Status innen risiko- og pålitelighetsmetoder - hva forskes det på i Norge?

07.02.2023

IFE

Research for a better future

Research Safety and Reliability, examples:

- Human Factors, safety and security assessments of control centres
- Ensure safety and efficiency in decommissioning
- Ensuring safe and reliable operation of future reactor types
- How to distinguish a failure from an attack
- How to maintain resilience and situational awareness with an increase in complexity
- Develop and evaluate user-centric digital technologies and services for safe, efficient and environmentally friendly transport systems and their management/monitoring
- Efficient safety assessments of applications that involve use of Hydrogen

IFE Digital Systems

8 Divisions

88

Advanced laboratories:

11

2022 publications:

>81

Applied Human Centred Research

Human Factors Analyses

Safety Demonstration

Risk assessment & Management

Cyber security

Modelling and simulation of physical systems

Condition monitoring process optimization

HALDEN PROJECT HTO

Human Factors, safety and security assessments of control centres

Method: CRIOP (Crisis intervention and operability analysis)

- Verify and validate: The ability of a control centre to handle all modes of operations safely and efficiently
- Results: Weak points and recommendations related to human factors

Methods control room and HSI design:

- Function and task analysis
- Workload analysis
- Context analysis
- Operational model
- Conceptual design

Contact: Linda Lunde-Hansen

Dette senteret skal erstatte flytårn ved 15 lufthavner i Norge

Det første spadetaket før byggingen av Avinors Remote Tower Centre er tatt.

I BODØ: Planen er at konvensjonelle tårn ved 15 lufthavner skal erstattes av dette senteret i Bodø. **ILLUSTRASJON:** ARCHUS ARKITEKTER

Weak points typically concern:

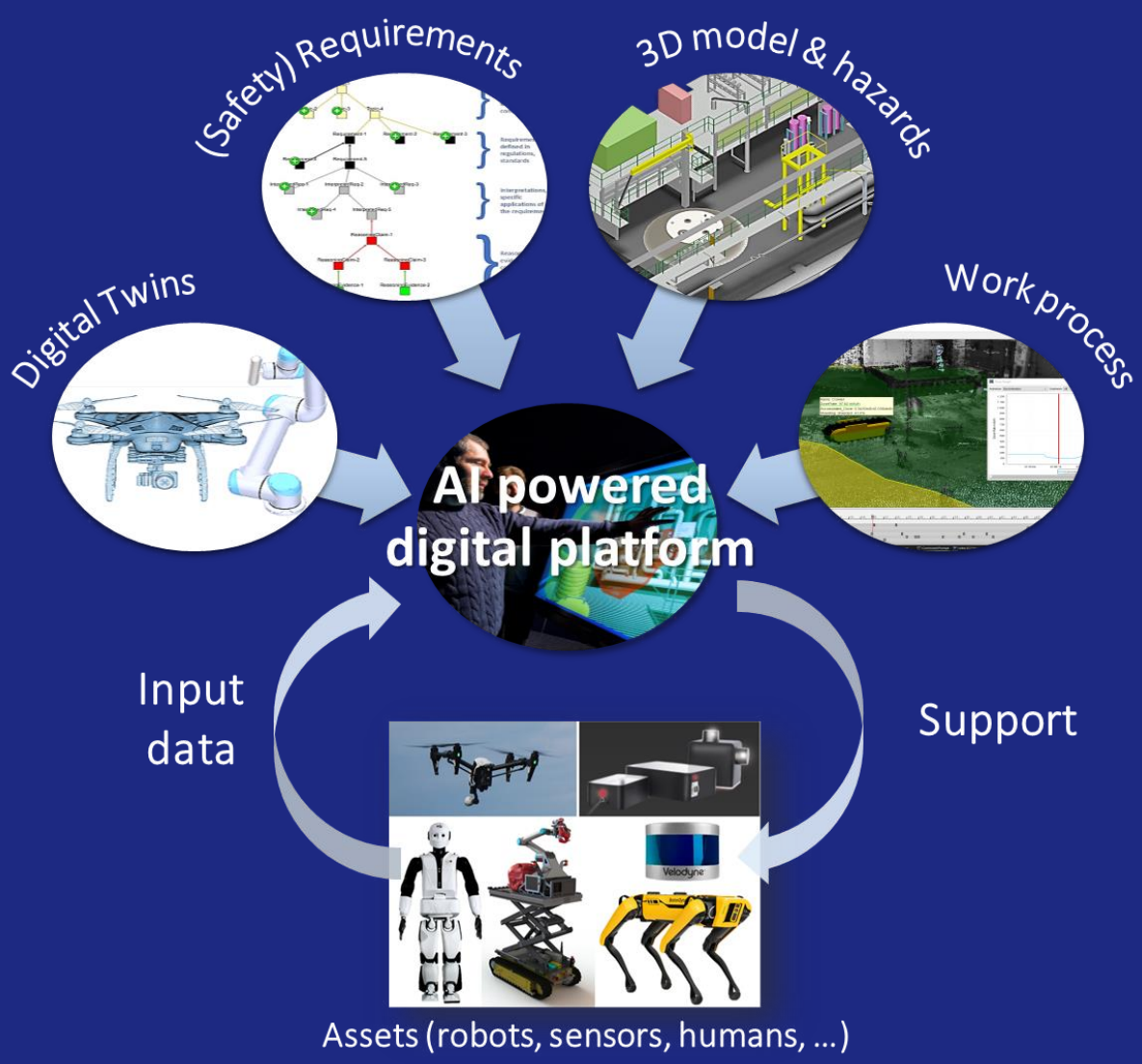
- Control room design (e.g. line of sight, cooperation)
- Human-system interface (information, design)
- Alarm design
- Teamwork, task allocation, communication
- Work environment
- Competence and training
- Procedures
- Emergency response

Ensure safety and efficiency in decommissioning

Method: Digitalization and robotics based transformation of decommissioning processes from a holistic perspective considering Human, Technology, Organizational, Regulatory and Sustainability aspects. The technology focus is on integration of BIM (Building Information Management), physics modelling and AI powered Digital Twin, scenario simulation, 3D scanning, and mobile robots into a comprehensive support system for work in potentially hazardous and safety critical processes.

Results: New methods and comprehensive 3D digital systems, integrated with and mobile robots, supporting characterization and planning, training, safety assurance, safe implementation, stakeholder involvement and other tasks in decommissioning.

Contact: István Szőke

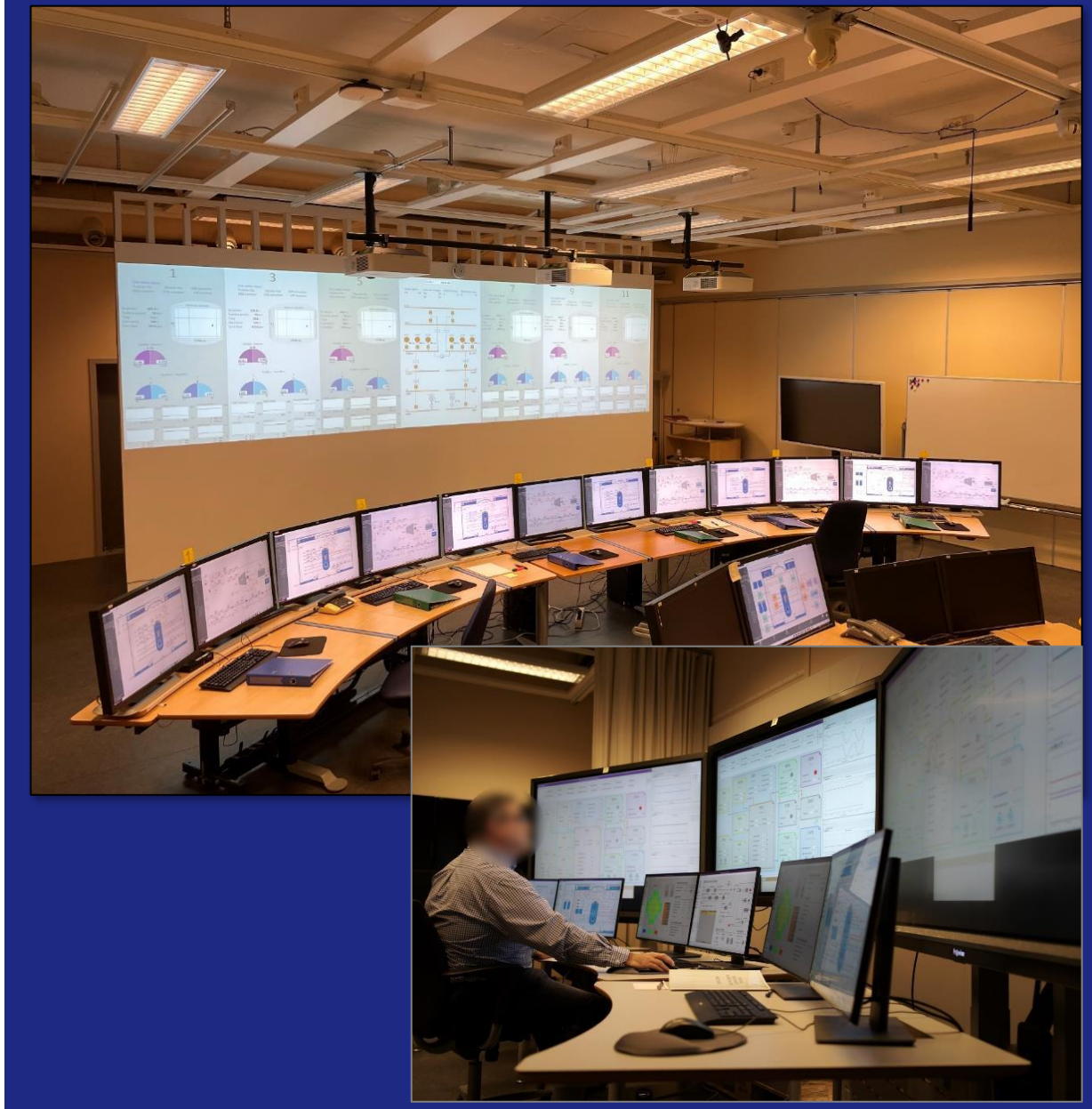


Ensuring safe and reliable operation of future reactor types

Method:

Empirical study of human performance in the operation of multiple Small Modular Reactors (SMR) to address the following research questions:

- How will SMRs be operated, and how different will this be from conventional nuclear power plants?
- What/where are the risks for safety & human error?
- Could there be opportunities for new human errors?
- What effects could multi-unit operation, passive safety systems, higher levels of automation, etc. have on human performance and safety?
- How can safe operation be assured under all conditions?



Contact: Claire Blackett

How to distinguish a failure from an attack?

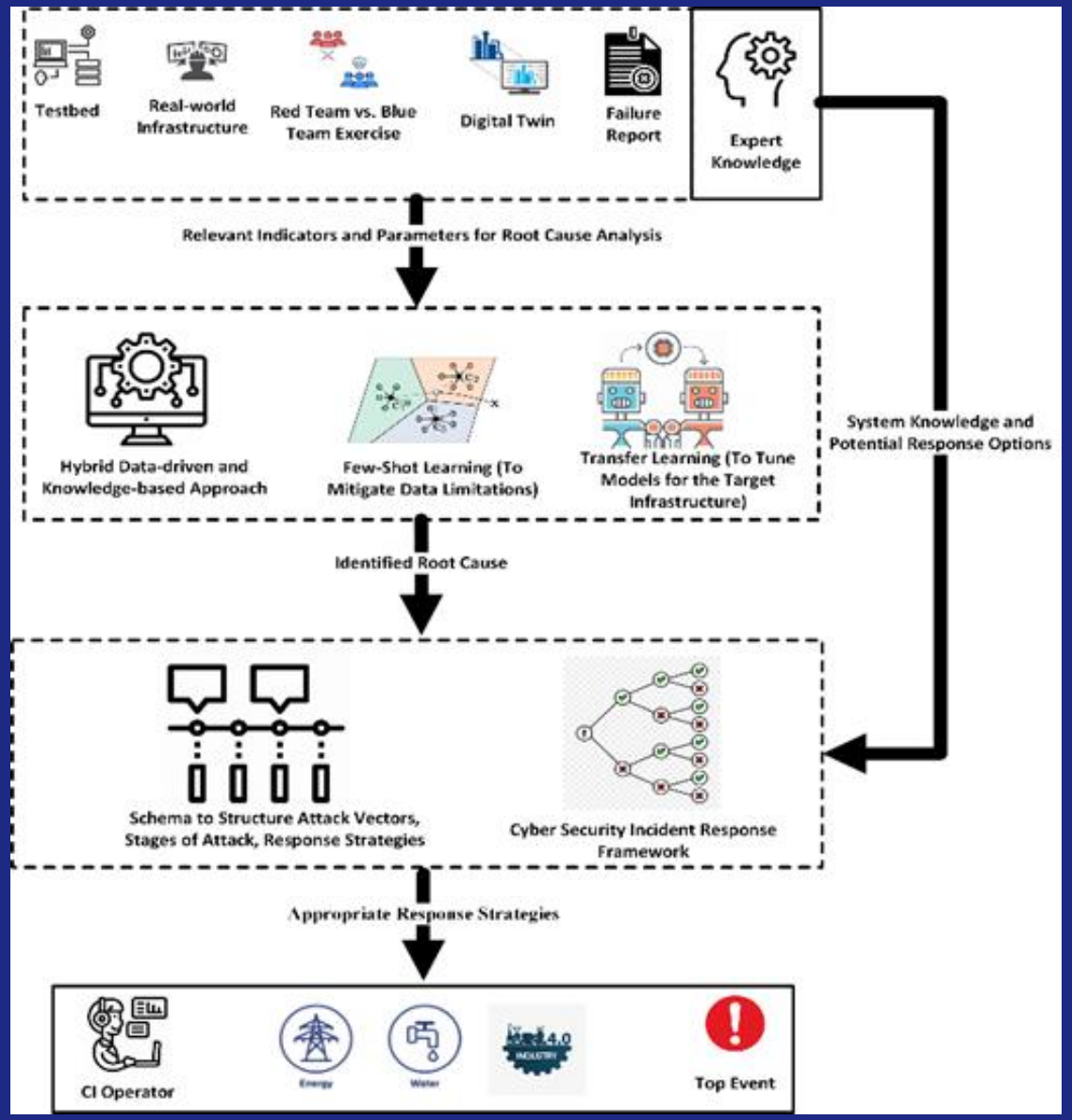
Essential, as the response strategies will be different:

- **Block the attack vector** in case of an attack (Cyber security personnel);
- **Fix the failure cause** in case of a fault (Safety personnel).

In the past, **Decision Support Systems (DSSs)** were **developed only using expert knowledge without empirical data.**

Research Questions (Method)

1. What are the key characteristics, benefits, and challenges of state-of-the-art DSSs developed for distinguishing attacks and faults? (Systematic Literature Review/State-of-the-Practice - interviews.)
2. How to develop an effective approach to gather, integrate, and use integrated empirical data from realistic data sources? (Utilize joint capabilities of our HAMMLAB and CyberLab.)
3. How to develop a hybrid data-driven and knowledge-based DSS for distinguishing attacks and faults that utilize both the empirical data from our CyberLab and complementing it with expert knowledge? (Determine which underlying AI/ML-based modelling technique can be effectively used.)



Contact: Sabarathinam Chockalingam

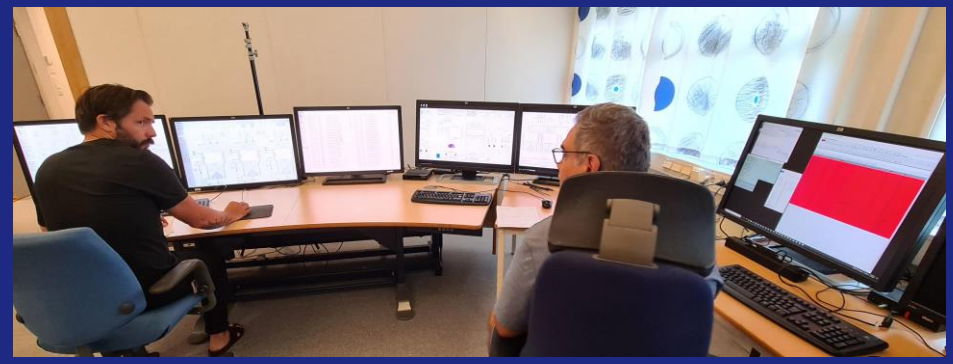
How to maintain resilience and situational awareness with an increase in complexity

Method:

- Simulator studies using operators in realistic incident / accident scenarios
- Measurement of operators' task performance, situation understanding under different conditions

Results:

- Insights on how safety and situation awareness is affected by support tools, work procedures, collaboration practices and situation complexity



Study NPP operator behaviour in scenarios with ambiguous component failures that may be interpreted as cyber-related

Study effect of priming: warning of potential cyber-attack vs no warning

GPWR simulator

4 single operators

4 scenarios of 10-15 minutes

Contact: Espen Nystad

Develop and evaluate user-centric digital technologies and services for safe, efficient and environmentally friendly transport systems and their management/monitoring

Enable the digitalization of planning, engineering, asset lifecycle management, maintenance and operational processes of the transport systems as a whole.

- assessing human and organizational factors for successful development and implementation of new technology

Deliver a set of digital enablers:

- a common scalable, reliable and interoperable data sharing and communications infrastructure,
- a common machine-readable semantic and syntactic description of the data, and
- a common digital assets planning, engineering and
- Digital Twin support development and run-time environment.

Contact: Sizarta Sarshar

The EU project “MOTIONAL” is paving the way towards the implementation of the future European Rail Traffic Management System to make rail the backbone of a multimodal transport system for passengers and freight.

Efficient safety and reliability assessments of applications that involve use of Hydrogen

How to

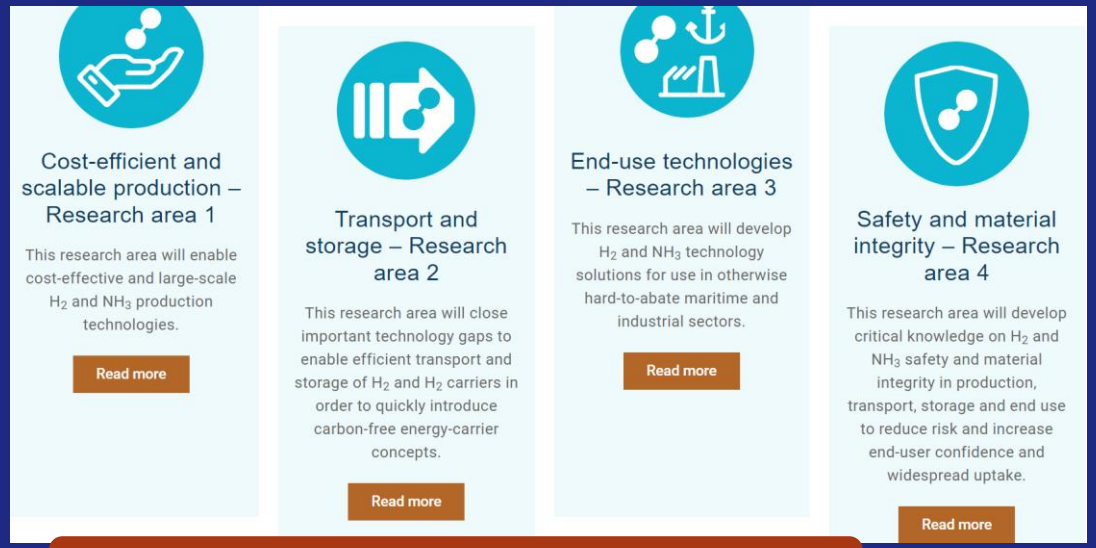
- demonstrate safety of new hydrogen technologies
- establish a management framework which is able to realistically describe the safety of hydrogen production, storage
- establish statistical basis to ensure robust risk and reliability calculations based on dedicated hydrogen failure mechanisms
- design and operate safe and cost-efficient systems and equipment for production, storage and use of hydrogen

Through

- Development of tools and methodologies for the safety risk management of hydrogen-based technologies and process
- Reliability data collection and application in safety lifecycle activities
- RAM, RBD, FTA, FMEA, etc.
- Structured Safety Argumentation method

Contact: Xueli Gao

Hydrogeni WP 4.2



Task 1 – Risk and reliability management framework

- IFE, NTNU, SINTEF ER, SINTEF I
- Develop a risk and reliability management framework dedicated to hydrogen value chain
- Input to Recommendation, Codes and Standards (RCS)

Task 2 – Frequency analysis

- SINTEF ER, SINTEF D, IFE
- Establish a pilot database/data collection template for failure and leak events on the hydrogen value chain
- Accident investigation and trend analysis

Task 3 – Physical phenomena

- SINTEF ER, USN
- Fundamental mechanisms and consequences of selected critical physical phenomena

Research for a better future

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