A Brief History of Safety Thinking: Theoretical Models of Incident Causation and their Application to Sport & Outdoor Programming

Delta State Presentation, October 4, 2022: Part I of II

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Outline of Session

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Introductions

Presentation: application to sport, outdoor programs

Presentation: safety science

Self-assessment

Discussion

Closure

Outcomes

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You will:

Understand risk management theories and models used across industries

Identify which models are most widely accepted as current best practice

Identify which model or models may be most useful for your context

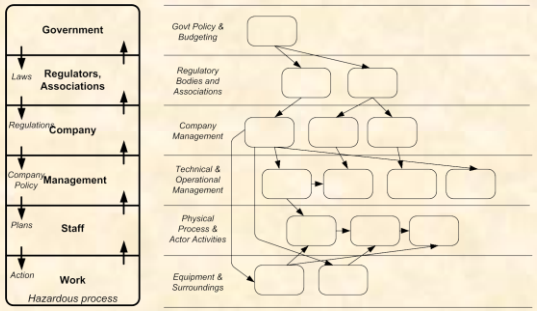
Understand the extent to which your current risk management structure reflects best practice

Establish an action plan for making any necessary improvements

Understand where to go to learn more about risk management for sport & outdoor programs

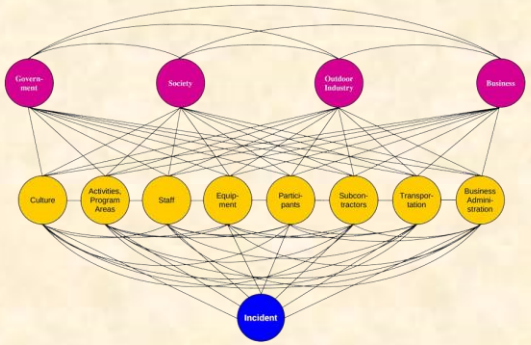
Principal Concepts

Many models of how to manage risk exist



It's important to use current models

Current models employ complex socio-technical systems theory



The Risk Domains Model is one current model

The Risk Domains model can be applied to sport/outdoor programs via resilience engineering & other techniques

On May 29, 2018, University of Maryland offensive lineman Jordan McNair collapsed from heatstroke during a practice. He died two weeks later.

His body core temperature was 41.1 degrees C (106 F).

An investigation showed he was not properly cared for after showing heat stroke symptoms. Standard treatment (cold water) immersion was not performed.

It was more than an hour before anyone called 911.

Basic Concepts

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Risk: the possibility of undesirable loss.

Risk Management: the process of maintaining risk at a socially acceptably level.

Four ways to manage risk:

Eliminate	Avoid certain activities, locations, conditions	No BASE jumping
Reduce	Institute sound safety practices	Assess providers before use
Transfer	Pass risk to insurers, contractors, participants	Liability waivers
Accept	Acknowledge some risk as unavoidable	Inherent risk

Safety Science

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The field of risk management includes:

- Career specialists
- Theories, models
- Academic journals
- PhD programs in risk management
- Best practices that apply across industries

Risk Management Models

The importance of using appropriate models:

- Your risk management system is based on theoretical models.
- Some models are now considered obsolete.
- You have a duty to use the current best thinking in risk management
- You may be held to that standard if an incident occurs.

Evolution in Safety Thinking

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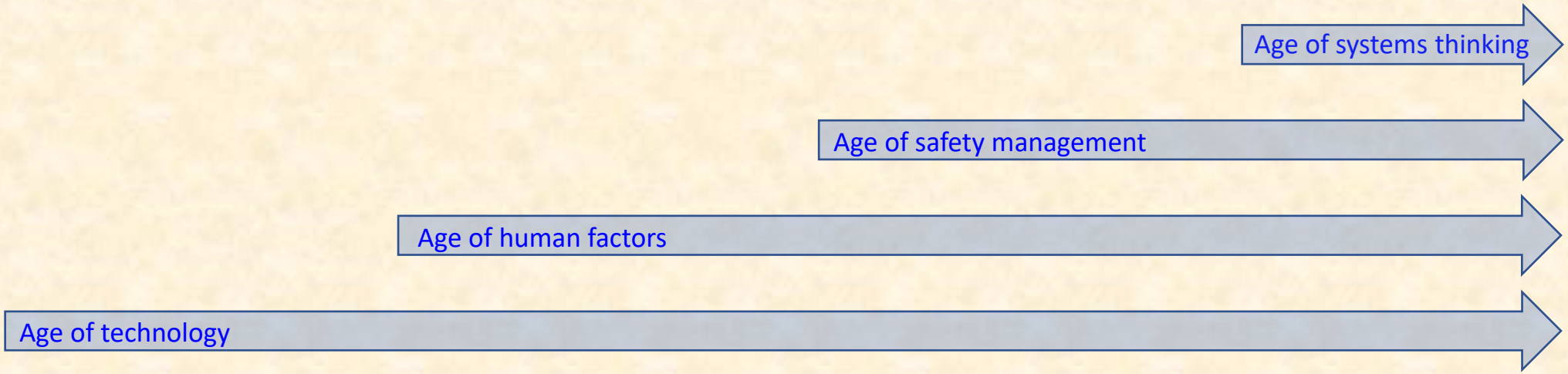

1800s	1970s	1980s	1990s
Technology	**Human Factors**	**Safety Management**	**Systems Thinking**
Humans as cogs in an industrial machine	Humans as hazards to be controlled	Adapting dynamically to risk environment	Complex socio-technical systems
Domino Model, Root Cause Analysis	Rules-based safety	Integrated safety culture	Resilience engineering

Adapted from: Defining the methodological challenges and opportunities for an effective science of sociotechnical systems and safety, Waterson et al., Ergonomics, 2015, Vol. 58, No. 4

Evolution in Safety Thinking

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Principle of causation	Single causes ('Root')	Multiple causes ('Latent')	Complex outcomes ('Emergent')
	OUTDATED	OUTDATED	CURRENT

(non-linear)

Epidemiological model (complex linear)

Sequential model (simple linear)

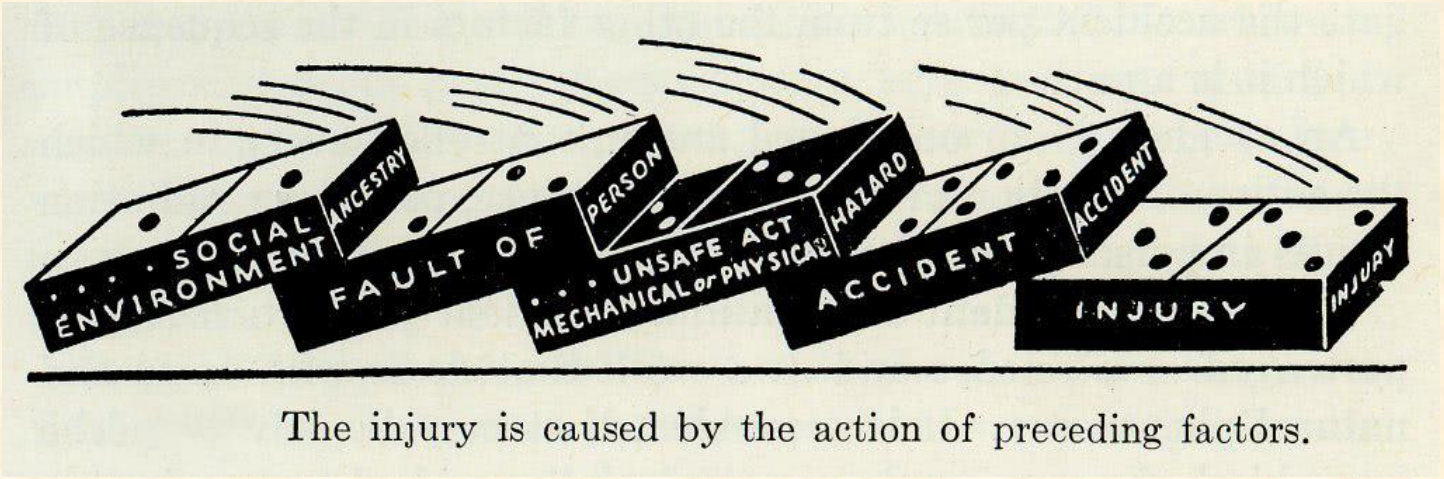
1920 1940 1960 1980 2000

Image credit: HaSPA (Health and Safety Professionals Alliance).(2012). The Core Body of Knowledge for Generalist OHS Professionals. Tullamarine, VIC. Safety Institute of Australia.

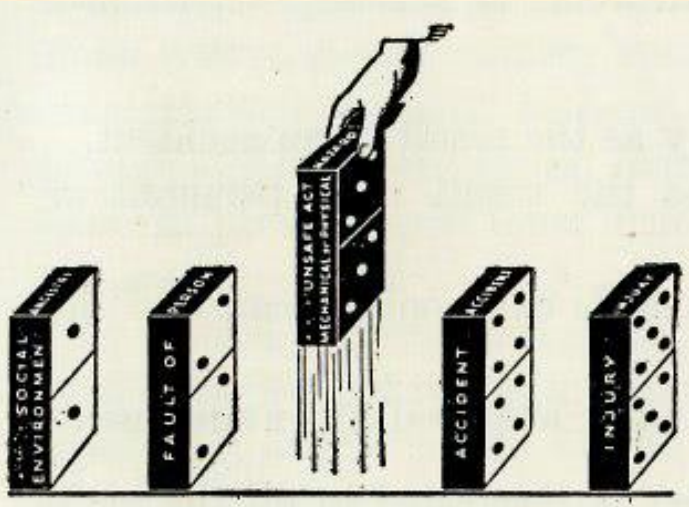
Linear Models

Domino model

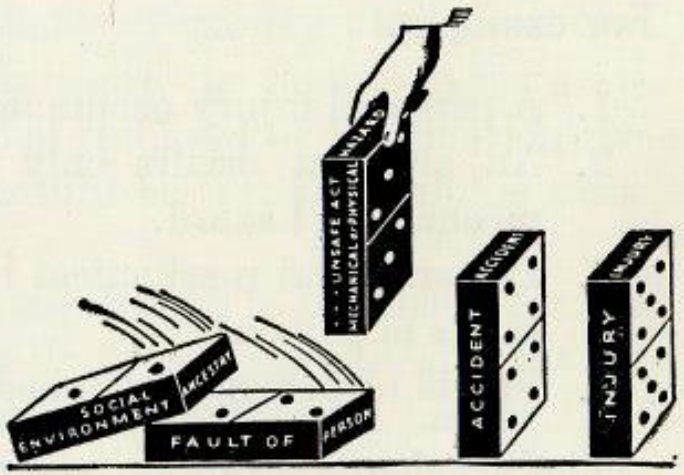
Herbert Heinrich, *Industrial Accident Prevention*, 1931.



The injury is caused by the action of preceding factors.



The unsafe act and mechanical hazard constitute the central factor in the accident sequence.



The removal of the central factor makes the action of preceding factors ineffective.

Linear Models

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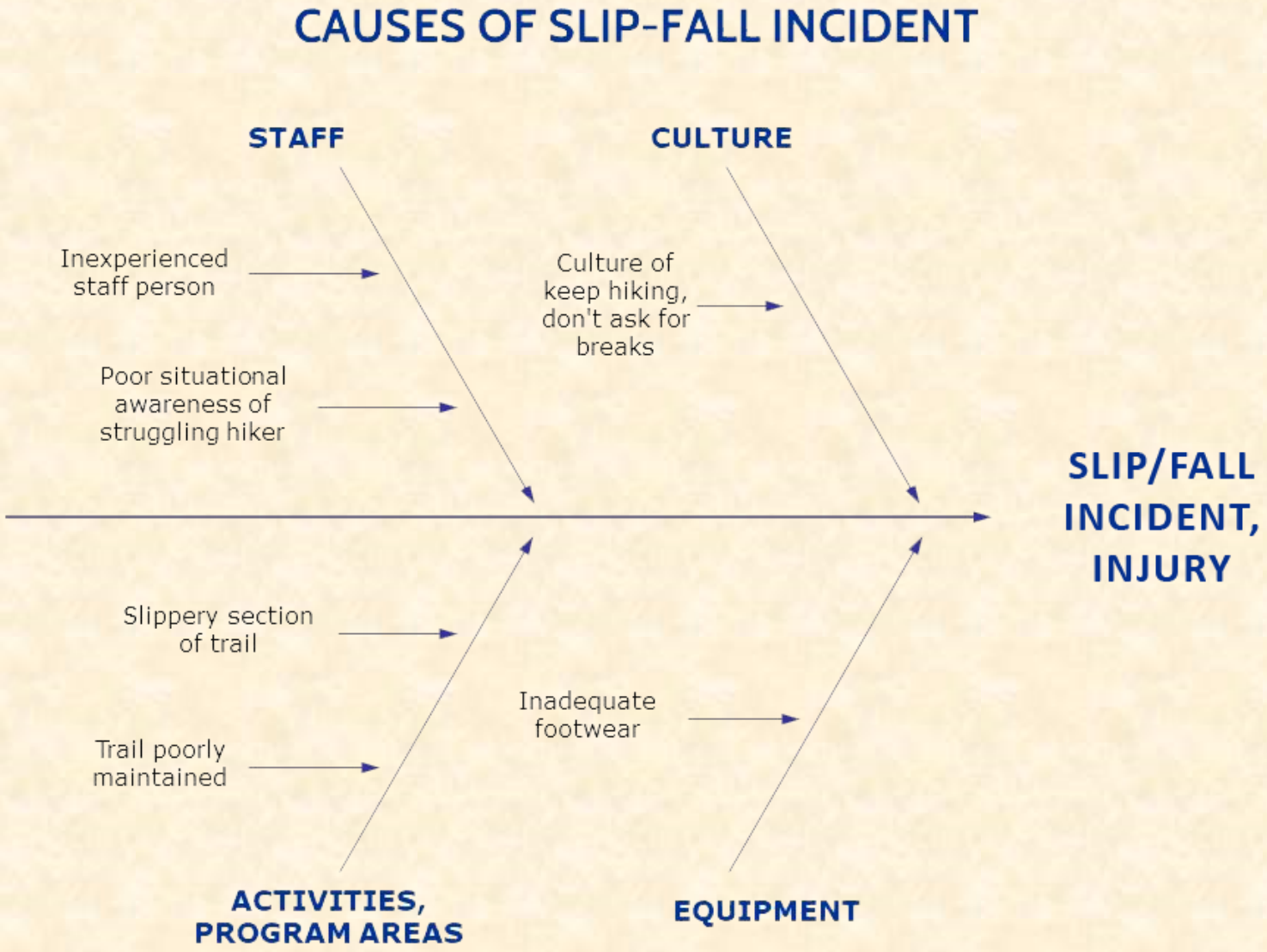
Fault tree analysis,
Fishbone diagram



Epidemiological Model

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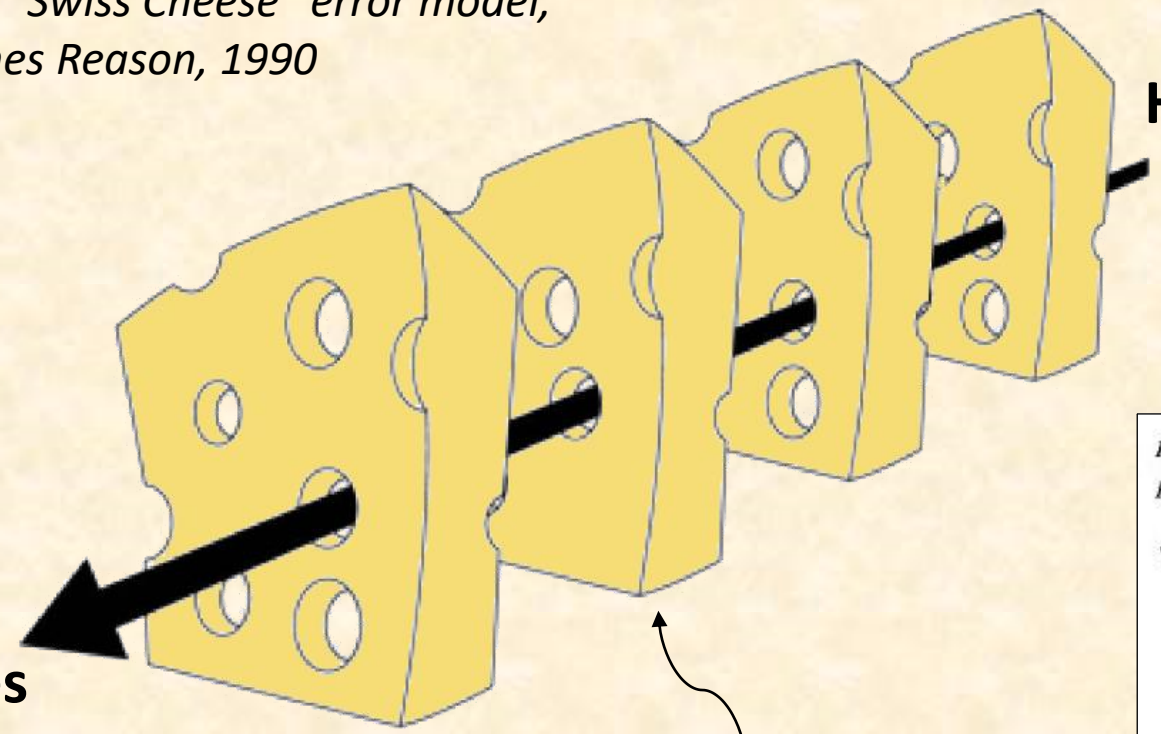
The "Swiss Cheese" error model, James Reason, 1990



- Events + latent conditions
- Like an exposure + a pathogen reservoir
- Complex linear model
- First systems model

Phil. Trans. R. Soc. Lond. B. **327**, 475–484 (1990)

Printed in Great Britain

The contribution of latent human failures to the breakdown of complex systems

By J. Reason

Department of Psychology, University of Manchester, Manchester M13 9PL, U.K.

Several recent accidents in complex high-risk technologies had their primary origins in a variety of delayed-action human failures committed long before an emergency state could be recognized. These disasters were due to the adverse conjunction of a

Complex Systems Model

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Characteristics of complex systems:

- Difficulty in achieving widely shared recognition that a problem even exists, and agreeing on a shared definition of the problem
- Difficulty identifying all the specific factors that influence the problem
- Limited or no influence or control over some causal elements of the problem
- Uncertainty about the impacts of specific interventions
- Incomplete information about the causes of the problem and the effectiveness of potential solutions
- A constantly shifting landscape where the nature of the problem itself and potential solutions are always changing

Examples of complex systems:

Global climate crisis

Inequity & exclusion

Organized sports

Complex Socio-technical Systems

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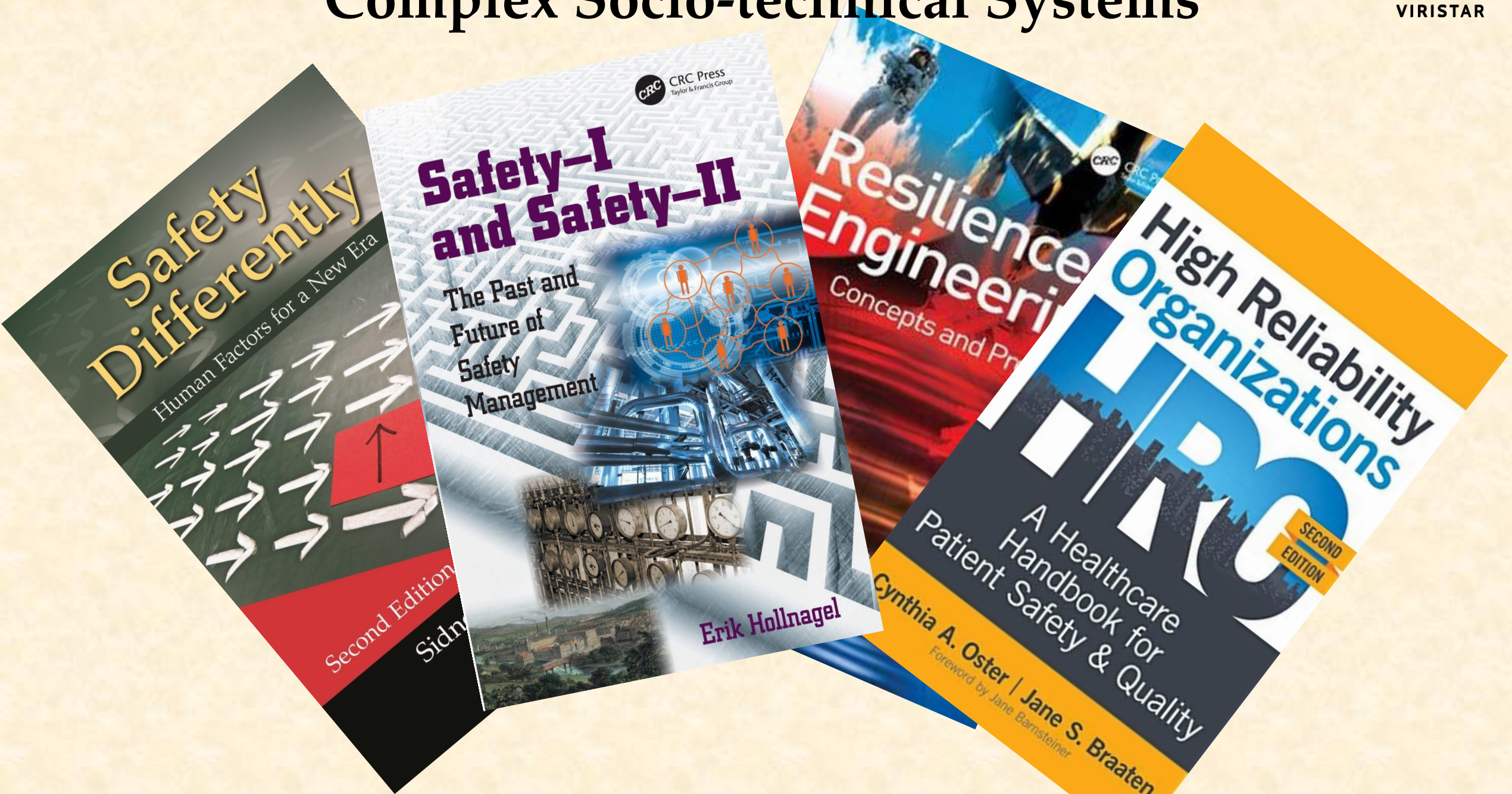

Complex Socio-technical Systems

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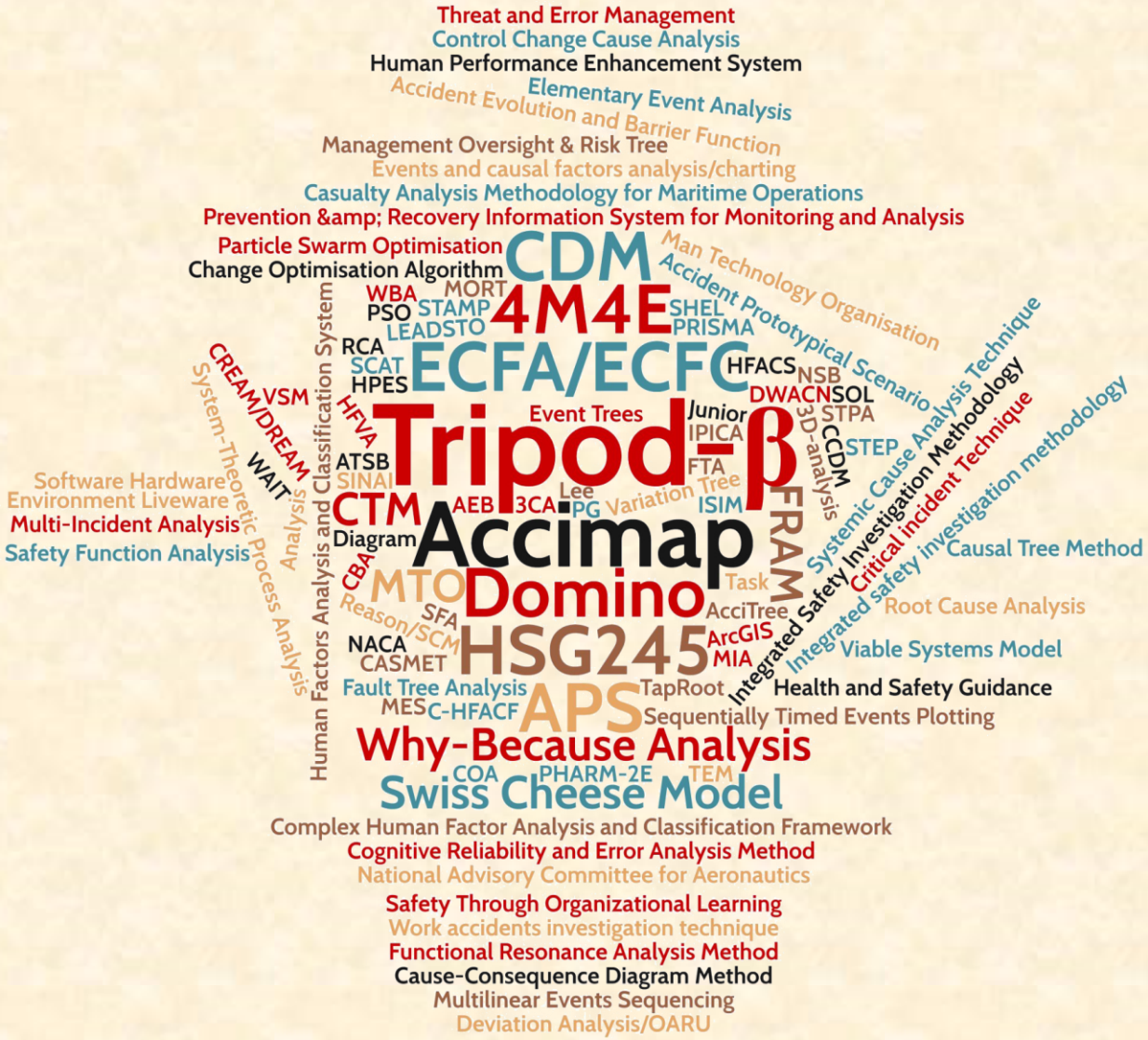

Government	*Passes laws*
Regulators, Associations	*Create regulations*
Company	*Sets policies*
Management	*Makes operating plans*
Staff	*Performs work actions*
Work	*May involve hazardouts processes*

AcciMap adapted from: Risk Management In a Dynamic Society: A Modelling Problem. Jens Rasmussen, Safety Science 27/2-3 (1997)

Complex Socio-technical Systems

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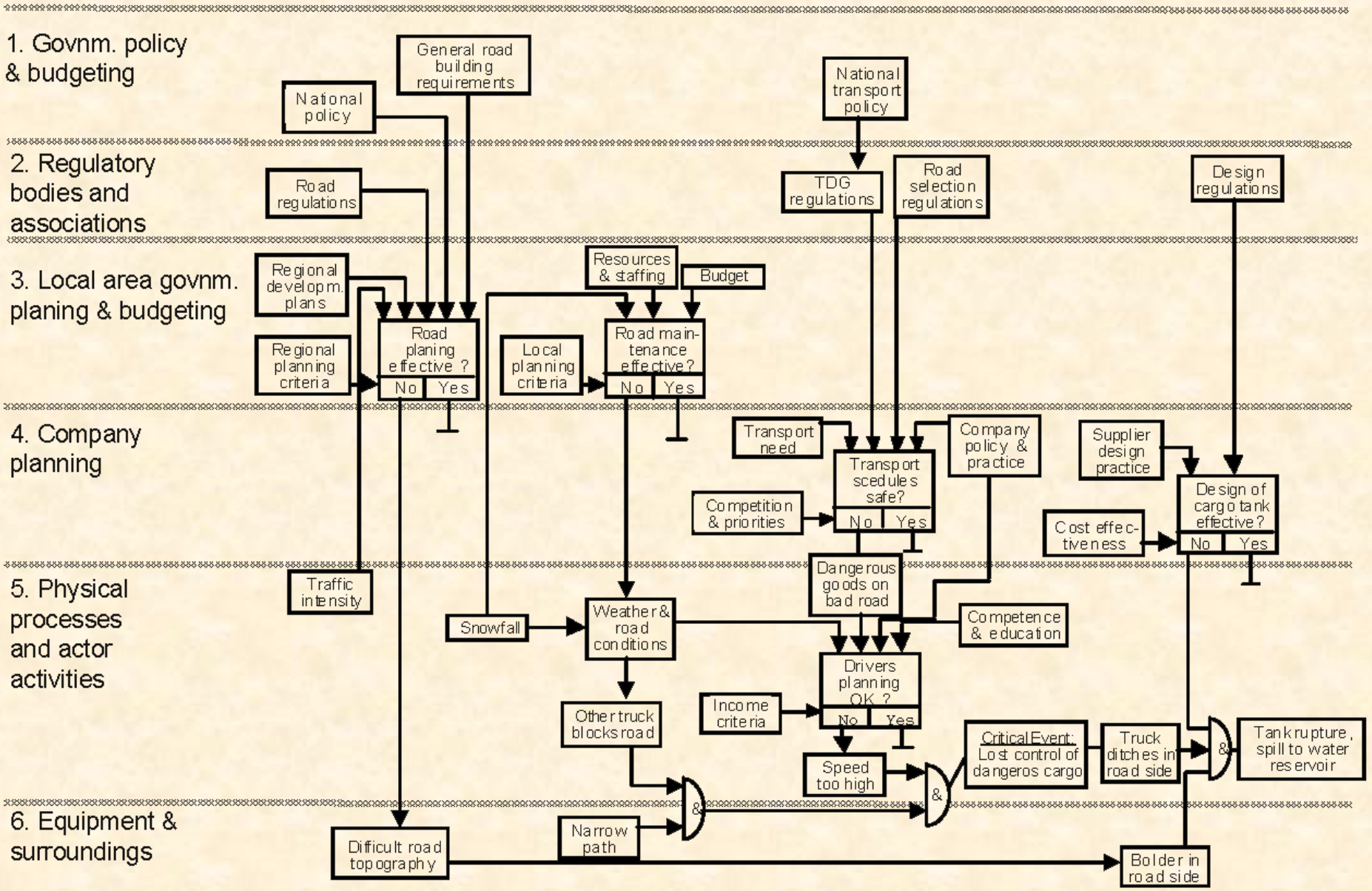

Complex Socio-technical Systems

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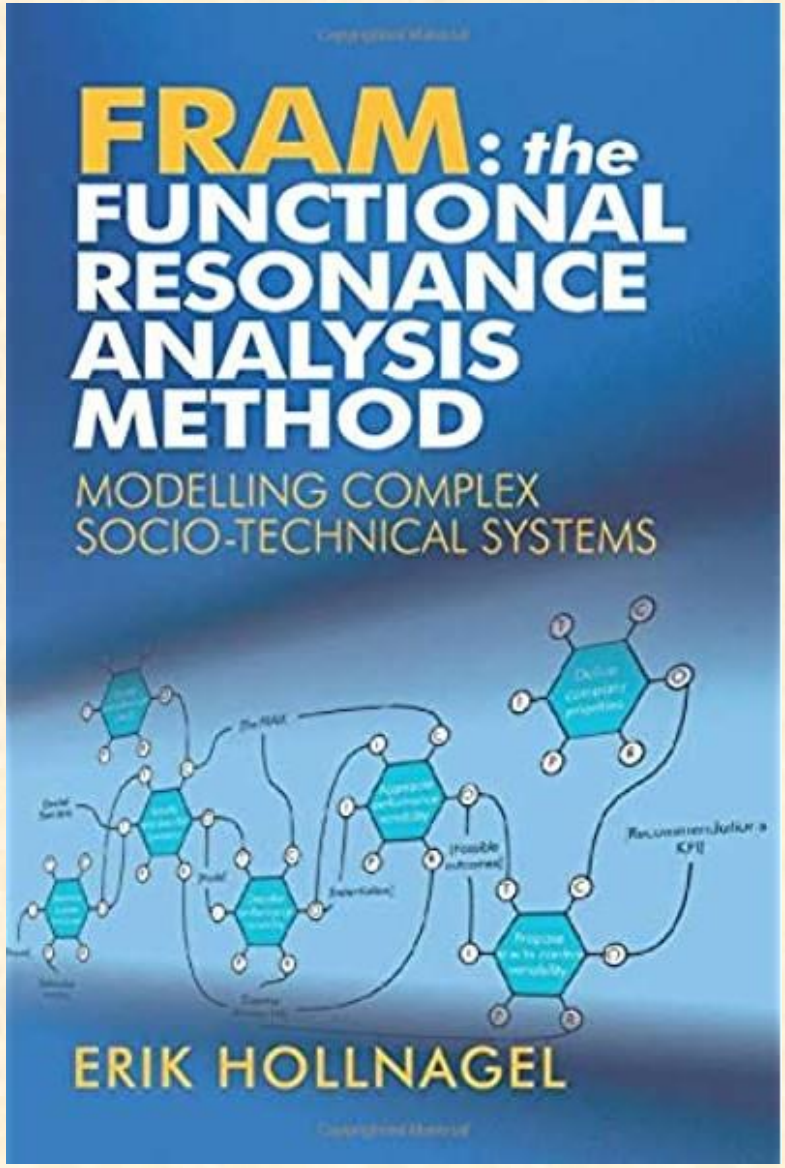

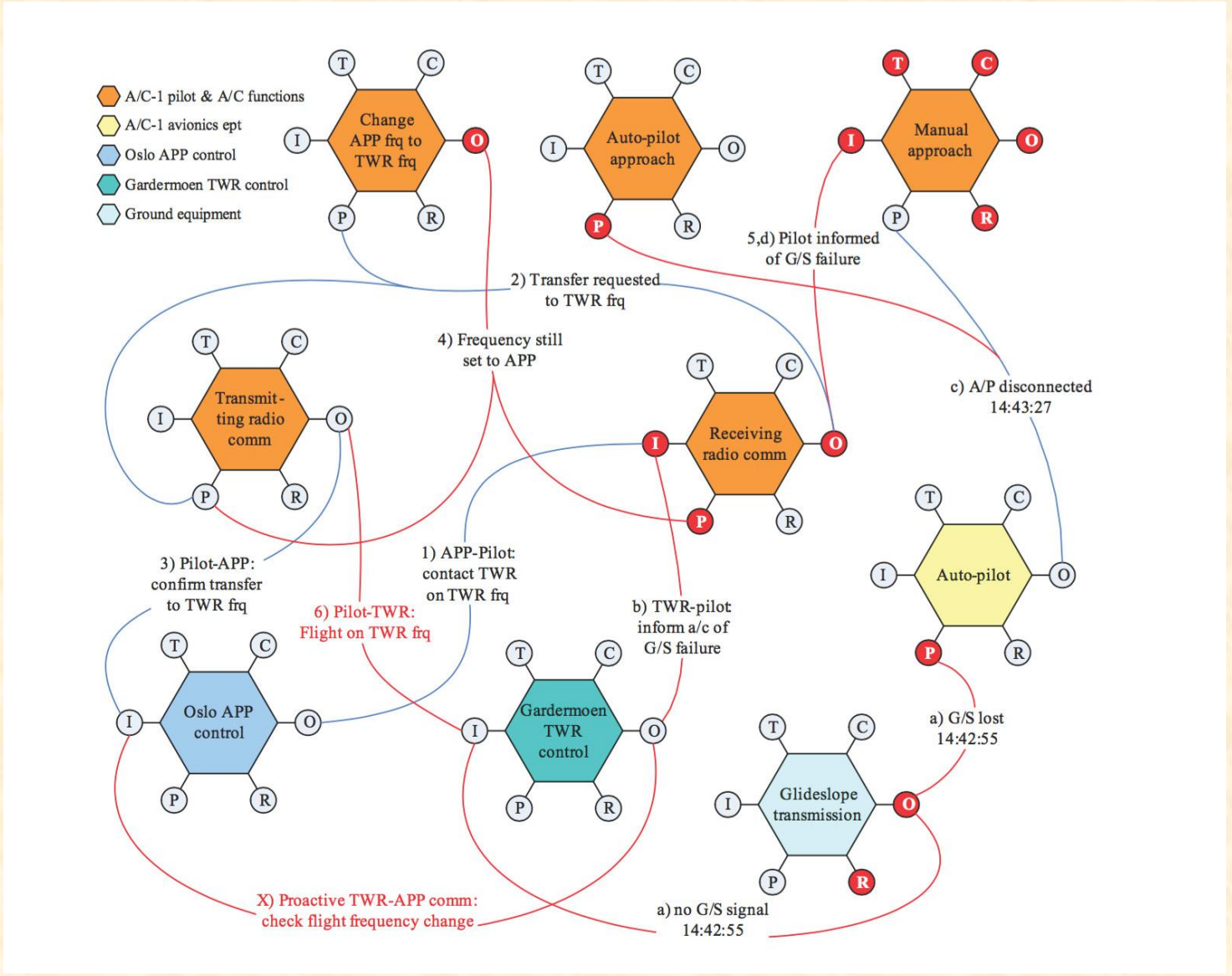

Risk Domains Model

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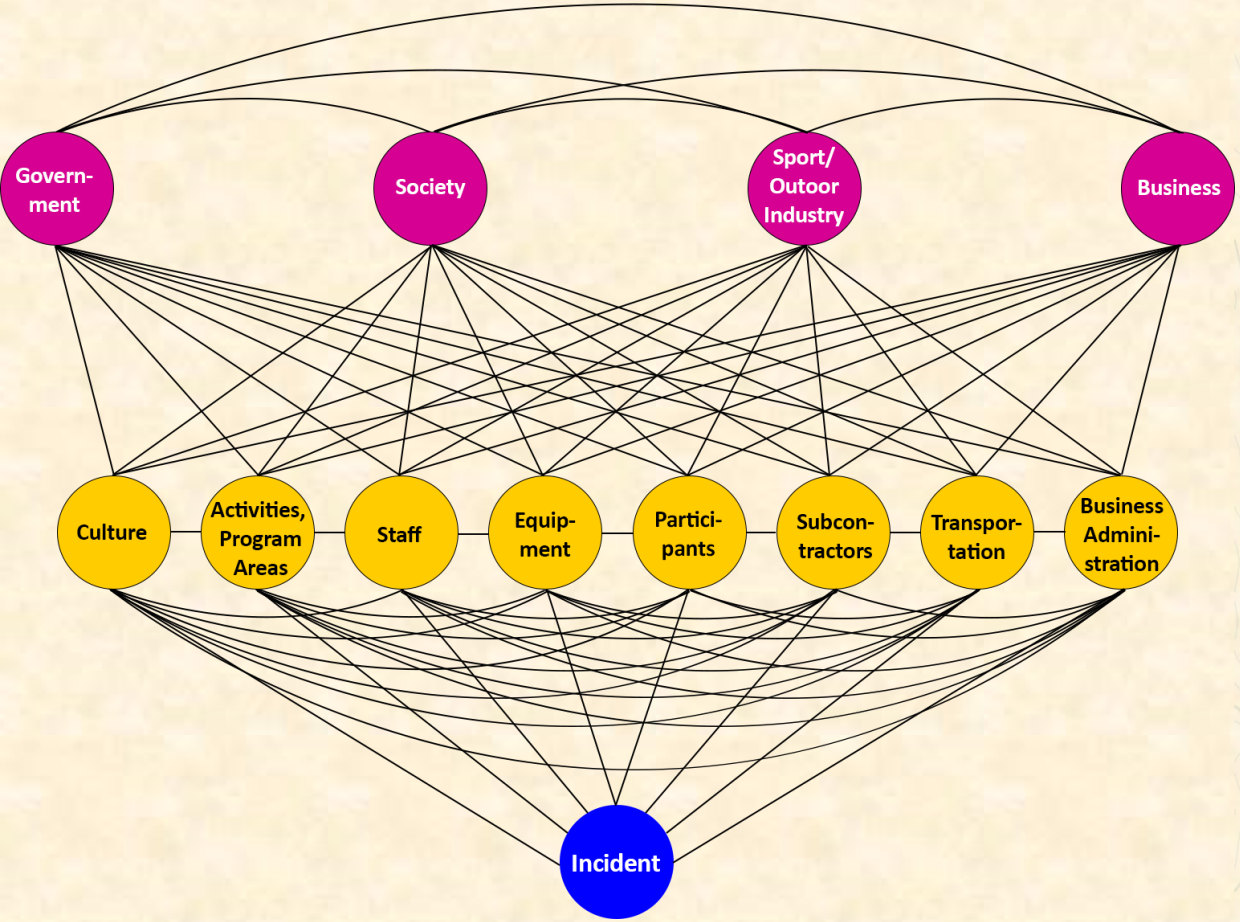

Manage risks in risk domains with policies, procedures, values and systems

Risk Management Instruments

- Risk Transfer
- Incident Management
- Incident Reporting
- Incident Reviews
- Risk Management Committee
- Medical Screening
- Risk Management Reviews
- Media Relations
- Documentation
- Accreditation
- Seeing Systems

Limitations of Risk Assessments

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Probabilistic Risk Assessment (PRA) approach:

Risk	Probability	Magnitude	Treatment

		Magnitude		
Probability		Slight	Moderate	Severe
	Unlikely			
	Possible			
	Likely			

Limitations of Risk Assessments

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- Typically assesses only direct, immediate risks from specific activities, locations or populations, such as
  - weather
  - traffic hazards
  - equipment failure
- Typically **fails to account for underlying risk factors** such as:
  - poor safety culture
  - financial pressures
  - deficits in training & documentation
  - lack of regulatory oversight
- Typically **fails to account for human factors in error causation**, e.g.
  - cognitive biases
  - cognitive shortcuts (heuristics)

- **Fails to consider systems effects**: how multiple risks interact in complex and unpredictable ways that to lead to incidents
- **Ineffective as a comprehensive risk management tool** or stand-alone indicator of good risk management

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