Scenarios and development trends of Production Systems

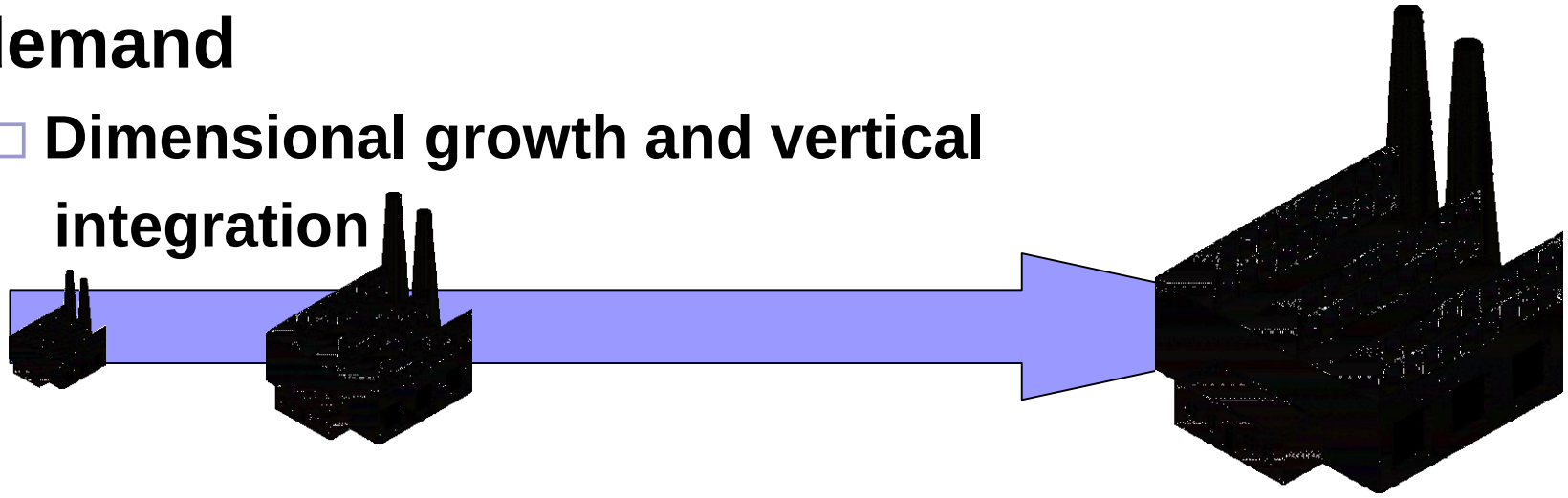
A bit of history

- **Variables of study**
  - **Social context evolution**
  - **Technology evolution**
  - **Competitive variables relative importance evolution**

- **Consequently, how does the industrial model change?**

The industrial model until the 60s

- **Volume growth to cope with an exuberant demand**
  - **Dimensional growth and vertical integration**



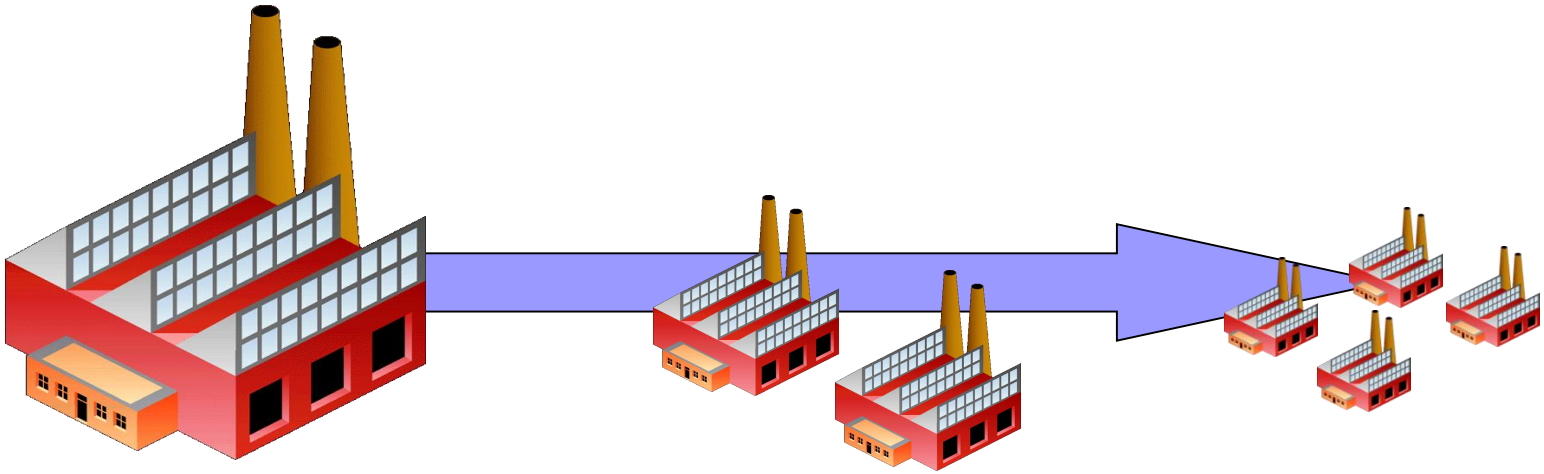
- **Evaluation criteria: turnover and consumption of production factors**
- **Service and residual Quality: the important thing is to make the product available**

The industrial model until the 60s

- **Increasing pressures after the 1960s**
  - **Increased competition**
    - **It is no longer enough to “produce”, you must “sell”**
  - **Containment of industrial costs**
    - **Oil and economic crisis**
    - **Factories must "make efficiency" internally**
  - **Increase of conflicts potential in industrial relations**
    - **Social crisis**

The reactions of the 70s

- The outsourcing phenomenon is born, focus on critical technologies and access to specialized supply sources

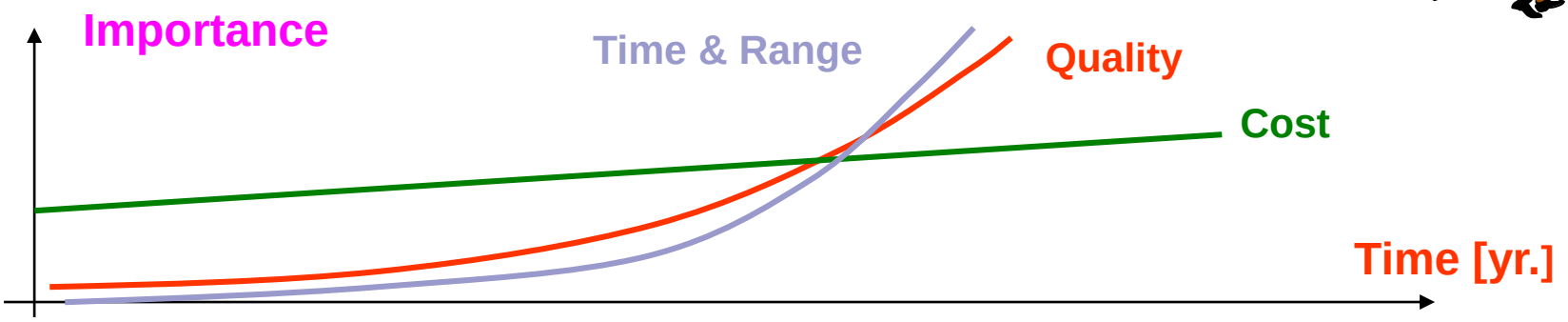


- Factory automation: replacement of costs with investments
- Evaluation criteria are still oriented towards cost reduction
- Service and quality are still residual: the important thing is that the product costs remains low

In the 80s

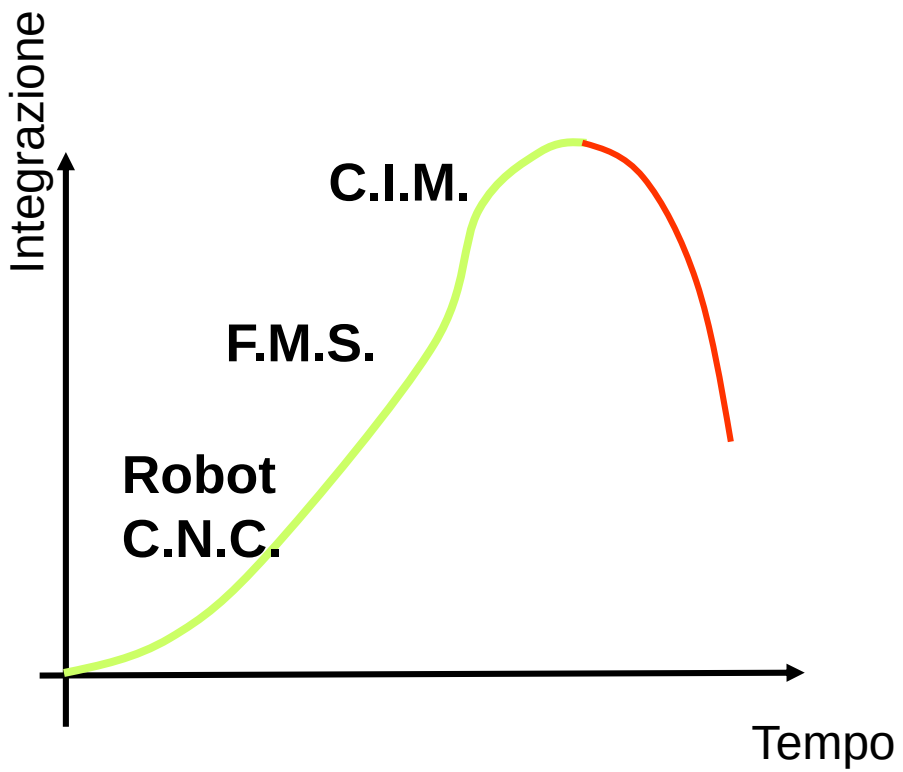
- **The relative importance of the "competitive variables" changes significantly**
  - **From the internal efficiency point of view**

  To that of external effectiveness



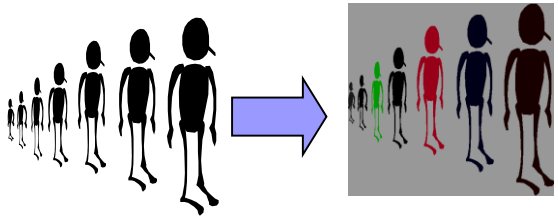
In the 80s

- Driven by the evolution of electronics, automation levels increase
- Nevertheless during mid 80s they undercome a big change: the factory “with no light” happens to be a utopia

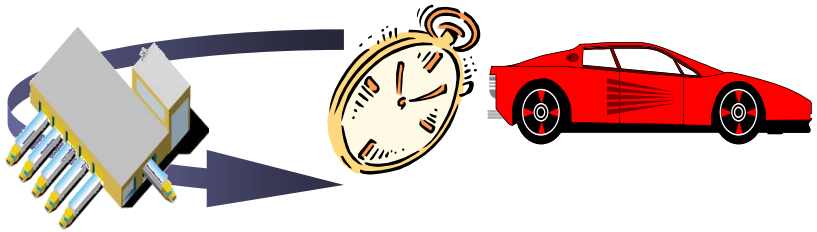


Until the 90s

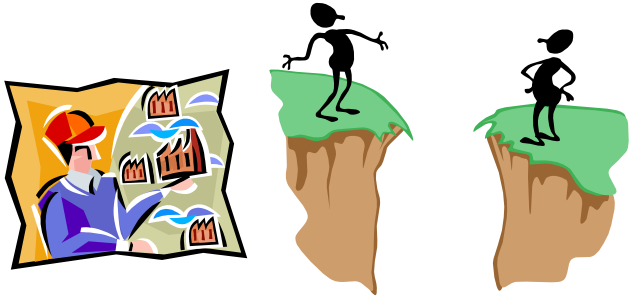
EXPLOSIVE RATES OF GROWTH OF THE RANGE



SPEED OF PROCESSES INCREASE REQUESTS

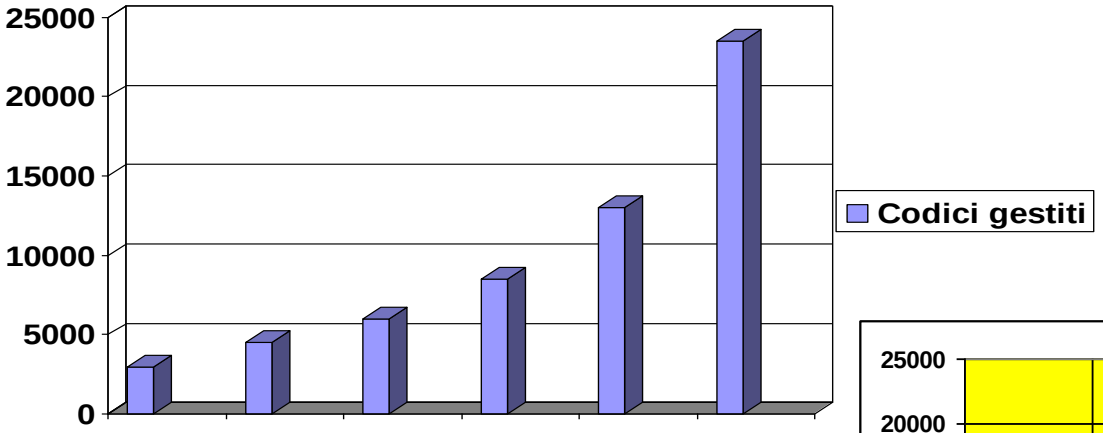


INTERNATIONALIZATION AND GLOBALIZATION OF MARKETS AND INDUSTRIAL STRUCTURE

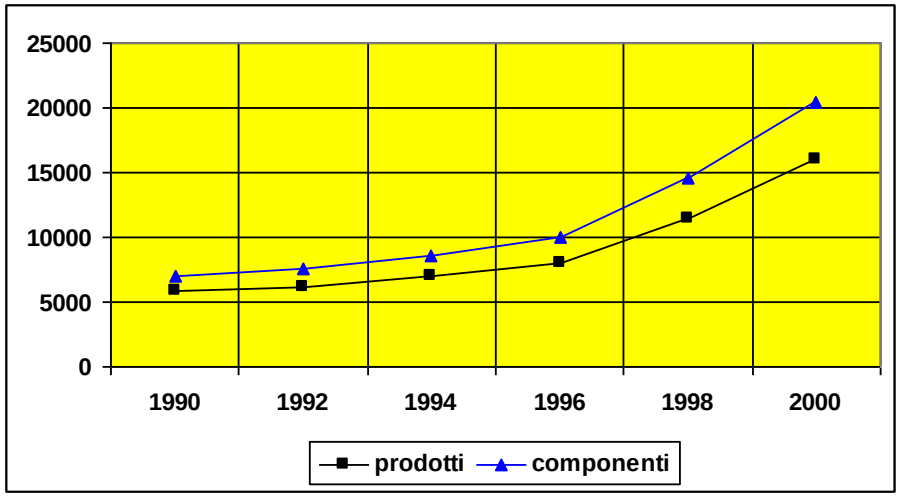


Until the 90s

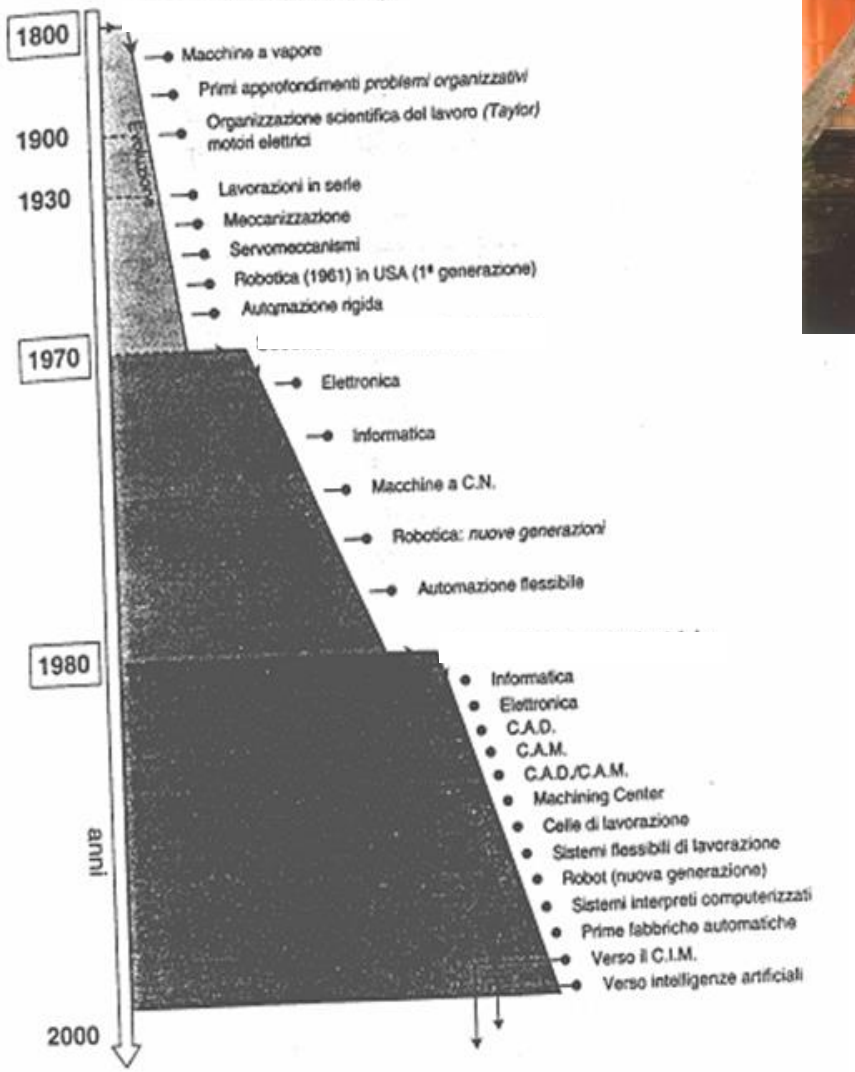
The range has impressive growth derivatives

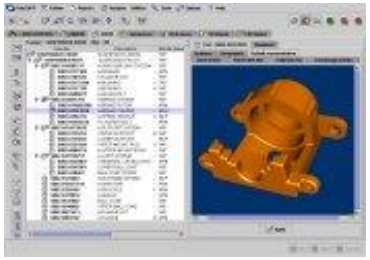


(Source: data from an electromechanical company)



The role of technology

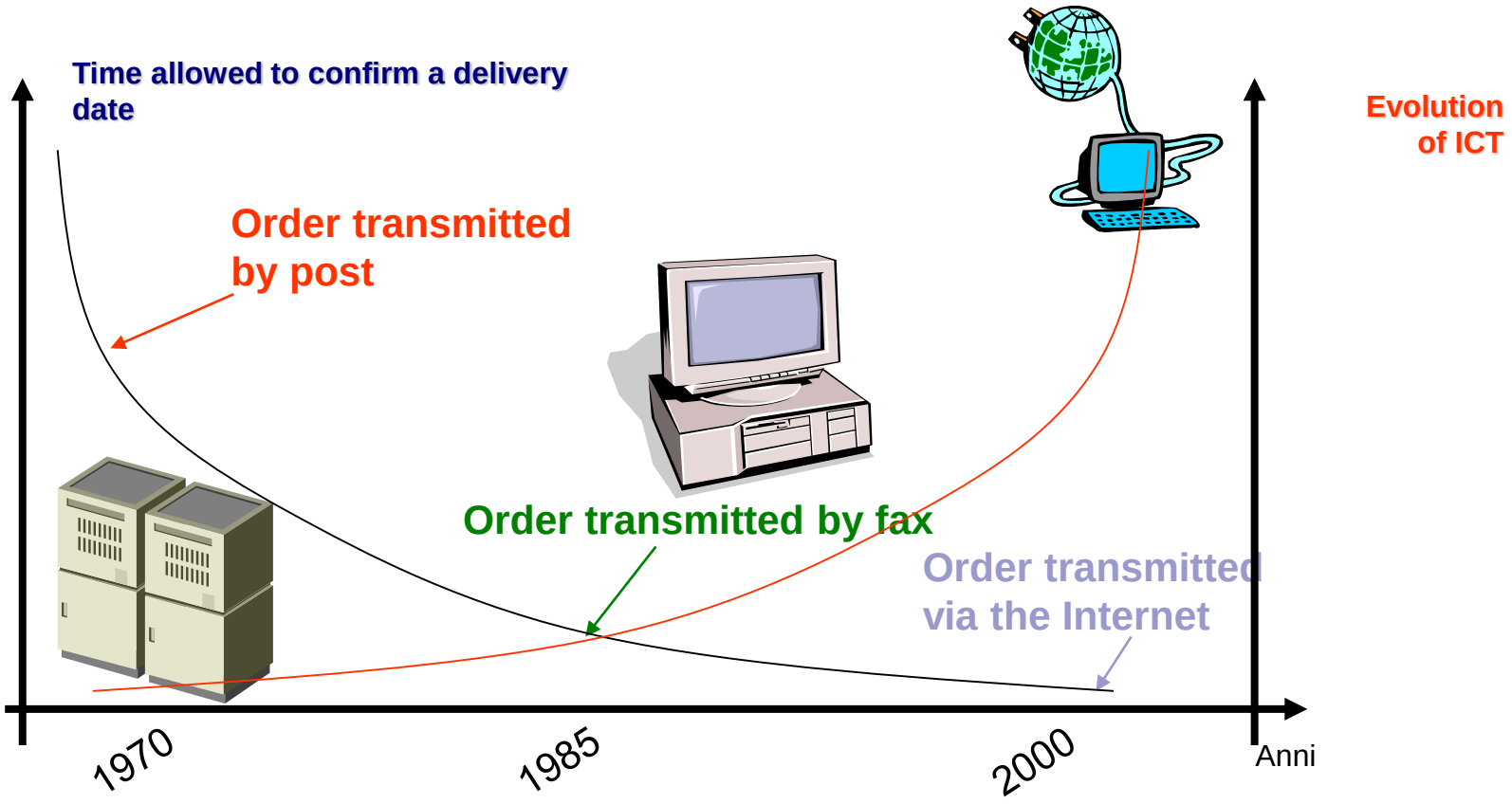




Today

- **Competitive variables are now "multivariate“**
  - **You can not afford not being efficient (cost reduction)**
  - **Cost reduction is no longer a target in itself**
  - **It’s necessary to free up resources to be more effective**
    - **Better quality**
    - **Best service**
    - **More punctuality and timeliness**
    - **…**

Today


Time allowed to confirm a delivery date
Evolution of ICT
Order transmitted by post
Order transmitted by fax
Order transmitted via the Internet
1970
1985
2000
Anni

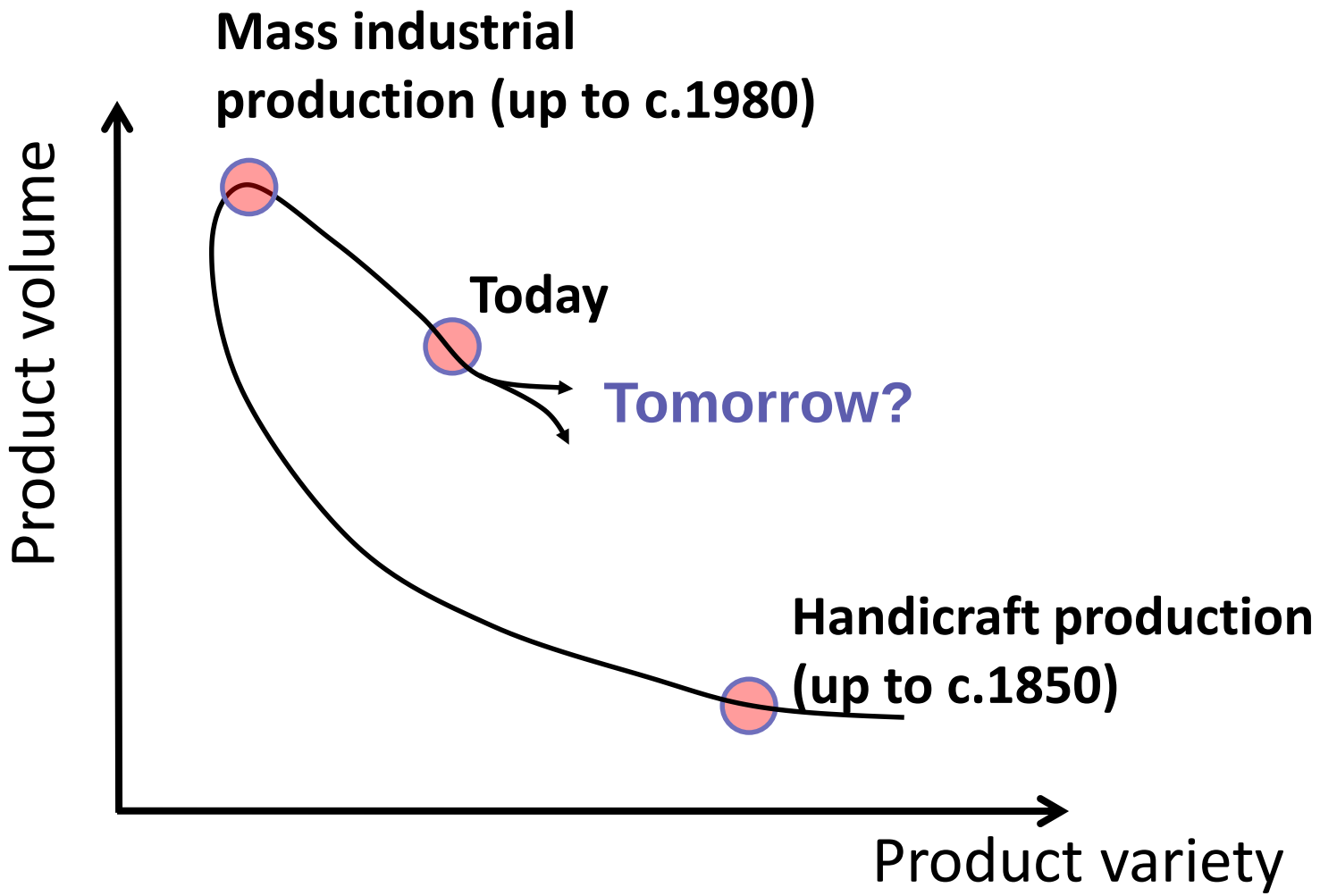
The world has changed

- **The product has changed, from “manufactured” products to "extended products"**
  - **More efficient and effective, more reliable and cheaper …**
  - **Customizable, supportable, maintainable, eco-friendly …**
- **The way to create value has changed**
  - **Not only functionality, but also intangible elements**
  - **Not just a physical asset, but also a service**
  - **Addressing more complex and multi-functional problems**
  - **Integrating more skills**
  - **Formalizing and making transferable the knowledge and innovation**

The world has changed

- **Markets show new trends, challenges and needs that companies must respond to**
  - **From mass production to mass customization**
  - **Transition to a product-service system**
  - **Network system, intra and extra business collaboration**
  - **Time To Market compression**
  - **Sustainable development and energy efficiency**

Where will the world go?



How to face the new challenges?

- As in the past, technology, with its development trends, offers new opportunities and responses to the needs of the industrial world
  - Integration of multiple technologies
  - Pervasiveness of Information & Communication Technologies (ICT)

How to face the new challenges?

- **ICT increasingly pervasive in the production system**
  - **Miniaturization of electronic systems with microprocessors (embedded systems) and increased performance**
  - **Increase of data transmission speed**
  - **Efficient and reliable wireless communication**
  - **Miniaturization of sensors and actuators**
  - **Standardization and orientation to the "service" of software components (eg Web Service Technologies)**

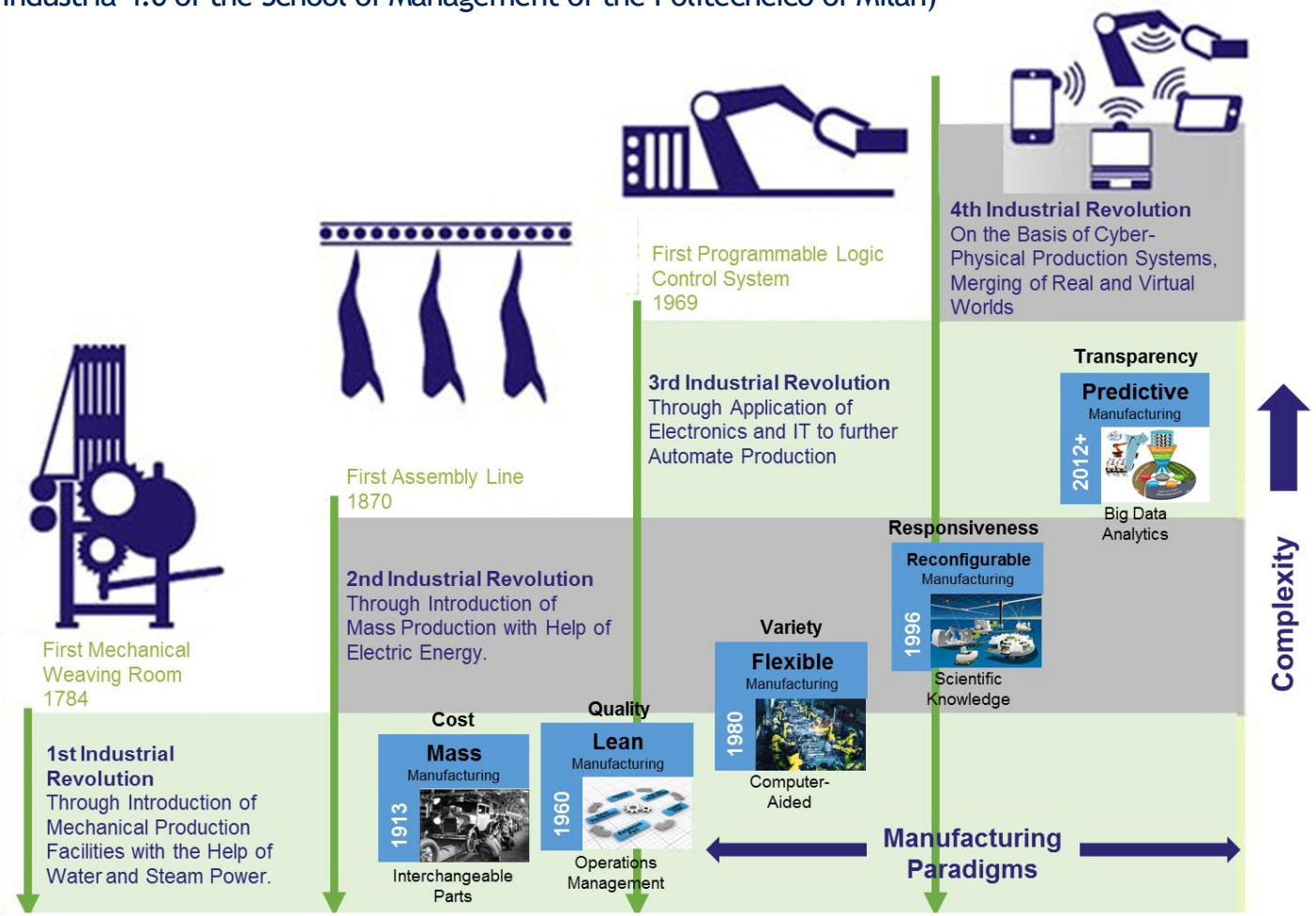
The new role of ICT at the factory

- **Virtual Engineering**
  - **Reduce the gap between design and production with a more efficient exchange of information**
- **Real Time Factory**
  - **Reduce the time between the occurrence of an event in the production system (e.g. failure) and the subsequent reporting to the manager, increasing the company's responsiveness**
- **Plant intelligence**
  - **Use business intelligence tools to identify areas of improvement in the performance of production systems, enabling the collection of more and more information of high granularity**

INDUSTRY 4.0

The fourth industrial revolution

Industry 4.0 states a **vision** of the future according to which industrial and manufacturing companies, thanks to **digital** technologies, will increase their **competitiveness** thanks to the greater **interconnection** of their resources (**plants**, **people**, **information**), both inside the Factory and distributed along the value chain (ref. Osservatorio Industria 4.0 of the School of Management of the Politecncico of Milan)



Manufacturing systems

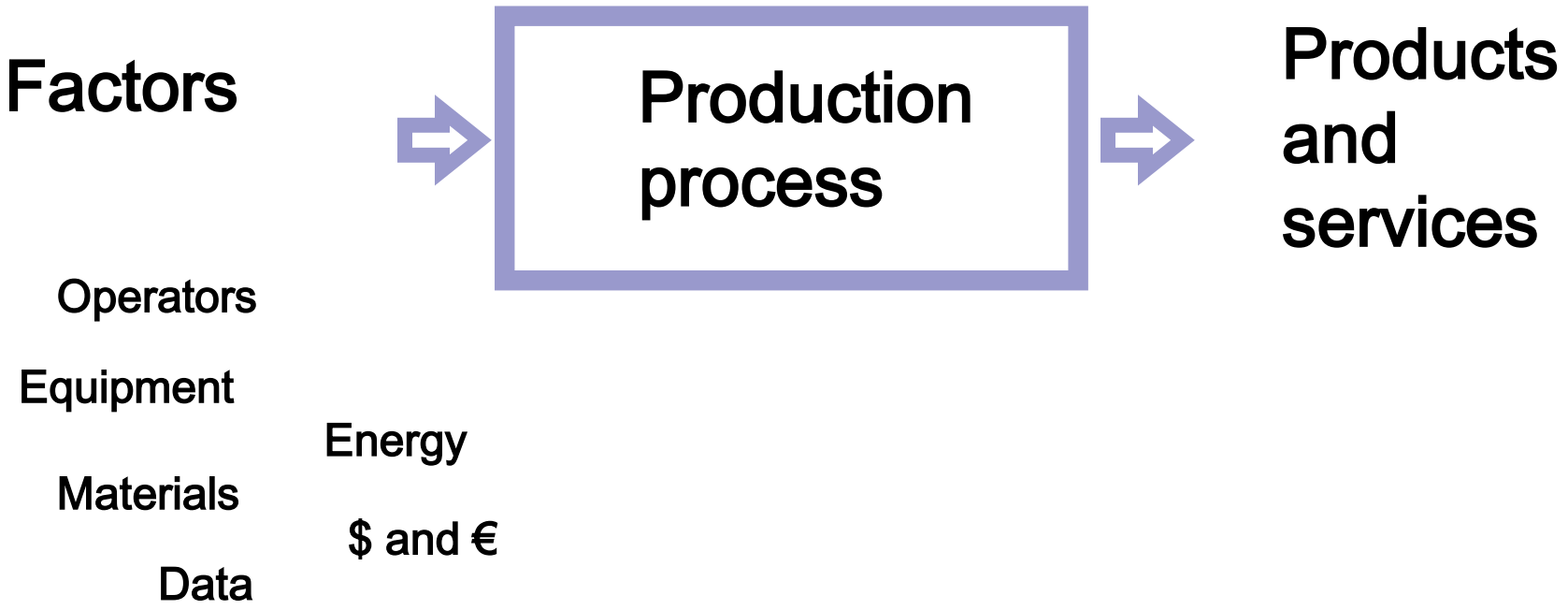
Introduction to production systems

Production (process) = set of activities (process) required to produce goods or services delivered to the market by a company

Production system = a subsystem of the company. It uses resources as inputs – raw materials, semi-finished goods, energy, information, knowledge, etc. – to provide products and services in order to satisfy the customer needs and the objectives established by the company's strategy

Production plant = physical plant where the production system is established

Production factors



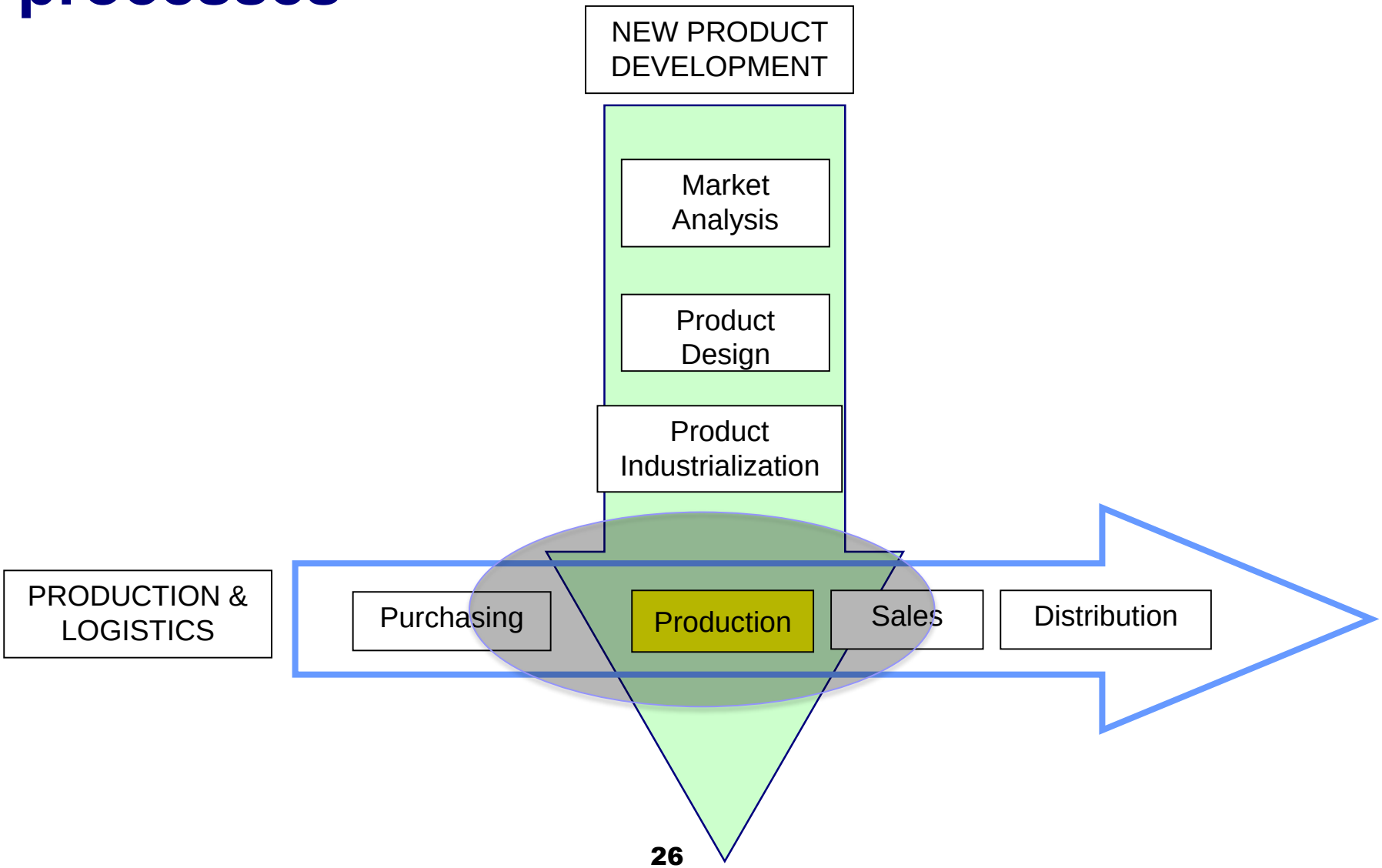
Production process

- Material acquisition, data and information retrieval
- Transformation
  - Raw materials in components and parts
  - Components and parts in final products
- Distribution

Production and Logistics

OUTBOUND LOGISTIC	INBOUND LOGISTIC	OUTBOUND LOGISTIC
PROCUREMENT	PRODUCTION	DISTRIBUTION

Production and others industrial processes

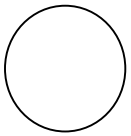


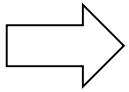
How to define a production system

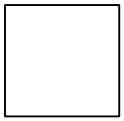
- Production process – ASME Diagram
- Flow sheet
- Layout
- Procedure

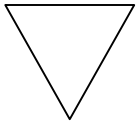
Production process

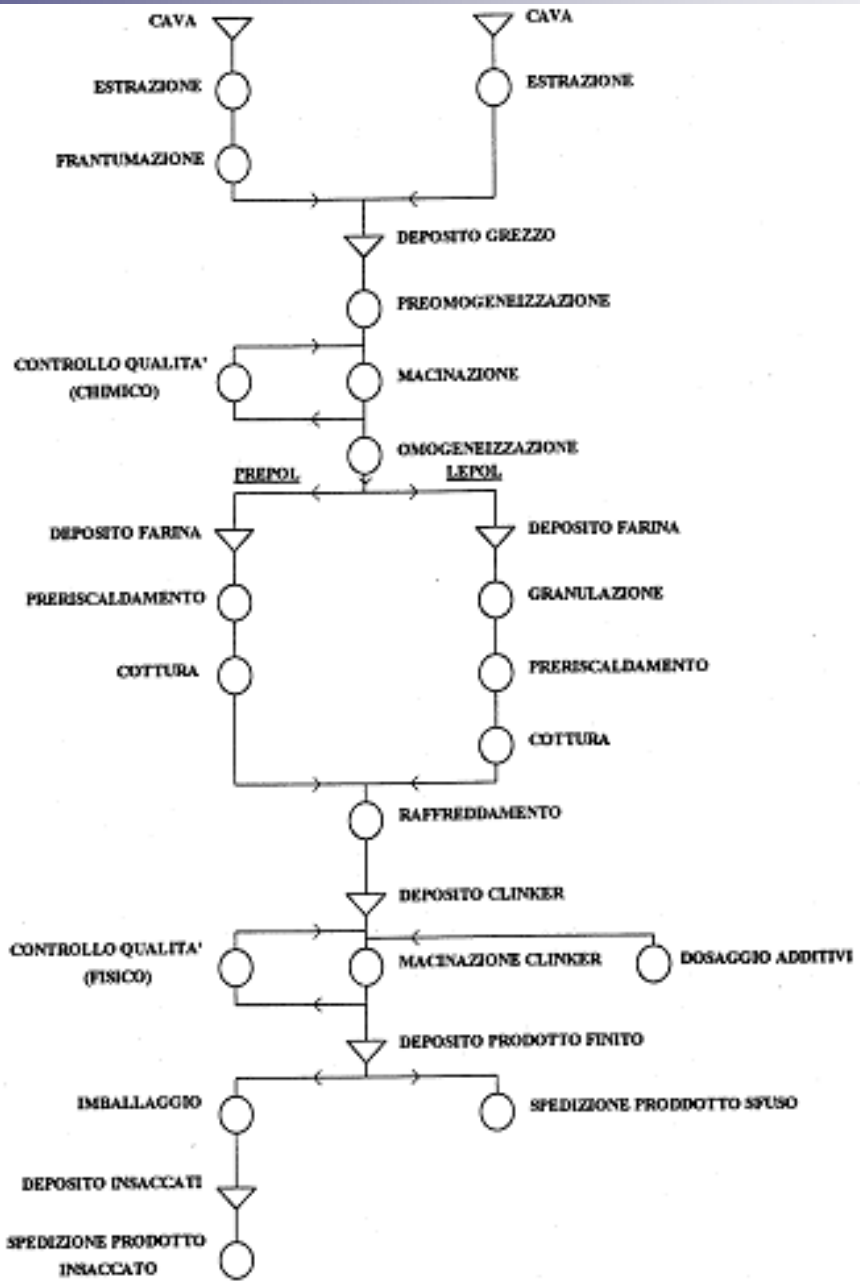
- **ASME – American Society of Manufacturing Engineering**


Production

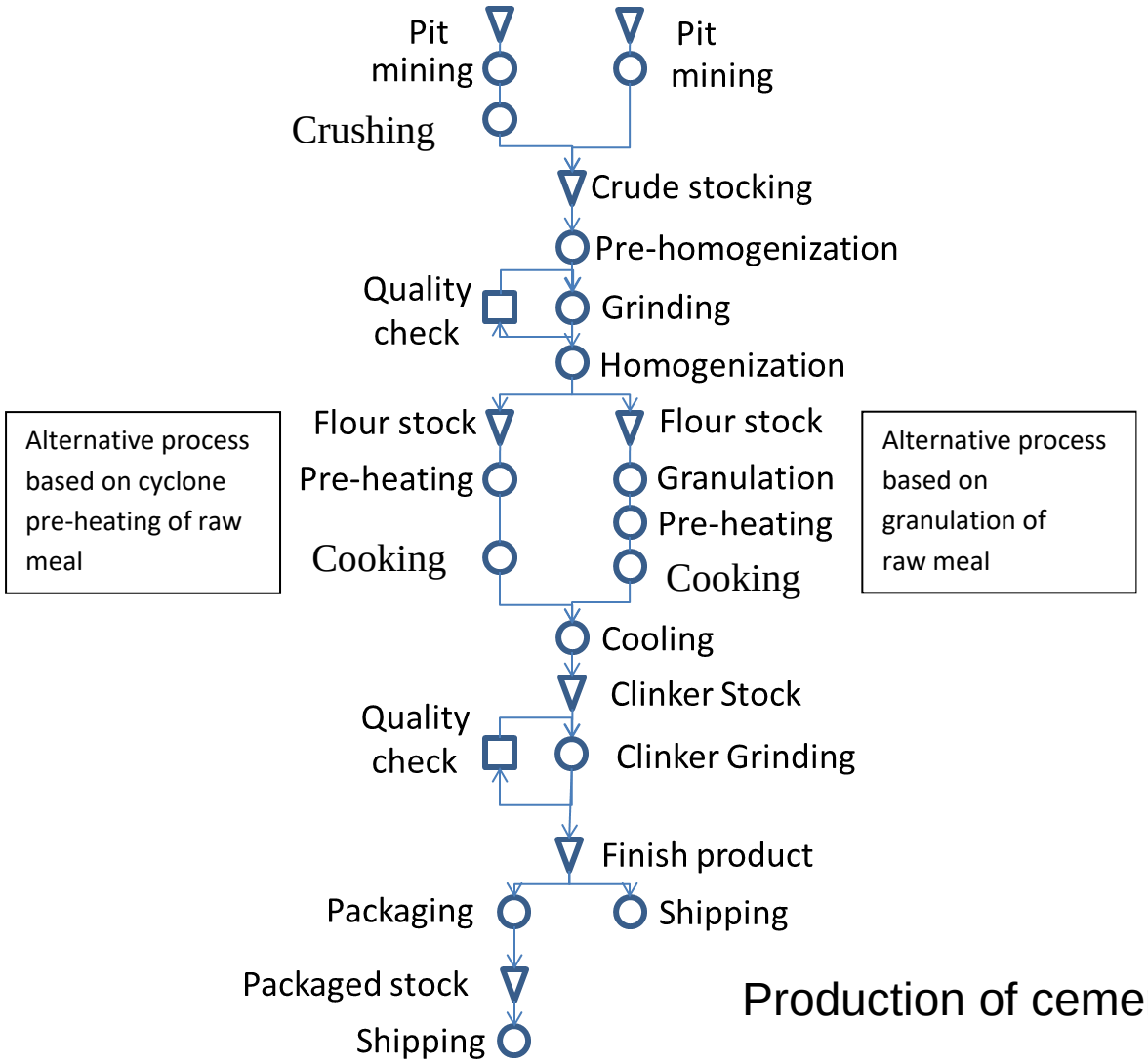

Flow, movement


Control


Waiting


CAVA
CAVA
ESTRAZIONE
ESTRAZIONE
FRANTUMAZIONE
DEPOSITO GREZZO
PREOMOGENEIZZAZIONE
CONTROLLO QUALITA'
(CHIMICO)
MACINAZIONE
OMOGENEIZZAZIONE
PREPOL
LEPOL
DEPOSITO FARINA
DEPOSITO FARINA
PRERISCALDAMENTO
GRANULAZIONE
COTTURA
PRERISCALDAMENTO
COTTURA
RAFFREDDAMENTO
DEPOSITO CLINKER
CONTROLLO QUALITA'
(FISICO)
MACINAZIONE CLINKER
DOSAGGIO ADDITIVI
DEPOSITO PRODOTTO FINITO
IMBALLAGGIO
SPEDIZIONE PRODDOTTO SFUSO
DEPOSITO INSACCATI
SPEDIZIONE PRODOTTO
INSACCATO

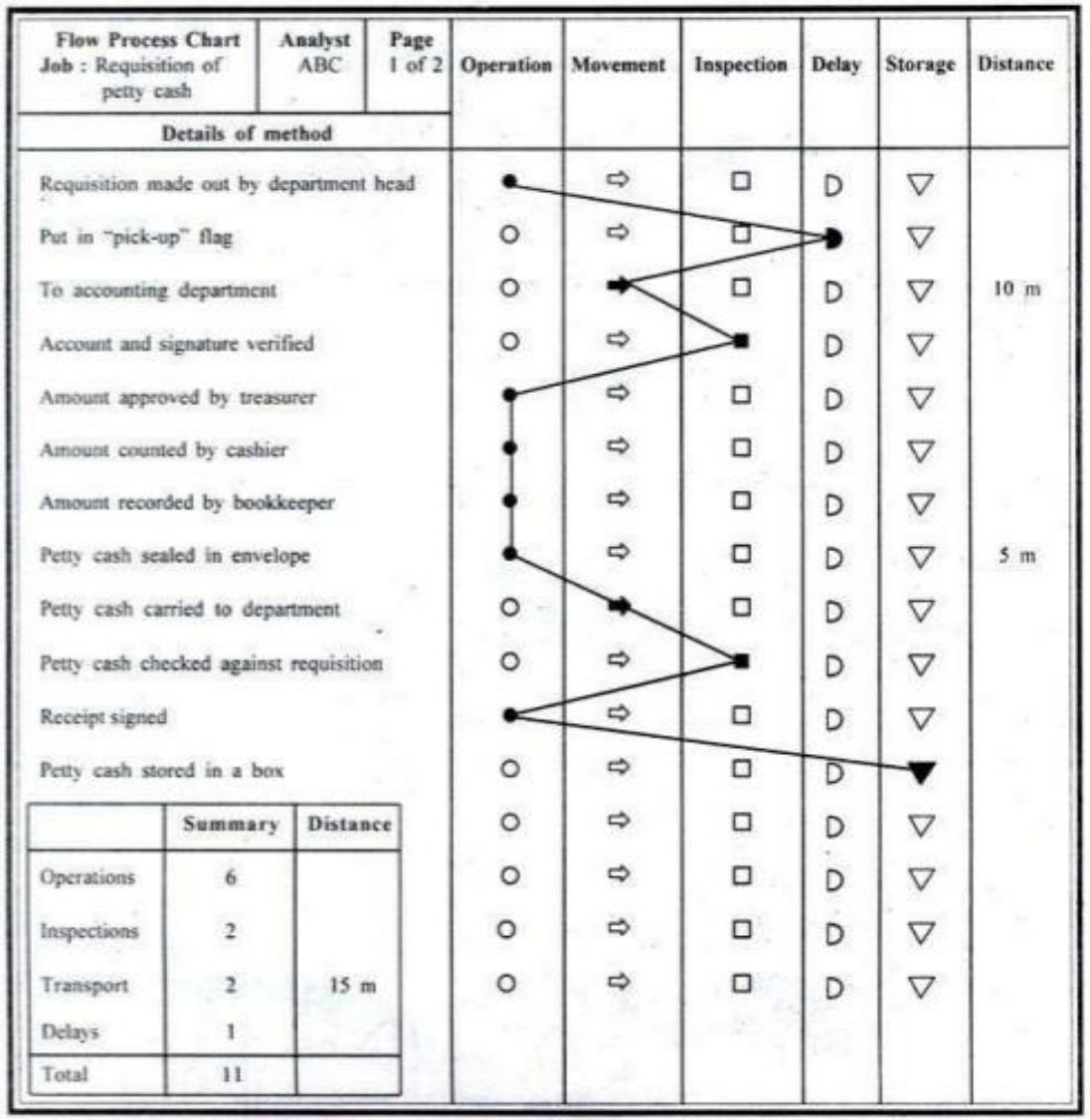
Example of a process diagram



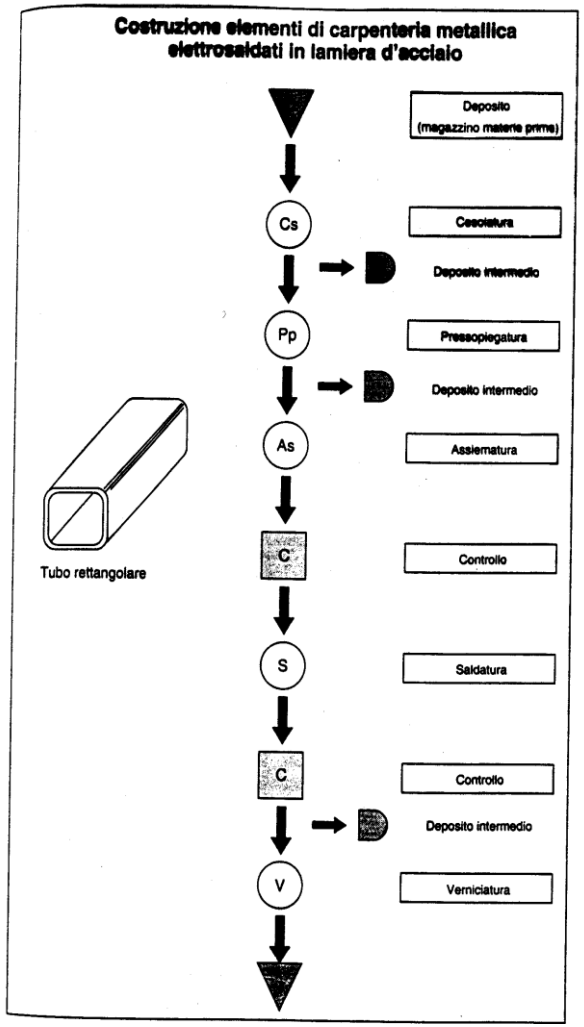
Production of cement by 2 alternative processes

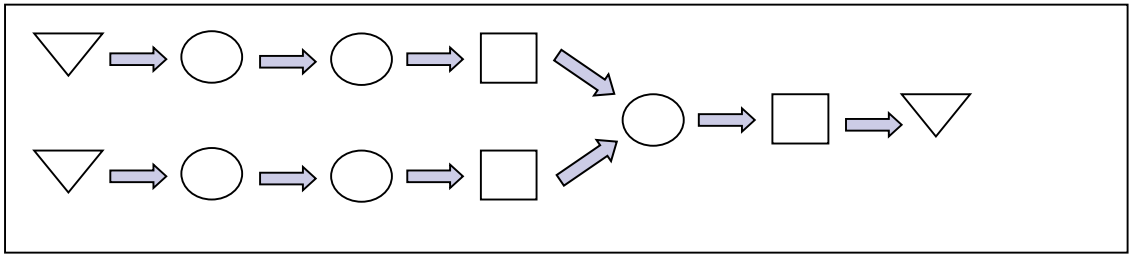
Costruzioni metalliche

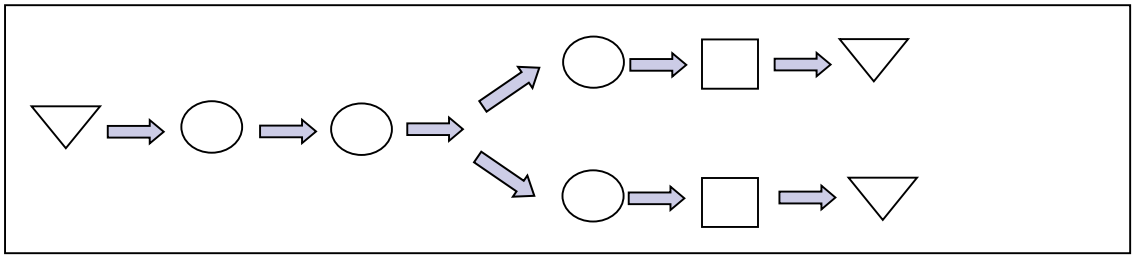
Descrizione	Simboli	distanza (m)	tempo (sec)	qunatità (kg)	Osservazioni
Magazzino					Gru a ponte
da magazzino a cesoiatura		30	60	Lotti di 2.500	
Cesoiatura			80 / pezzo		
Deposito intermedio					Spazio accanto alla cesoia
da deposito intermedio a presso-piegatura		20		2.200	
Presso-piegatura			45 / pezzo		
Deposito intermedio					Spazio accanto alla pressa
da deposito intermedio ad assiematura		25			
Assiematura			240		
Controllo					Il controllo avviene nello stesso luogo di assiematura
da controllo a saldatura					
Saldatura		30	600		
Deposito intermedio					Spazio accanto reparto di saldatura
da deposito intermedio a verniciatura		20			
Verniciatura			500		
da verniciatura a magazzino		20			
Magazzino					

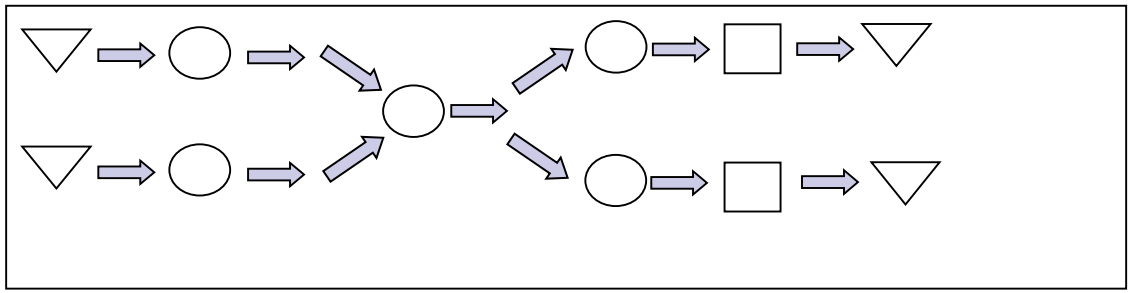

Flow Process Chart
Job : Requisition of petty cash
Analyst
ABC
Page
1 of 2
Operation
Movement
Inspection
Delay
Storage
Distance
Details of method
Requisition made out by department head
Put in "pick-up" flag
To accounting department
Account and signature verified
Amount approved by treasurer
Amount counted by cashier
Amount recorded by bookkeeper
Petty cash sealed in envelope
Petty cash carried to department
Petty cash checked against requisition
Receipt signed
Petty cash stored in a box
10 m
5 m
Summary
Distance
Operations 6
Inspections 2
Transport 2 15 m
Delays 1
Total 11

Different types of production flows

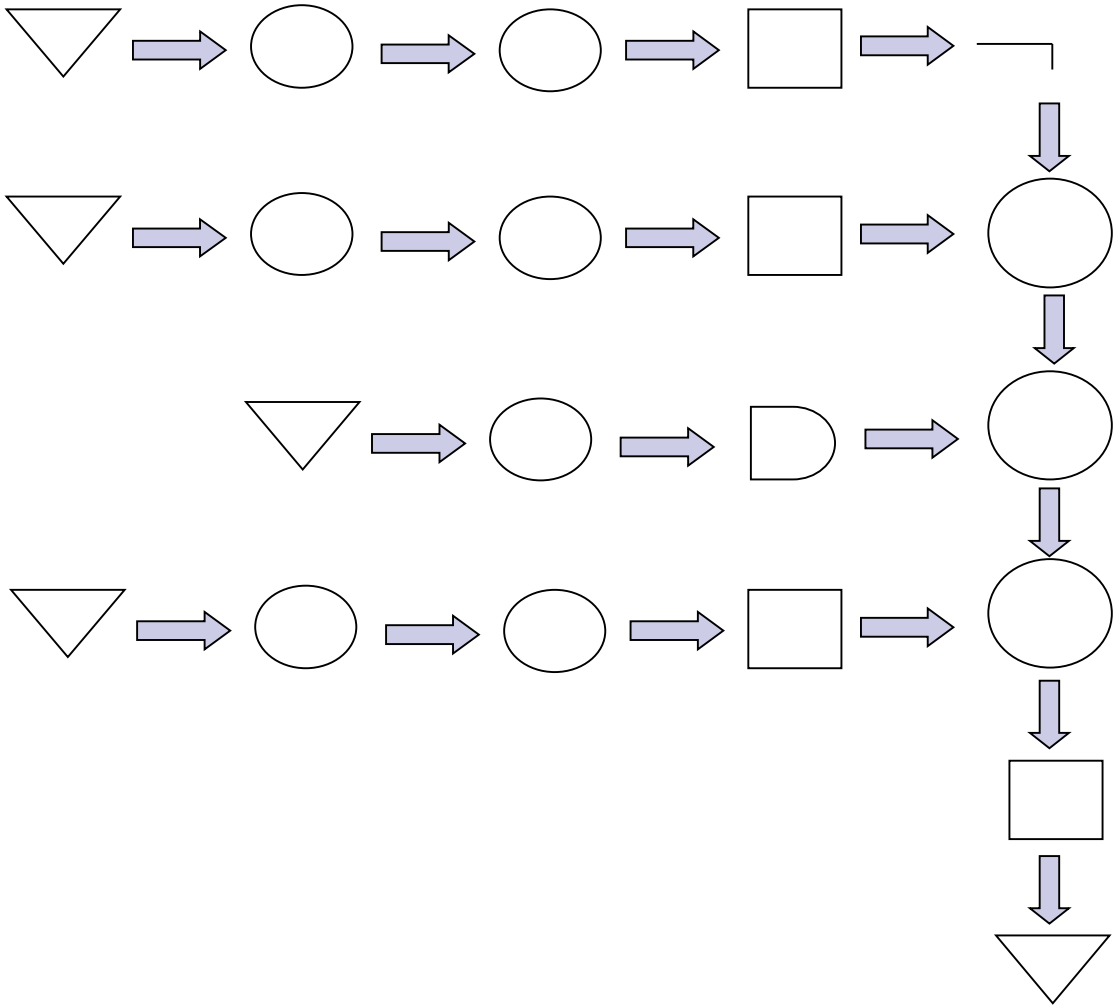




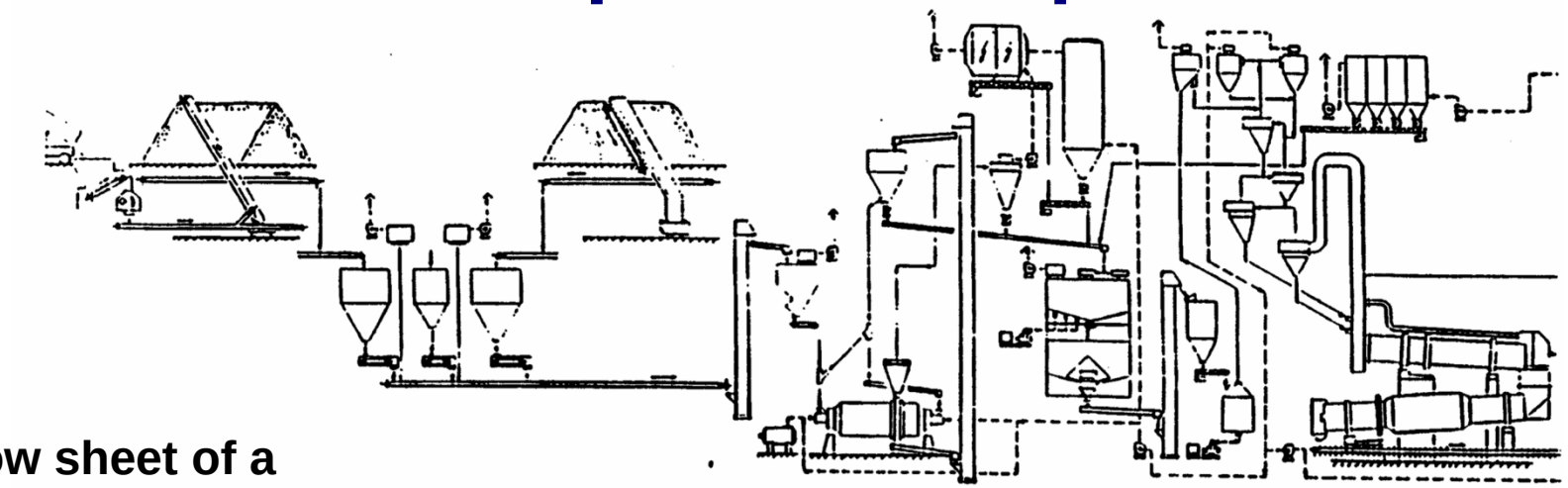




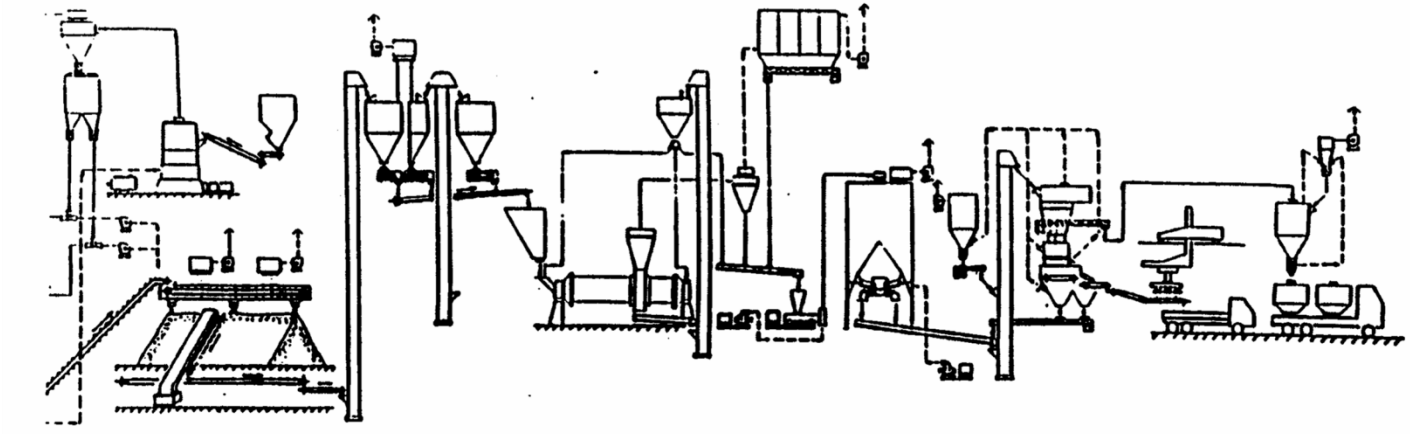
Different types of production flows



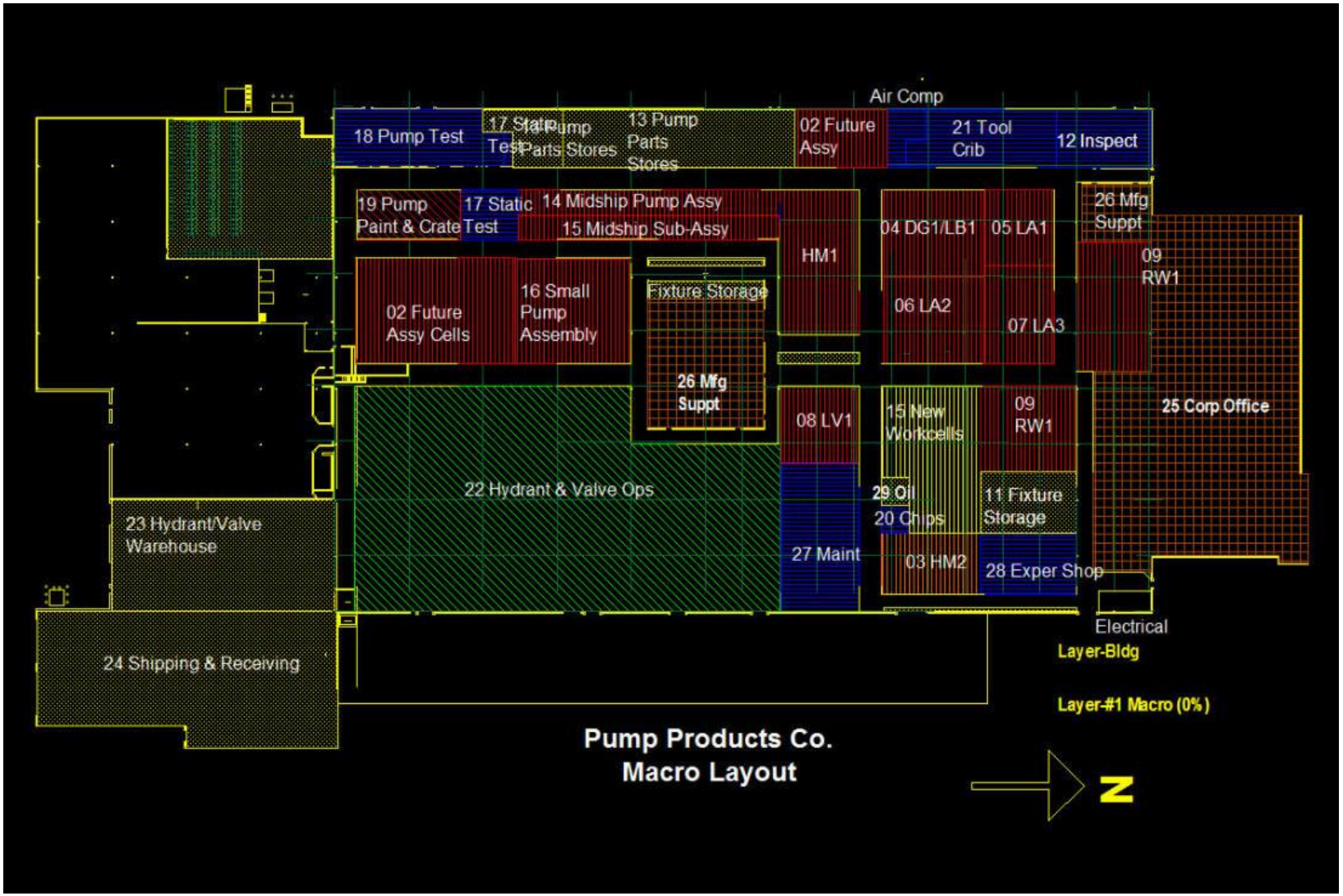
Flow sheet of a production plant



Flow sheet of a cement plant



Layout of a production plant



Layout of a production plant

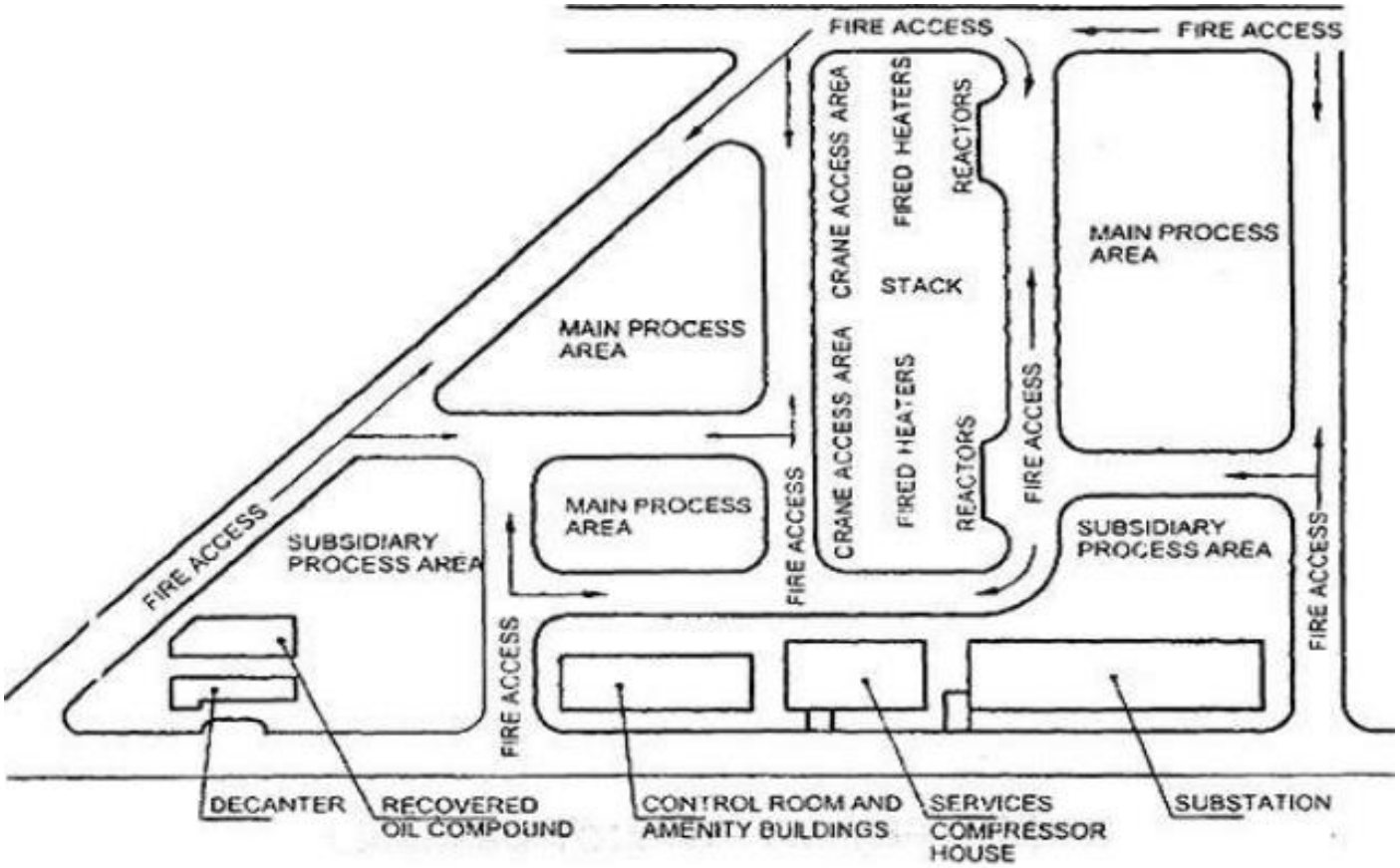
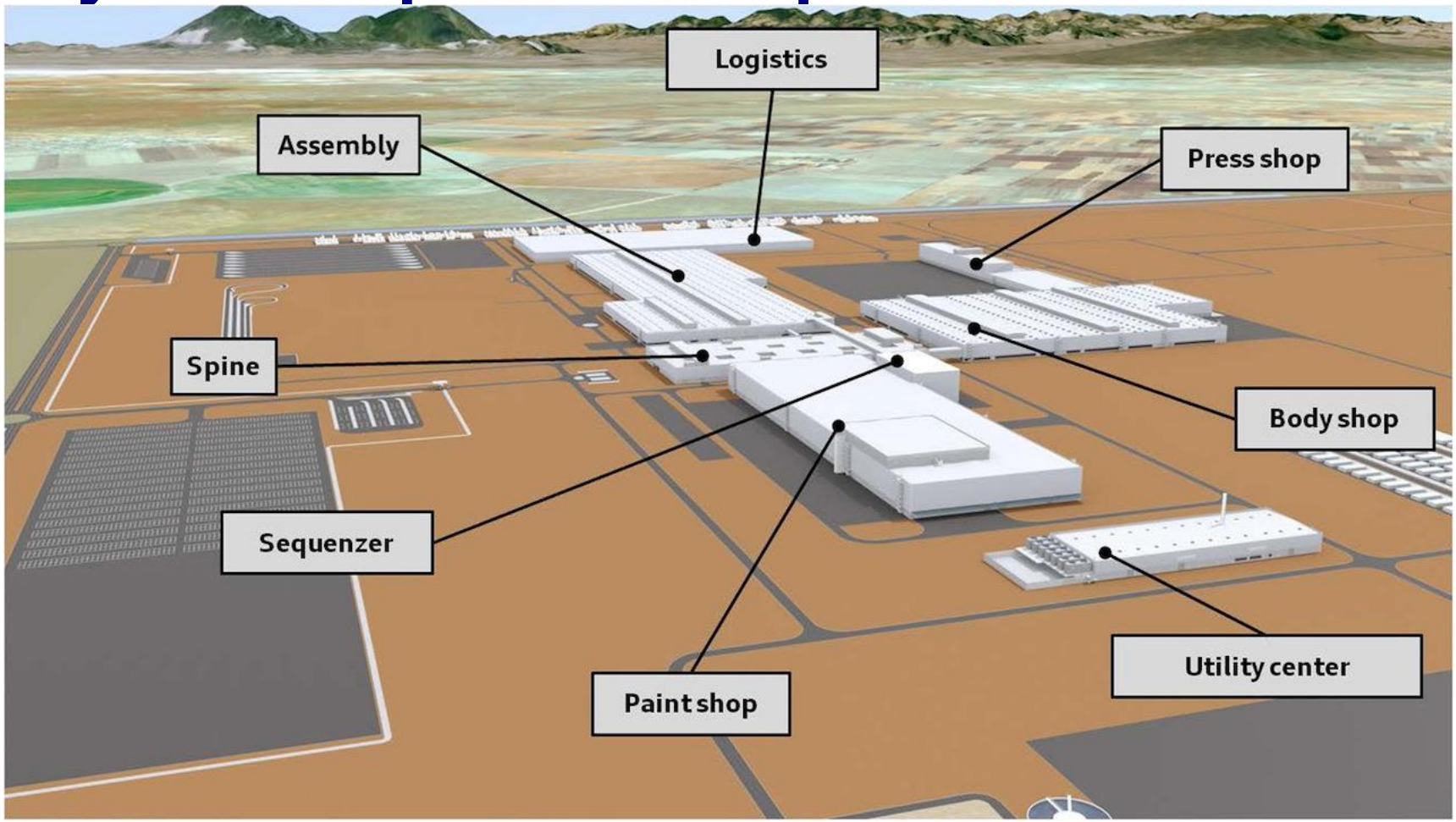
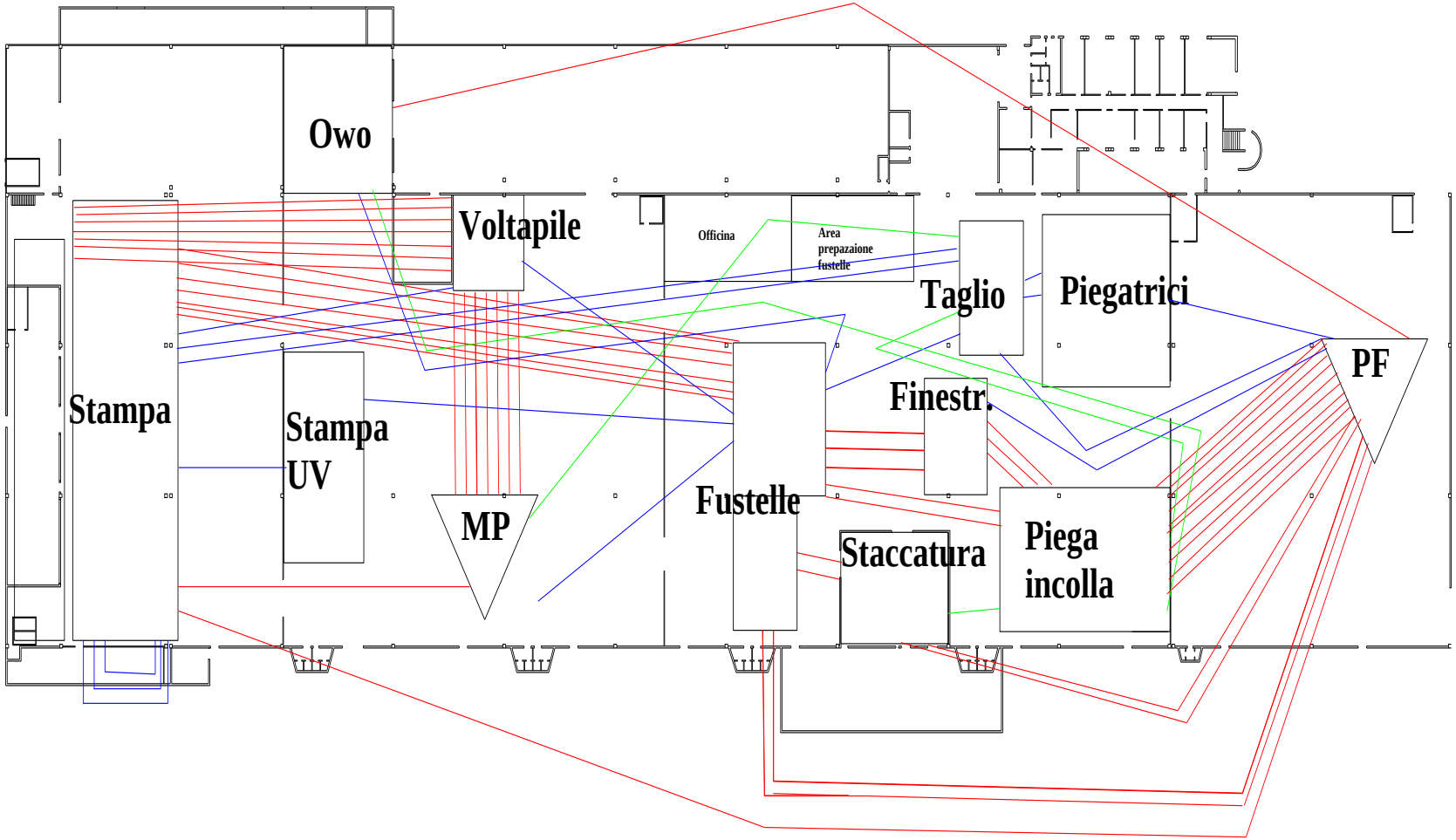


Fig. Layout System in the Process Area of a Petrochemical Plant

Layout of a production plant



Layout of a production plant



Procedural aspects

- **It shows the operational aspects of a production process, by describing the different phases that constitute the operational procedure of production management.**
- **It includes the following phases:**
  - **(Aggregate) production planning**
  - **Material requirements planning**
  - **Production scheduling**
  - **Production control**
- **The typical tool is the *flow-chart***

The *Flow-chart*