Perspectives of human and organisational factors (HOF) – attempt of a systemic approach

?Can be risks at "human factor,, reduced?

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Examples of accidents

Human errors as a contributing factor have played a decisive role for the following examples of accidents.

The causes cited in the following overheads neither are nor were the only causes and are solely intended to show the "human factor" contribution by way of examples.

Information source generally Wikipedia.

"Costa Concordia" maritime disaster

The ship collided with a rock off the island of Giglio in the Mediterranean Sea on 13 January 2012. The accident claimed 32 lives.

Such manoeuvres – including the "bowing down", which caused the accident – were tolerated, or even demanded to increase the attraction for tourists.

According to statements by an on-board photographer, a similar incident occurred as early as 2005 off Sorrento in the Gulf of Napels. Yet this incident was glossed over. The shipping line, however, dismissed these allegations.

"Deepwater-Horizon" oil platform

An explosion followed by a fire occurred on 20 April 2010.

It became known in the course of investigations that the national supervisory authority had failed to develop a formerly prescribed accident emergency plan for a large number of platforms in the Gulf of Mexico.

The justification provided for this was that a major oil accident was unlikely to impossible and that the oil rigs were far enough out to sea anyway to prevent the coastal regions from being affected, even in the case of an oil spill.

"BP Refinery explosion" in Texas City

A refinery exploded on 23 March 2005, killing 15 contractor employees.

Operating and occupational accidents occurred several times in the refinery, causing 20 fatalities from 1974 to 2003 and several operating interruptions.

There was a high acceptance of risk and no clear operating instructions.
The accident managers were deemed inadequately trained.

"Sandoz" chemical plant

A major fire broke out on 1 November 1986 at the Sandoz chemicals group in Schweizerhalle near Basel.

Prussian Blue poses a considerable fire risk.
The dye supplier Degussa advises on its safety data sheet:
Keep away from ignition sources.
Work was nevertheless performed with an open flame to affix the Prussian Blue with plastic to pallets.

"Icmesa" chemical plant (Seveso accident)

A chemical accident occurred on 10 July 1986 near Icmesa in Meda, Italy, 12 miles north of Mailand.

An autoclave agitator was shut down at the end of the night shift. A chemical reaction began at around 12:30 pm.
This culminated 7 minutes later in an explosion.
The safety relief valve freely released dioxin into the environment.
The poisonous cloud polluted a highly populated region comprising more than 2 square miles.

Inadequate means of monitoring.
No precautionary measures and inadequate employee training.

Aircraft accidents – intentional crash?

On 24 March, 2015,
an Airbus A320 of the Lufthansa subsidiary German wings crashed. All 150 passengers on board were killed

Six accidents have occurred with commercial aircraft since 1980, for which the probable cause has been concluded to be the premeditated manoeuvre of a crew member.

Source: Interim report on the "Germanwings" accident on 24 March 2015

Systemic empirical evaluation?
Controversial precaution?

"Severe accidents" in nuclear power plants

Tschernobyl (1986)
INES 7

Three-Mile-Island (1979)
INES 5

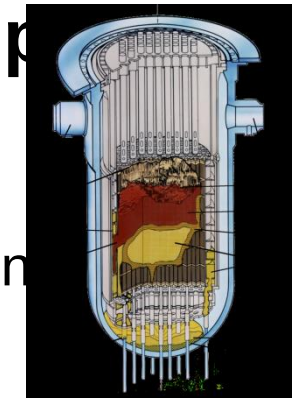
Fukushima (2011)
INES 7

HF

Safety culture

?

Three Mile Island (TMI) nuclear power p



The meltdown accident occurred on 28 March1979 in Penn
near Harrisburg, USA

Main causes:

A malfunction of a pneumatic control caused the reactor cooling by the two steam generators to fail.

The relief valve required for this jammed and remained open.
No direct indication of the valve position was displayed in the control room, resulting in this malfunction remaining unnoticed.

Poorly equipped control room and inadequate employee training!

Tschernobyl nuclear power plant

The catastrophe occurred on 26 April, 1986

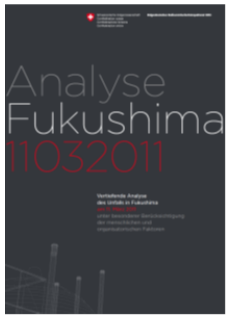
A complete power loss was to be simulated as part of an experiment. This was intended to provide evidence of adequate power supply to the plant (afterwards).

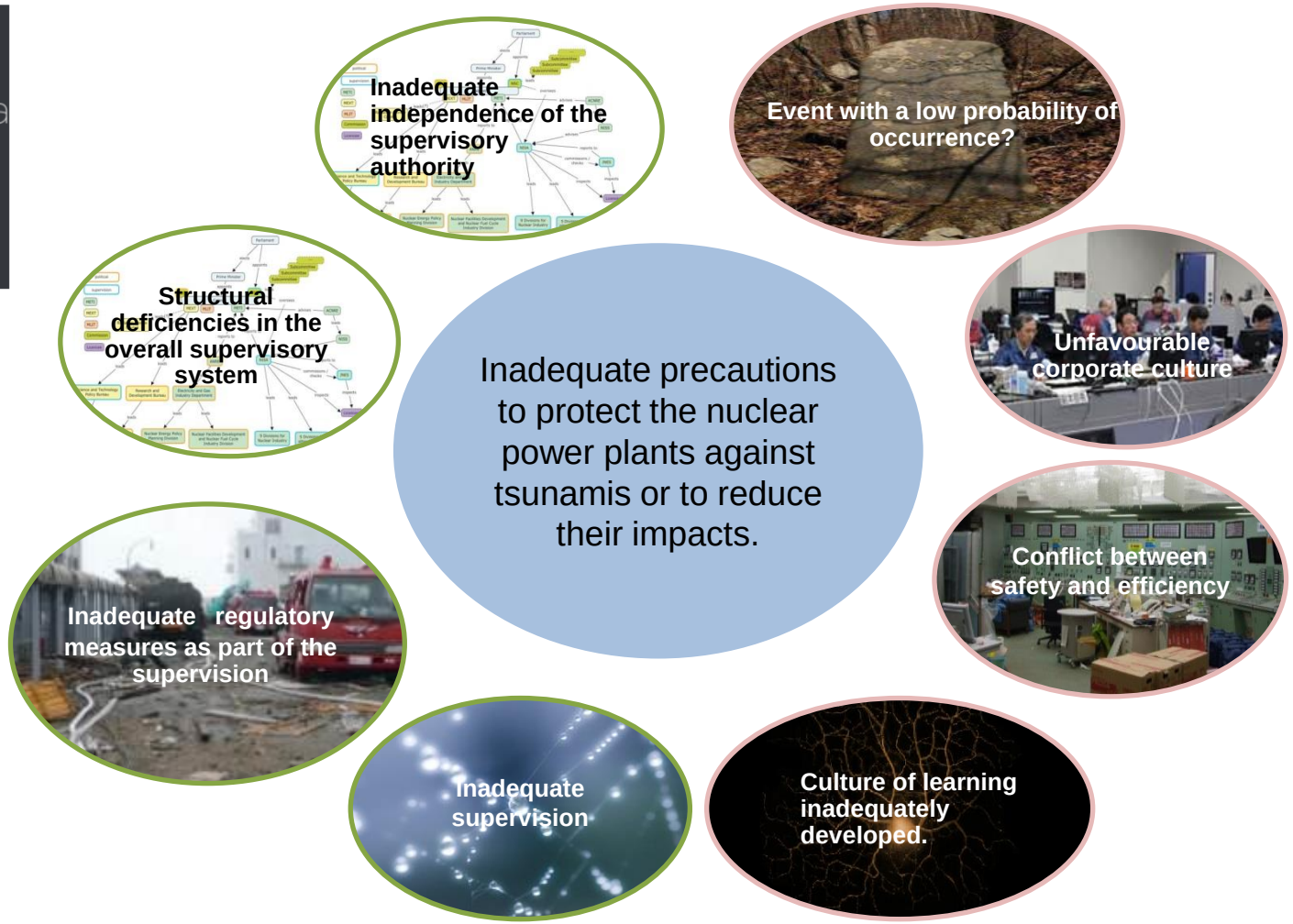
Main causes:

Design-related properties.

Serious violations of applicable safety requirements by the operators during the experiment.

Fukushima nuclear power plants (organisational)





ENSI, In-depth Analysis of the Accident at Fukushima on 11 March 2011 –
With Special Consideration of Human and Organisational Factors, ENSI, Brugg/Switzerland (2011).

Defense-in-depth in nuclear power plants - technical

Level of defence	Objective	Means
1	Prevention of deviations from normal operation	Conservative design and high manufacturing quality of the operating systems, good operational management[9]

ENSI ENSI, Integrated Oversight, ENSI report on Oversight Practice, ENSI-AN-8968, ENSI, Brugg/Switzerland (2014).

The graded safety precautions in nuclear power plants - organisational

- Work planning, work preparation, work performance

- Checklists
- Requirements
- Dual-control principle
- 3-way communication
- STAR (Stop-Think-Act-Review)
- ODM (operational decision making)
- Peer checking
- Pre-job briefing / Debriefing
- Reportingsystem
- Training and qualification systems
- …

Assurance of organisational barriers

Learned and periodically verified **expertise**
and **solid experience** in the specific speciality areas
form the **basis for safe human actions**.

A **clear and easily understandable** management system for quality assurance and reasonable actions for promoting a positive safety culture support the organisation in reducing the chance of errors and **strengthening the person as a safety factor.**

ENSI, The Organisation of Nuclear Installations, Guideline for Swiss Nuclear Installations ENSI G07, ENSI, Brugg/Switzerland (2013).

Incident review (evaluation of event – learning by experience)

- What happened during the incident? (result, process)
- Why did the incident occur? (cause)
- What do we need to change? (actions)

Reaction/measures:

- Technical correction/repair
- Review of the remaining comparable technical systems; possible retrofitting
- Training / awareness raising of the employees
  - directly affected employees ("causers")
  - remaining employees
- Adaptation of existing and creation of new requirements/instructions (including employee training)
- Possible sanctioning of the directly affected employee ("causer")
- …

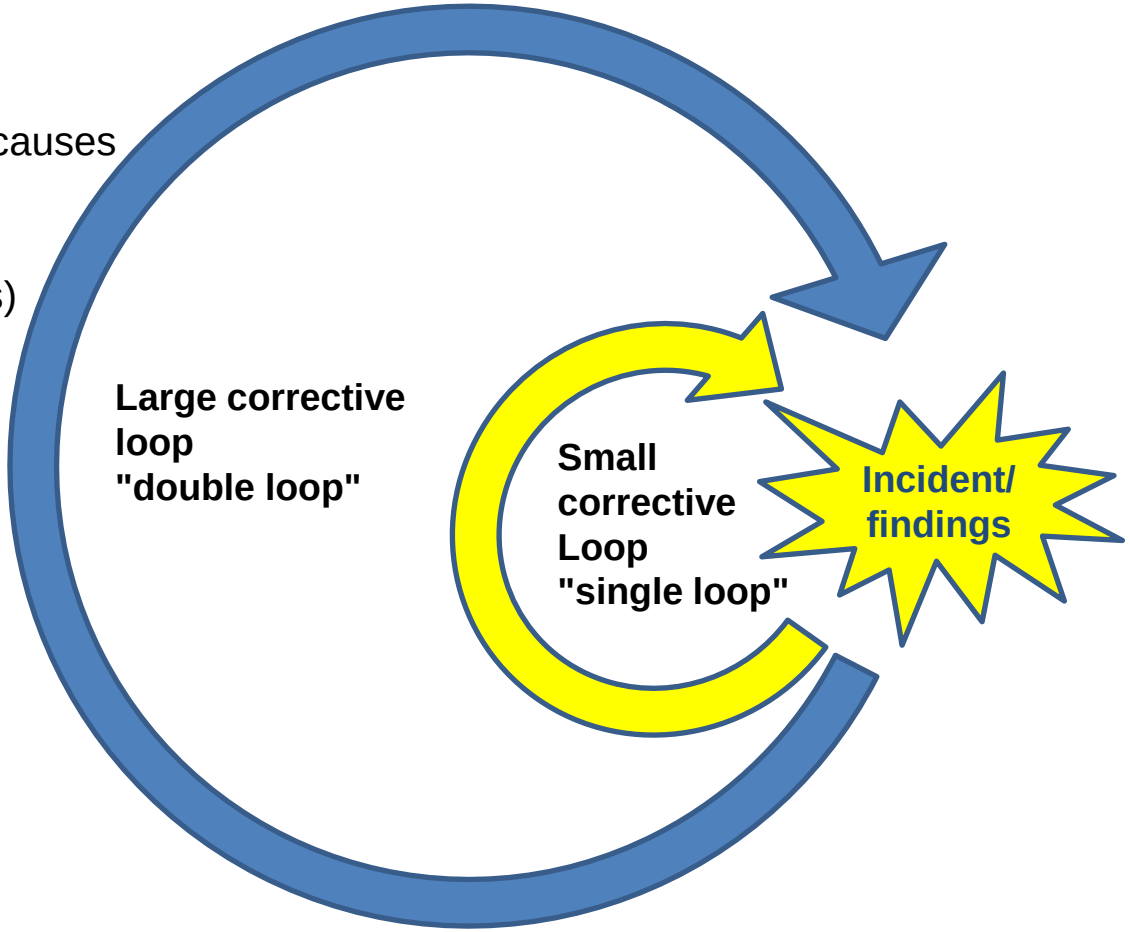
➢ Specific for the event

➢ Frequent false assumption:

Action taken = problem eliminated/solved

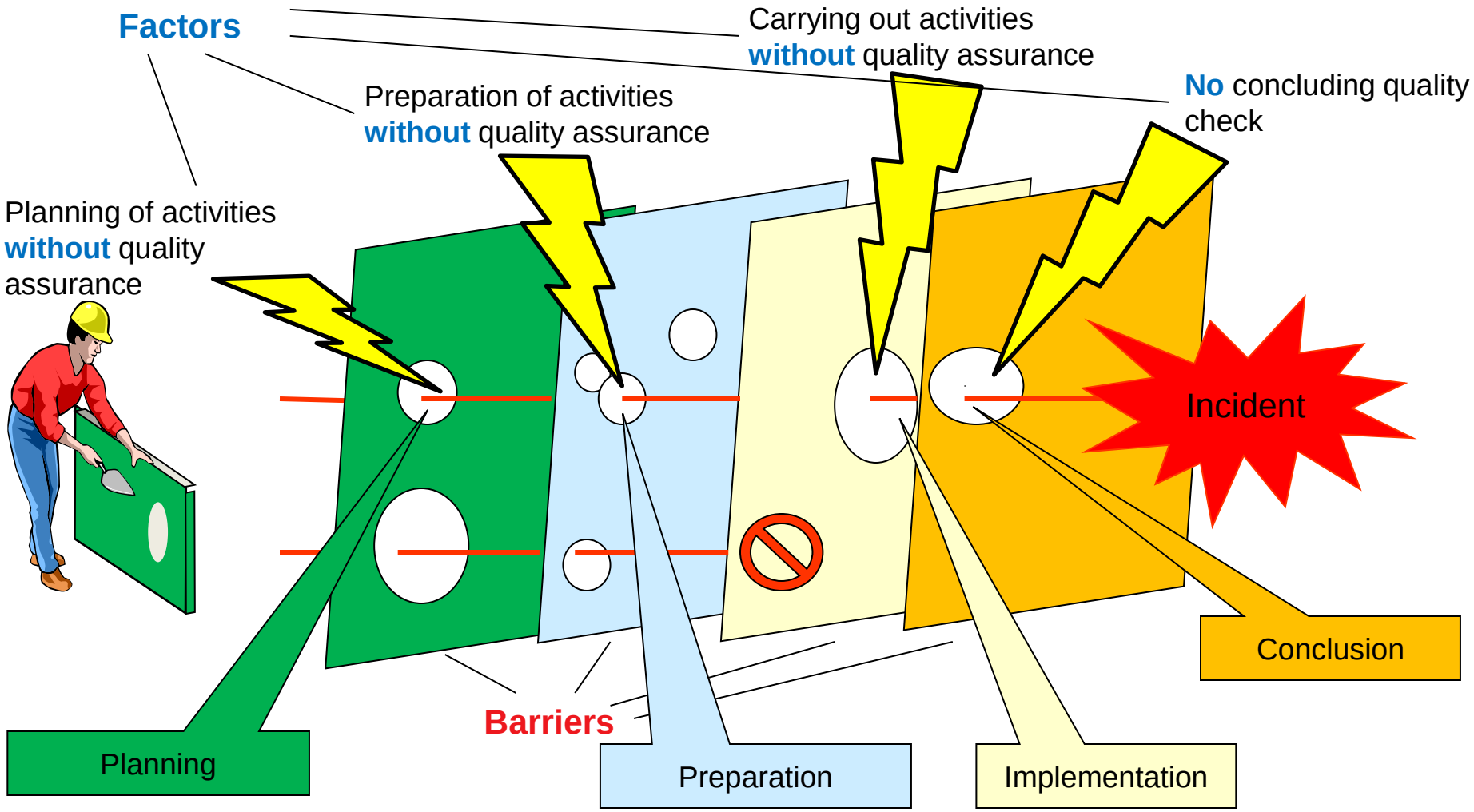
Detailed HOF analysis (HOF = Human and Organizational Factors)

- Which basic higher-level general conditions, behaviours, processes, structures, etc. are the underlying causes of the incident?
- To what extent did our culture (our basic assumptions, our values) play a role?
- To what extent can the incident be attributed to additional systems/areas?
- To what extent is the incident connected with other/former incidents/findings?



- ➢ Comprehensive learning
- ➢ Improvements beyond the event
- ➢ Organisational changes

Model according to reason



James T. Reason “Managing the Risks of Organizational Accidents” Aldershot, Ashgate (1997

Work organisation

Management:

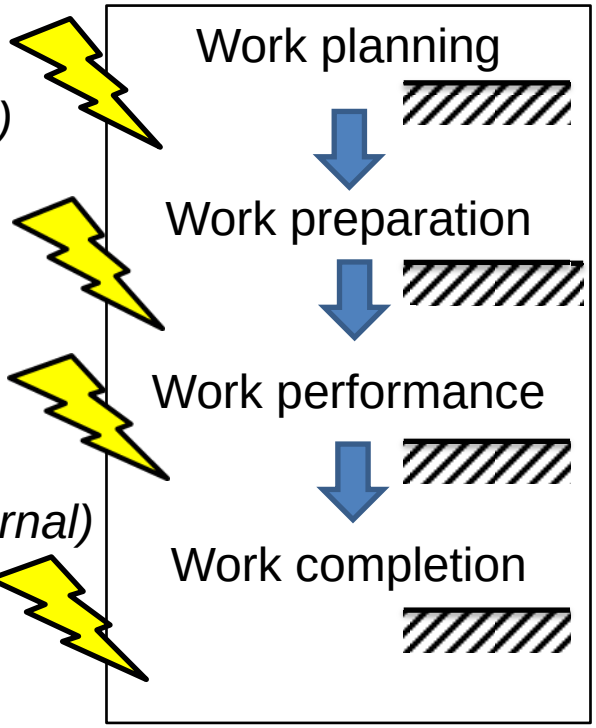
- *Competence (training)*
- *Attitude, behaviour*
- *Instructions (Time, task)*
- *Decisions*

Work practice:

- *Competence (training)*
- *Attitude, behaviour*
- *Interfaces (internal, external)*

→ *Communication (formal and informal)*

Maintenance work (system change, tests, ...)



Communication

Preliminary explanations
Planning: The technical department considers interfaces
Methods: ODM, STAR, dual-control principle,…

Job & requirements
Prepare resources
Methods: Pre-job briefing, …

Avoiding error
Methods: 3-way communication, STAR peer checking, ...)

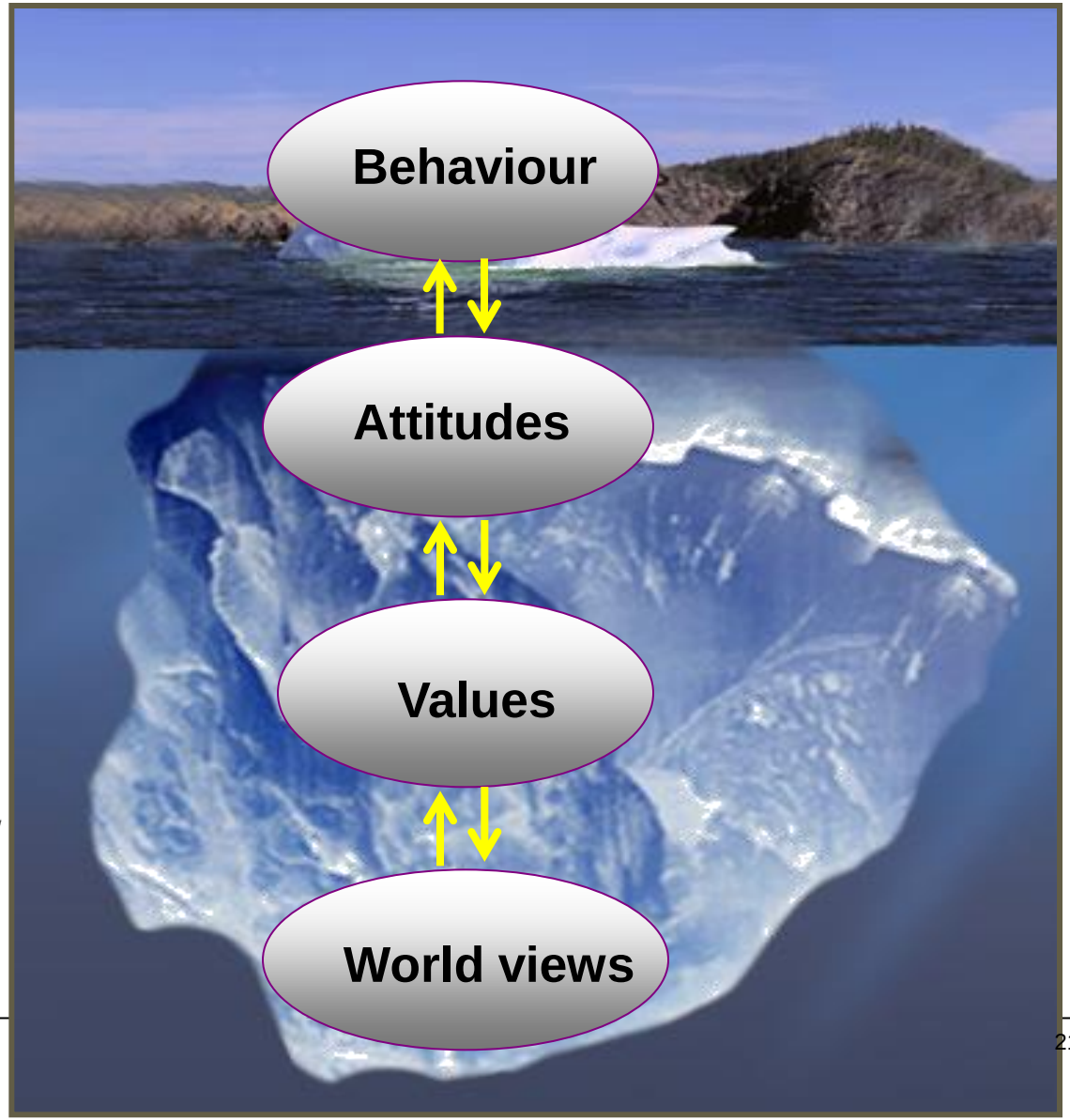
Independent check (monitoring) and release
Debriefing

The "Ice-berg model" of the (safety) culture

partially conscious,
partially non-conscious

conscious

non-conscious

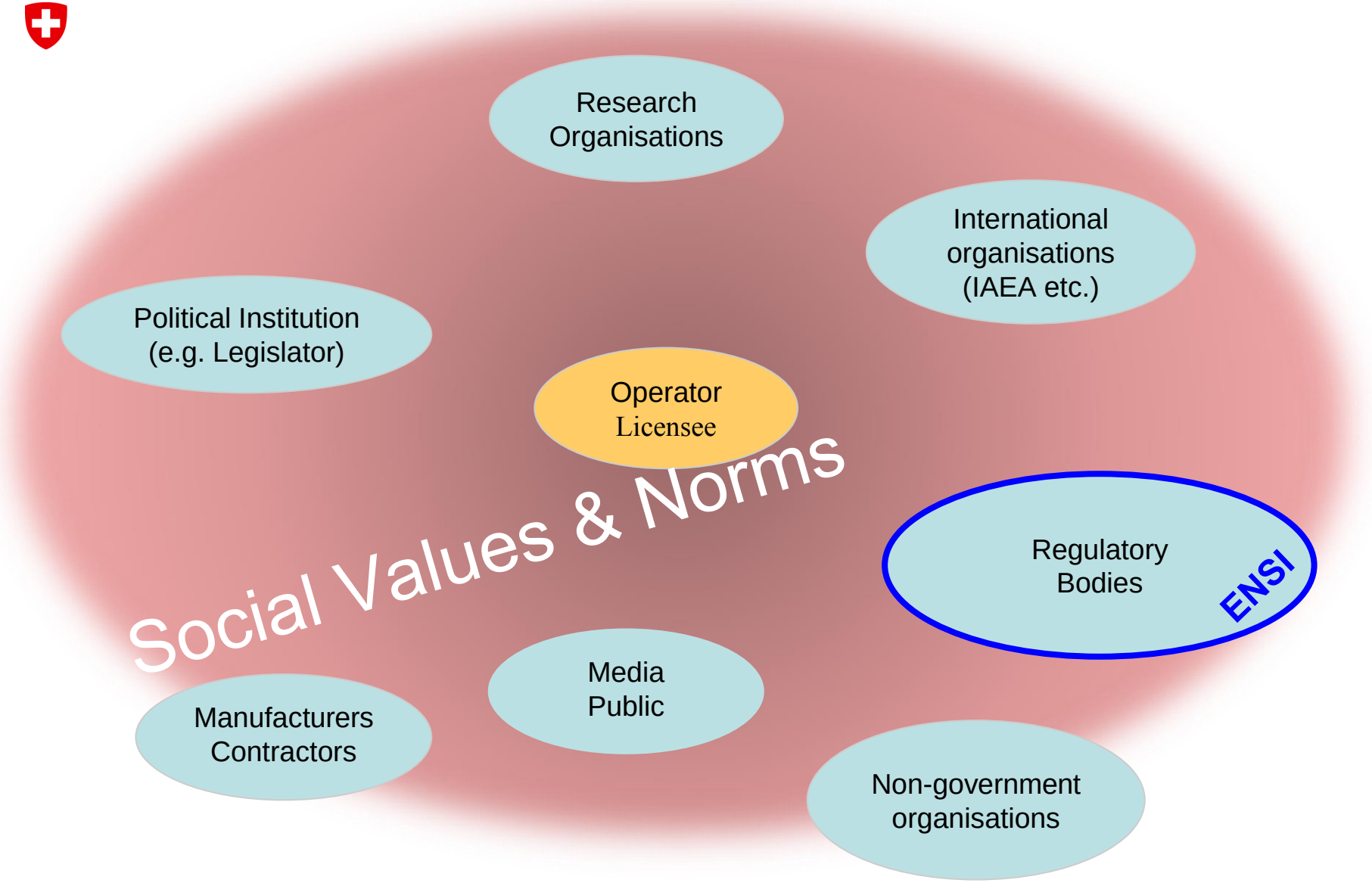


Source: IAEA

ENSI report on oversight practice

"OVERSIGHT ON THE SAFETY CULTURE OF NUCLEAR FACILITIES"

ENSI, Oversight of Safety Culture in Nuclear Installations, ENSI Report on Oversight Practice, ENSI-AN-8980, ENSI, Brugg/Switzerland (2014).



ENSI ENSI, Oversight of Safety Culture in Nuclear Installations, ENSI Report on Oversight Practice, ENSI-AN-8980, ENSI, Brugg/Switzerland (2014).

ENSI - Definition of safety culture

(for the needs of Swiss supervision)

Safety culture comprised of ***values, world views,*** *verbal and non-verbal* ***behaviour****, and characteristics of the* ***physical environment*** which are shared by the members of the organisation of the operator of a nuclear facility*.*

Safety culture includes those values, world views and environmental features that determine or demonstrate how the members of the organisation approach and deal with nuclear safety.

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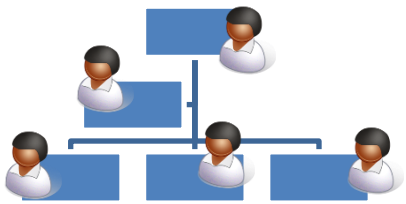
ENSI, Oversight of Safety Culture in Nuclear Installations, ENSI Report on Oversight Practice, ENSI-AN-8980, ENSI, Brugg/Switzerland (2014).

What is a «good» safety culture?

- Safety is without a doubt an internally and externally recognised value (main criteria – trust!)
- The management supports it unequivocally
- Everyone is aware of their responsibility for safety/trust
- All activities are generally safety-oriented
- Safety is developed through ongoing learning

- The list of characteristics is not exhaustive; no absolute valid «standard» exists
- The characteristics, their significance and implementation depend on the specific context (organisation, culture, etc.)

Resilient organisation



General characteristics

- **Mindfulness**
  - Proactive handling of errors (reporting, learning)
  - Employee does not make rash decisions – queries the cause, employee applies the rules interpretatively
  - Experts are recognised, heard, and involved in decision-making
  - A resilient organisation expects the unexpected/unforeseeable
- **Diversity and redundancy (vs. efficiency)**
  - Competencies held by more than one person
  - Pooling of different competencies
- **Company culture of trust and cooperation**
  - Mutual respect
  - Strong networks supported by trust
- **Situational and mediating management**
  - Management adapted to the situation
  - Integrative effect with a view of the whole picture

Summary and questions

- Experience increases safety!
- ➢ How do I share the experiences?
- Technical systems increase safety (reliability)!
- ➢ How do I handle the increasing complexity?
- Automation creates more quality!
- ➢ How do I handle the increased demands on the employees?
- Organisational barriers reduce the likelihood of occurrence!
- ➢ How do I keep attention levels up?

- ➢ How do I deal with the "natural drift" within an organisation?
- Autonomy (self-determined, e.g. without decisions) vs. heteronomy (externally determined, e.g. written instructions)
- Appreciation - mistakes vs. consequences?

Summary and questions

- How do I learn from the experience of others?
- What is the task of the management?
- Can more technology reduce the HF risk?
- Can more regulations reduce the HF risk?
- What new risks can result from this?
- Can all risks be recognised?
- How do I keep attention levels up?
- How is compliance with requirements verified?

Conclusion – Possible improvement in safety management by:

- Check-lists – yes! The **ability** to **congruently** confirm safety criteria in a functional manner! Implementation monitoring – who does it??
- Check the compatibility of technical competencies with safety competencies (methods)!
- Demand and adhere to **communication channels** – especially with the interfaces! **DEBRIEFING!**
- Support decisions relevant to safety on a broader basis **across departments**.
- Demand systemic view.
- Integrate **new employees** in topics of safety at an early stage – new issues, **new solution approaches**.

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