

# **RISK ASSESSMENT TERMINOLOGY**

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EHSEC



# TWO SIDES OF ONE COIN

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**Risk and  
opportunity**

**are two sides  
of the same  
coin**

MAINTENANCE MANAGEMENT HAS TO BE DONE BASED

**ON RISK/ OPPORTUNITY ASSESSMENT !**

# TWO SIDES OF ONE COIN

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Accident  
prevention during  
maintenance  
activities

Prevention of  
accident caused  
by maintenance  
activities



MAINTENANCE MANAGEMENT HAS TO BE DONE BASED  
**ON RISK / OPPORTUNITY ASSESSMENT!**

Accident  
prevention  
during  
maintenance  
activities

# HOW TO MANAGE THE RISKS THROUGH MAINTENANCE MANAGEMENT

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1. STEP: MACHINERY SAFETY
2. STEP: OH&S LEGAL REQUIREMENTS
3. OH&S MANAGEMENT SYSTEMS



Accident prevention during maintenance activities

# LEGAL REQUIREMENTS – EU DIRECTIVES

Treaty of the functioning of the European Union

Art. 114



Art. 153

Removal of trade barriers in the EU internal market

Collaboration between EU states on social issues

## MACHINERY

LOW VOLTAGE  
DIRECTIVE  
  
2014/35/EU

**MACHINERY  
SAFETY  
2006/42/EC**

EMC  
DIRECTIVE  
  
2014/30/EU

## WORKPLACE

Framework requirements for improvement OHS  
**89/391/EEC**

Directive - min. safety+health  
requirements Workplace  
89/654/EEC

**Work equipment  
directive  
2009/104/EC**

Harmonized EU standards

20 additional individual directives (act.16, 89/391/EEC)  
Specific standards

Declaration of conformity, CE marking

Safety operating instructions

MACHINE MANUFACTURER

**RESIDUAL RISK: USER MANUAL**

MACHINE OPERATOR in the working environment

**ACCEPTABLE RISK: SAFE PROCEDURES**

**THE BASE OF THE HOUSE = RISK ASSESSMENT**

Free market

≠

Free rules!



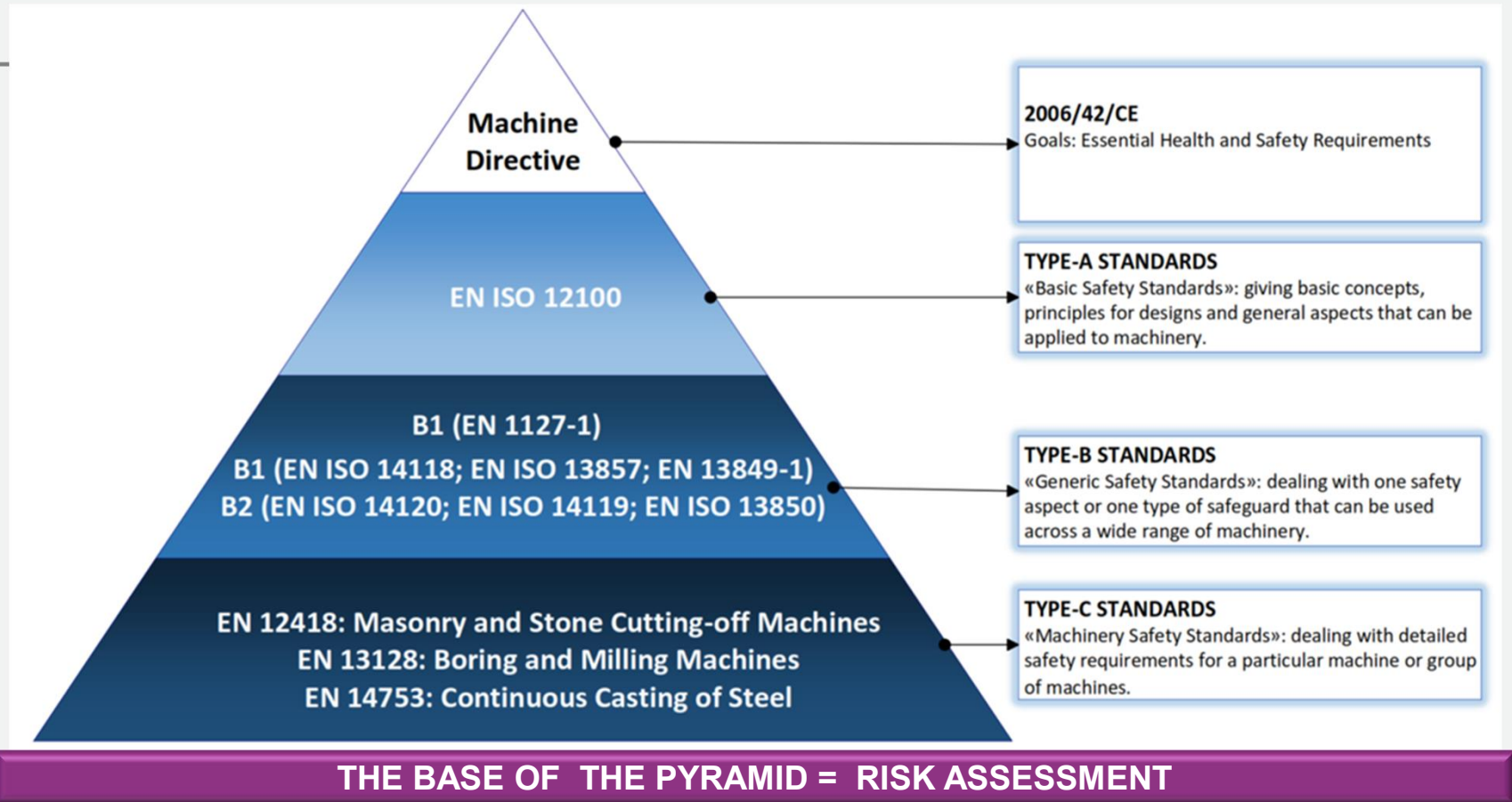
Accident  
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during  
maintenance  
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# LEGAL REQUIREMENTS - Harmonized standards

Free market

≠

Free rules!





Accident  
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during  
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# RISK ASSESSMNET (RA)

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## 1. STEP: MACHINERY SAFETY

## 2. STEP: OH&S LEGAL REQUIREMENT

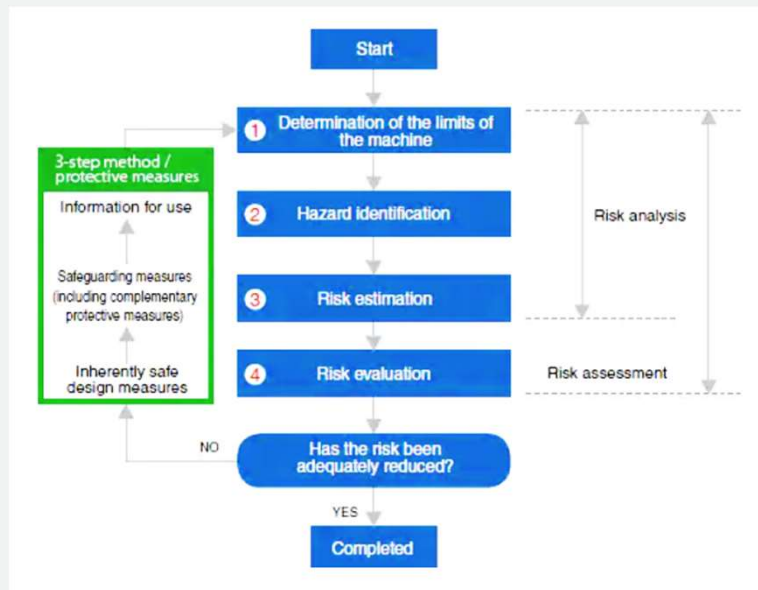
## 3. OH&S MANAGEMENT SYSTEMS

**Risk** (according to the Machinery Directive) is defined as the combination of the probability and severity of an accident or injury that may result from a hazardous situation.

Accident  
prevention  
during  
maintenance  
activities

# RISK ASSESSMNET - definition

**ISO 12100:** RA - overall process comprising a risk analysis and a risk evaluation.



The risk assessment consists of:

- determination of machine boundaries,
- hazard identification,
- risk estimation,
- risk evaluation.



# Task identification (ISO 12100)

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should consider all those tasks associated with all the phases of the machine life cycle. Task identification should also take into account, but not be limited to, the following task categories:

- setting;
- testing;
- teaching/programming;
- process/tool changeover;
- start-up;
- all modes of operation;
- feeding machine;
- removal of product from machine;
- stopping the machine;
- stopping the machine in an emergency;
- recovery of operation from jam;
- re-start after unscheduled stop;
- faultfinding/trouble-shooting (operator intervention);
- cleaning and housekeeping;
  
- **preventive maintenance;**
- **corrective maintenance.**

# RA: 1.LIMITS OF MACHINERY, 2.HAZARDS IDENTIFICATION

BASIC PRINCIPLE: Accident causality/ scenario: Hazard (type) → hazardous situation → hazardous event → harm → loss



**Hazard:** potential source of harm.  
The term “hazard” can be qualified in order to define its origin (e.g. mechanical hazard, electrical hazard) or the nature of the potential harm (e.g. electric shock hazard, cutting hazard, toxic hazard, fire hazard).



**hazardous situation:** circumstance in which a person is exposed to at least one hazard

**hazard zone:** any space within and/or around machinery in which a person can be exposed to a hazard



INITIATION: Hazardous event  
mistake, machinery failure, ...

**hazardous event:** event that can cause harm

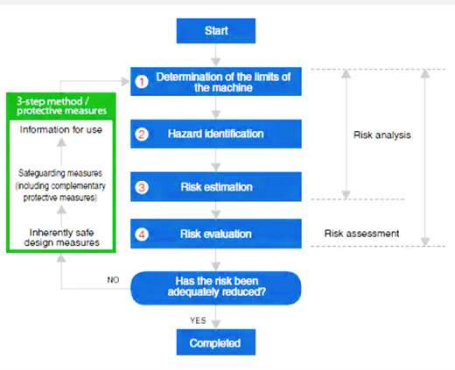


**Harm**

physical injury or damage to health

**Loss**  
How much?

$$R = P \times C$$



# RISK ASSESSMENT (ISO 12100)

## **Risk analysis:**

combination of the specification of the limits of the machine, hazard identification and risk estimation.

## **Risk estimation:**

definition of severity likelihood of harm and probability of its occurrence ( $R = P \times C$ ).

## **Risk evaluation:**

judgement, on the basis of risk analysis, of whether the risk reduction objectives have been achieved

A **hazard identification checklist**, also known as a hazard assessment form, is a tool used by designers/ or safety officers in performing hazard assessments. The main purpose of a hazard assessment is to identify potential health and safety hazards by examining conditions of using the machinery/ or conditions or practices in the workplace.

## IDENTIFICATION OF HAZARDS

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Hazard identification is one of the most important steps in the risk management process.

**The list of hazards must be carefully established.**

A list of all the energy sources or all the man-machine interfaces that can affect the health and safety of exposed workers must be carefully established, whether they are moving elements (mechanical hazard), electrified components (electrical hazard), machine components that are too hot or too cold (thermal hazard), noise, vibration, visible (laser) or invisible radiation (electromagnetic), hazardous materials or awkward postures (ergonomic hazard).

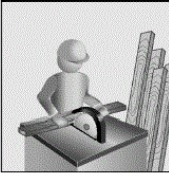
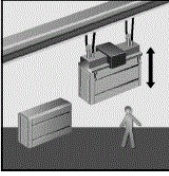

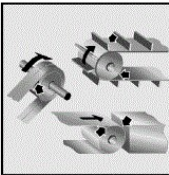
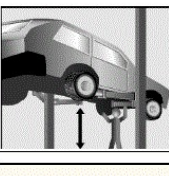
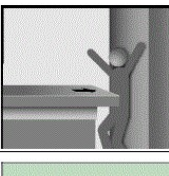
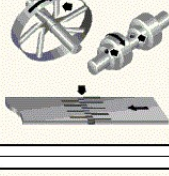
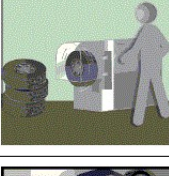
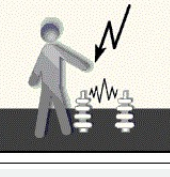
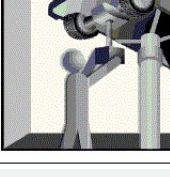
These hazards are then linked to the hazardous situations to which the workers are exposed.

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activities

# IDENTIFICATION OF HAZARDS (ISO 12100)

Check – list 10 Types of hazards	Hazardous situation	Y/N
Mechanical hazards		Y
Electrical hazards		Y
Thermal hazards		Y
Noise hazards		Y
Vibration hazards		Y
Radiation hazards		N
Material/ substance hazards		N
Ergonomic hazards		Y
Hazards associated with environment in which the machine is used		N
Combination of hazards		N

Table A.2

Hazard		Hazard	
	<b>Origin</b> cutting parts <b>Potential consequences</b> — cutting — severing		<b>Origin</b> falling objects <b>Potential consequences</b> — crushing — impact
	<b>Origin</b> moving elements <b>Potential consequences</b> — crushing — impact — shearing		<b>Origin</b> moving elements (three examples) <b>Potential consequences</b> — drawing-in — friction, abrasion — impact
	<b>Origin</b> gravity, stability <b>Potential consequences</b> — crushing — trapping		<b>Origin</b> approach of a moving element to a fixed part <b>Potential consequences</b> — crushing — impact
	<b>Origin</b> rotating or moving elements (three examples) <b>Potential consequences</b> — severing — entanglement		<b>Origin</b> moving elements <b>Potential consequences</b> — crushing — friction, abrasion — impact — severing
	<b>Origin</b> live electrical parts <b>Potential consequences</b> — electric shock — burn — puncture — scald		<b>Origin</b> objects or materials with a high or low temperature <b>Potential consequences</b> — burn

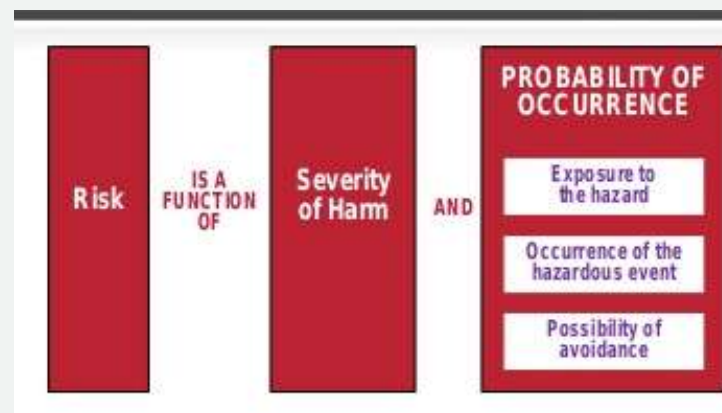
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## RISK definition ISO 12100

**RISK:** combination of the probability of occurrence of harm and the severity of that harm.

**ADEQUATE RISK REDUCTION:** risk reduction at least in accordance with legal requirements under consideration of the current state of the art.

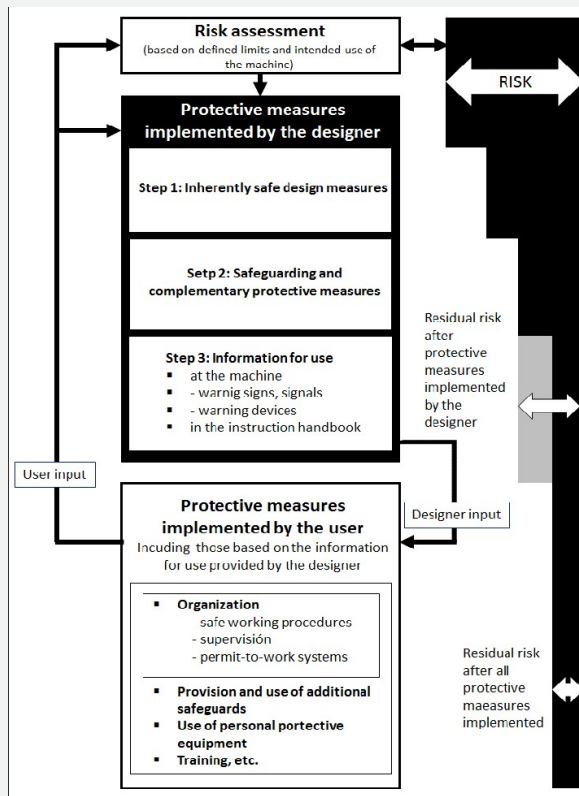
**RESIDUAL RISK:** risk remaining after protective measures have been taken.





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## RISK REDUCTION (3 steps ISO 12100)



- **STEP 1:** Measures for self-design safety - eliminate or reduce associated risks.
- **STEP 2:** Safety protection and additional protective measures - reduce risks by applying technical measures.
- **STEP 3:** Use Information - **Reduces residual risks by proper use and maintenance.**



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# RISK estimation tools (TNI/ISO/TR 14121-2)

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- ☐ Risk matrix
- ☐ Risk graph (PL/SIL)
- ☐ Numerical scoring
  
- ☐ Fault/failure tree analysis – FTA
- ☐ Failure mode and effect analysis – FMEA
- ☐ Hazard and operability study - HAZOP



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# RISK ASSESSMNET (RA)

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**1. STEP: MACHINERY SAFETY**



**1. STEP: OH&S LEGAL REQUIREMENT**

**2. OH&S MANAGEMENT SYSTEMS**

**Prevention (according to the OHS Directive):** all the steps or measures taken or planned at all stages of work in the undertaking to prevent or reduce occupational risks.



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# THE CONTROL OF HAZARDOUS ENERGY

## Lockout, Tagout ANSI/ASSPZ 224.1-2016

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**Hazardous energy:** Any form of energy, stored or residual, having the ability of unexpected connection or mobilization of equipment (e.g. capacitors, springs, elevated machinery parts, rotational flywheels, hydraulic systems, pneumatic systems, gases, vapours etc.).

OR: Any electrical, mechanical, hydraulic, pneumatic, chemical, nuclear, thermal, gravitational or other energy, that could cause harm to personnel.

**The objective of LOTO system implementation** is to increase occupational health and safety at work (OHS), preferably of the **maintenance personnel**, or of all the employees performing works by unblocked protective equipment or their removed covers. The same applies to the employees having to touch a dangerous part when repairing the machine or the equipment thus endangering their health or life, as well as the employees being forced to work within the hazard zone thus being exposed to the machinery hazardous energy source.

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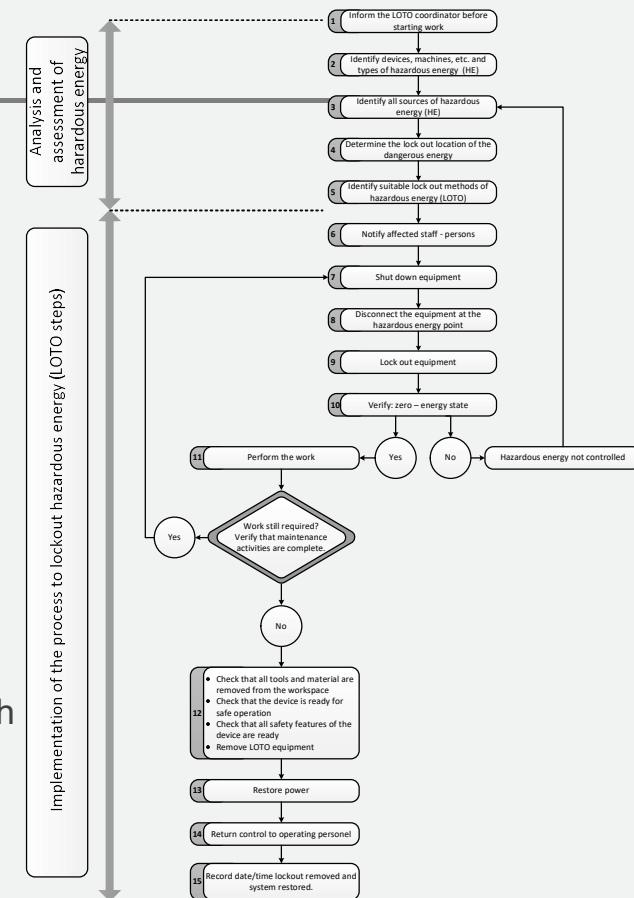
# „LOTO“ RISK Assessment Terminology



**Risk Assessment:** Total procedure (algorithm) containing the analysis and risk assessment.

**Residual risk:** The risk that remained after taking of safety measures (adopted by a constructor and/or operator).

**Hazardous Energy Management System:** HEMS represents a coordinated and systematic approach for risk management arising from hazard of life and health of employees, by exposing or striking by hazardous energy throughout maintenance activities. HEMS constantly helps to improve performance in terms of OHS and ensure conformity with legislative requirements as well as respective standards.





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# RISK estimation tools

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- ❑ Risk matrix
- ❑ RCFA
- ❑ Failure/ fault tree analysis – FTA
- ❑ Even tree analysis – ETA
- ❑ Bow tie
- ❑ LOPA
- ❑ Human reliability analysis – HRA
- ❑ Failure mode and effect analysis – FMEA
- ❑ Hazard and operability study - HAZOP





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# RISK ASSESSMNET (RA)

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1. STEP: MACHINERY SAFETY



1. STEP: OH&S LEGAL REQUIREMENT



1. OH&S MANAGEMENT SYSTEMS

**Risk Assessment** (according to the ISO 41001): all the steps or measures taken or planned at all stages of work in the undertaking to prevent or reduce occupational risks.



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# OH&S Management SYSTEM (ISO 45001)

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## **RISK - effect of uncertainty (on objectives)**

**Hazard** – Anything that has a potential to cause injury or ill health. Hazards are identified for all processes so that actions can be taken to control or mitigate the effects of the hazards on workers. 5 levels of hazard controls in ISO 45001.

**OH&S risk** - combination of the likelihood of occurrence of a work-related hazardous event or exposure and the severity of injury or ill health that can be caused by the event or exposures).

**OH&S opportunity** - circumstance or set of circumstances than can lead to improvement of OH&S performance.



# HOW MANAGE THE RISKS THROUGH MAINTENANCE MANAGEMENT

**RISK - effect of uncertainty (on maintenance management objectives)**

**Opportunity** - circumstance or set of circumstances than can lead to improvement of MAINTENANCE performance.

Stakeholder ... Cutomers, Legal requirement, Employees, public

Process approach (main processes – preventive, predictive, corective)

Improvement of maintenance management not equipment!

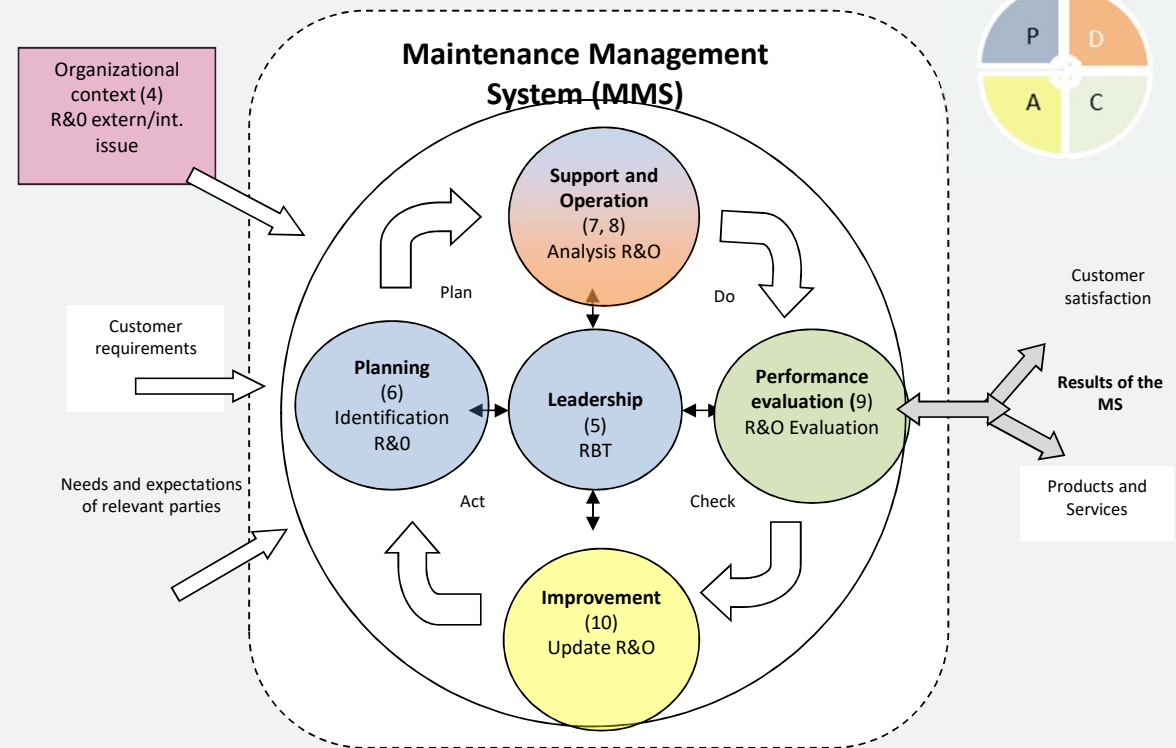
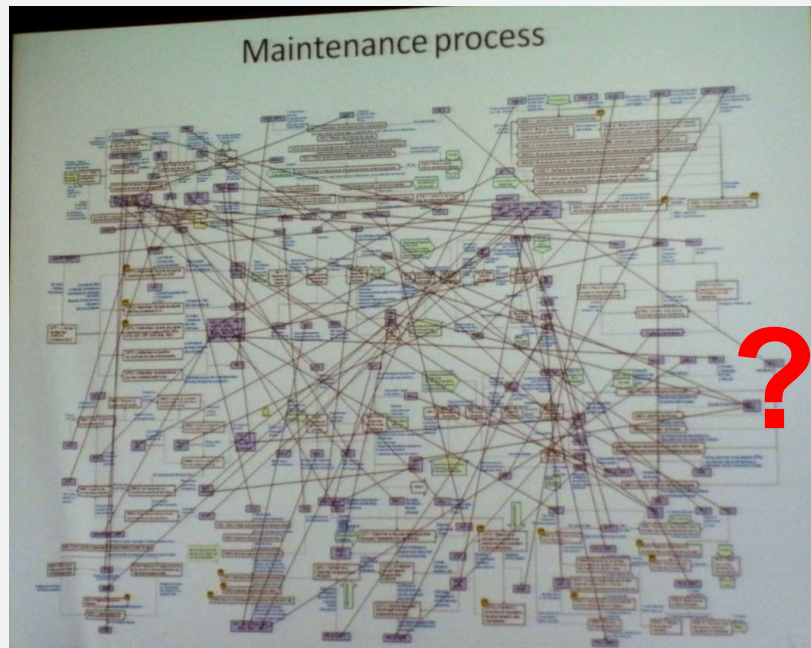
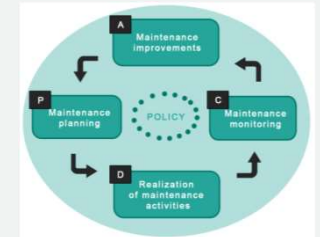
PDCA cycle

Risk-Based Thinking (RBT)

WHY NOT ???

MAINTENANCE MANAGEMENT SYSTEM – STRUCTURE BY ISO ANNEX SL!

# What does it mean MMS?



# MANAGEMENT TOOLS - PLAN

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P: RbT - strategy: MCA, RCM – FMEA, QRA(RBI)

HAZOP, ...

D: Strategy realisation

C: KPI, RCFA, ... QRA: FTA, ETA ...

A: Improvement strategy of maintenance!