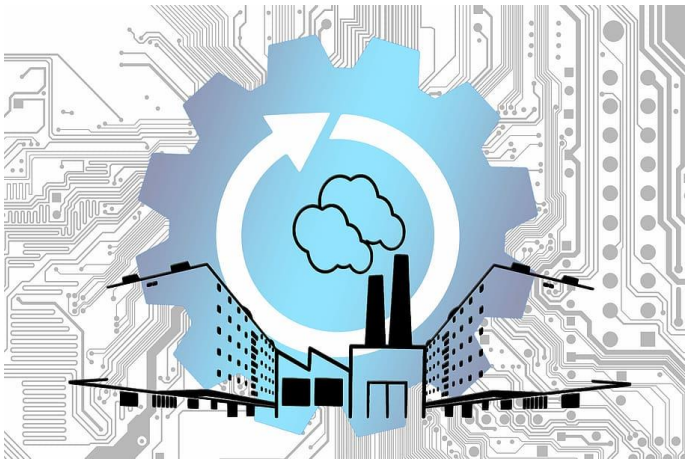
Last Name:
First Name:
CLASS / GROUP:

# WORKSHOP Industrial and Supply Chain Management



**Solène FANJUL & Bertrand MARCONNET**

***C2MI Department*** *(Design, Manufacturing and Industrial Management)*

**TEAM NAME:**

**1ST TEAM-MATE:**

**2ND TEAM-MATE:**

**3RD TEAM-MATE:**

**4TH TEAM-MATE:**

**5TH TEAM-MATE:**

**6TH TEAM-MATE:**

**7TH TEAM-MATE:**

**8TH TEAM-MATE:**

**COHESION VALUE TEAM**:

| | |
|---|---|
| Commitment | Solidarity |
| Excellency | Truthfulness |
| Straightforwardness | Honesty |
| Effort | Courage |
| Fraternity | Rigor |
| Justice | Humor |

These values will allow you to solve difficulties among the team.

# WORKSHOP
# INDUSTRIAL & SUPPLY CHAIN MANAGEMENT

## *Structure and Organization of Workshop*

**Main objective:**

Beyond the scientific & technical, organizational, economic and environmental dimensions, this Industrial & Supply Chain Management workshop also purports a human experience - team working project around industrial problematics.
We do hope this workshop will benefit you during your engineering student degree and will convince you to choose the 'Industrial & Supply Chain Management' specialty for your 3rd year among the engineer cycle EENG.

**Expected skills:**

- To know, identify and choose the best fitting workflow to a situation
- To be able to choose the most suitable organization according to the sales requirements
- From pre-established elements, to be able to achieve a product line for a joining operation
- To be able to evaluate workload and define the necessary resources.
- From an ergonomics standard, to design and implement a full-scale model of a workstation, which would be suitable for both the workload and the flow requirements.
- To be able to perform the work according to the model, to make a simplified critical analysis and then, to propose beginnings of an action plan.

**Pedagogy:**

- Distribution of a course material
- Working in teams (4 teams)
- Supervised by two teachers
- Evaluation: four milestones each one at the end of a session

**Session # 1** (Speakers SF + BM):

- 1:00: Project presentation and organization of the workshop (operating rules and notation)

Teams composition and determination of project management's operating rules

- 2:00: Course's elements and exercises around the production organization to meet the sales forecasts:

  1St Year: 500 parts
  2nd Year: 4 000 parts
  3rd Year: 40 000 parts

  **1st Milestone:** Presentation of each team (workload, FTE and Production organization & sales) presented in 2 slides

- 1:00: Presentation of teamworks.

  Synthesis / Conclusion

**Session # 2** (speakers SF + BM ):

- 1:00: From pre-established elements, construction of the assembly procedure (routing sheet), in correspondence with various scenarios, Routing course's elements
- 2:00: From a real dismantled 3D model and a printed speaker, retro engineering and production range with its phases
  **2nd Milestone :** Presentation by each team of its routing sheet with calculated items (cost price calculations, new workload calculations and determination of the necessary resources, forecast flows) in the form of two slides
- 1:00: Presentation of teamworks.
  Synthesis / Conclusion

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**Session # 3** (Speakers SF + BM):

- 1:00: Ergonomics course
- 2:00: From the ergonomic design standard (manuscript sketches in perspective with principal dimensioning elements and implementation of a full-scale model of a workstation adapted to the workload and flow requirements, operating workstation test, time recordings, ...
  **3rd Milestone:** Presentation by each team of its workstation
- 1:00: Presentation of teamworks.

  Synthesis / Conclusion

**Session # 4** (Speakers SF + BM):

- 1:00: Inventory management and global Supply Chain organization course in correspondence with the different steps of the product lifecycle
- 2:00: **4th Milestone :** Carrying out the layout plan of the manufacturing workshop, scaling it on an A3 sheet. Display each step of the manufacturing process (from storage of components to the shipping of the end product).
  Presentation by each team of the results.
- 1:00: Workshop-end, thanking, students' feedbacks

**Session # 5** (Speakers SF + BM):

- Summarize of the workshop with a general presentation

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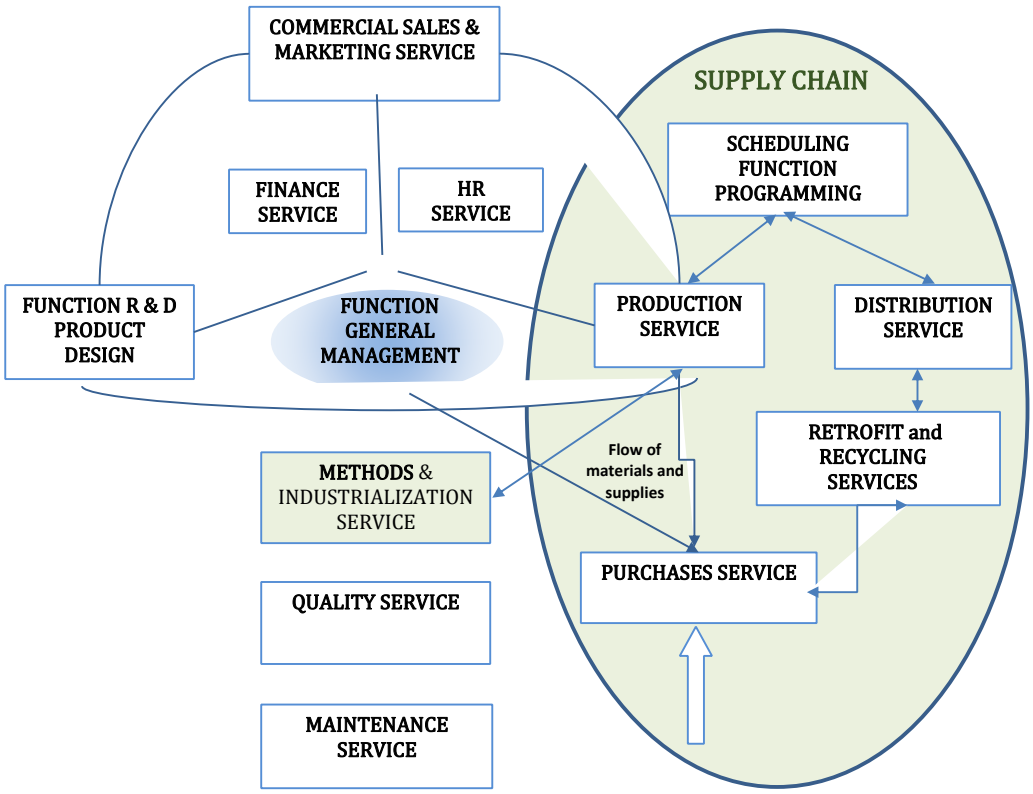
## *Subject: Industrialization, manufacture and delivery of a vibrating speaker connected and personalized*

ECAM Factory is a SMI (Small and Medium Industry) of 60 people that designs, manufactures and markets premium products online.

Your Supply Chain project team will be composed of team members from services (in green below) of the company:




The project team you just created will aim at designing and implementing a global supply chain organization integrating industrialization and mass production of a new model of connected speaker.

You have 6 months to be able to provide customers deliveries in accordance with sales forecasts.

This speaker uses Bluetooth technology, it could provide sound in a room around 25m2 **(see demo).**

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# INDUSTRIAL & SUPPLY CHAIN MANAGEMENT

Industrialization and manufacturing only affect the operations:

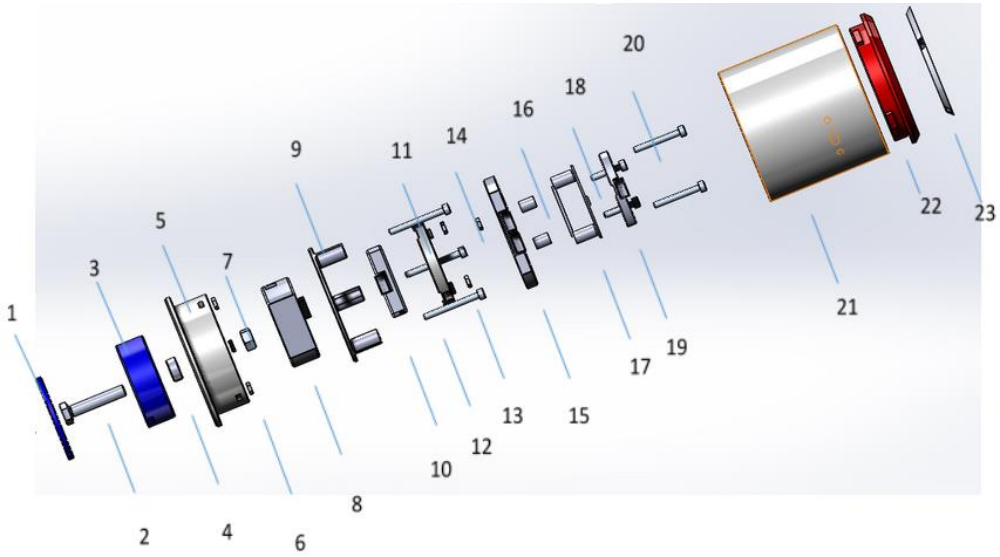
- Connecting and assembling operations
- Personalization and Packaging

For this Workshop, a printed model (scale 1) will be used.

Input data:

- Each enclosure can be customized by an engraving on his upper membrane, carried out using a micro numerically controlled milling machine.
- The time to realize this engraving is 24 hours between order and expedition, customers have to be Delivered in less than 48 hours.
- Sales Forecast:
  - YEAR 1: 500 products
  - YEAR 2: 4 000 products
  - YEAR 3: 40 000 products

Internal parts of the connected speaker



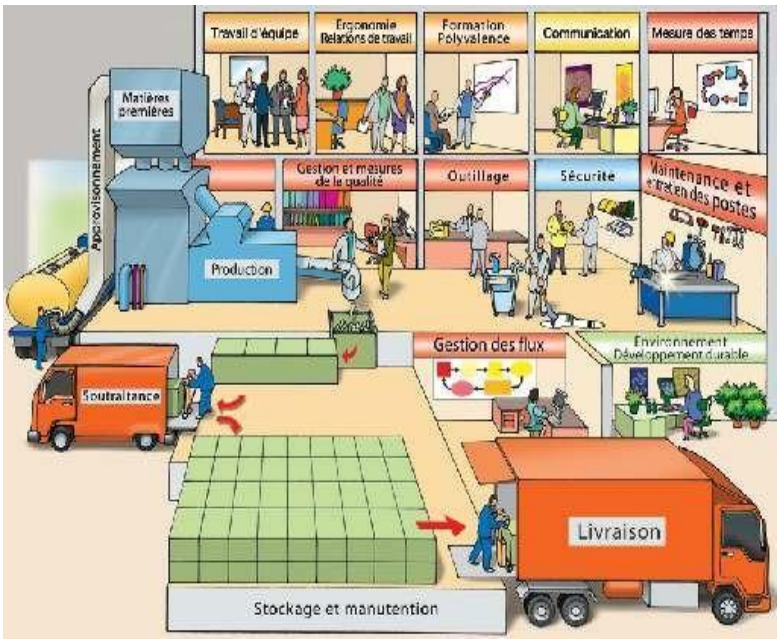

| No | Designation | Quantity |
|---|---|---|
| 1 | Lower diaphragm | 1 |
| 2 | Screw M6 x 25 | 1 |
| 3 | Foot | 1 |
| 4 | Spacer | 1 |
| 5 | Bottom cover | 1 |
| 6 | Nut M3 | 3 |
| 7 | Nut M6 | 1 |
| 8 | Vibrating pot | 1 |
| 9 | Motherboard support | 1 |
| 10 | Battery | 1 |
| 11 | Battery support | 1 |
| 12 | Screw CHC M3 x 35mm | 3 |
| 13 | Nut M3 | 2 |
| 14 | Nut M3 | 2 |
| 15 | Electronic board | 1 |
| 16 | Matrix board | 1 |
| 17 | Bluetooth board support | 1 |
| 18 | Screw CHC M3 x 16mm | 2 |
| 19 | Bluetooth board | 1 |
| 20 | Screw CHC M3 x 25 mm | 2 |
| 21 | Body | 1 |
| 22 | Top cover | 1 |
| 23 | Upper membrane | 1 |
| 24 | Connection cables | 2 |

| | | |
|---|---|---|
| 25 | Welding cable | 1 |

## *Course element to be completed over ½ days*

### *SESSION 1 COURSE 1: INTRODUCTION TO INDUSTRIAL AND SUPPLY CHAIN MANAGEMENT*

*General presentation*




## Supply Chain

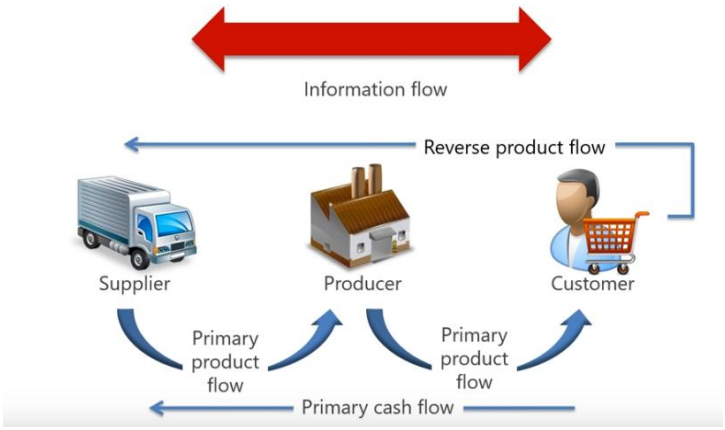
**«Supply Chain»**: The global network used to deliver products and services from raw material to end customers through an engineered flow of information, physical distribution, and cash.

(APICS Dictionary)

This concept was popularized in the mid 1990's. The main objective is to develop a process vision for analysis and resolution of interrelated problems, previously treated independently for organizational reasons (limits of service responsibility).

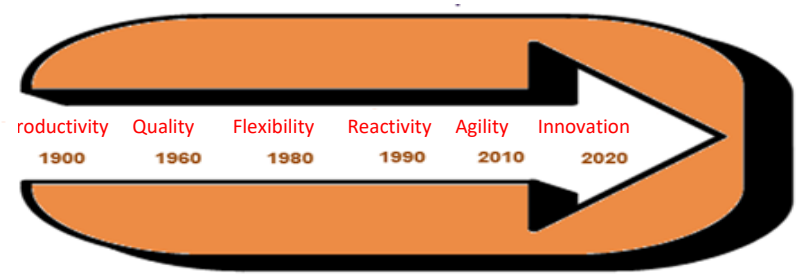
## Supply Chain Management

The design, planning, execution, control and monitoring of supply chain activities with the objective of creating net value, building a competitive infrastructure, leveraging worldwide logistics, synchronizing supply with demand, and measuring performance globally.




*Simplified Supply Chain flows representation*

## Market requirements




**1900**: Maximum productivity in research designed from a difference between the value of outgoing products and the cost of incoming goods as well as taking into account the factors of production.

**1960**: We looked to make products more reliable, following quality standards. Emergence of quality assurance systems and certification procedures.

**1980**: Mechanization and automation have introduced the concept of flexibility and quick-changing references techniques.

**1990**: Looking for a better reactivity to various disturbances such as changes in demand, the supply hazards, declining inventories, and complex machine failures.

**2010**: Emergence of multiple imperatives related to the integration of new data:

- Evaluation of performances
- Advanced approach
  - Techniques
  - Organizational
  - Human & Environmental

**2020**: Innovate and design new products and services with a sustainable development vision.

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The Supply Chain is more and more complex with globalization : we can produce and buy products from any industrialized country in the world. You can have partners, customers and suppliers in lots of different countries.

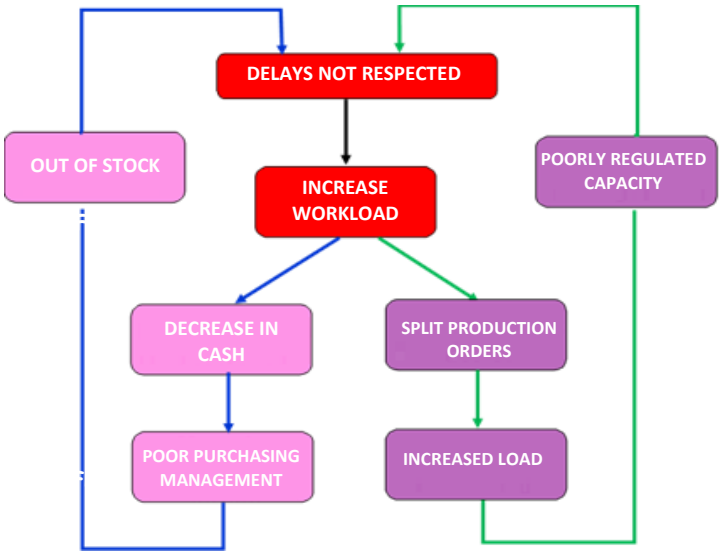
## *The industrial requirements*

- Complex product with high performances.
- Diversity of processing steps.
- Increasing number of components
  Ex: Bicycle 200 to 700 components
  Automotive 4 000 to 10 000 components
  Rocket 20 000 to 60 000 components
- Development of customer's offer with many variations

## *General problems related to order management*

The main problem encountered in production management is mainly related to non-compliance with deadlines. The analysis of a company in difficulty leads to the following observation: Customers are not delivered on time, so all the production orders become a priority, inventories grow and elongation of financial cycles increases capital's need which create a financial mismatch.

The mechanism is described as follows:




Finally, the relationship between Sales service and production becomes strained, social climate deteriorates, production decreases.

## Identification of tasks and functions related to the production

The tasks related to production are still characterized by:

- the entry of information on computer or input data
- The implementation of analysis methods which can be manual, automatic or mixed
- The analysis and control of the validity of the results

Overall, a production problem entails following tasks:

- Registering data and define customer needs
- Technical study
  - About product design
  - In terms of enforcement methods

Study of manufacturing processing conditions that best meet the three objectives

  - full use of resources
  - Respect deadlines
  - Reduced inventory and workload

All tasks must be prepared and carried out according to the objectives of the general management of the company. The decisions represent the company policy.

The diversity of tasks and specialization of performers require precise coordination, the first level is : Grouping tasks per function.

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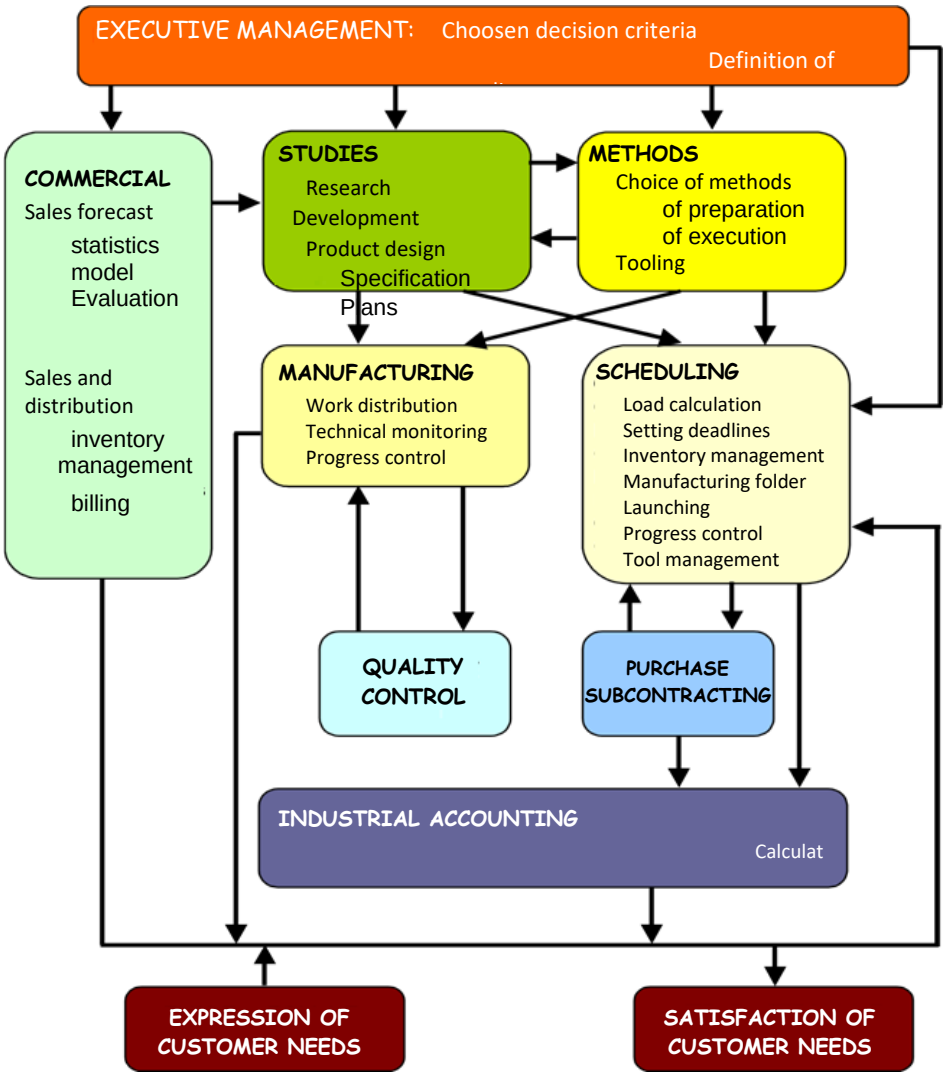

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*SEANCE 1 COURSE 2: PRODUCTION MANAGEMENT ORGANIZATION*

## *General presentation*

In our company, manufacturing is a major activity, as it brings value to the product and it is where investments are the most considerable.

Therefore, the proper use of the means of production through scheduling and workflow management becomes ever more important.

Here, we will only carry out assembly and printing of the speakers. We are then facing two problems:

- Inventory management
- Flow management

The major issue about flow management is to satisfy the customer's needs, this is why it should manage to deal with both types of flows in accordance with the quality standards of products and related services:

- **Physical flows:** Supply of raw materials, movement of raw materials and components, output of end products.
- **Information flows:** Orders, production orders (PO), routings, control of technical data, maintenance, scraps, consumption materials, labor hours, use of the means of production.

**Inventory management** aims at ensuring the control of supplies in order to satisfy their availability for product development or customer needs.

In order to meet these needs of management of stocks and flows, there are many tools (MRP, Kanban, etc.) but they cannot be used in every situation.

They are generally adapted to a type of production organization and unsuitable to another type.

**Consequently, it is necessary to define the type of organization in a manufacturing company**. The classification criteria are numerous.

Several criteria can be applied, the main ones are:

- The type of workflow (continuous or discontinuous),
- The size of the fabricated series (single or very large series)
- The types of sales and production (from stock, on order),
- The type of product.

## *Material flows*

A key objective of any company is to deliver products to its customers, when they demand it. It is therefore necessary to ensure efficient management and control the flow of materials, components and finished products within the company. The flow of material flow from suppliers of raw materials to the delivery of finished products via the various manufacturing operations has little in common with the flow of a quiet river. Instead, we are facing a river coming across many dams, locks and waterfalls rushing.

The different types of sale (by order, from stocks or limited in advance) will also influence the flow management.

## *The different types of productions*

They are closely related to the main types of sale:

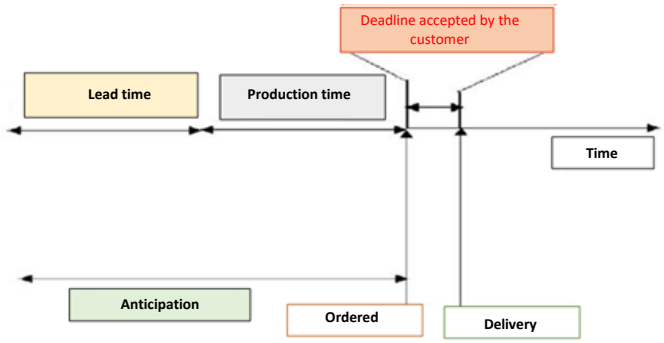
### Make to stock

When the processing time exceeds the limit accepted by the customer, it is necessary to produce before receiving the customer's order.

*Example:* clothing, television...

To reduce production costs it is sometimes necessary to produce in large quantities. Example of drawing a book in 3000 copies.

When the seasonality of demand is too strong and it is useless to keep men and resources to produce all year.




### Make to order

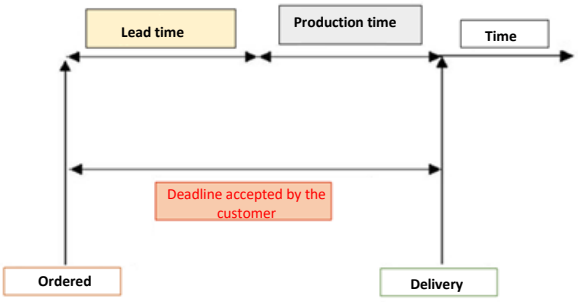
The manufacturer expects the firm customer orders starting to supply and produce.

For now this is the ideal case because it produces only what they sell.

This is the case for example of manufacturing specific products businesses, often complex, such as special machine tools, special electronic circuit...

It is necessary that the time accepted by the client is compatible with the production time.

The challenge for manufacturers is to reduce time for delivery.



## Assemble to order

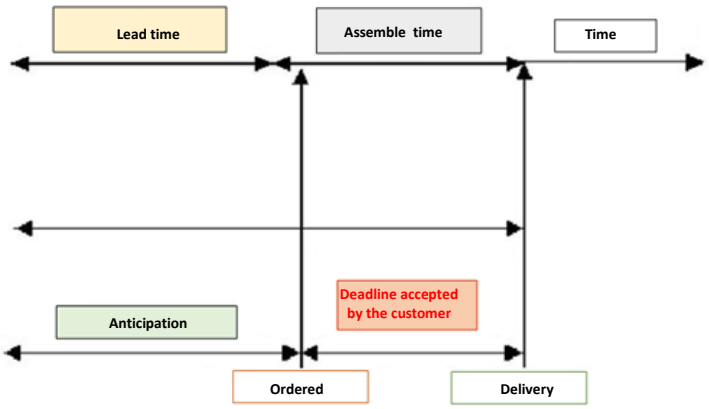
When the dilemma is presented to a company:

Quickly deliver orders to customers while the supply and production times are long.

The solution consists by combining the two previous methods.

Making subsets standard product stocks and at the customer's order, assemble subsystems to achieve the required product.

*Example:* Some fast foods have opted for this solution: The hamburgers are cooked in advance and they assembling the burger when they have to the customer's order.



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## The production master plan

### *Stock building year 1*

You must set up a production organization that will allow you to deliver your customers by respecting the following quality deadlines :

1. End of November : IS, Initial Samples, they validates the start of the pre-series
   Manufacturing time 2 weeks - 150 units
2. End of January : PPAP Production Part Approval Process which validates serial production for stock
   manufacturing time 2 weeks - 250 units
3. April : Entry of 400 speakers in stock, manufacturing time 8 weeks
4. July : Entry of 600 speakers in stock, manufacturing time 8 weeks

### *Sales forecast year 1 : 500 speakers*

| | Sept | Oct | Nov | Dec | Jan | Feb | Mach | April | May | June | July | Aug |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sales forecast | **0** | **0** | **0** | **0** | **0** | **0** | **20** | **45** | **62** | **83** | **92** | **0** |
| Firm orders | **0** | **0** | **0** | **0** | **0** | **0** | **80** | **55** | **38** | **17** | **8** | **0** |
| Forecast available Starting stock: 0 | | | | 150 | 400 | 400 | 300 | 600 | 500 | 400 | 900 | |
| Production (end) | | | IS | | PPAP | | | 400 | | | 600 | |
| | | | 150 | | 250 | | | | | | | |
| Production (start) | | 150 | | 250 | | 400 | | | 600 | | | |
| Total number of speakers to manufacture: | | | | | | | | | | 1 400 | | |

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## *SESSION 1 COURSE 3: THE LOAD*

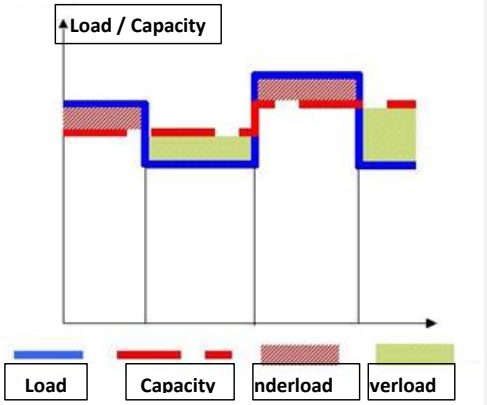
The load is the measure of the amount of flow required to satisfy the demand.

It is a measure of the requested rate. Capacity and load concepts correspond, such as supply and demand. It is recommended to register them in the same units.

### Graphic Representation:

The capacity of a resource can vary over time. Preventive maintenance stops, periodic cleaning, adjustments to working time, etc., can reduce the capacity of a resource. The load of a workstation is rarely equal to the capacity. When it is lower, it means that the station is under load.

Same problem if the station is overbooked.




### Effectiveness and performance rates : OEE,OOE and TEEP

OEE (Overall Equipment Effectiveness) - $(in\ French\ TRS) = \frac{t_U}{t_R} = \frac{Useful\ Time}{Required\ Time}$

OOE (Overall Operations Effectiveness) - $(in\ French\ TRG) = \frac{t_U}{t_O} = \frac{Useful\ Time}{Opening\ Time}$

TEEP (Total Effective Equipment Performance) - $(in\ French\ TRE) = \frac{t_U}{t_T} = \frac{Useful\ Time}{Total\ Time}$

<table>
<tr><td colspan="5">$t_T$ =Total Time</td></tr>
<tr><td colspan="4">$t_O$ = Opening Time</td><td rowspan="5">workshop closing</td></tr>
<tr><td colspan="3">$t_R$ = Required Time</td><td rowspan="4">Cleaning modification<br>Under charge<br>Trial<br>Training<br>Meeting / pause<br>Preventive maintenance</td></tr>
<tr><td colspan="2">$t_F$ = Operating Time</td><td rowspan="3">Failures<br>Change of series<br>Setting<br>Lack of staff</td></tr>
<tr><td>$t_N$ = Net Time</td><td rowspan="2">Cadence deviations</td></tr>
<tr><td>$t_U$ =Useful Time</td><td>Non Quality</td></tr>
</table>

### Load Calculation

You now need to calculate the workload generated, as well as the number of FTEs you will need by completing the table below.

| Input data | Year 2 | Year 3 |
|---|---|---|
| Reference working time | 35H / week | 35H / week |
| Number of speakers to be manufactured / year | 4 000 | 40 000 |
| Opening times | 35H / week | 70H / week |
| Number of weeks worked / year | 47 week | 47 week |
| Absenteeism | 6% | 4% |
| Useful time for 100 pieces | 33H | 26,40H |
| OEE | 70 | 85 |
| Calculation of required time | $\frac{33}{0,7} = 47,143$ | $\frac{26,4}{0,85} = 31,059$ |
| Workload calculation | $47,143 \times 40 = 1\,885,72$ | $31,059 \times 400 = 12\,423,60$ |
| Calculation of an FTE | $47 \times 35 \times 0,94 = 1\,546,30$ | $47 \times 35 \times 0,96 = 1\,579,20$ |
| Calculation of the number of FTEs | $\frac{1\,885,72}{1\,546,30} = 1,219$ | $\frac{12\,426,60}{1\,589,20} = 7,867$ |

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# INDUSTRIAL & SUPPLY CHAIN MANAGEMENT

## *SESSION 2 COURSE 1: TECHNICAL DATA*

The basic technical data of an industrial company consists of items, bill of materials and routing sheet

### The Items (Vision Product)

These two words mean a finished product or a subset or component or raw material whose specific features mean that all units with the same reference are strictly interchangeable.

### The Bill Of Materials - BOM (Vision Components)

Structured list of components and materials necessary for making a reference (component or finished product)

Knowing the BOM (structure) of a product is better understand

- All components
- The links between them

And this is the result of a product analysis

### The Routing Sheet

It is the ordered sequence of phases that define a process and as a document, it is sometimes accompanied by instruction sheets.

It includes all the information related to the execution analysis (decomposition of a process into its components (range, phase, in phase operation, part of work ...)

There are two categories of information:

- Technical information
- The management information

#### *The phase*

This is the ordered sequence of operations executed by one or more performers to the same workstation.

#### *The sub-phase*

This is the phase fraction defined by changes in the tool or in the position of a product during shaping.

#### *The operation*

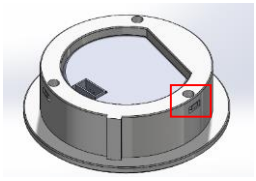
This is the action on the material or product which corresponds to an ordered set of work items and that implements a given equipment at the workplace.

### Complete the Manufacturing Range table below

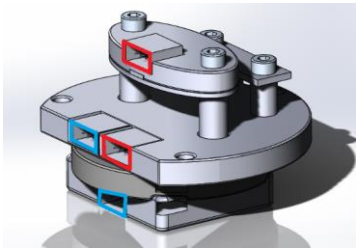
## Specific assembly instructions:

- The Top membrane is glued to the top cover after engraving with a glue gun.
- The Battery is glued to its support using a glue gun.
- The Lower membrane is glued to the base using a glue gun.
- The Nuts are embedded in the parts in specific housings.

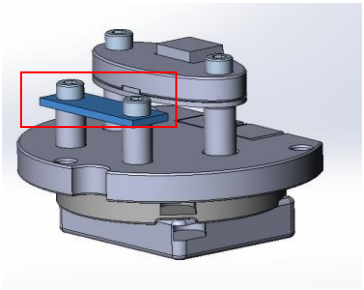
E.g.

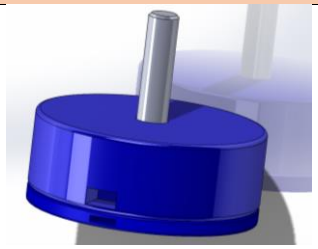
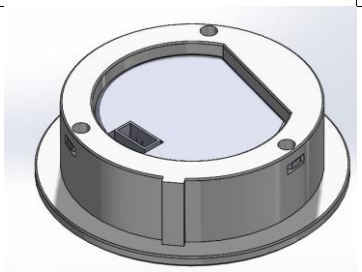
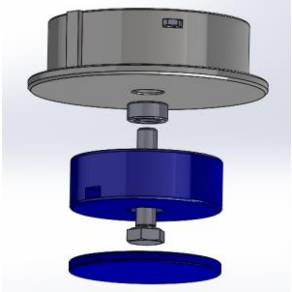
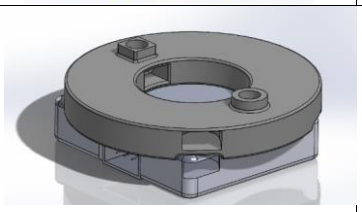


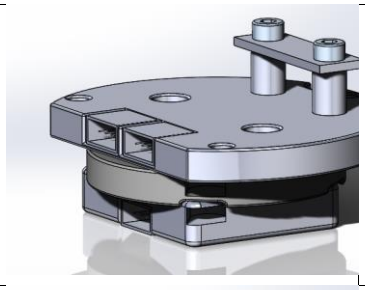
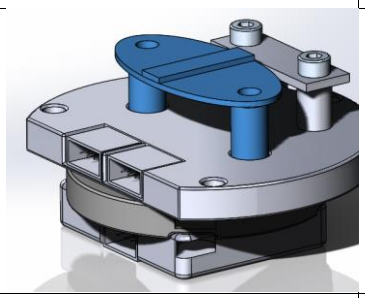
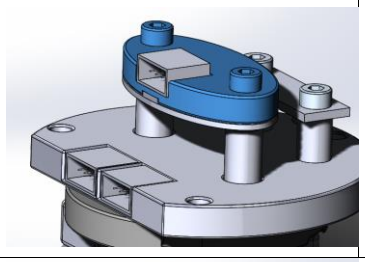
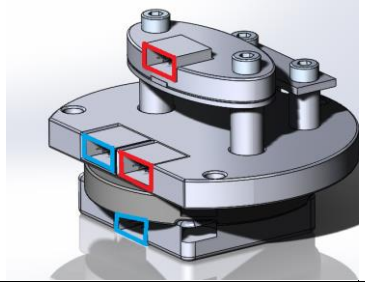
- The Electronic Board - Bluetooth Board cable is plugged into the connector on the right side of the electronic card.
- The PCB-Battery cable is plugged into the left connector on the PCB.

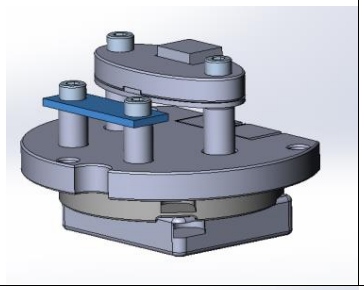
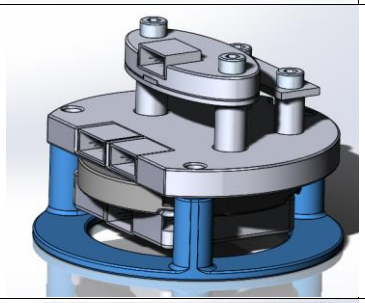
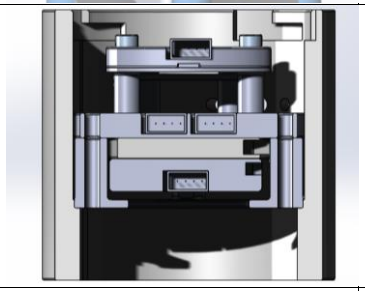


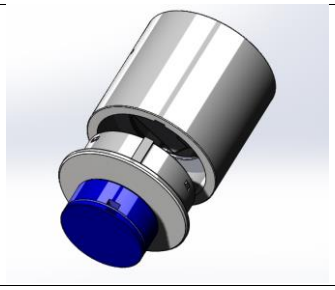
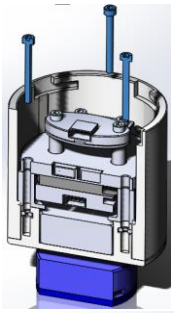
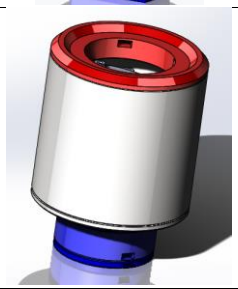
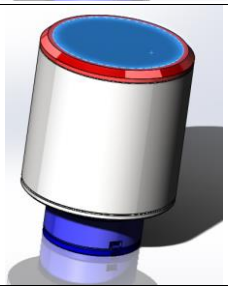
- The Cable Vibratory Pot - PCB is connected to the connector of the vibratory feeder and then soldered to a Matrix Board which is screwed to the PCB (blue).



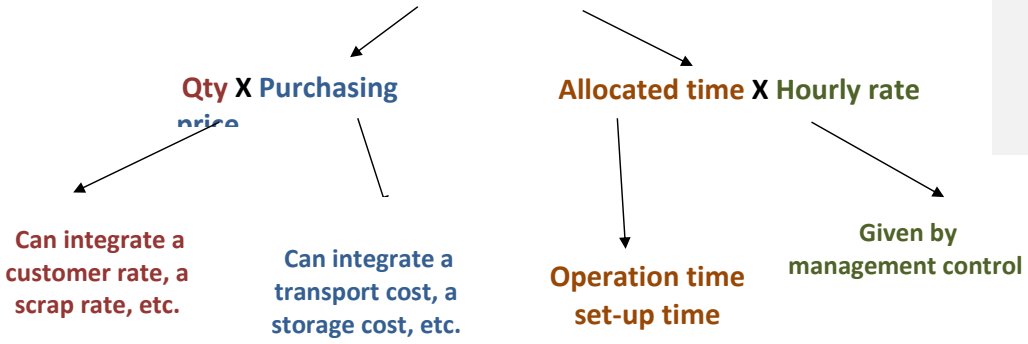
| Routing Sheet | | | | | |
|---|---|---|---|---|---|
| Set: Speaker | | | | | |
| N° | Operations | Parts | Diagrams | Tools | Estimated time |
| 10 | **Magnetize** the lower diaphragm on the foot | **1 - 2 - 3** |  | | 5s |
| 20 | **Place** the vibrating pot in the lower cover | **8 - 5** |  | | 5s |
| 30 | **Place** the spacer between the Foot and the Lower cover and screw on the lower assembly | **1 – 2 – 3 – 4 – 5** |  | | 30s |
| 40 | **Magnetize** the battery on its support | **10 - 11** |  | | 5s |

| | | | | | |
|---|---|---|---|---|---|
| 50 | **Assemble** the Battery support on the Electronic board | **15** |  | | 10s |
| 60 | **Attach** the Bluetooth board holder to the Electronic board | **17** |  | | 5s |
| 70 | **Screw** the Bluetooth board on its support | **19 – 20 (2 screws CHC M3 x 25 mm)** |  | CHC screwdriver or screwdriver | 30s |
| 80 | **Connecting** the connectors : Bluetooth board, Electronic board, Battery, Electronic board | **2 cables grove 4 pins** |  | | 30s |

| | | | | | |
|---|---|---|---|---|---|
| 90 | **Weld** the four pins of the Stripped cable to the Matrix boards | **1 cable grove 4 pins stripped on one side** |  | Welding station | 120s |
| 100 | **Place** the electronic assembly on the motherboard support | **9** |  | | 10s |
| 110 | **Place** the electronic assembly on the shoulder inside the body (pay attention to the passage of the wires) | **21** |  | | 20s |
| 120 | **Connect** the Welded wire to the Vibrating pot beforehand. | | | | 10s |

| | | | | | |
|---|---|---|---|---|---|
| 130 | **Place** the body on the lower assembly | |  | | 10s |
| 140 | **Screw** on the lower assembly and the electronic assembly | **12 : 3 screws M3 x 30mm** |  | CHC screwdriver or screwdriver | 60s |
| 150 | **Screw** the cover on the body | **22** |  | | 5s |
| 160 | **Magnetize** the upper membrane on the top cover | **23** |  | | 5s |

Calculation of the cost price of the enclosure




***Calculation of the cost price of labor*** $DPC_L$ ***with a workshop hourly rate of 40€***

*We will neglect the operation times*

***0,33 *x 40€ = 13.20€***

***Calculation of the cost price of the components purchased*** $DPC_{RM}$

*Accumulated component price detail = 15,54€*

***Total cost price***

***15,54 + 13,20 = 28,74€***

## *SESSION 2 COURSE 2: FMECA - FAILURE MODE, EFFECTS AND CRITICALITY ANALYSIS*

### Goals

- Determine the weak points of a system and to make remedies
- Specify the means to protect themselves against certain failures
- To engage those affected by a project
- To better understand the system
- To study the consequences of failure on the reliability, availability, maintainability and safety
- Rank failures according to certain criteria
- Facilitate the design
- Locate critical operations that may be the cause of a non-conforming product

### Different FMECA

The FMECA can serve as a way to study living current equipment failures

If a forward FMECA has been made, it is good to check the assumptions used in the beginning, in the light of the experience.

The FMECA made during life, has similar objectives to the forecast FMECA:

- Improvements
- Maintenance policy best suited
- Better monitoring of operating parameters
- Diagnosis Faster failures


### How to choose between the different solutions found to reduce criticality

There are two methods of scoring these solutions to find consensus:

LIKERT METHOD – Constant absolute interval

5 - Totally agree
4 - All right
3 - Neither disagree nor agree
2 - Disagree
1 - Not agree at all

It is recommended for short series.

FORMULA 1 METHOD – Constant relative interval

10 - Totally agree
6 - All right
4 - Neither disagree nor agree
3 - Disagree
2 - Not agree at all
1 - Not agree at all

Very determining method it is very suitable for long lists

# WORKSHOP
# INDUSTRIAL & SUPPLY CHAIN MANAGEMENT

## Assessment by the decision matrix for the 2nd Year

Reminder:

For year 2 = 4000 parts will be sold

| Input data | COBOT | Control bench |
|---|---|---|
| Cost of investment | 25 000€ | 16 000€ |
| Save time in manufacturing | 0,05h / speaker | 0h |
| Reduction of waste and loss of time | 2 000€ | 8 000€ |

$$ROI\ calculation = \frac{Investment\ amount}{Annual\ Gain}$$

| COBOT Solution | Control bench solution |
|---|---|
| $\frac{25\,000}{10\,000} = 2{,}5\ years$ | $\frac{16\,000}{8\,000} = 2\ years$ |

| Criteria | COBOT Solution | Control bench solution |
|---|---|---|
| ROI (Return On Invest) | 6 | 10 |
| Quality | 4 | 10 |
| Deadline | 4 | 6 |
| Total Score | 14 | 26 |

**Commenté [1]:** 0.33h x 40 eur = 28.74 eur. (actuel)
0.28h (-0.05) x 40 eur = 26.74 eur (futur)
gain de 2 eur soit 4000 piecesx2euros= 8000 euros de gains

Last Name:
First Name:
CLASS / GROUP:

| | ANALYSIS OF FAILURE MODES OF THEIR EFFECTS AND THEIR CRITICALITY | | FMECA PROCESS |
|---|---|---|---|
| | System: | Operating phase: | |
| | Sub-system: | Date of analysis: | Page: |

| Element | FUNCTION | FAILURE | | | Detection | CRITICALITY | | | | EVOLUTION | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MODE | EFFECT | CAUSE | | O | S | D | RPN | Corrective action | Resp. | Deadline | nO | nS | nD | new RPN |
| Operation | | *List all failure modes* | *List the most serious effects* | *List all the root causes* | *What can warn of the failure mechanism* | | | | | | | | | | | |
| | | Poor welding | Not working | | Nothing | 3 | 5 | 5 | 75 | Auto control with PPVS test (Presence Polarity Value Solder) + operator training COBOT installation | | | 1 | 5 | 2 | 10 |
| | | Poorly positioned weld | Not working | Lack of operator training<br>Lack of operator attention | Nothing | 3 | 5 | 4 | 60 | | | | 1 | 5 | 2 | 10 |

$20 \leq RPN < 80$ : criticality prohibited ⍰ Questioning the process

**Commenté [2]:** RPN : Risk PRiority Number

**Commenté [3]:** O x S x D Ocurrence x Severity x Detection

Last Name:
First Name:
CLASS / GROUP:

## *SESSION 3 COURSE 1: DESIGNING A WORKSTATION*

The ergonomic design of a position is critical to the health of operators and for the performance of the company.

To help you in designing your workstation follow the **OCORDAC methodology**

During this workshop we will take care of step 6 and 7.

| No. | Steps | | Means |
|---|---|---|---|
| 1 | **O**bserver (To WATCH) | 1. Summary observations<br>2. Grouping and preliminary analysis of studies | |
| 2 | To **C**hoose | 1. Choosing the position according to selection criteria (cost, quality, time) | |
| 3 | **O**bserver (To WATCH) (study of the workstation) | 1. Detailed comments | |
| 4 | **R**éfléchir (To THINK) & to Analyze (design of the workstation) | 1. Constructive criticism | |
| | | 2. Simulation (CAD), meeting | |
| 5 | To **D**ecide | 1. 1st Estimated balance | |
| 6 | To **A**CT | 1. Create the prototype scale 1:1 of the new workbench | • |
| | | 2. Timing | • Camera and timer |
| 7 | To **C**ontrol | 1. 2nd final assessment | • |
| | | 2. Monitoring performance and problems solving | • |

**The 22 rules of economy of movement to use for the design and implementation of the workstation.**

*Simultaneous movements*

1. Both hands should begin and end their movement together
2. Both hands should not remain inactive at the same time except during rest
3. The arm movements must be symmetrical and simultaneous.

*Minimum expenditure of energy*

4. The movements necessary for the work required to implement the smallest possible muscle mass.
5. Continuous movements are preferable to movements "Zig Zag" or movements in broken lines with sharp angles

*The main force*

6. The main force should be used whenever possible to help the operator's movements. It must be minimized if the movement is controlled.
7. Ballistic movements are faster, easier and more accurate than forced or controlled movements.

*Pace*

8. Acquiring a Rhythm is Essential to the Easy and Automatic Execution of a Job

*Order of the fitted work area*

9. There must be a definite place for all materials or components.
10. Tools, materials and auditors should be placed as close as possible and at the earliest possible front of the operator.
11. The materials, components and tools must be willing to allow the best result possible movements.

*Use of gravity*

12. Boxes and containers gravity feed must supply the performers or close to their workplace.
13. We must use gravity to evacuate: chutes, conveyors, inclined rollers ...

*Comfort and worktop lighting*

14. We must develop each operator the best conditions for lighting work.
15. The height of the work surface and the seat should allow as much as possible to work standing or sitting.
16. A seat for good posture must be provided to each operator.

*Freedom hands*

17. Hands should be relieved of all work that can be done more conveniently by mounting.

*Combine / position*

18. Tools should be combined whenever possible
19. Tools and equipment must be positioned wherever possible.

*Load fingers*

20. When each finger performs a separate movement, the load of each finger is to be divided according to each capacity.

*Bodies orders*

21. The handles should allow the largest possible contact surface
22. The levers, winches and steering wheels to enable them maneuver with the slightest change in posture and with more possible mechanical efficiency.

## *SEANCE 3 COURSE 2: DETERMINATION OF MANUFACTURING TIME*

One of the main methods for determining the working time you need to use is the chrono analysis

The reference pace presupposes in principle, in addition to the ability of the performer:

- Maintaining a good physical and mental state, given compensatory rest, and therefore, the definition of the atmosphere and the conditions under which the work is performed.
- Correct execution of the work in quality and quantity and, therefore, the definition of the qualification of the performer, his degree of training and habituation.

This is the equivalent of:

Walking in 5 km/h on flat ground
(Under normal conditions)

Qualifications to carry the judgment of pace

The timekeeper will acquire during their training, the four qualifications for any performance measure:

- **Sensitivity:** or ability to discriminate between two adjacent gaits whichever is larger
- **Constancy:** which means that throughout the range of paces, the gap between the real speed and the average of the judgments remains practically constant and of the same sign.
- **Precision:** of always wearing the same sentence for the same speed.
- **Accuracy:** whereby the judgment corresponds to the real speed (for the same fraction repeated at the same known speed, accuracy is assessed by the difference between the average of the judgments and the true speed)

Theoretical Calculation of Time - *Th*

The specialist method is stabilized with a job that is executed following a procedure, each fraction having its time reference, Pace time 100 or also called *To*.

The pace 100 cannot be held on a continuous basis throughout the work day without excessive fatigue of the working person.

Account must be taken of physiological factors related include:

- A physical load and energy expenditure that results.
- A posture.
- At the frequency of certain movements.

All these features cause excessive fatigue if the rest are not granted to the performer.

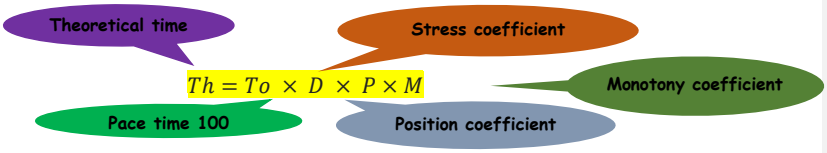
For these reasons must be given to the rest running that increase the reference time (*To*)

We call the resulting time, **theoretical time** because it can only be observed if there are no surface irregularities at work.

This theoretical time can be held by the performer without accumulation of fatigue for the duration of the work.

- In stabilized working conditions.
  If the contractor is qualified and has the physical skills required.

If *To* is the time to look 100, the theoretical time *Th* is given by the following formula:

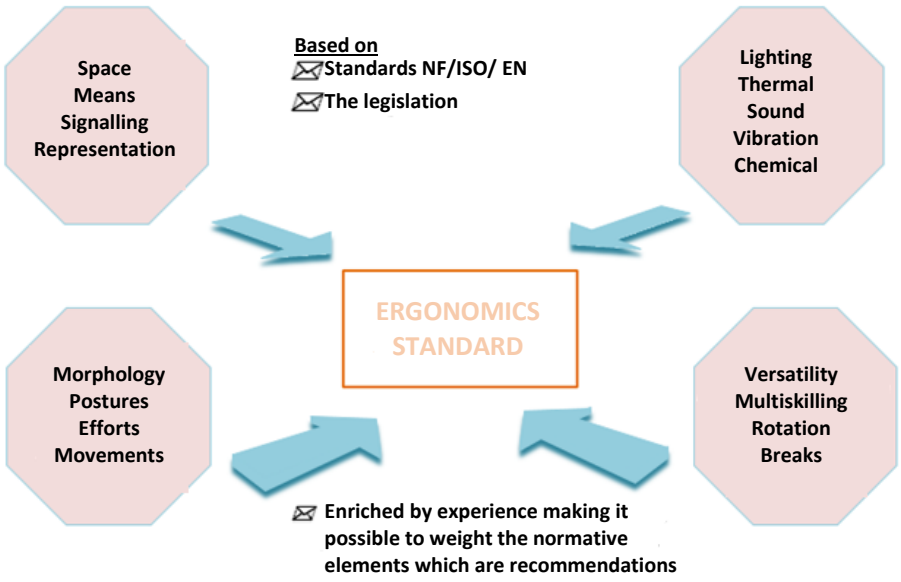



In our study the physiological values coefficients will be: D x P = 1.15 and M = 1.04

## SESSION 3 LESSON : STANDARD ERGONOMICS

### STANDARD ERGONOMICS

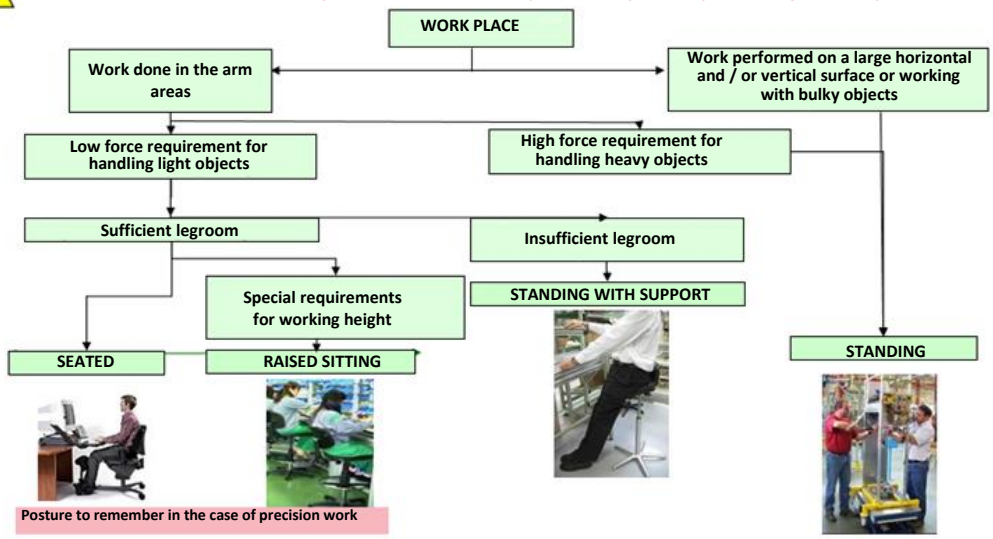
**The ergonomics standard, co-construction for improving working conditions and preventing arduous work**



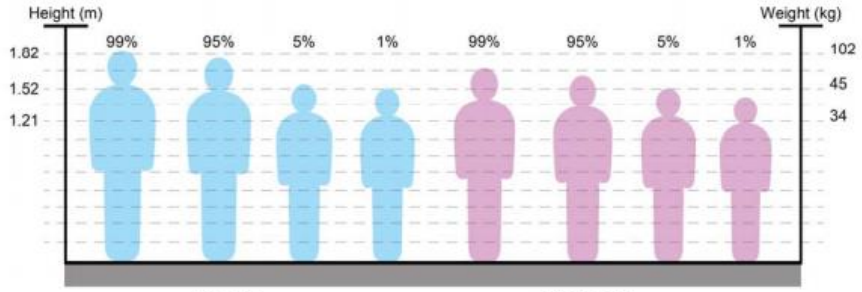
## *CHOICE OF WORKING POSTURE*

**Posture is the element to be defined in the first place, the other elements of the workstation are to be defined in relation to it.**

**The most common cause of fatigue is due to the work posture imposed by the design of the position**




Posture to remember in the case of precision work




| Item | Condition of Use | Depth mm | Height mm | Thickness mm |
|---|---|---|---|---|
| **Work bench** | Utility | 600 | 900 | Max 35 |
| **Writing bench** | Keyboard use | 750 | 680-720 | Max 35 |
| **Writing bench – height adjustable** | Keyboard use | 750 | 610-760 | Max 35 |
| **Writing bench – height adjustable** | Keyboard use | 750 | 660-1180 | Max 35 |
| **High Counter (parcel shelf)** | Over bench | 250 | 1150 | 20-35 |
| **Shelving** | Over 900mm high bench | 350 | 1520-1810 | 20-25* |
| **Shelving** | Over 720mm high bench | 350 | 1370-1710 | 20-25* |
| **Shelving Unit** | Full Height | 350-400 | 1500-1810 | 20-25* |

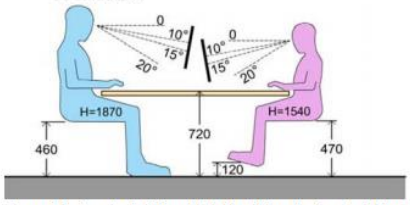



Figure 3.2: People of different heights sitting at a fixed height workstation

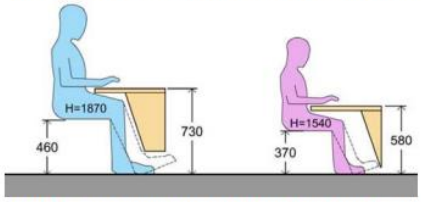
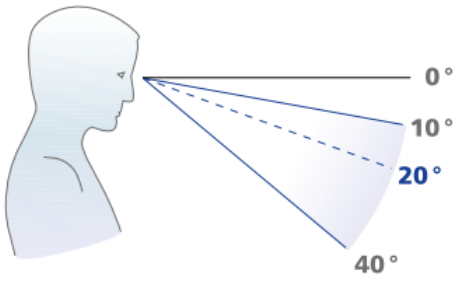
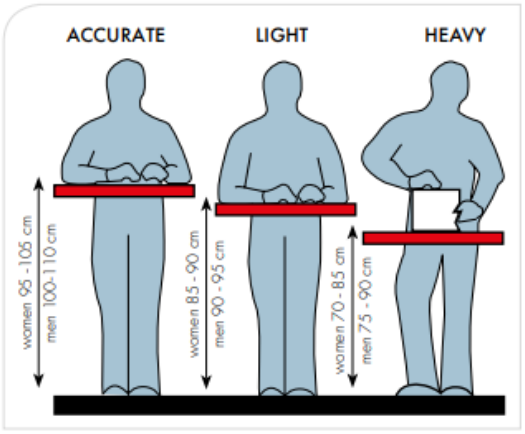



Figure 3.3: People of different heights sitting at an adjustable height workstation



## *SESSION 4 COURSE 1: STOCK MANAGEMENT*

### *Introduction*

The role of the stock function is to manage the company's products in order to satisfy in a timely manner (in a logic of Just-in-time), the availability and delivery of these for development of products.

## The supply

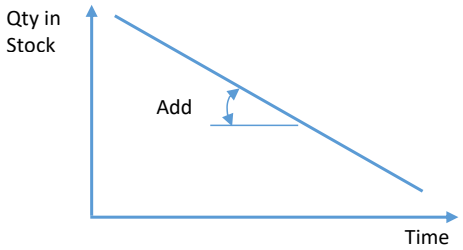
The stock is the result of a difference between the supply flow and flow of demand

## General presentation

### *The flow demand*

Demand forecasts are extrapolated linearly, logarithmically or exponentially depending on the demand trend.

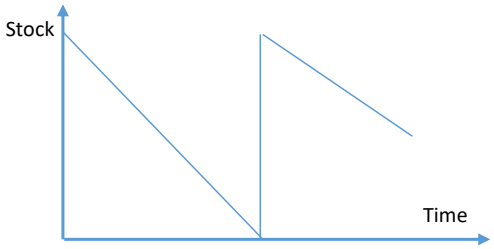
Most of the time the request is modeled by a straight line whose slope represents the average daily demand (Add).



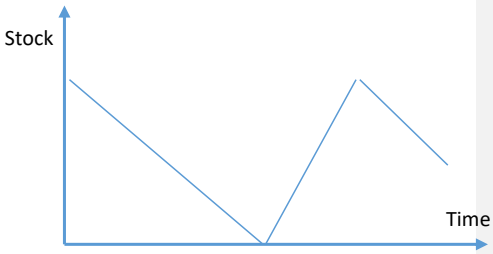

### *The supply flows*

Supply flows correspond to deliveries of products in stock. These deliveries can be made by an external supplier or by the company's production system.

These deliveries can be made all at once or gradually as the parts are produced




Delivery at once




Delivery as production progresses

### *Procurement Policy*

Supply is secure programming delivery needs and inventory as part of the overall planning of the company.

Define a procurement policy is basically to answer 3 questions:

1. WHAT (which product) does it supply?
2. WHEN should you supply it?

3. HOW should we supply?

After you have answered the "what", you can answer the other questions

- Date or amount FIXED?
- VARIABLE date or quantity?

It is therefore possible to define, according to the combinations of the above, 4 inventory procurement policies.

| When? | Fixed date | Fixed date | Variable date | Variable date |
|---|---|---|---|---|
| How ? | fixed quantity | variable quantity | fixed quantity | variable quantity |
| Method name | fixed periodic replenishment | periodic replenishment | Point of order | Lot-for-lot |

Obviously each policy is suitable for a product or product category, which often leads companies to use these policies 4 simultaneously.

The challenge is to choose the best policy for every product to avoid stock outs without significant financial assets.

We choose to assign an extremely safe method of supply, but probably the most expensive, the most important products (Class A) and a simple and economical method to least important products (class C). For Class B products or we consider them as Class A products or Class C according to the service policy adopted by the company.

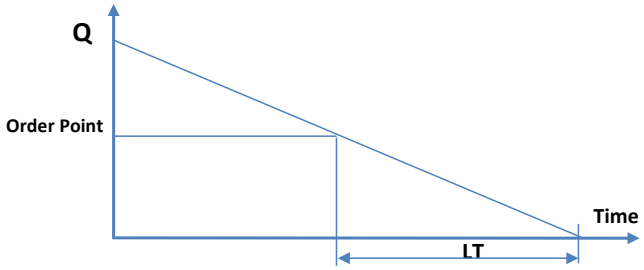
## *Variable date / fixed quantity supply (Point of order method)*

Better known as an order point, this policy consists in defining in a Just In Time concept, the level of stock which must allow the purchase order to be triggered so as to be delivered just at the time of use. from the last play.

It is equal to: $Add \times LT$ where

$Add =$ Average daily consumption

$LT =$ Supply lead time expressed in days



## *The safety stock*

Safety stock is used to prevent stockouts in case of short term and unpredictable variations in demand.

A company is exposed to stockout when the stock is low, so just before item receipt.

The safety stock calculation depends on :

- the desired service level : The higher it is, the more safety stock we need
- the ability to forecast demand : The more variability in demand we have, the more safety stock we will need
- the frequency of ordering : The more often we order, the more we are exposed to stockout, but we are also more responsive in case of variation in demand.
- the length of the lead time : The longer the leadtime, the more safety stock we need.

Safety stock is the limit to never go under when you manage inventory.

## *SESSION 4 CONCLUSION*

During these days, we introduced you to a part of Industrial and Supply Chain management.

This management's purpose is to improve the management of flows from "supplier to supplier" to the "customer of the customer".

We wish that this awareness will have tempted you to follow the Industrial and Supply Chain Management specialty in the 3rd year of your engineering cycle.

Thank you for your participation.

See you soon.