HUMAN, TECHNICAL & ORGANIZATIONAL FACTORS

The IAEA International School of Nuclear and Radiological Leadership for Safety

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Cesar Candas

IAEA
International Atomic Energy Agency

Human & Organizational Factors

- Normative
- Origin and Development of the Human & Organizational Factors Program.
- Systemic Approach to Safety: Human, Technical & Organizational Factors (HTO)
- Human Performance
- Elements of a Human & Organizational Factors Program (HOF).
- Main Conclusions

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Normative

IAEA Fundamental Safety Principles



Principle 3 Leadership and Management for Safety

To prevent Human and Organizational failures, **human factors** have to be taken into account and **good performance** and **good practices** have to be supported.

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IAEA Fundamental Safety Principles



Principle 3 Leadership and Management for Safety

Where **control measures** or **operator actions** are called on to maintain safety, an **initial safety assessment** has to be carried out to demonstrate that the arrangements made are **robust and that they can be relied on**. A facility may only be constructed and commissioned or an activity may only be commenced once it has been demonstrated to the satisfaction of the **regulatory body** that **the proposed safety measures are adequate**.

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IAEA General Safety Requirements GSR-1



GOVERNMENTAL, LEGAL AND REGULATORY FRAMEWORK FOR SAFETY

Requirement 26 Graded approach to review and assessment of a facility or an activity.

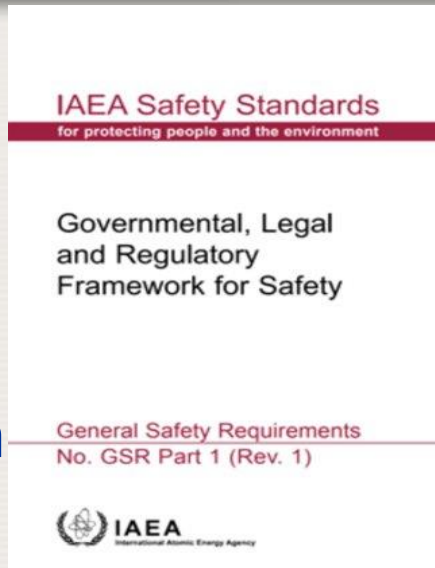
In the process of its review and assessment of a facility or an activity, the **regulatory body** shall take into account such considerations and factors as:

- …
- The applicable **management system**,
- The **competence and skills** necessary for operating the facility or conducting the activity.

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IAEA General Safety Requirements GSR-1



GOVERNMENTAL, LEGAL AND REGULATORY FRAMEWORK FOR SAFETY

Requirement 29 Graded Approach to Inspection of Facilities and Activities.

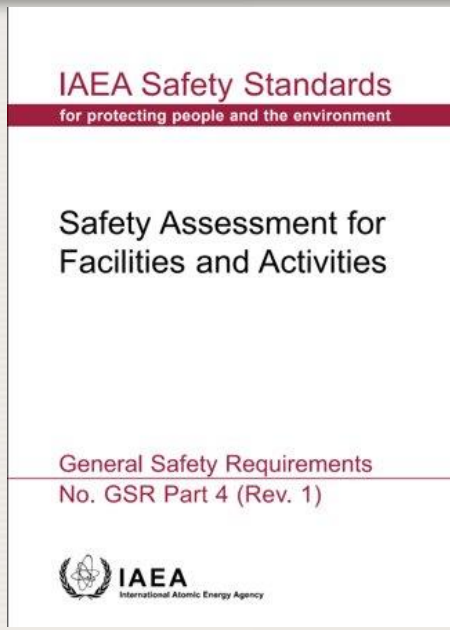
In conducting inspections, the **regulatory body s**hall consider a number of aspects, including:

- **Management Systems**
- **Operational activities and procedures.**
- **Competence of staff**.
- **Safety culture.**

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IAEA General Safety Requirements GSR-4



SAFETY ASSESSMENT FOR FACILITIES AND ACTIVITIES

Requirement 11 Assessment of Human Factors.

Human interactions with the facility or activity shall be addressed in the safety assessment, and it shall be determined whether the **procedures** and **safety measures that** are provided for all normal operational activities and those that are required for responding to anticipated operational occurrences and to accident conditions, ensure an adequate level of safety.

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IAEA Code of Conduct on the Safety of Research Reactors



Role of the Operating organization

- The **operating organization** should take into account the **capabilities and limitations of human performance** throughout the live of the research reactor for operational state and also taking into account human factors related to experiments.

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Development of Human & Organizational Factors Program

- TMI-2 Accident (1979) brought **Human Factors** into the Nuclear arena.

The Accident led the Nuclear Community to acknowledge the role of non-technical aspects of nuclear operations such as:

- Man-machine interface
- Training
- Procedure design
- Procedure adherence

Human reliability and **ergonomics** became important.



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Development of Human & Organizational Factors Program

- Chernobyl Accident (1986) brought **Safety Culture** and Organizational Factors into the Nuclear field.

The Accident led the Nuclear Community to see the role of well-defined process within a management system as the most important part of ensuring that all **Human** and **Organizational Factors** could be identified and managed.

Lack of Safety Culture was highlighted as the main cause of the accident.



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Development of Human & Organizational Factors Program

- Non-nuclear Accidents like Bhopal (1984), Challenger (1986), Exxon Valdes (1989) had shown the importance of **Management** and **Organizational Factors.**

The nuclear community began to develop the idea of Integrated Management System for Safety. **Human Performance** is included in the Integrated Management System for Safety.



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Development of Human & Organizational Factors Program

- Fukushima Daiichi Accident (2011) brings into the Nuclear field the need to apply a **Systemic Approach to Safety.**

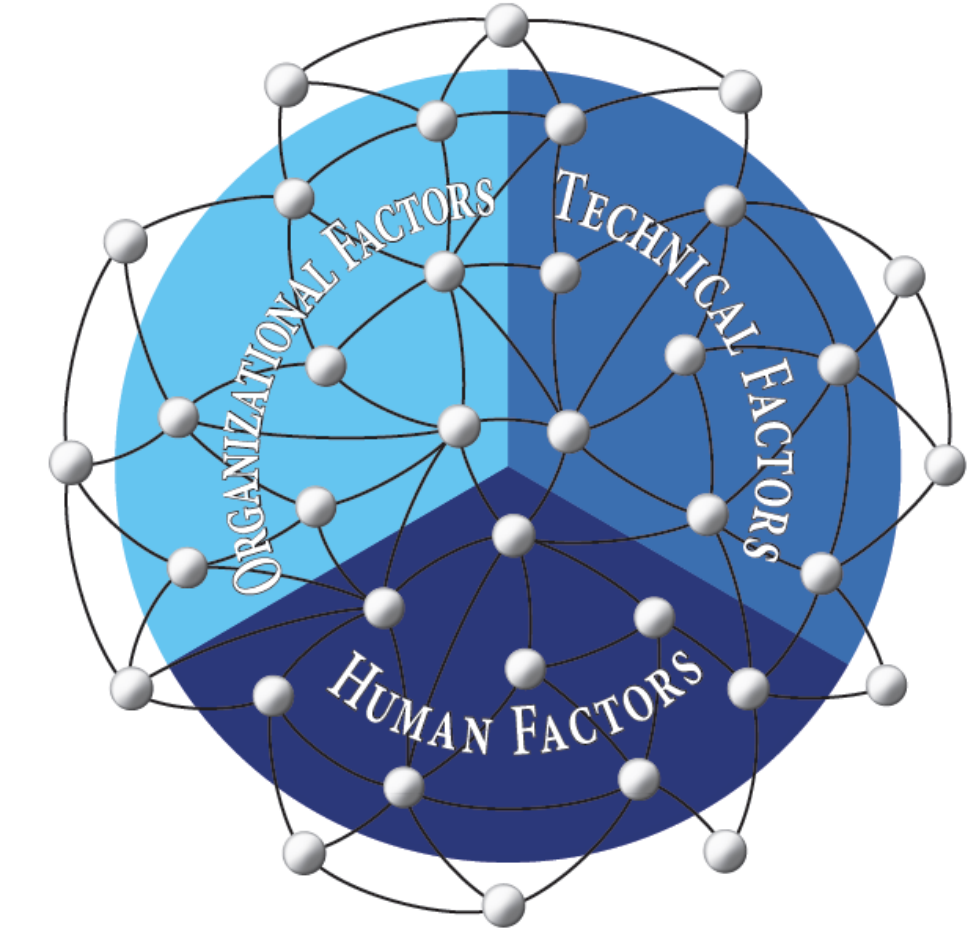
The Accident led the Nuclear Community to acknowledge that the traditional approach to safety should be complemented by a systemic approach that considers not only the human, organizational and technological factors that contribute to safety, but also the **complexity of the interrelationships** among them.



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Systemic Approach to Safety: Human, Organizational & Technical Factors

Complex Interactions between Individuals, Technology, Organization and Stakeholder's influence.

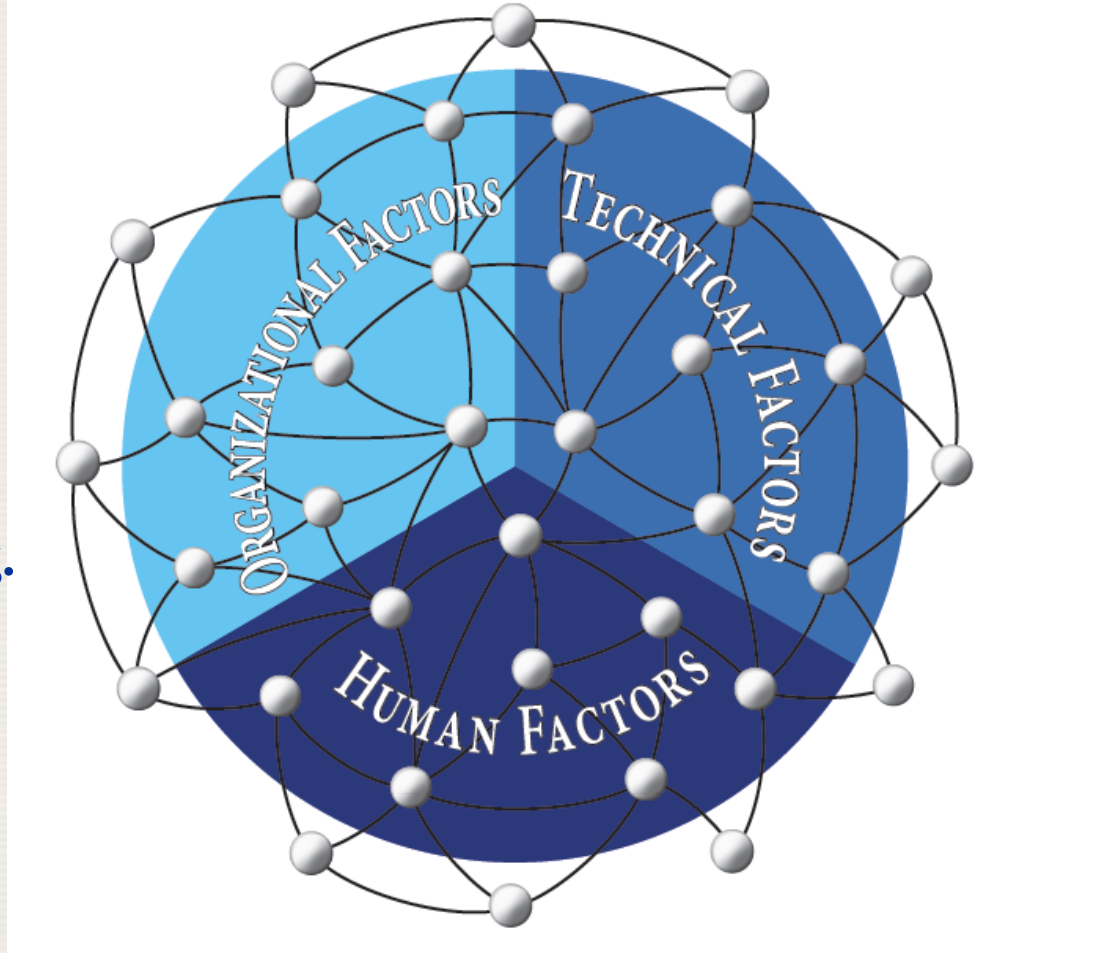


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Systemic Approach to Safety: Human, Organizational & Technical Factors

Human Factors:

- Human capabilities.
- Human limitations.
- Perceived Work Environment.
- Motivation.
- Individuals' understanding.
- Emotions.
- Etc.

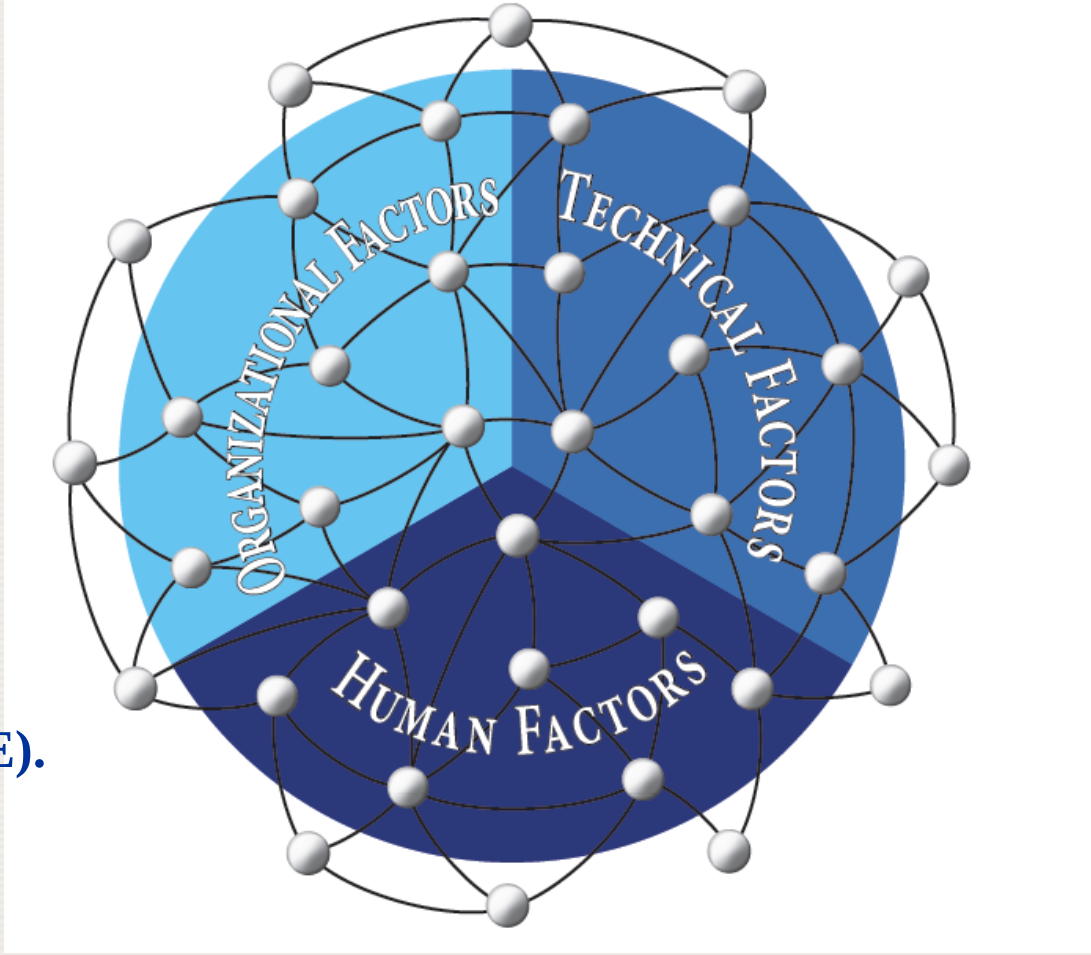


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Systemic Approach to Safety: Human, Organizational & Technical Factors

Organizational Factors:

- Vision and Objectives.
- Strategies.
- Integrated Management System.
- Continuous Improvement.
- Priorities
- Knowledge Management.
- Communication
- Work Environment (SCWE).
- Culture

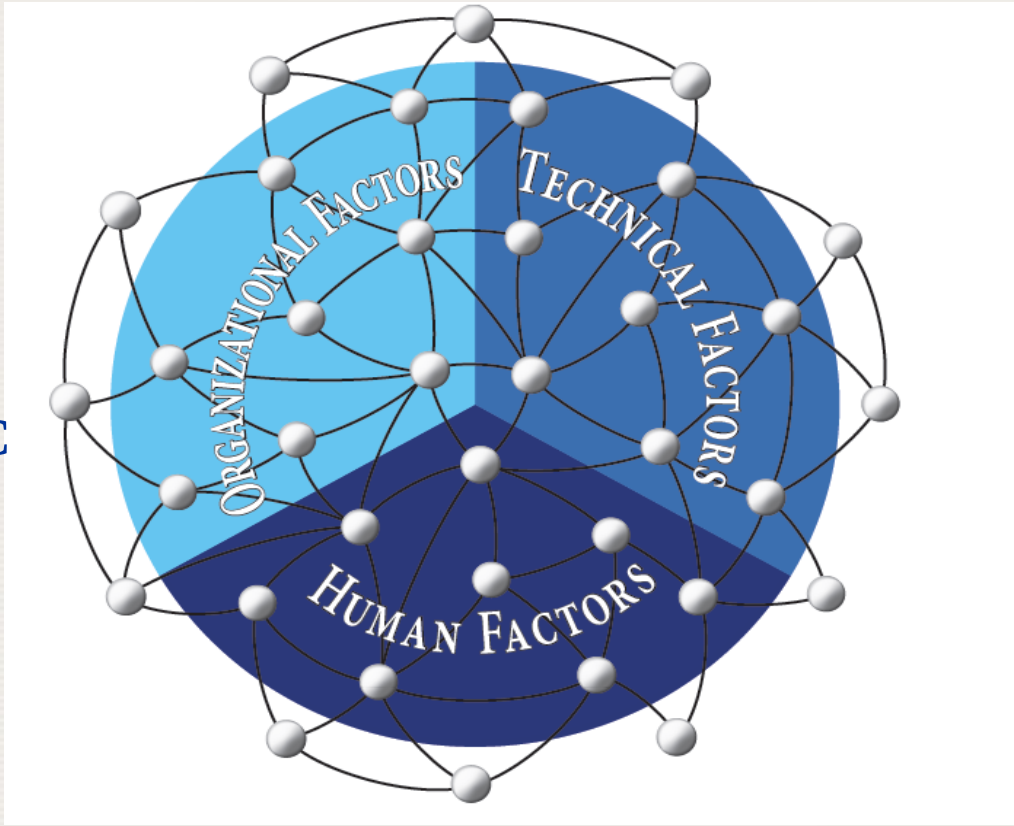


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Systemic Approach to Safety: Human, Organizational & Technical Factors

Technical Factors :

- Existing Technology.
- Installation Design.
- Safety Assessments.
- Instrumentation & Control I/C
- Technical Specifications.
- Material´s Quality
- Document Configuration.
- Equipment.
- Etc.



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Human Performance

- Human & Organizational Factores – factors that influence **human performance** as it relates to the operation and safety of a nuclear facility or activity throughout its life cycle.
- Many factors influence human performance in complex systems.
- Human performance is an important element of Safety Culture (INSAG-4):
  - "...and all organizations with a safety responsibility, must so develop Safety Culture as to prevent **human error** and to benefit from the **positive aspects** of human action."



We need **organizations that learn** from errors and personal and collective successes.

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Human Performance

A **learning organization** apply methods of **constructive communication** to benefit from the successes and errors that occur in the organization.

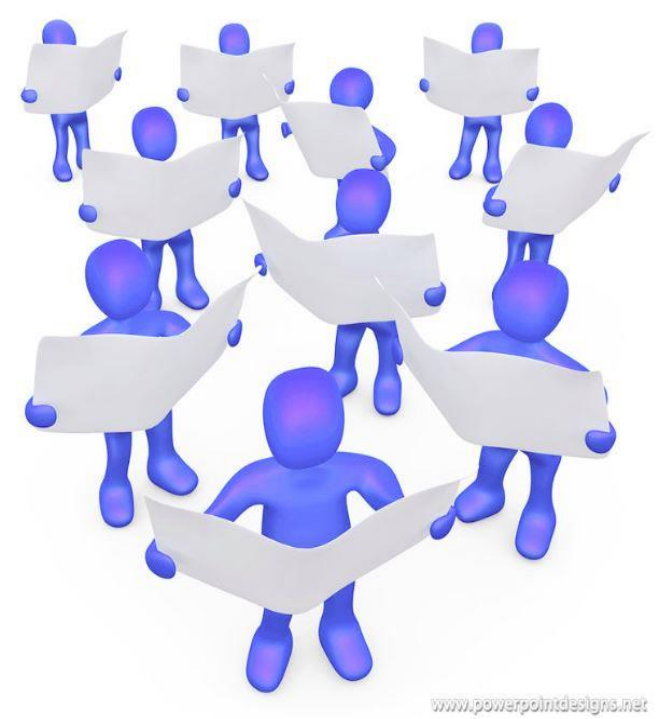
- An error represents a **PROBLEM** to be solved **together**. A **solution** is how to reduce problems in the organization in the future.
- An error is seen as an **OPPORTUNITY TO LEARN**. This opportunity can be utilized if the error is analyzed and right conclusions about its causes are made.
- An error is an **OPPORTUNITY TO BUILD TRUST** by showing that the organization is able to deal with errors constructively, properly and in a just & transparent manner. This builds a healthy learning orientated culture.
- An error is **PART OF NORMAL HUMAN ACTIVITY**. If there are no errors, there is typically no activity either (or alternatively, errors are hidden).

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Source: modified from PhD Teemu Reiman. Lilikoi Consulting

Human Performance

The organization has the ultimate decision on how to approach learning from human errors.



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Focus on system / no-blame

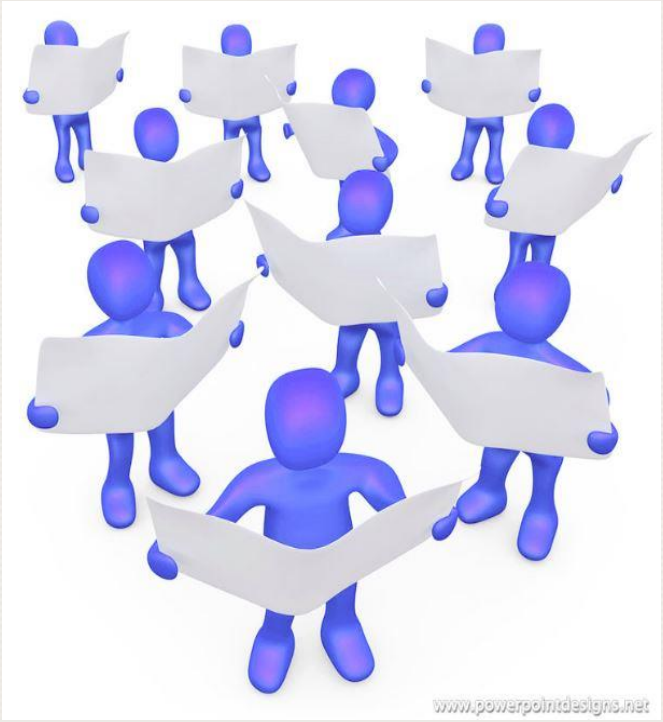
Focus on individual / blaming

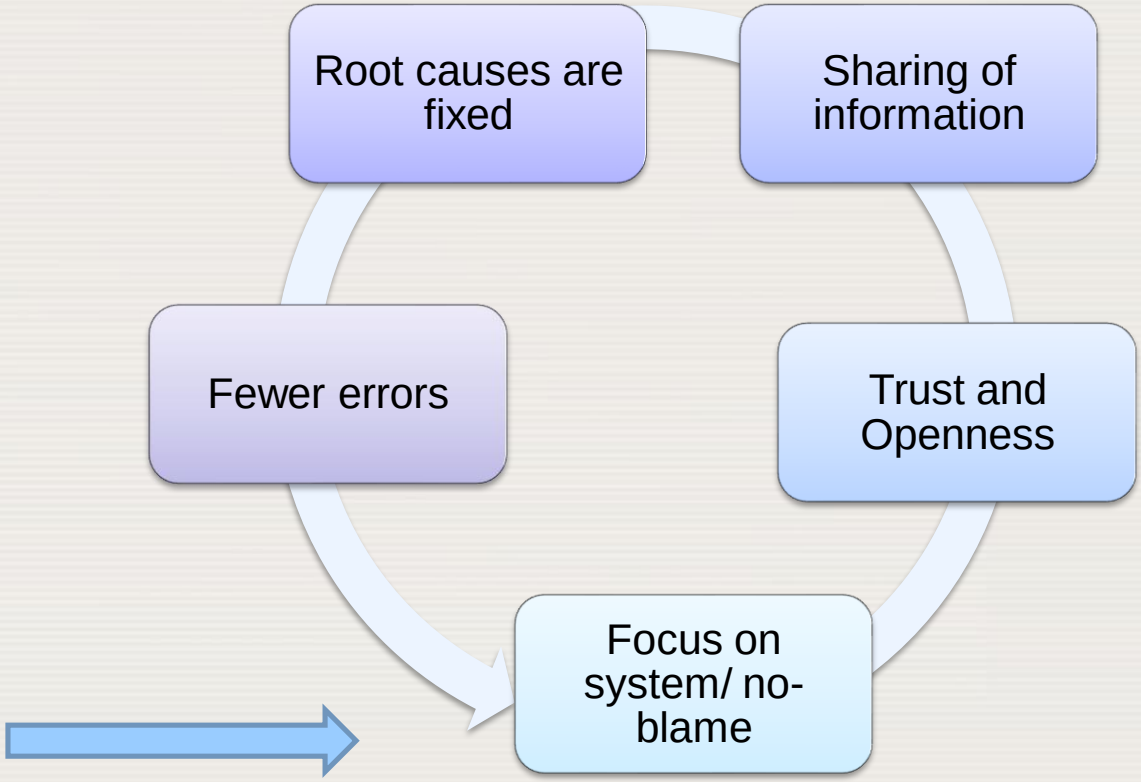
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Source: modified from PhD Teemu Reiman. Lilikoi Consulting

Human Performance

The approach taken to cope with human errors determines the organization's culture for safety and its future results.



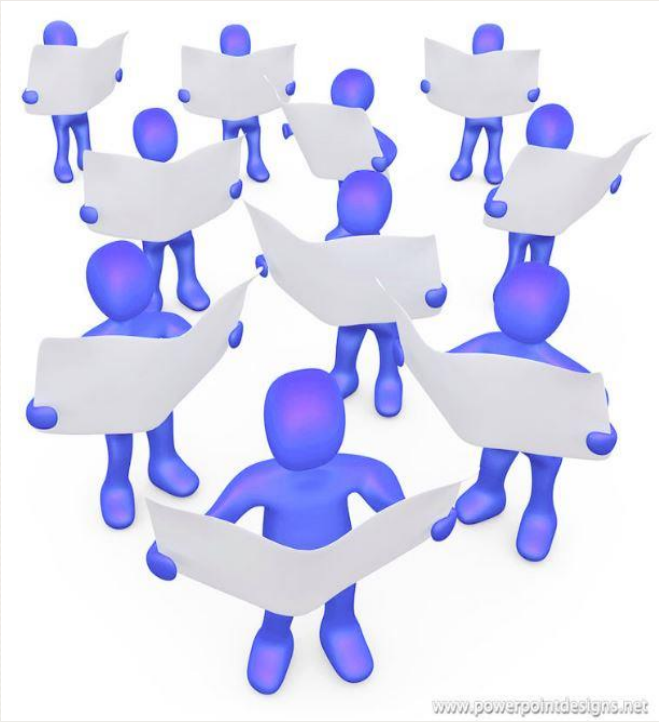


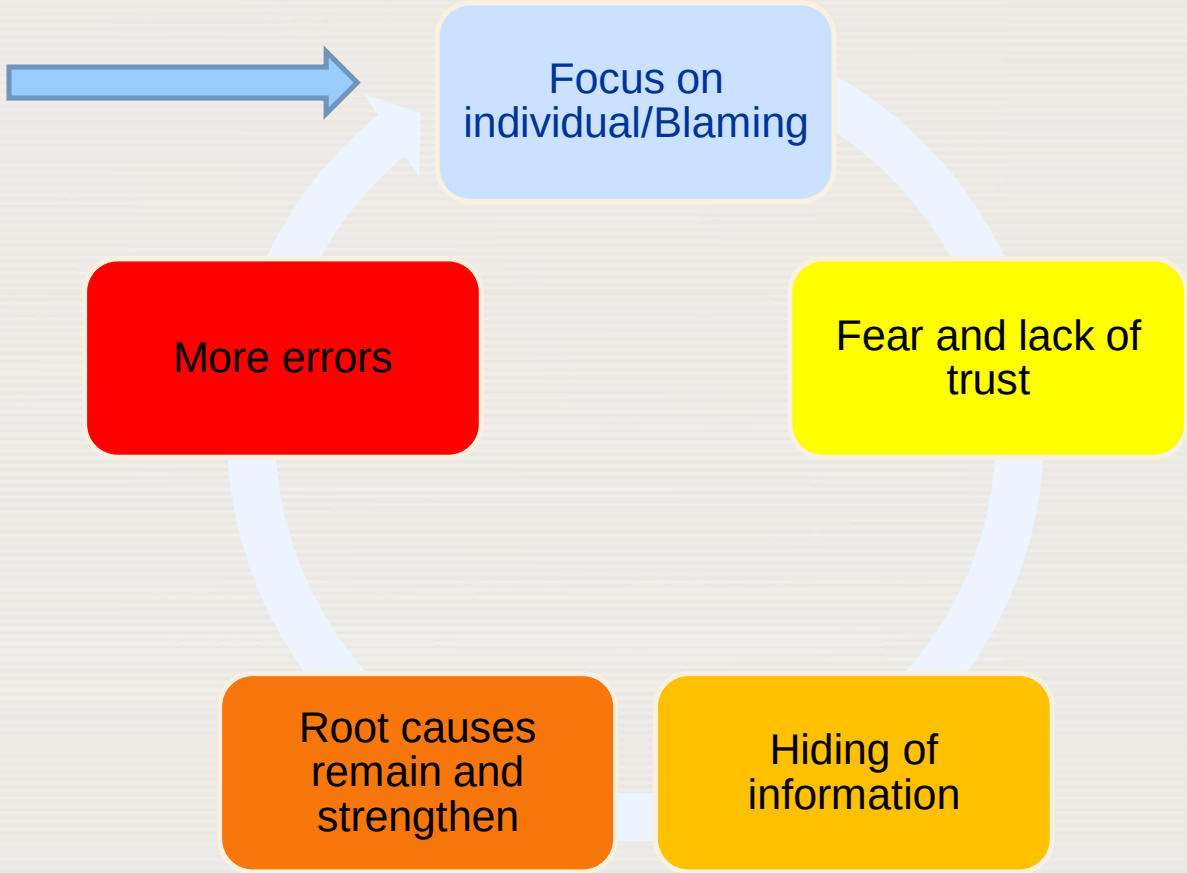
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Human Performance

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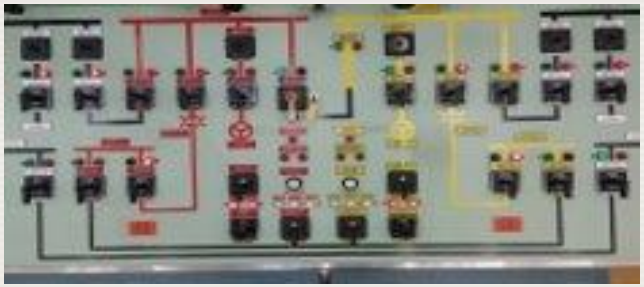
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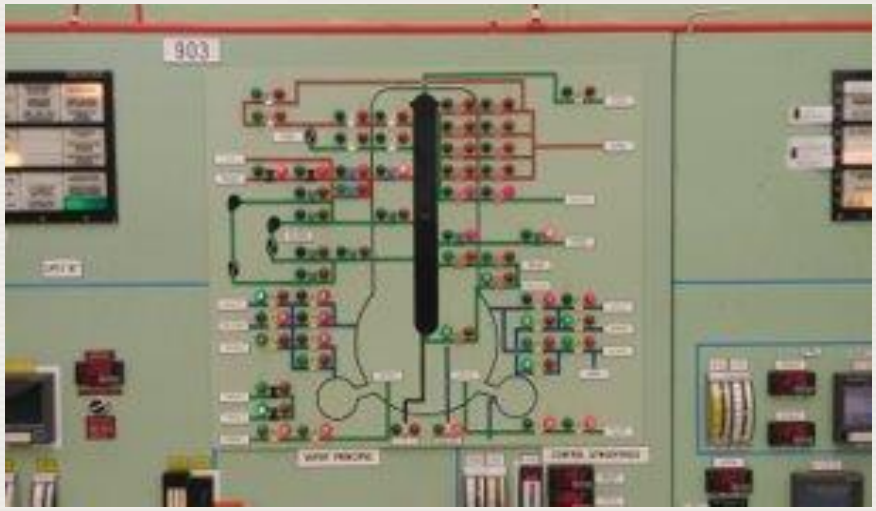
Elements of a HOF Program

- Improve Human-system interface.
  - Redesign of the Control Room to ensure effective ergonomic operation of the installation in normal operation and in emergencies.
  - Guides are available (v.g. Nureg 700 Human-System Interface Desigh Review Guidelines)
  - Identify and grade deviations.









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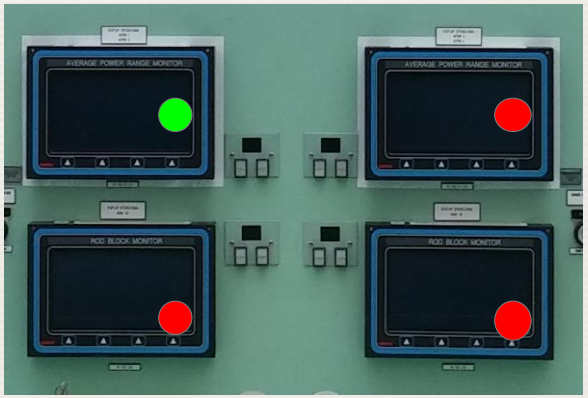
Elements of a HOF Program

- Human factors engineering in design changes.
- Procedures improvement taking into account human and organizational factors.
  - Development of guides on how to prepare written protocols taking into account human factors.
- Equipment labelling and operating aids.
- Configuration control of human factors at the Plant.
- Configuration control of documentation.

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Elements of a HOF Program

- Human error prevention plan.
  - Human performance tools for individuals:
    - Star (STOP, THINK, ACT, REVIEW)
    - OOPS (Out Of Procedures Stop)
    - Questioning attitude.
    - Use of procedures and adherence,...
  - Human performance tools for work-teams:
    - Pre-job briefing/Post-job review.
    - Verification practices.
    - Flagging,...



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Elements of a HOF Program

- Verification and validation of human factors.
- Plant equipment condition improvement
  - Periodic Plant inspections by multidisciplinary groups with managers involvement.
- Performance assessment and Knowledge management.
  - Learning from internal and external operating experience.
    - Constructive communication of incidents and near-misses.
    - Personnel initiatives.

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Elements of a HOF Program

- Conservative decision making process.
- Personnel motivation and communication program.
  - Managers on the field: observations of activities at the facility .
  - Periodic meetings.
  - Giving feedback: Positive reinforcement, correction.
- Organizational change management.

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Elements of a HOF Program

- Safety culture improvement program.
  - External safety culture assessment.
  - Periodic safety culture self-assessment.
  - Managers giving training on safety culture.

- Human factors on emergency drills and exercises
  - Emergency drills and exercises must be understood as big opportunities for learning.
  - Fukushima accident has shown that human factors play a critical role during accident response.

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Elements of a HOF Program

- Personnel training in Human and Organizational Factors.
  - On the job training.
  - Training at a human factors simulator facility .







TECNATOM Human Factors Simulator. Tarragona (Spain)

Conclusions

- To prevent Human and Organizational failures, **human factors** have to be taken into account and **good performance** and **good practices** have to be supported.
- **People are fallible,** and even the best people make mistakes.
- Individual behaviour is influenced by organizational **processes** and **values.**
- People achieve high levels of performance based largely on the encouragement and reinforcement received by leaders, peers, and collaborators.
- A **learning organization** apply methods of **constructive communication** to benefit from the successes and errors that occur in the organization.

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…Thank you for your attention



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