Summary and Q&A

TU-E3150 Safety management in complex sociotechnical systems

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Reminders

- Read the writing instructions
- Email to contact the teacher: reimanteemu@gmail.com
- No Learning Log required for Lecture 12
- Deadline for the final essay 31.5 – please notify if you are not able to submit in time

Learning logs

- Many “good” examples of bad indicators!
- Safety walks “may create a superficial or performative safety culture if conducted as checkbox exercises without genuine engagement. …. Additionally, their limited scope and focus may result in important safety hazards being overlooked. Lastly, safety walks can foster a culture of blame and scapegoating if they solely focus on individual errors or non-compliance.”
- In what ways may human performance tools be less effective in highly complex and dynamic environments where multiple factors interact and influence safety outcomes and how to address these weaknesses?
- “Conducting effective self-assessments of safety culture might require significant resources and expertise. It would be important to ensure that such assessments are comprehensive, engaging, and provide actionable insights for improvement”
- Reflection about motivation
  - A Leader in a nuclear power company “good organization has to handle the fact that not everyone is 100 % motivated every day”
  - Right kind of motivation contributes to safety, but safety cannot rely on motivation only
  - Motivation without competence may also be dangerous

Summary of topics

- Human and organizational factors
- Accident (and safety) models
- Organizational accidents
- Learning from incidents and accidents
- Cultural influences on safety
- Safety leadership
- Safety management
- Methods and tools of safety management

Safety management in complex sociotechnical systems

- The “enemy” of safety is the complexity of our sociotechnical systems
  - Drift, normalization, structural secrecy, sub-optimization, routinization create and change risks
  - Error seldom requires negligence - human error is a label given with the benefit of hindsight to those actions that fail to meet their goals
- Safety culture denotes the shared assumptions about hazards and safety and ways of controlling them
  - Safety management both influences and is influenced by culture (dilemma of management)
- All safety risks stem from hazards
  - Hazards stem from structures, technology, practices, personnel, culture (or mindset) and environment, and their interaction
- Safety can be defined as the ability of the system to succeed under varying conditions

  …while minimizing and keeping hazards in control, and minimizing and keeping errors in control

Safety management in complex sociotechnical systems

- Requires taking into account the characteristics of complex sociotechnical systems (non-linearity, self-organizing, emergence, history dependency, systems-within-systems)
  - History has taught us that accidents seldom have a single major cause but rather are a combination of latent conditions, active variability and errors and various concurrent events
  - Accidents are often surprising, but seldom sudden – an unsafe condition develops gradually yet easily remains ignored by the organization
  - One major issue is communication across cultural boundaries, whether these are occupational, organizational, hierarchical or national cultures (cf. Schein 2010, p. 398)
- Safety requires adaptive management that cannot be based solely on restricting behavior, standardization and barriers
  - Several principles are needed, from building preconditions to monitoring current boundaries to innovating new solutions => but also standardization, barriers and reducing unwanted variance and its negative consequences
  - The focus of safety management depends on many factors, including the current level of safety, the inherent hazards to be controlled, culture of the company

Main introduced models and concepts

Safety = Absence of errors / deviations

Remove **individual** errors and deviations as much as possible, avoiding that something goes wrong

Focus on error prevention and detection of latent weaknesses

Safety = Hazard control

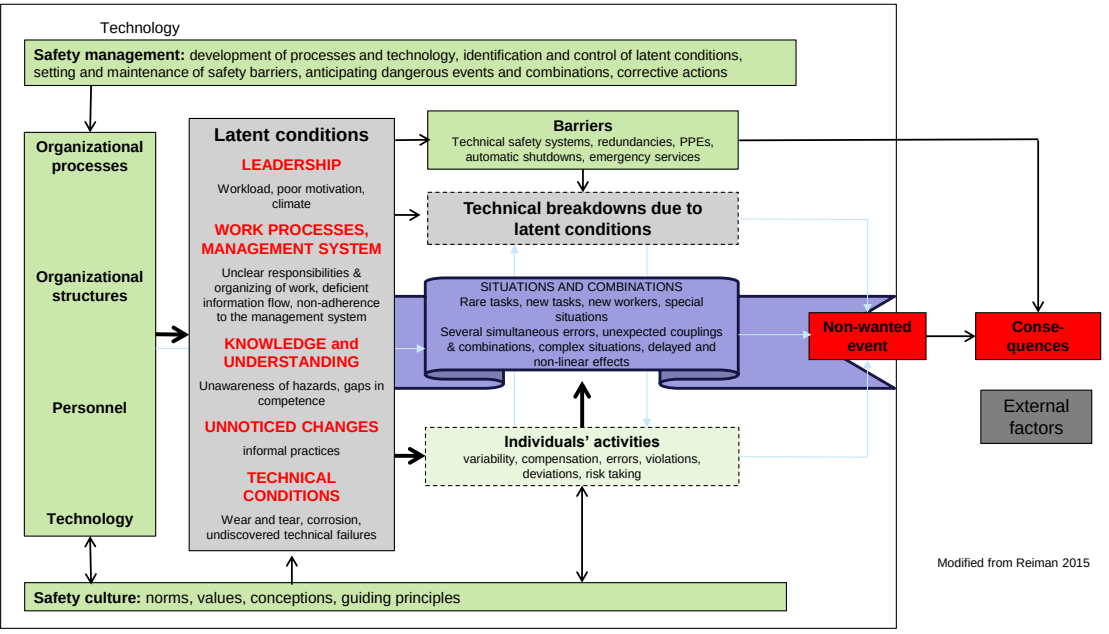
Remove / decrease **hazards,** reduce their probability and minimize the consequences of actualized hazards

Focus on design and redesign of systems, operational limits => hierarchy of hazard controls

Safety = Ability to succeed under varying conditions

Improve the **organization's** ability to anticipate and monitor hazards, respond to events and learn from the past; ensuring that everything goes right

Focus on capacity building



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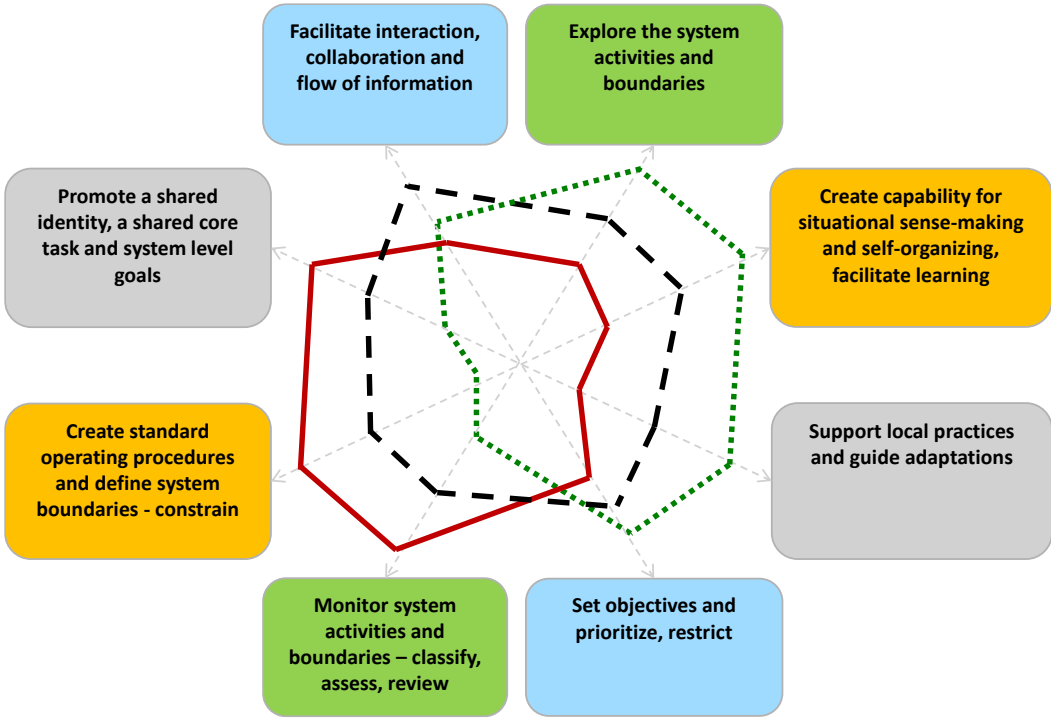

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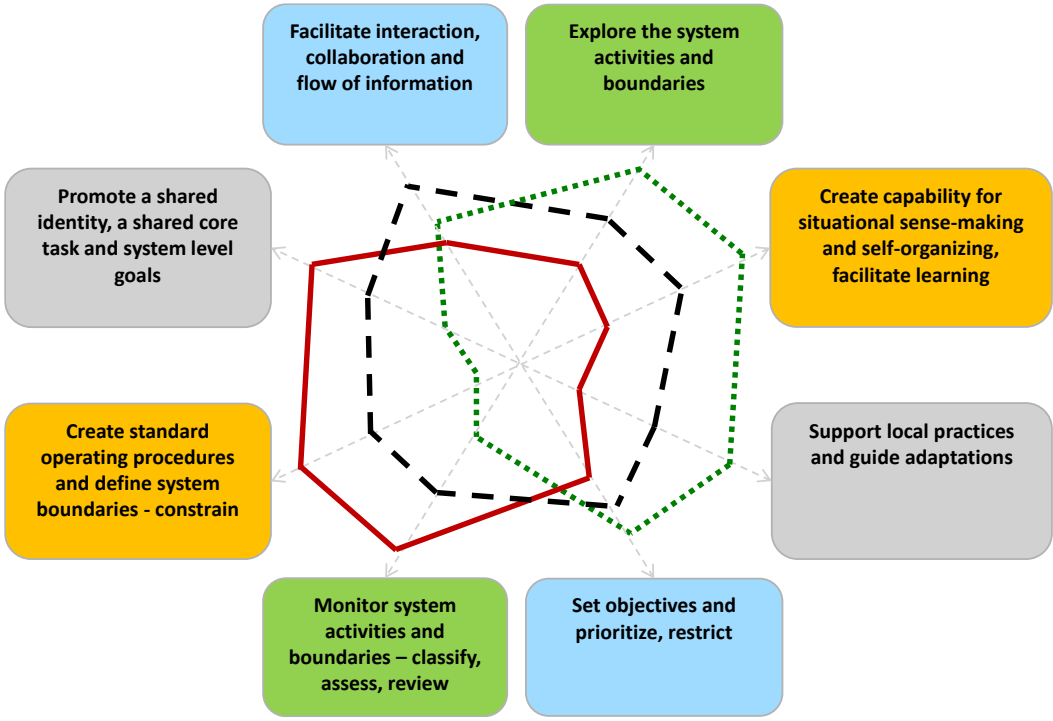

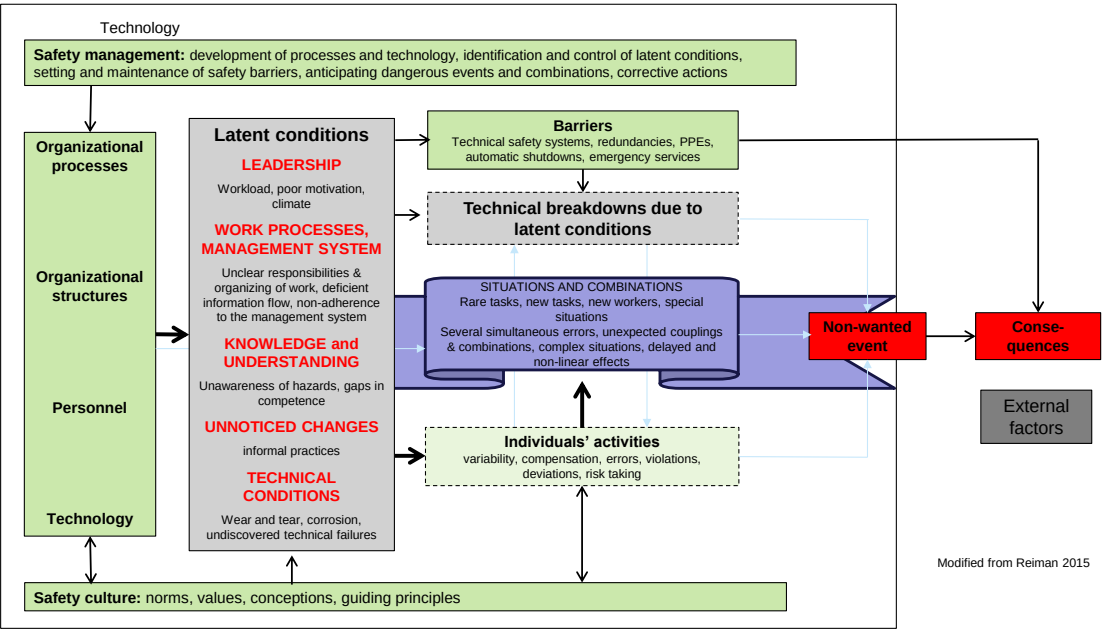

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Safety is an emergent property of the system. Safety cannot be managed, but the system can. This requires identifying and removing hazards and adverse (latent) conditions, but also improving organization's ability to succeed (anticipate, monitor, respond, learn).

Safety science is moving from seeing safety as an absence of negative to safety as an ability to succeed, as a presence of organizational capabilities

(modified from Hollnagel, 2008)

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How to select the right tools

Safety management system offers the framework for safety activity / utilization of the tools, but how and when the tools are used depends on many factors

1. Stability of process
   - For a stable and well-known process more focus can be put on standardization and monitoring (however see other points) => the ”ultra-safe” model
2. Complexity of the sociotechnical system
   - More complexity, more monitoring but also more exploring and situational sense-making => high reliability organization model
3. Competition & production pressure
   - when there is high competition more focus to system level goals to prevent local drift
   - However, emphasis on supporting local practices is needed to survive financially
4. Age of company:
   - A new company needs to define system level goals, set the boundaries as standard operating procedures, and monitor for compliance
   - For an older company, the boundaries have probably shifted and thus exploration and situational adaptation are needed, as well as local adjustment
5. Age of technology
   - Both very new and very old technology requires exploration and situational adaptation, as well as local adjustment
6. Current safety level
   - If there are many hazards with high potential for harm standardization and system level goals can reduce the risk fast – when safety is already on a higher level further improvements require also the other dimensions
7. Current culture
   - Culture influences which actions are considered necessary and which are accepted

An action list for managing safety, modified from Dekker (2018), based on Reiman et al. (2015), Rasmussen (1997), Hollnagel (2014)

1. Constrain activities and set safety boundaries
   a. But, consider what you are trying to manage (the work, not safety)
2. Promote safety as a shared, guiding principle
   a. But, eliminate meaningless slogans and propaganda
3. Optimize local efficiency and contextualize solutions
   a. But, be willing to make sacrifices for the greater good (global goals)
4. Facilitate interaction and build connections
   a. But, eliminate counting of observations of visible safety behavior
5. Create capabilities for self-organizing and situational action
   a. But, make sure these capabilities also re-create themselves
6. Facilitate novelty and diversity
   a. But, make sense of the old, retain the meaning
7. Permit pride of workmanship and create the conditions for intrinsic motivation
8. Set goals and prioritize safety actions
   a. But, eliminate quantitative targets and managerial bonuses for safety performance

Dangers of over-emphasizing the principles

The organization tries to involve everyone and is overly-democratic in its decision making, leading to an action paralysis and lack of goal clarity. Difficult / unpopular decision are debated endlessly. Transparency of information leads to information overload.

Focus on exploration of the system can lead to an organisation without clear boundaries for what is acceptable and what is not, and what is safety. Out-of-the-box thinking and experimentation may question the existing activities too much causing excess uncertainty. Risk taking is seen as acceptable and even promoted.

Facilitate interaction, collaboration and flow of information

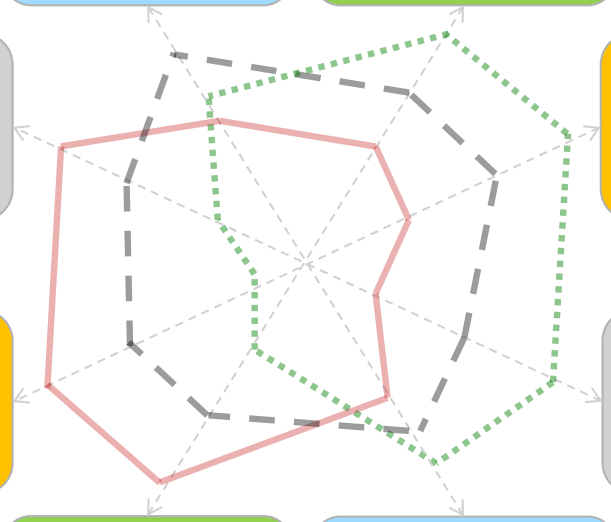
Explore the system activities and boundaries

The organization is focused on long-term issues and goals, but neglects short-term acute tasks as well as financial and efficiency goals. Organization is incapable of making short-term trade-offs based on situational requirements.

Promote a shared identity & shared core and system level goals

Create situational and self facilita

Diversity of people, opinions, practices and ways of working can be a source of risk that is difficult to manage without shared guidelines. Autonomy can also promote risk taking. Constant changes cause a wide gap between prescribed work (procedures) and work as done.



Past actions (to manage hazards) are standardized into shared responses to future contingencies. This limits organizational attention (solutions looking for problems); new hazards may go unnoticed and new situations cause problems. Lack of diversity hinders development

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Support and guid

Chronic issues and goals are neglected due to an overemphasis on acute and short-term issues. The organization lives in the present without learning from the past or orienting towards future. The organization may be overly influenced by external factors and outsource responsibility.

Monitor system activities and boundaries – classify,

Set objectives and prioritize, restrict

Removing variance leads to a rigid system without the necessary requisite variety for dealing with surprising events or making accidental discoveries / developments. Variance is seen as negative and uniformity an ideal state; inflexible routines, suppression of differences, bureaucratization of safety.

Relying too heavily on the top-down mode of control with restriction on participation, the full competence of personnel is not utilized. Prioritizations and decisions made without personnel involvement may also build mistrust between management and personnel. Decisions are made based on formal authority instead of expertise. The organization does not know what it knows, and what it doesn't know

Selected accident cases with good information available and adequate complexity to extract lessons

Nuclear

- Three Mile Island 1979
- Chernobyl 1986
- Davis Besse NPP reactor head corrosion discovered in 2002
- Fukushima Daiichi nuclear accident 2011

Petrochemical

- Bhopal chemical accident, India, 1984
- Piper Alpha oil rig disaster, North Sea, 6 July 1988
- BP America's Texas City isomerization unit explosion 23 March 2005 - only with a very good reason
- BP Deepwater Horizon explosion, Gulf of Mexico, 20 April 2010

Rail

- Clapham Junction railway crash, London, 12 December 1988
- Ladbroke Grove rail crash, London, 5 October 1999
- Amagasaki rail crash, Osaka, 25 April 2005
- Lac-Méqantic oil shipment train derailment, Quebec Canada, July 6, 2013

Aviation

- Teneriffe airport runway collision 27 March 1977
- Space Shuttle Challenger 1986 – only with a very good reason
- Überlingen mid-air collision, over Germany, 2002
- Space Shuttle Columbia disaster 1 February 2003
- ValuJet Flight 592 DC-9, Everglades, 1996
- Air France Flight 447, 2009
- Boeing 737 Max airplane accidents 2018-2019

Maritime

- Capsizing of the Herald of Free Enterprise, English Channel, 6 March 1987
- Sinking of MS Estonia in the Baltic Sea 28 September 1994
- Capsizing of Costa Concordia, Italy, 13 January 2012
- Sinking of MV Sewol, South-Korea, 16 April 2014

Others

- King's Cross London underground fire 18 November 1987

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