Introduction to Business

TOPIC 4. The Production Function



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The function of production

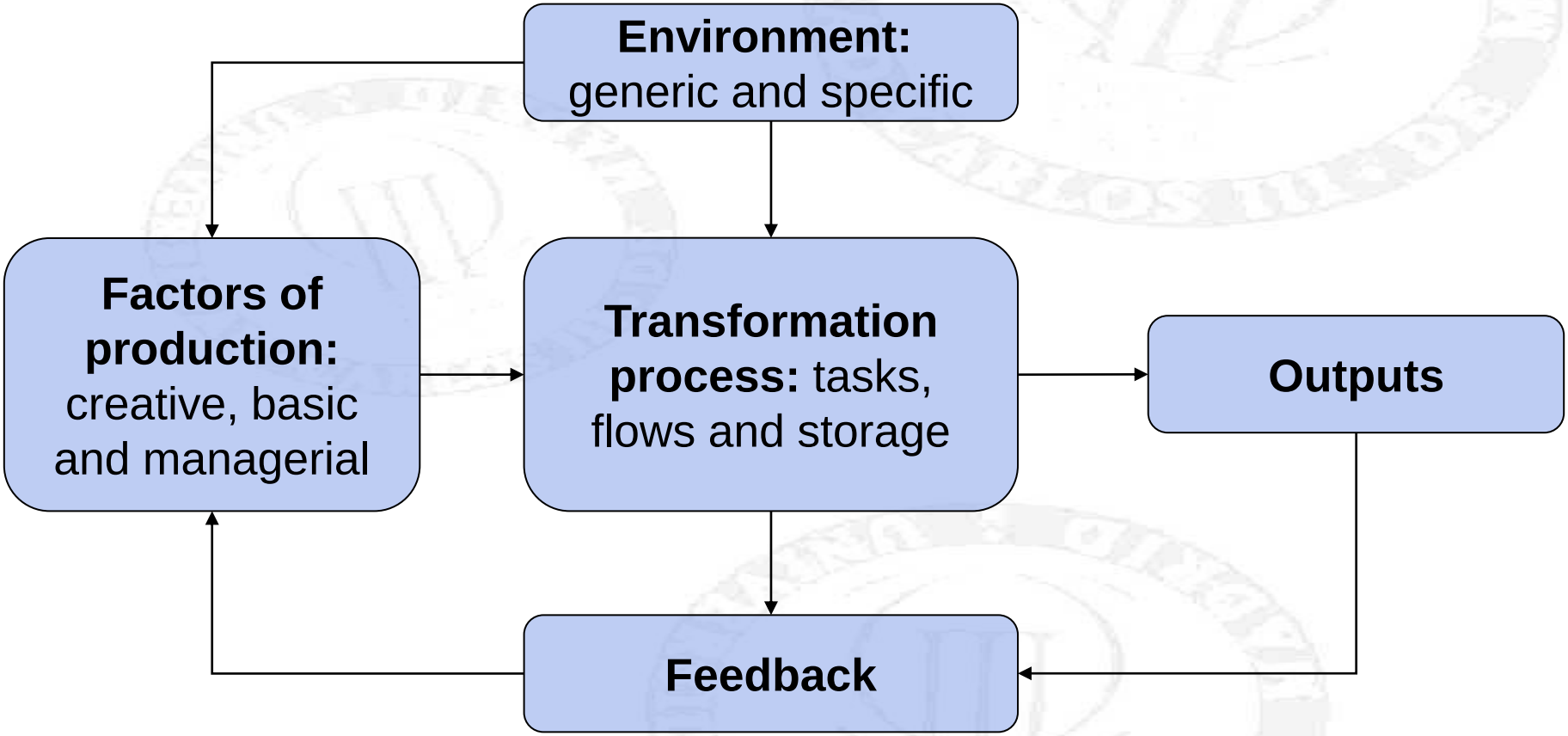
- The function of production. Concept and objectives
- Types of production systems
  - Rigid production
  - Flexible production
  - Just in Time production
- Production planning and control
  - Planning tool: GANTT graphs
  - Control of efficiency

The function of production. Concept and objectives

A **production system** is a method for converting inputs into outputs

Production management (operations management) is the set of activities aimed at planning, designing, staffing and controlling a firm's production system

The function of production



Objectives of the function of production

- COST
- QUALITY
- TIME OF DELIVERY
- FLEXIBILITY

Potential contradictions between the objectives

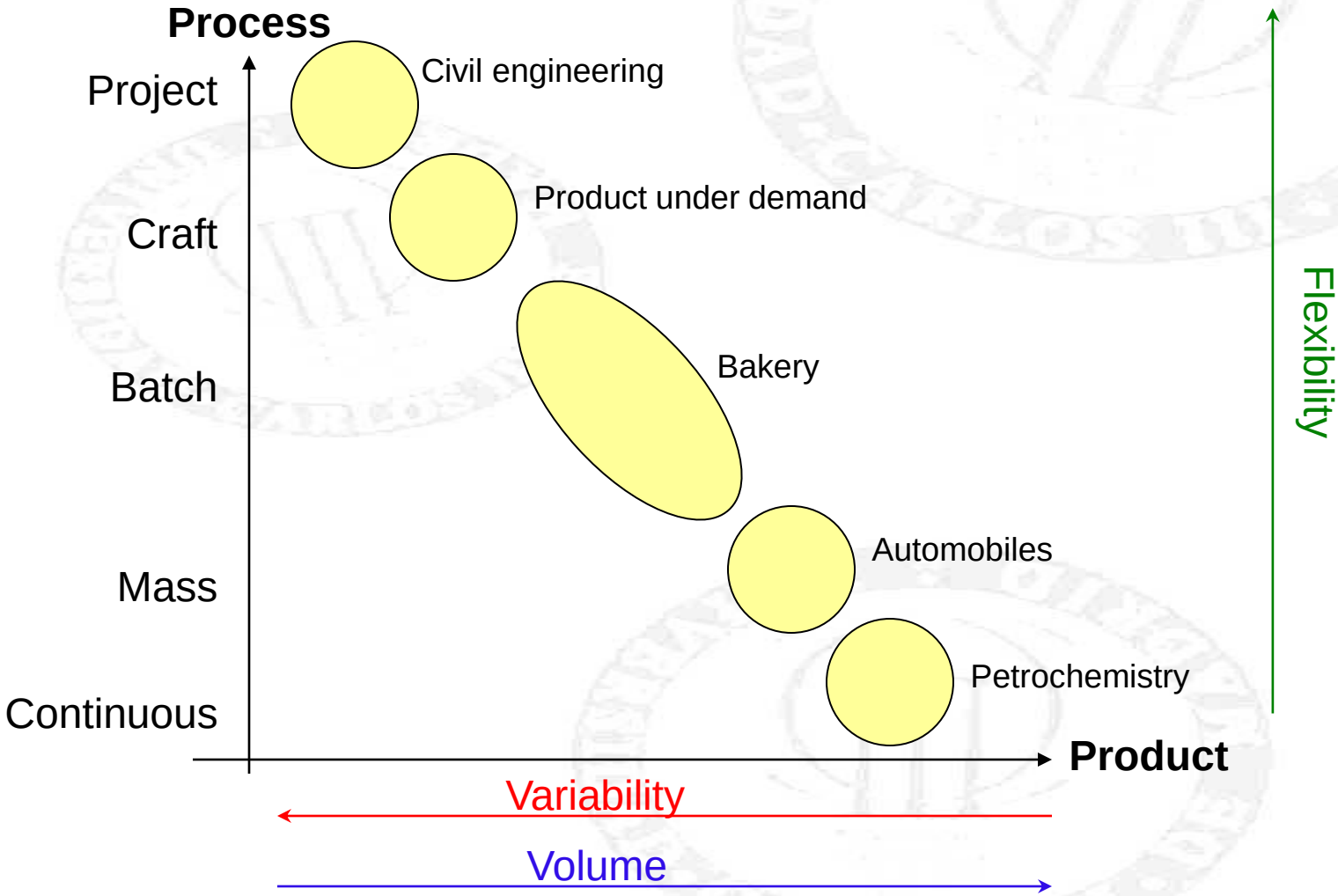
COST - QUALITY

FLEXIBILITY - COST

TIME OF DELIVERY - COST

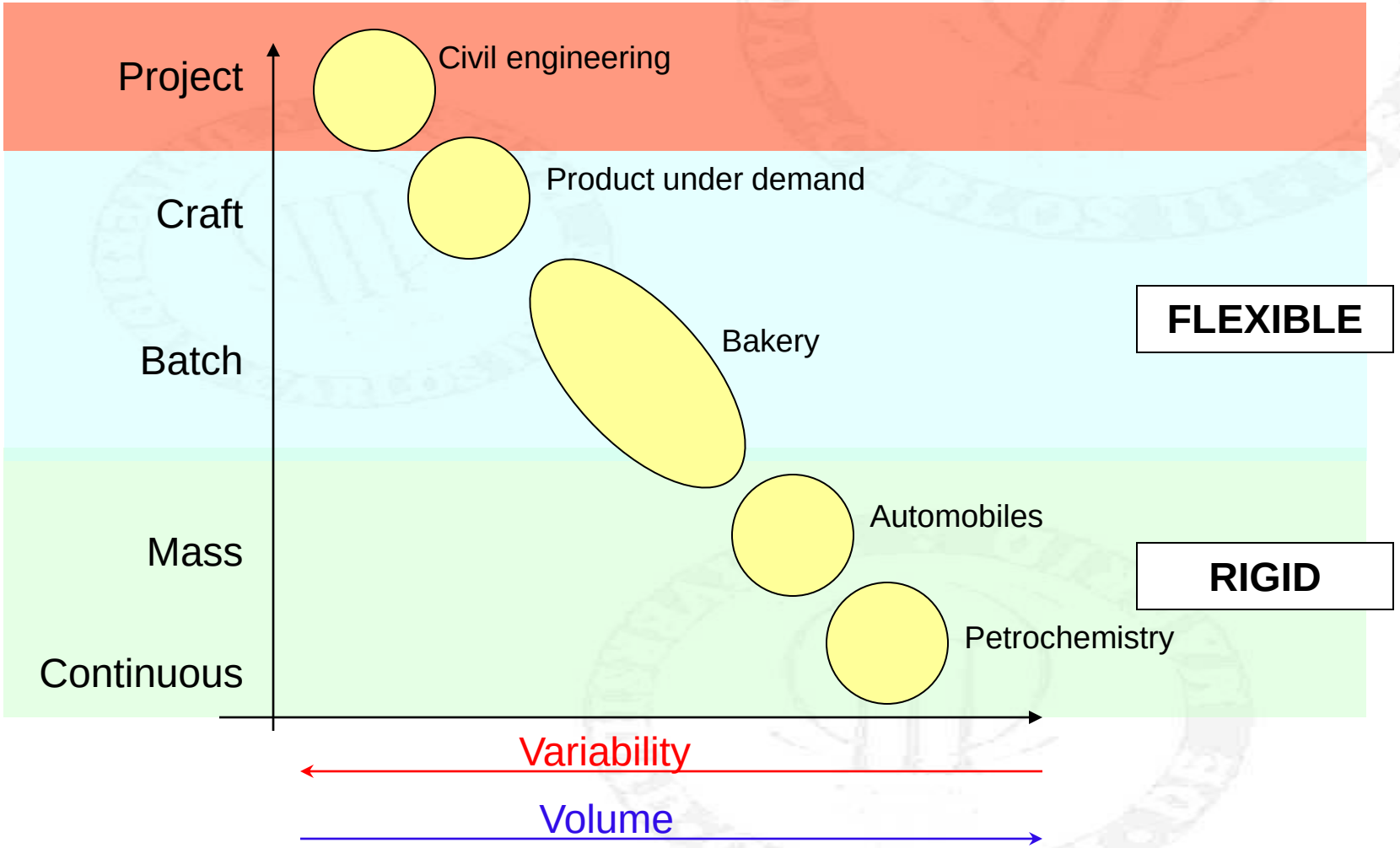
Types of production systems

Matrix product-process



Types of production systems

5 generic types grouped in 3 categories:



Types of production systems

RIGID or CONTINUOUS

FLEXIBLE or INTERMITTENT

JUST IN TIME

Rigid production

Characteristics

- Big volumes of production
- Low price commercialization
- Standard products
- Capital intensive

Advantages of the job specialization

- Less time to learn a task
- The simplicity of the task makes the learning process cheaper
- Time elimination for changing from one task to another
- The worker acquires expertise in performing the task
- Better adequacy worker–job position
- Easy replacement of workers (and mechanization)

Organization of the factory

Division of labour creating different **job positions**

Assignment criteria: **Seniority**

BUREAUCRATIZATION OF THE COMPANY

Types

Mass production

Continuous or process production

Flexible or Intermittent production

Characteristics

Flexible volumes of production

More complex and differentiated products

Higher qualified workers

Equipment for general use

Flexible production

Organization

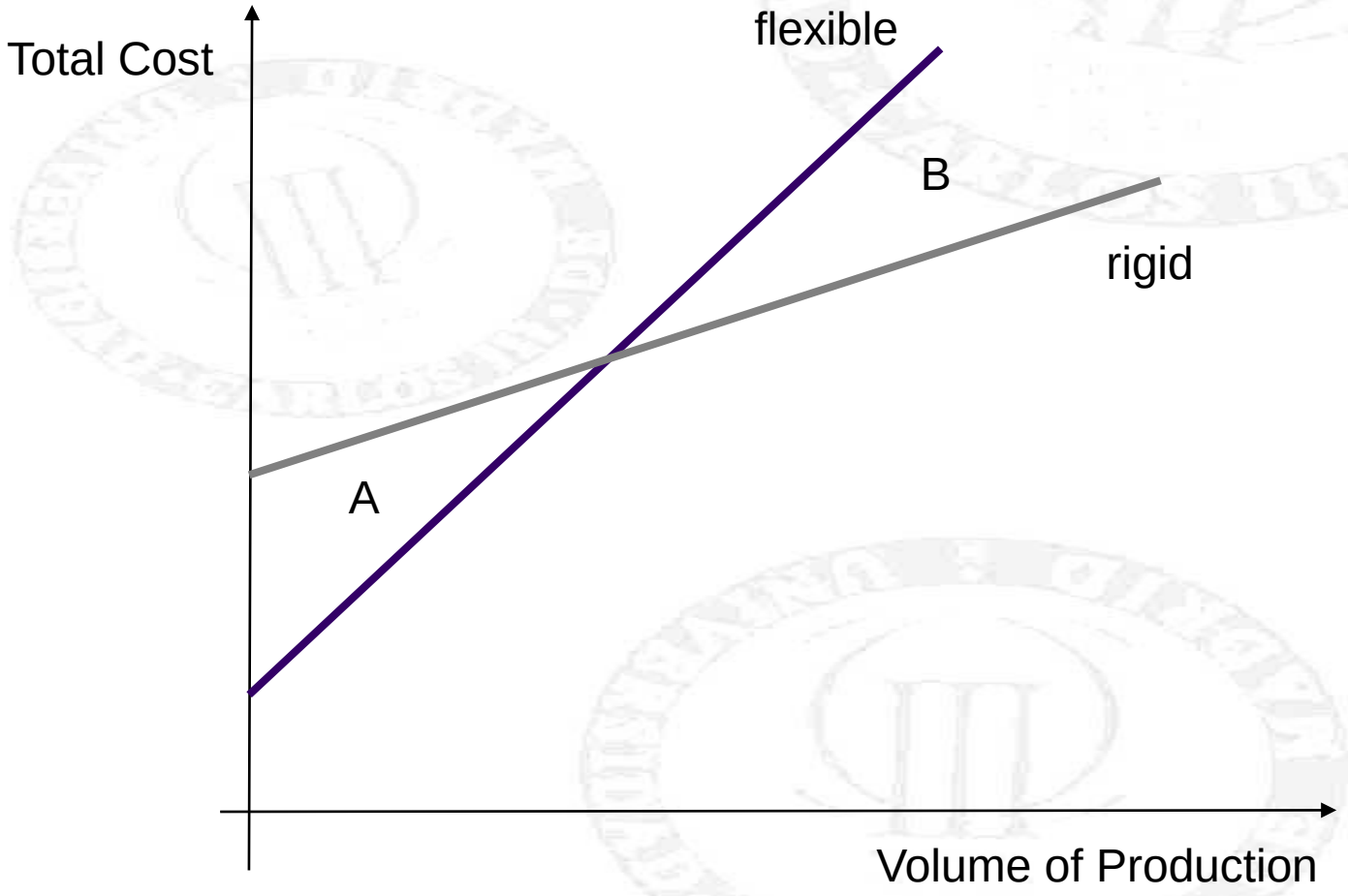
- Plant layout based on teamwork
- Workers have more responsibility
- Less hierarchical levels (layers)
- Employee rotation
- Remuneration depends on qualification

Types

Craft production

Batch production

Flexible vs. Rigid production



“Just in Time”

It arises from the need for manufacturing many types of automobiles, in small batches but under the same production process.

It is based on requests and eliminates inventories

Competitive advantages

Manufacture high quality products

Reduce the whole production cycle

"Just in Time"

Internal organization — Job cells

Plant distribution — U shape

Mechanisms to support quality — JIDOKA, POKA YOKE

Mechanisms of visual control

- ANDON
- CONTROL PANNELS
- WORK SHEETS
- KANBAN

Plant layout

- Functional or process layout
- Product layout
- Fixed layout

Types of production systems

5 generic types:

Project

Individualized products: high cost, qualified workers, equipment for general use, difficult planning and control

***Plant layout:* "fixed"**

Craft

Batches

Low quantity of a great variety of products:

- Craft: more adaptability, less quantity
- Batches: more uniformity, more quantity (batch size)

***Plant layout:* "functional"**

Mass

Continuous

Standard products for mass markets, division of labour:

- Mass: more dependant on workers than machines
- Continuous: more dependant on machines than workers

***Plant layout:* "product"**

Functional or process layout

Advantages

- High use of the machines
- Machines can be easily replaced
- If similar machines are close, operators can train and supervise themselves easily.
- Specific incentive system for each worker

Disadvantages

- Distance between functions
- Handling wastes when transporting the materials
- Flow of materials and operator's work is difficult to standardize
- Flow of materials is difficult to plan
- Activities are difficult to plan
- Lines are not balanced: some are saturated and others free

Product layout

Advantages

- Few workload in process
- It requires less space for transport and for the temporal storage of the products
- Planning and control systems are simplified
- Operators need low preparation
- Flow of materials is easy to anticipate

Disadvantages

- Inflexible
- Time is determined by the slowest machine. “Bottlenecks” should be avoided
- Problems in one machine affect the rest of the process
- High investment is needed
- Difficult to define incentive programmes for each employee

Fixed layout

A **fixed layout** is a plant layout in which the product stays in one place and the machinery, materials and labour are brought to that one place

Production planning and control

Production planning is the determination of what products to produce and where, when and how to produce them

Production control is the effort to ensure that production plans or schedules are met

Basic production planning and control process

1. Receiving the orders from customers
2. Developing a list of required materials
3. Developing a route sheet
4. Developing production schedules
5. Dispatching notices to operators to begin work
6. Following up to see that the schedule is being met

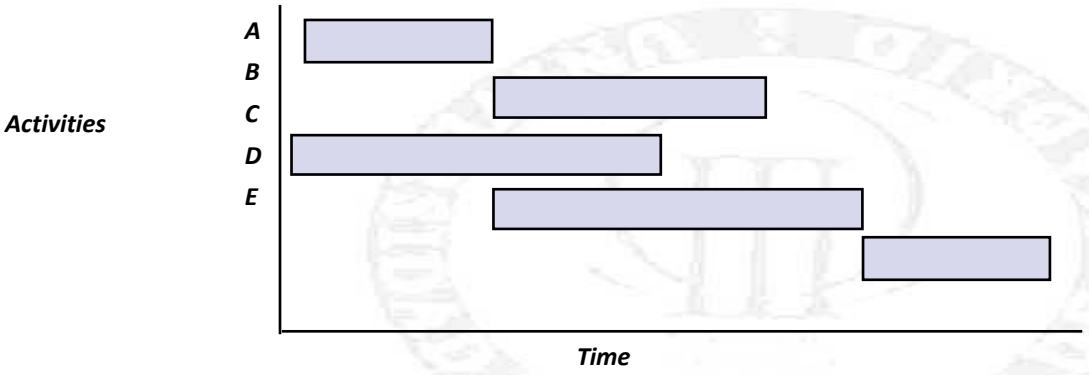
GANTT Charts

The **Gantt chart** is a common technique for representing the phases and activities of a project work breakdown structure

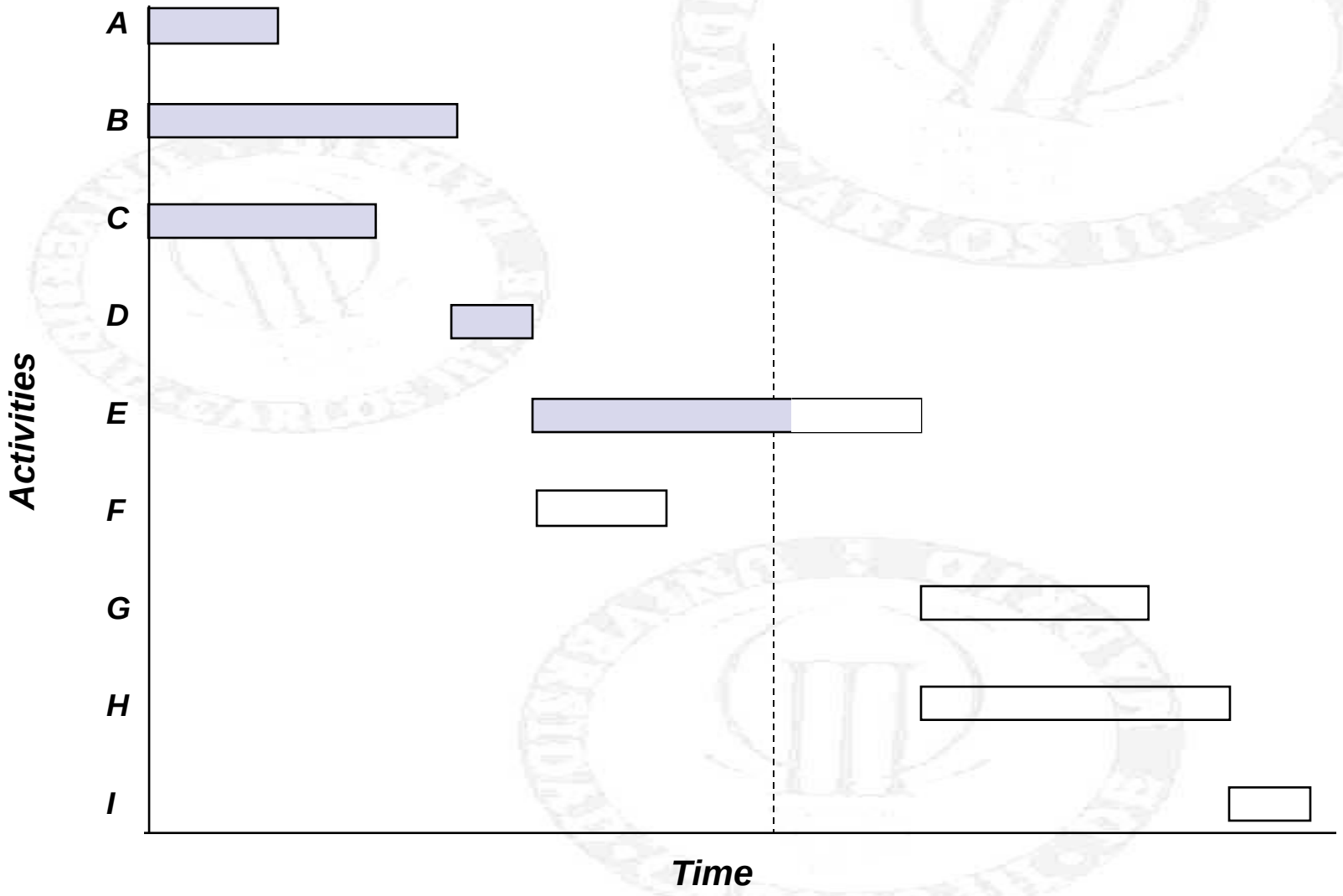
Named after Henry Gantt, who developed the form in the early 1900's

Gantt graphs

- **GANTT CHART**
  - Bar chart that shows the scheduled start and stop dates of each production step
  - Visual illustration of times
  - Used for non-complex projects
  - Normally they do not show dependency relationships between activities
  - Used to show current schedule status using percent-complete shadings and a vertical “TODAY” line



Gantt graphs



Control of efficiency

EFFICIENCY ≠ EFFICACY

EFFICIENCY Indexes:

- **PRODUCTIVITY** *"a posteriori"*
- **COST ANALYSIS** *"a priori"*

Productivity

Total Productivity Indexes:

$$\text{Total Productivity} = \frac{\text{Goods and services}}{\text{Labour} + \text{Capital} + \text{Raw materials} + \text{Energy}}$$

Partial Productivity Indexes:

$$\text{Labour Productivity} = \frac{\text{Goods and services}}{\text{Labour}}$$

Productivity factors

- External factors
- Factors of capacity
- Product factors
- Factors of process design
- Factors of human resources
- Quality factors

BREAK-EVEN POINT ANALYSIS

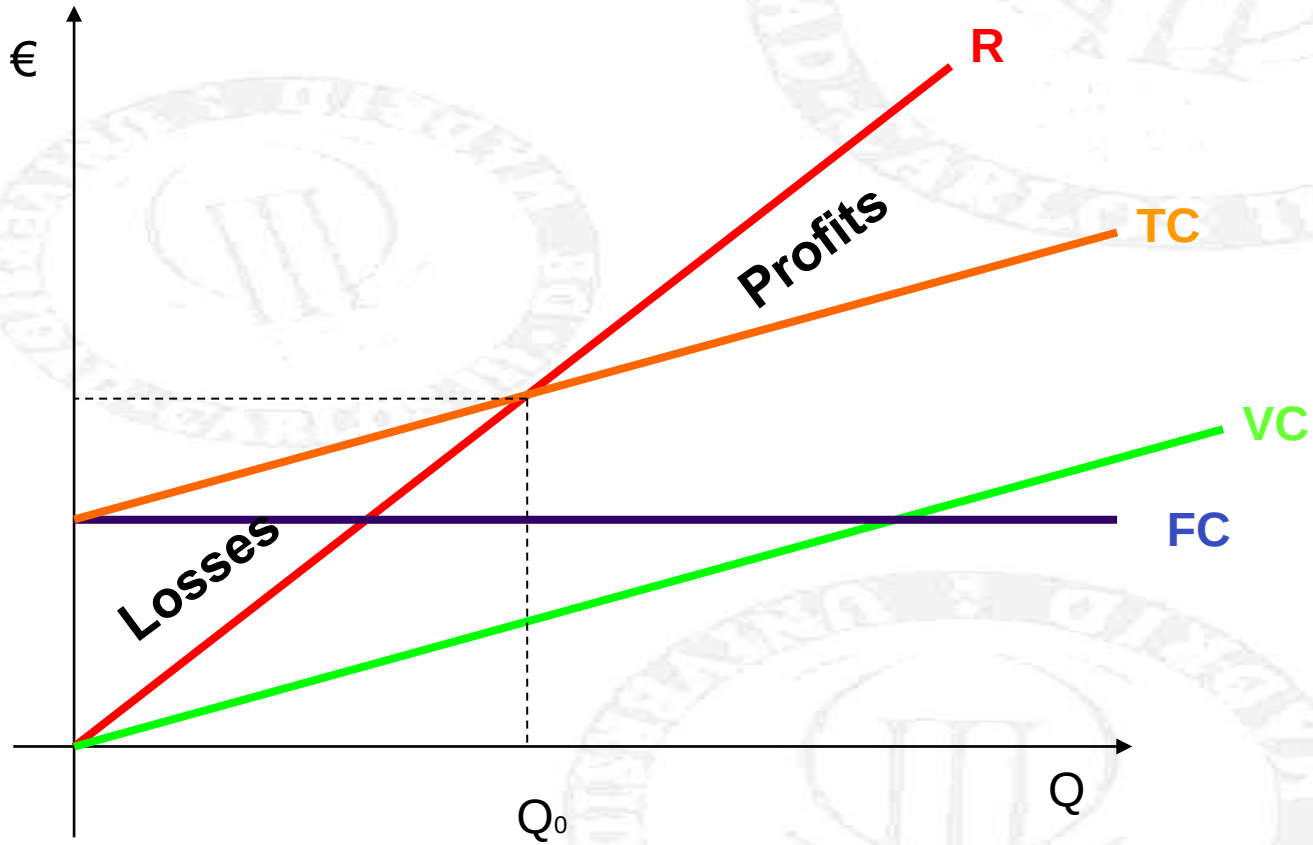
Volume of sales/production at which the company covers its total costs.

Volume of sales/production from which the company starts to get profits.

Depends on costs structure

Control of the production system

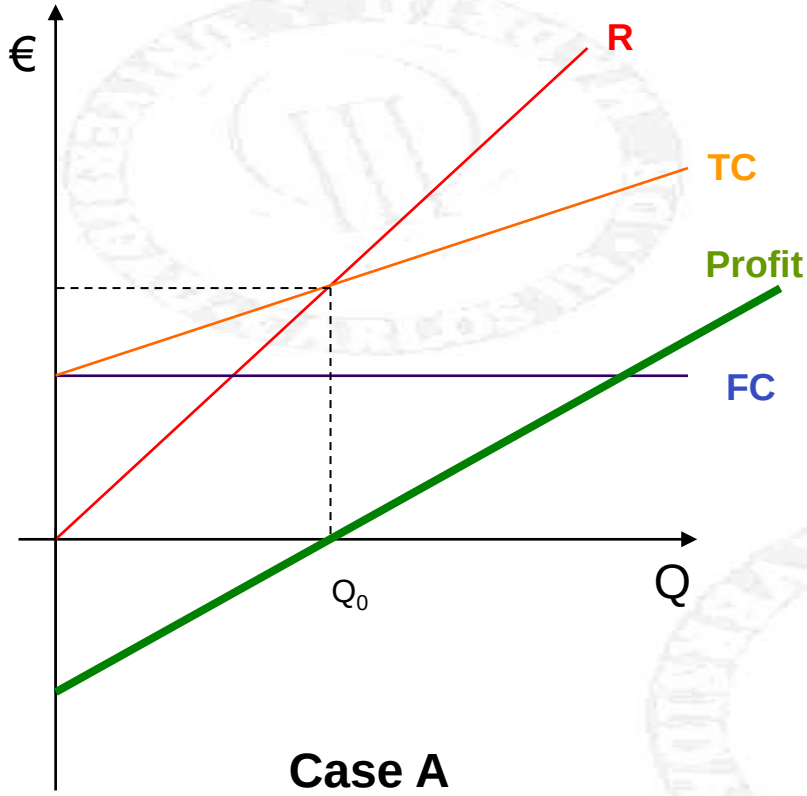
Cost analysis. Break-even point



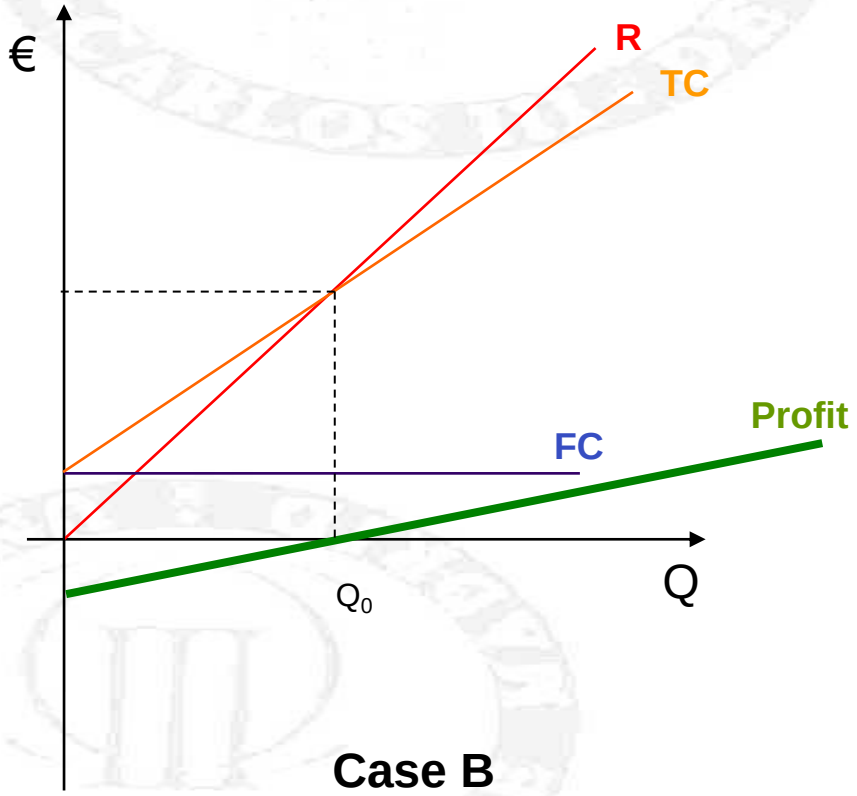
$$Q_0 = \frac{FC}{P - VC} = \frac{FC}{m}$$

Control of the production system

Cost analysis. Break-even point



Case A



Case B

Cost analysis. Operating leverage

Operating Leverage Calculation:

$$OL = \frac{\frac{\Delta Profit}{Profit}}{\frac{\Delta Q}{Q}}$$

Considering that: $Profit = P*Q - (VC*Q + FC) = Q*(P - VC) - FC$

Where: $\Delta Profit = \Delta Q*(P - VC)$

Substituting:

$$OL = \frac{\frac{\Delta Q*(P - VC)}{Q*(P - VC) - FC}}{\frac{\Delta Q}{Q}} = \frac{Q*(P - VC)}{Q*(P - VC) - FC} = \frac{Q*m}{Q*m - FC} = \frac{Q*m}{Profit}$$

it measures how a change in sales translates into a change in operating income (profit or loss).

$$OL = \frac{\frac{\Delta Profit}{Profit}}{\frac{\Delta Q}{Q}}$$

$$OL = \frac{Q*m}{Q*m - FC}$$

INTERPRETATION

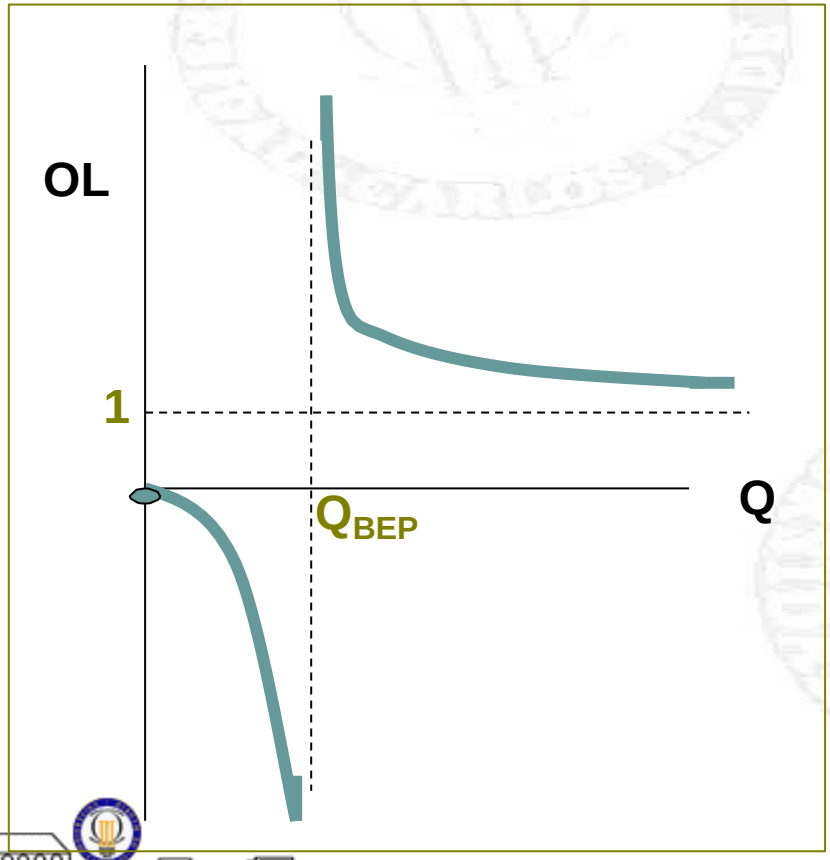
OL = 3 . An increase on sales of 1% makes the profits to increase 3%. A decrease on sales of 10% generates a decrease on profits by 30%

Comments on OL

- It captures the income sensitivity, change in operating income for a given change in sales (revenue)
- Index of ECONOMIC RISK (operating risk)
- To compare business in the same sector
- *Ceteris paribus*, higher FC, higher OL

Relationship between BEP and OL

$$OL = \frac{Q^*m}{Q^*m - FC} \rightarrow OL = \frac{Q}{Q - Q^*}$$



Profits

- If Q>Q* : OL>1
  - More than proportional

Losses

- If Q<Q* : OL<=0
  - Amplifier effect or more than proportional:
- OL<-1
  - Less than proportional effect:
- -1<OL<0

MARGIN OF SAFETY

Represents the strength of the business.

It enables a business to know that what is the exact amount it has gained or lost over or below BEP

in u: MS = (Q-Q*)

in mu: MS = (Q –Q*)*m

in %: MS = (Q-Q*) /Q*