Improving Outcomes Through Applying Safety Science

America Outdoors Annual Conference, Nov 29-Dec 2, 2022 : Part I of II

Jeff Baierlein, Director, Viristar

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Outline of Session

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Introductions

Presentation: application to 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

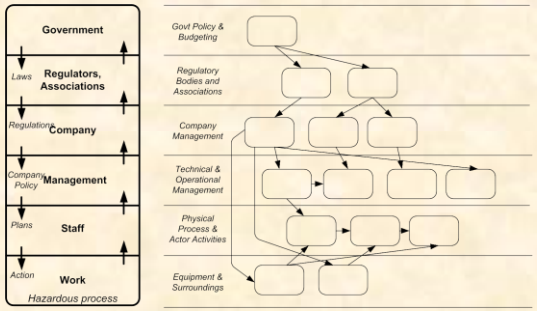
Identify which model or models may be most useful for your context

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

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

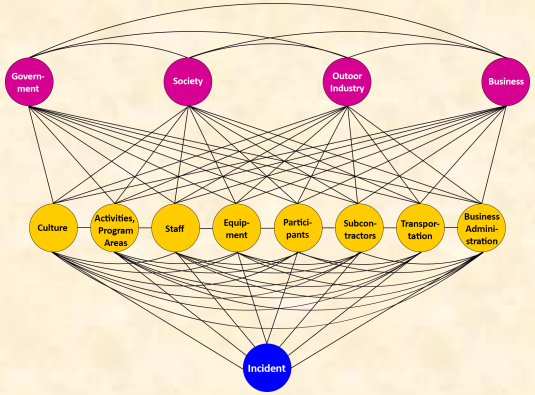
Principal Concepts

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 outdoor programs via resilience engineering & other techniques

Basic Concepts

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 running Class VI rapids
Reduce	Institute sound safety practices	Helmets & PFDs required
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

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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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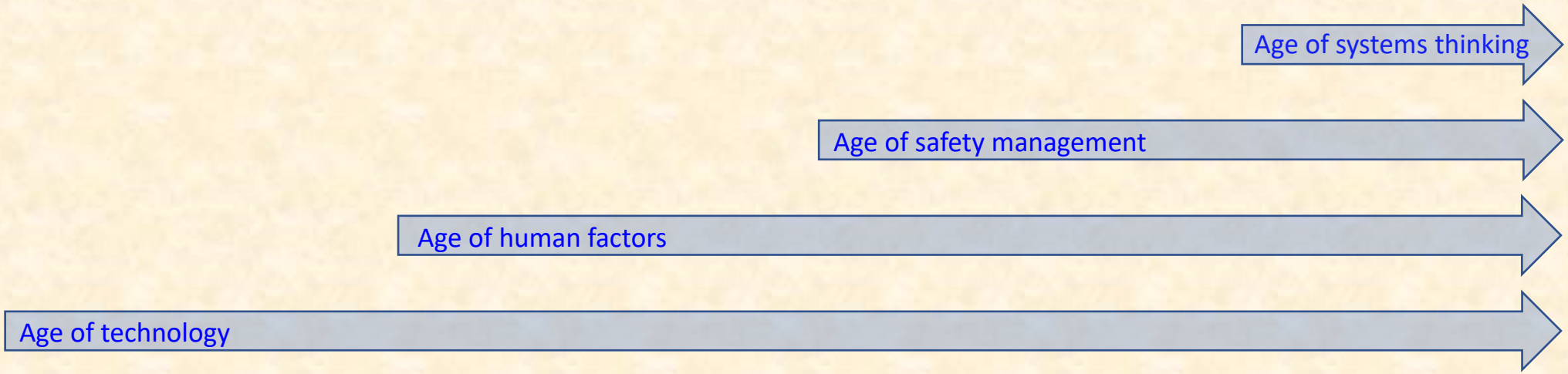

1800s	1970s	1980s	1990s
Technology	**Human Factors**	**Safety Management**	**Systems Thinking**
Humans as cogs in an industrial machine	Humans as hazards to be controlled	Adapting dynamically to risk environment	Complex socio-technical systems
Domino Model, Root Cause Analysis	Rules-based safety	Integrated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

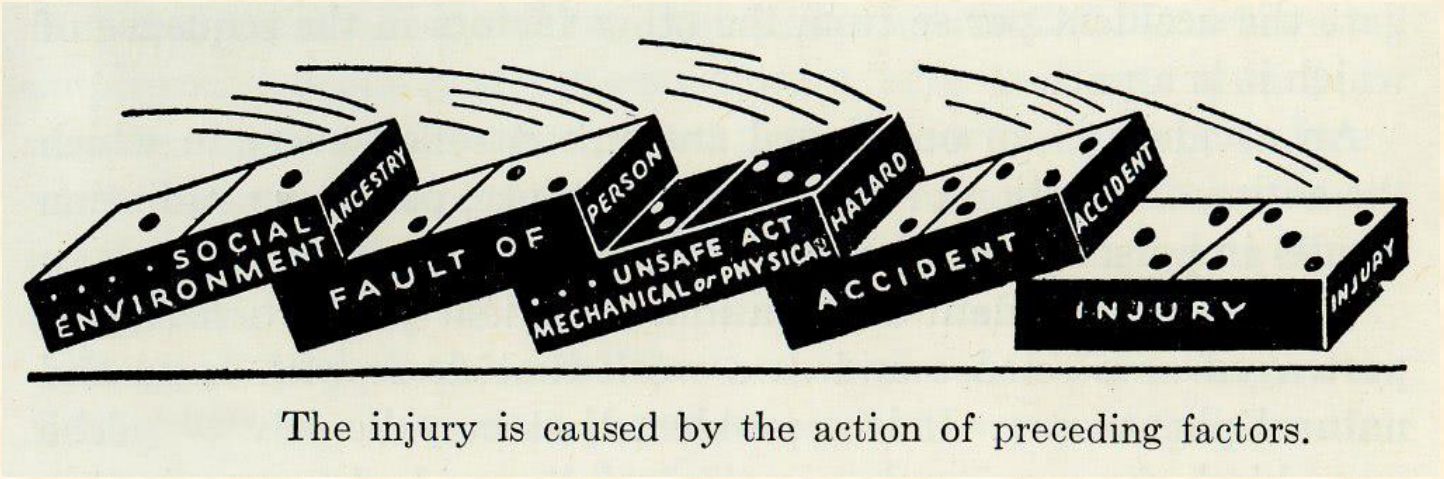
1920 1940 1960 1980 2000

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

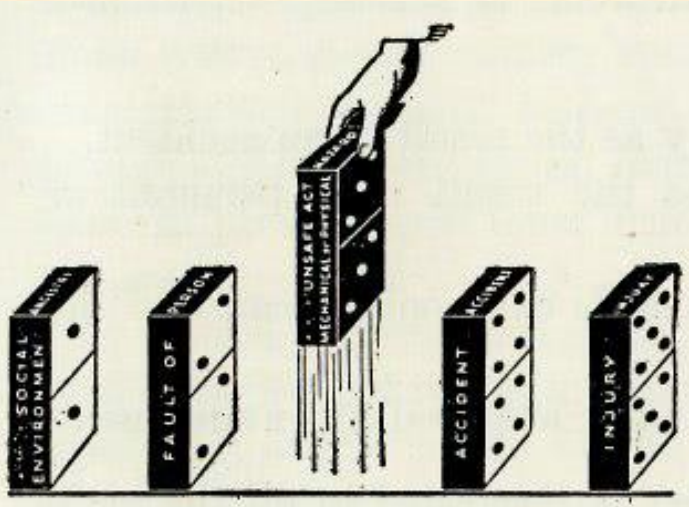
Linear Models

Domino model

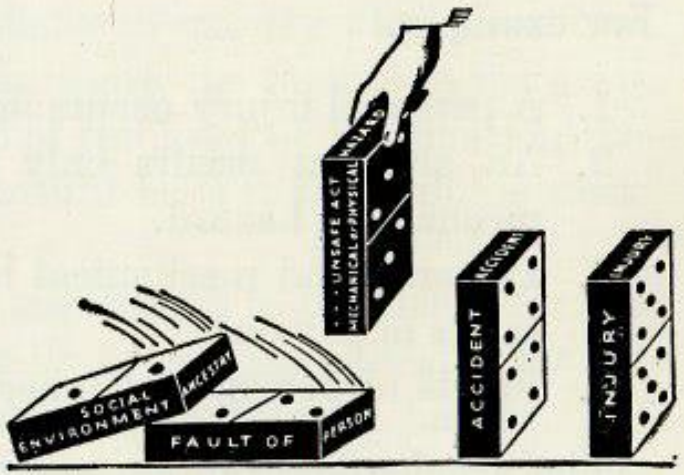
Herbert Heinrich, *Industrial Accident Prevention*, 1931.



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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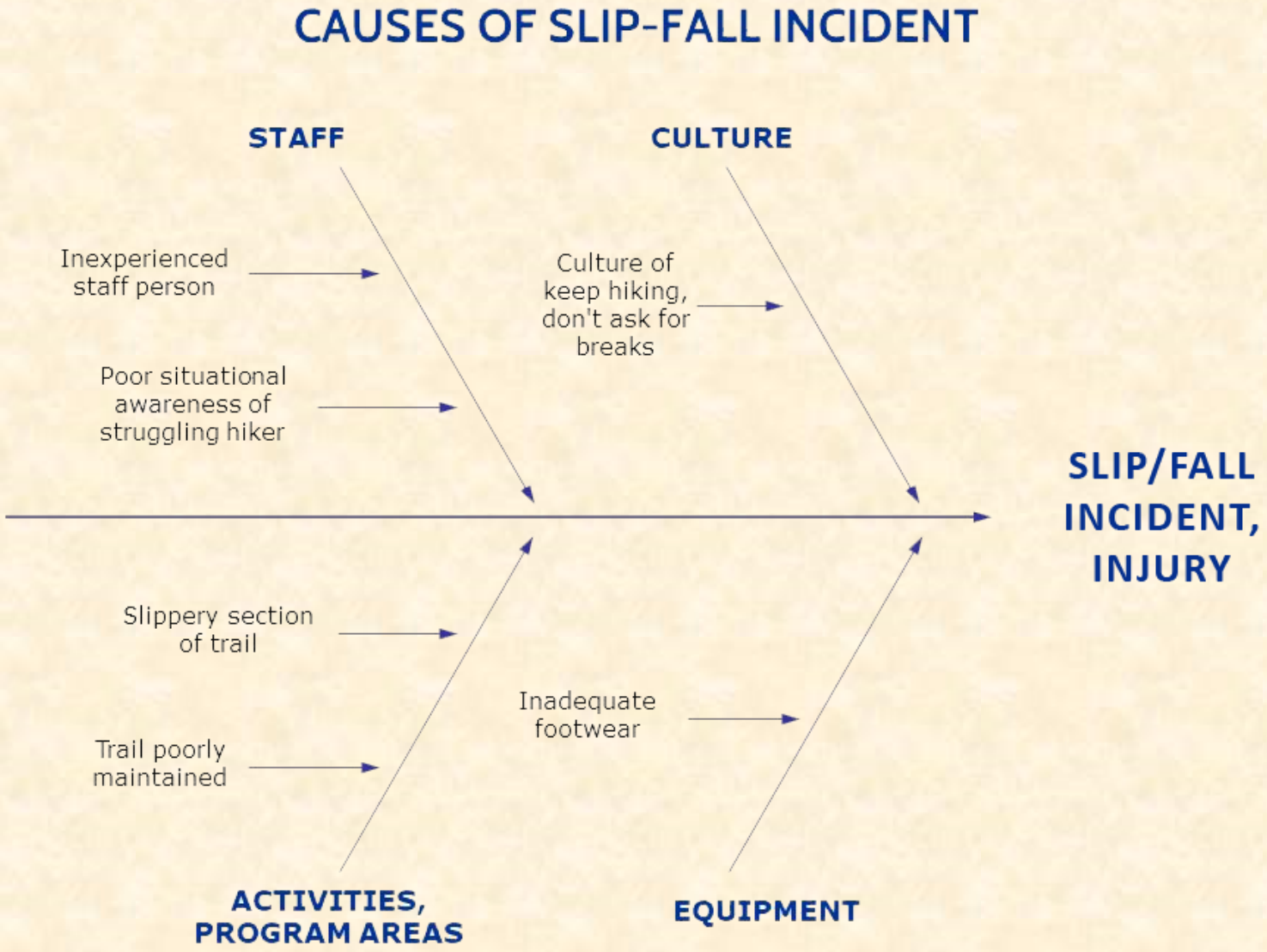
Fault tree analysis,
Fishbone diagram



Epidemiological Model

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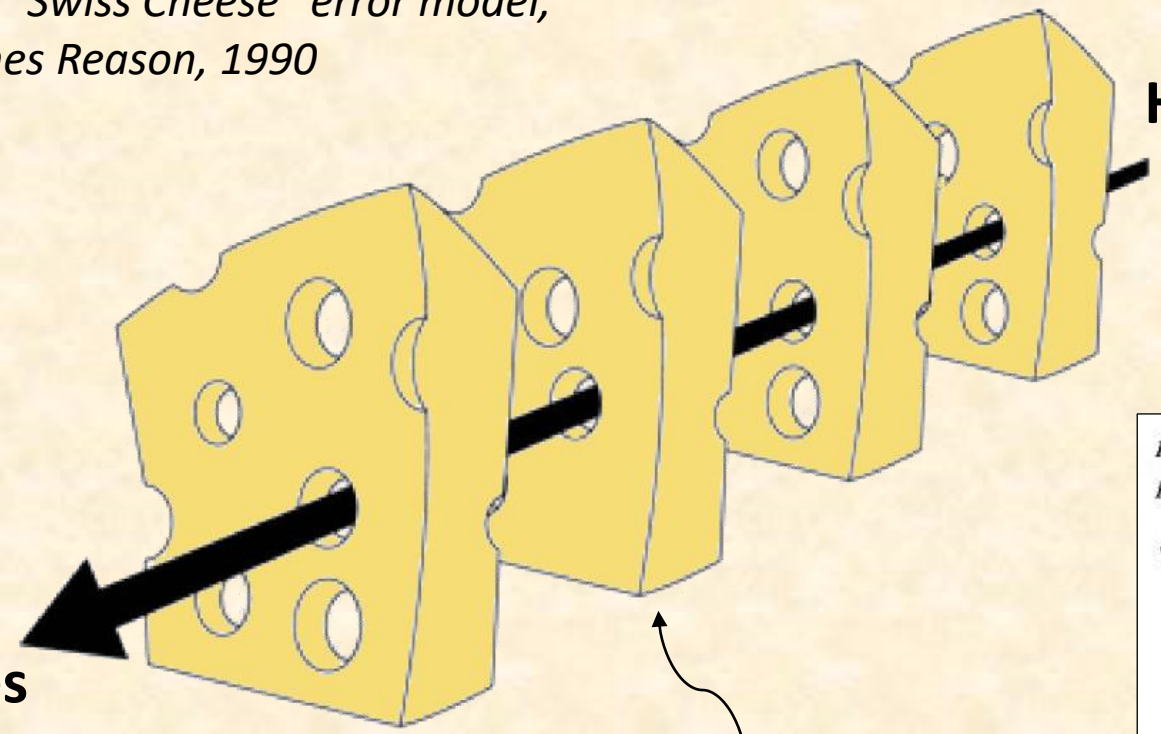
The "Swiss Cheese" error model, James Reason, 1990



- 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

Outdoor recreation

Complex Socio-technical Systems

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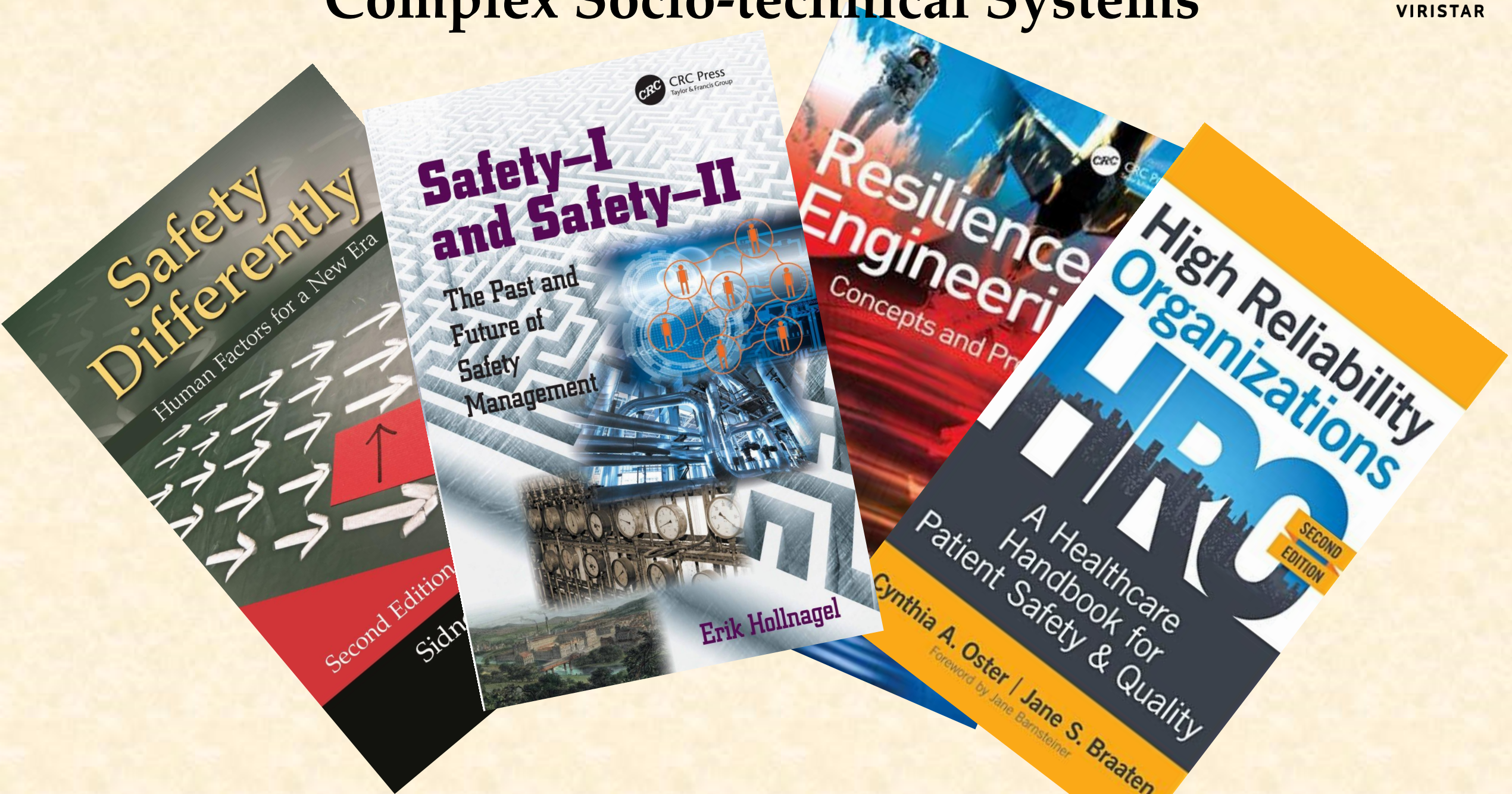

Complex Socio-technical Systems

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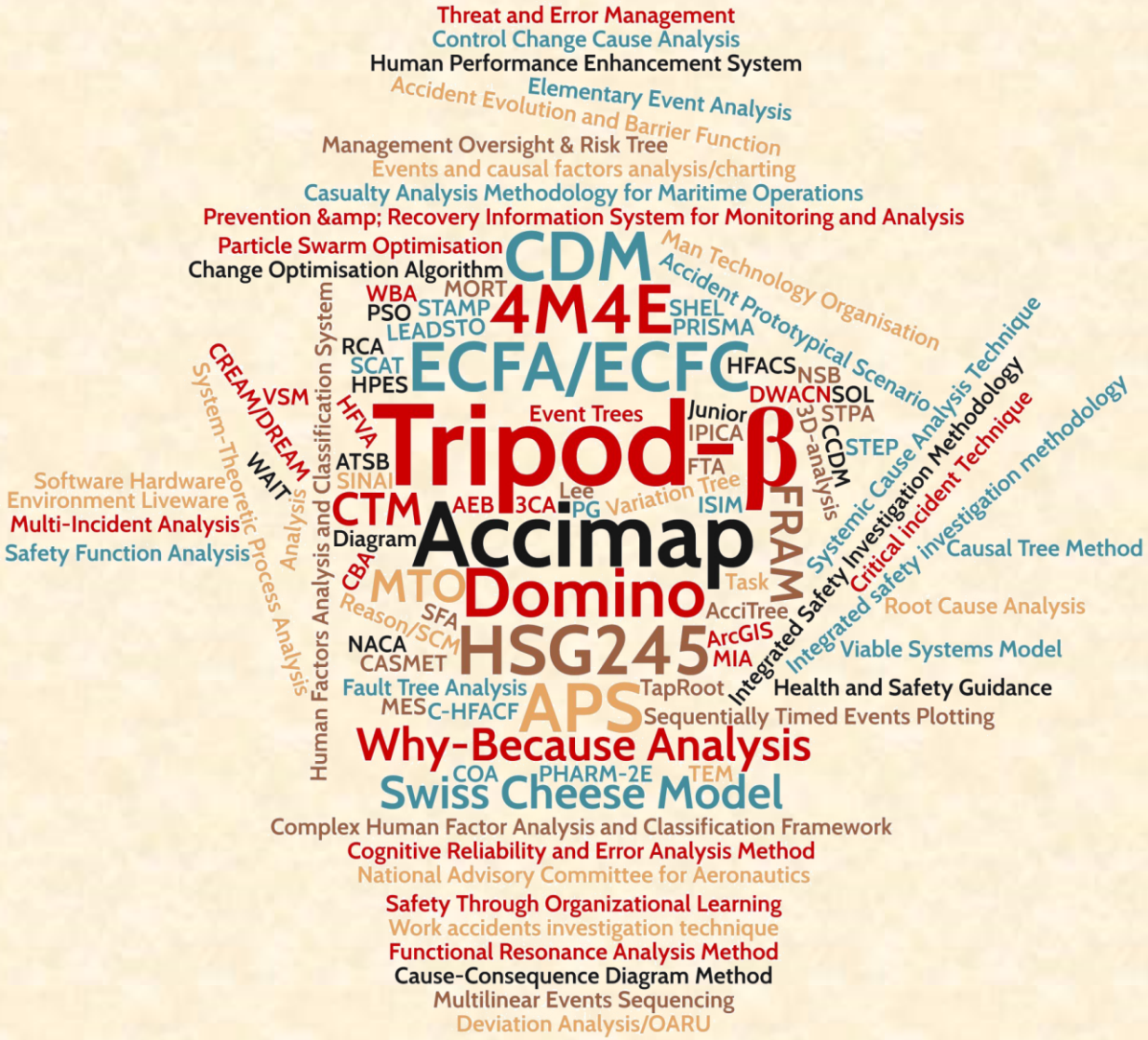

Government	*Passes laws*
Regulators, Associations	*Create regulations*
Company	*Sets policies*
Management	*Makes operating plans*
Staff	*Performs work actions*
Work	*May involve hazardouts processes*

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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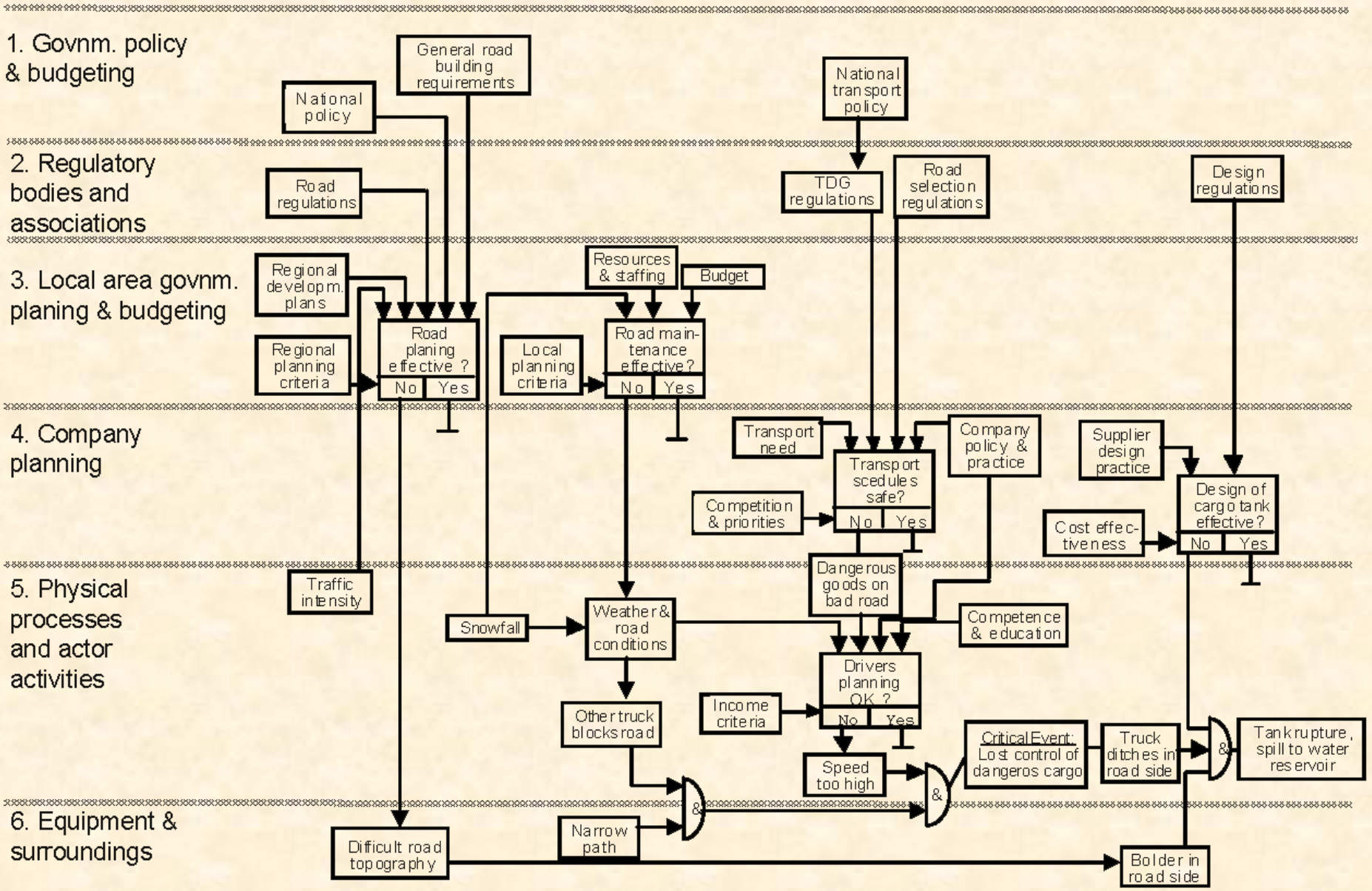

Complex Socio-technical Systems

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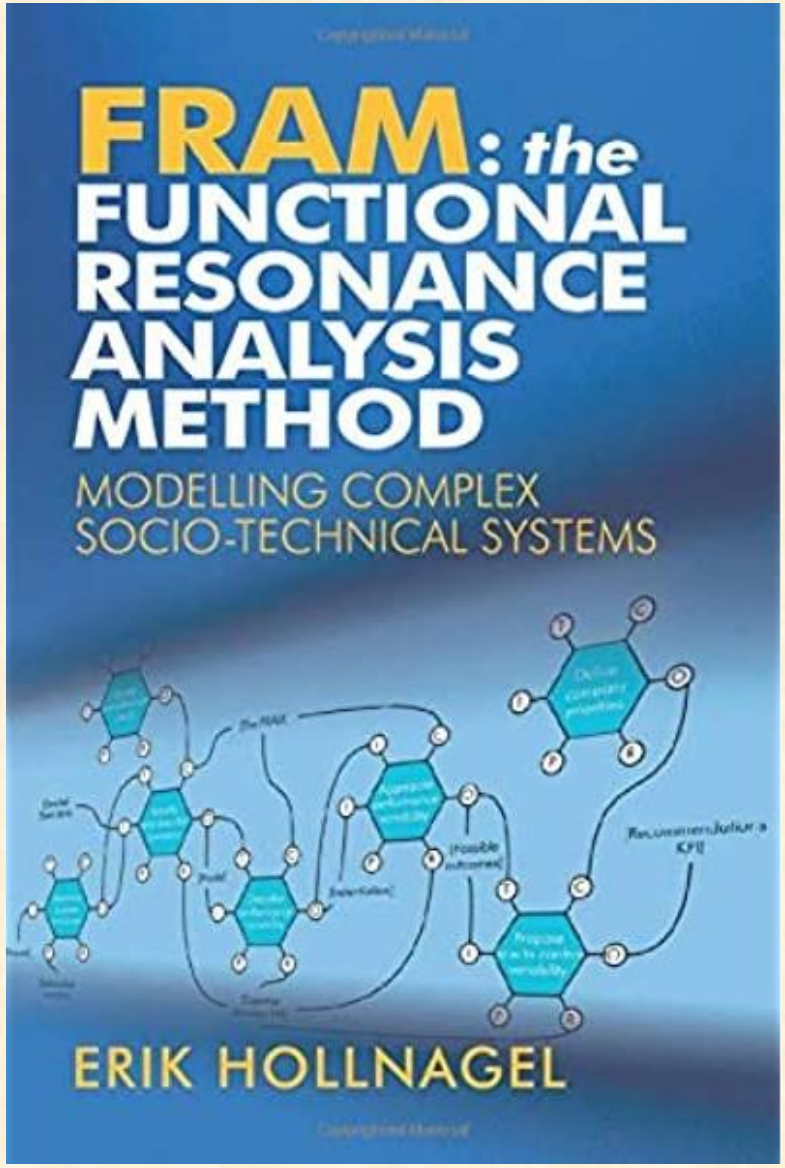

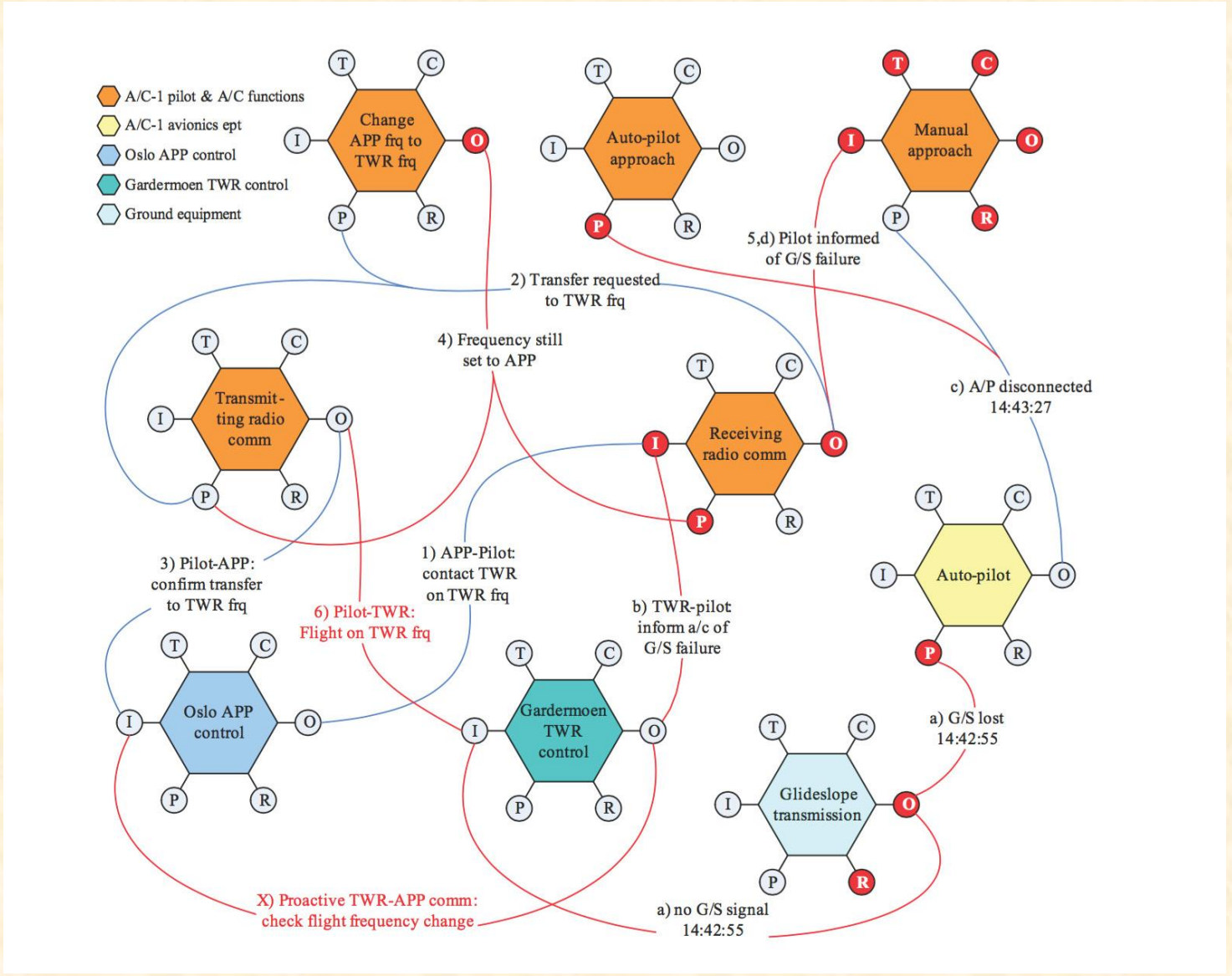

Risk Domains Model

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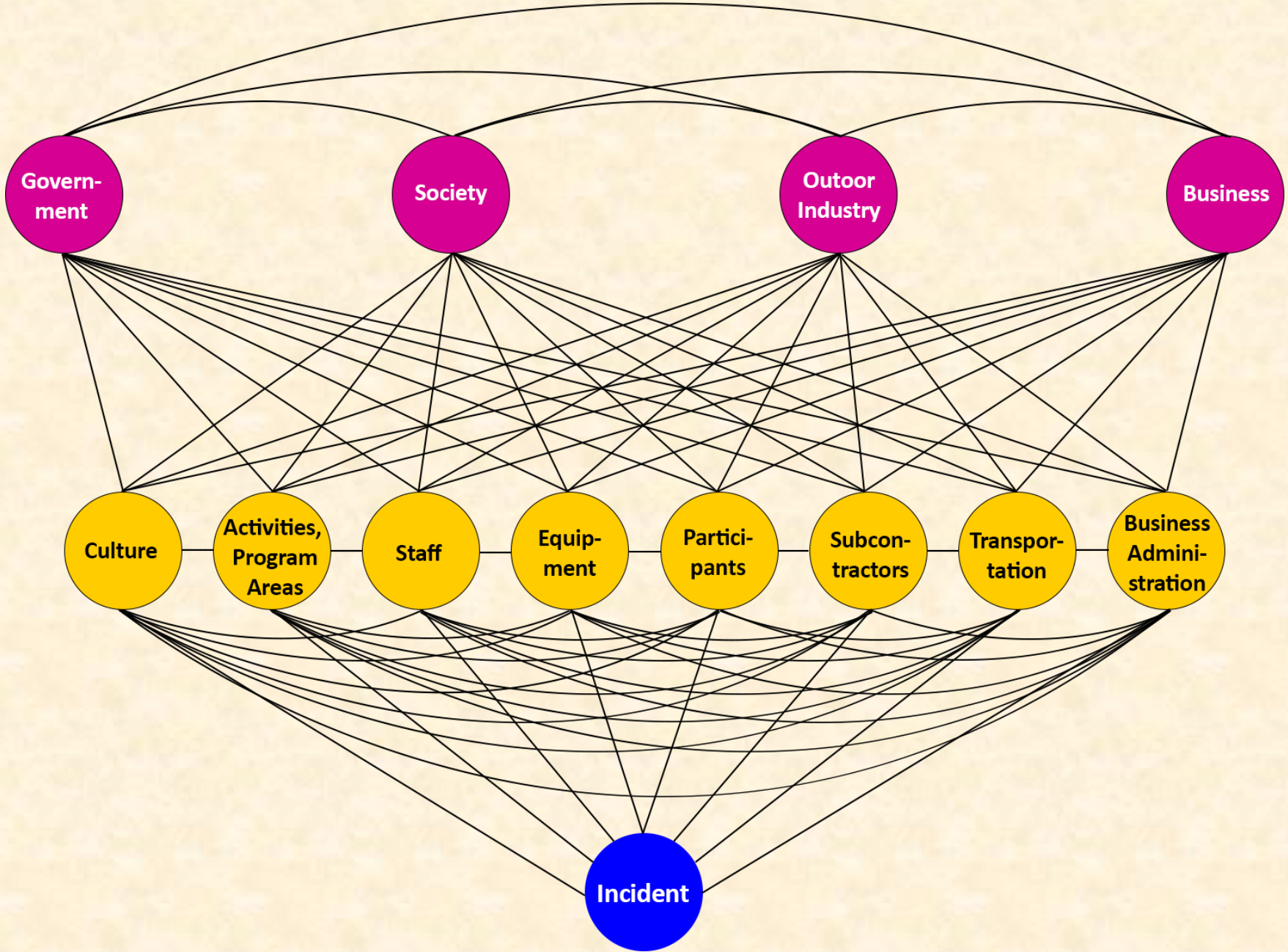

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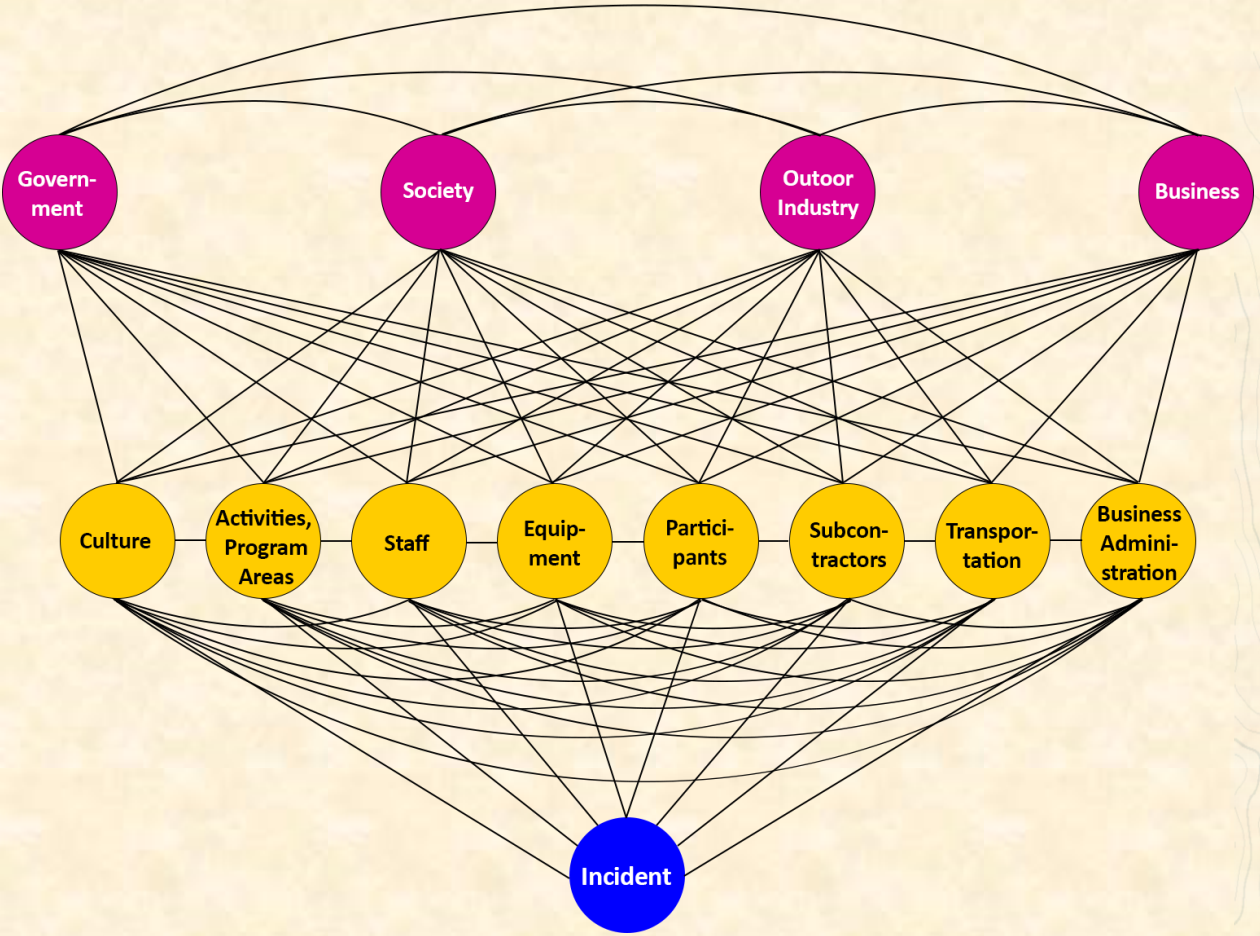

Risk Management Instruments

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

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

Sidebar: Risk Assessments

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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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Complex STS Theory: Application

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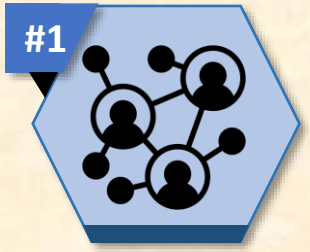
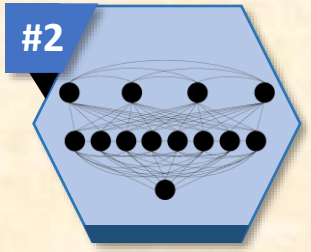
How do we apply complex socio-technical systems theory to outdoor programs?



RESILIENCE ENGINEERING



CONSIDER
ALL RISK DOMAINS

CONSIDER ALL RISK
MANAGEMENT INSTRUMENTS

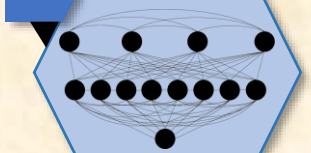
CONSIDER
STRATEGIC RISKS

SYSTEMS-INFORMED
STRATEGIC PLANNING

#1

Resilience Engineering

#2



Consider All Risk Domains

#3

Consider All Risk Management Instruments

#4

Consider Strategic Risks

#5

Systems-Informed Strategic Planning

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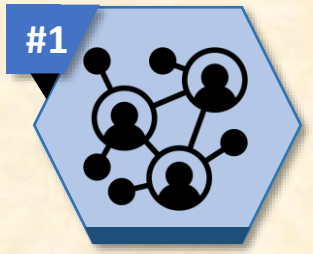

RESILIENCE ENGINEERING

CONSIDER ALL RISK DOMAINS

CONSIDER ALL RISK MANAGEMENT INSTRUMENTS

CONSIDER STRATEGIC RISKS

SYSTEMS-INFORMED STRATEGIC PLANNING

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Resilience engineering: create the conditions to withstand unanticipated problems

How?

1. Extra Capacity
2. Redundancy
3. Integrated Safety Culture
4. Psychological Resilience

Extra Capacity

- Backup staff available
- Backup equipment available
- Staff trained to operate at level higher than conditions normally require—e.g. Class IV paddler to lead Class III whitewater

Redundancy

- Multiple ways to identify emerging safety issues
- Multiple leaders per group
- Multiple leaders trained in first aid
- Participants trained in first aid, emergency response if leaders incapacitated
- Multiple emergency telecom devices
- Multiple emergency evac options

#1 RESILIENCE ENGINEERING

#2 CONSIDER ALL RISK DOMAINS

#3 CONSIDER ALL RISK MANAGEMENT INSTRUMENTS

#4 CONSIDER STRATEGIC RISKS

#5 SYSTEMS-INFORMED STRATEGIC PLANNING

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Integrated Safety Culture

- Balancing rules-based safety with allowing staff to use their judgement

Psychological Resilience

- Recruiting, hiring, training and retaining staff who have positive attitude towards challenge

#1 Resilience Engineering

#2 Consider All Risk Domains

#3 Consider All Risk Management Instruments

#4 Consider Strategic Risks

#5 Systems-Informed Strategic Planning

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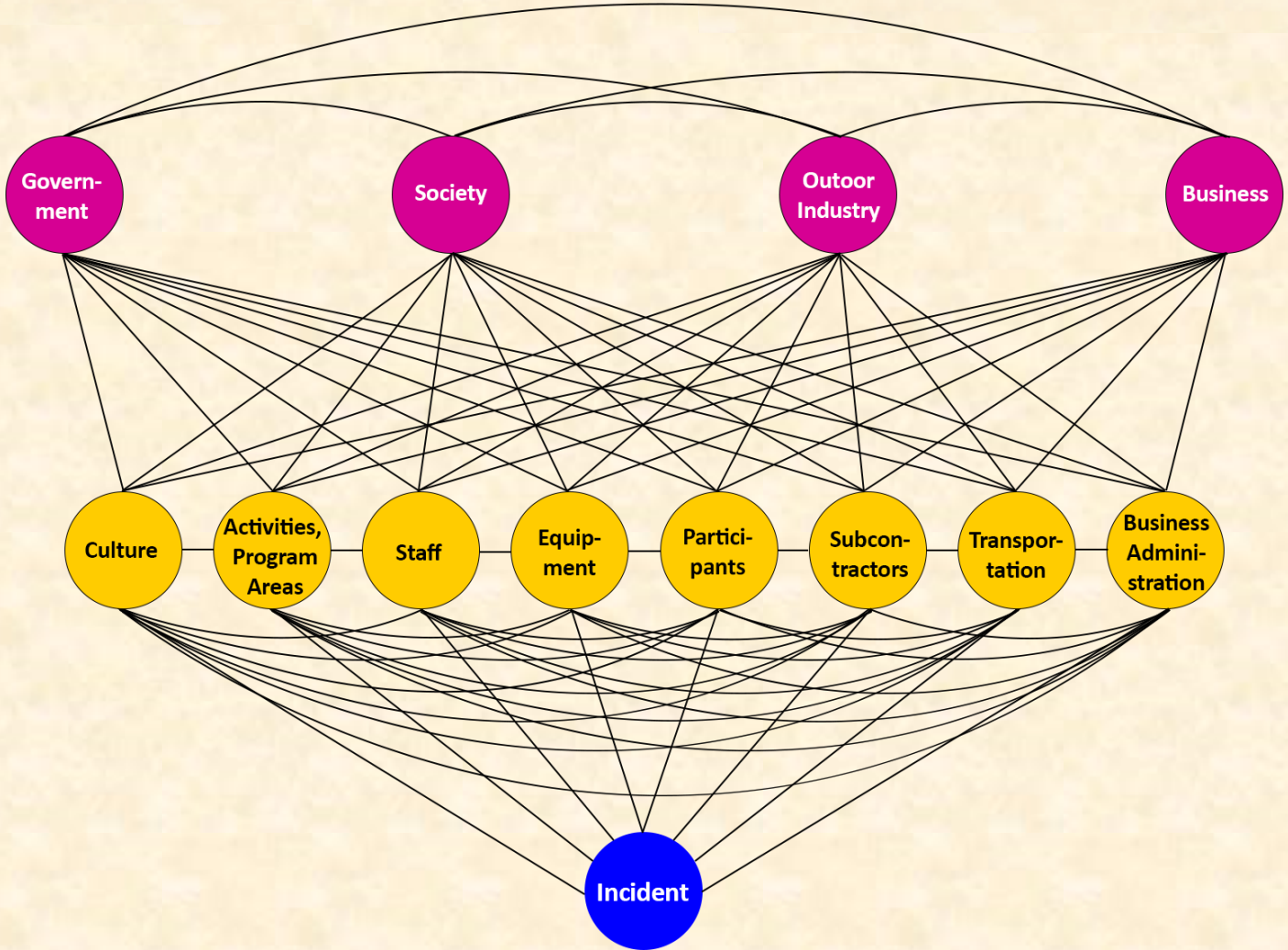

Examples:

- Just culture
- Comprehensive new activity/location/ population planning
- Evaluate all domains in incident analysis, incident reviews, risk management reviews

Just Culture

When an error occurs:

- Don’t automatically blame the person
- Look for the underlying systems that led to the error

Focus is on *what went wrong*, not *who caused the problem*

This empowers people to report incidents, and helps the organization resolve the underlying safety issues

#1 Resilience Engineering

#2 Consider All Risk Domains

#3 **Consider All Risk Management Instruments**

#4 Consider Strategic Risks

#5 Systems-Informed Strategic Planning

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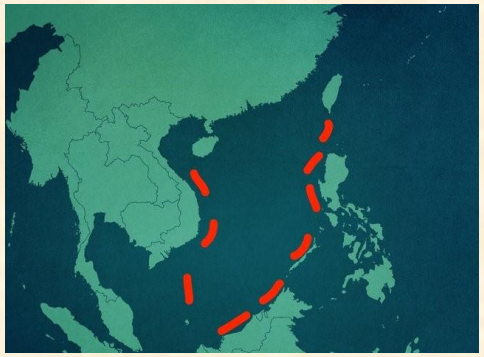
Demographic, Market and Social Shifts

Geopolitical Conflict and Instability



Climate Crisis

Legal trends & precedents

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Pre-mortem

- Assume a catastrophic failure has occurred
- Individually brainstorm causes of the failure
- Combine causes into one list
- Review, assess, and prioritize causes
- Using this information, strengthen risk management systems

Complex STS Theory: Application

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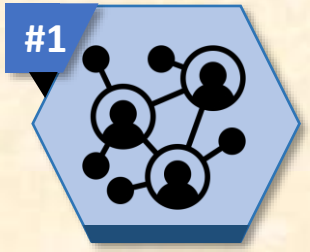
How do we apply complex socio-technical systems theory to outdoor programs?



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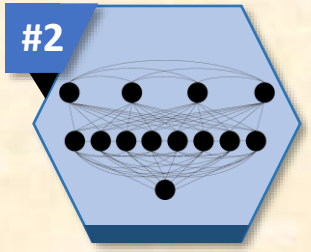

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Self-Assessment

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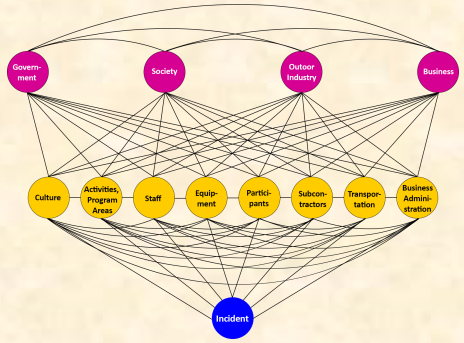
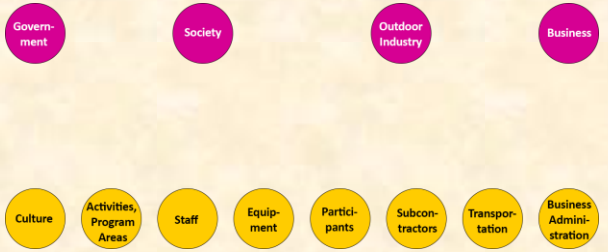
Complete the self-assessment on paper or at viristar.com/ao-safety-science to evaluate the extent to which your program employs risk management models, theories and systems-informed design in its risk management infrastructure:

Uses current models of incident causation/prevention

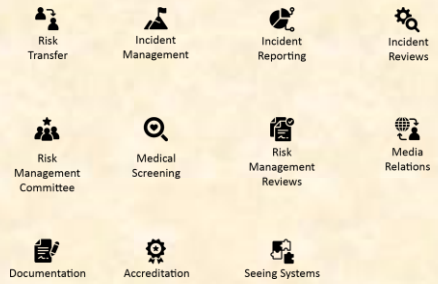


Employs complex STS theory in safety system design

Identifies and manages specific risks in each risk domain



Employs all applicable Risk Management Instruments

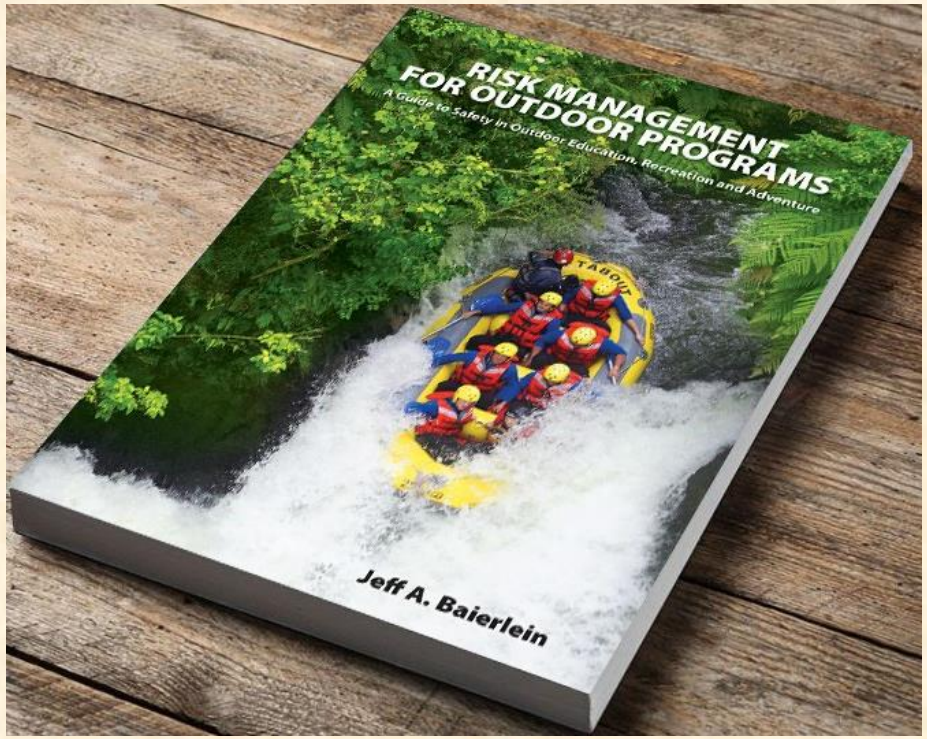


Employs principles of resilience engineering

Addresses strategic risks

For More Information

Risk Management for Outdoor Programs: A Guide to Safety in Outdoor Education, Recreation and Adventure



Risk Management for Outdoor Programs
40 hour online training, held over 4 weeks
courses.viristar.com

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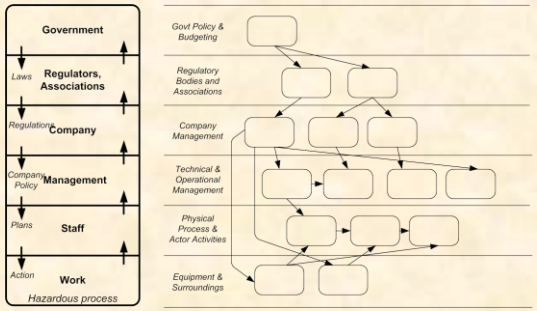

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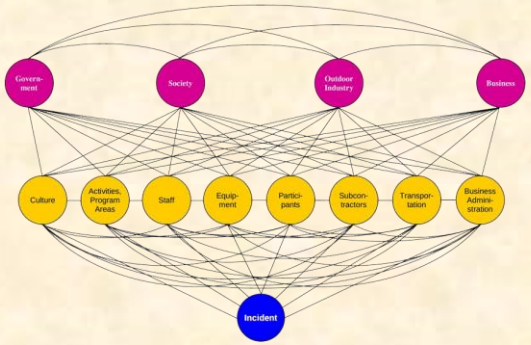

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The Risk Domains model can be applied to outdoor programs via resilience engineering & other techniques

Outcomes

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You will:

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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

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

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