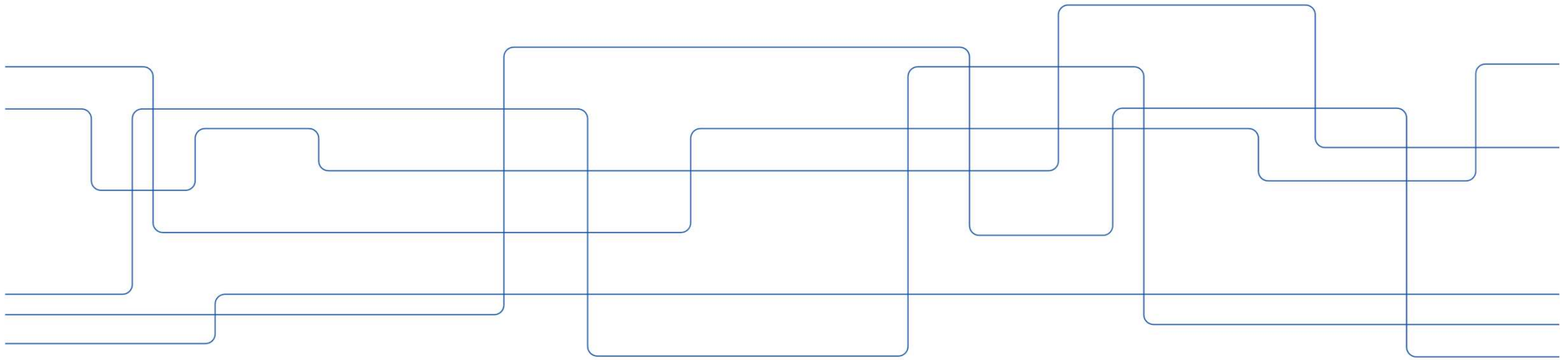




# Human Systems Integration

Pernilla Ulfvengren

Docent Industrial engineering and sociotechnical system



# Why? Why? Why? Why? Why?



1991



2018

”Automation induced surprises”



# Aviation safety projects

- HILAS - Human integration into the lifecycle of aviation system
- MASCA - Managing system change in aviation
- PROSPERO- Proactive safety performance in operations
- ORION – advanced safety and risk management





# Human Systems Integration

**HSI2019**  
Human Systems Integration  
Conference

Biarritz, France  
September 11 - 13, 2019

- Human-centered design (HCD)
- Systems engineering (SE)



- INCOSE Human System Integration Working Group
- Guy Boy – Initiative – HF chapter in INCOSE
- Modeling and simulation capabilities tremendously improve possibilities of taking into account **human factors** during the early stages of design and throughout the entire life cycle of systems.
- **Operational personnel** can be involved in virtual operations tests to determine appropriate requirements for effective design and development
- **What about all the other humans in the life cycle?**



# INCOSE och Systems Engineering

1. Systems engineering Handbook – scope
2. Systems engineering overview
3. Generic Life Cycle Stages
4. Technical processes
5. Technical management processes
6. Agreement processes
7. Organizational Project – enabling processes
8. Tailoring process and Application of Systems Engineering
9. Cross-cutting systems engineering methods
- 10. Specialty engineering activities**



# 10. Specialty engineering activities

- **Reliability, Availability and Maintainability**
  - Reliability – linked to safety engineering for example "Engineering a safer world" (Leveson)
- **Resilience engineering**
  - Ref. to Hollnagel as organizational systems as opposed to technical and engineering
- **System Safety Engineering**
- **System Security Engineering**
- **Training Need Analysis**
  - training for users, maintenance and support
- **Value Engineering-** function/cost – linked to project time
- **Usability Analysis / Human System Integration**



# Human System Integration (& Usability analysis)

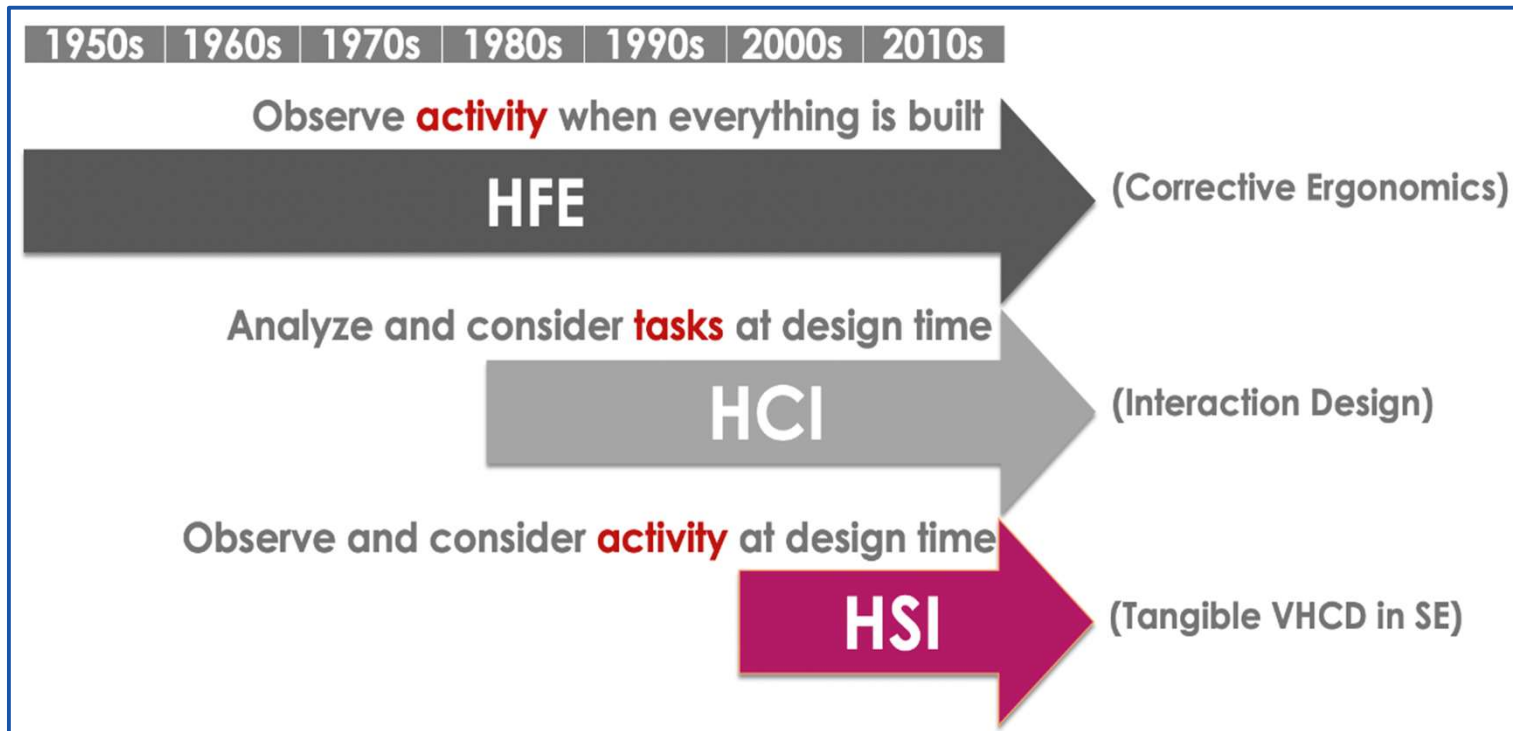
- Interdisciplinary technical and management process for integrating human considerations within and across all system elements.
- HSI focuses on the human, an integral element of every system, over the system life cycle.
- A total system approach, humans and technology (HW and SW)
- Personnel: system owners, operators, maintainers, trainers, users/customers, decision makers, support personnel, peripheral...
- Human- centered disciplines – improve overall system design and performance
- Human capabilities and limitations –treated as a critical element
- Individuals, crews, teams, units, or organizations
- Front-end analysis, HFE, safety, work environment, occupational safety, protection,
- **Integrated in SE processes**







# HSI



Old wine in new bottles?



Boy, Guy. (2020). Human–Systems Integration: From Virtual to Tangible. 10.1201/9780429351686.

VHCD - Virtual Human-Centered Design



# We used to say - there is a need to:

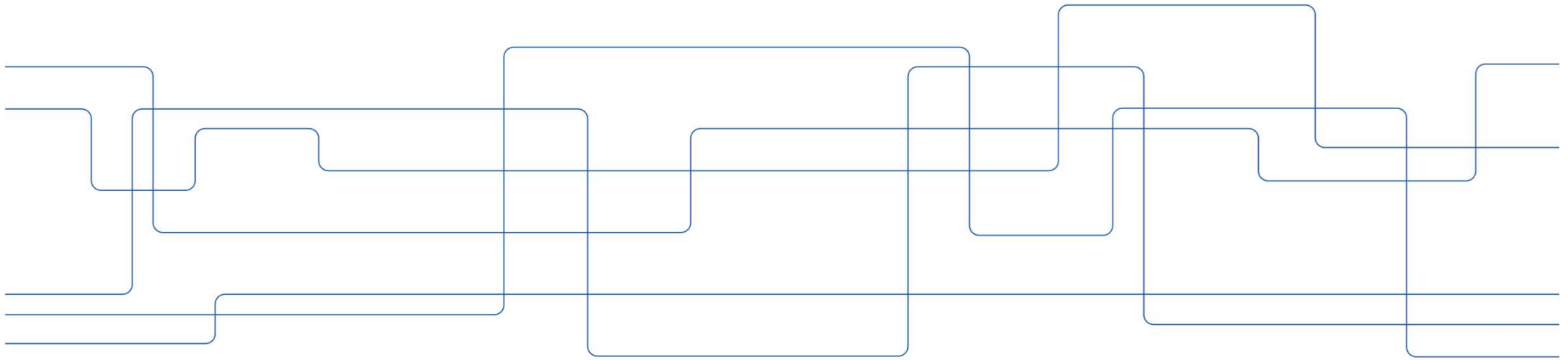
- transform technology into their behavioral equivalents
- translate behavioral principles into technology
  
- Still true?
  
- Did HFE and HCI community fail engineers in complex system development?
- Did we become lost in translation (somewhere across the lifecycle)?
  
- Perhaps more true now?
  
- Systems behave like humans
- Systems need new technology to understand autonomous system behaviours



# Engineers' activity, tasks at design time?

- Human factors of engineers and engineering organizations
- Engineer-centered design factors
- Translate system behaviour into practices in systems engineering!

# Safety engineering vs Safety management



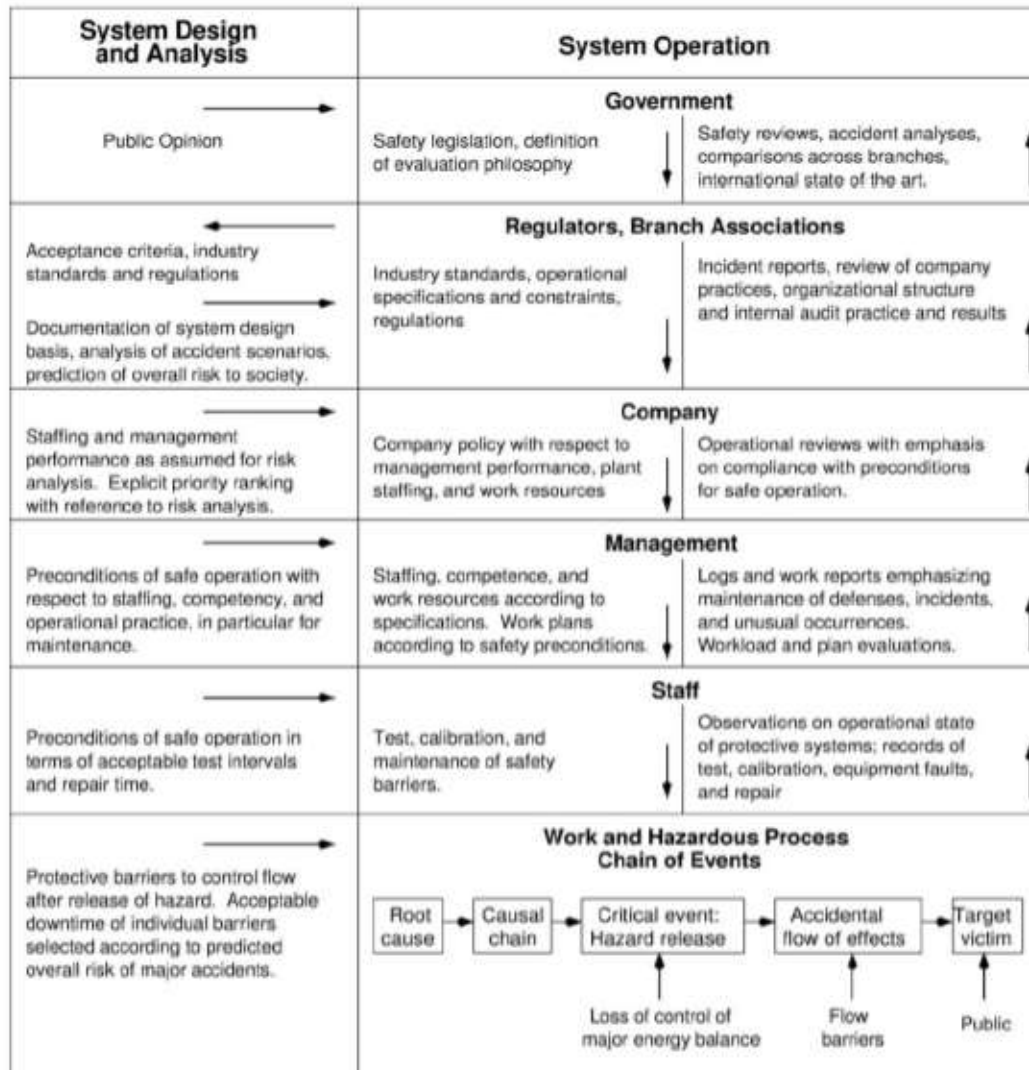


## **Management**

- Operations management
- Safety management
- Resilience (engineering)
- Risk management
- Project management

## **Engineering**

- Product development
  - Design
  - Ergonomics
- Systems engineering
  - Complex system design
  - System safety engineering



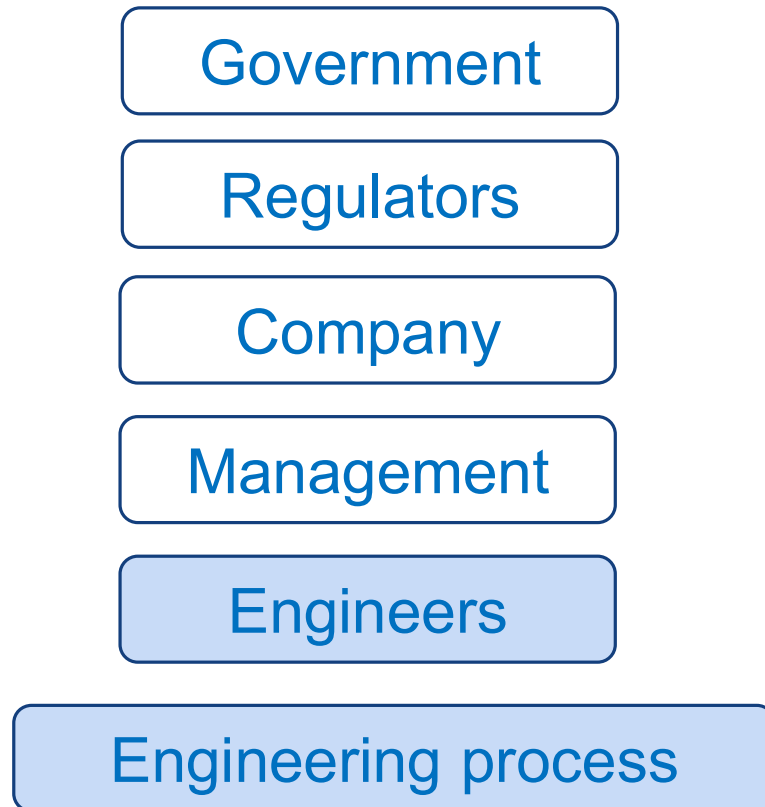
Rasmussen, 1997

Figure 4: Hierarchical Model of Safety Control (Rasmussen, 1997)





# System development



# System operations



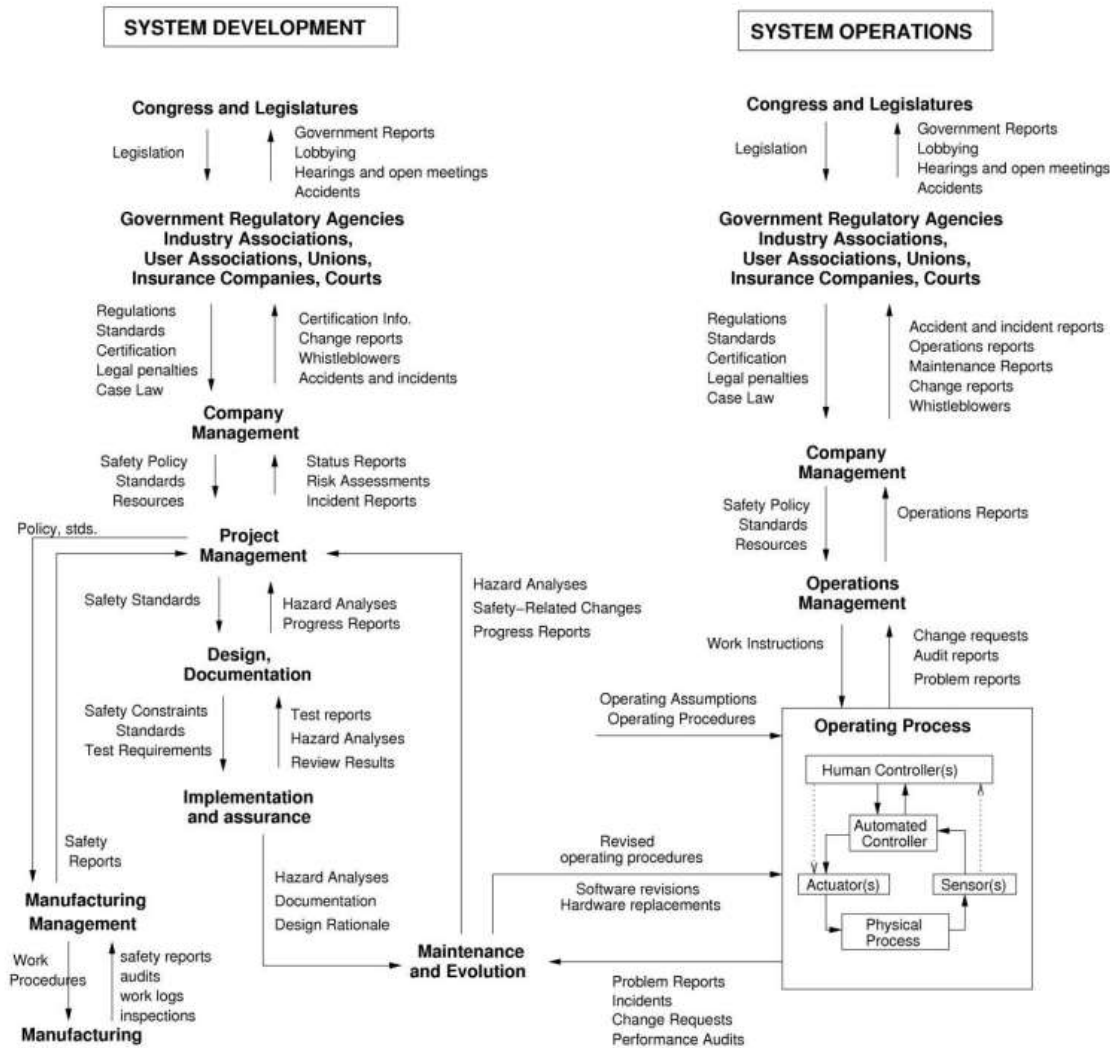
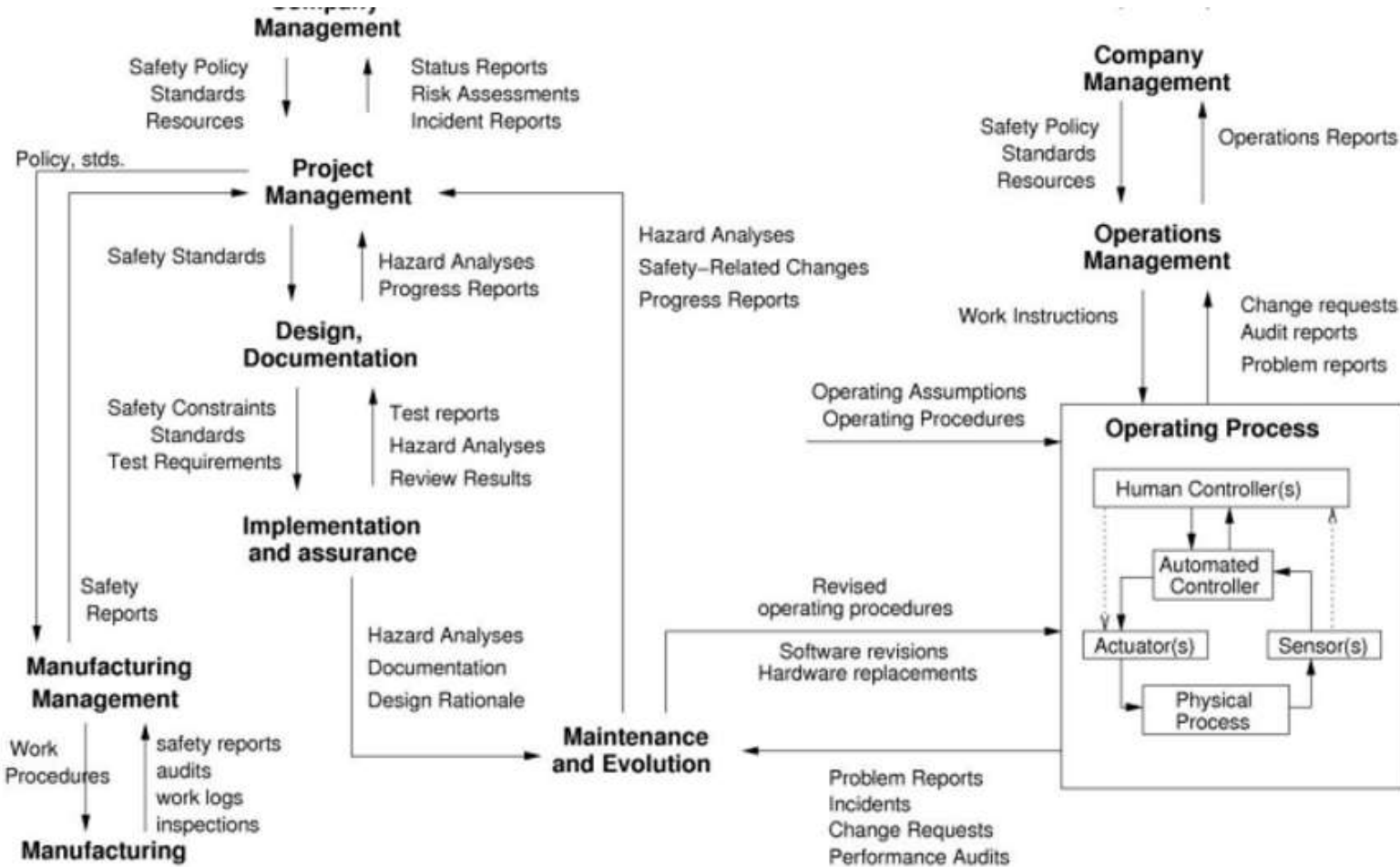


Figure 17: An example of a safety control structure



HSI? / SE  
-cognitive  
systems  
engineering  
????

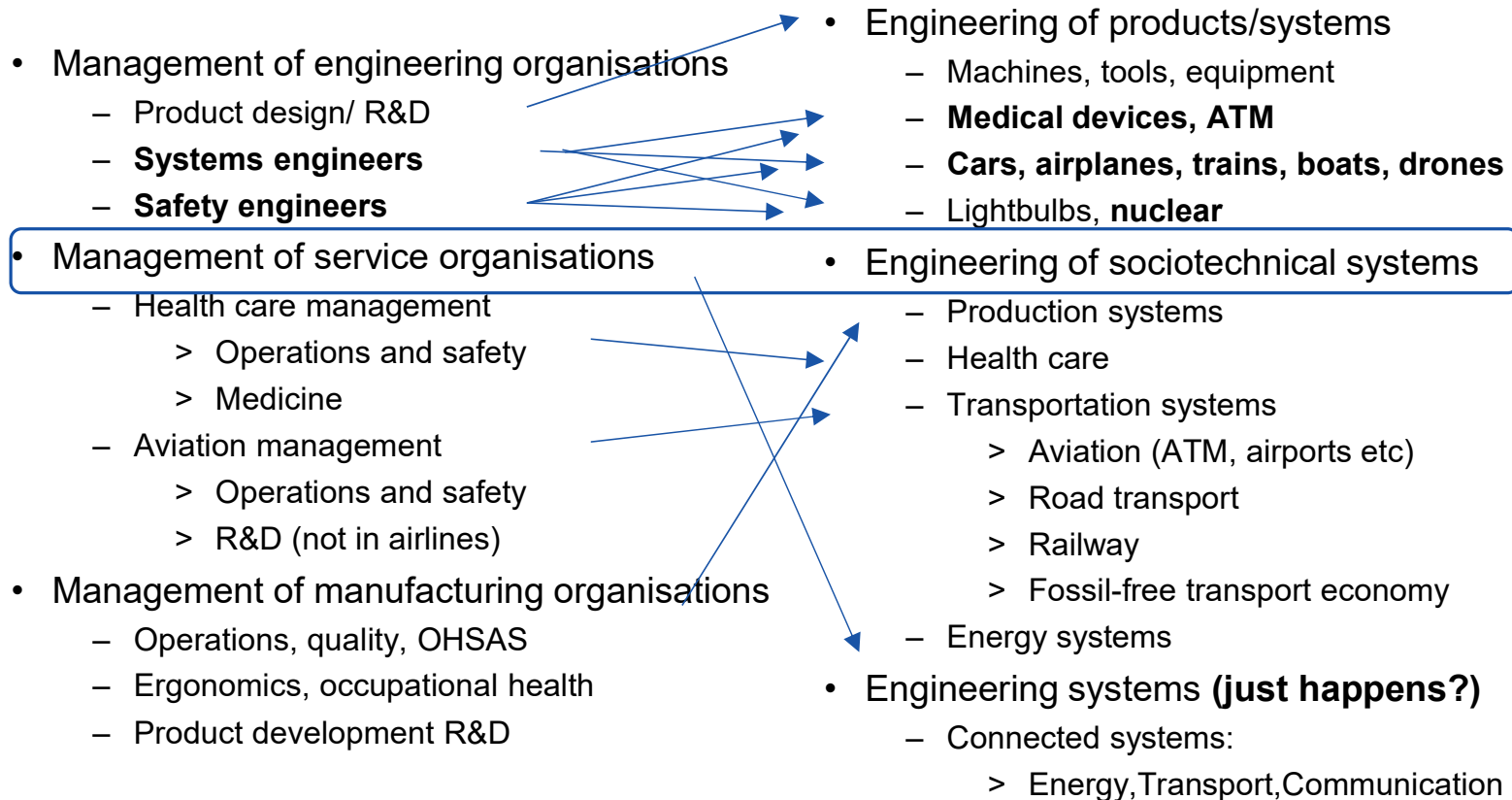


Analysis,  
evaluation and  
guidelines  
Typically  
"workplace safety"  
HF & resilience  
engineering  
-cognitive systems  
engineering

Parts of fig. 17 in Leveson, 2016



# Management of engineering operations?



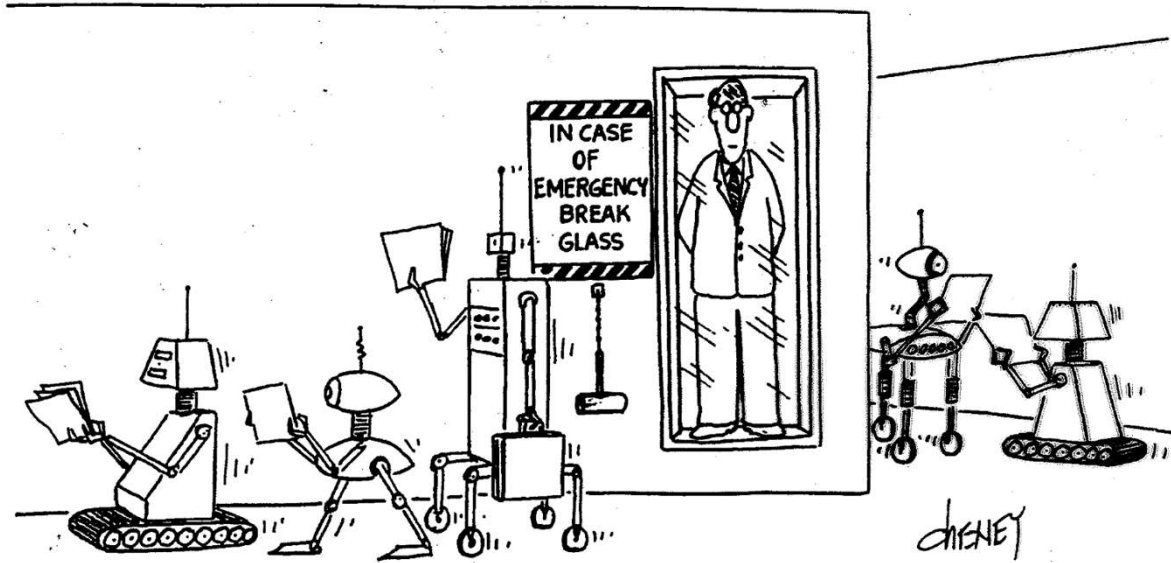


# Human integration into the lifecycle systems

- There is much more to be said:
- **Study engineering tasks and activities** and apply **engineering centered** approaches
- Do research in engineering "operations" **mangement innovation**
- Teach future engineers **engineering!**
- Achieve a **risk information flow** from operations to manufacturers and developers
  - Continuous validation in operational context!

# If human role in future system is to handle "autonomy induced surprises", we need to:

- Develop managerial and operational support for both operators and engineers!



**FIGURE 3.5**

Ultimate functional allocation when using a "capability" criterion. (Source: Cheney, 1989. New Yorker Magazine, Inc.)