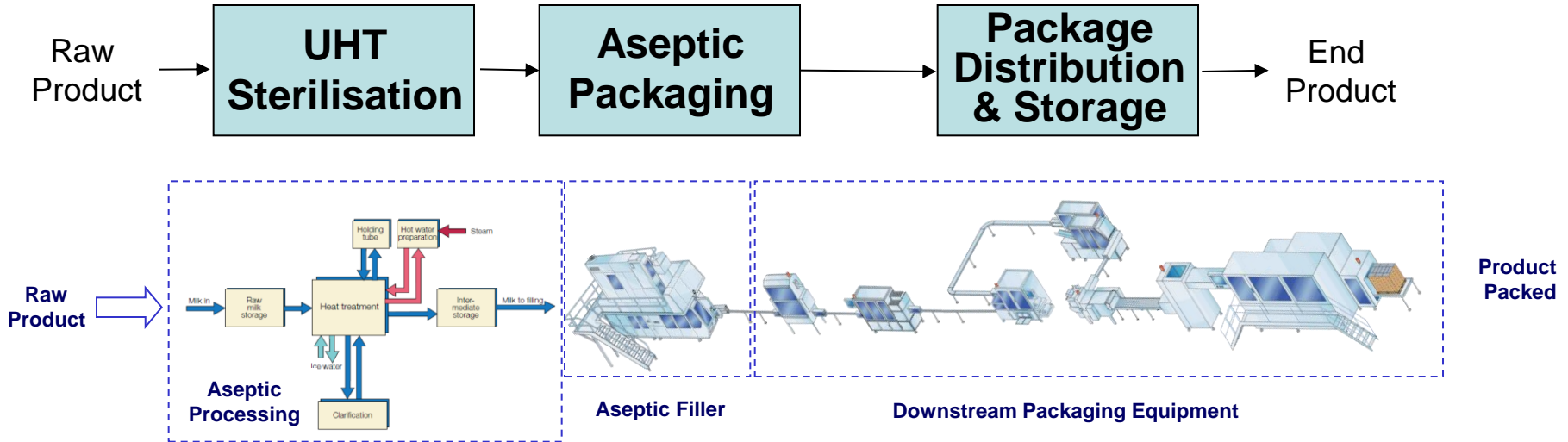


Designing Food Safety Through Maintenance Engineering

Sauro Riccetti

1. Background of the Project



1.1 Field of application of the project: **Aseptic Food Packaging Industry**

1.2 Packaging line are complex: with several Critical Control Points (**CCPs**)
identification and **monitoring**

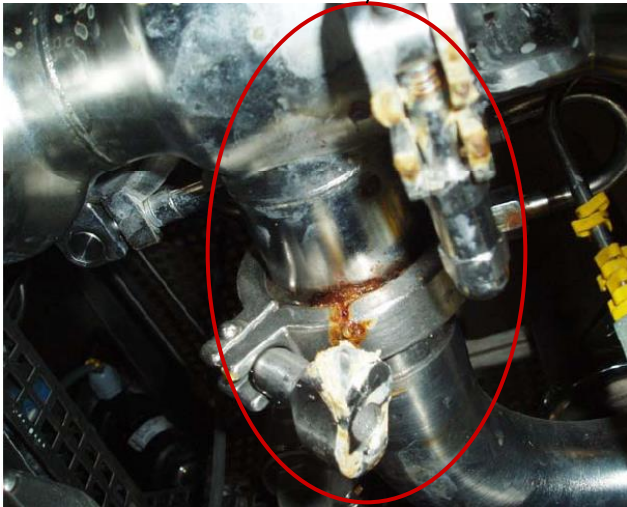
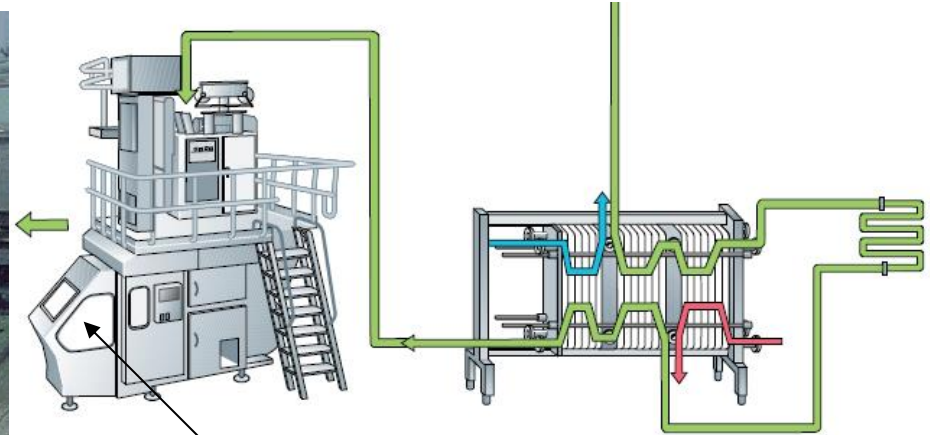
1.3 In case of loss of control: **food contamination...** dangerous for public health

- Many case studies have shown dramatic effects on public health
- Product contamination is often due to **equipment failure**

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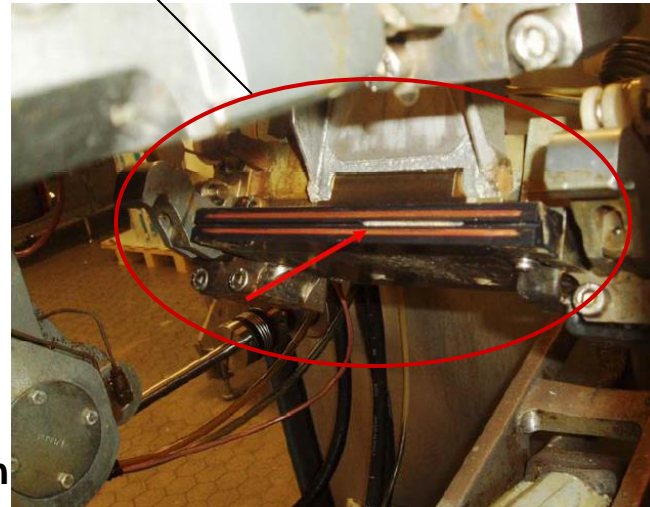
2. Threats (are often coming from EQUIPMENT used in the process)



Food Product contact with the external environment



Food Product Contamination



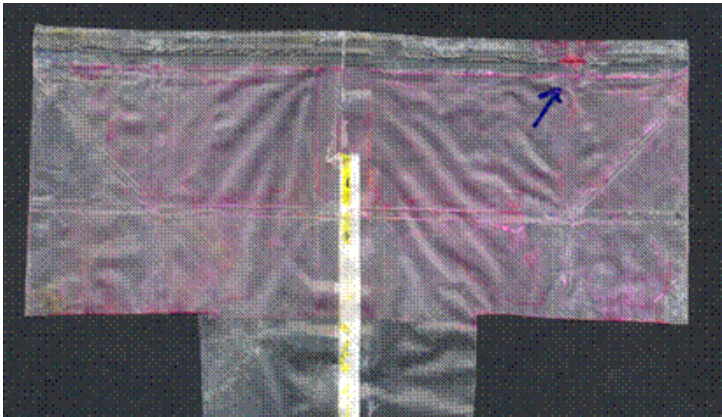
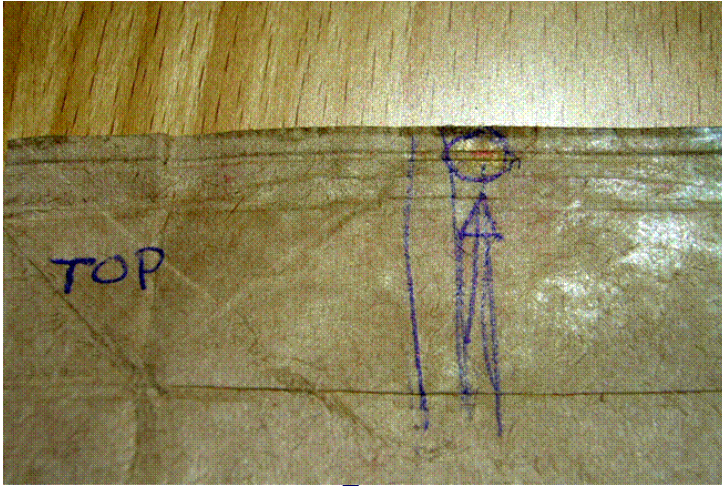
-mechanical wear
-wrong electrical parameters on a **Sealing element**



Container Integrity problems

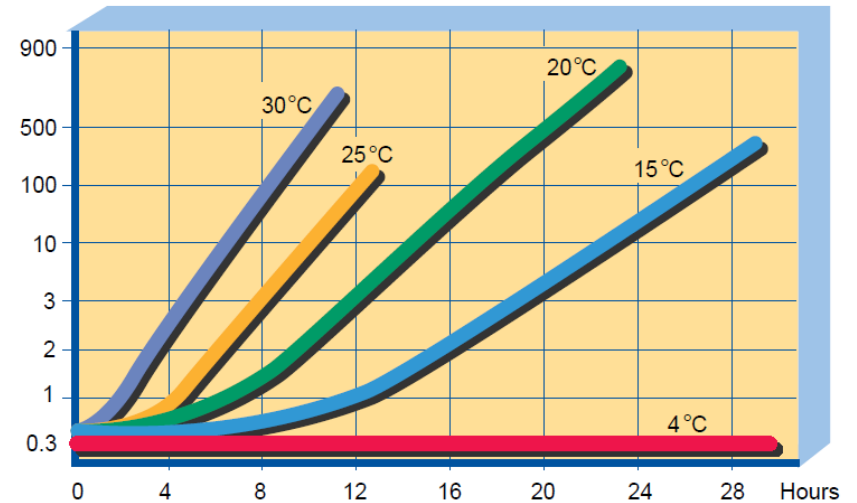
Container Integrity: a real THREAT

During Package forming, sealing and cutting



Quick bacterial growth in milk

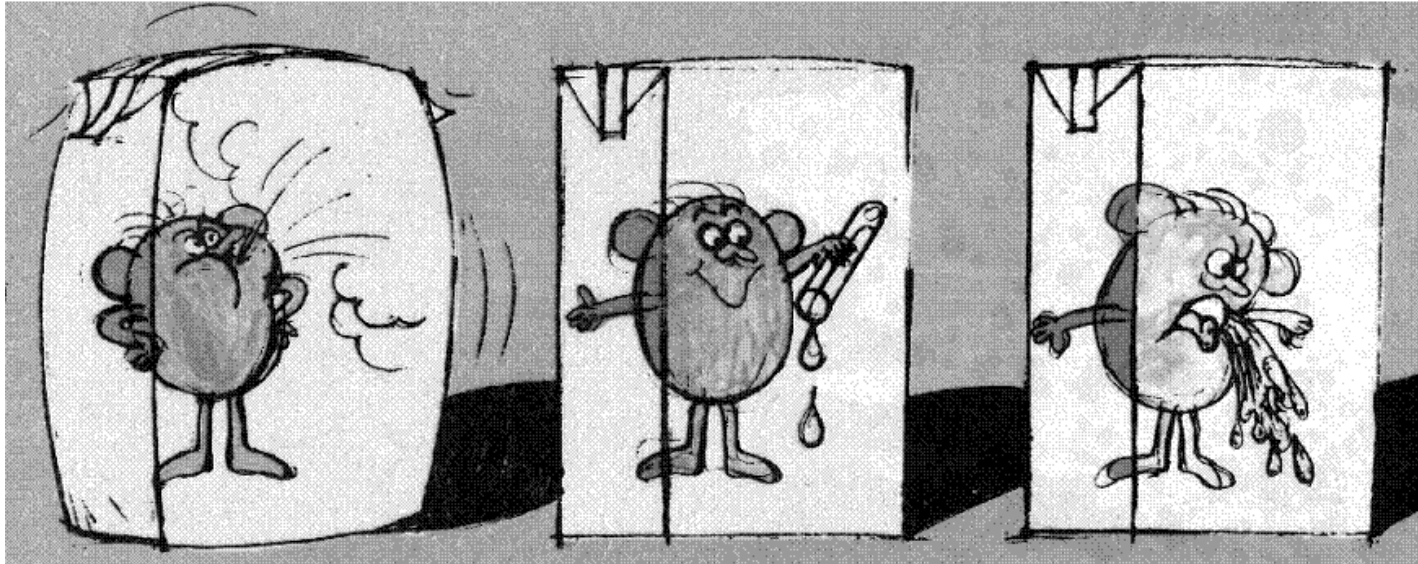
Million bacterias / ml



3. Threats & Challenges

Lack of **container integrity** represents one of the most critical issue
Depending on criticalities in place in **forming**, **filling**, **sealing** and **cutting the package**

Types of spoilage



Gas formation

Acid formation

Flavour change

...Threats & Challenges

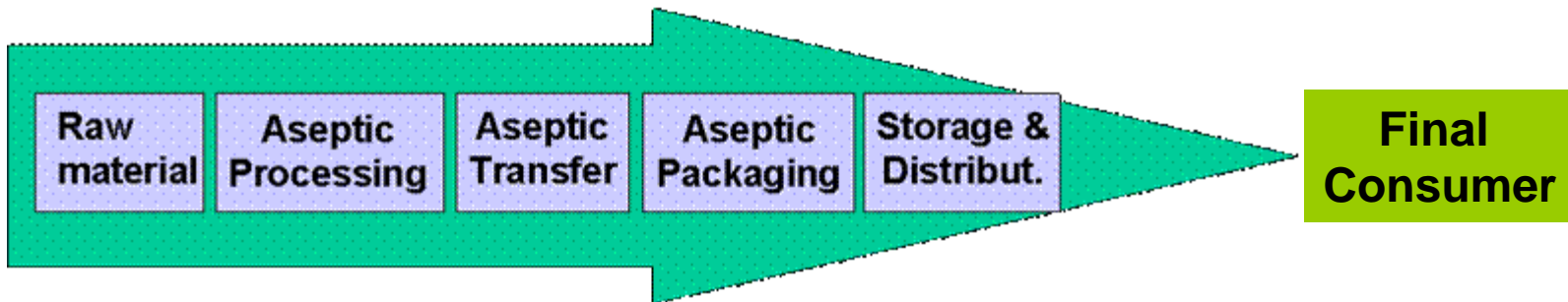
European Legislation (EEC Directives)

Directive 93/43: is based on implementation of Hazard Analysis and Critical Control Points (HACCP)

Directive 852/04 (best practices in hygiene, sanitation, health...)

These Directives

Call food producers to **implement HACCP on equipment and process as a Mandatory** requirements



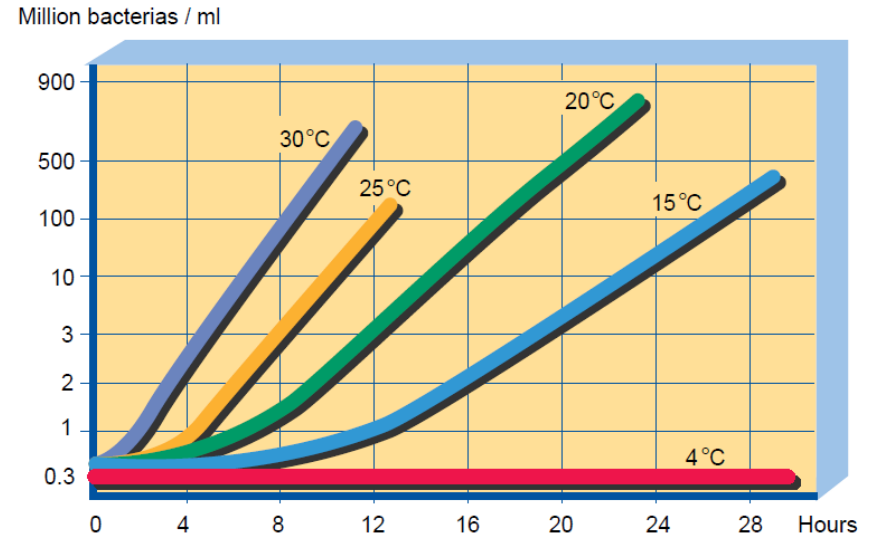
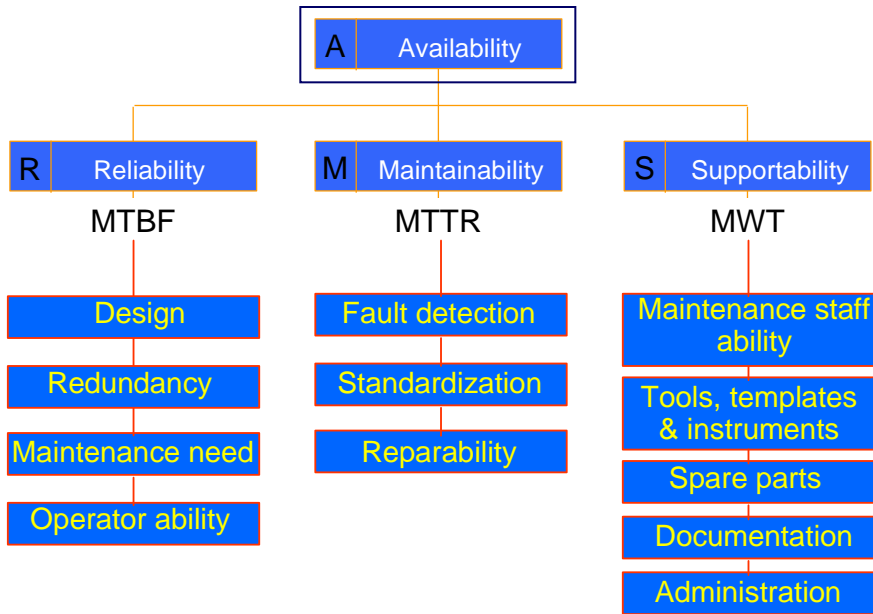
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...Threats & Challenges

How to Manage Critical Variables in the Food Production Process?

Equipment Efficiency → **Measure effect of Equipment failure Food Product Safety & Quality**



Reliability (**MTBF**): Time Domain.....To..... **HACCP**

4. The Opportunity: **DESIGN A PROCESS** to establish Food safety through equipment reliability

To fill the gap existing between equipment reliability and food product safety HACCP methodology has been integrated with reliability principles and techniques.

The **DESIGN PROCESS** is based on the following 5 steps:

HACCP
Hazard Analysis &
Critical Control Points

Identification of **product safety CCPs** (equipment & process)
IDENTIFICATION

B: Biological, **C**: Chemical, **P**: Physical **Risks**
through the application of **HACCP** and **HAZOP (Hazard Oper.)**

RCM Analysis
Reliability Analysis
Based on Quant+Qual.

Application of **RCM** technique (**R**eliability **C**entered **M**aintenance)

- 1) Identify equipment failure effects:
Quantitative & Qualitative Analysis of failures
- 2) Define a **Maintenance Approach** for each Failure Effect

..The opportunity: Food safety through equipment reliability

HACCP + RCM
Safety & Reliability
Analysis

Safety & Reliability analysis through
FMEHA (Failure Modes Effect & Hazard Analysis)
FORM that produce a **global RPN** (Risk Priority Number)
to weight a specific risk

List of Priorities
Safety & Reliability
Analysis

Application of HACCP, HAZOP and RCM techniques to:

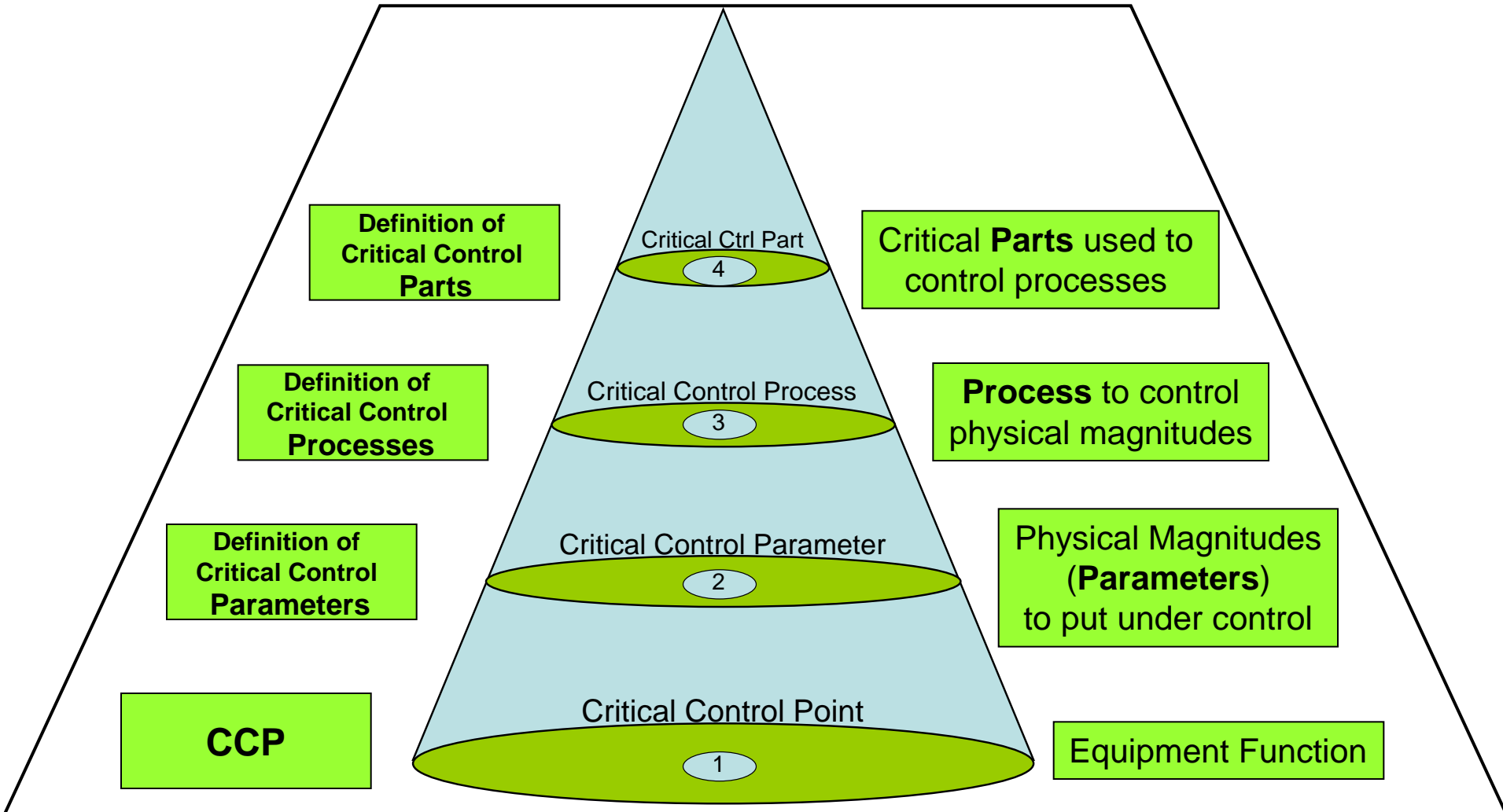
- 1) Identify the **total RPN** which embodies safety & reliability risks
- 2) Define the list of **priorities** according to failure effects

**Design of
Maintenance Tasks**

Define the **maintenance strategy** for each failure mode/effect:

..The opportunity: Food safety through equipment reliability

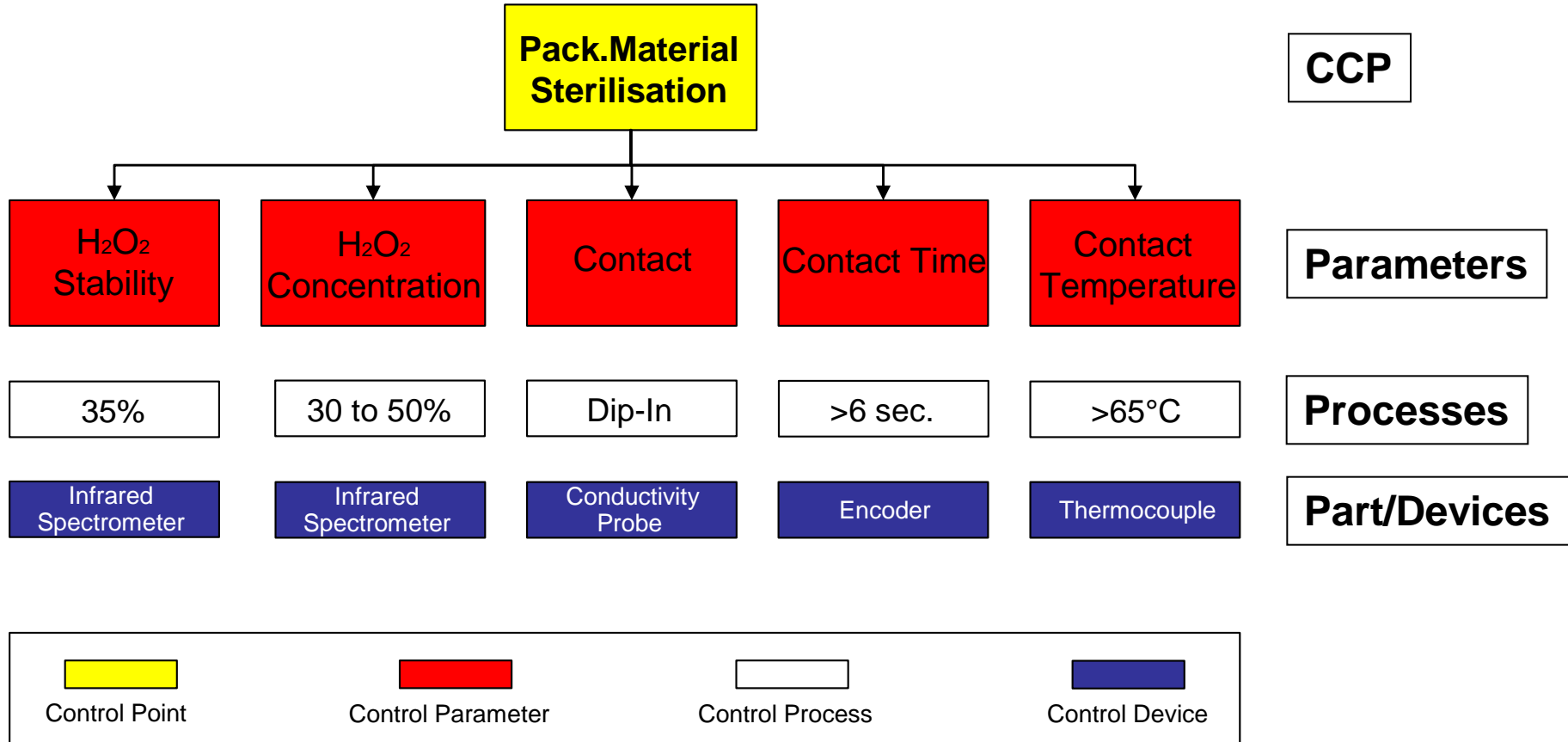
HACCP Methodology implemented on Equipment



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..The opportunity: Food safety through equipment reliability



5. Main results achieved: Economical Indicators

Direct Costs

Costs to launch the investment intended to generate added value in terms of higher company's competitiveness. These costs refer to **manpower salaries, spare parts, templates...**

Indirect Costs

All costs generated by a poor packaging line effectiveness. Could be due to **non conformity products** claimed from the market..

Packaging material, product, energy waste...

Loss of Revenues

Every hour of production lost.

This is to be regarded in terms of missing containers sold on the market.

Every container rejected represents a damage depending on loss of revenue and waste of money to produce and then withdraw the container from the market.

..Main results achieved: KPIs

Indirect costs of company (A) **Reactive Culture:**

- (a) packaging material waste: 4% on 200 millions of packs/year = **850.000 Euro**;
 - (b) Product unsterility/year: No. 2 main cases = **35.000 Euro**;
 - (c) Non conformity product: No. 60.000 non conformity packages = **10.000 Euro**;
 - (d) Energy loss: due to equipment downtime = **2000 Euro**;
 - (e) Chemicals loss: due to cleaning phases following equipment failure = **5000 Euro**.
- Total indirect costs = **902.000 Euro**.

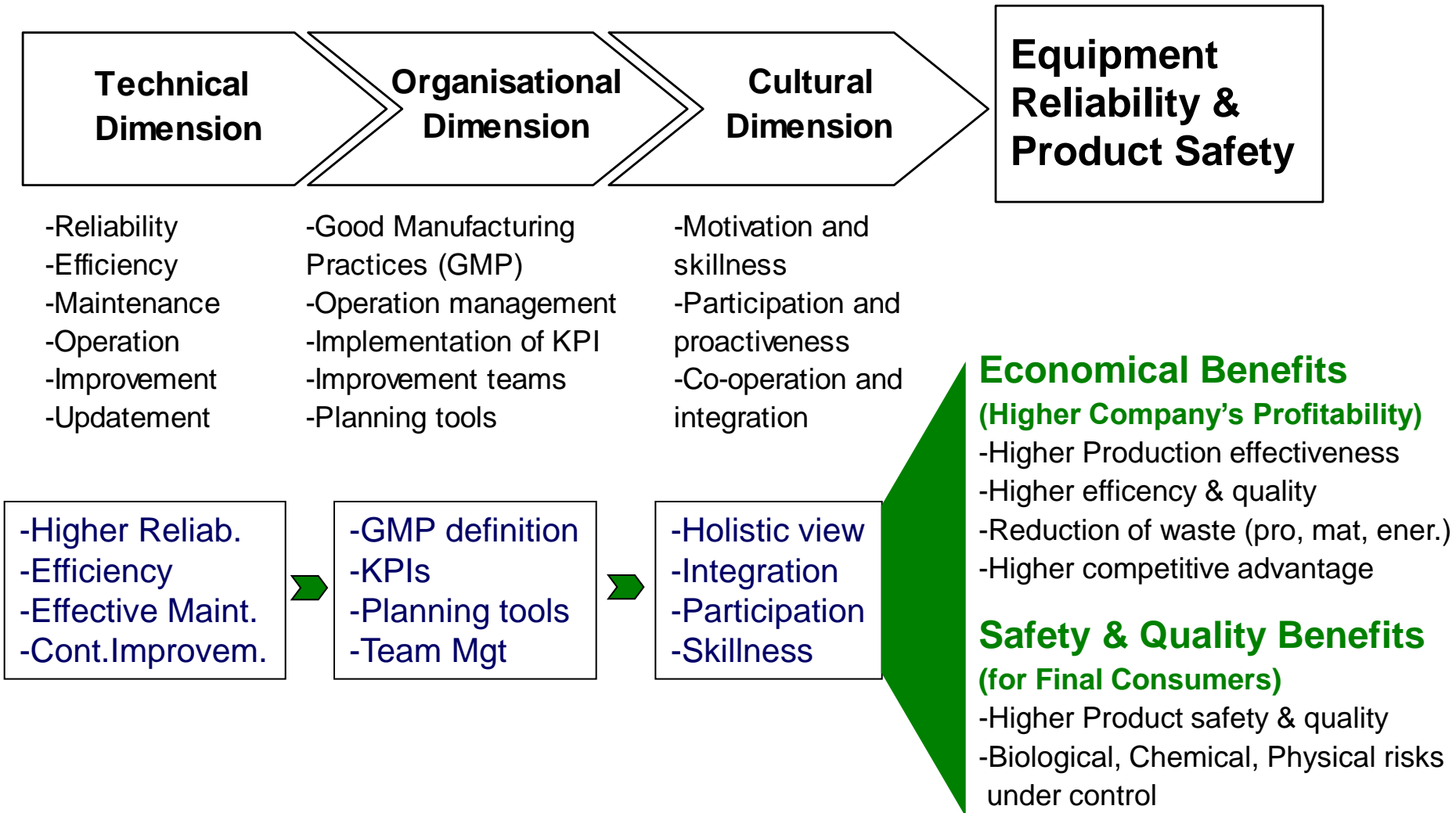
Indirect costs of company (B) **Proactive Culture:**

- (a) packaging material waste: 2% on 200 millions of packs/year = 423.500 Euro;
 - (b) Product unsterility/year: No. 1 small case = 10.000 Euro;
 - (c) Non conformity product: No. 7.000 non conformity packages = 2.000 Euro;
 - (d) Energy loss: due to equipment downtime = 1200 Euro;
 - (e) Chemicals loss: due to cleaning phases following equipment failure = 2000 Euro.
- Total indirect costs = **438.700 Euro**.

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..Main Benefits: Tech., Org. and Cultural..



Designing Food Safety Through Maintenance Engineering

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Designing Food Safety and Equipment Reliability Through Maintenance Engineering



SAURO RICCETTI

 CRC Press
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A PRODUCTIVITY PRESS BOOK

PARTNERSHIP ACTORS

Research

Brunel University London

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Maintenance & Engineering

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This book describes the design & implementation process with techniques and benefits achieved



Thanks