Systemic Approach to Safety -
The interaction between Human, Organisational and Technical factors (HTO)
Systemic Approach to Safety

Stressing the dimension of:

• Interactions
• Dynamics
• On-going
• Complexity
Systemic Approach to Safety

Same concept – different labels

- Systemic safety
- Systems view
- Holistic safety
- System safety
- Socio-technical system
- MTO/ITO/HTO

*This concept is not new it was born out of TMI*

IAEA
This thinking is not new...
A systemic approach to safety in the Kemeny report of TMI

"When we say that the basic problems are people-related, we do not mean to limit this term to shortcomings of individual human beings -- although those do exist. We mean more generally that our investigation has revealed problems with the "system" that manufactures, operates, and regulates nuclear power plants."
“The cause of the accident should not be treated merely as a natural disaster due to an enormous tsunami being something difficult to anticipate.

We believe it is necessary to seriously acknowledge the result that TEPCO failed to avoid an accident which might have been avoided if ample preparations had been made in advance with thorough use of human intellect.”
Conclusion from IEM5

IEM5 – International Experts Meeting on Human and Organizational Factors in Nuclear Safety in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant

IEM5 Report:
"One of the major lessons learned from the Fukushima Daiichi accident, as discussed by the IEM participants, is that the nuclear community needs to better understand and implement an integrated, or systemic, approach to safety."

“With a systemic approach to safety that analyses the human, organisational and technical factors, and organization can be better prepared for an unexpected event.”

“Expert form the behavioural sciences, and the related research, needs to be better utilized in the effort to understand and apply a systemic approach to safety”
The Interaction between individuals, technology and the organization

3.14. “An important factor in a management system is the recognition of the entire range of interactions of individuals at all levels with technology and with organizations. To prevent human and organizational failures, human factors have to be taken into account and good performance and good practices have to be supported.”
The current nuclear safety approach

- The common approach in nuclear safety is an analytical approach – we break down the systems into smaller parts to make it manageable and to ensure nothing is left unattended – we compartmentalize.
- Necessary due to the complexity of nuclear technology and its application.
- Provides robustness for most predicted and unpredicted situations.
The current nuclear safety approach

- The common approach in nuclear safety is to break down the systems into smaller parts to make it manageable and to ensure nothing is left unattended – we compartmentalize
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BUT...

- Working with each aspect separately does not give the full picture of the system
- Tends to overemphasise technical factors – a strong belief that if the technology works, the plant is safe
- A systemic approach to safety complement the current safety approach
Individual, Technical and Organizational Factors
The systemic approach to safety – HTO
The systemic approach to safety – HTO

- A systemic approach to safety means that we comprehend the whole systems interplay between humans, technology and organization (HTO).
- As the whole HTO system is fare to complex for one individual to comprehend, an integrated approach is needed, which invites different competencies and thinking.
- Understanding the dynamics of the HTO interactions helps us to evaluate their ability to produce safety outcomes more effectively.
- Safety outcomes emerges from HTO interactions.
- A systemic approach to safety offers a complementary safety perspective.
Systemic mapping of a maintenance service on an emergency diesel generator
Examples of Human, Organizational and Technical Factors

Organizational Factors (OF):
- Vision and objectives
- Strategies
- Integrated Management System
- Continuous improvements
- Priorities
- Knowledge management
- Communication
- Contracting
- Work environment
- Culture
- etc

Technical Factors (TF):
- Existing technology
- Sciences
- Design
- PSA/DSA
- I/C
- Technical Specifications
- Quality of material
- Equipment
- etc

Human Factors (HF):
- Human capabilities
- Human constraints
- Perceived work environment
- Motivation
- Individuals understanding
- Emotions
- etc
“You are only as strong as your weakest link”

The systemic approach to safety capitalizes on understanding the strengths as well as the vulnerabilities in all factors influencing nuclear safety.
Complexity and Systemic Challenges in relation to Safety

Organizational Factors (OF):
• Alignment of vision and objectives
• Clear and appropriate strategies
• Current Integrated Management System
• Continuous improvements
• Priorities
• Transfer of knowledge
• Openness of communication
• Contractor management
• Systematic and continuous improvements of safety culture
• etc

Technical Factors (TF):
• Existing technology
• Advanced technology
• Automation
• Analogue/digital
• Modifications
• etc

Human Factors (HF):
• Job readiness
• Cooperation and teamwork
• Learning and reflection
• Stress and fatigue
• Motivation
• Individuals understanding
• Trust
• Self-management
• etc
The systemic approach for global nuclear safety

• A systemic approach to safety means that we comprehend the whole systems interplay between individuals, technology and organization (HTO)
• As the whole HTO system is fare to complex for one individual to comprehend, an integrated approach is needed, which invites different competencies and thinking
• Understanding the dynamics of the HTO interactions helps us to evaluate their ability to produce safety outcomes more effectively
• Safety outcomes emerges from HTO interactions
• A systemic approach to safety offers a complementary safety perspective
• More dimensions are needed to comprehend the global system of interactions
Including the outside world

Corporate organization

Contractors

Government

Regulator

TSOs

Vendor

International organizations

Customers

Public media
Systemic View of Interactions between Organizations
The researchers’ messages

• It not enough to learn from past successes and failures

• Need to anticipate complexity of future possibilities

• Asking what we do not know

• Thinking out of the boundaries with the help of exposure to diversity of disciplines

• Cultivate a culture of inquiring

• Pay attention to the unnoticed on-going interactions
The researchers’ recommendations

To be better prepared for the unexpected organizations need to:

• **Avoid simplification – encompass the complexity**
  High Reliability Organization (Weick & Sutcliffe)

• **Enhance organizational Mindfulness and Heedfulness**
  High Reliability Organization (Weick & Sutcliffe)

• **Build organizational capabilities for flexibility and adaptation**
  Resilience Engineering (Hollnagel, Paries, Woods)

Link to DVD and materials from the TM on Managing the Unexpected
[http://gnssn.iaea.org/NSNI/EaT/TM/Pages/MtU.aspx](http://gnssn.iaea.org/NSNI/EaT/TM/Pages/MtU.aspx)
Finally safety is about our human capability to effectively interact and share.
There are myriads interaction ongoing moment by moment and some of them can play a significant role in safety – therefore it's important to be cultivate mindfulness through continuous good shared space.
The Hindsight bias

Figure 6: The orderliness of looking back.

Ref. Hollnagel
Figure 5: The indeterminacy of looking ahead.

Ref. Hollnagel, 1998
Reactive towards Proactive

The concept of HTO can be used as a tool to structure our thinking.
Principles of HTO

Value and seek diversity through

- Ensure diversified competencies in teams
- Encourage diversity in thinking and opinions as it minimize simplification in safety decisions
- Be comfortable with ambiguity
- Encompass the complexity, the nature of dynamic and non-linear relationships
- Utilize systemic mapping to comprehend the unnoticed interactions
- Communicate through dialogue rather than argumentation to avoid polarization
…Thank you for your attention