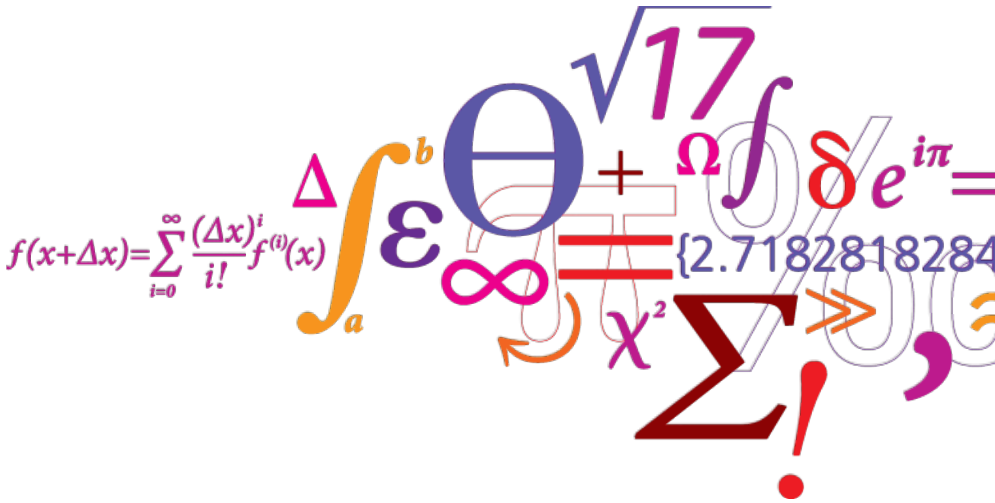
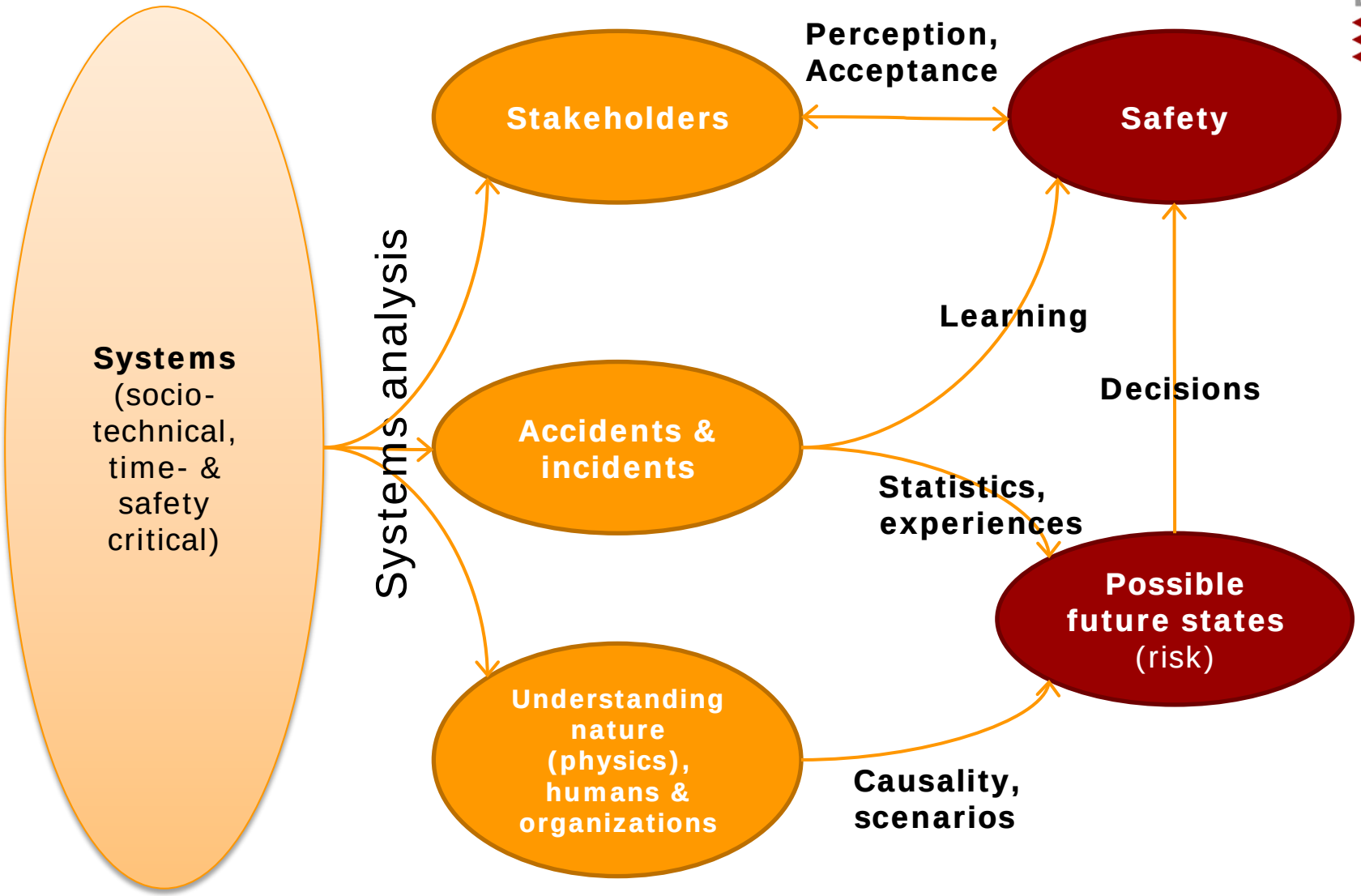
Safety and Risk Management



DTU Management Engineering
Department of Management Engineering


Systems
(socio-technical, time- & safety critical)
Systems analysis
Stakeholders
Accidents & incidents
Understanding nature (physics), humans & organizations
Perception, Acceptance
Safety
Learning
Decisions
Statistics, experiences
Possible future states
(risk)
Causality, scenarios

Safety
SRM's objective and disciplines

- *Contribute to knowledge, methods and techniques that improve safety and reduce the likelihood and consequences of accidents.*

- Using:
  - Formal science:
    - Systems Analysis
  - Engineering science:
    - Safety Engineering
    - Safety management
    - Risk management
  - Social science:
    - Human Factors

Systems
Our concepts

- We focus on *time- and safety-critical* systems.

- We discriminate within the system:
  - The technical components;
  - The human-machine interface (HMI);
  - The people;
  - The organization and the organizational functions necessary for safe operation;
  - The societal context.

- We want to know:
  - How these elements condition the **performance** of the other elements in the system;
  - What functions are performed to promote that the system as a whole **avoids** dangerous deviations and can **recover** from them, respectively.

Accidents
Our concepts

- The occurrence of failures a stochastic process. Risk is expressed **probabilistically**

- Accidents originate from combinations of initiating events and **latent conditions.** We look at:
  - root cause analysis
  - safety-barrier performance
  - human and organizational factors

- Monitoring of risk indicators can be transferred to **learning** to continuously improve system safety.

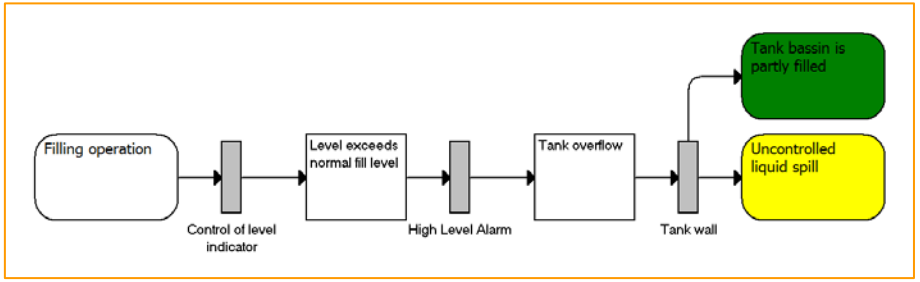
- We consider **resilience**: the ability of a system to withstand and respond to threats and failures including:
  - Error management (reduction of error)
  - Flexible response adapted to unexpected events.

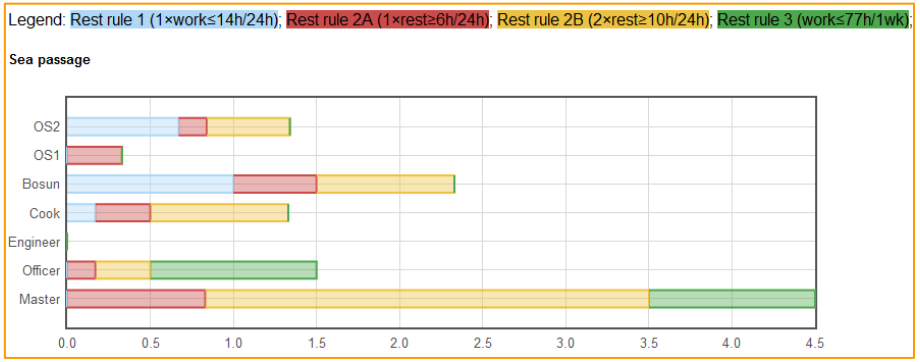
Learning from accidents and incidents
Some key methods

- Accident and incident analysis;
- Statistical analysis of failures, incidents and accidents;
- Interview techniques;
- Development and validation of failure taxonomies
- Introduction of incident reporting

Risk analysis
Some key methods

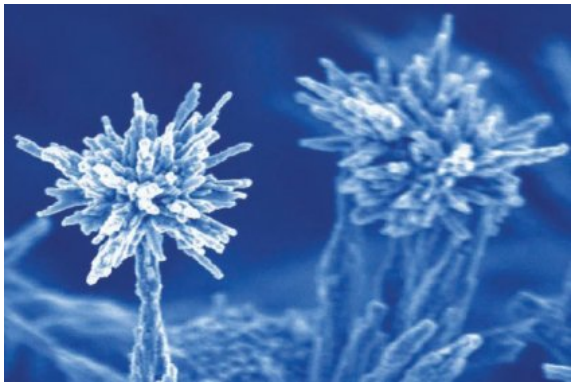
- Task analysis
- Hazard identification techniques
- Human Reliability Assessment
- Questionnaire investigations
- Assessment of human-machine interfaces
- Fault tree and event tree analysis
- Uncertainty analysis
- Stochastic modeling
- Consequence assessment
- Live cycle evaluations





How can we improve risk management? Some research questions

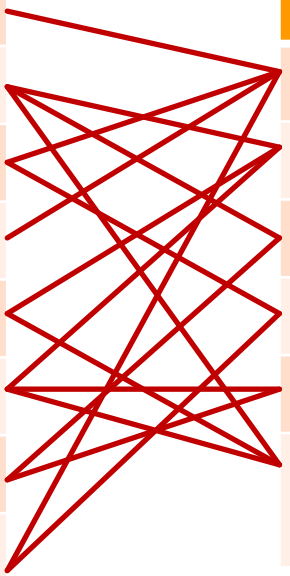
- In what ways do organizations shape safety?
- What is the optimal balance between *prescribed* and *improvised* response?
- How shall uncertainty be incorporated in risk management?
- How can we predict and manage risks of new and emerging technologies?



Stakeholders
Subject domains

- Safety and risk management can be applied in (almost?) all domains of modern society

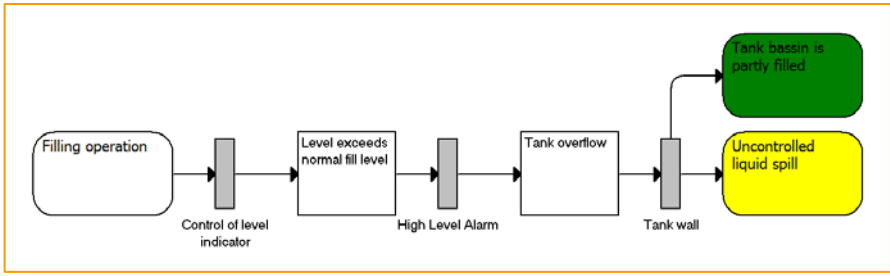
Domains
Healthcare
Process industry
Rail transport
Civil aviation
Maritime transport
Offshore oil & gas production
Wind energy
Hydrogen and other alternative energy carriers



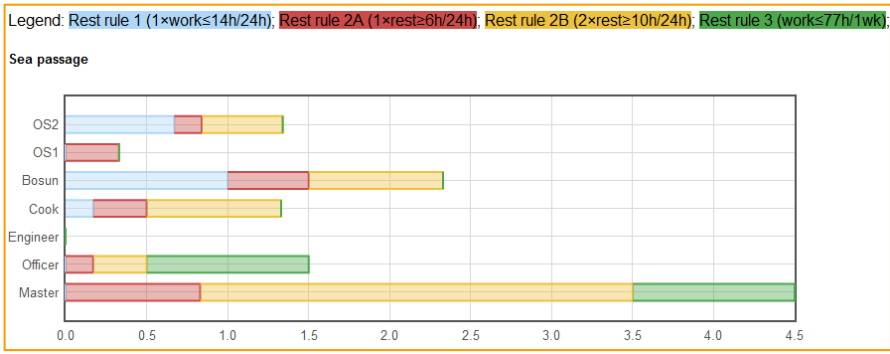
Stakeholders
Users
Employees
Nearby population
3rd parties
Assets (owners)
Environment (authorities, NGO)

Examples of tools and techniques developed and used by our group

- Safety barrier diagrams
  - Example of simple model using our SafetyBarrierDiagram software



- Simulation of human activities
  - Example of rest rules violations aboard a commercial cargo ship using our Discrete-Event Simulation engine



- Assessment of human-machine interfaces
  - Example in a cockpit using eye-tracking

iNTeg-Risk – EU co-operative project

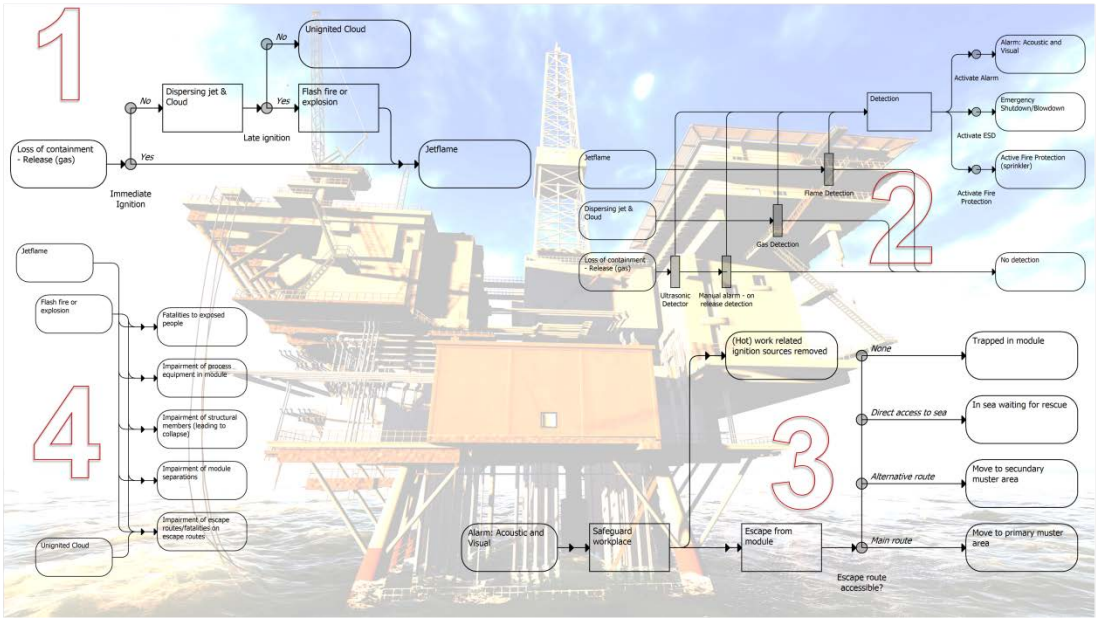
To improve the management of safety of new technologies and related emerging risks. iNTeg-Risk has matched this goal by providing a common paradigm and a common “framework” for managing emerging industrial risks.

1. iNTeg-Risk Catalogue of Emerging Risks – RiskEars system
2. iNTeg-Risk Framework for Emerging Risk Management
3. Library of iNTeg-Risk Methods, Handbooks and Guidelines for emerging risk analysis
4. iNTeg-Risk dynamic library of emerging Risks Key Indicators (KPIs)
5. iNTeg-Risk CWA (CEN Workshop Agreement) document – the European pre-standardization document for Emerging Risk Management,
6. European Master and Certification in the area of Risk Engineering and Management
7. iNTeg-Risk Risk Radar & 1StopShop – the web-based prototype system-of-systems for early detection, recognition, monitoring and management of emerging risks.

OPHRA: Offshore Platform Hydrocarbon Risk Analysis

Discrete-Event Simulation to simulate the interaction between **concurrent** phenomena following Loss of Containment:

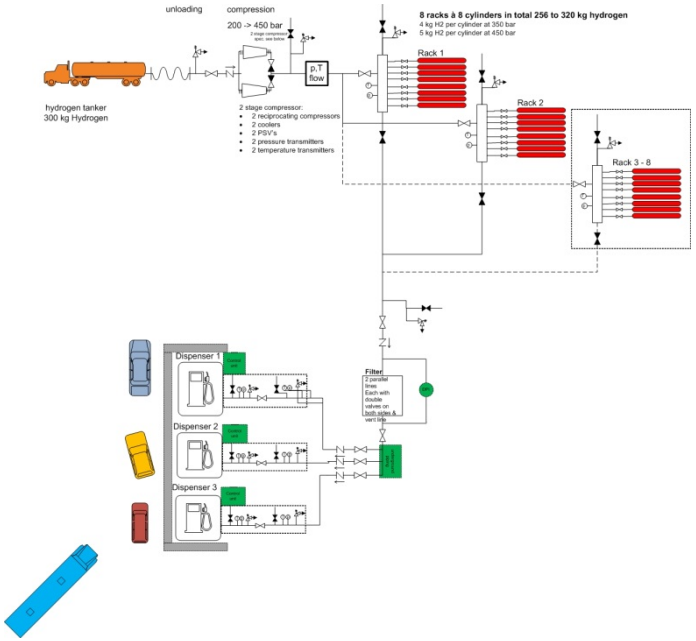
1. The physical processes (outflow, dispersion, ignition, heat radiation, explosion)
2. Detection, alarming and emergency shutdown
3. Escape and evacuation
4. Impact on persons, escalation and impairment of safety functions

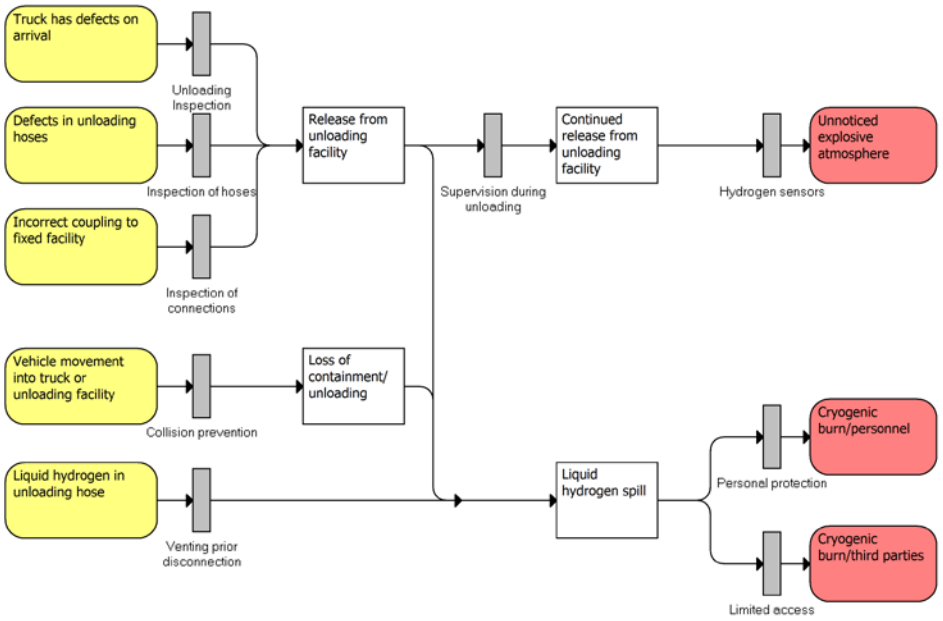


HySafe – An initiative to establish a safe transition to a future hydrogen economy

Example: Risk assessment using barrier analysis on a refuelling station

- The goal is to provide an overview on the main safety functions and to discuss these functions in relation to safety management and emergency situations.
- Hazard identification has been performed to identify the safety functions and barriers present in a generic large hydrogen refuelling station.





Who's who in SRM

- Henning Boje Andersen, professor

- Martin Mose Bentzen assistant professor

- Nijs Jan Duijm, senior researcher

- Mette Bach Hansen PhD student

- Kirsten Jørgensen associate professor

- Igor Kozine, senior researcher

- Frank Markert, senior researcher

- Jacob Thommesen senior researcher