UNVERSITY OF SALAHADDIN
COLLEGE OF ADMINISTRATION & ECONOMIC
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Projects Evaluation and Investment Decisions

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Chapter one

Projects and Investment Decision

Fundamental approaches to projects evaluation and investment decision

Basic definitions

Some of the basic conventions related to the topic of the subject in this year must be known, and they are:

- 1- Investment // means the use of funds, whether in building new projects or in existing projects, in a way that makes an additional return or benefits for them.

- 2- The investment project // is a meant idea that requires the distribution of a certain amount of resources in the hope of doing a certain amount of economic or social results in the future.

- 3- Investment activity // means creating new productive capacities or increasing the already available energies.

- 4- The investment program // is a group of investment projects that are related to a special sector that enjoys a degree of agreement and relationship.

- 5- The investment plan // is a set of investment programs at doing common goals for all economic sectors.

- **What is the Project?**

- It is a group of activities with the goal of serving specific groups.

- **Types of production or service projects**

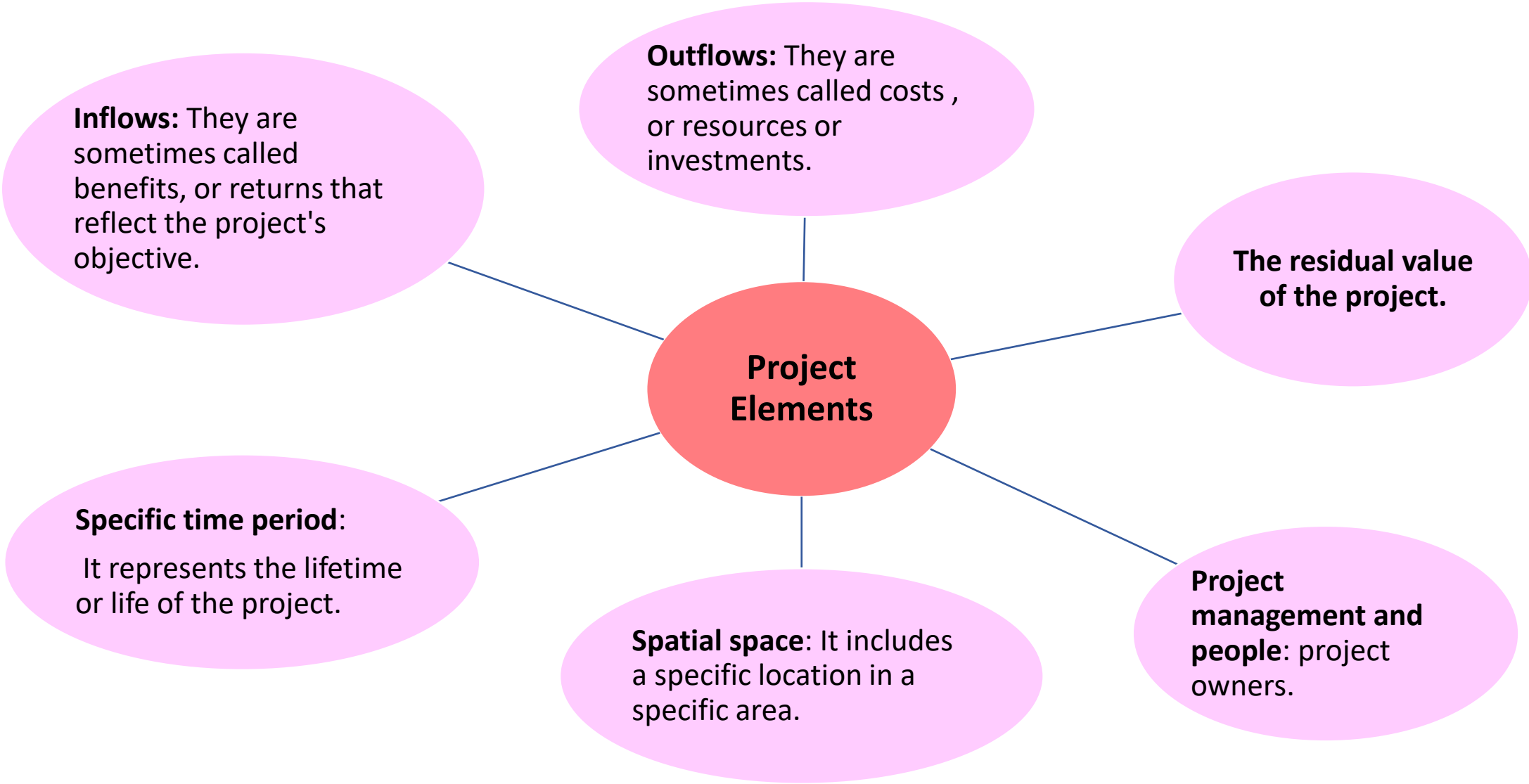
- **represented by:-**

- 1-Public projects: These are projects owned by the state and goal of achieving public benefit.

- 2-Private projects: These are projects that are owned by individuals and goal of achieving economic profit.

- 3-Joint projects: These are projects owned by the state and individuals together, with the goal of achieving an economic profit or public benefit.

What are the elements of the project?



- **What are the investment project classifications?**

It is represented by:-

- 1-Classification by nature: physical investments and financial investments...etc.
- 2- Classification by goal : renewal or replacement investments ,expansion investments and innovation investments...etc.
- 3- Classification by sectors: agricultural projects, industrial projects and service projects...etc.
- 4-Classification by size: large projects, medium projects and small projects.
- 5-Classification according to place or geography: local projects ,regional projects and national projects.

- **investment decision**

It is an action usually taken either by a single person or by a group of people, related to the transfer of financial resources into goods and service products during a certain period of time.

The importance of the investment decision

represented by:-

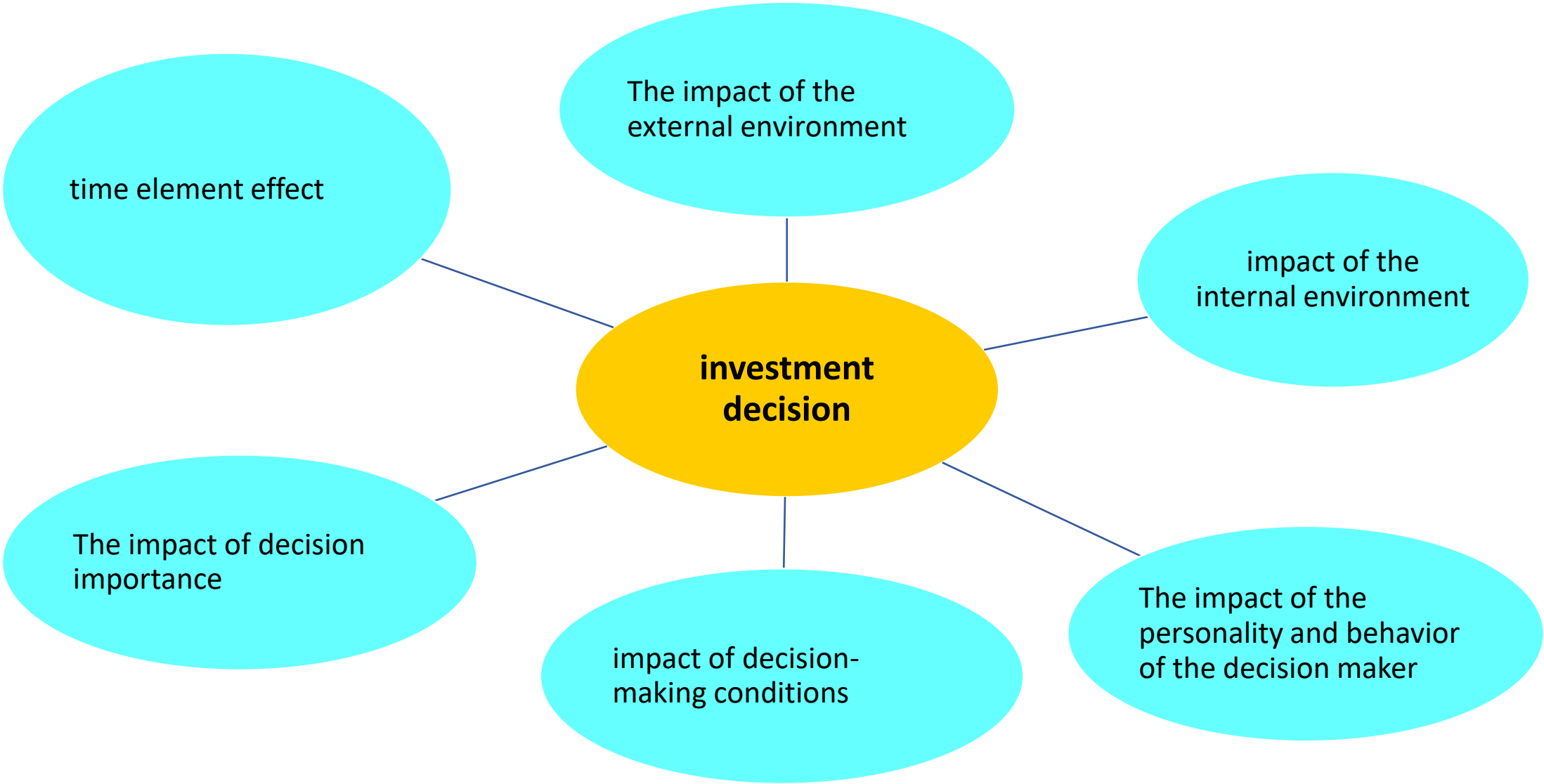
1 - Investment is the only engine for development and long-term residue.

2- Invest important resources.

3-It is required to know the impact of the economic and financial environment.

- **Characteristic of an investment decision**
- **represented by:-**
- 1- The expenditure incurred by the project.
- 2 The investment comes with risks as a result of uncertain returns.
- 3- The investment decision impacts the financial structure of the project.
- 4- It is difficult to rescind the investment and cancel it.
- **what are the principles for making investment decisions?**
- **represented by:-**
- 1-Adopt an a proper strategy.
- 2- Adopt the scientific bases for decision-making.
- 3- Take into account the relationship between return and risk.

what are the factors affecting investment decision making?



Chapter Two

The Projects Feasibility Study , Stages of preparing the feasibility study & The marketing study

- **What is the meaning of the Evaluation?**

- It is a process of measuring specific criterias about what has been planned in the project and the results of the project.

- **What is the meaning of the project's feasibility study**

It is a scientific method that includes a set of studies goal at examining and evaluating the project, in order to make a decision to start it and practice its activity or not.

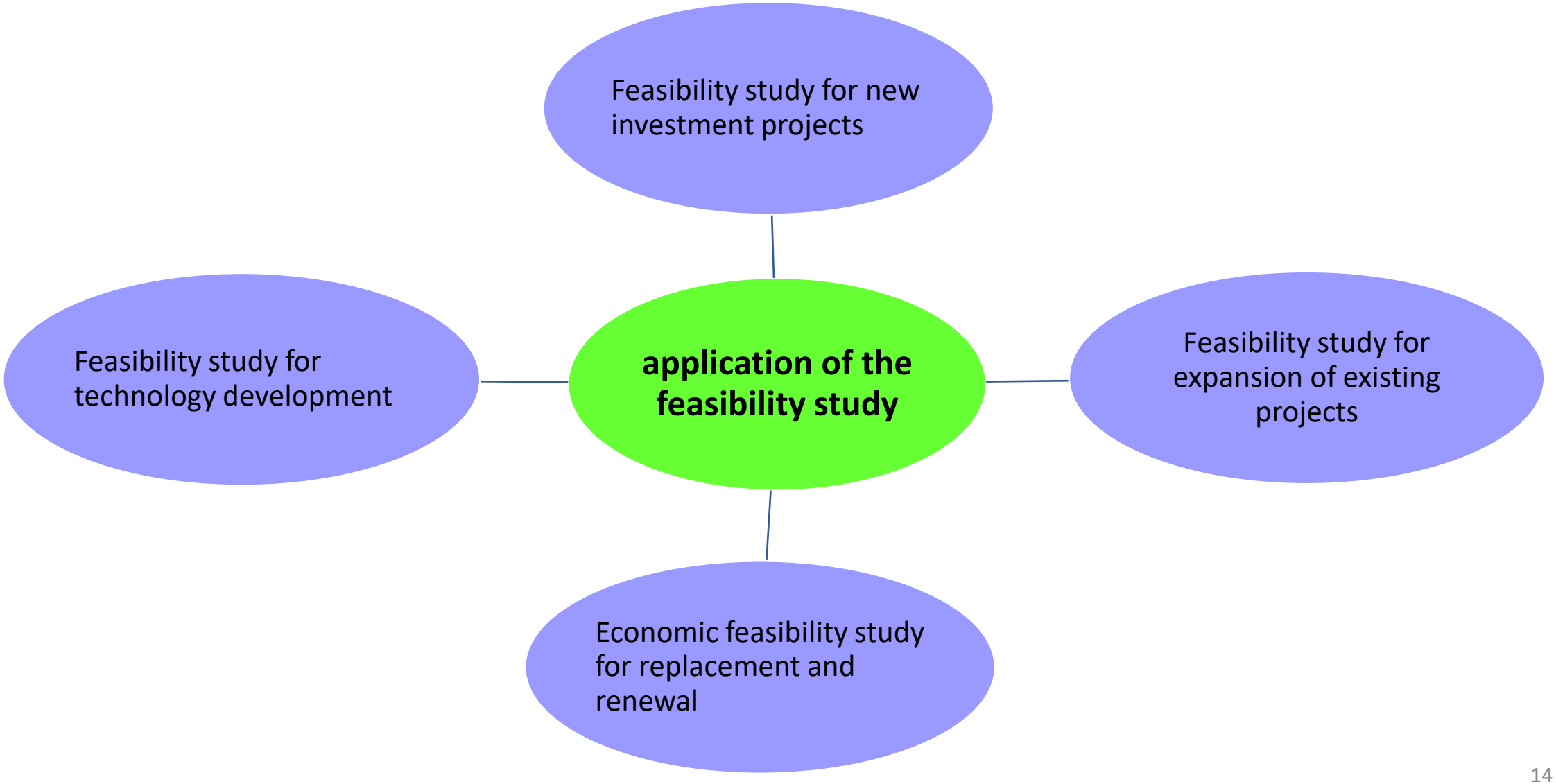
- **What are the most important basic principles of feasibility studies ?**

- 1- Proving the technical and economic feasibility of the project.

- 2- Comparing a group of projects and choosing the best one.

- 3- Knowing the reasons for the differences between the planned results and actual results.

What are the fields of application of the feasibility study?

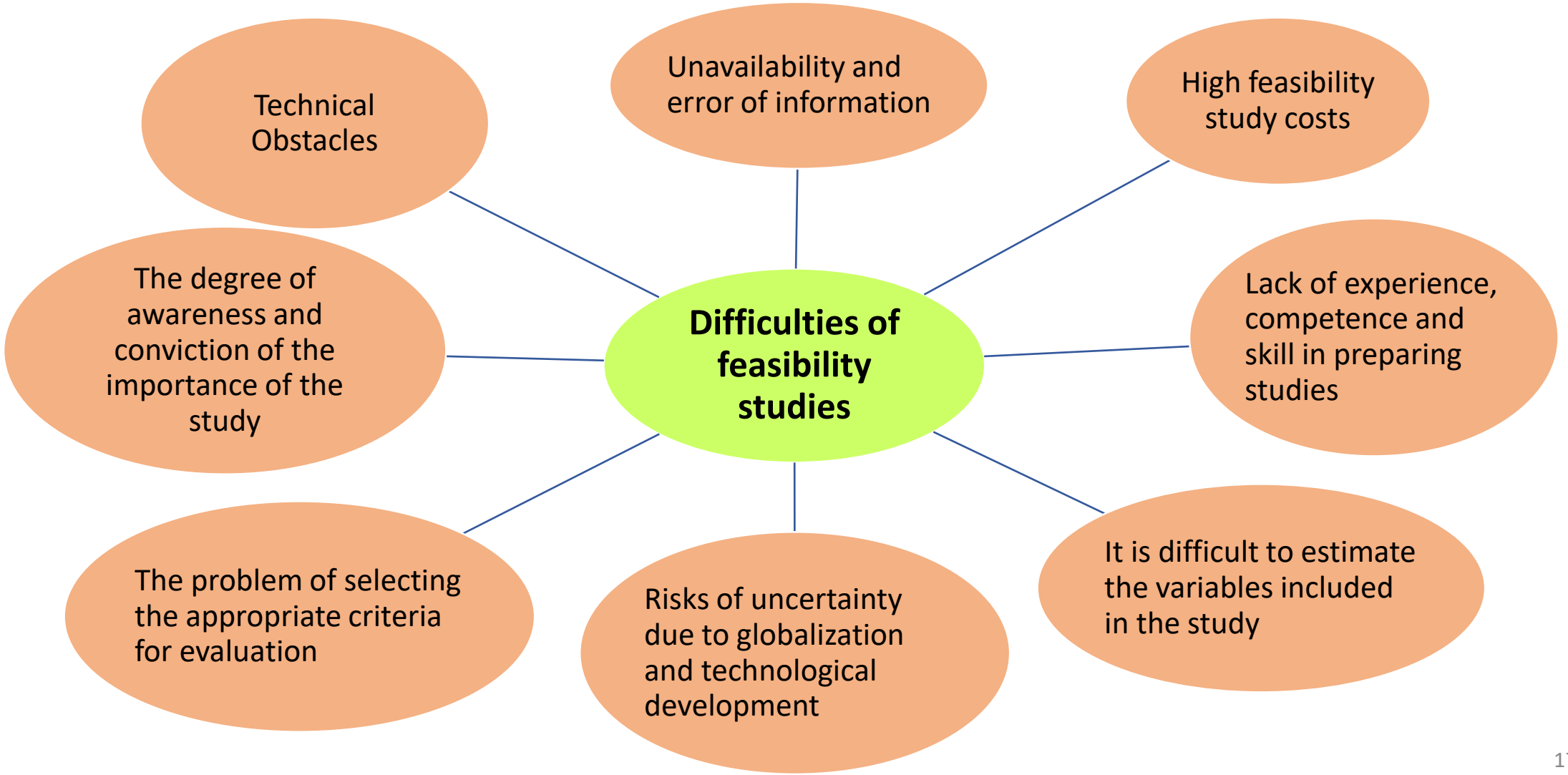


- **The feasibility study raises the following questions:**

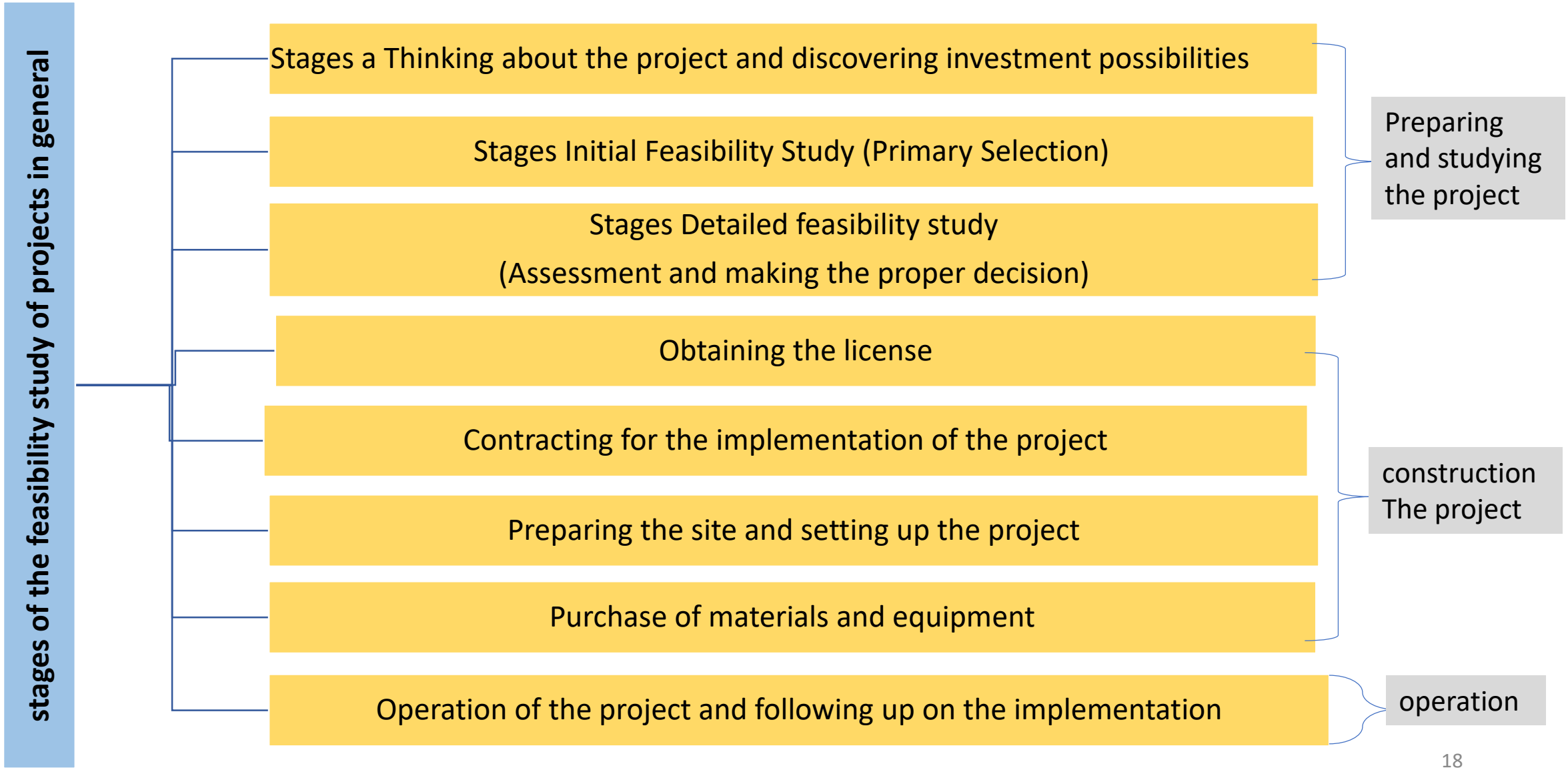
- 1- What is the best projects I can do?
- 2-Why is this project done alone?
- 3- Where is the project set up?
- 4- What is the best time to set up the project and introduce its products?
- 5- Who is the goal group in the project?

- 6- How will the project be established?
- 7- How much does the project need workers and machines ...?
- 8- How much will the project cost?
- 9 - Will it make profits or not?
- 10 What are the sources of financing the project?
- 11-How do I choose a project from a group of alternative projects?
- 12- How do I prove that the project is economically feasible?

What are the difficulties in conducting and applying feasibility studies



What are the stages of the feasibility study of projects in general and them graphically?



- **Q/ Explain the stages of preparing a feasibility study for projects**
- **First: The stage of thinking about the project and discovering investment possibilities**
- At this stage, a group of indexes s is used to discover investment possibilities, which are:-
- 1- Analysis of import lists.
- 2-Study the primary resources used in the project.
- 3-Studying the workforce in the country and their skill levels.
- 4-Study the technological means used in the project.
- 5-Studying projects similar to the proposed project, as well as studying projects that have not been implemented and have been excluded.

Second: The stage initial feasibility study stage (primary selection)

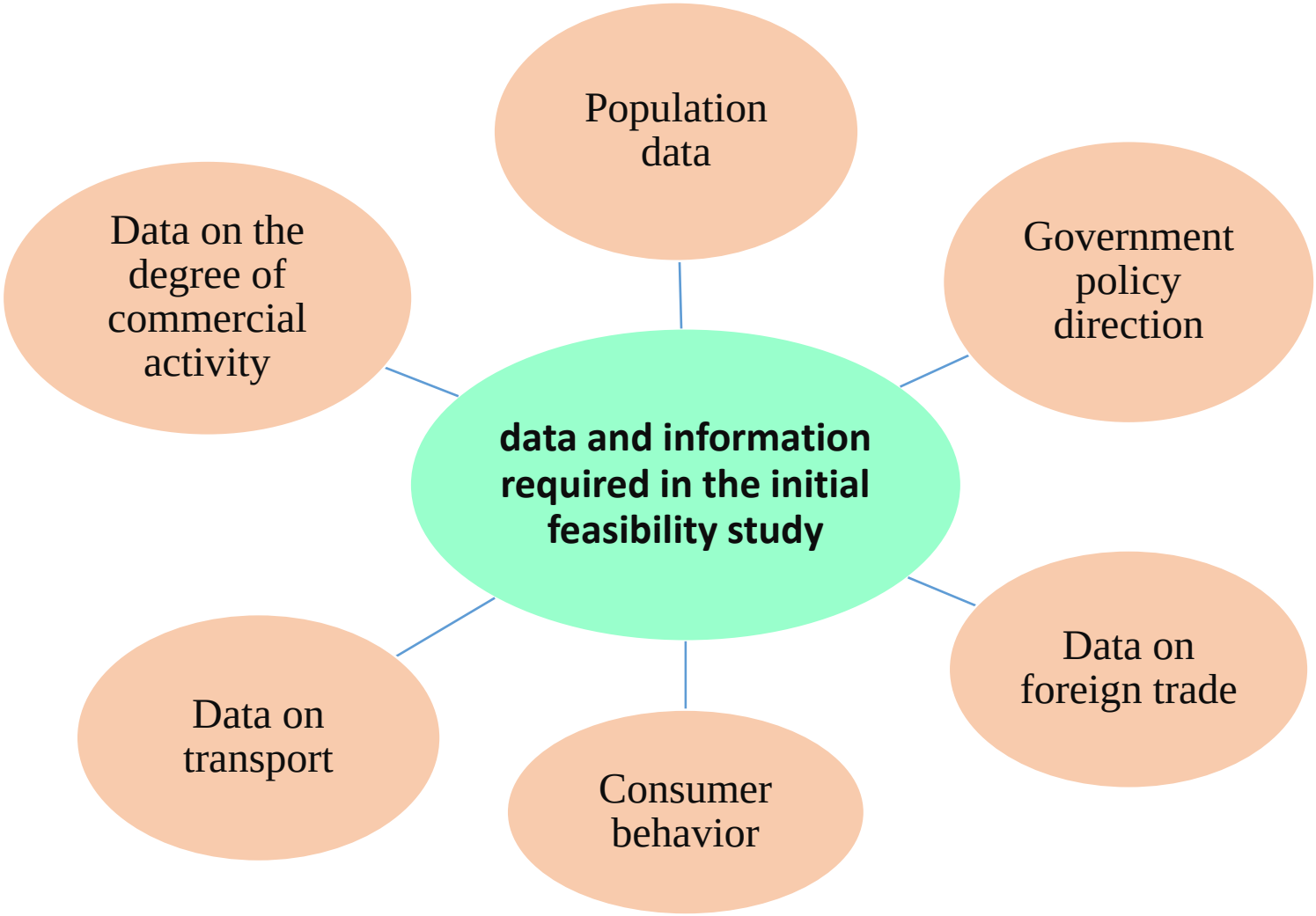
This stage is a link between the stage thinking about the project and discovering investment and the stage of a detailed feasibility study

The second stage can be expressed in the following scheme, which shows the comparison between, for example, 5 proposed projects.

- The projects under study are Project (1, 2, 3, 4, 5).
- Initial market study:- Estimate demand and supply, Market price estimation
- Project (5) The absence of a market is excluded and the project remains (1, 2, 3, 4)
- Technical and technological study for projects (1, 2, 3, 4) :- Providing production factors(raw materials –labor-energy…etc) selection of production methods , production quantity
- Project (4) not providing raw materials, and project (1, 2, 3) remains
- Commercial profitability of projects (1, 2, 3) :- Production cost , Revenue
- Project (3) commercial profitability is low, and project (1, 2) remains
- The remaining projects (1, 2) will be subject to a detailed feasibility study

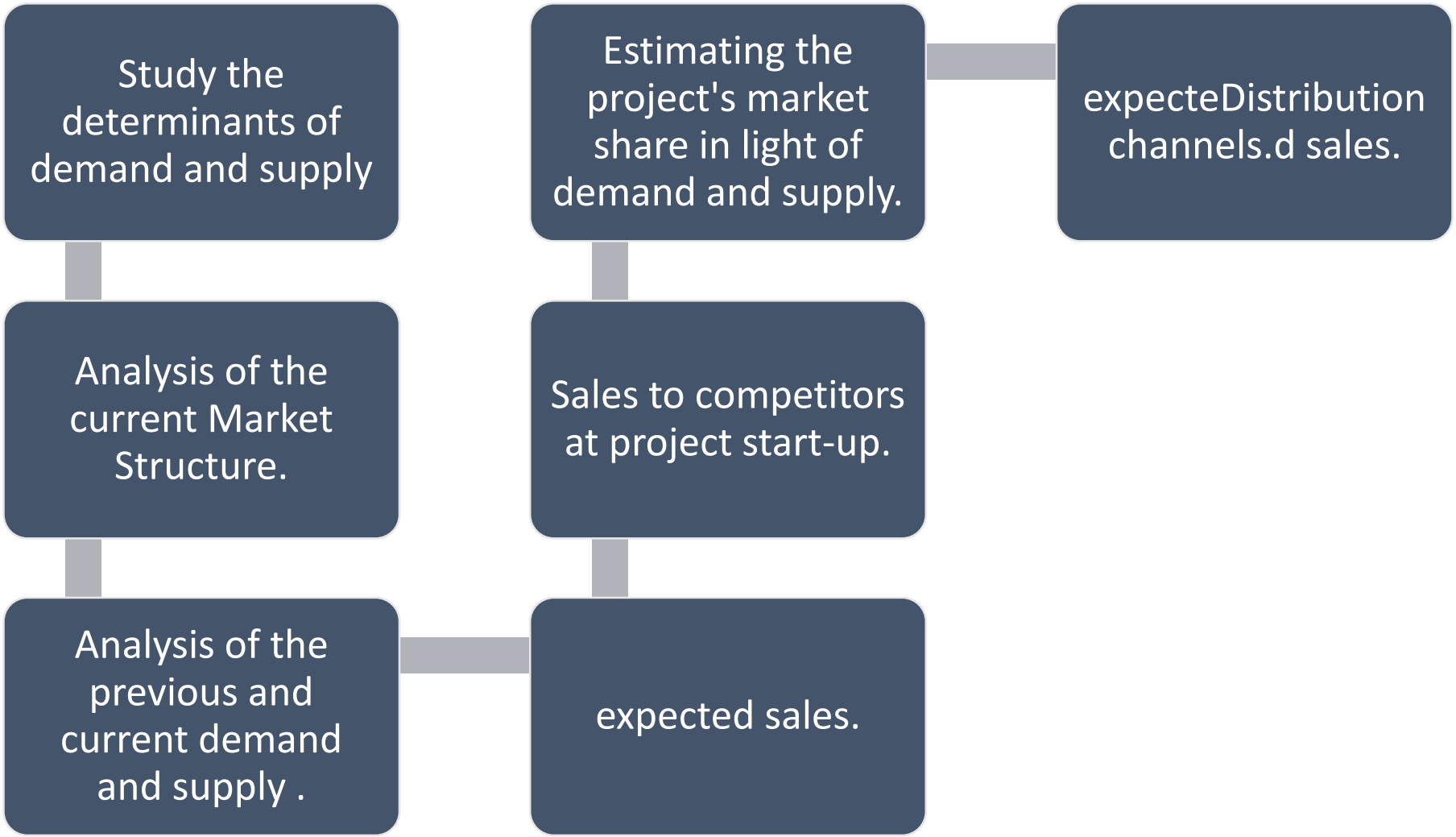
- **Resources of information collection for the initial feasibility study is done through: -**
- 1- Field Resources : Such as personal interviews with, possibility customers, government officials, room of commerce, and trade unions ... etc.
- 2- Office Resources: It is represented in data and statistics published by government agencies and agencies such as the Ministry of Planning, the Central Agency, the Statistics, and banks, in addition to scientific research.

what are the most important data and information required in the initial feasibility study:-



- **Third: The stage of the detailed study of the feasibility**
- **represented by:-**
- **1- Detailed market study**
- **Q/According to the market, for establishing any project depends on two basic things:-**
- -Existence of a local or international market for the selected good or service to be produced by the proposed project.
- -The ability of the proposed project to compete, whether local or foreign.

What is the detailed market feasibility study?



- An example :of a market study application:

- A person (A) is seriously thinking to implant 130 thousand dunams of the rice. If we assume that the total demand for the rice in Iraq is 11 million tons / year, and this quantity is distributed as follows:

- - The volume of local the rice production (total supply) = 4 million tons annually

- - The volume of import (gap size) of the rice = 7 million tons annually

- - A Dunum productivity of the rice = 3 tons / donum.

- **Required: What does the market study indicate for this project?**

- **The solution**

- **1- Total demand = volume of local production + volume of imports**

- Total order volume = 4 million + 7 million = 11 million tons

- **2- So the share of the proposed project to produce from the demand gap**

- If we look at the proposed project to grow 130 thousand dunams of the rice, and the productivity of a dunum of the rice = 3 tons / dunum.

- So (130) thousand dunums × (3) tons = 390 tons

- = $\frac{390{,}000}{11{,}000{,}000}$ *100 = 3.546 ≈ 3.6% representing the project's share of the demand gap

- **An example of a market study application:**

A person (D) seriously thought of establishing a project to produce 100 thousand tons of milk. If we assume that the total demand for milk in Iraq is 7 million tons / year, and this quantity is distributed as follows:

- - The volume of local milk production (total supply) = 2 million tons annually
- - The volume of import (gap size) of milk is 5 million tons annually
- - And the project's productivity of milk = 2 tons.
- **Required**: **What does the market study indicate for this project?**

- **Estimating future demand**

It is the rate of change in demand for production, by increase or decrease resulting from comparing two time periods.

-Rate of Change in Demand = $\frac{\text{current year sales}}{\text{previous year sale}}$

-Next Year Sales Volume = current year sales $\times$ rate of change in demand

-Average rate of change of demand = $\frac{\sum \text{ rates of change in demand a given period of times}}{\text{numberof rates of change in demand}}$

Example: The data in the below table sells a product for millions of dinars over 7 years in a project.

Watch number N	Years Xi	The amount of sales for a product in millions of dinars Yi
1	2016	65
2	2017	75
3	2018	95
4	2019	105
5	2020	125
6	2021	135
7	2022	145
8	2023	?

Requirement:

-What is the Rate of Change in Demand on the years?

-Estimate the amount of sales for 2023 ?

- What is the average sales change over 6 years ?

- **The solution**
- **-Estimate the amount of sales for 2023?**

-Rate of Change in Demand**2017** = $\frac{\text{current year sales}}{\text{previous year sale}} = \frac{75}{65} = 1.15$

Rate of Change in Demand**2018** = $\frac{95}{75} = 1.27$

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Rate of Change in Demand**2022** = $\frac{145}{135} = 1.07$

-Next Year Sales Volume = current year sales × rate of change in demand = $145 \times 1.07 = 155.15 \approx 155$

- What is the average sales change over 6 years?

$$\text{-Average rate of change of demand} = \frac{\sum \text{ rates of change in demand a given period of times}}{\text{numberof rates of change in demand}}$$

$$\text{Average rate of change of demand} = \frac{\sum 1.15+1.27+1.11+1.19+1.08+1.07}{6} = \frac{6.87}{6} = 1.145 \approx$$

1.15 is the average sales change over 6 years.

Watch number N	Years Xi	The amount of sales for a product in millions of dinars Yi	Rate of Change in Demand
1	2016	65	-
2	2017	75	1.15
3	2018	95	1.27
4	2019	105	1.11
5	2020	125	1.19
6	2021	135	1.08
7	2022	145	1.07
8	2023	**155**	-

Example: The data in the below table sells a product for millions of dinars over 9 years in a project.

Watch number N	Years Ri	The amount of sales for a product in millions of dinars Zi
1	2015	13
2	2016	33
3	2017	63
4	2018	83
5	2019	103
6	2020	106
7	2021	110
8	2022	113
9	2023	116
10	2024	?

Requirement:

-What is the Rate of Change in Demand on the years?

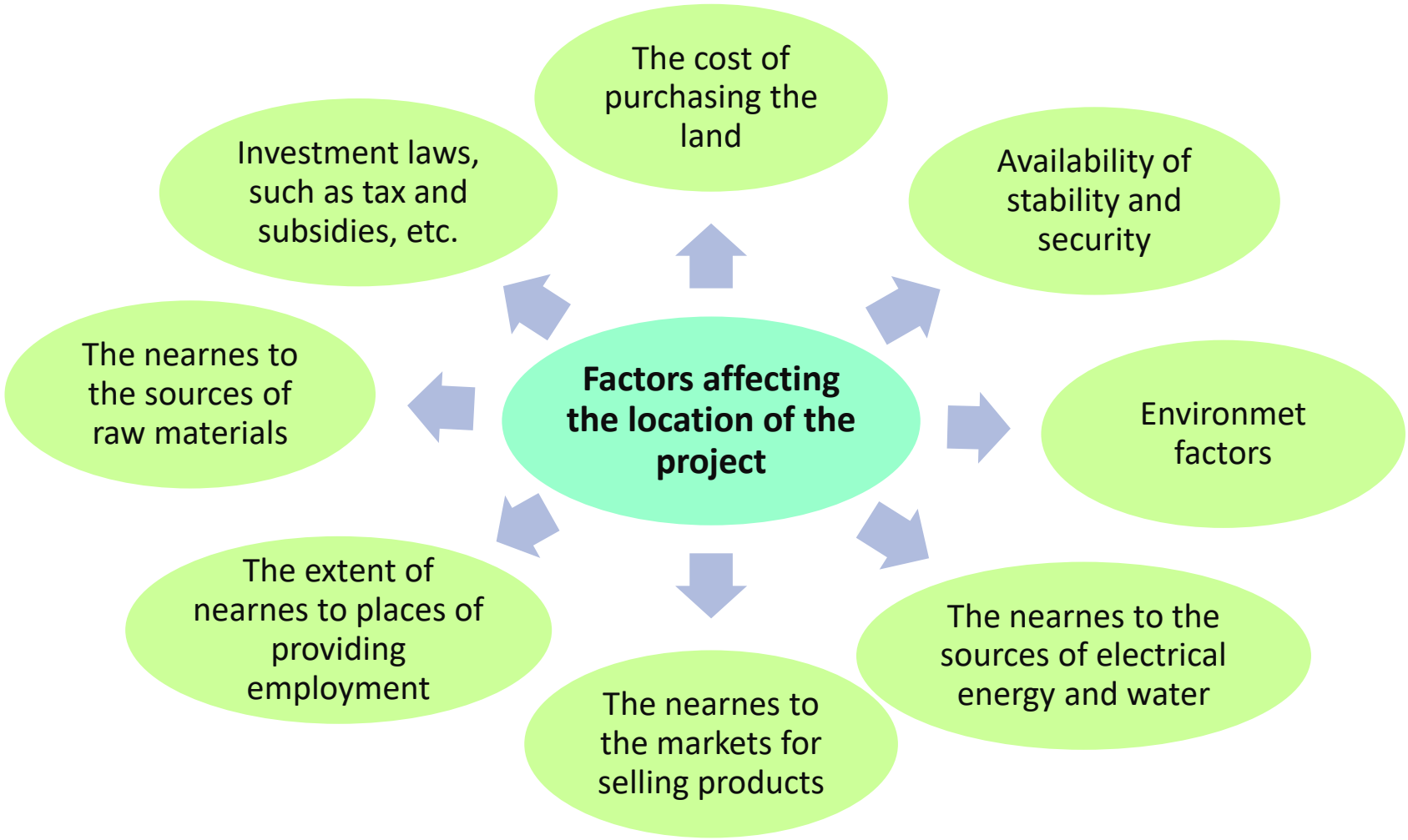
-Estimate the amount of sales for 2024?

- What is the average sales change over 8 years ?

- **2- The detailed study of the technical feasibility of the project**
- **represented by:**
- **A**-determine the size of the project
- **B**-determine the type of technological requirements for the project

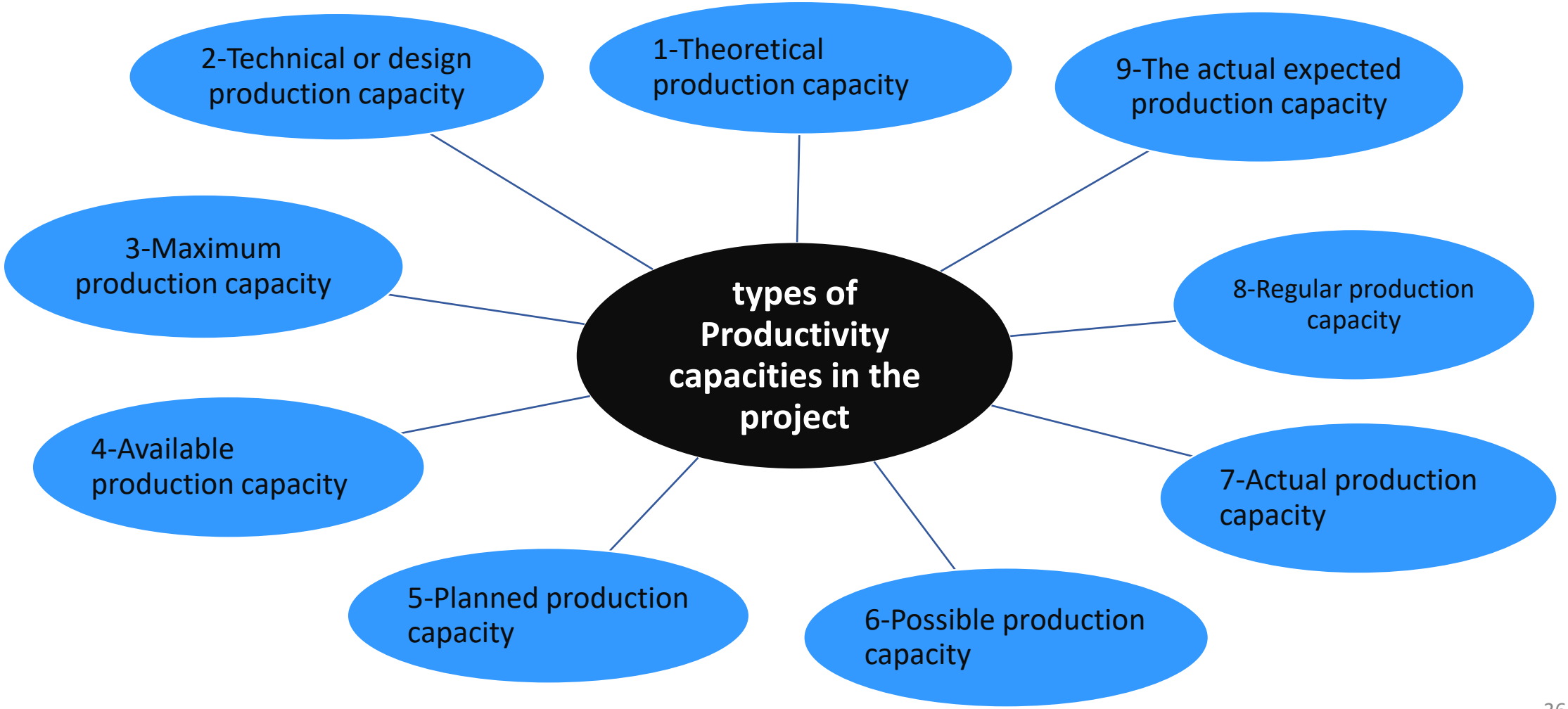
C-determine the location of the project

What are the factors affecting the location of the project?



D-determine the project's production capacity

what are they types of Productivity capacities in the project



- **3- A detailed study of the administrative and organizational of the project**

It is represented by: -

- - The general administrative structure of the project.
- -The financial structure of the project.
- -The technical structure of the project.
- **4- Detailed study of the economic feasibility of the project**

It is represented by: -

- -Determine project costs and revenues.
- -Evaluating the costs and revenues of the project in monetary units, for example (Dinars, Dollars, Euros...etc).
- - Determine the profitability of the project, whether it is economic or social.

Some sample questions for the first and second chapters for discussion

- What is the meaning of the Evaluation?

- -What are they definitions : Investment , The investment project , Investment activity , The investment program , The investment plan .

- - What is the Project?

- - Definition of the project feasibility study, and What the Importance of the feasibility study?

- -What are the stages of the feasibility study of projects in general and them graphically?

- -Explain the stages of preparing a feasibility study for projects.

- -What are the elements of the project?

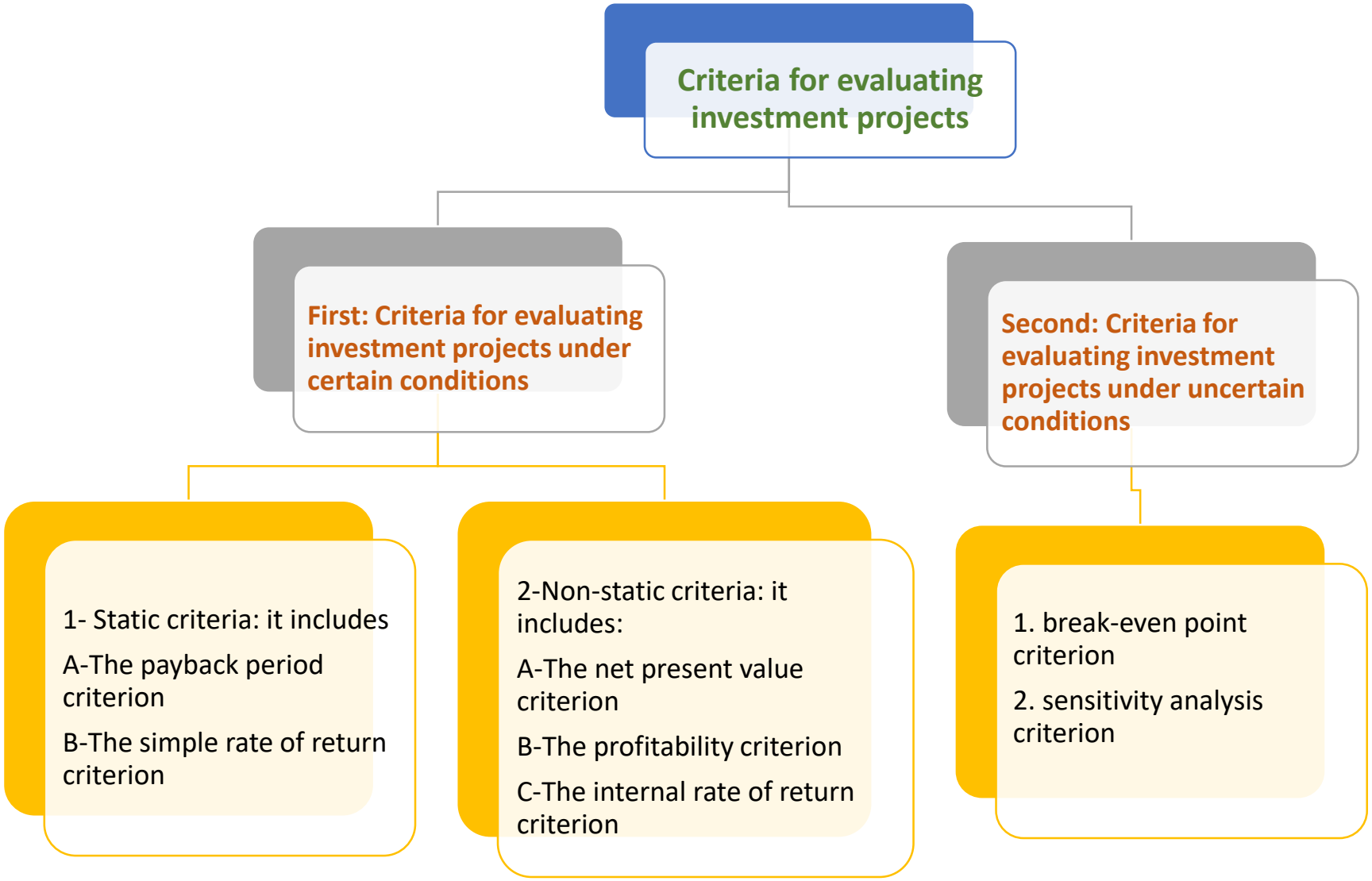
Some sample questions for the first and second chapters for discussion

- -What is the characteristics of an investment decision?
- -What do you the most important data and information required in the initial feasibility study ? and explain one of them.
- What are the factors affecting the location of the project?
- what are they types of Productivity capacities in the project
- Q/ Fill in the blanks below :
- 1----------is a meant idea that requires the allocation of a certain amount of resources in the hope of doing a certain amount of ---------- or ----------in the future.
- 2- Resources of information collection for the initial feasibility study is done through,---------- and----------.
- 3-The detailed market feasibility study by estimating the project's market share in light of ,---------- and ----------.

• Chapter Three

Evaluation criteria from the business profitability and national economic profitability

What are the Evaluation Criteria for business profitability?



- **Criteria for evaluating investment projects**

- Through these criteria, a universal study of all the apparent and implicit costs of the proposed investment project is conducted. This study helps to know the success of the project as well as its ability to cover all costs and goal a net profit margin that helps in its continuity. In general, there are a number of criteria for evaluating investment projects, namely:-

- **First: Criteria for evaluating investment projects under certain conditions**

- The idea of evaluating investment alternatives is based on comparing the expected cash flows for each alternative (project), then the project that goals the greatest return through cash flows is selected and in light of the conditions determined by the administration and the conditions of certainty. The criteria for evaluating investment projects under certain conditions are divided into:

1- Static criteria: They are criteria that do not take into account the time value of money, and include each of the criteria:

- **A/ criteria of the Payback Period:**

By this we mean the period of time required for the project to recover the investment costs that were spent on the project. The project that recovers its investment costs is chosen in the shortest possible period of time.

The basis for the investment decision according to the payback period criterion is as follows:

- If the payback period = the typical period, the project is acceptable.
- If the payback period (<) than the typical period, the project is acceptable.
- If the payback period (>) than the typical period, the project will be rejected.

- **There are two cases for calculating the payback period:**

1-In the case of equal cash flows, in which case the payback period is calculated by this formula:

$$\mathrm{PBP} = \frac{\mathrm{I}}{\mathrm{NCF}}$$

- whereas:
- PBP: Payback period
- I:Initial investment (investment costs)
- NFC: Net cash flow

- **Example**

The investment costs of the project were estimated at (135) monetary unit, and its net cash flows over 6 years were estimated at (60) monetary unit, knowing that the typical period is 4 years.

- **Required: Determine the payback period.**
- **The solution**
- $\mathrm{PBP} = \frac{\mathrm{I}}{\mathrm{NCF}} = \frac{135}{60} = 2.25 \approx 2.3$
- So we accept the establishment of the project, because the recovery period is less than the typical period.

- **Example**:

Suppose that there are two investment projects and the investment costs needed for each of them are 118 monetary unit, and the net cash flows of the first project are 34 monetary unit and the second is 14 monetary unit, bearing in mind that the typical period is 5 years.

- **Required: Determine which project is the best according to the payback period.**
- **The solution**
- The first project :$\mathrm{PBP} = \frac{\mathrm{I}}{\mathrm{NCF}} = \frac{118}{34} = 3.47 \approx 3.5$
- The second project :$\mathrm{PBP} = \frac{\mathrm{I}}{\mathrm{NCF}} = \frac{118}{14} = 8.43 \approx 8.4$
- So the first project is the best because the payback period is less than the typical period.

Example:

The investment costs of a project were estimated at 300 monetary unit, and its annual net cash flow over 5 years was 80 monetary unit, so what is the payback period for this project, knowing that the typical period is 4 years.

- Required: Determine the payback period.
- **Example:**

Suppose there are two investment projects and the investment costs needed for each of them are (180) monetary unit, and the net cash flows of the first project are 40 monetary unit and the second is 70 monetary unit, bearing in mind that the typical period is 5 years.

- Required: Determine which project is the best according to the payback period.

- 2- In the case of unequal cash flows, the payback period is calculated by one of two methods:

A/ In this case the payback period is equal to the number of years in which the accumulated total of the net annual cash flows achieved during them is equal to the project's investment flows, and the payback period is calculated by these equations:

$$\mathrm{Av} = \frac{\mathrm{TNCF}}{\mathrm{PL}}$$

Whereas:

Av : Average cash flow

TNCF :Total accumulated net cash flow

PL : Productivity Life of the project

$$\mathrm{PBP} = \frac{\mathrm{In}}{\mathrm{Av}}$$

Whereas:

PBP: Payback period

In : Investment costs

Av : Average cash flow

Example

An investment project whose cost was estimated at 756 monetary unit and the annual cash flows were as shown in the table below, Note that the typical period is 6 years.

the years	Net Cash flow
1	180
2	200
3	160
4	180
5	220

Required: Calculating the accumulated cash flows achieved by the project, specifying the payback period for investment costs.

- **The solution**

the years	Net Cash flow	**Accumulated cash flow (TNCF)**
1	180	180
2	200	380
3	160	540
4	180	720
5	220	940

- $\text{Av} = \frac{\text{TNCF}}{\text{PL}} = \frac{940}{5} = 188$
- $\text{PBP} = \frac{\text{In}}{\text{Av}} = \frac{756}{188} = 4.0$

So the project can recover the investment costs within 4 years, which is less than the typical period, so the project is accepted.

Example

An investment project whose cost was estimated at 924 monetary unit and the annual cash flows were as shown in the table below, bearing in mind that the typical period is 4 years

the years	Net Cash flow
1	170
2	210
3	195
4	175
5	180
6	190

Required: Calculating the accumulated cash flows achieved by the project, specifying the payback period for investment costs.

B/ In the case when the investment costs are different for a number of projects, as well as with unequal cash flows for them.

Example:

A service project wants to increase its production capacity due to the increased demand for its services, and after conducting several studies, the technical department has determined C, B, A projects that achieve their productivity goals, as follows:

projects	investment cost	NCF1	NCF2	NCF3	NCF4	NCF5	NCF6
A	67500	20000	22500	25000	17500	15000	10000
B	75000	22500	20000	17500	15000	12500	8750
C	68400	15000	15000	14500	12500	11400	10000

- **Required**: What is the project that the technical department will choose according to the criterion of the normal payback period, with an accurate time period for it?

The solution

- We calculate the normal payback period according to the total annual cash flows:

-Project A:**NCF1 +NCF2 +NCF3** = 20000 + 22500 + 25000 =67500

So, project A will be reimbursed at the end of the 3 year, so it will be chosen by the project's technical management.

-Project B: **NCF1 +NCF2 +NCF3 +NFC4** = 22500 + 20000 + 17500 + 15000 = 75000

So, project B will be reimbursed during the 4 year.

-Project C:**NCF1 +NCF2 +NCF3 + NCF4+ NCF5** = 15000 + 15000 + 14500 +12500 +11400=68400

So Project C will be reimbursed during the 5 year.

-We determine the time period for recovering the cost of the project:

- **Project A** , $\text{Av} = \frac{\text{TNCF}}{\text{PL}} = \frac{20000 + 22500 + 25000}{3} = 22500$
- **Project A** , $\text{PBP} = \frac{\text{In}}{\text{Av}} = \frac{67500}{22500} = 3\ years$
- **Project B**, $\text{Av} = \frac{\text{TNCF}}{\text{PL}} = \frac{22500 + 20000 + 17500 + 15000}{4} = 18750$
- **Project B** , $\text{PBP} = \frac{\text{In}}{\text{Av}} = \frac{75000}{18750} = 4\ years$
- **Project C** , $\text{Av} = \frac{\text{TNCF}}{\text{PL}} = \frac{15000 + 15000 + 14500 + 12500 + 11400}{5} = 13680$
- **Project C** , $\text{PBP} = \frac{\text{In}}{\text{Av}} = \frac{68400}{13680} = 5\ years$

So the technical management of the project will choose Project A because the payback period for investment costs is less compared to projects B and C.

Example:

A production project wants to increase its production capacity due to the increase in demand for its products. After conducting several studies, the technical department has determined C, B, A projects that achieve their production goals, as follows:

projects	investment cost	NCF1	NCF2	NCF3	NCF4	NCF5
A	54750	12000	14250	15875	12625	11750
B	38375	13250	13000	12125	11375	10875
C	20000	9500	10500	9625	10125	10500

- **Required**: What is the project that the technical department will choose according to the standard of the normal payback period, with an accurate time period for it?

Example:

In Table About four different projects, the payback period is as shown in the accounts in the table of life will choose whichever is different according to the economic assets?

Data	Project A	Project B	Project C	Project D
Investments	25000	25000	25000	25000
Average annual profit	3500	3500	3500	3500
Life of the project	6	5	8	10
Total profit	35000	25000	40000	50000
Payback period	3	3	3	3

The solution:

Seen from the above information that the project (D) is better because it:

1-The payback period is appropriate to recover investment costs.

2-It gives us more total profit compared to projects A, B and C.

3-The longevity of the project is more compared to the life of the other three projects A, B, and C.

Example:

In Table About three different projects, the payback period is as shown in the accounts in the table of life will choose whichever is different according to the economic assets?

Data	Project A	Project B	Project C
Investments	40000	40000	40000
Average annual profit	5000	5000	5000
Life of the project	13	9	6
Total profit	90000	66000	55000
Payback period	4	4	4

B /simple rate of return criterion

Definition of the simple rate of return : It is the ratio of the net profit of the proposed project compared to its initial estimated cost.

There are a number of ways to calculate the standard simple rate of return, which are:

1-The first method is the annual formula, which expresses the ratio of the annual net profit to the initial cost of the proposed project and is found according to the following equation:

$$\mathrm{SR} = \frac{Prod \sum (P - C)}{\mathrm{Ei}} \times 100$$

SR: simple rate of return.

Prod: The annual production volume of the project.

P:Price per unit of the product.

C: Cost per unit of the product.

Ei: Estimated initial costs of the proposed project.

The basis of the investment decision according to the simple rate of return criterion is as follows:

- **-**If the simple rate of return = the required investment rate of return, the project is acceptable.
- **-**If the simple rate of return (>) than the interest rate prevailing in commercial banks, then the project is acceptable.
- **-**If the simple rate of return (<) than the interest rate prevailing in commercial banks, then the project is rejected.

Example:

If the initial cost of the proposed project is estimated at (150) monetary units, and the annual production volume of the proposed project is estimated at (70) production units, and the price of one unit of the product has been estimated at (0.6) monetary units, and the total cost of one unit is (0.4) units cash.

Required: Do you recommend establishing the project or not according to the simple rate of return criterion, and if you know that the interest rate prevailing in commercial banks is (7%).

The solution

$$\mathrm{SR} = \frac{Prod \sum(P-C)}{\mathrm{Ei}} \times 100$$

$$\mathrm{SR} = \frac{70 \sum(0.6-0.4)}{150} \times 100 = \%9.33 \approx \%9$$

Since the simple rate of return, which is equal to (9%), which is greater than the interest rate prevailing in commercial banks, therefore it is recommended to accept the proposed project.

- **Example:**

If the initial cost of the proposed project is estimated at (350) monetary units, and the annual production volume of the proposed project is estimated at (150) production units, and the price of one unit of the product has been estimated at (0.7) monetary units, and the total cost of one unit is (0.5) units cash.

Required: Do you recommend establishing the project or not according to the simple rate of return criterion, and if you know that the interest rate prevailing in commercial banks is (11%).

2- The second way to estimate a simple yield rate, this method is more actually from the first method and is rely on the following equation:

$$\mathrm{SR} = \frac{\sum Prod_i \, (P_i - C_i)}{\mathrm{N}} \div Ei \times 100$$

whereas:

$Prod_i$: The volume of production for the project every year of the age of the project(i).

P_i : The price of one unit every year of the age of the project (i).

C_i : The cost of one unit every year of the age of the project (i).

N: Number of years of age the project.

E_i : The initial costs of the proposed project (i).

Example

If we impose that the amount of production, prices and estimated costs of the proposed projects are as explained in the table below, and the project is expected for 5 years, and the initial cost of the project is (71,429) monetary units.

the years	production volume	Price per unit	cost per unit
1	57143	0.55	0.48
2	71429	0.53	0.45
3	92857	0.50	0.40
4	107143	0.48	0.35
5	117857	0.48	0.33

Required: Find a simple return rate for the project, make a decision on accepting or rejecting the project, if they learned that interest rate prevailing in commercial banks (11%).

- **The solution**
- $\mathrm{SR} = \frac{\sum Prod_i\,(P_i - C_i)}{\mathrm{N}} \div Ei \times 100$

the years	production volume	Price per unit	cost per unit	$\sum Prod_i\,(P_i - C_i)$
1	57143	0.55	0.48	4000
2	71429	0.53	0.45	5714
3	92857	0.50	0.40	9286
4	107143	0.48	0.35	13929
5	117857	0.48	0.33	17679
			Total	**50,608**

- $\mathrm{SR} = \frac{\sum 57143\,(0.55-0.48)+71429\,(0.53-0.45)+92857\,(0.50-0.40)+107143\,(0.48-0.35)+117857\,(0.48-0.33)}{5} \div 71429 \times 100$
- $\mathrm{SR} = \frac{50600}{5} \div 71429 = 10121.6 \div 71429 \times 100 = 14.17 \approx \%14$

Because the rate of simple yield is greater than the prevailing interest rate in the market so recommends to accept the project.

Example:

If we impose that the amount of production, prices and estimated costs of the proposed projects are as explained in the table below, and the project is expected to continue for 6 years. and the initial cost of the project is (114,286) monetary units.

the years	production volume	Price per unit	cost per unit
1	54133	1.55	0.975
2	67467	1.53	0.95
3	87467	1.50	0.9
4	100800	1.48	0.85
5	110800	1.45	0.83
6	116800	1.45	0.82

Required: Find a simple return rate for the project, make a decision on accepting or rejecting the project, if you know that the interest rate in commercial banks is 17%.

- **Example**

We have three different projects and the information related to each project is shown in the table below:

Information	Project 1	Project 2	Project 3
Investment cost	7000	12500	15000
residual value	3000	2500	3000
accumulative cash flows	10000 over 4 years	12500 over 5 years	9000 over 6 years

- Required:Calculate the simple return rate for each project , Choosing the best project from among the three projects.

- **The solution:**
- $\text{SR} = \frac{\sum NCF}{N} \div \frac{Ei+VR}{2} \times 100$

Where: (VR) represents the residual value of the investment.

- $S\text{R project } 1 = \frac{10000}{4} \div \frac{7000+3000}{2} \times 100 = 2500 \div 5000 \times 100 = \%50$
- $S\text{R project } 2 = \frac{12500}{5} \div \frac{12500+2500}{2} \times 100 = 2500 \div 7500 \times 100 = \%33.33$
- $S\text{R project } 3 = \frac{9000}{6} \div \frac{15000+3000}{2} \times 100 = 1500 \div 9000 \times 100 = \%16.67$

So the first project is the best among the third projects because it achieves the highest rate of return.

Example:

We have two different projects and the information related to each project is shown in the table below

Information	Project A	Project B
Investment cost	13500	18500
residual value	4000	3000
accumulative cash flows	15000 over 5 years	21,000 over 7 years

Required:Calculate the simple return rate for each project , Choosing the best project from among the two projects.

2-Non-static criteria: They are criteria that take into account the time value of money, meaning that the value of the monetary unit is not fixed and changes over the life of the project. These criteria include (the net present value criterion, the profitability criterion and the internal rate of return criterion). So the general principles of these standards are:-

First:The concept of the time value of money : It is known that the value of the monetary unit varies according to the time in which it is achieved, as the value of money that can be obtained in the future will be equal to a value less than money at the present time, and this is called the term time value of money, and this is caused by the following reasons:

A. The effect of the inflation rate on the value of money.

B. The difference or mismatch between the dates of realization of cash flows, as the cash flows are distributed over several years.

To avoid these problems, we calculate the value of the expected future cash flows during the life of the project and return them to year 0 or the beginning of the first year, which is the initial investment costs.

Second: the concept of interest rate and discount rate:-

1- The interest rate: It is the future value that is payable after depositing a sum of money with a bank. The interest rate is calculated according to this equation:

$$\mathbf{A} = \mathrm{P}(1 + i)^n$$

whereas:

- A: Represents the amount to be paid by the bank to a person who deposited the amount after n years.
- P: represents the amount that has been deposited in the bank at the present time.
- i: represents the interest rate prevailing at the banks.
- n: the number of years the amount was deposited with the bank.

2- Discount rate:

In order to return the value of all cash flows of the expected revenues and costs of an investment project to the starting point (the time of appraisal) they are discounted to use the discount rate.

The discount rate can be defined as the present value of the cash flow per monetary unit at the end of a number of future years (n) at an interest rate (i).

The discount rate is the opposite process of the interest rate process, if the discount rate is calculated according to this equation:

$$\mathbf{Sn} = \frac{1}{(1+ i)\ n}$$

whereas:

- Sn: the discount rate.
- i: the interest rate prevailing at the banks.
- The value of a monetary unit after a number of future years and at an interest rate.

A/ Net present value criterion

The net present value is the difference between the sum of the present values of the investment cash flows of the project and the sum of the present values of the net annual cash flows during the life of the project.

Or

The net present value also means the difference between the present value of cash inflows or revenues and the present value of cash outflows or costs.

The net present value criterion can be clarified according to the following equation:

$$\mathbf{NPV} = \sum S_n \times Q_t(P_t - C_t) - \mathrm{E}$$

whereas:

Q_t : the production volume of the project in a years.

P_t : the unit price in a year.

C_t : the unit cost in a year .

S_n : discount rate

n : years.

E: the estimated initial costs of the proposed project.

The basis of the investment decision according to the NPV criterion is as follows:-

- If the NPV = 0, which means that the realized return equals only the applicable discount rate, and therefore it is better for the investor to lend his money than to expose it to risk.

-If the NPV is positive, which means that the project achieves a rate of return greater (>)than the discount rate.

- If the NPV is negative, which means that the project achieves a rate of return less (<)than the discount rate.

Example : If we have three projects(A), (B) and (C).

Project A		Project B		Project C	
Costs monetary units	Returns monetary units	Costs monetary units	Returns monetary units	Costs monetary units	Returns monetary units
7638	9651	4937	5876	3432	7000

Required : Calculate the net return and which project is better.

The solution:

Net Return= Return – Cost

Net Return the Project A=9651-7638=2013 monetary units. (Positive value)

Net Return the Project B= 5876-4937 =939 monetary units. (Positive value)

Net Return the Project C= 7000-3432 =3568 monetary units. (Positive value)

So we will choose Project C for the following reasons:

1- We note that all three projects are positive.

It is noted that the net return for project C is (3568) monetary unit, which is greater than the net return for projects A and B and reach's (2013) monetary unit and (939) monetary unit, respectively.

Example : If we have two projects(A) and (B).

Project A		Project B	
Costs monetary units	Returns monetary units	Costs monetary units	Returns monetary units
8996	15849	13680	18009

Required :Calculate the net return and which project is better.

Example:

Indeed, data from the initial costs project (49,182) monetary union and a life expectancy of 8 years and a interest rate (7%).

Years	Production size (Qt) monetary unit	unit price (Pt) monetary unit	unit cost (Ct) monetary unit
1	12500	2	1.50
2	16250	2	1.48
3	22500	1.88	1.42
4	31250	1.71	1.31
5	33750	1.58	1.24
6	36250	1.50	1.17
7	38750	1.47	1.13
8	47500	1.47	1.13

- **Required:**

-Calculate the expected net present value of the project.

-will the project achieve a net rate of return greater or less than the discount rate.

The solution:

1- Calculate the expected net present value of the project: $\mathbf{NPV} = \sum \mathrm{Sn} \times \mathrm{Q}t(\mathrm{P}t - \mathrm{C}t) - E$

Years	Production size (Qt) monetary unit	unit price (Pt) monetary unit	Unit cost (Ct) monetary unit	Discount factor when the discount rate (7%) (Sn)	Qt(Pt-Ct)	$\sum \mathbf{Sn} \times \mathbf{Q}t(\mathbf{P}t - \mathbf{C}t)$
1	12500	2	1.50	0.935	6250	5844
2	16250	2	1.48	0.873	8450	7377
3	22500	1.88	1.42	0.816	10350	8446
4	31250	1.71	1.31	0.763	12500	9538
5	33750	1.58	1.24	0.713	11475	8182
6	36250	1.50	1.17	0.666	11963	7967
7	38750	1.47	1.13	0.623	13175	8208
8	47500	1.47	1.13	0.582	16150	9399
					Total	**64961**

Discount factor when the discount rate

$$\mathbf{Sn} = \frac{1}{(1+\mathrm{i})\ \mathrm{n}} = \frac{1}{(1+0.07)\ \hat{}1} = 0.935$$

NPV=64961 – 49182= **15779** monetary unit

So If the project is expected to achieve a positive rate of return estimated (15779) monetary unit .

2- The rate of return of the project is greater than the discount rate, if the proposed project is accepted.

Example:

Indeed, data from the initial costs project (701,938) monetary union and a life expectancy of 6 years and a interest rate (5%).

Years	Production size (Qt) monetary unit	unit price (Pt) monetary unit	unit cost (Ct) monetary unit
1	25550	2.50	2
2	29300	3	1.98
3	35550	2.93	1.89
4	44300	2.81	1.77
5	46800	2.77	2.74
6	49300	2.77	1.65

- **Required:**

-Calculate the expected net present value of the project.

-will the project achieve a net rate of return greater or less than the discount rate.

The solution:

1- Calculate the expected net present value of the project: $\mathbf{NPV} = \sum \mathrm{Sn} \times \mathrm{Q}t(\mathrm{P}t - \mathrm{C}t) - E$

Years	Production size (Qt) monetary unit	unit price (Pt) monetary unit	Unit cost (Ct) monetary unit	Discount factor when the discount rate (5%) (Sn)	Qt(Pt-Ct)	$\sum \mathbf{Sn} \times \mathbf{Q}t(\mathbf{P}t - \mathbf{C}t)$
1	25550	2.50	2	0.952	12775	12162
2	29300	3	1.98	0.907	29885	27106
3	35550	2.93	1.89	0.864	36971	31943
4	44300	2.81	1.77	0.823	46071	37917
5	46800	2.77	2.74	0.784	1404	1101
6	49300	2.77	1.65	0.746	55215	41191
					Total	**151,419**

Discount factor when the discount rate

$$\mathbf{Sn} = \frac{1}{(1+\mathrm{i})\ \mathrm{n}} = \frac{1}{(1+0.05)\ \hat{}1} = 0.952$$

NPV=151419 – 701938= -**550519** monetary unit

So If the project is expected to achieve a negative rate of return estimated(- 550519) monetary unit .

2- The rate of return of the project is less than the discount rate, if the proposed project is rejected.

Example:

Indeed, data from the initial costs project (381,365) monetary union and a life expectancy of 6 years and a interest rate (8%).

Years	Production size (Qt) monetary unit	unit price (Pt) monetary unit	unit cost (Ct) monetary unit
1	99152	1.50	1
2	10102	1.50	0.99
3	10415	1.47	0.98
4	10852	1.44	0.97
5	10977	1.30	0.95
6	11102	1.30	0.95

- **Required:**

-Calculate the expected net present value of the project.

-will the project achieve a net rate of return greater or less than the discount rate.

Calculating the net present value in the event that there is a residual value of the investment at the end of the period, and it is calculated according to this equation:

- $\mathbf{NPV} = \sum \mathrm{Sn} \times \mathrm{Q}t(\mathrm{P}t - \mathrm{C}t) \ + VR - E$

Where: VR , is the residual value of the investment at the end of the period.

Example:

Indeed, data from the initial costs project (94,913) monetary union and a life expectancy of 7 years and a interest rate (4%) , the residual value of the investment was estimated at (25,000) monetary units at the end of the life of the project.

Years	Production size (Qt) monetary unit	unit price (Pt) monetary unit	unit cost (Ct) monetary unit
1	21111	1.50	1
2	21667	1.99	0.99
3	23444	1.48	0.98
4	23889	1.43	0.81
5	25333	1.27	0.74
6	37111	1.19	0.67
7	42222	1.19	0.67

- **Required:**

-Calculate the expected net present value of the project , With the residual value of the investment also calculated>

-will the project achieve a net rate of return greater or less than the discount rate.

The solution:

1- Calculate the expected net present value of the project: $\mathbf{NPV} = \sum \mathrm{Sn} \times \mathrm{Q}t(\mathrm{P}t - \mathrm{C}t) + VR - E$

Years	Production size (Qt) monetary unit	unit price (Pt) monetary unit	Unit cost (Ct) monetary unit	Discount factor when the discount rate (4%) (Sn)	Qt(Pt-Ct)	$\sum \mathbf{Sn} \times \mathbf{Q}t(\mathbf{P}t - \mathbf{C}t)$
1	21111	1.50	1	0.962	10556	10154
2	21667	1.99	0.99	0.925	21667	20042
3	23444	1.48	0.98	0.889	11722	10421
4	23889	1.43	0.81	0.855	14811	12664
5	25333	1.27	0.74	0.822	13427	11037
6	37111	1.19	0.67	0.790	19298	15245
7	42222	1.19	0.67	0.760	21956	16686
					Total	**96249**

Discount factor when the discount rate

$$\mathbf{Sn} = \frac{1}{(1+\mathrm{i})\ \mathrm{n}} = \frac{1}{(1+0.04)\ \hat{}1} = 0.962$$

NPV=96249 +(0.760 X 25000) – 94913= 96249 +19000- 94913 = **20336** monetary unit

So If the project is expected to achieve a positive rate of return estimated (20336) monetary unit .

2- The rate of return of the project is greater than the discount rate, if the proposed project is accepted.

Example:

Indeed, data from the initial costs project (294800) monetary union and a life expectancy of 6 years and a interest rate (9%) , the residual value of the investment was estimated at (117889) monetary units at the end of the life of the project.

Years	Production size (Qt) monetary unit	unit price (Pt) monetary unit	unit cost (Ct) monetary unit
1	39784	2.50	1.50
2	40340	2.41	1.595
3	42117	2.40	1.58
4	42564	2.11	1.41
5	44009	2	1.06
6	55789	2	1.06

- **Required:**

-Calculate the expected net present value of the project , With the residual value of the investment also calculated>

-will the project achieve a net rate of return greater or less than the discount rate.

Example :

We have four costs for each project (2500) monetary unit and the Return of each of them equally and equal to (4200)monetary unit, the project life adult (6 years) each.

years	Project A	Project B	Project C	Project D
1	950	850	780	900
2	800	790	755	860
3	800	750	690	720
4	600	690	686	684
5	550	580	675	532
6	500	540	614	504
Total	**4200**	**4200**	**4200**	**4200**

- **Required:** What is the best project at a interest rate (6%).

The solution:

years	Project A	Project B	Project C	Project D	The present value of the monetary unit at discount rate 6%	Project A The present value of the monetary unit	Project B The present value of the monetary unit	Project C The present value of the monetary unit	Project D The present value of the monetary unit
1	950	850	780	900	0.943	896	802	736	849
2	800	790	755	860	0.890	712	703	672	765
3	800	750	690	720	0.840	672	630	580	605
4	600	690	686	684	0.792	475	546	543	542
5	550	580	675	532	0.747	411	433	504	397
6	500	540	614	504	0.705	353	381	433	355
Total	**4200**	**4200**	**4200**	**4200**		**3518**	**3495**	**3467**	**3513**

The present value of the monetary unit at discount rate $Sn = \frac{1}{(1+ i)\ n} = \frac{1}{(1+ 0.6)\ ^1} = 0.943$

And after subtracting the cost (2500) monetary unit for each of them will get:

-**Project A** :3518 - 2500 = **1018**

-**Project B**:3495 - 2500 = **995**

-Project C :3467 - 2500 = **967**

-Project D :3513 - 2500 = **1013**

This is the project A will be the best .

Example :

We have three cost of each project (2500) monetary unit and the Return of each of them equally and equal to (5926) monetary unit , the project life adult (7 years) each.

years	Project A	Project B	Project C
1	900	950	890
2	875	940	884
3	850	901	875
4	844	878	868
5	825	804	820
6	818	754	797
7	815	700	794
Total	**5926**	**5926**	**5926**

- **Required:** What is the best project at a interest rate (8%).

Example

If you have the following data from the three projects (A-B-C).

the details	Project A	Project B	Project C
The investment cost of the project	20000	25000	19000
The useful life	7 years	5 years	8 years
Annual net revenue	6000	8000	5000

- **Knowing that:**

  1. the cost of the initial investment paid a single payment for the projects (A & C).

  2. Pay the initial cost of investment in two equal installments, the first when incorporation and the second in two years for the project (B).

  3. The interest rate is the prevailing (4%).

- **Required:** Which projects is a best way by the net present value?

The solution:

The project (A):

1. The present value of the cost for the project (investment cost) is 20000 the monetary unit pays for it all at once.

2. The present value of the monetary unit at discount rate

$$Sn = \frac{1}{(1+ i)\ n}$$

3.Net Present Value = sum of discounted revenues - total discounted costs

= 36018 - 20000 = **16018** monetary unit

Project A			
years	**Annual net revenue**	**discount rate 4%**	**The present value of the monetary unit at discount rate 4%**
1	6000	0.962	5772
2	6000	0.925	5550
3	6000	0.889	5334
4	6000	0.855	5130
5	6000	0.822	4932
6	6000	0.790	4740
7	6000	0.760	4560
		Total	**36018**

- **The solution:**

- The project (B):
  1-extract discounted investment cost.
  a-12500 monetary unit for the first installment not discounting to drive it in the course of incorporation.

b- but we are discounting the second installment, which shot just after two years at a discount rate (4%)

and we will get:

B-second installment: $\frac{25000}{2}$ =12500

12500 × 0.925 = **11563**monetary unit

Total investment cost is discounted:

12500 + 11563 = **24063** current value of the investment

2. The present value of the monetary unit at discount rate $Sn=\frac{1}{(1+i)\ n}$

3.Net Present Value = sum of discounted revenues - total discounted costs

= 35624 - 24063 = **11561** monetary unit

Project B			
years	**Annual net revenue**	**discount rate 4%**	**The present value of the monetary unit at discount rate 4%**
1	8000	0.962	7696
2	8000	0.925	7400
3	8000	0.889	7112
4	8000	0.855	6840
5	8000	0.822	6576
		Total	**35624**

- **The solution:**

  The project (C):

1.The present value of the cost for the project (investment cost) is 19000 the monetary unit pays for it all at once.

2. The present value of the monetary unit at discount rate

$$Sn = \frac{1}{(1+i)^n}$$

3.Net Present Value = sum of discounted revenues - total discounted costs

= 33670 - 19000 = **14670** monetary unit

If we choose project A because it achieves the highest net present value(16018) compared to the other two projects B and C (11561)(&(14670) respectively.

Project C			
years	**Annual net revenue**	**discount rate 4%**	**The present value of the monetary unit at discount rate 4%**
1	5000	0.962	4810
2	5000	0.925	4625
3	5000	0.889	4445
4	5000	0.855	4275
5	5000	0.822	4110
6	5000	0.790	3950
7	5000	0.760	3800
8	5000	0.731	3655
		Total	**33670**

Example

If you have the following data from the two projects (A and B).

the details	Project A	Project B
The investment cost of the project	11000	17000
The useful life	3years	5 years
Annual net revenue	3500	6800

- **Knowing that:**

1. Pay the initial cost of investment in two equal installments, the first when incorporation and the second in two years for the project (A).

2. the cost of the initial investment paid a single payment for the projects (B).

3. The interest rate is the prevailing (9%) (Prevailing interest rate).

- **Required:** Which projects is a better way by the net present value?

B/The profitability criterion

This standard deals with the time value of money. The point of difference between it and the present value criterion, if the present value criterion determines the net return of the invested monetary unit, while the profitability guide criterion determines the total return of the invested monetary unit.

The profitability criterion is divided into:

1- Profitability guide.

2- Business Profitability

3- Profitability rate

4- Capital turnover rate.

5-Basis of Calculating Depreciation

The base of the investment decision according to the profitability criterion is as follows:

- -If the profitability criterion = 0 , the project is considered acceptable.
- -If the profitability criterion is (>) 1 , the project is considered acceptable.
- -If the profitability criterion is (<) 0 , the project is considered rejected.

1- Profitability guide

The profitability guide is calculated according to the following equation:

$$\mathbf{IP} = \frac{\sum \mathrm{Sn} \times \mathrm{CF}}{\mathrm{Ei}}$$

whereas:

IP: Profitability guide .

Sn: discount rate.

CF: cash flows.

Ei: the investment costs project.

Example

If we have two investment projects (A) and (B), and their investment costs are estimated at (100,000) monetary unit and (130,000) monetary unit, respectively, the interest rate was 14%, the cash flows for both projects were as shown in the table below during 5 years

Years	Project A	Project B
1	25000	10000
2	10000	50000
3	30000	40000
4	40000	60000
5	70000	80000

Required: Determine which project is best using the profitability guide.

The solution:

$$IP = \frac{\sum Sn \times CF}{Ei}$$

$$Sn = \frac{1}{(1+i)\ n} = \frac{1}{(1+0.14)\ ^1} = 0.877$$

$$IP \text{ Project A} = \frac{109875}{100000} = 1.10$$

$$IP \text{ Project B} = \frac{151260}{130000} = 1.16$$

years	Project A (CF)	Project B (CF)	discount rate % 14 Sn	Present value of project cash flows A $\sum Sn \times CF$	Present value of project cash flows B $\sum Sn \times CF$
1	25000	10000	0.877	21925	8770
2	10000	50000	0.769	7690	38450
3	30000	40000	0.675	20250	27000
4	40000	60000	0.592	23680	35520
5	70000	80000	0.519	36330	41520
			Total	**109875**	**151260**

So project B is best than project A , because the profitability guide value of project B is greater than project A.

Example

If we have two investment projects (A) and (B), and their investment costs are estimated at (120,000) monetary unit and (160,000) monetary unit, respectively, the interest rate was 17 %, the cash flows for both projects were as shown in the table below during 6 years

Years	Project A	Project B
1	40894	23658
2	25894	63658
3	45894	53658
4	55894	73658
5	85894	93658
6	95894	96658

Required: Determine which project is best using the profitability guide.

2-Business Profitability

The business profitability is calculated according to the following equation:

$$\mathbf{BP} = \frac{\mathbf{ANPF}}{\mathbf{TC}} \times \mathbf{100}$$

whereas:

BP : business profitability .

ANPF: The annual net profit forecast.

TC: Total capital.

Example

Below four projects (A-B-C-D) specific to each project and information.

Sequence	Data	Project A	Project B	Project C	Project D
1	Annual discount rate	6%	6%	6%	6%
2	Annual output value	850	1200	600	1400
3	Taxes and other expenses	210	900	90	589
4	The annual net profit forecast	70	50	40	80
5	Annual costs	900	1567	490	573
6	Fixed capital	600	860	950	639
7	Working capital (variable)	30	50	70	20

Required: -

What is the order of the project in terms of business profitability?

$$\mathbf{BP = \frac{ANPF}{TC} \times 100}$$

Solution:

Total capital =Fixed capital + Working capital (variable)

Total capital project A = 600 + 30 =630

Total capital project B = 860 + 50 =910

Total capital project C = 950 + 70 =1020

Total capital project D= 639 + 20 =659

project A $= \frac{70}{630}$ ×100 = % 11

Project B$= \frac{50}{910}$ ×100 = % 5

project C $= \frac{40}{1020}$ ×100 = % 4

project D $= \frac{80}{659}$ ×100 = % 12

If we choose Project D because it achieves the highest business profitability compared to other projects.

Example

Below three projects (A-B-C) specific to each project and information.

Sequence	Data	Project A	Project B	Project C
1	Annual discount rate	7%	7%	7%
2	Annual output value	958	900	439
3	Taxes and other expenses	440	548	70
4	The annual net profit forecast	90	40	30
5	Annual costs	1100	1300	283
6	Fixed capital	900	860	764
7	Working capital (variable)	50	30	20

Required: -

What is the order of the project in terms of business profitability?

3-Profitability rate

The profitability rate is calculated according to the following equation:

$$\mathbf{PR} = \frac{\mathbf{NAI}}{\mathbf{FC}} \times \mathbf{100}$$

whereas:

PR : Profitability rate .

NAI :Net annual income.

FC: Fixed capital.

Example

Below are four projects (A-B-C-D) and information for each project?

Sequence	data	Project A	Project B	Project C	Project D
1	**Fixed capital**	275	500	320	400
2	**The annual income**	40	76	54	55
3	**Expenses**	13	19	16	20
4	**Net annual income**	27	55	44	50

- **Required:** What is the order of the project in terms of profitability rate?

Solution:

$$\mathbf{PR = \frac{NAI}{FC} \times 100}$$

project A $= \frac{27}{275}$ ×100 = % 10

Project B$= \frac{55}{500}$ ×100 = % 11

project C $= \frac{44}{320}$ ×100 = % 13

project D $= \frac{50}{400}$ ×100 = % 12.5

If we choose Project C because it achieves the highest profitability rate compared to other projects.

Example

Below are three projects (A-B-C) and information for each project?

Sequence	data	Project A	Project B	Project C
1	Fixed capital	198	253	260
2	The annual income	77	53	69
3	Expenses	18	14	22
4	Net annual income	35	41	37

- **Required:** What is the order of the project in terms of profitability rate?

4-capital turnover rate

It is the ratio between the annual output value of the project and the capital. This ratio (the speed of capital turnover) reflects the project's ability to achieve profits without the need to estimate or calculate the profit.

The capital turnover rate is calculated according to the following equation:

$$\mathrm{CTR} = \frac{OV}{\mathrm{TC}}$$

whereas:

CTR : capital turnover rate .

NAI :Output Value.

TC: Total capital.

Note: Select the project that achieves the highest capital turnover rate .

Example

Below are four projects (A-B-C-D) and the information for each project required is the order of the project in terms of the rate of turnover of capital?

Sequence	data	Project A	Project B	Project C	Project D
1	**Total capital**	200	900	180	300
2	**Output value**	600	1800	1600	1300

Solution:

$$\text{CTR} = \frac{OV}{\text{TC}}$$

project A $= \frac{600}{200}$ = 3 Third

Project B$= \frac{1800}{900}$ = 2 Fourth

project C $= \frac{1600}{180}$ = 9 First

project D $= \frac{1300}{300}$ = 4 Second

Sequence	data	Project A	Project B	Project C	Project D
1	**Total capital**	200	900	180	300
2	**Output value**	600	1800	1600	1300
3	**Capital turnover**	**3**	**2**	**9**	**4**
4	**Arrange for projects upon selection**	**Third**	**Fourth**	**First**	**Second**

If we choose Project C because it achieves the highest capital turnover rate compared to other projects.

Example

Below are three projects (A-B-C) and the information for each project required is the order of the project in terms of the rate of turnover of capital?

Sequence	data	Project A	Project B	Project C
1	**Total capital**	300	500	700
2	**Output value**	5854	3430	2500

5-Basis of Calculating Depreciation

depreciation of assets of an accounting charge carried at the expense of profits and losses and reflects the use of assets and the depreciation of their value as a result of such use or statute of limitations in order to reach the figure reflects profits as a reflection of the truth.

Depreciation is calculated in many different ways, but the most important and most common are:

1- Fixed-line method:

Depreciation is calculated on the basis of a fixed percentage of the original value during its economic life as in the following equation:

$$D=\frac{C-S}{N}$$

Whereas:

D =Annual depreciation premium.

C = initial value of the origin.

S = The value of the ruins(rubble).

N = the economic age of the original.

Example :

Assuming that project (D)bought a machine for $ 23,000, the useful life of this machine is 5 years, while the asset's residual value at the end of its useful life is estimated at $ 3,000.

Required: Estimating the Annual depreciation premium of the machine .

The solution:

$$\textbf{Annual depreciation premium(D)} = \frac{\mathbf{C - S}}{\mathbf{N}} = \frac{23000 - 3000}{5} = 4000\ \$$$

So the annual loss of the machine is 4000 $.

Example

Assuming that project (A) bought a machine for $9000, the useful life of this machine is 3 years, while the asset's residual value at the end of its useful life is estimated at $ 2100.

Required: Estimating the Annual depreciation premium of the machine .

2-The reduced installment method:

Depreciation under this method is calculated using the rate of the original value as in the equation below:

Annual depreciation = The value of the asset purchase x the percentage of the loss rate

Annual depreciation under this method decreases each year compared to the previous year.

Example :

The project (A)purchased a machine valued at $ 50,000 , Depreciation is calculated at a rate of 20% annually and the useful life of the asset is estimated at 10 years.

Required: **Calculate the annual depreciation premium for this machine.**

The solution:

First year depreciation = 50,000 x 0.20= 10,000

Depreciation of the second year = (50,000 - 10,000) x 0.20 = 8000

Depreciation of the third year = (40,000 - 8000) x 0.20 = 6400

Depreciation for the fourth year = (32,000 - 6400) x 0.20 = 5120

Depreciation for the fifth year = (25,600 - 5120) x 0.20 = 4096

Depreciation of the sixth year = (20,480 - 4096) x 0.20 = 3277.8

Depreciation for the seventh year = (16,384 - 3277) x 0.20 = 2621.4

Depreciation for the eighth year = (13,107 - 2621.4) x 0.20 = 2097.2

Depreciation for the ninth year = (10,485.6 - 2097.2) x 0.20 = 1677.7

Depreciation of the tenth year = (8388.4 – 1677.7) x 0.20 = 1342.16

So it becomes clear that the annual value of the machine is decreasing as a result of its annual loss.

Example

The project (B)purchased a machine valued at $ 35,000 , Depreciation is calculated at a rate of 16% annually and the useful life of the asset is estimated at 5 years.

Required: **Calculate the annual depreciation premium for this machine.**

C/ The internal rate of return criterion

One of the important criteria used in the comparison between the proposed investment projects. Because of its importance, most international financial institutions, especially the International Monetary Fund and the World Bank for Development and Reconstruction, rely on it when they provide any loans or investments to any country.

The internal rate of return criterion can be defined as the discount rate at which the value of cash inflows equals the value of cash outflows. What is the discount rate that gives a present value of the project equal to zero. The internal rate of return is calculated according to the following equation:

$$IRR = r_1 + (r_2 - r_1)\text{X}\frac{NPV_1}{NPV_1 - NPV_2}$$

whereas:

- IRR: the internal rate of return.
- r_1: the least discount rate.
- r_2: the above discount rate.
- $(r_2 - r_1)$: difference between the discount price .
- NPV_1: The net present value at the least discount rate.
- NPV_2: The net present value at the above discount rate.

The investment decision base according to the internal rate of return criterion is:

- If the internal rate of return > the prevailing interest rate, the project is accepted.

- If the internal rate of return < the prevailing interest rate, the project will be rejected.

- **Example**

The following data represent the total revenue and costs for industrial project supposed to produce iron.

Years	Revenues monetary unit	Costs monetary unit
1	17500	42500
2	34000	50500
3	61500	51500
4	61500	51500
5	61500	51500
6	61500	51500
7	61500	51500
8	71500	51500
9	76500	51500
10	81500	51500

Required:

Calculate the internal rate of return for the project, noting that the approved interest rate ranging between (8% - 17%), as the prevailing interest rate in the market is 15%.

- **The solution:**

Years	Revenues monetary unit	Costs monetary unit	discount rate of 8%	Discount rate 17%	The present value of the Revenues at 8%	The present value of the costs at 8%	The present value of the Revenues at 17%	The present value of the costs at 17%
1	17500	42500	0.926	0.855	16205	39355	14963	36338
2	34000	50500	0.857	0.731	29138	43279	24854	36916
3	61500	51500	0.794	0.624	48831	40891	38376	32136
4	61500	51500	0.735	0.534	45203	37853	32841	27501
5	61500	51500	0.681	0.456	41882	35072	28044	23484
6	61500	51500	0.630	0.390	38745	32445	23985	20085
7	61500	51500	0.583	0.333	35855	30025	20480	17150
8	71500	51500	0.540	0.285	38610	27810	20378	14678
9	76500	51500	0.500	0.243	38250	25750	18590	12515
10	81500	51500	0.463	0.208	37735	23845	16952	10712
Total					**370,452**	**336,323**	**239,461**	**231,513**

The solution

$$IRR = r_1 + (r_2 - r_1)\text{X}\frac{NPV_1}{NPV_1 - NPV_2}$$

1- The current value of the $Sn = \frac{1}{(1+i)^n}$

2- NPV_1 **,8%** = The present value of the Revenues at 8% , The present value of the costs at 8%

370452 - 336323 = **34129** monetary unit

3- NPV_2 **,17%** = The present value of the Revenues at 17% , The present value of the costs at 17%

- 239461 - 231513 = **7949** monetary unit

4- $(r_2 - r_1)$ =17-8 =9

5- IRR =8+ 9 X $\frac{34129}{34129-7949}$ = 8+9 x $\frac{34129}{26180}$

$= 8 + 9$ x(1.304) = $8+11.736 =$ **% 19.736**

So we accept the project because the internal rate of return is 19.736 % larger than the prevailing interest rate, which is 15% price.

Example

the following data represent the aesthetic revenues and total costs of the project are supposed to produce industrial clothes.

- Note that the approved interest rate of between (6% -14%)

- Note that the interest rate in the market is 10%.

Years	Revenue monetary unit	Costs monetary unit
1	21000	45500
2	37500	53500
3	65000	54500
4	65000	54500
5	65000	54500
6	65000	54500
7	65000	54500
8	75000	54500

Required: Calculate the internal rate of return for the project.

Example:

The institution wants to invest in one of the two projects, and the present value of the cash flows for them is as shown in the table below, bearing in mind that the approved interest rate ranges between

(4% - 6%), and the prevailing interest rate is (23%).

Years	First project		Second project	
	Present value of cash flows at a discount rate %4	Present value of cash flows at a discount rate %6	Present value of cash flows at a discount rate %4	Present value of cash flows at a discount rate %6
1	42891	316667	38547	34000
2	92888	33333	40679	36025
3	99551	40000	42807	38260
4	149558	56667	48300	43675
5	186225	60000	53571	51167

Required: Calculate the internal rate of return, specifying which of the two projects is the best and why?

The solution:

$$IRR = r_1 + (r_2 - r_1)\text{X}\frac{NPV_1}{NPV_1 - NPV_2}$$

Years	First project		Second project	
	Present value of cash flows at a discount rate 4%	Present value of cash flows at a discount rate 6%	Present value of cash flows at a discount rate 4%	Present value of cash flows at a discount rate 6%
1	42891	316667	38547	34000
2	92888	33333	40679	36025
3	99551	40000	42807	38260
4	149558	56667	48300	43675
5	186225	60000	53571	51167
Total	**571,114**	**506,667**	**223,904**	**203,127**

IRR, First project $= 4 + (6-4)\text{ X}\frac{571114}{571114-506667} = 4+2\text{ x}\frac{571114}{64447} = 4+2(8.862) = 4+17.724 = 21.724\%$

IRR, Second project $= 4 + (6-4)\text{ X}\frac{223904}{223904-203127} = 4+2\text{ x}\frac{223904}{20777} = 4+2(10.777) = 4+21.554 = 25.554\%$

If the second project is best because it achieves an internal rate of return (25.55%)greater than the interest rate(23%).

Example:

The institution wants to invest in one of the two projects, and the present value of the cash flows for them is as shown in the table below, bearing in mind that the approved interest rate ranges between (3% - 7%), and the prevailing interest rate is (12%).

Years	First project		Second project	
	Present value of cash flows at a discount rate %3	Present value of cash flows at a discount rate %7	Present value of cash flows at a discount rate %3	Present value of cash flows at a discount rate %7
1	21043	22285	39041	23811
2	31038	8285	42240	26848
3	41033	12285	45431	30201
4	46043	27285	48671	38324

Required: Calculate the internal rate of return, specifying which of the two projects is the best and why?

Second: Criteria for evaluating investment projects in light of uncertainty and risk

We have previously discussed the criteria and methods of evaluation under conditions of certainty, and we have ignored the element of risk that affects the cash flows of the investment project. In the estimates of cash flows, and accordingly, the evaluation of investment projects under conditions of certainty, despite being considered an ideal model, is considered unrealistic at the present time, which may make the results shaded, or questionable in validity, and therefore we had to include the element of risk in the evaluation process. investment projects.

Second: Criteria for evaluating investment projects under uncertain conditions

1.break-even point criterion

It is the point at which total revenue equals the total costs (variable and fixed). By determining the break-even point, we can determine the minimum number of units that must be produced and sold in order for the project to cover its costs and not incur losses.

$$\textbf{break-even point Criteria(Equalizer quantity)} = \frac{\textbf{Fixed costs}}{\textbf{unit sale price} - \textbf{unit variable cost}}$$

Importance and benefits of break-even analysis:

1-Identifying the impact of fixed and variable costs on profits, in order to reduce them.

2-Identify potential profits at a specific level or volume of production.

3-Determine the volume of sales required to achieve a specific profit.

4-Determine the minimum amount of production sold, at which revenues are equal to costs, in order to avoid losses.

Example

A project produces a specific type of product, and the data it has is as follows:

-The unit sale price is $ 28.

-The unit variable cost is $ 15.

-Fixed costs $ 100,000

Required :

1-Determine the break-even point (amount and value).

2-Determine the quantity of production sold to achieve a profit of $ 4900.

3-Determine the value of sales needed to make a profit of $ 4900.

This solution:

1-Calculating the break-even point

$$\textbf{break-even point (Equalizer quantity)} = \frac{\textbf{Fixed costs}}{\textbf{unit sale price} - \textbf{unit variable cost}}$$

$$\text{break-even point} = \frac{100000}{28 - 15} = \textbf{7692.31} \approx \textbf{7692 units}$$

What you notice is that the volume of production, which is equal to sales with costs, is 7692 units, and in order for the project to achieve profits, it must plan for the volume of production to be more than 7692 units.

The breakeven sales value is calculated by multiplying the extracted break-even quantity by the unit sale price as follows:

Break-even value = break-even point x Unit Sale Price

Break-even value = 7692 x 28 = 215385 $

2-Determining the quantity of sold production necessary to achieve a profit of $ 4900:

$$\textbf{The amount needed to achieve the target profit} = \frac{\textbf{Fixed costs} + \textbf{Quantity of production sold to achieve a profit}}{\textbf{unit sale price} - \textbf{unit variable cost}}$$

$$\text{The amount needed to achieve the target profit} = \frac{100000 + 4900}{28 - 15} = \mathbf{8069.23} \approx \mathbf{8069\ unit}$$

3-Determine the value of sales necessary to achieve a profit of $ 4900:

Sales needed to achieve profit target= The amount needed to achieve the target profit * unit sale price

Sales needed to achieve profit **target =** 8069 x 28 = **225938** $

Example

A project produces a specific type of product, and the data it has is as follows:

-The unit sale price is $ 12.

-The unit variable cost is $ 4.

-Fixed costs $ 550,000

Required :

1-Determine the break-even point (amount and value).

2-Determine the quantity of production sold to achieve a profit of $ 1700.

3-Determine the value of sales needed to make a profit of $ 1700.

2. Sensitivity Analysis Criterion

It is the measurement of the effects of changes that may occur in the inputs and outputs of the investment project during the life of the hypothetical, which affects the profitability of the project positively or negatively. The sensitivity of the project is analyzed through (investment size, expected annual returns, project life, discount rate ... etc.) .

- **Example**

  If we have a project as follows:

The details	data
The investment cost of the project	280,000 $
The annual returns of the project (net expected annual return)	10,000 $
The life project	5 years
discount rate	10%
Fifth-year discount price	3.791

- **Required**, Sensitivity analysis is for each of:

1-The size of the investment.

2-Expected annual returns.

- **The solution :**

1-The size of the investment

Maximum investment spending allowed so that it does not exceed the expected returns of the project.

Net present value of annual returns = net expected annual return x discount price

= 10000 x 3.791 =**37910** $

Given that the current investment (10000 $) and the expected annual returns amounted to (37910 $), it means that other investments can be added to the project in a way that does not exceed the net present value of the annual returns, but we do not add other investment amounts to the investment.

2-Expected annual returns

The lowest current value of the project returns is allowed.

so that it is not less than the investment cost = $\frac{\textbf{investment cost}}{\textbf{discount price}}$

$$= \frac{280000}{3.791} = 73859\ \$$$

represents the annual returns that the project is supposed to achieve annually, and it should not be less than the investment cost of the project.

- **Example**

  If we have a project as follows:

The details	data
The investment cost of the project	300,000 $
The annual returns of the project (net expected annual return)	12,000 $
The life project	6 years
discount rate	13%
Sixth - year discount price	3.998

- **Required**, Sensitivity analysis is for each of:

1-The size of the investment.

2-Expected annual returns.

Chapter Four

Performance evaluation criteria in the production units

Evaluation criteria in the production units

Here as a number of different methods and standards by which performance is evaluated in production units, including: -

First:the standard capacity

The goal of all economic units is the capacity utilization highest possible efficiency of different economic systems and it is of great importance in developing countries which suffered from the economic backwardness and social resources, and addition to the economic limitations of it, those limitations that require the need to maintain the proper use of those resources and not extravagant where by mobilizing all the available capacity in order to raise the rates of production quantity and quality.

The indicators used to measure the efficiency of performance using standard production capacity, they are:

$$\text{A: utilization ratio of the design capacity} = \frac{\text{The actual production capacity}}{\text{Production design capacity}} \times 100$$

$$\text{B: benefit ratio of the planned energy} = \frac{\text{The actual production capacity}}{\text{Planned production capacity}} \times 100$$

$$\text{c: The utilization ratio of available energy} = \frac{\text{The actual production capacity}}{\text{Production capacity available}} \times 100$$

$$\text{D: Operating ratio} = \frac{\text{Planned production capacity}}{\text{Production design capacity}} \times 100$$

Example: From the data below to project default:

Required : Extract utilization ratio of the extracted design capacity?

years	The design capacity	Actual output
2012	725,000	702,500
2013	3,000,000	1,250,000
2014	3,000,000	1,470,000
2015	3,000,000	1,625,000
2016	3,000,000	1,730,000
2017	3,000,000	1,840,000
2018	3,000,000	1,878,000
2019	3,000,000	1,993,400
2020	3,000,000	1,953,530
2021	3,000,000	2,092,500
2022	3,000,000	2,174,980

The solution:-

So that the utilization ratio (exploitation) of design capacity for the year 2012 are:

$$\text{Utilization percentage of design capacity} = \frac{\text{the actual production capacity for the year 2012}}{\text{Production design capacity for the year 2012}} \times 100$$

$$\frac{702500}{725000} \times 100 = \% 97$$

The energy deactivated = the design capacity - the actual capacity

=725000-702500 **= 22500 units**

$$\text{this means that the Deactivate power ratio for the year 2012} = \frac{\text{Deactivate capacity}}{\text{The design capacity}} \times 100$$

$$= \frac{22500}{725000} \times 100 = \% 3.10$$

years	The design capacity	Actual output	Utilization ratio%
2012	725,000	702,500	97
2013	3,000,000	1,250,000	42
2014	3,000,000	1,470,000	49
2015	3,000,000	1,625,000	54
2016	3,000,000	1,730,000	58
2017	3,000,000	1,840,000	61
2018	3,000,000	1,878,000	63
2019	3,000,000	1,993,400	66
2020	3,000,000	1,953,530	65
2021	3,000,000	2,092,500	70
2022	3,000,000	2,174,980	72

Example: From the data below to project default:

Required : Extract utilization ratio of the extracted design capacity?

years	The design capacity	Actual output
2017	1,365,000	902,500
2018	4,400,000	1,450,000
2019	4,400,000	1,670,000
2020	4,400,000	2,825,000
2021	4,400,000	3,230,000
2022	4,400,000	3,370,000

Example: Below represent the data capacity (Aluminum) in the Aluminum plant for the period (2010-2022).

The required: Identify the amount of capacity utilization at the facility.

The years	Actual energy	Planned energy	Energy available	The design capacity
2010	1188406	2110000	3281883	4709177
2011	1274723	2000000	3281883	4709177
2012	1061723	1850000	3315000	4753572
2013	1149723	1850000	3315000	4753572
2014	1238723	1850000	3315000	4753572
2015	1236723	1900000	3315000	4753572
2016	1246723	1900000	3315000	4753572
2017	1251723	1900000	3315000	4753572
2018	1257723	1987000	3315000	4753572
2019	1272723	1987000	3315000	4753572
2020	1279723	1987000	3315000	4753572
2021	1283723	1987000	3315000	4753572
2022	993000	987000	1315000	1753572

Solution:

Years	Utilization percentage of design capacity (%)	Utilization percentage of the energy available (%)	Utilization ratio of the planned energy (%)	Operating ratio (%)	The energy deactivated	The percentage of deactivated capacity(%)
2010	25.24	36.21	36.21	44.81	3520771	74.76
2011	27.07	38.84	38.84	42.47	3434454	72.93
2012	22.34	32.03	32.03	38.92	3691849	77.66
2013	24.19	34.68	34.68	38.92	3603849	75.81
2014	26.06	37.37	37.37	38.92	3514849	73.94
2015	26.02	37.31	37.31	39.97	3516849	73.98
2016	26.23	37.61	37.61	39.97	3506849	73.77
2017	26.33	37.76	37.76	39.97	3501849	73.67
2018	26.46	37.94	37.94	41.80	3495849	73.54
2019	26.77	38.39	38.39	41.80	3480849	73.23
2020	26.92	38.60	38.60	41.80	3473849	73.08
2021	27.01	38.72	38.72	41.80	3469849	72.99
2022	56.63	75.51	100.61	56.29	760572	43.37

Solution:

$$\text{Utilization percentage of design capacity} = \frac{\text{Actual energy}}{\text{The design capacity}} \times 100 = \frac{1188406}{4709177} \times 100 = \%\ 25.24$$

$$\text{Utilization percentage of the energy available} = \frac{\text{Actual energy}}{\text{Energy available}} \times 100 = \frac{1188406}{3281883} \times 100 = \%\ 36.21$$

$$\text{Utilization ratio of the planned energy} = \frac{\text{Actual energy}}{\text{Planned energy}} \times 100 = \frac{1188406}{2110000} \times 100 = \%\ 56.32$$

$$\text{Operating ratio} = \frac{\text{Planned energy}}{\text{The design capacity}} \times 100 = \frac{2110000}{4709177} \times 100 = \%\ 44.81$$

$$\text{The energy deactivated} = \text{The design capacity} - \text{Actual energy} = 4709177 - 1188406 = 3520771$$

$$\text{The percentage of deactivated capacity} = \frac{\text{The energy deactivated}}{\text{The design capacity}} \times 100 = \frac{3520771}{4709177} \times 100 = \%74.76$$

Example: Below represent the data capacity (wood) in the wood plant for the period (2015-2022).

The required: Identify the amount of capacity utilization at the facility

The years	Actual energy	Planned energy	Energy available	The design capacity
2015	1249723	2850000	5315000	7753572
2016	1338723	2850000	5315000	7753572
2017	1336723	2900000	5315000	7753572
2018	1346723	2900000	5315000	7753572
2019	1351723	2900000	5315000	7753572
2020	1357723	2987000	5315000	7753572
2021	1372723	2987000	5315000	7753572
2022	1379723	2987000	5315000	7753572

Second : Productivity standard:

Today, the issue of productivity is given increasing attention in both developed and developing countries, given its importance, impact and benefits at the project, Labour and community levels.

1- The concept of productivity: It can distinguish between production and productivity:

A - The concept of production: It is an activity carried out by an individual or productive or service institution with other productive elements with the intention of finding a good or providing a service of benefit.

B - the concept of productivity: the relationship between the quantitative measurement of products on the one hand and the work involved in securing those products on the other hand. Or the relationship between outputs (output) and inputs (input). It can be said that productivity in essence revolves around the relationship Between the size or value of the output and the size or value of the production factors used in the production process.

- Any: -

$$\text{Productivity} = \frac{\text{The final product}}{\text{Production elements used in the production process}}$$

2 - Analysis of productivity and forms:

Based on the above, we can divide productivity into two main parts:

A - The overall productivity standard:

This criterion is based on the relationship between the size of the production and the inputs used in the production process in its overall form, whether expressed in this relation in terms of eyes(Kind) or values.

The overall productivity standard is one of the most reliable criteria in the study and measurement of the efficiency of performance in the production units, but in real terms the use of some of the problems and constraints in the planning and policy-making processes because:

* Difference in product quality and synthesis product mix.

* The nature of different resources in the production process.

It can be expressed in different formats:

$$\text{Total productivity} = \frac{\text{Outputs}}{\text{Input}} \text{ Or } \frac{\text{Total production volume}}{\text{Total output elements used(Materials used)}}$$

B-Partial Productivity Standard:

The need to measure the partial productivity as a result of the above mentioned difficulties, which results from the use of the index of total productivity and therefore it can be said that partial productivity expresses the relationship between the volume of production and one of the factors of production as expressed by the following formula:

$$\text{Partial productivity} = \frac{\text{Output}}{\text{One of the factors}}$$

Or

$$\text{Partial productivity} = \frac{\text{Size or value}}{\text{used is production of a single component of production or its value}}$$

In view of the multiplicity of factors of production, there are several types of partial productivity, including:

1. Labour productivity standard:

The productivity of the work has become an important and important space in economic studies because of the effectiveness of work, making it a moving factor and can be continuously improved in order to increase productivity. The productivity of the work can be expressed as follows:

$$\textbf{Work productivity} = \frac{\textbf{production quantity}}{\textbf{Number of workers (number of workers, actual hours)}}$$

There are several ways to measure labour productivity, including:

A: In-kind method or natural units:

This method is one of the easiest and most accurate methods used in the calculation and planning of productivity, which is a direct expression of the impact of the labour force and the extent of its development. This method is used when production is a single and finished product, this method gives us the index of productivity depending on the units in kind, Which is carried out according to the following formula:

$$PL = \frac{Y}{L}$$

whereas :

PL: Work productivity.

Y: The output quantity.

L: Amount of work spent (number of employees, hours worked, working days).

Example :

The data below represents the production capacity of the ready-made garment factory:

* The total number of units producing 57000 units

* Total number of working hours per man / hour 48300.

Required: Measure the work productivity of this facility using the in-kind method?

The solution :

$$\frac{\text{The total number of units producing units}}{\text{Total number of working hours per man / hour}} = \frac{57000}{48300}$$ = 1.18 units per hour, meaning 1.18 units per hour.

$$\frac{\text{Total number of working hours per man / hour}}{\text{The total number of units producing units}} = \frac{48300}{57000}$$ = 0.85 hours working , meaning 0.85 hours production unit was made one.

But in many cases cannot be used or applied in scientific reality, because of:

* Rarely find a facility, especially the industrial ones, which produce one product.

* In addition to the difference in the unit of measurement for those products (tons, meters, litters ..... etc.)

From this point of view we cannot compare or combine under these variables, which leads us to think in a different way to help us overcome this problem and the possibility of standardization of different measures, the method of conversion coefficient, or coefficient of equivalence.

Example :

The data below represents the production capacity of the ready-made garment factory.

* The total number of units producing 96400 units

* Total number of working hours per man / hour 57900.

Required: Measure the work productivity of this facility using the in-kind method?

B: Conversion or equivalence coefficients (modified natural method):

This indicator can be used in projects that produce more than one commodity, and there are differences between them that cannot be combined. This indicator requires the selection of a product as A standard on which to convert other products. They can be expressed as follows:

$$P_L = \frac{\Sigma\ Ei.\ Yi}{Li}$$

whereas :

PL: Work productivity.

Yi: The output quantity of good (i).

Ei: Conversion coefficient of different commodities (i).

Li: The amount of work done to produce the item (i).

Example:

Assuming that the industrial facility produces two secondary products (D, E) and its products (M), and that the unit of measurement for these products is different.

From the data of the three were as follows:

M = 839 tons D = 584 units C =1000 litters

The time required to produce one of these products was as follows:

M = 7 hours D = 7.30 hours E= 7.50 hours

Note: The number of employees is (86 workers) working daily (9 hours) over (300 days) per year.

Required: Measure the productivity of work at this facility?

The solution :

In order to achieve the measurement of work productivity in this facility, it is necessary first to estimate the equivalence coefficients between the different products in the designated production unit, for the purpose of converting the by-products to the equivalent of the main product (M) as follows:

-Parity coefficient between (D / M) = $\frac{\text{Number of time units required to produce one unit of (D)}}{\text{Number of time units required to produce one unit of (M)}} = \frac{7.30}{7} = 1.04$

-Parity coefficient between (E / M) = $\frac{\text{Number of time units required to produce one unit of (E)}}{\text{Number of time units required to produce one unit of (M)}} = \frac{7.50}{7} = 1.07$

The total production in the establishment is equal to:

ΣEi . Yi = 839 + (584 x 1.04) + (1000 x 1.07)

= 839 + 607 + 1070

= 2515

The amount of production work is:

= 86 x 9 x 300= **232200** business hours (Li)

$P_L = \frac{\Sigma Ei \,.\, Yi}{Li} = \frac{2515}{232200}$ = **0.0108** tons / hour

Example:

Assuming that the industrial facility produces two secondary products (B, C) and its products (A), and that the unit of measurement for these products is different.

From the data of the three were as follows:

A = 754 tons B = 426 units C =800 litters

The time required to produce one of these products was as follows:

A = 6 hours B = 6.30 hours C = 6.40 hours

Note: The number of employees is (94 workers) working daily (7 hours) over (300 days) per year.

Required: Measure the productivity of work at this facility?