Safety and Risk Management Aspects for Major Accident Industry in Poland

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PROCESS SAFETY MANAGEMENT
What is PSM?

**COMPREHENSIVE EVERGREEN SYSTEM
FOR
PREVENTION OF MAJOR ACCIDENTS**

Focus on
**- AVOIDING THE OCCURRENCE OF CATASTROPHIC
RELEASES**

**- MINIMIZING THE CONSEQUENCES OF CATASTROPHIC
RELEASES**

Accidents are viewed as lack
of Management Control

Process Safety Developmenet

- Highly publicized accidents, eg. Flixborough, 1974, Seveso 1976, Bohpal 1984, Piper Alpha 1984………

- Increasing number and size of facilities

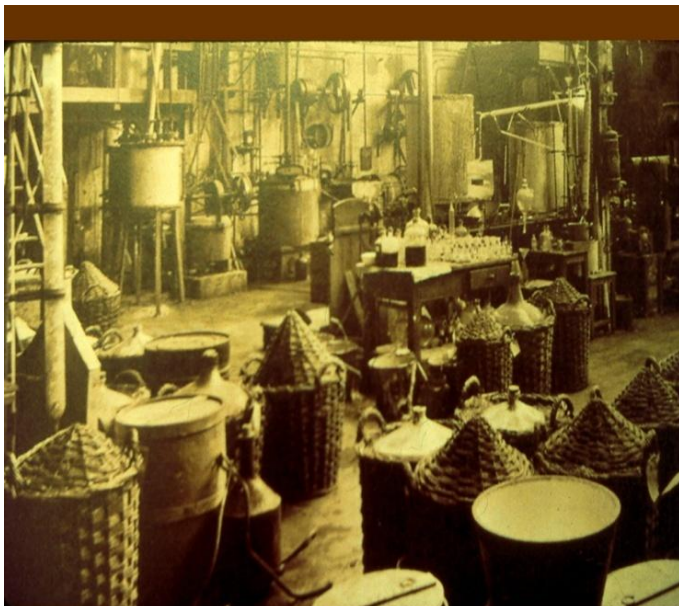- Highly complex new technologies using large inventories, working under extreme operating conditions.
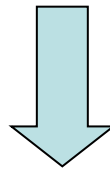
Increase awareness and concern about major accident (safety science, organisations and government and industry Regulations (Seveso Directive in EU) !

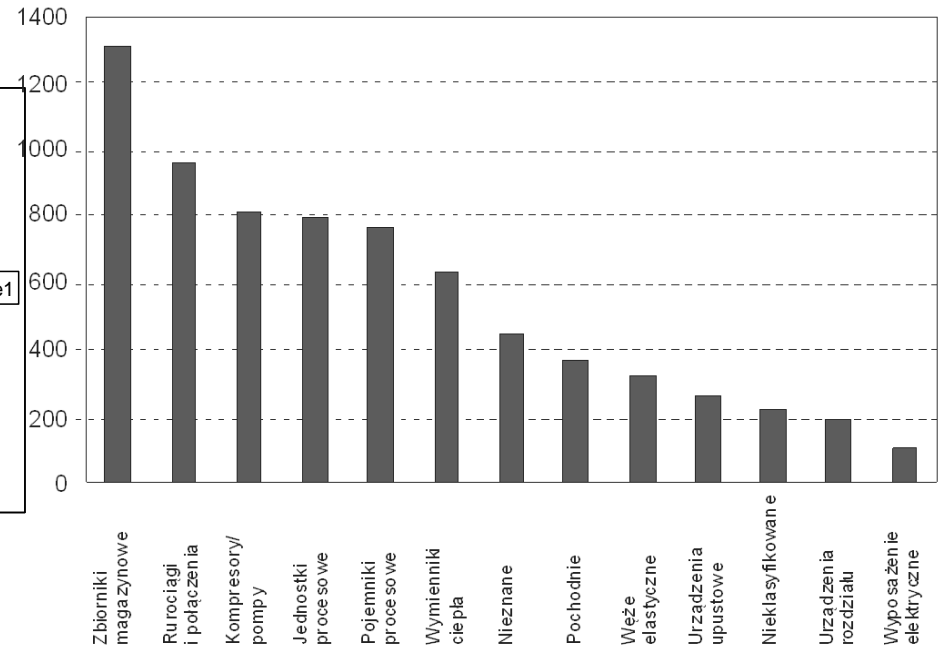# Industrial plant changes

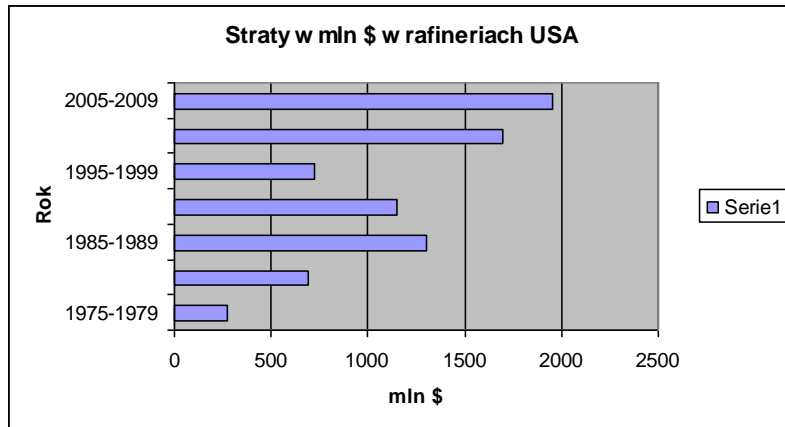

k2615585 www.fotosearch.com

Major Accidents

Flixborough Incident 1974
....

Losses and causes for major accidents

Losses in USA refineries due to major accident hazards

Type of the equipment

The main causes of major accidents - management oversights and omissions (up to 70-80%)

Elements of PSM

The key element of PSM applicable to major hazard industry is _Risk Management Process_.

Process Safety Management – Elements

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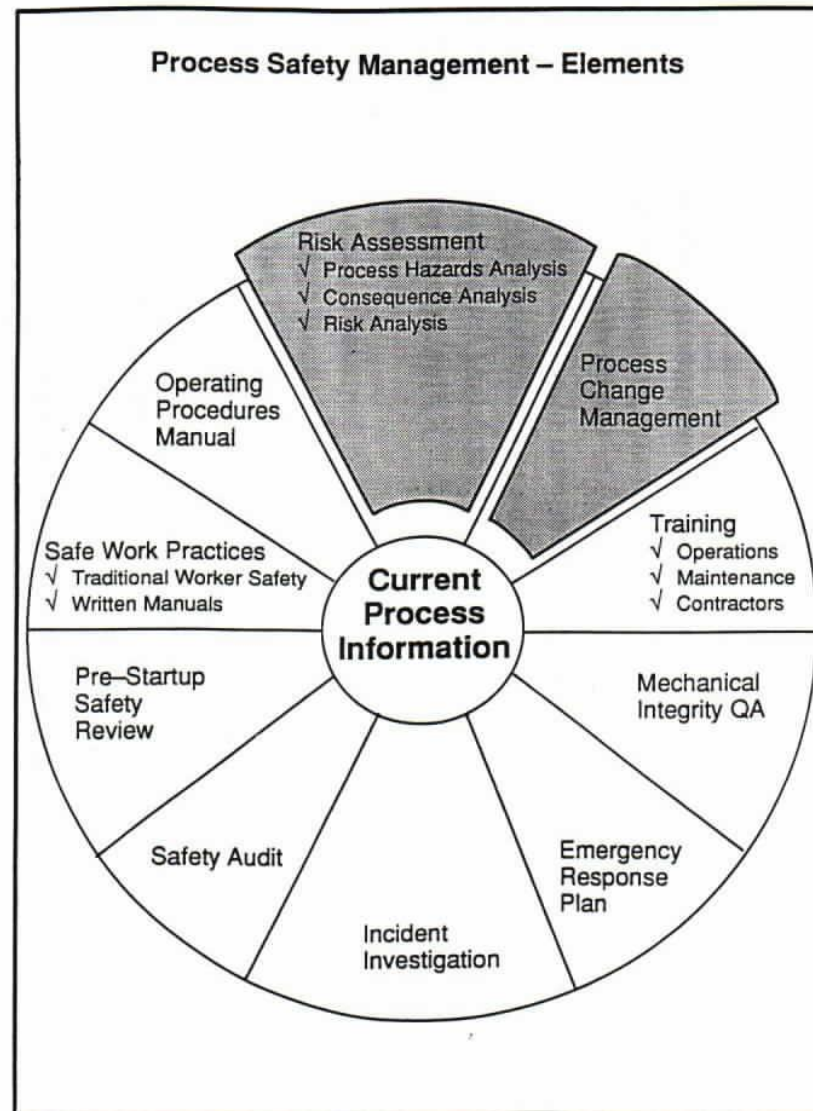
Process Safety Mangement Benefits
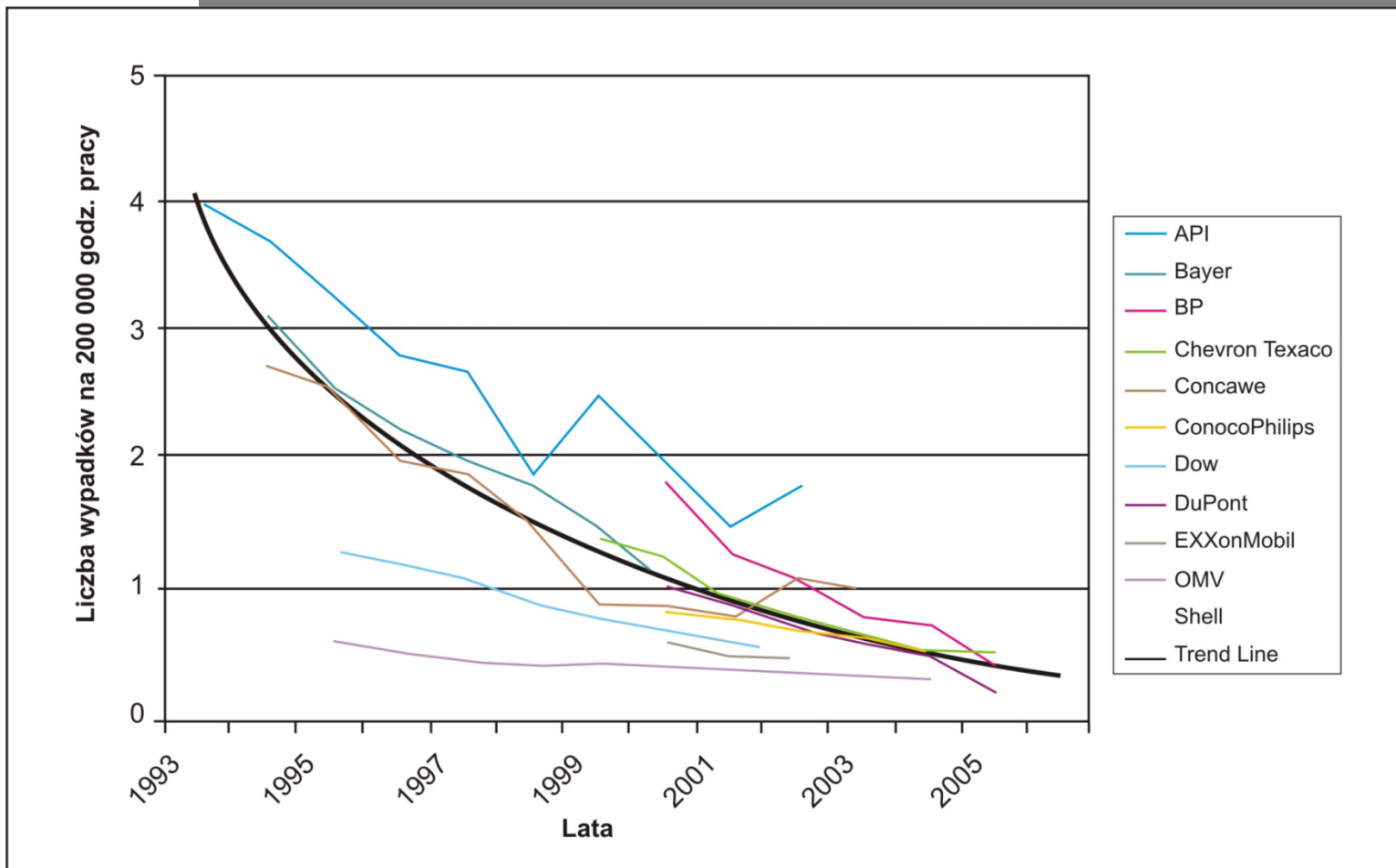
Protecting people, Avoiding production and Markets lost after accident, Satisfying regulatory requirements, Reduction of insurance costs

Process Safety Mangement and Risk Management Process

Risk Management Process

Layers of Protection

Prevention   Mitigation

CAUSES → TE → CONSEQUENCES

Process Safety Management

Process Risk Mangement

State of the art in Process Safety Management in Poland

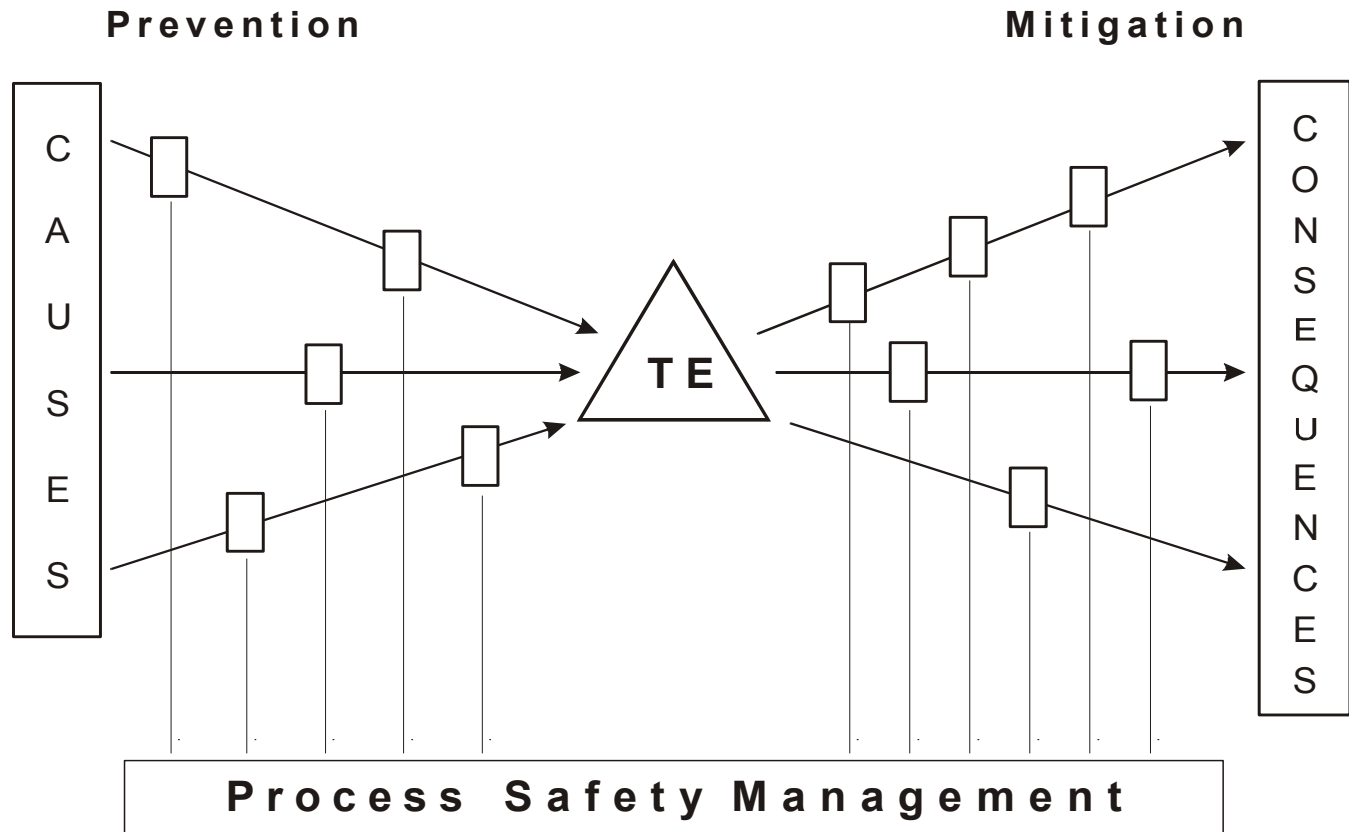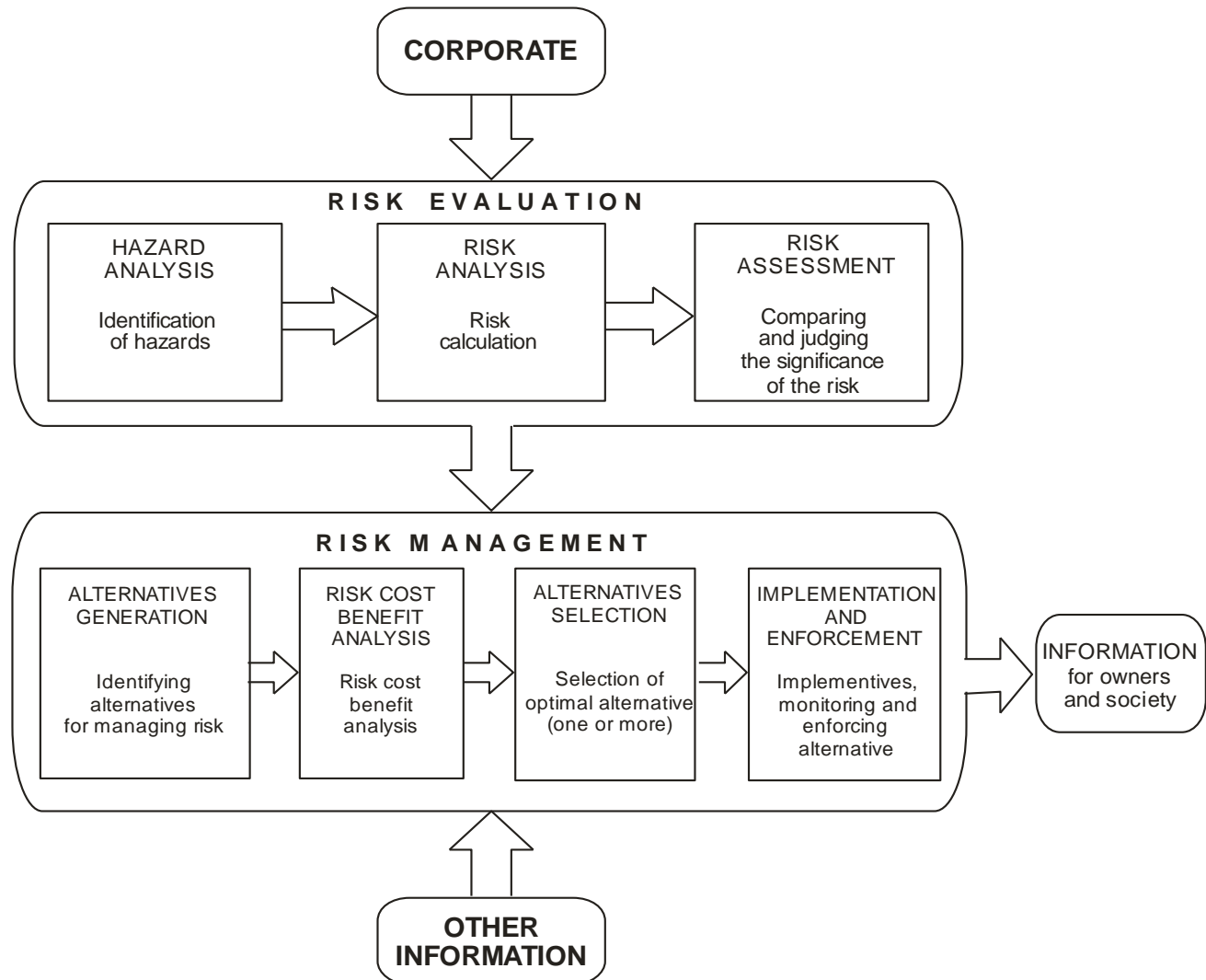358 Seveso Plants (171 upper-tier and 187 lower-tier plants)

1205 non- Seveso Establishments

Advantages of Polish process safety measures	Disadvantages of Polish process safety measures
- general conformity to the technical standards, - quite good technical standards, - well organized health and safety staff and Labour Inspection, - well organized accident investigation process and rescue system.	- not appreciation of safety management system, - limited staff involved in process safety manag, - not enough specialists and tools in process risk - limited application of risk analysis, - unsatisfactory safety culture.

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Elements of PSM of special intrest to the Polish Industry

1. Process Risk Management

2. Management of Change

3. Human Error - Safety Culture

4. Learning from Incident

5. Safety Performance Indicators

The methods used in Risk Management

Group	Relevance criteria				
	Input data and level of team expertise	Complexity of the plant and method	Nature and degree of uncertainty	Applicability to SEVESO sites	Time required
Ranking methods	Low	Low	Low	Low	Low
PHA methods	Low	Medium/ High	Medium	Medium	Medium
Scenario analysis methods	Medium	Medium	High	Medium	High
LOPA Basic methods	**Medium**	**Medium**	**Medium**	**Medium/ high**	**Medium**
Complex methods, QRA	High	High	High	High	Very long

Layer of Protection Analysis-LOPA
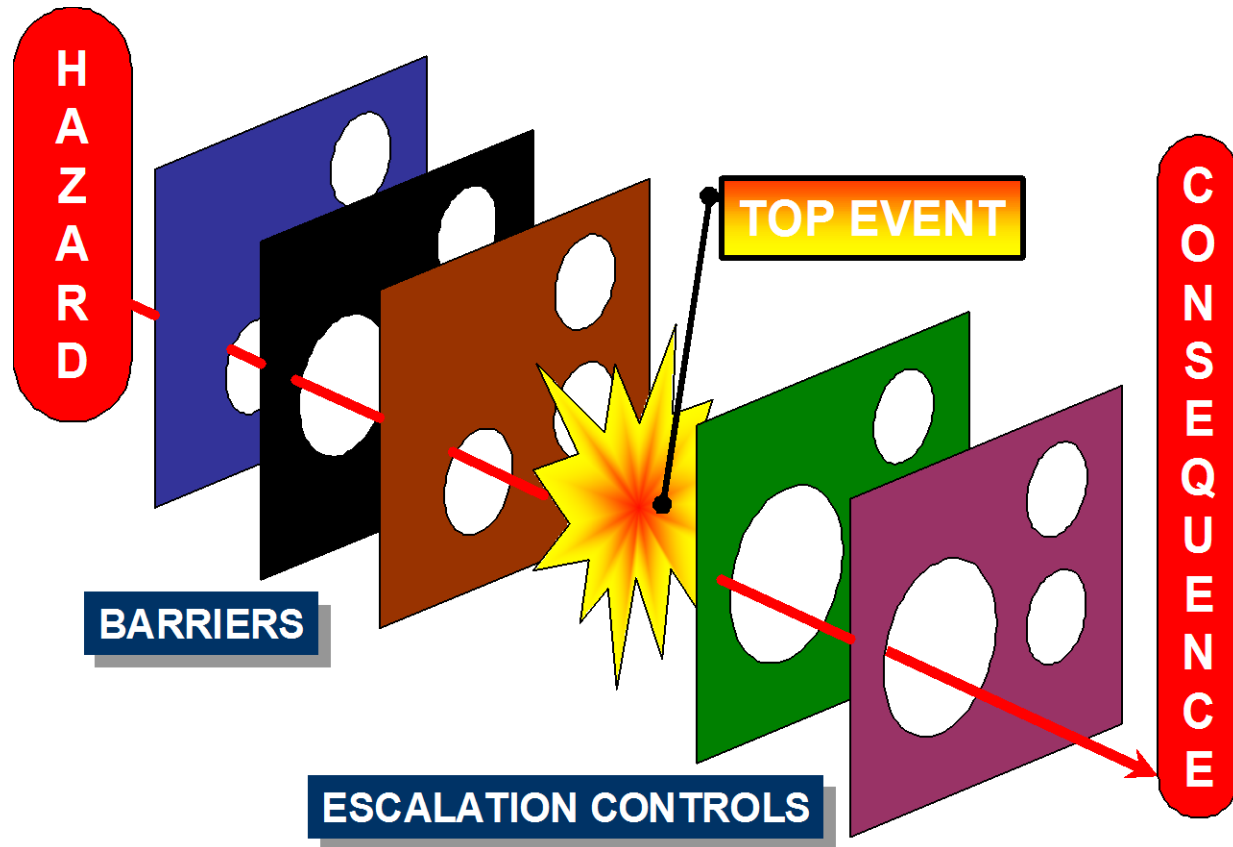
The LOPA assumes that no layer of protection is perfect; every layer has some probability failure on demand (PFD). Therefore the risk of occurrence of unwanted consequences depends on the failure of the Independent Protection Layers-IPLs.

LOPA

Advantages	Disadvantages
Focuses on major accident hazard events	Does not identify incident scenario
Useful for prioritizing hazard scenario and making a risk-based decision	No effect of the mitigated severity of consequence on the risk index
Allocates risk reduction measures efficiently	Uncertainty of frequency data used
Is less work-demanding than FTA /QRA	PFD only available for basic IPLs and initiating causes
Is intuitive, easy to learn and well understood by industry people	Doesn't pay an attention to non-SIS layer of protection, especially human and operating culture
Possible extension of LOPA framework to other risk assessment purposes	

ExLOPA for ATEX
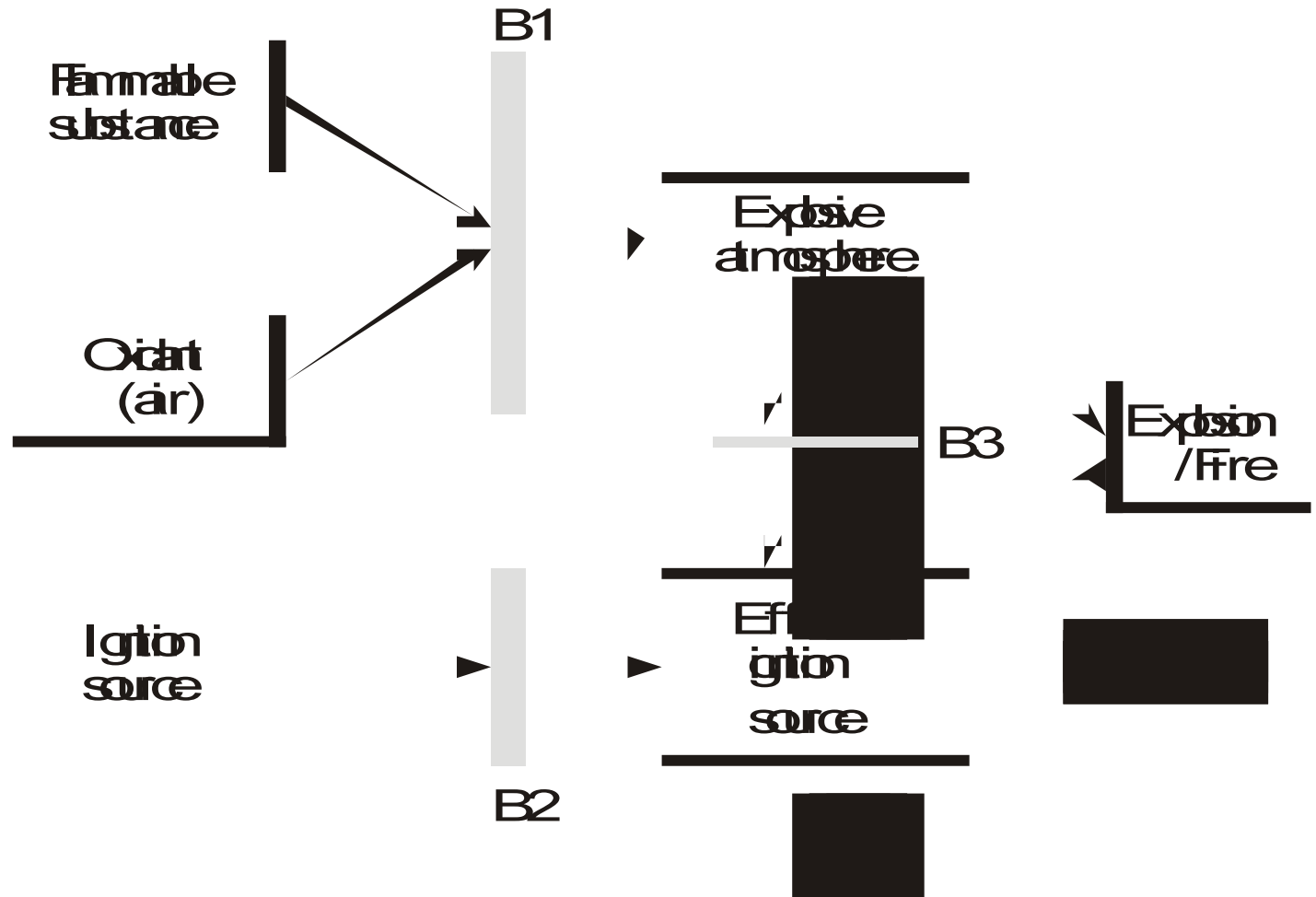
$$R_n (T_{EXP}) = f (F_{atex}, P_{EFI}, F_{SM}, SC)$$

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MART for Accident Investigation

Diagram elements:

- Losses
- Future losses
- S/M. Accident events (AE1, AE2 .... AE13)
- R Assumed risk (A)
- What happened? — Why?
- S Specific control factors LTA
- M. SMS (Safety Report) LTA

- SA1 Energy release
- SA2 Barriers LTA
- SA3 Persons, objects in threatened zone (B)
- MA1 Management elements LTA (C)
- MA2 Process risk assessment LTA
- MA3 Safety culture LTA (D)

- Conditional events — SB1 (E)
- Initiating events — SB2
- Technical barriers LTA — SB3
- MB1 Organizational barriers LTA
- MB2 Goals LTA
- Information system LTA — MB3 (F)
- Hazard analysis process LTA — MB4 (G)
- Safety program review LTA — MB5 (H)

- EE (I) SC1
- PU (J) SC2
- TF (K) SC3
- HE (L) SC4
- MO (M) SC5
- Control layer LTA — SC6 (N)
- Safety layer LTA — SC7 (O)
- Mitigation layer LTA — SC8 (P.)
- Operator supervision LTA — MC1 (R)
- Maintenance LTA — MC2 (S)
- Inspection LTA — MC3 (T)
- Procedural (EOP) LTA — MC4 (U)

Legend:

- ▭ Generic event, fault, oversight or malcondition
- ◯ Basic event
- ⬭ Expected event
- ⌢ AND gate
- ⌒ OR gate
- △ Transfer to / from other element

- SMS - Safety Management System
- Safety Report
- EOP - Emergency Operational Plan
- A...U - subtrees

- EE - external events
- PU - process upsets
- TF - technical failures
- HE - human errors
- MO - management oversights

- RED — LTA Less Than Adequate
- BLUE — NMI Need more information
- GREEN OK.

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Management of Change

Establish and implement Written Management of Change Procedures which address:

Technical Basis
Impact on Safety and Health (risk assesment)
Modifications to Operating Procedures
Necessary Time Period for the Change
Authorization Requirements

Safety Culture

Achieving a positive safety culture in organization is fundamental to managing health and safety effectively.

The following organisational factors need to be included:

- Visible management commitment (leadership)
- Management style
- Good communication between all levels of employee
- A balance of health and safety and production goals
- Participation in safety Health & safety resources
- Risk-taking behavior
- Trust between management and frontline staff
- Industrial relations and job satisfaction
- Safety training

**Safety culture assessment should be adopted!**

You don't improve what you don't measure

An effective Process Management System requires to **use of key performance Indicators.**

In Poland, there is practice to analyse so called **„lagging metrics"**. They represent a retrospective measures of unexpected failures occurring in normal operations.
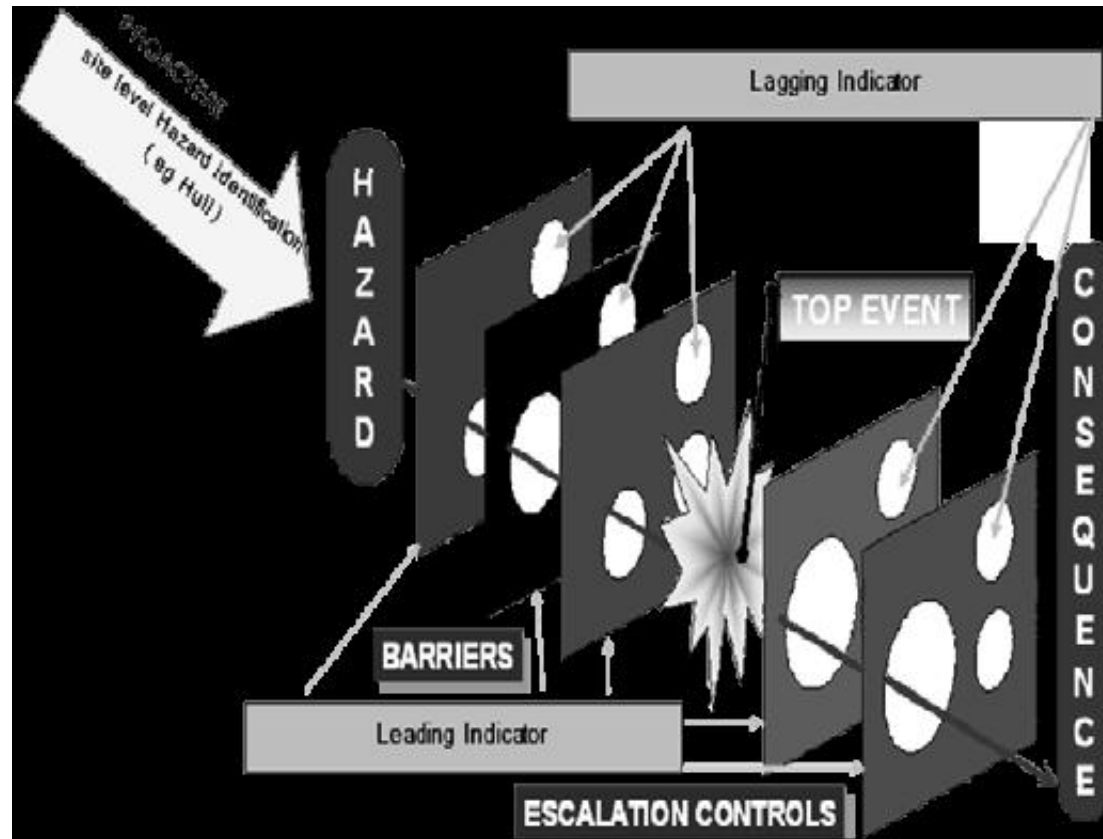
In terms of prevention it is important to use **„leading metrics",** representing measures of acivity in risk
 control discover during routine checks.

The leading metrics can be subsequently used for assessment of potentaillity of major hazards occurances.
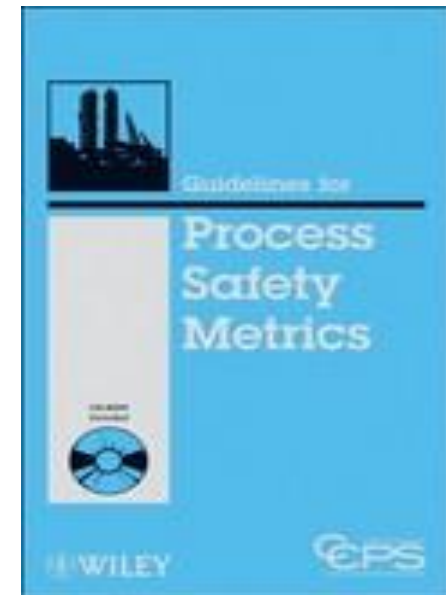
Lagging and leading metrics

lagging metrics represent a retrospective measures of unexpected failures occurring in normal operations
„leading metrics", representing measures of acivity in risk control discover during routine checks before major failure

Learning from incidents

Six steps for effective learning from incidents

1. Detection of a SHE incident

2. Reporting of the incident

3. Aplly proper analysis of the incident (Tripod, MART, MORT)

4. Establishing of the learning effects

5. Implementation of the learning effects

6. Checking the effectiveness of the implementation

Learning must go on various organizational levels: site level, plant level and corporate lavel.

Conclusions

1. There is need for national data base on incident /accidents and development of cooperation with other international sources.

2. Risk management process implementation requires process safety education program to be included in Polish Higher Learning. Uncertainity aspects in analysis should be widlely considered.

3. Speciall attention should be paid to the management of change, safety performance Indicators, safety culture and learning from incidents. These elements shoud be an integral part of PSM in each Polish major hazard company.

4. Attention should be paid also to the Non-Seveso establishments which poses the events with the attributes of a major accident.