MEC-E3004 Safety management in complex sociotechnical systems

Lecture 1: Introduction and the basic concepts of safety management and sociotechnical systems

MEC-E3004 Safety management in complex sociotechnical systems

- Course consists of:
  - Lectures and course material
  - Learning logs after each lecture
  - Mid-term assignment (accident case)
  - Final paper on a selected topic
- Course lecturer: PhD (Psych.), Teemu Reiman (reimanteemu@gmail.com)
- Course assistant is Douglas Owen (douglas.owen@aalto.fi)

- Course material and all accouncements can be found in MyCourses

MEC-E3004 Safety management in complex sociotechnical systems
Tentative agenda and topics of the lectures

1. 2.3. Introduction and the basic concepts of safety management
2. 9.3 Basic concepts: Human Factors and Safety Management (Douglas Owen)
3. 16.3 Accident models
4. 23.3 Accident case
   - Mid-term assignment
5. 30.3 Organizational learning

6.4 NO LECTURE

13.4 Returning the mid-term assignment

6. 13.4. Safety culture Safety leadership
7. 20.4. Safety leadership The basic principles of safety management
8. 27.4. The basic principles of safety management Safety management systems
9. 4.5 The basic principles of safety management
10. 11.5. Tools of safety management
11. 17.5 Future challenges and new directions of safety management (TIME!)
12. 25.5 Recap and Q&A
    - Deadline for returning the paper 31.5.2023

Safety management in complex sociotechnical systems

- The course deals with the challenges of managing complex sociotechnical systems (e.g. nuclear, petrochemical, maritime, aviation, rail).
  - human and organizational factors,
  - safety and accident models,
  - new safety paradigms,
  - safety management
  - safety culture
- The course illustrates the different approaches of managing safety as well as the different types of safety present in modern complex organizations.

- The course specifies the problems and development challenges related to managing safety critical organizations and deals with the central theoretical approaches to analyzing and developing them.
- During the course several accident cases (at least from nuclear, space exploration, oil&gas) are reviewed from the point of view of what they have taught us about safety critical organizations and how to investigate incidents in safety critical organizations.

Final paper

- 10-15 pages on a selected topic (font 12, line spacing 1,5)
  - Topics to be announced later, several choices available based on lectures
- Separate writing instructions will be published later on the course website
- Deadline for returning the paper 31.5.2023

The course focus

Safety

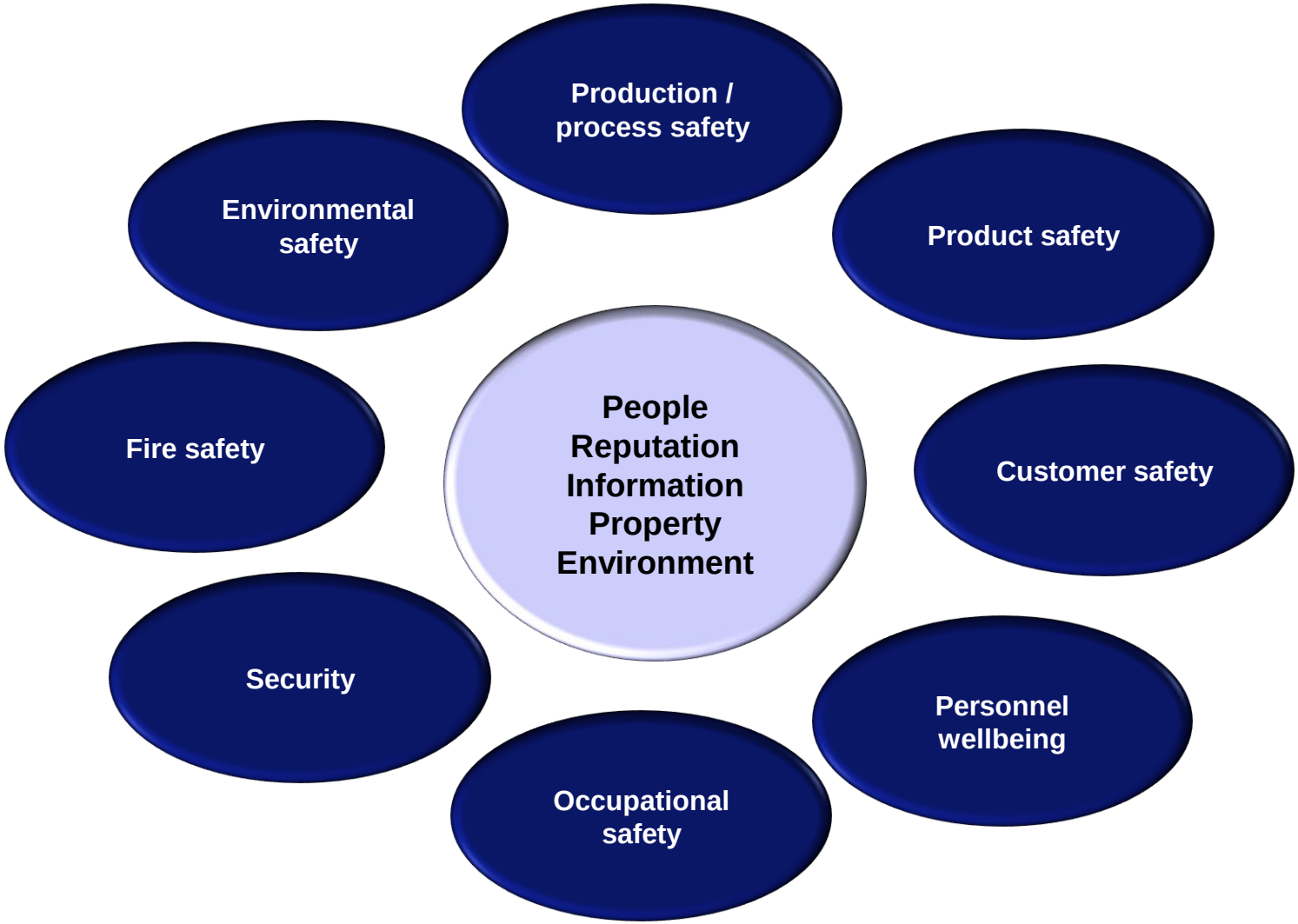
management

in

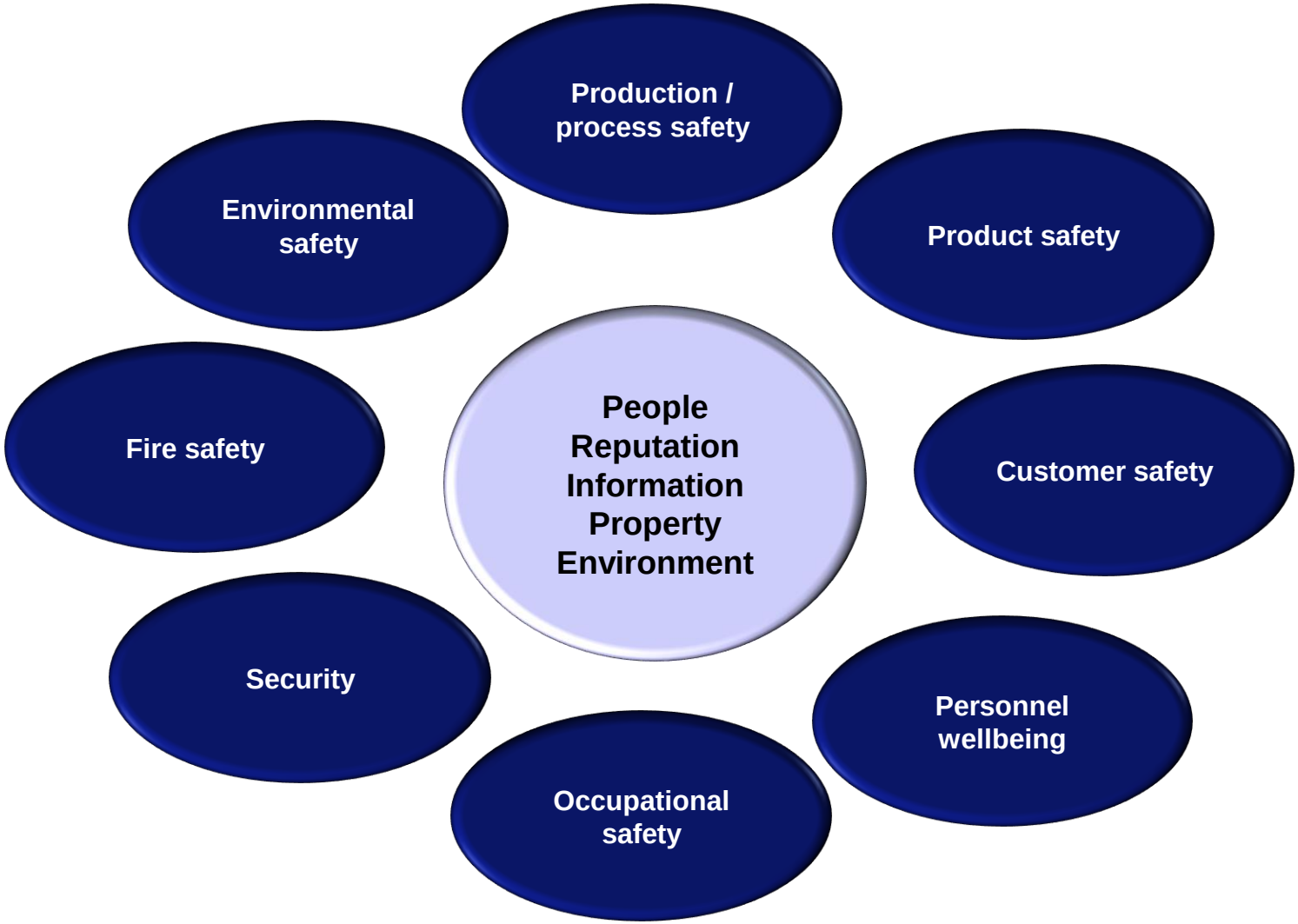
complex sociotechnical *systems*

Safety of what? What is at risk?

What types of safety there are



The course focuses on process safety and environmental safety, but also the other types of safetys are discussed – further many of the human and organizational factors discussed during the course affect all types of safety



Our understanding of complex systems has improved mostly after major accidents – different ages of safety offer different explanations

The Adaptive Systems Age (2000 -)

Complexity, variability and adaptations in daily work

Adaptive systems view

“Complexity creates hazards that humans need to control”

The Management Systems Age (1980 – 2000)

Focus on safety management systems and organizational factors

Safety assessments

Consideration of human, organizational and technical factors

Open systems view

“There are human, technical and organizational hazards”

The Human Factors Age 1940 - 1980

Focus on human behaviour, errors, ergonomics

Human performance on an individual and team level, decision making

Human-machine interface issues

“Humans are the hazard to be controlled”

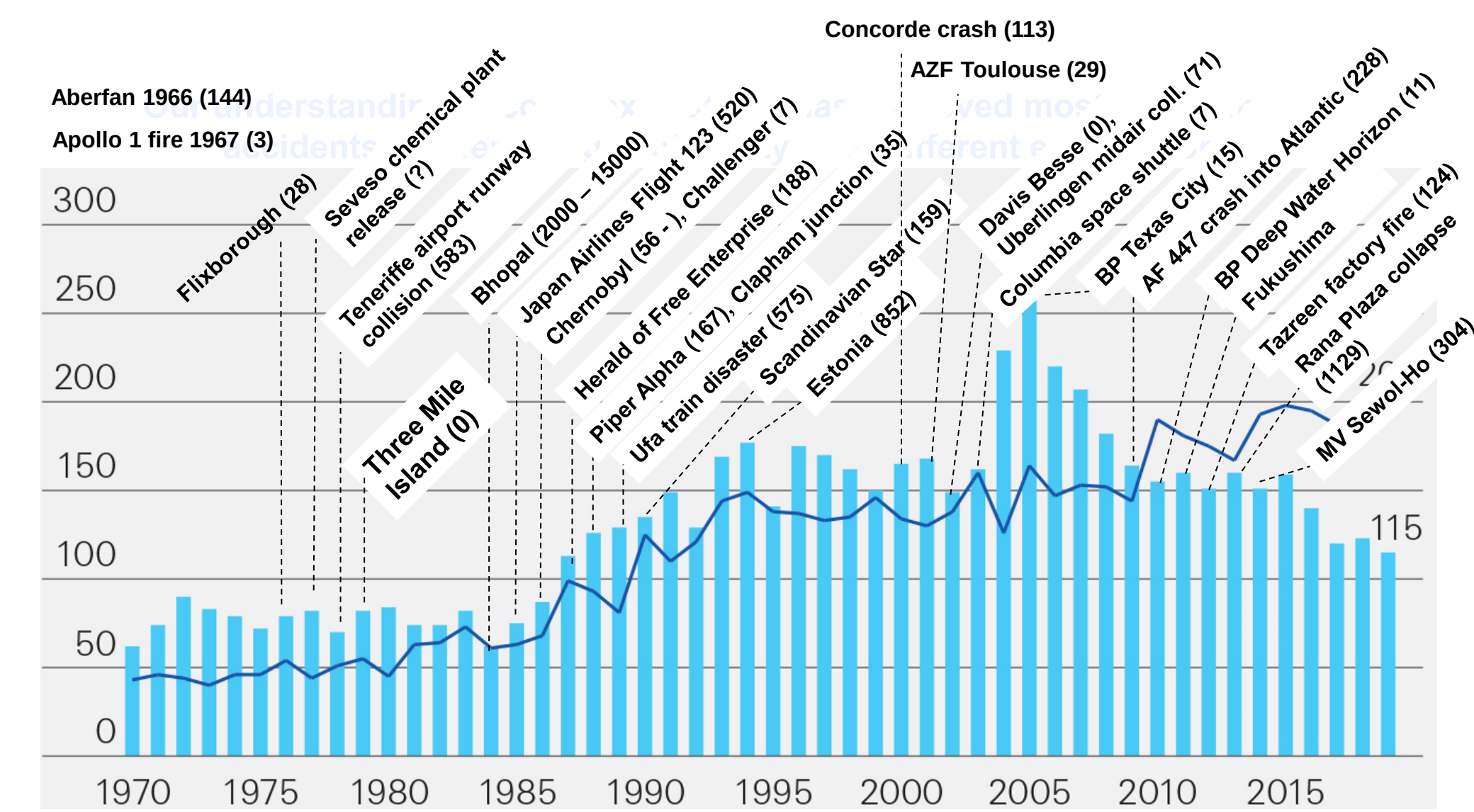
The Technological Age (1750 – 1940)

Focus on technology, hierarchy of controls

Technical barriers

Recruitment and training

“Technology is the hazard to be controlled”



The Human Factors Age

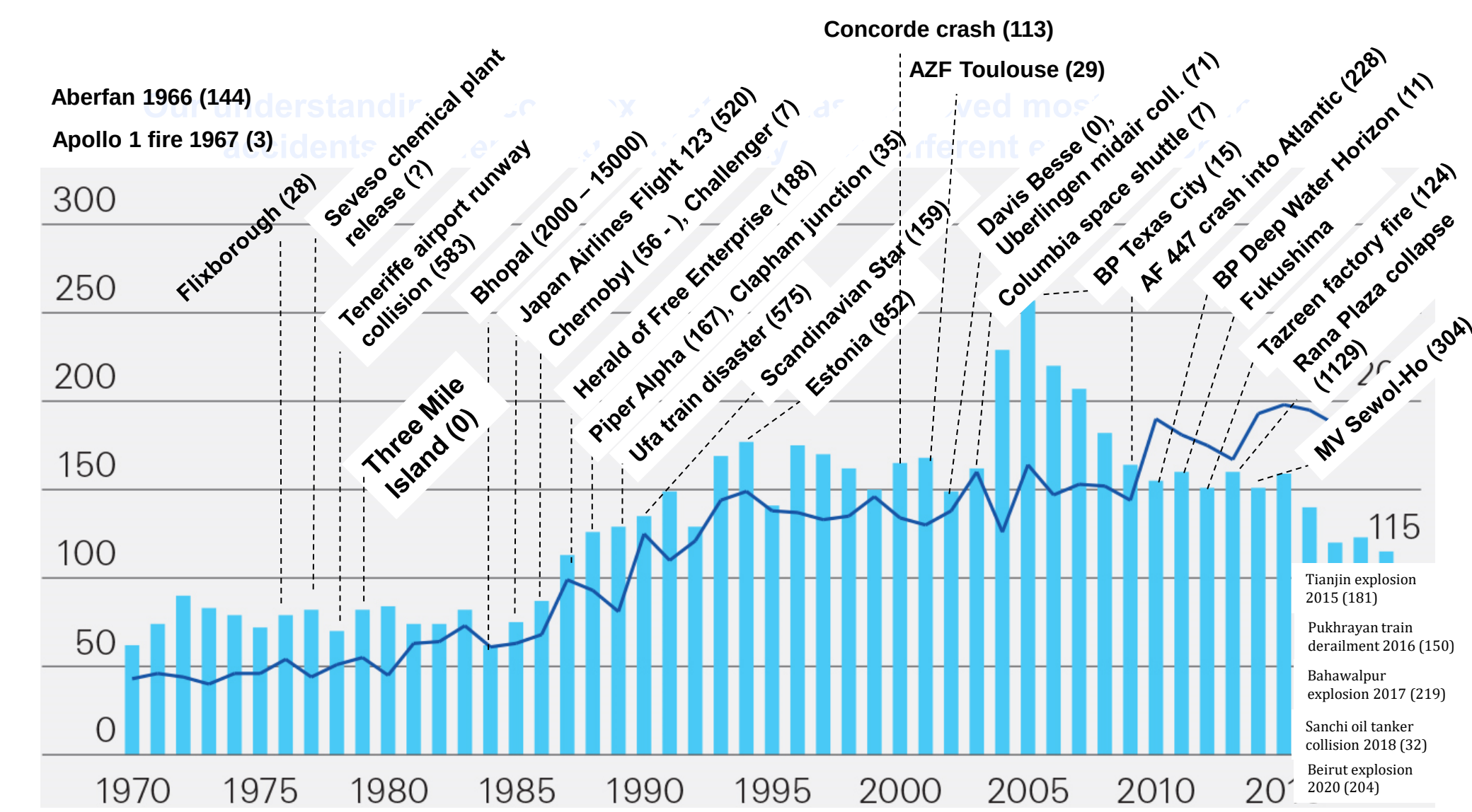
Focus on human behaviour, errors, ergonomics

The Management Systems Age

Focus on organizational factors, management systems, safety cases, MTO integration

The Adaptive Systems Age

Variability, practices, conflicts and adaptations in the sociotechnical system, normal work



The Human Factors Age

Focus on human behaviour, errors, ergonomics

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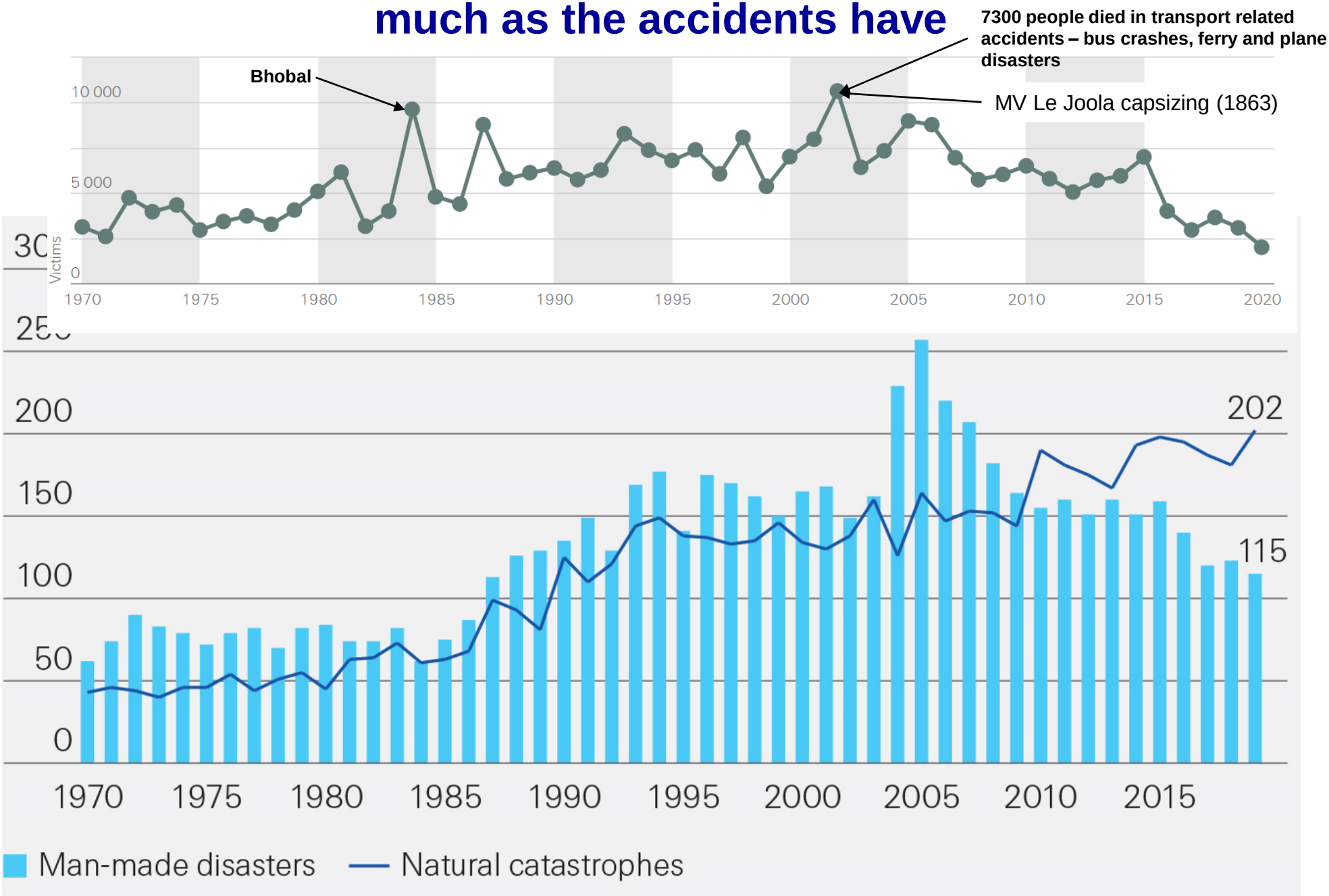
Focus on organizational factors, management systems, safety cases, MTO integration

The Adaptive Systems Age

Variability, practices, conflicts and adaptations in the sociotechnical system, normal work

Deaths caused by accidents have not increased as much as the accidents have



Each age introduced concepts that are still in use – although many are used in a different way today

The Technological Age Focus on technology, hierarchy of controls Technical barriers Recruitment and training "Technology is the hazard to be controlled"	Hierarchy of controls Accident proneness	Unsafe acts
The Human Factors Age Focus on human behaviour, errors, ergonomics Human performance on an individual and team level, decision making Human-machine interface issues "Humans are the hazard to be controlled"	Decision heuristics & biases Behavioral-based safety Function allocation Attitudes Situation awareness	Human errors Errors and violations Skill, rule and knowledge based mistakes
The Management Systems Age Focus on safety management systems and organizational factors Safety assessments Consideration of human, organizational and technical factors Open systems view "There are human, technical and organizational hazards"	Sociotechnical systems Safety management Safety culture Trade-offs	Latent failures / conditions Organizational accidents Swiss Cheese accident model Safety management systems
The Adaptive Systems Age Complexity, variability and adaptations in daily work Adaptive systems view "Complexity creates hazards that humans need to control"	Resilience Complex adaptive systems Drift Adaptation	System accident models Resilience engineering Safety II

The fourth era of safety management combines many features from the three previous eras

- Technical barriers, defence-in-depth, hierarchy of controls
- Human errors / variability of human performance
- Human and organizational factors

This course provides an overview of how the fourth era looks at the above concepts and what new it brings to safety management

References

- Borys, D., Else, D. & Leggett, S. (2009). The fifth age of safety: the adaptive age. Journal of Health Services Research & Policy 1(1):19-27
- Dekker, S. (2011). Drift into Failure. From Hunting Broken Components to Understanding Complex Systems. Ashgate.
- Hale, A. & Hovden, J. (2001). Management and culture: the third age of safety – a review of approaches to organisational aspects of safety, health and environment In: Feyer A, Williamson A, eds. Occupational injury: risk prevention and intervention. London, UK: Taylor and Francis.
- Hollnagel, E. (2014). Safety-I and Safety-II: the past and future of safety management. Aldershot, UK: Ashgate.
- Rasmussen, J. (1997). Risk management in a dynamic society: A modelling problem. Safety Science, 27, 183-213.
- Reason, J. (1990). Human error. Cambridge: Cambridge University Press.
- Reiman, T. & Oedewald, P. (2008). Turvallisuuskriittiset organisaatiot – Onnettomuudet, kulttuuri ja johtaminen. Helsinki: Edita.
- Swiss Re. (2020). Natural catastrophes and man-made disasters in 2019. Swiss Reinsurance Company Ltd, Zurich.
- Weick, K.E. & Sutcliffe, K.M. (2007). Managing the unexpected. Resilient performance in an age of uncertainty. 2nd Edition. San Francisco: Jossey-Bass.