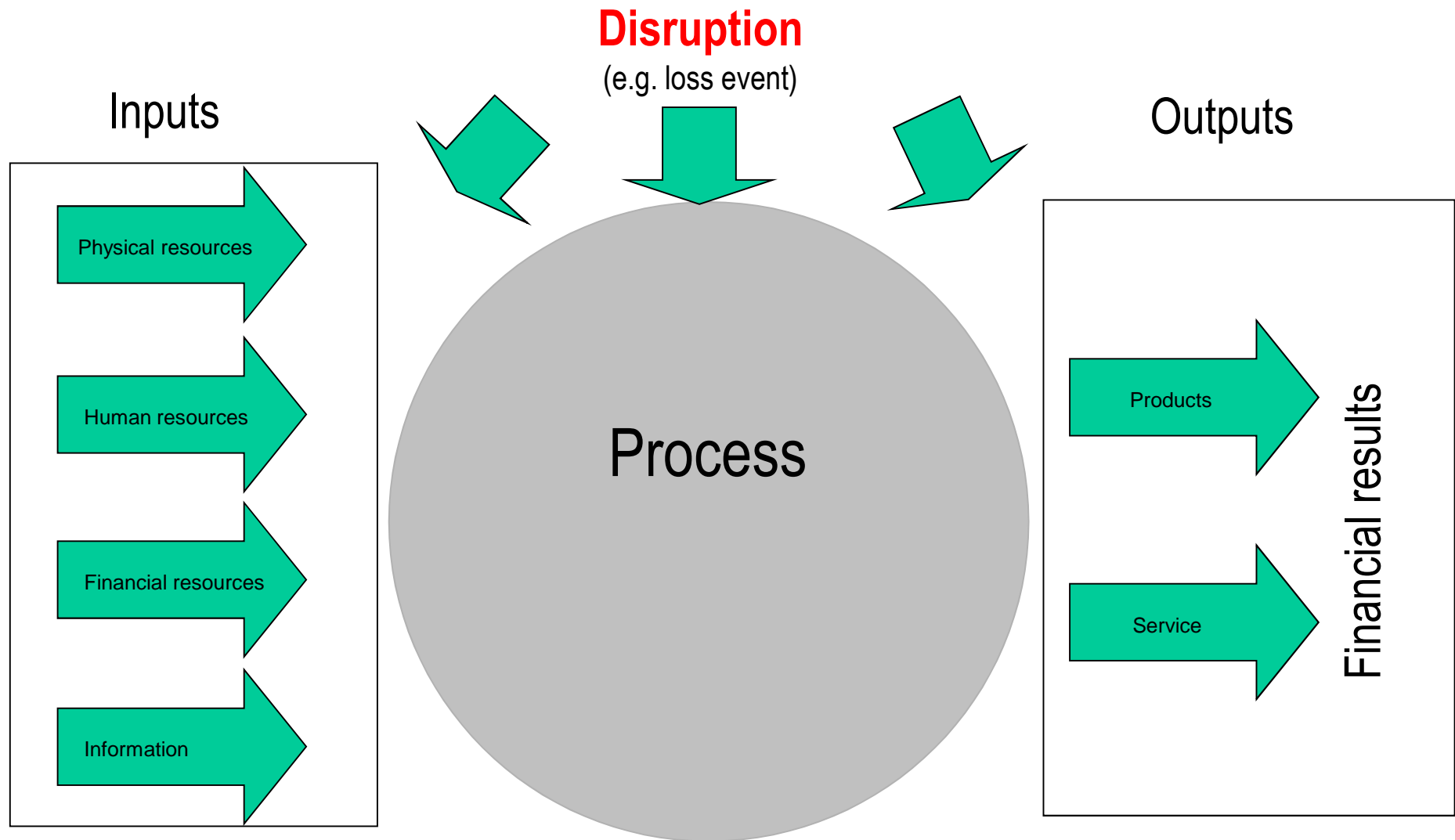# Audit including risk assessment by insurer

Ph.D. Dariusz Gołębiewski
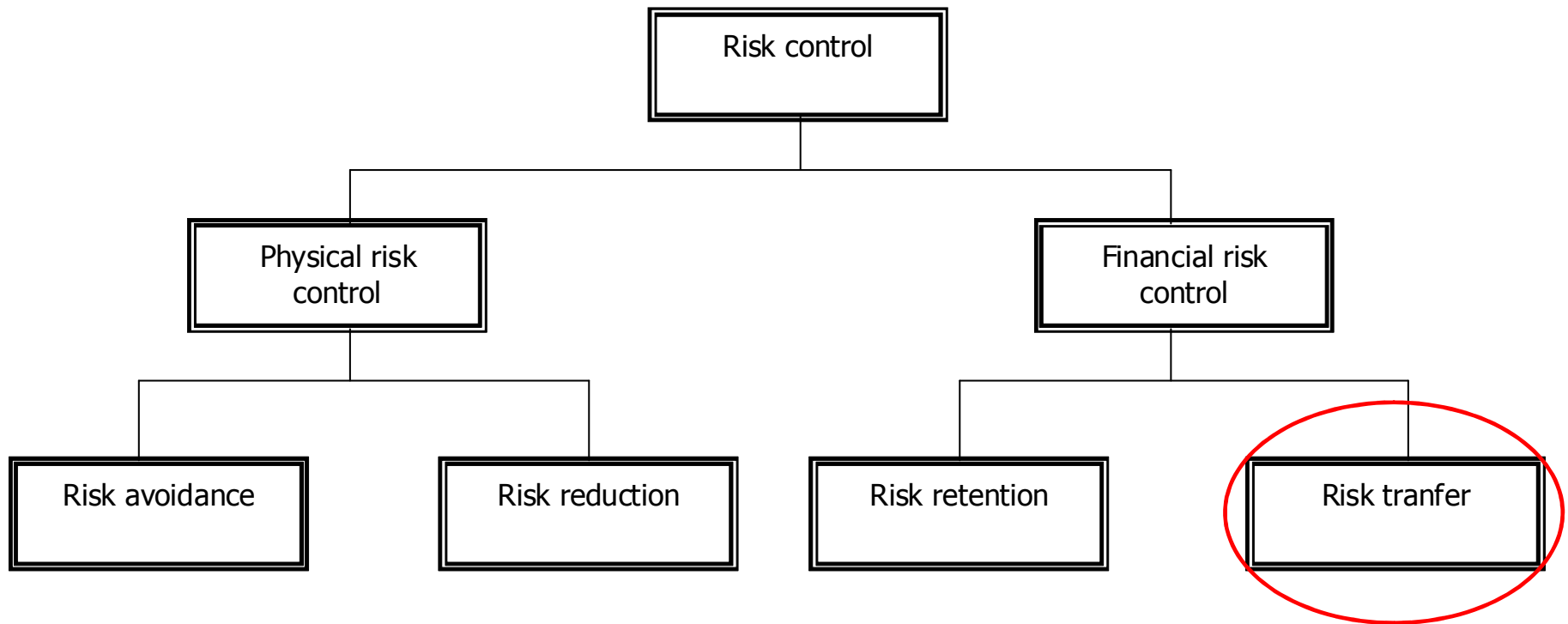
Phone: 666 888 382
E-mail: dgolebiewski@pzu.pl

The Risk management process in the enterprise

Disruption
(e.g. loss event)

Inputs

- Physical resources
- Human resources
- Financial resources
- Information

Process

Outputs

- Products
- Service

Financial results

The Risk management process in the enterprise

```
                        ┌─────────────────────┐
                        │    Risk control     │
                        └──────────┬──────────┘
            ┌──────────────────────┴──────────────────────┐
  ┌──────────────────┐                          ┌──────────────────┐
  │  Physical risk   │                          │  Financial risk  │
  │     control      │                          │     control      │
  └────────┬─────────┘                          └────────┬─────────┘
      ┌────┴────┐                                    ┌────┴────┐
┌──────────┐  ┌──────────┐                    ┌──────────┐  ┌──────────┐
│  Risk    │  │  Risk    │                    │  Risk    │  │  Risk    │
│avoidance │  │reduction │                    │retention │  │ tranfer  │
└──────────┘  └──────────┘                    └──────────┘  └──────────┘
```
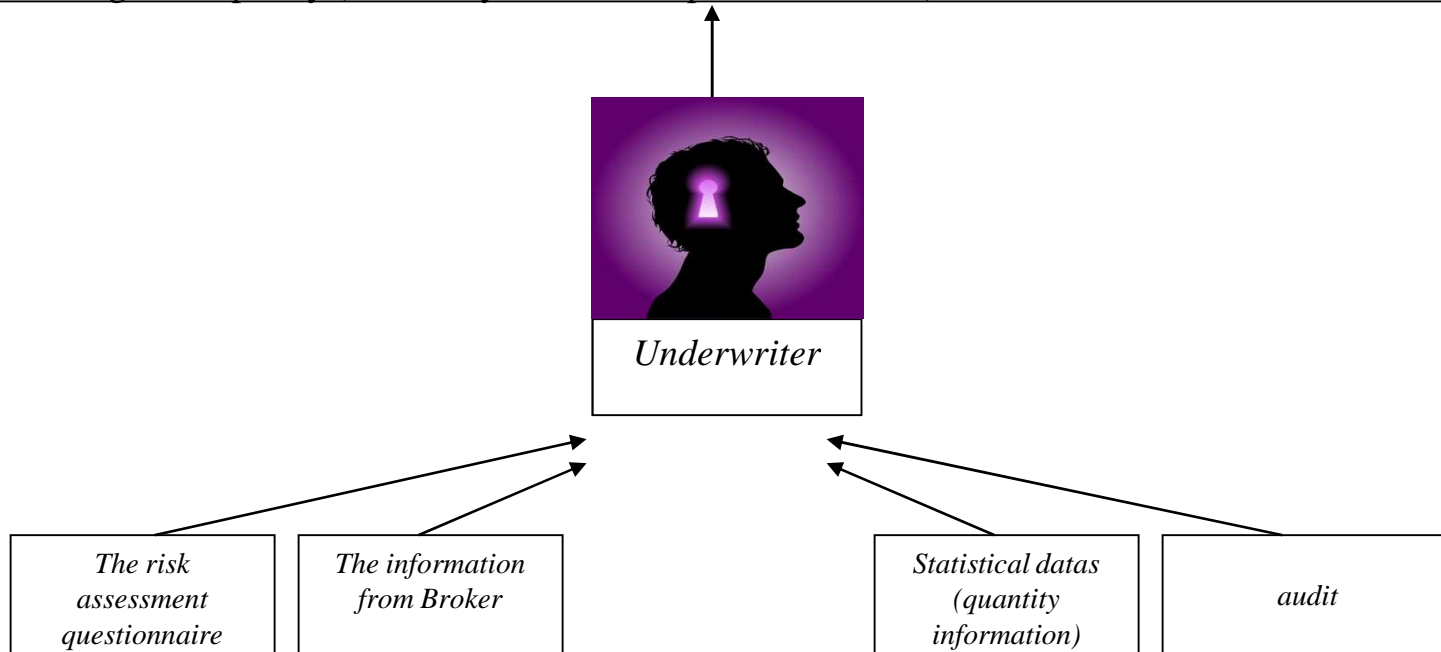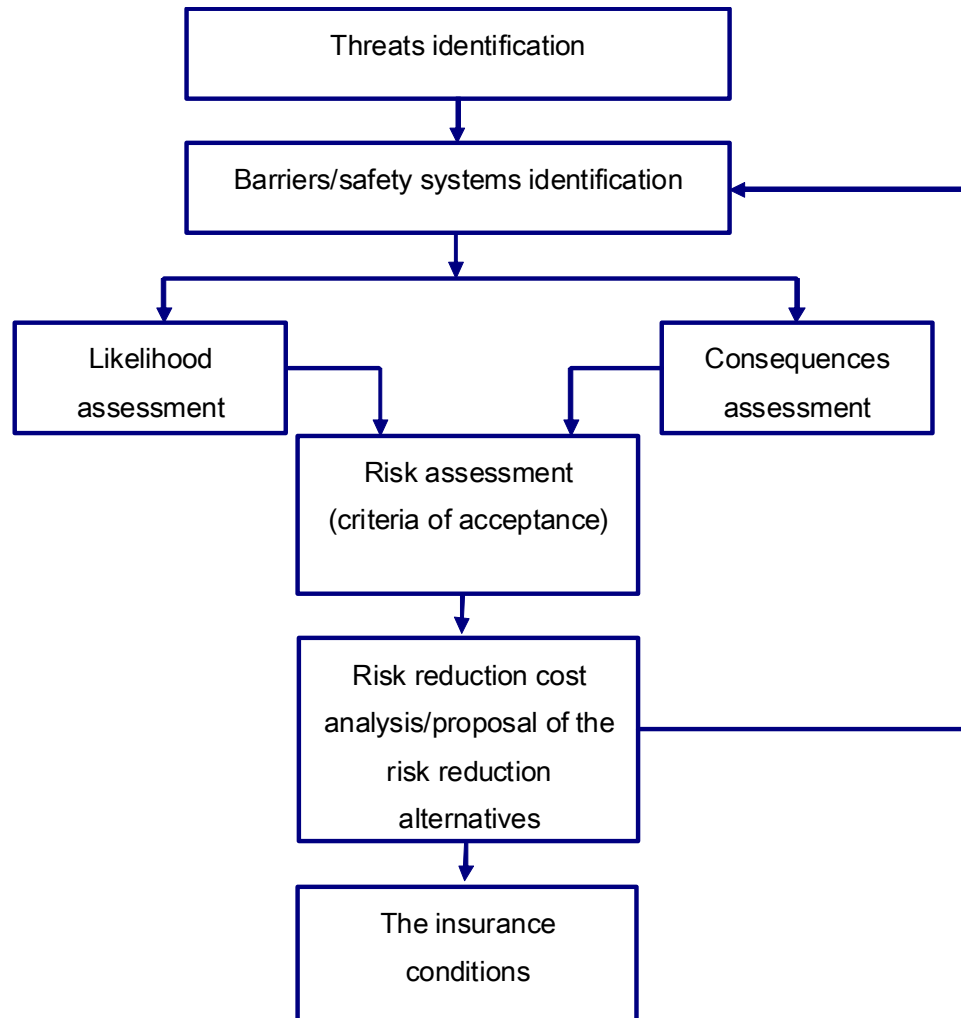
The diagram of risk management

Importance of the risk analysis in the insurance process

The insurance decisions:

- Acceptance or refusal
- assessment of the insurance premium
- the wording of the policy (indemnity limits, a scope of cover, etc.)

Underwriter

| *The risk assessment questionnaire* | *The information from Broker* | *Statistical datas (quantity information)* | *audit* |

The insurance audit

Threats identification → Barriers/safety systems identification → Likelihood assessment / Consequences assessment → Risk assessment (criteria of acceptance) → Risk reduction cost analysis/proposal of the risk reduction alternatives → The insurance conditions

The layout analysis process

EnBW Coal fired power plant Heilbronn 700 MW

1. Steam generator
2. Desulphurization plant
3. Electrostatic precipitator
4. DeNOx-plant
5. Cooling tower
6. Coal handling
7. Machine house with steam turbine and generator
8. Desalination
9. Water supply
10. Stack
11. Water-/steam system
12. Waste water treatment

The Processes schemas analysis:
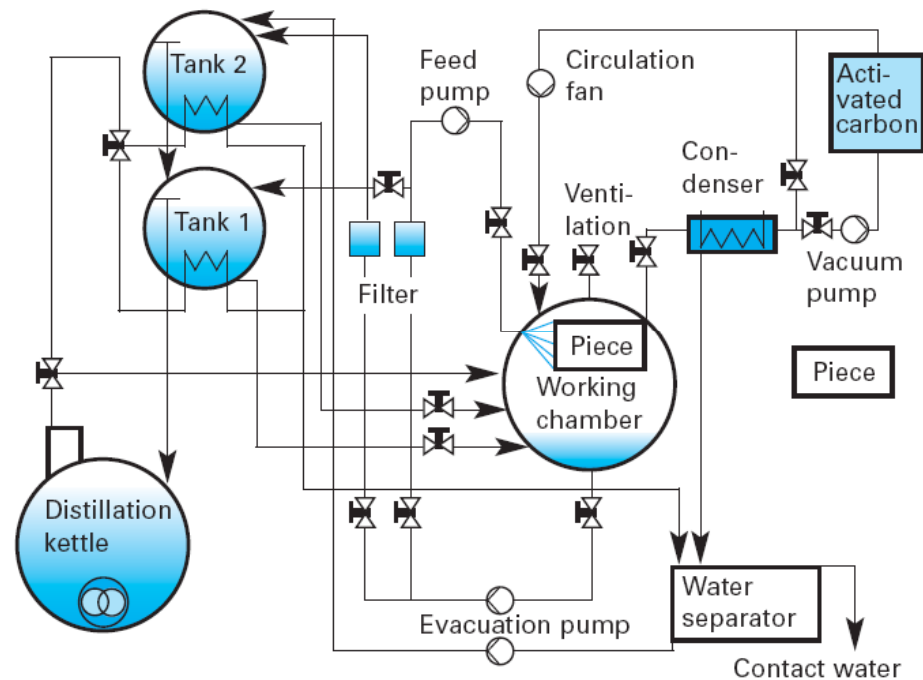
Source: Munich Re seminar materials

The initiating events categorization

A. Disturbances of processes:

1. Fire liquids/gases/combustible materials stocked in processes installation ;
2. Explosion of gases/dusts;
3. Implosion;
4. Uncontrolled chemical reaction;
5. Leakage processes liquid, dangerous substances;
6. Electrical surge;
7. Short circuit;
8. Operation of mechanical force;

The initiating events categorization

B. Human/Operator activity :

1. Wrong process/machinery control
   (start-up, stopping)
2. Imprudence during building works/erection/modernisation
3. Faulty disign
4. Construction fault
5. Faulty materials

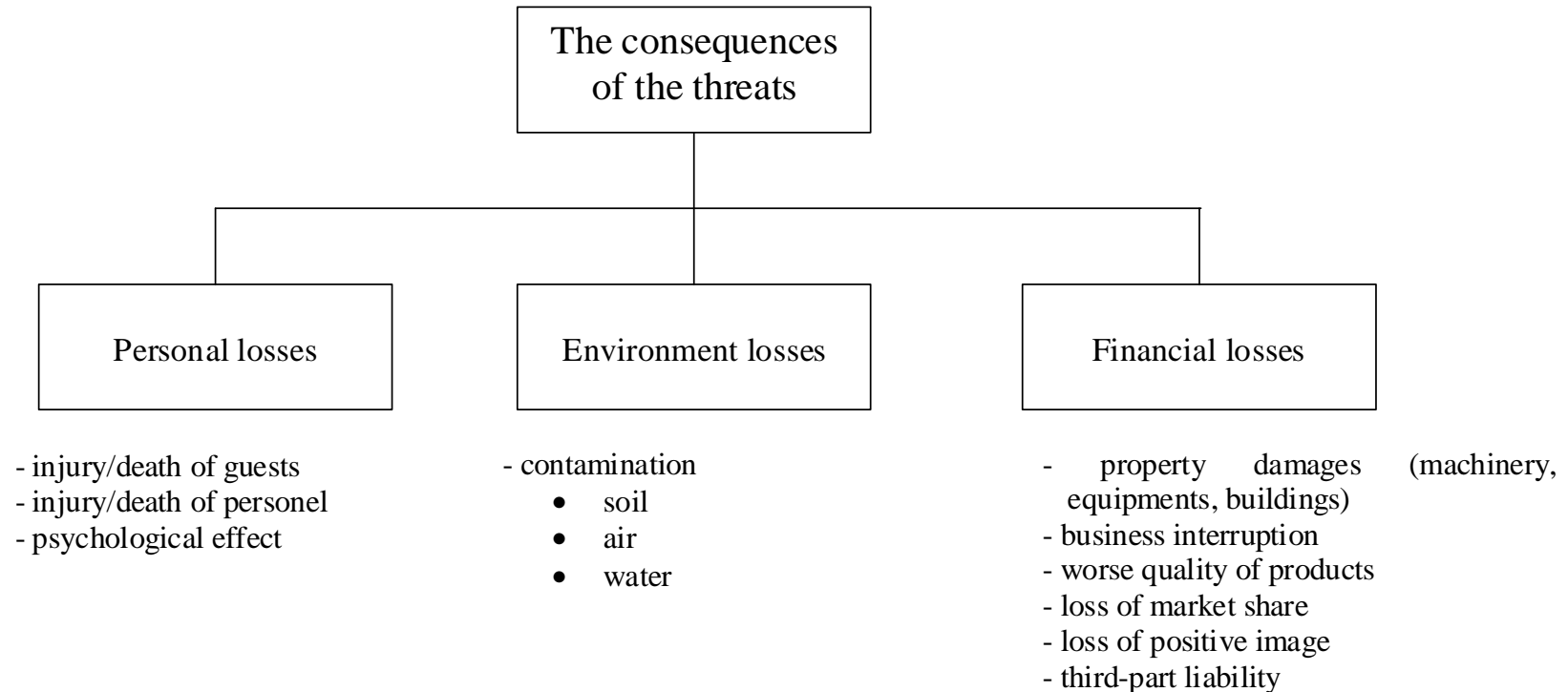# The initiating events categorization

C. External events:

1. Lightning
2. Storm
3. Flood
4. Hail
5. Impact of snow
6. Earthquake
7. Land subsidence
8. Avalanche
9. Collapse of the aircraft

The initiating events categorization

C. External events (continued):

11. Losses due to rescue action
12. Theft
13. Robbery
14. Third-party action
15. Tree collapse
16. Terrorism
17. Devastation

PZU SA

The Consequences categotization

```
                    ┌─────────────────┐
                    │ The consequences │
                    │  of the threats  │
                    └─────────────────┘
          ┌──────────────────┼──────────────────┐
   ┌─────────────┐   ┌─────────────────┐   ┌─────────────┐
   │   Personal  │   │   Environment   │   │  Financial  │
   │    losses   │   │     losses      │   │   losses    │
   └─────────────┘   └─────────────────┘   └─────────────┘
```

- injury/death of guests
- injury/death of personel
- psychological effect

- contamination
  - soil
  - air
  - water

-   property damages (machinery, equipments, buildings)
- business interruption
- worse quality of products
- loss of market share
- loss of positive image
- third-part liability

The likelihood assessment

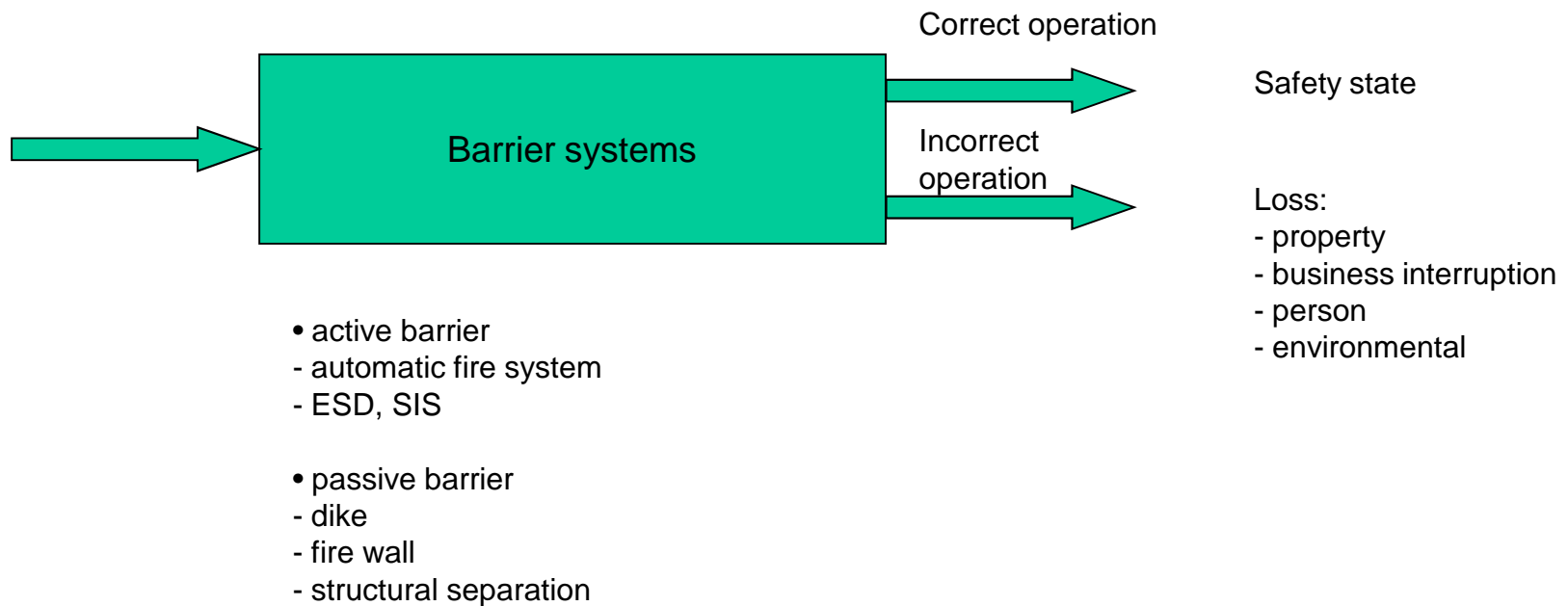| Likelihood category	Criteria
1 – very low	$<1 \times 10^{-5}, 1 \times 10^{-3})$ [a^{-1}]
2 – low	$<1 \times 10^{-3}, 1 \times 10^{-2})$ [a^{-1}]
3 – medium	$<1 \times 10^{-2}, 3 \times 10^{-1})$ [a^{-1}]
4 - high	$<3 \times 10^{-1}, 1)$ [a^{-1}]
5 – very high	$<1, 10>$ [a^{-1}]

The consequence assessment

Level of losses for property

Level of loss	Rate of loss (%)	Definition
1 – negligible	<0,1)	Local damages don't need the repair
2 – light	<1,10)	Local damages don't need the main repair
3 – medium	<10,25)	Significant local damages many components
4 - heavy	<25,60)	Damages to the equipment, process installations. Overhaul required.
5 - catastrophy	<60,100)	Structural damages on great scale the buildings and installations

PZU SA

The identification of barrier systems

INITIATING EVENTS

CONSEQUENCES

Correct operation

Barrier systems

Safety state

Incorrect operation

Loss:
- property
- business interruption
- person
- environmental

• active barrier
- automatic fire system
- ESD, SIS

• passive barrier
- dike
- fire wall
- structural separation

PZU SA

The identification of barrier systems

The event scenarios

Initiating event	Barrier function				Property loss [monetary unit]			Business interruption loss [time unit]	Third part of liability loss [monetary unit]
	A	B	C	D	Buildings	Machinery	Stocks		

$f_{ZI}\ [a^{-1}]$

$1 - P_A$

$1 - P_B$

P_A

$1 - P_C$

P_B

$1 - P_D$

P_C

P_D

TIME

The event scenarios

Initiating events	Barrier function				Frequency of scenario

A	B	C	D

$$f_{ZI}^1 = f_{ZI} * (1 - P_A)$$

$1 - P_A$

f_{ZI}

$1 - P_B$

$$f_{ZI}^2 = f_{ZI} * (P_A) * (1 - P_B)$$

P_A

$1 - P_C$

$$f_{ZI}^3 = f_{ZI} * (P_A) * (P_B) * (1 - P_C)$$

P_B

$1 - P_D$

$$f_{ZI}^4 = f_{ZI} * (P_A) * (P_B) * (P_C) * (1 - P_D)$$

P_C

P_D

$$f_{ZI}^5 = f_{ZI} * (P_A) * (P_B) * (P_C) * (P_D)$$

Influence factors (risk factors)

The risk acceptance criteria

$$f'^{k}_{i} = \sum_{c=1}^{\Psi} f^{k}_{i}$$
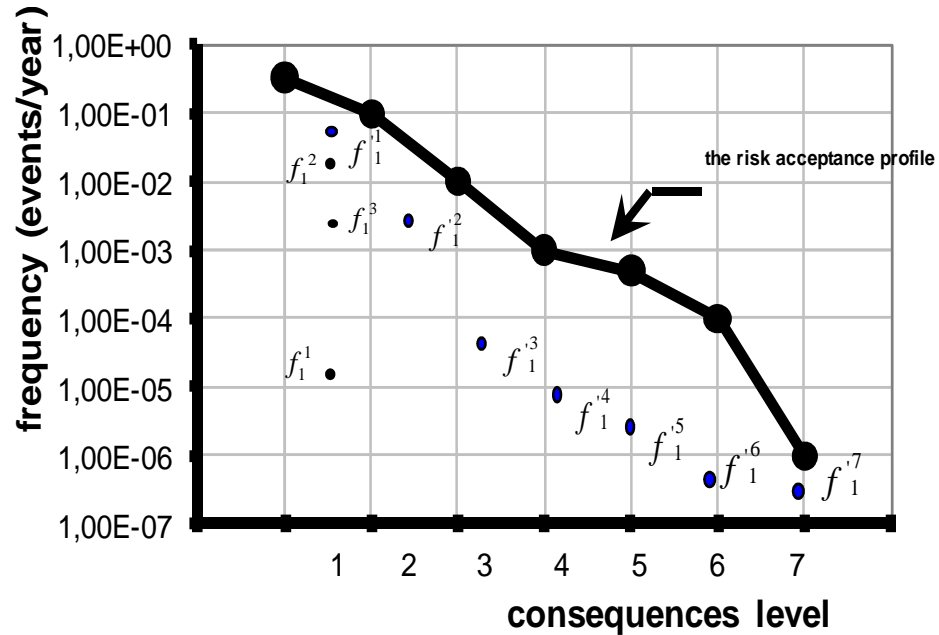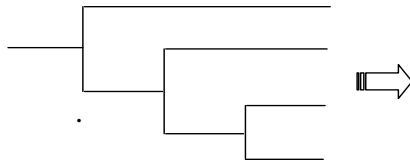
f'^{k}_{i} - Frequency of loss at the level k for i - IE (initiating event)

Ψ - Number of events scenario at the level k

The Risk factors

The risk factors gradation

category of the risk factors	Description
A	Conditions better then the reference level
B	Conditions corresponding to the reference level
C	Satisfactory conditions but worse then the reference level
D	Acceptable conditions according with norms but deviations from reference level are significant
E	Conditions worse that D
F	Unacceptable conditions

The Risk factors

Category of RF	RF	Description
Personel	Competence	Expirience, knowledge, training
	Workload/stress	Workload of personel
	Environmental of work	Noise, pollination, vibrations, toxic vapour
	Organization of work	Ordering of job
Tasks	Task control	Control of tasks by supervisors
	Methodology	Way of performing tasks
	Complexity of tasks	Tasks demand numbers of complex operations
	Pressure of time	Pressure of time in the planning, operating, etc.

The Risk factors

Category of RF	RF	Description
Technical system	Material properties	Quality of materials used
	Process complexity	Complexity of processes operate by technical system
	HMI	Ergonomic features, feedback from valve, alarms, etc.
	Availability	Ease of access to equipment
	Systems feedback	Possibilities of mistake and problems identification
	Technical state	Technical state of system
	Working environment of the system	Pollination, vibration, humidity

The Risk factors

Category of RF	RF	Description
Administrative control	Procedures	Quality, avaibility, and upgrading
	Permission system	Permission to perform the work, control, acceptance
	Documentation	Quality, avaibility, and upgrading
Organization factors	Preventive programs	Inspections
	Communication	Ways of communication among staff
	Management of changes	Ways of modifications and informing about changes

The Preventive recommendations

The categories of recommendation:

- **technical** – concerning construction solutions, reliability
- **legal** – legal aspect of activity
- **organizational** – establishment of appropriate procedures
- **education** – personel training

Thank you
for your attention