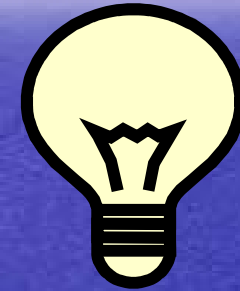


2- Tasks on MAGNITUDE ORDER stage



Main objectives

- Discarding *unfeasible* ideas
- Acquiring an "order of magnitude" of the conflict to fix
- Being able to plan *suitable* a problem
- Focus on the right project objective

Main asks in this stage

2-1 Project definition

- Clear objectives

2-2 Usage of the products

- Main users and others

2-3 Variables, restrictions , criteria, requirements

- Control level on its design: functional analysis

2-4 State of the art

- Useful information

2-5 Size of the project

- Investment, market, human resources

2-6 First economic evaluation (see chapter 3)

2-1 Project definition

- **Purpose**
 - Generic and abstract exposition, individual and collective improvements that must be achieved, or damage that must be avoided by means of an action, activity, operation or project.
- **Objective**
 - Specific solution to a specific problem
- **Scope**
 - Objective limit exposition within which the problem is framed

Creativity Techniques: Brainstorming

- The brainstorming essence lies in **liberating the mind** from any value judgements about what one is thinking about.
- In normal way, before saying or making anything our mind makes a judgement.
- There is some kind of constant feedback or control.

- In brainstorming it is necessary to say the first thing that comes to your mind, without thinking it twice. (Without making any mental judgement)., **even if it is nonsense**
- The rule is: **NOT TO CRITICISE** what is coming up.
- Every idea may give rise to new ideas.
- The result is that many ideas are exposed
- **It can be focused on a resolution:**
 - Of the problem as a whole
 - Of a certain aspect of a problem
 - SCAMPER method
 - (Substituir, Combinar, Añadir, Magnificar, Poner en valor, Eliminar, Reordenar)

Composition of a session:

- Between 7 and 12 people
- They must be experts in the discussed topic
- They must have different specialisations
- Heterogeneous group, different age and different sex (men and women)
- The session should not be shorter than 20 minutes and longer than 40

The moderator or chairman will try to:

- Ensure that rules are followed (no ideas should be evaluated or criticised).
- Stop the group from going off topic
- Encourage everyone to participate
- Slow down the *dominant* people
- Be as neutral as possible, accepting everything
- **Decide the moment session must finish**
- **The secretary will take notes**

- After the session is over:
 - Ideas are classified
 - Ideas are evaluated
 - 2, 3 or 4 ideas are chosen to work on them

Classification and evaluation means:

- Ideas that can be directly used.
- Wrong or ridiculous ideas (it is necessary to extract whatever is useful from them).
- In the list of useful ideas, new aspects and factors that are additional to the problem must be considered.
- Selecting ideas that have been excluded at first sight, thinking they were wrong.
- Selecting ideas that suggest the possibility we might obtain more information from them
- Making a list of the ideas that have been already experimented

2-2 Product usage

- 2-2.1 User benefits and needs. Maslow pyramid
- 2-2.2 Types of users and their differences according to their project position
- 2-2.3 Ergonomic main variables

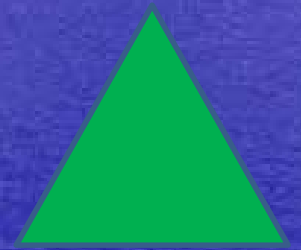
User

Every physical or legal person that at some time and under certain circumstances, becomes part of a man-device(service)
- atmosphere.

- The objective of a project is to provide welfare to the user
- The welfare will depend on:
 - The company the user works in, user's needs...
 - Kind of user, user position with respect to the designed system...

What environment is the user in?

- 5 - Self-achievement
- 4 - Self value recognition
- 3 - Group integration
- 2 - Physical environmental domain
- 1 - Life preservation



The Maslow values pyramid
Abraham Harold Maslow (1908,NY)

2-2.2 Types of users and their differences according to their project position

Different users will expect different things from the same project !!!!!!!

Due to the position

Internal

External

Third parties

Due to the relationship with the system

Free

Forced

Due to how long the project is used

Permanent

Sporadic

Due to an accident

Due to the government's capacity

Owner user

Exploiter user

Operator user

Consumer user

Forced user

He/She expects:

Security

Economical or moral reward of the negative side effects

Having fun

Keeping Status Quo

Third party user

He/She expects:

Not to suffer any nuisance or trouble from or because of the system or the device direct aggression.

Owner/consumer user

He/She expects:

To satisfy his needs

Comfort, easy use (user-friendly)

Service reliability

Taking the most of the time

Security

Having fun

Short and easy to learn

Exploiter user

He/She expects:

Profitability

Taking the most of the work done

Availability

Maintenance

Security

Short learning period

Operator user

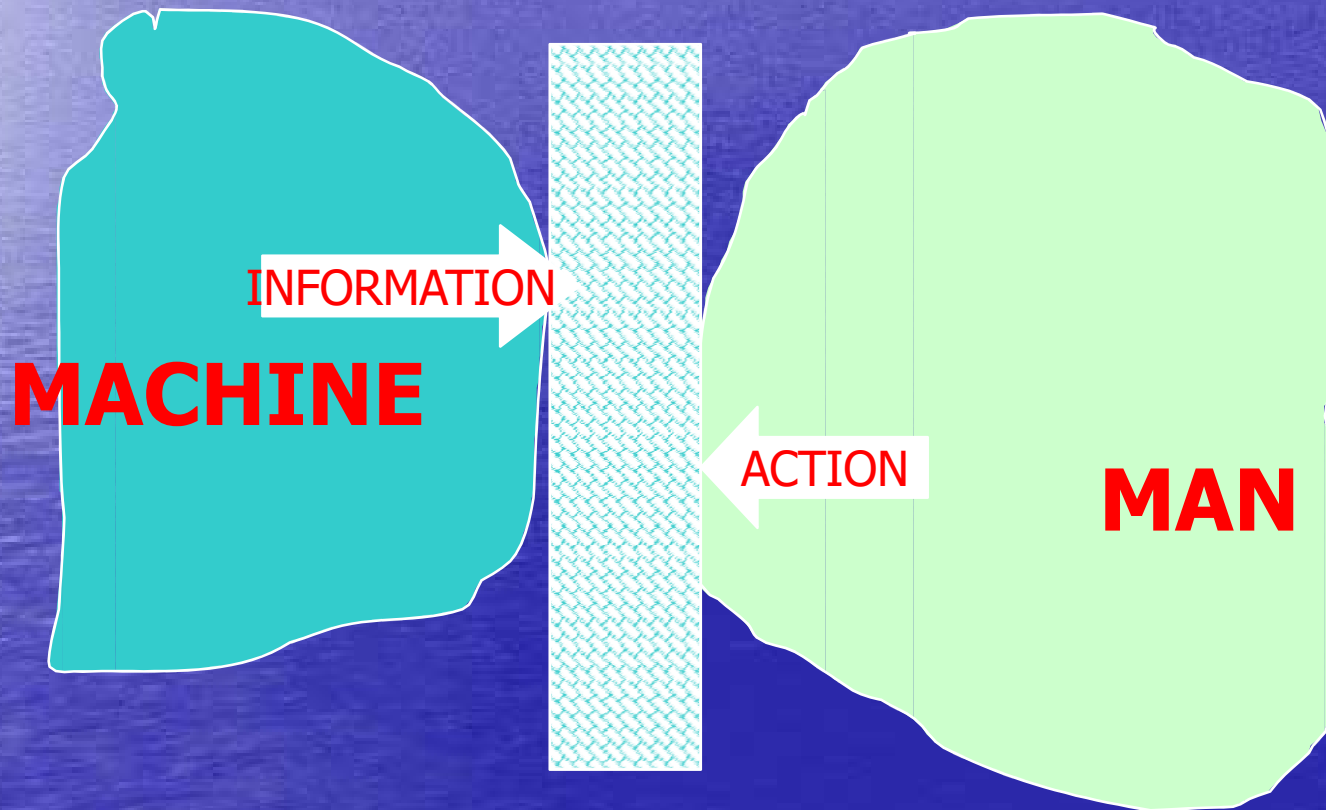
He/She expects:

His own security

Comfort, easy to use

Having fun

2-2.3 Ergonomic main variables



Machines and people: man-device-atmosphere system

Human action

Machines or workers?

Human efficiency/Machine efficiency > 1

- Sensing low level stimulus
- Detecting sound stimulus with background noise
- Sensing not usual events in the environment
- Deciding alternatives in case of failures
- Estimating and subjectively evaluating
- When necessary concentrating on important activities
- Using experience to make decisions
- Thinking inductively generalising observations
- Recognising complex sequences

Human efficiency/Machine efficiency <1

- Counting and measuring physical amounts
- Executing at the same time different activities
- Performing in hostile environments
- Working without any distractions
- Keeping activity level throughout time
- Answering quickly and consistently to inputs
- In order to sense stimulus that are out of human range nature
- Storing big amounts of data and providing data
- Processing data with a specific programming

Critical work environment situation:

Clean and hygienic

Environmental noise

Excessive temperature

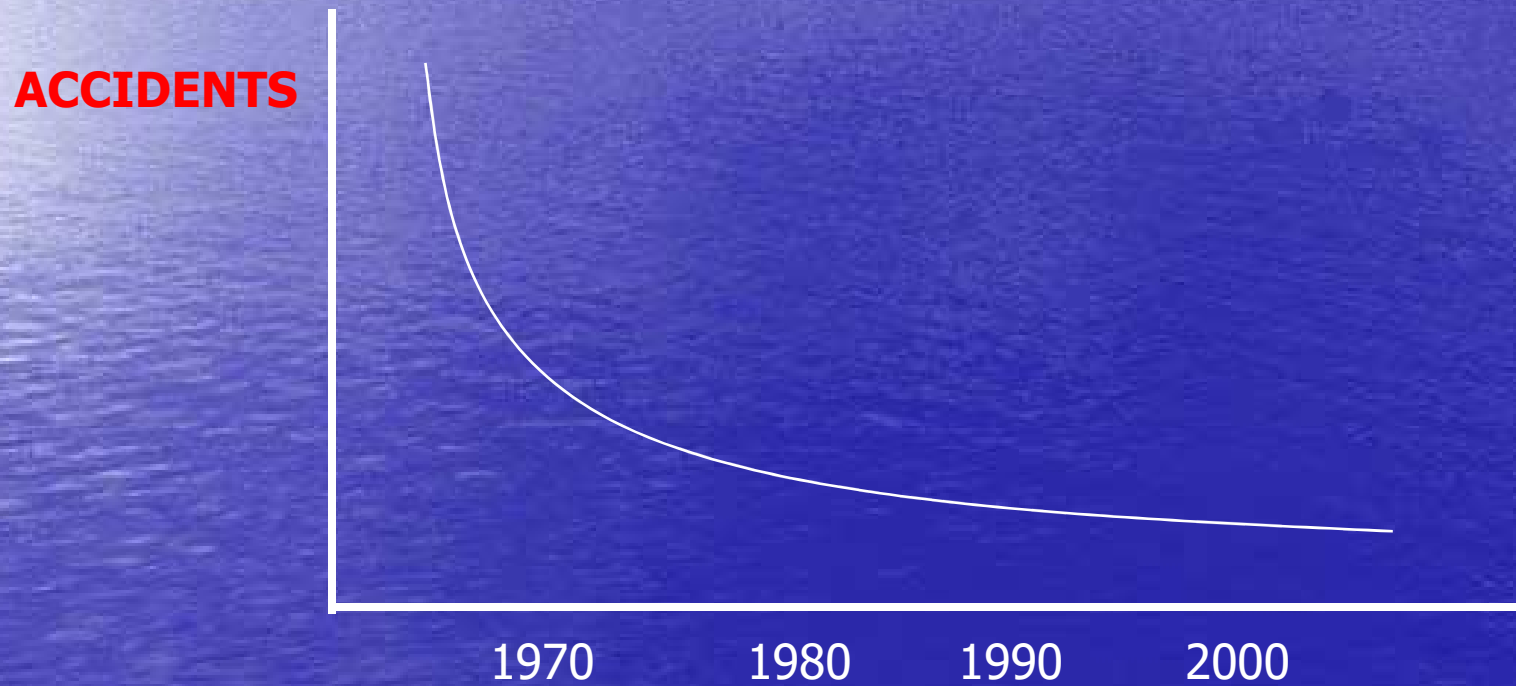
Brightness

Excessive working time

Excessive responsibility

■

Evolution accidents in the big European industry:



Error: system failure

Human error is inevitable !!!

Now or some time ago someone made an error

The consequences of an error depend on luck

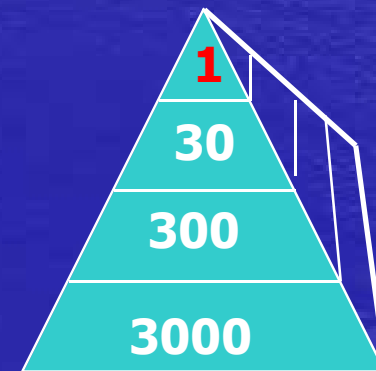
accident-incident pyramid:

1 Critical injured

30 accidents with Minor injured

300 incidents with low injuries

3000 critical situations



Ergonomy

It is the study of the human being in his working environment (Murrell, 1965).

It is a communication technology in man-machines systems (Montmollin, 1970).

It relates human beings with the project problem trying to adapt/suit the working environment to the subject and the product to the consumer (McCormick, 1988).

Ergonomic design objectives:

From Production security and profitability point of view

Operator Interventions Reliability

From Human Operator Acceptance point of view

Fragility related aspects

Welfare related aspects

Ergonomic welfare determining factors: Ergonomic design

Creating a suitable man-machine(service)-atmosphere interactive environment is necessary while analysing the man/machine use in every project.

Main ergonomic variables

Anthropometry (1/6)

The following is valued:

- Site working methods
- Postures, movements and their frequency
- Forces that will be developed
- Clothing and equipment
- Information and control device attention and importance and frequency of manipulation.

Thermal environment (2/6)

Fanger average value index (IVM) :

- Evaluates the activity level, type of clothing, the T_{dry} , Tradiant average, relative humidity and air speed.
- Its limits are -3 (very cold) to 3 (very hot)

Acoustic environment (3/6)

It is characterised by acoustic pressure and frequency

Its limits are:

- $2 \cdot 10^{-5}$ Pa and $2 \cdot 10^4$ Pa
- 16 Hz and 16000Hz
- $L_p = 20 \log (p / (2 \cdot 10^{-5} \text{Pa}))$ db

Acoustic value scale

Minimum audible for 1000Hz	$2 \cdot 10^{(-5)} \text{ Pa}$	0 dB
Motorbike without exhausting pipe 1 meter away	2 Pa	100 dB
Pain limit at 1000Hz	20 Pa	120 dB

Sound effects on human beings

- Blood pressure increase
- Heart rhythm acceleration
- Skin capillary contraction
- Metabolism increase
- Slow digestion
- Muscle tension increase
- Sleeping problems
- Working capacity decrease
- Nervous alteration
- Duodenal ulcers
- Mental work decrease
- Visual keenness decrease
- Organism defence decrease

Vision and Light: (4/6)

- Light flux: (lumen)
 - Amount of light that is emitted per second
- Light intensity: (candela)
 - It characterises light emission by its direction
- Lighting level: (lux, lumen/m²)
 - It characterises the amount of light that is focused on a surface
- Luminance: (candela/m²)
 - Amount of light emitted by a surface

Lighting values

Occupation/activity	Recommended Lux
Simple visual needs	Between 50 and 500
Indoors jobs	Between 750 and 5000
Precise jobs	Between 7500 and 20000

Energy disposal and physical working capacity (5/6)

- It is measured in watt/m²
- It is calculated by means of direct calorimetry (expensive) or by means of non-direct calorimetry (Oxygen consumption and cardiac frequency relation up to 170 pulses per minute)
- http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=13895
- http://www.jniosh.go.jp/old/niih/en/indu_hel/2006/pdf/indhealth_44_3_368.pdf

Physical work classification (ISO 7243)

0	Resting	$M < 65$
1	light	$65 < M < 130$
2	moderate	$130 < M < 200$
3	heavy	$2000 < M < 260$
4	very heavy	$260 < M$

Mental load (6/6)

They are perceptive elements, cognitive elements and emotional reactions that are involved in the development of an activity.

Working performance factors related with stress disease

Working environment situation

Instructions

Tasks

Psychological stress

Physiological stress

Organic factors

Stress symptoms

Permanent fatigue

Nervous tics

Lack of concentration

Insomnia

Accelerated pulse

Stimulant consumption

Tendency to get sick

Hunger for sweet food

Irritability

High blood pressure

Task

Complexity

Lack of feedback

Frequency and repeatability

Man machine interface

Instructions

Oral transmission: problematic

Written transmission: more reliable

Caution notice: security

Working methods: organisation
and lack of stress

Physiological stress

Process situation rapidly changes

How long a stress situation lasts

Monotonous and boring job

Sensory deprivation

Distractions

Environmental pressure

Physical stress

Fatigue

Discomfort

Limited movements

Anoxy

Pressure variations

Organic factors

Entertainment

Intelligence and personality

Motivation

Physical condition

External influence

Hertzberg's motivating and demotivating factors

(Frederick Herzberg (1923-2000) Massachusetts)

Demotivating:

- Company administration and policy
- Technical or personal supervision
- Working conditions
- Wages, benefits

Motivating:

- Direct perception of what we achieve with our task
- Being recognised by our peers
- Responsibility increase
- Opportunity of increasing knowledge and capacity
- Promotion possibilities

2.3 Variables, restrictions and criteria

2-3.1 Variables, restrictions and criteria

2-3.2 Functional analysis

2-3.1 Variables, restrictions, criteria, requirements..

Variables: Values that engineer can choose

Restrictions: External limits, physical or legal,
for those values

Criteria: How engineer wants to choose those values

Requirements: What customer is wanting

Technical specifications: Final result

2-3.2 Functional analysis

The functional analysis is a methodology that allows us to generate solutions.

This is a method to analyse, develop and describe a function structure.

In this particular case, the function structure should be considered as a product model to be developed. It will be based on the product physical characteristics like form, size and materials used.

This method completely describes the product functions and the product parts. It also describes how they are related.

A product function can be described as a transformation process **that it is done by itself** of a part of its own environment.

The function structure will be the gathering of functions or organs that will constitute the developing product in order to give it the expected external functionality.

Functional analysis can be defined as the method with which a function structure can be analysed and described.

FUNCTIONAL ANALYSIS OF A LANTERN

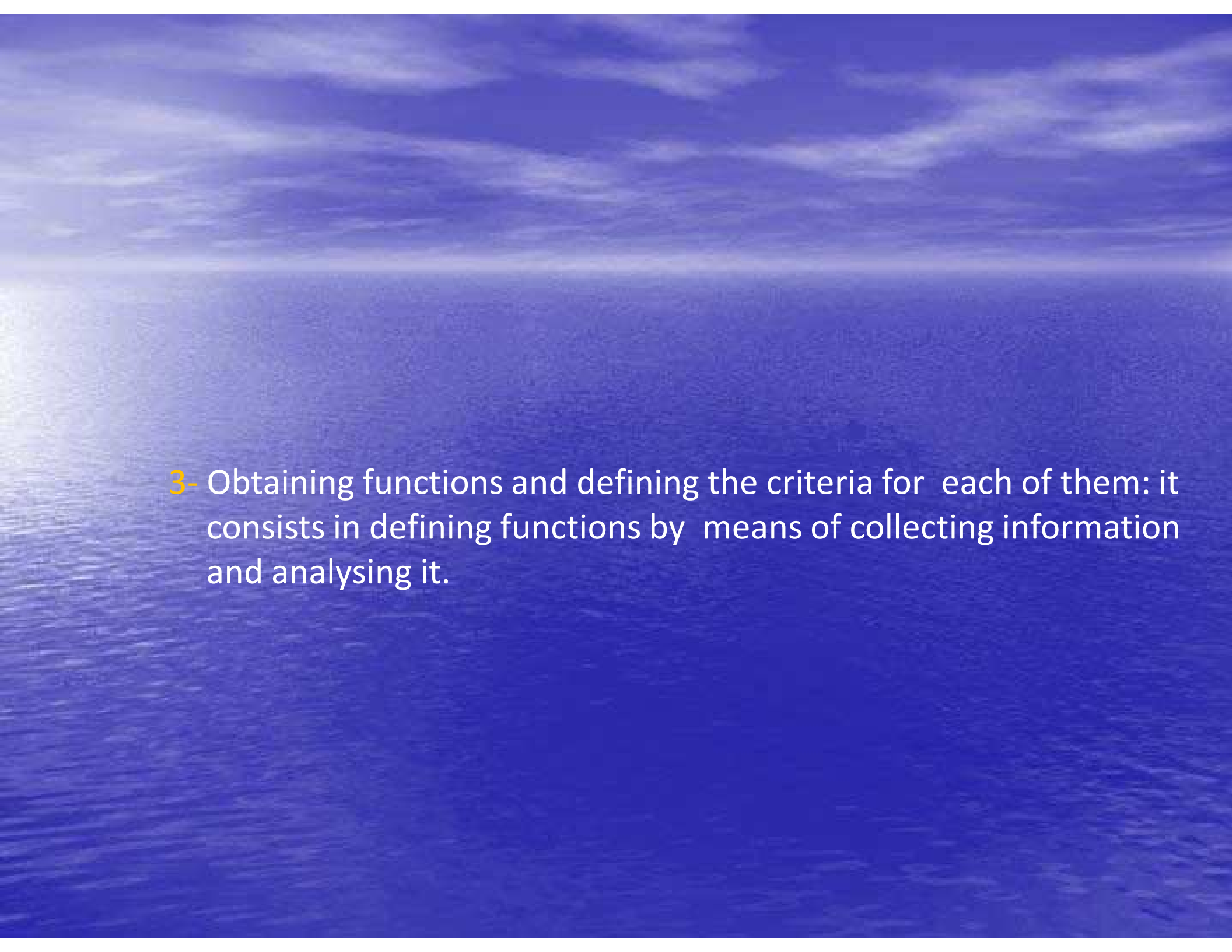


General methodology for gathering information:

- 1-** Defining the working group: it must include 5 to 9 people, gathering a multidisciplinary working group with complementary knowledge (marketing, design, quality, production...)
- 2-** Understanding the analysed object: exhaustively gathering information and organising it.

Working techniques for 2 : 5 REQUIREMENT METHOD

- 1- Usage requirements: users, performance, reliability, maintenance, **operativity** and environmental uses.
- 2- Selling requirements: selling spots, transport, prices, product differentiation, distribution and selling periods and amount.
- 3- Design requests: legal regulations, standardisations, plans and previous drawings.
- 4- Manufacturing requests: related to the production team, manufacturing location, staff costs, manufacturing processes costs, directs and indirects,
- 5- Execution requests: manufacturing in the company itself or outsourcing



3- Obtaining functions and defining the criteria for each of them: it consists in defining functions by means of collecting information and analysing it.

Used semantics for 3

Requests	verb	complement	criteria
USERS			
This light torch will be used by women and kids Light paths during the night	To light	surroundings	X Lux for Y meters
Adaptable to the pocket or to the bag	To facilitate	storing	Size of a cigarette package
Attractive and easy to use	To retain	attractive	Attractive to kids and women
ENVIRONMENTAL USE			
Used at night and on rainy nights	To prevent	Water intake	No leaks
PERFORMANCE			
The light operates at X watts	To give	Light	X watts
Using two A batteries	To fit	batteries	

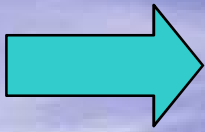
4- Systematising functions:

- 1- Putting functions on cards (rectangles), simulating units or related subsystems.
- 2- **Identifying the main service function**, the one that comes up to the user's expectations
- 3- Bringing together **Basic and Support** functions. Basic functions are those which have a positive answer to the question: Is the function essential for the execution of the main function?

- **4- Identifying Basic functions:**
 - How is the main function executed?
- **5- Identifying Support functions:**
 - Addressed to Grant Security
 - Assuring Comfort
 - Highlighting the Product
 - Being pleasant to the senses
 - ...

5- Executing the Technical Condition Function Documents: executing the precise technical description of the part which is found on the diagram's right side FAST.

HOW



**BASIC
FUNCTIONS**

**Environmental
control**

Heat adding

Heat removing

Circulating air

**Humidity
removing**

**supporting
structure**

Ensuring safety

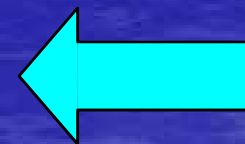
Adding comodity

**Enhance the
product**

**Pleasing to the
senses**



IN ORDER TO



Value Analysis

Value analysis is a method for designing or redesigning a product or service, to ensure, with minimum cost, all the functions that the customer wants and is willing to pay

2-4 State of the art

Searching information

- Technical reviews
- Laws and Regulations
- Standards
- Technological Fairs
- Internet
- Research centers
- Competitors
- How mature is technology
- ...