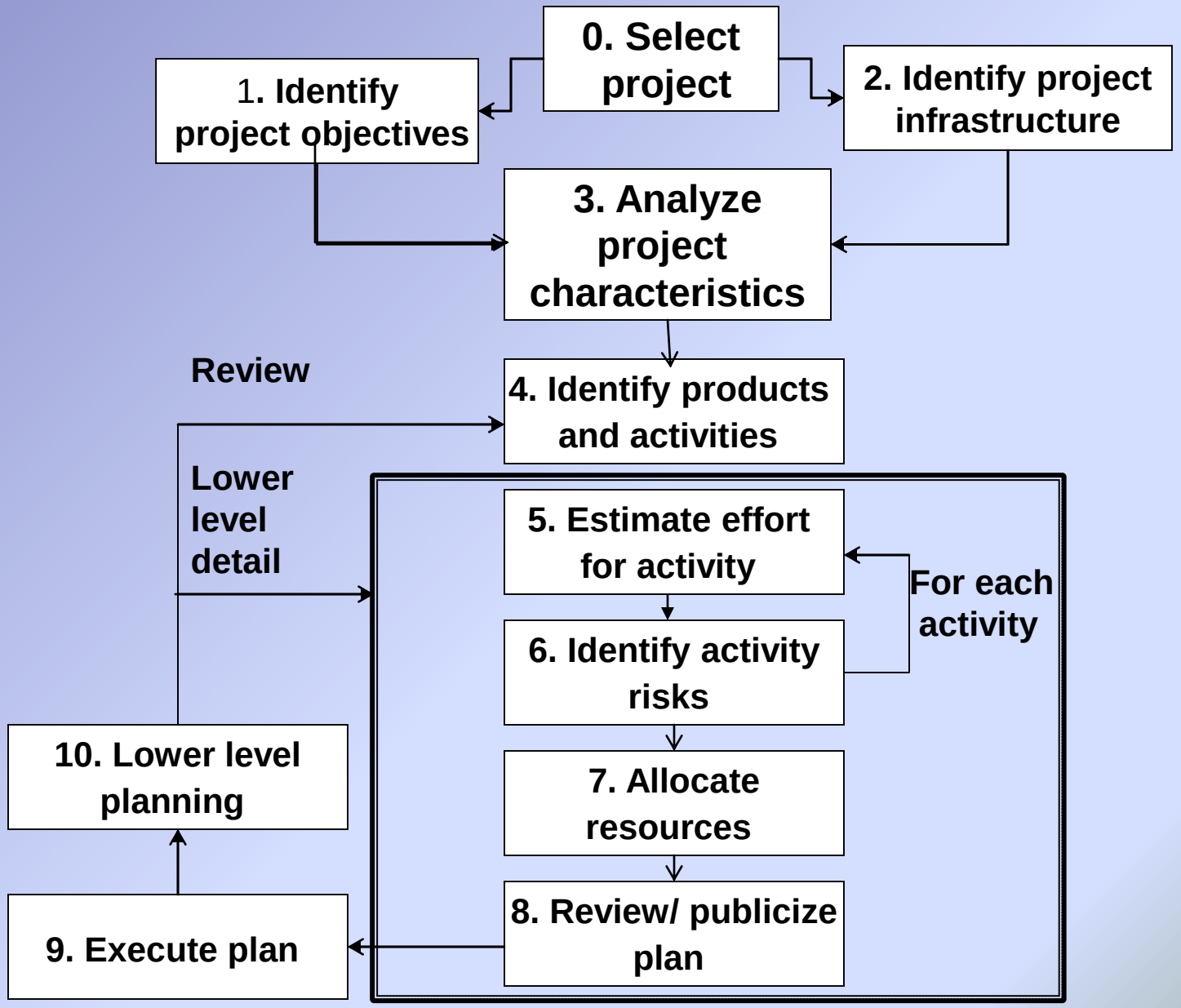
7 Allocate resources
- 7.1 Identify and allocate resources
- 7.2 Revise plans and estimates to account for resource constraints

8 Review/publicize plan
- 8.1 Review quality aspects of project plan
- 8.2 Document plans and obtain agreement

9 Execute plan

10 Lower levels of planning

‘Step Wise’ - an overview



Step 1: Identify Project Scope And Objectives

- The **activities** in this step ensure that **all the parties** to the project **agree on the objectives** and are **committed to the success** of the project.

1.1 Identify objectives and practical measures of the effectiveness in meeting those objectives.

1.2 Establish a project authority.

1.3 Identify all stakeholders in the project and their interests.

1.4 Modify objectives in the light of stakeholder analysis.

1.5 Establish methods of communication with all parties.

1.1 Identify objectives and practical measures of the effectiveness in meeting those objectives.

‘how do we know if we have succeeded?’

1.2 Establish a project authority

- ‘who is the boss?’
- A single overall project authority needs to be established so that there is unity of purpose among all those concerned.

1.3 Identify all stakeholders in the project and their interests

- ‘who will be affected/involved in the project?’
- Identify all stakeholders in the project and their interests- **Stakeholder Analysis**.

1.4 **Modify objectives in the light of stakeholder analysis**

- In order to gain the full cooperation of all concerned, it **might be necessary to modify** the project objectives.
- This could be **adding new features** to the system.
- This process done consciously and controlled manner.

1.5 **Establish methods of communication with all parties**

- 'how do we keep in contact?'
- First draft of a ***communication plan.***

Step 2: Identify Project Infrastructure

- Usually project used to fit in existing infrastructure.
- A project manager used to find out the precise nature of infrastructure for both in-house and the outside organization carrying out the work for a client.

2.1 Identify relationship between the project and strategic planning.

2.2 Identify installation standards and procedures.

2.3. Identify project team organization.

2.1 Identify relationship between the project and strategic planning

- ‘why they want the project?’

2.2 Identify installation standards and procedures

- ‘what standards do we have to follow?’
- Procedural standards-quality checks(standards)
- Project planning and control standards.

2.3. Identify project team organization

- ‘where do I fit in?’
- Project leader –software developers

Step 3: Analyze Project Characteristics

The purpose of this step is to ensure that **appropriate methods are used for the project.**

3.1 Distinguish the project as either objective- or product-driven (based).

Many Software projects usually have 2 stages

(1) is an **objective driven project**. Create a new software system.

(2) is a **product driven project**. Create the software product.

Product-driven &Objective-driven project:

- **Product-driven project:**
  - A project will be to create a product.
  - The details of the product is provided by the client.
- **Objective-driven project:**
  - A project is to meet an objective.
  - The Client may have a problem and asks a specialist to recommend solutions.

Step 3: Analyze Project Characteristics…

3.2 Analyze other project characteristics (including quality based ones)

- what is different about this project? (Ex—Safty)

3.3 Identify high level project risks

- ‘what could go wrong?’
- ‘what can we do to stop it?’

Step 3: Analyze Project Characteristics…

3.4 Take into account user requirements concerning implementation

3.5 Select development methodology and life cycle approach

- waterfall? Increments? Prototypes?

3.6 Review overall resource estimates

- ‘does all this increase the cost?’

Step 4: Identify Project Products And Activities

In this step the more **detailed planning** of the individual activities takes place.

4.1 Identify and describe project products (deliverables)

- ‘what do we have to produce?’

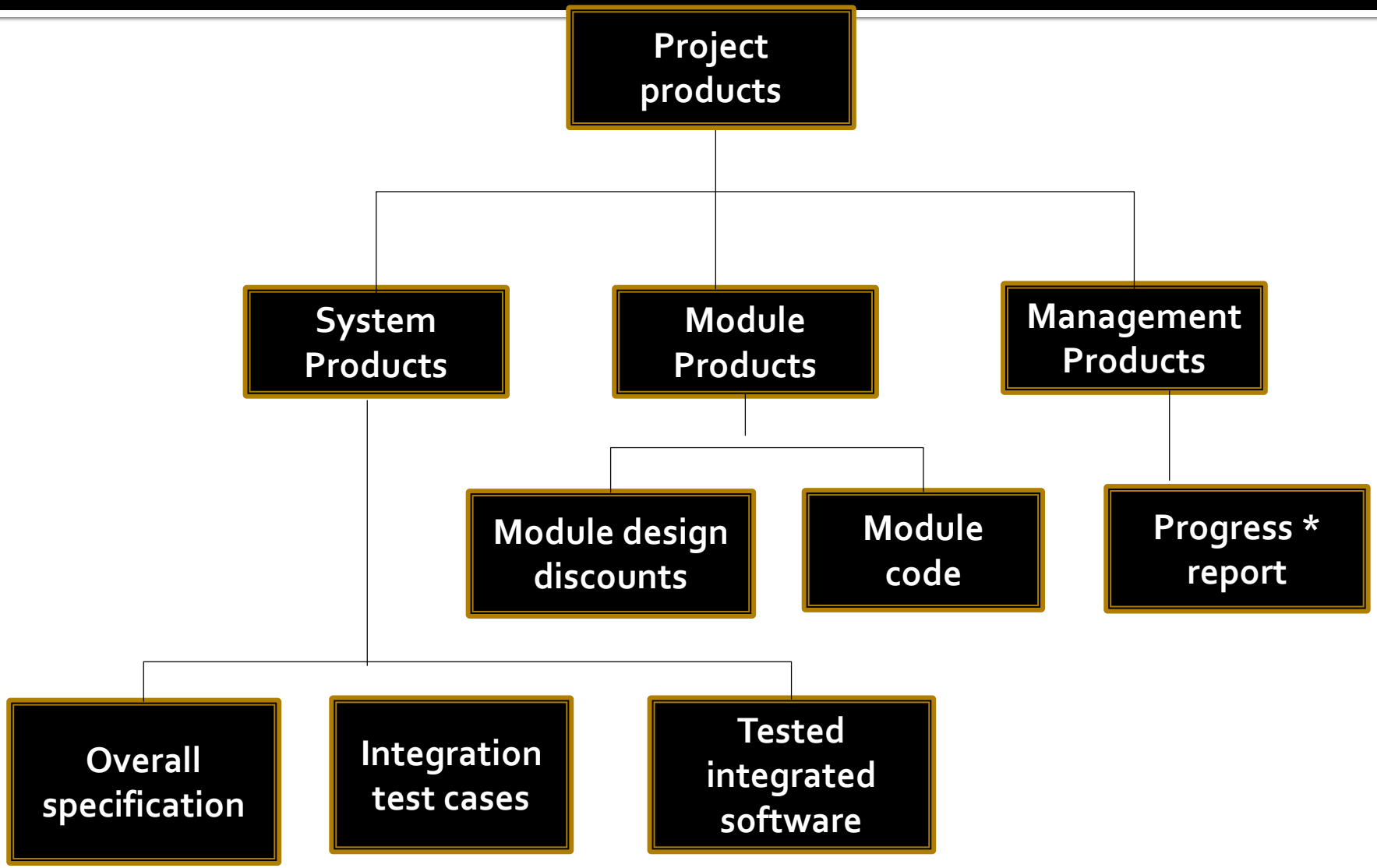
Products

- The **result** of an activity can be a product. For ex:
  - physical thing (‘installed pc’),
  - a document (‘logical data structure’)
  - a person (‘trained user’)
  - a new version of an old product (‘updated software’).

Products

- Products CAN BE *deliverable* or *intermediate*.
- The **product** will form a **hierarchy**.
  - The main products will have sets of **component products** which in turn may have **sub-component products** and so on.
- These relationships can be documented in **a *Product Breakdown Structure(PBS).***

Product Breakdown Structure(PBS)



PBS

Note—The * in the progress reports indicates that there will be new **instance of the entity** ‘ progress report’ created repeatedly throughout the project.

Product description (PD)

Products at the bottom of the PBS should be documented by **Product Descriptions** which contain:

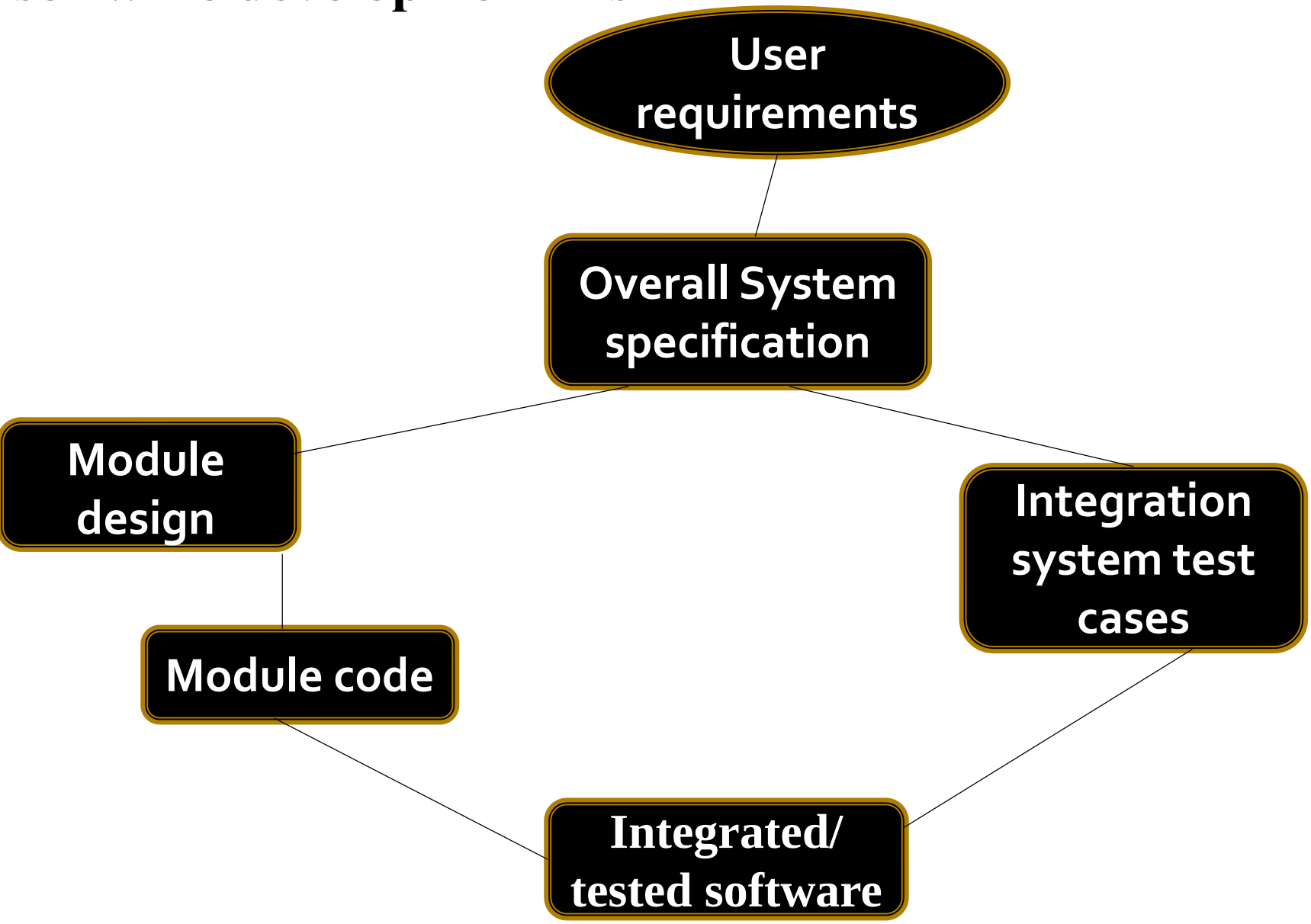
- Product **Name**/identity
- **Purpose** of the product (Description - what is it?)
- **Derivation** – ie the other products from which it is derived
- **Composition** - what does it contain?
- **Format** –Form of the Product
- Relevant **standards**
- **Quality** criteria that define whether the product is acceptable.

4.2 Document generic product flows

- Some products will need one or more other product, to exist.
- for ex: a program design must be created before the program can be written and program specification must exist before the design can be commenced.

- These relationships can be portrayed in a Product Flow diagram (PFD).

A fragment of a product Flow Diagram(PFD) for a software development task



4.3 Recognize product instances

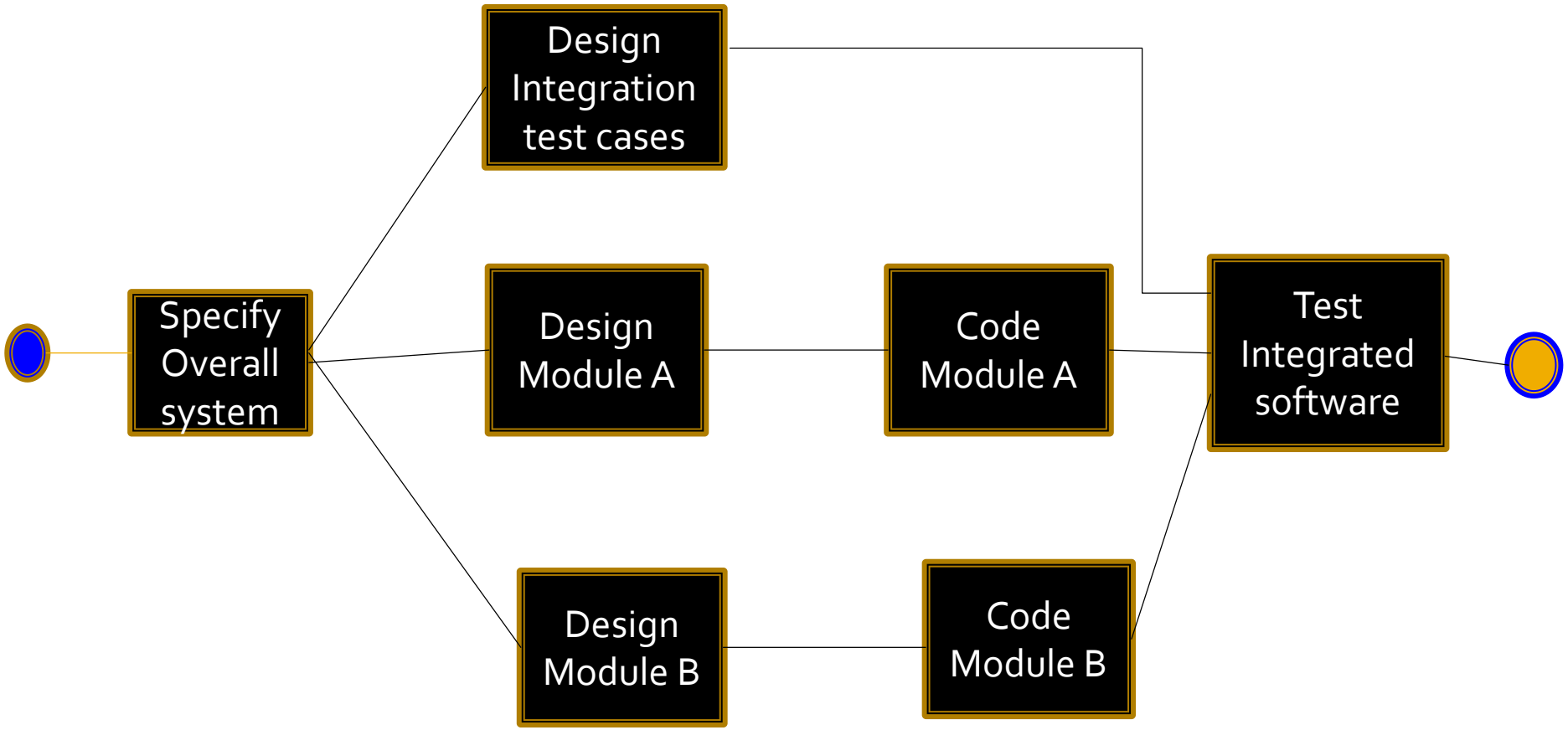
- The same generic PFD fragment relates to more than one instance of a particular type of product, an attempt should be made to identify each of those instances.

- In previousEx: we can recognize the integrated/tested software have many instances like module design and module code and integration test case.

4.4. Produce ideal activity network

- In order to generate **one product from another** there must be **one or more activities** that carry out the transformation**.**
- By identifying these activities we can create an **activity network.**
- Activity network will show the **tasks that have to be carried out** and the **order in which they have to be executed.**

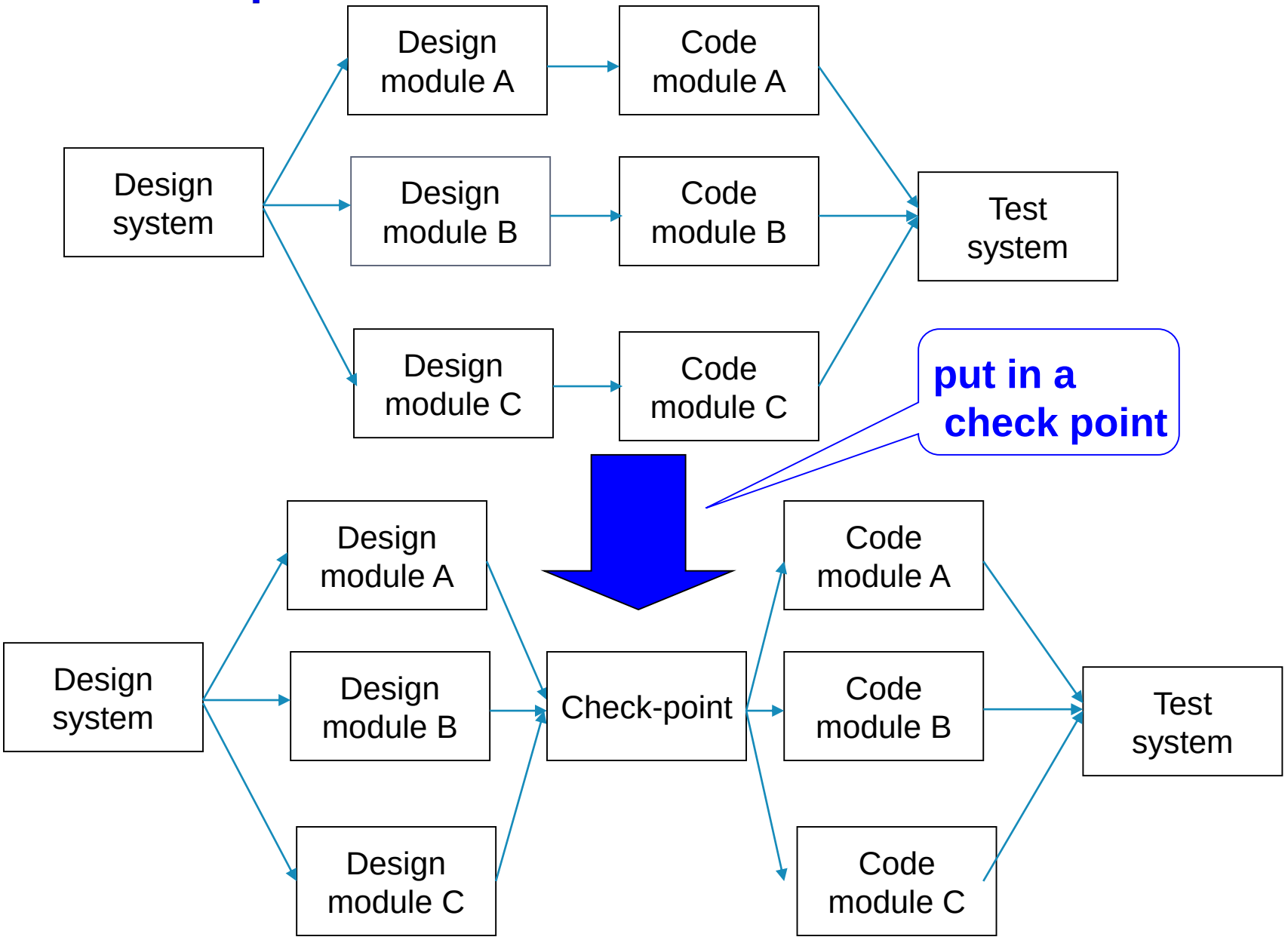
An example of an ideal activity Network



4.5 Modify the ideal to take into account need for stages and check-points

- The activity will start as soon as the preceding once have been completed.
- The approach helps in minimizing the **overall duration** or **elapsed time** for project.
- This can be done by modifying the ideal i.e., by **dividing into stages** and introducing **checkpoint** activities.

4.5 Add check-points if needed



Step 5: Estimate Effort For Each Activity

5.1 Carry out bottom-up estimates

- The **individual activity** estimates of effort should be **summed** to get an **overall bottom-up estimate**.

- The overall duration of the project can be calculated by referring the activities on the activity network with their elapsed time.

- distinguish carefully between ***effort*** and ***elapsed time***
  - **effort**→ is the amount of work that need to be done.
  - **Ex**: If task requires 3 members of staff to work 2 full days each, then effort expended is 6 days.
  - **Elapsed time** →is the time between the start and end of a task.
  - **Ex:** If the 3 members of staff start and finish at the same time then the elapsed time for the activity would be 2 days.

Difference b/w *elapsed time* and *effort*

	Effort	Duration	Elapsed Time
What it is	The number of work units that is vital to complete an activity	The entire time taken to complete the activity that you are assigned which is based on the resources allocated to the project	Time between designating a resource to a task to the completion of the task
What it is measured in	Staff - hours, days or weeks	Work Hours, Work Days and Work Weeks (does not cover weekends or holidays)	Work Hours, Work Days and Work Weeks (covers weekends and holidays)
Example	House Painting : You work 6 hours a day for 9 days Effort is 54 hours.	House Painting : You work 6 hours a day for 9 days Duration is 9 days	House Painting : You work 6 hours a day for 9 days Time Elapsed is 11 days.

5.2. Revise plan to create controllable activities

- **break up very long activities** into a series of smaller ones(**Subtasks**).
- bundle up very short activities (create check lists?)
- Example**…** **Training Course--**book Rooms and equipment, notify those attending, register students on the training system, order refreshments, copy training materials and so on
- Bundle the activities into a single merged activity ‘ make training course arrangements’ which could be supplemented with a checklist.

Step 6: Identify Activity Risks

6.1. Identify and quantify activity based risks

- Product damage if risk occurs (measure in time lost or money)
- Risks are uncertain, so identify each activity based risk.

6.2. Plan risk reduction and contingency measures where appropriate.

- **risk reduction**: activity to stop risk occurring

It may be possible to avoid / atleast reduce some of the **identified** risks

- **Contingency plan** : says what action can be taken if risk occurs.

Example—A contingency plan could be to use contract staff if a member of the project team is unavailable at a key time because of serious illness.

6.3 Adjust overall plans and estimates to take account of risks

- we may change plan by adding new activities which reduce risks associated with other activities
- e.g. if new programming language is used then schedule training course for programmers to practice new language skills

Step 7: Allocate Resources

7.1 Identify and allocate resources

-- The ***staff available*** for the project are identified and are ***provisionally*** allocated to activities.

7.2 Revise plans and estimates to take into account resource constraints

- e.g. staff not being available until a later date

-Some **staff may be needed for more than one task** at the same time and in this case, an **order of priority is established**.

Step 8: Review/Publicize Plan

8.1 Review quality aspects of the project plan

-Each task should have quality criteria. These are **quality checks** that have to be passed before the activity can be '**signed off' as completed**.

8.2 Document plan and obtain agreement

-It is important that the plans be carefully documented.

-All the parties to the project understand and agree to the commitments required to them in the plan.

Step 9 and 10: Execute plan and create lower level plans

- Project outline need to be planned first and the detailed plan of the first activity can be done.
- It is necessary to **make provisional plans** for the more distant (later) task.

Key points—Planning approach

- Establish the project **objectives**.
- (**Analysis**)Think about the characteristics of the project.
- Discover/set up the **infrastructure** to support the project (including standards, tools)
- Identify **products** to be created and the **activities** that will create them
- Allocate **resource**s
- Set up **quality** processes

Project Evaluation

Contents

- Project Evaluation
  - **Cost Benefit Analysis**
  - **Cash flow forecasting**
  - **Cost-benefit evaluation techniques**

Evaluation of individual Projects

- The individual project **feasibility is evaluated**

Technical Assessment –

Technical assessment of proposed system consists of evaluating:

- whether the **required functionality** can be achie**ve**d with current affordable technologies.
- The cost of the technology adopted must be taken into account in the **cost-benefit analysis**.

Evaluation of individual Projects…

Cost Benefit Analysis (CBA)

This (CBA) comprises of two steps:

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

   –these include development cost, operating cost and benefits expected from the new system (proposed system).

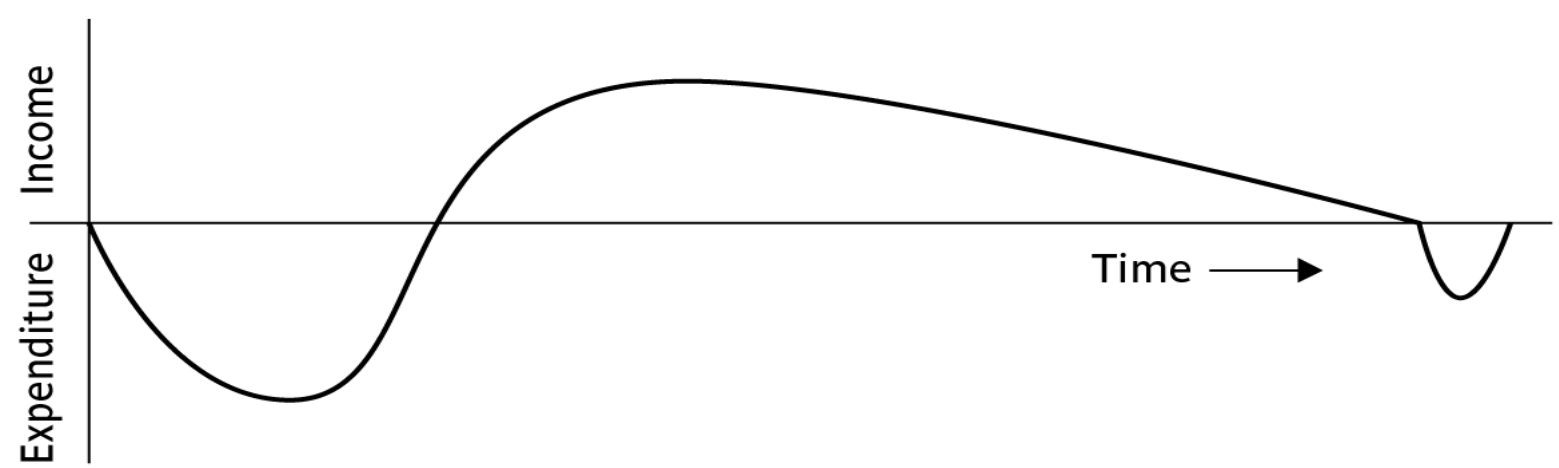
2. Expressing these costs and benefits in common units.
   - **Development costs** (development staff cost)
   - **Set-up** (costs of putting the system into place, mainly of any new hardware, recruitment, staff training)
   - **Operational costs** (operating the system after installation).

- Check benefits are greater than costs.

Cash Flow Forecasting

- **Estimating the overall costs and benefits** of a project by producing a **cash flow forecasting** →which indicates the **expenditure and income taken place** .
  - Money spent for staff wages, during project's development cannot wait until income received. **A forecast is needed** of when expenditure, such as payment of salaries, and any income are to be expected.
- So the following figure shows the typical **product life cycle cash flow** .

Product/system life cycle cash flows



- The timing of costs and income for a product of system needs to be estimated.
- The development of the project will incur costs.
- When the system or product is released it will generate income that gradually pays off costs.

Cost-benefit Evaluation Techniques

- There are some **methods for comparing projects** on the basis of their **cash flow forecasts**.
- It is assumed that the cash flows take place at the **end of each year.**
  - For short-term projects, there are **seasonal cash flow patterns**, some are **quarterly** or even monthly.

- Following are some of the cost-benefit evaluation techniques:

1. Net profit
2. Payback period
3. Return On Investment (ROI)
4. Net Present Value (NPV)
5. Internal Rate of Return (IRR)

1. Net profit

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

- Consider the project cash flow estimates shown in the given table.
- Here negative values represent expenditure and positive values represent income.

1. Net profit

Year	Cash-flow
0	-100,000
1	10,000
2	10,000
3	10,000
4	20,000
5	100,000
Net profit	50,000

- ‘Year 0’ represents initial investment made at the start of the project.
- ‘Cash-flow’ is value of income less outgoing .
- Net profit value of all the cash-flows for the lifetime of the application.

Calculate Net Profit for project 2, 3 and 4

Year	Project-2 (Cash-Flow)	Project-3 (Cash-Flow)	Project-4 (Cash-Flow)
0	-1,000,000	-100,000	-120,000
1	200,000	30,000	30,000
2	200,000	30,000	30,000
3	200,000	30,000	30,000
4	200,000	30,000	30,000
5	300,000	30,000	75,000
Net Profit			

2. Payback period

- The payback period is the time taken to break even or **pay back** the **initial investment**.

- Normally the project with the shortest payback period will be chosen on the basis that an organization will wish to minimize the time that a project is ‘in debt’

Pay back period...

- This is the **time taken** to **pay back the initial investment**. This is the time it takes to start generating a surplus of income over outgoings.

Year	Cash-flow (project 1)	Accumulated
0	-100,000	-100,000
1	10,000	-90,000
2	10,000	-80,000
3	10,000	-70,000
4	20,000	-50,000
5	100,000	50,000

Pay back Period=5 years

Pay back period...

- **Advantage:** it is simple to calculate and is not partcularly sensitive to small forecasting errors.
- **Disadvantage:** as a selection technique it ignores the overall profitability of the project, in-fact, it totally ignores any income (or expenditure) once the project has broken even.

Consider the cash-flows of project 2, 3 & 4 and Calculate Payback period for each of them.

Year	Project-2 (Cash-Flow)	Project-3 (Cash-Flow)	Project-4 (Cash-Flow)
0	-1,000,000	-100,000	-120,000
1	200,000	30,000	30,000
2	200,000	30,000	30,000
3	200,000	30,000	30,000
4	200,000	30,000	30,000
5	300,000	30,000	75,000
Payback Period is:			

Analysis task:

Q1) Rank the four projects in order of financial desirability and make a note of your reasons for ranking them in that way.

Q2) Analyze the payback period of each project and chose which project would you favor? Give reason.

Answers:

Year	Project-2	Project-3	Project-4
0	-1,000,000	-100,000	-120,000
1	200,000	30,000	30,000
2	200,000	30,000	30,000
3	200,000	30,000	30,000
4	200,000	30,000	30,000
5	300,000	30,000	75,000
Net Profit	100,000	50,000	75,000

Pay back Period for:

Project-2= 5 years
Project-3= 4 years
And
Project-4= 4 years

3. Return on Investment (ROI)

- Return on Investment is also known as the **Accounting Rate of Return (ARR),** provides a way of comparing the **net profitability** to the **investment** required.

Return on investment (ROI)...

the formula used to calculate ROI is:

$$\text{ROI} = \frac{\text{Average annual profit}}{\text{Total investment}} \times 100$$

•Calculating the ROI for project-1, the net profit is 50,000 and the total investment is 100,000. therefore:

- Average annual profit = $\frac{50{,}000}{5} = 10{,}000$

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

$$= 10\%$$

Solve the given problem statement

Calculate the ROI for each of the other projects 2, 3 & 4(shown in previous slide) and decide which, on the basis of this criterion , is the most worthwhile.

4. Net Present Value (NPV)

- Net Present value considers profitability of a project and the timing of each cash flows that are produced.

$$NPV = \frac{\text{Sum of Expected Cash Flows For Each Period}}{(1 + \text{Discount Rate})^{\text{Period (year)}}} - \text{Initial Investment}$$

- i.e.,

$$NPV = \sum_{t=1}^{T} \frac{\text{Cash Flow}_t}{(1+r)^t} - \text{Initial Cash Investment}$$

where,
t = Cash Flow Period
r = Interest Rate Assumption

NPV…

- For example: Calculate the Present value

After 1 year the value is 110

So the rate of interest is 10%

$$\text{Present value} = \frac{value\ in\ year\ t}{(1+r)^t}$$

So,

- Present value = $\frac{110}{(1+0.1)^1} = \frac{110}{1.1} = 100$

Discount Factor:

- **Discount factor** $= \dfrac{1}{(1+r)^t}$

Where , *r* is the interest rate(also called discount rate)

t is the number of years

Discount rate : the annual rate by which we discount future earnings is known as discount rate.

Discount factor...

In the case of 10% rate and **one year**
Discount factor = 1/(1+0.10) = 0.9091

In the case of 10% rate and **two years**
Discount factor = $1/(1+0.10)^2$ = 1/(1.10 x 1.10)
=0.8294

So on.....

Calculating Project-1 Discount factor at the discount rate =10%

Year	Project 1(Cash-flow)	Discount factor @ 10%
0	-100,000	1.0000
1	10,000	0.9091
2	10,000	0.8264
3	10,000	0.7513
4	20,000	0.6830
5	100,000	0.6209

Table 3.3 *Table of NPV discount factors*

	Discount rate (%)					
Year	*5*	*6*	*8*	*10*	*12*	*15*
1	0.9524	0.9434	0.9259	0.9091	0.8929	0.8696
2	0.9070	0.8900	0.8573	0.8264	0.7972	0.7561
3	0.8638	0.8396	0.7938	0.7513	0.7118	0.6575
4	0.8227	0.7921	0.7350	0.6830	0.6355	0.5718
5	0.7835	0.7473	0.6806	0.6209	0.5674	0.4972
6	0.7462	0.7050	0.6302	0.5645	0.5066	0.4323
7	0.7107	0.6651	0.5835	0.5132	0.4523	0.3759
8	0.6768	0.6274	0.5403	0.4665	0.4039	0.3269
9	0.6446	0.5919	0.5002	0.4241	0.3606	0.2843
10	0.6139	0.5584	0.4632	0.3855	0.3220	0.2472
15	0.4810	0.4173	0.3152	0.2394	0.1827	0.1229
20	0.3769	0.3118	0.2145	0.1486	0.1037	0.0611
25	0.2953	0.2330	0.1460	0.0923	0.0588	0.0304

Net Present Value (NPV)

- Alternatively, the Present value of cash flow may be calculated by **multiplying cash flow by appropriate discount factor**.

- The NPV for a project is obtained by discounting each cash flow (both –ve and +ve) and summing the discounted values.

i.e.,

- Present value = cash_flow x discount factor

NPV = Sum of Discounted cash_flow - Investment

NPV-Applying discount factors

Year	Project 1 (Cash-flow)	Discount factor @ 10%	Discounted cash flow
0	-100,000	1.0000	-100,000
1	10,000	0.9091	9,091
2	10,000	0.8264	8,264
3	10,000	0.7513	7,513
4	20,000	0.6830	13,660
5	100,000	0.6209	62,090
		(Net Present Value) NPV=	618

Calculate NPV for project 2,3 and 4

Year	Project-2	Project-3	Project-4
0	-1,000,000	-100,000	-120,000
1	200,000	30,000	30,000
2	200,000	30,000	30,000
3	200,000	30,000	30,000
4	200,000	30,000	30,000
5	300,000	30,000	75,000
Net Profit	100,000	50,000	75,000

NPV for project-2

Year	Project-2 (Cash-flow)	Discount factor @ 8%	Discounted cash flow
0	-1,000,000	1.0000	-1,000,000
1	200,000	0.9259	1,85,180
2	200,000	0.8573	171,460
3	200,000	0.7938	158,760
4	200,000	0.7350	147,000
5	300,000	0.6806	204,180
Net Profit =	100,000	NPV =	133,420

NPV for project-3

Year	Project-3 (Cash-flow)	Discount factor @ 10%	Discounted cash flow
0	-100,000	1.0000	-1,00,000
1	30,000	0.9091	27,273
2	30,000	0.8264	24,792
3	30,000	0.7513	22,539
4	30,000	0.6830	20,490
5	30,000	0.6209	18,627
Net Profit	50,000	NPV =	13,721

NPV for project-4

Year	Project-3 (Cash-flow)	Discount factor @ 12%	Discounted cash flow
0	-120,000	1.0000	-1,20,000
1	30,000	0.8929	26,787
2	30,000	0.7972	23,916
3	30,000	0.7118	21,354
4	30,000	0.6355	19,065
5	75,000	0.5674	42,555
Net Profit	75,000		NPV = 13,677

5. Internal Rate of Return(IRR)

- Internal rate of return (IRR) is the **discount rate** that would **produce an NPV of 0** for the project.
- IRR can be used to **compare** different investment opportunities.
- There is a Microsoft Excel function which can be used to calculate IRR.

IRR…

- The IRR rule states that if the **internal rate of return** on a project or and investment is **greater than** the minimum **required rate of return** (or **cost of capital**) then the project or investment should be **pursued** **(accept**).

- Conversely, if the **IRR** on a project is **lower than** the **cost of capital**, then the best course of action is to **reject it**.

IRR…

- IRR is the rate of return which a project likely to generate.
- IRR is that discount factor rate where PVCI is equal to PVCO.

  IRR is obtained if PVCI = PVCO

  ie., NPV = 0
- IRR is calculated by trial and error method.

*(Note: **PVCI** is Present Value of Cash Inflow*
***PVCO** is Present Value of Cash Outflow)*

Risk Evaluation : Dealing with uncertainty

- Project A might appear to give a **better return** than B but could be **riskier.**
- Could draw up draw a **project risk matrix** for each project to **assess risks**.(Risk identification and Ranking)
- For riskier projects could use higher discount rates.

Risk identification and ranking

Risk	Importance	Likelihood
Client rejects proposed look and feel of site	H	—
Competitors undercut prices	H	M
Warehouse unable to deal with increased demand	M	L
Online payment has security problems	M	M
Maintenance costs higher than estimated	L	L
Response times deter purchasers	M	M

TABLE 2.5 A fragment of a basic project/business risk matrix for an e-commerce application

- Unlikely, H High , L Low , M Medium

END OF UNIT-4