Integrating Systems Thinking With Safety I and Safety II: From Reactive to Proactive Risk Management

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Introduction

Rick Curtis

Pronouns: he, him, his

Director, Princeton University Outdoor Action Program

Founder: **www.IncidentAnalytix.com**

Founder: **www.OutdoorEd.com**

Author: **The Backpacker's Field Manual**

Format

- Presentation
- Small Group Work
- Sharing your Knowledge
- Questions - throughout
  - Parking Lot
- Discussion - throughout
  - Parking Lot

Always maintain your personal safety

Keep your own personal safety in mind at all times as well as the safety of others in the room.

If at any point you feel uncomfortable, take a safety break.

If you feel unsafe, let me know if there is anything I can modify in my presentation.

Guidelines

What is discussed here regarding specific incidents or personal stories stays in this room.

Real names should not be used except when they refer to situations that are clearly in the public domain (ex. Larry Nassar)

We are here to create safer programs, not to assign blame.

Learning Objectives

- Understand the **Systems Thinking Approach** to risk management

- Learn how the **Safety-I** framework and **Safety-II** framework are complementary parts of an overall risk management plan

- Learn how a **Risk Management Information System (RMIS)** can provide rich data for implementing Safety-I and Safety-II principles

- Learn how to assess your program by building **AcciMaps** and **PreventiMaps**

Concepts
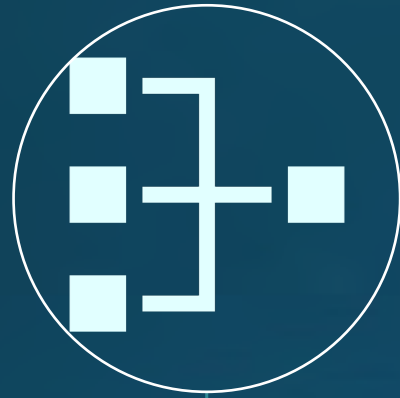
Systems Thinking

Safety-I

Safety-II

Terminology

- **Safety Science** - concerned with finding and understanding the causes of adverse incidents and accidents and discovering ways to prevent them

- **Domains/Subdomains** – the industry/work setting where you operate (health care, aviation, outdoors – therapeutic adventure vs college outdoor program)

Terminology

- **Taxonomy** – the practice of classification of things or concepts. Related to the Domain.

Terminology

- **Incident/Event** – Something that occurred
  - **Accident –** an event with some adverse outcome
  - **Close Call** – an event with the possibility of an adverse outcome but none occurred
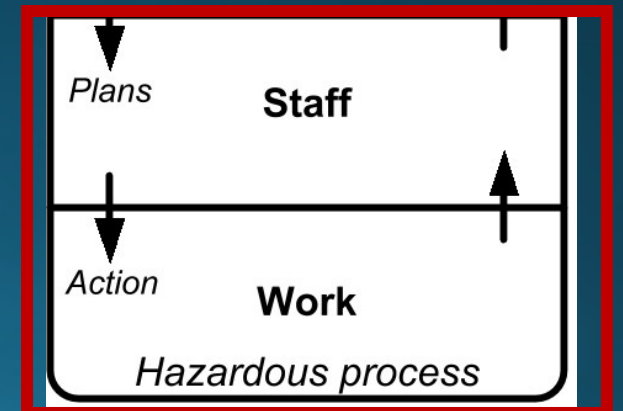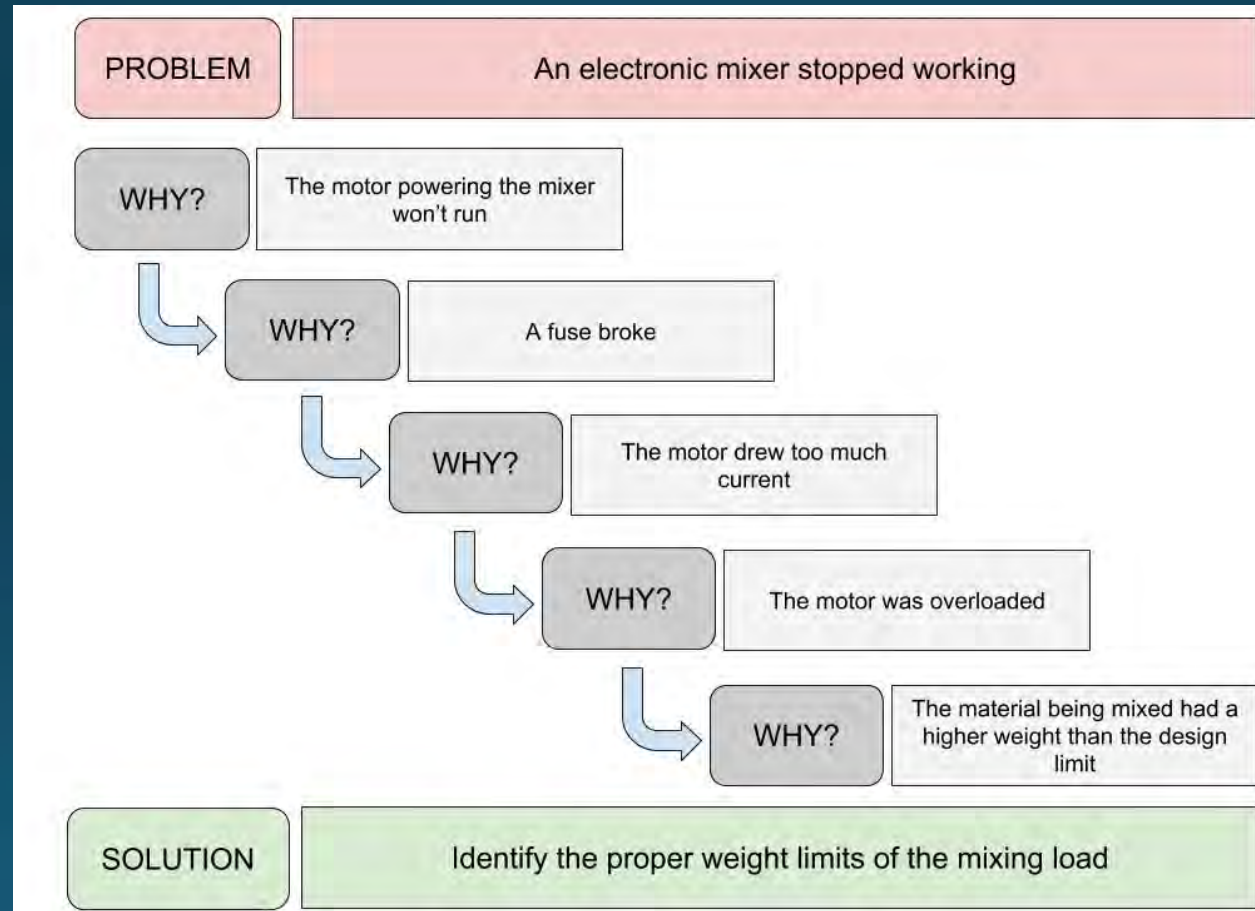
Accident Causation

Traditional Accident Analysis focuses here

Root Cause Analysis

Systems Thinking
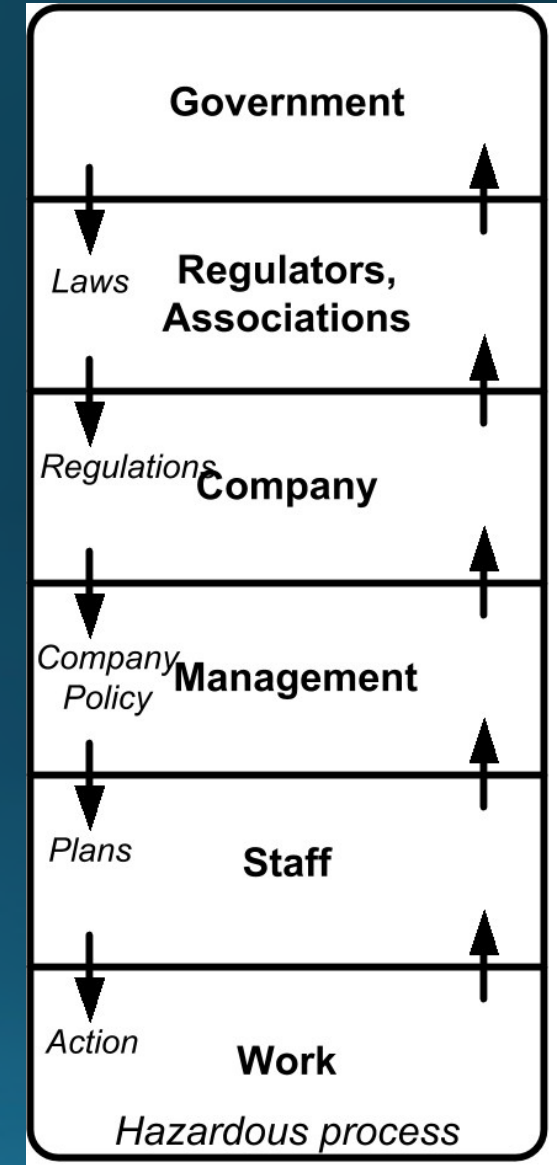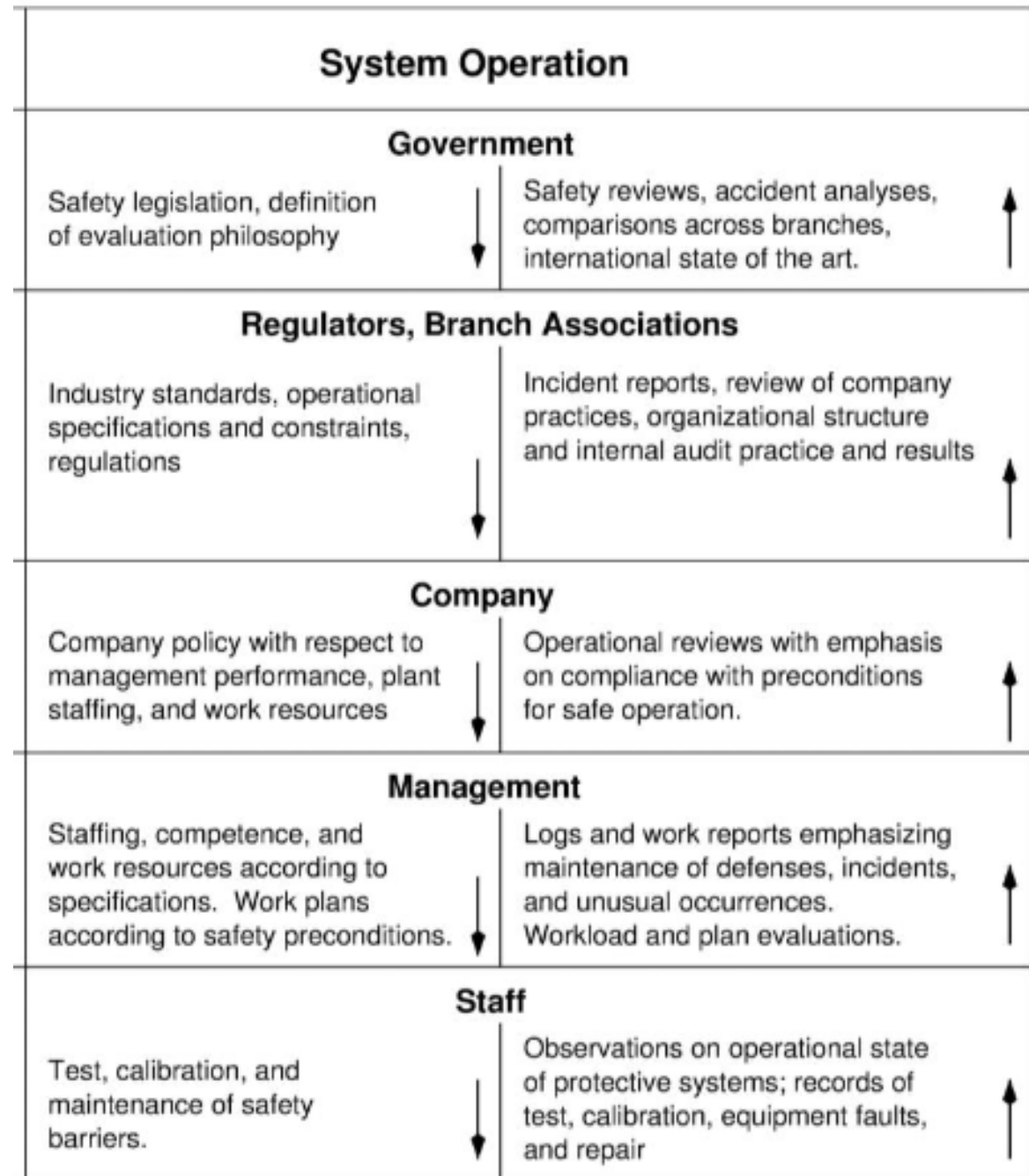
Risk Management in a Dynamic Society
Jens Rasmussen, Safety Science, 1997

- **Socio-technical System** – a system where social aspects (like communication, decision-making, and organizational structures) interact and intertwine with technical aspects (such as tools, technologies, and processes). These aspects do not exist in isolation but influence each other in complex ways.

Systems Thinking

- Downward Flow
- Upward Flow

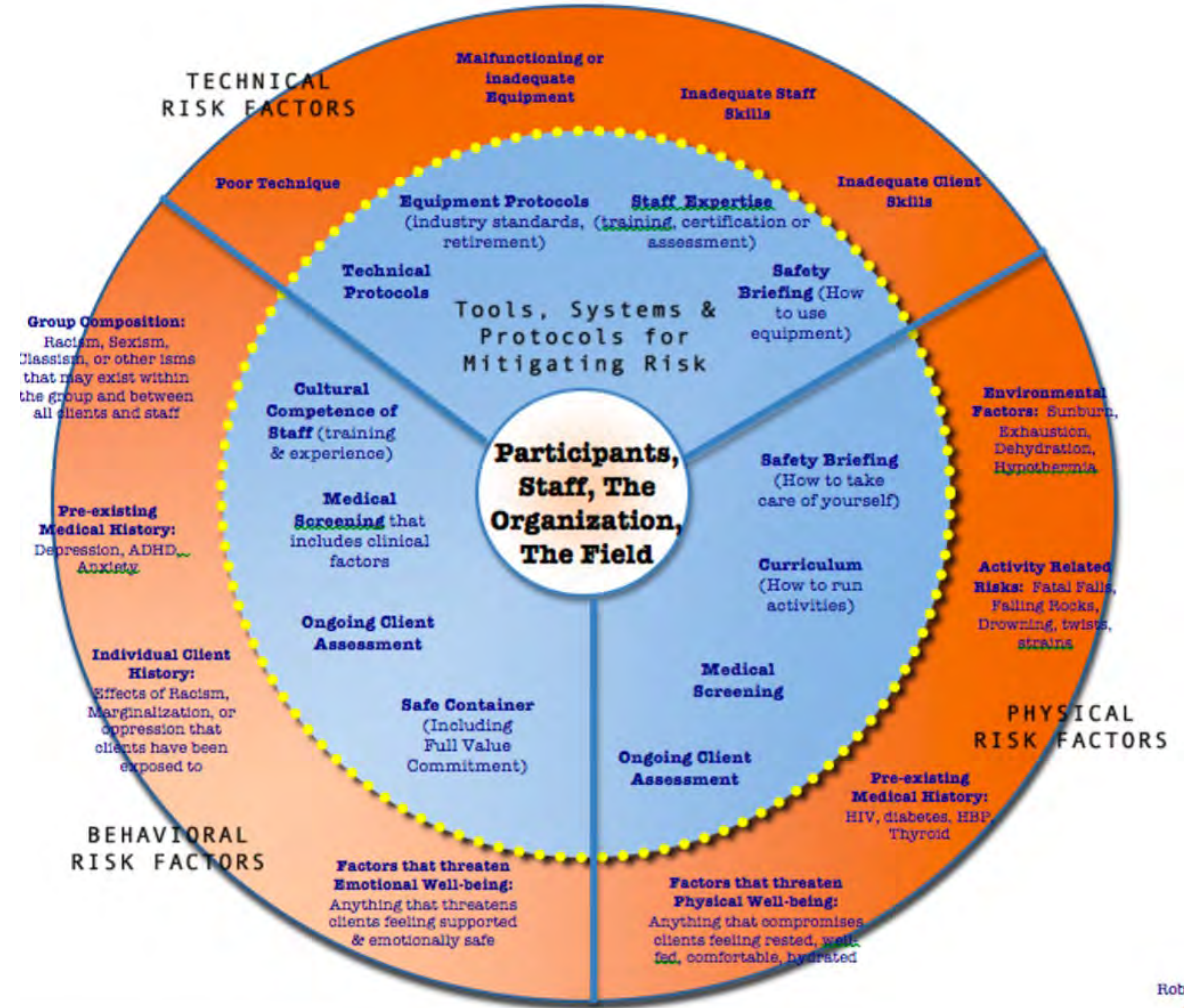| System Operation	
Government	
Safety legislation, definition of evaluation philosophy ↓	Safety reviews, accident analyses, comparisons across branches, international state of the art. ↑
Regulators, Branch Associations	
Industry standards, operational specifications and constraints, regulations ↓	Incident reports, review of company practices, organizational structure and internal audit practice and results ↑
Company	
Company policy with respect to management performance, plant staffing, and work resources ↓	Operational reviews with emphasis on compliance with preconditions for safe operation. ↑
Management	
Staffing, competence, and work resources according to specifications. Work plans according to safety preconditions. ↓	Logs and work reports emphasizing maintenance of defenses, incidents, and unusual occurrences. Workload and plan evaluations. ↑
Staff	
Test, calibration, and maintenance of safety barriers. ↓	Observations on operational state of protective systems; records of test, calibration, equipment faults, and repair ↑

Systems Thinking

- Near misses and adverse events are caused by multiple, interacting, contributing factors, not just a single bad decision or action.

- Behavior and safety is impacted by the decisions and actions of everyone in the system, not just individuals.

- Effective countermeasures focus on systemic changes rather than on individuals.

UPLOADS Project, https://uploadsproject.org

Remembering our friend & colleague Nina Roberts

https://rpt.sfsu.edu/nina-scholarship

Behavioral Risk Management Model

TECHNICAL RISK FACTORS

Malfunctioning or inadequate Equipment

Inadequate Staff Skills

Poor Technique

Inadequate Client Skills

Equipment Protocols (industry standards, retirement)

Staff Expertise (training, certification or assessment)

Technical Protocols

Safety Briefing (How to use equipment)

Group Composition: Racism, Sexism, Classism, or other isms that may exist within the group and between all clients and staff

Tools, Systems & Protocols for Mitigating Risk

Cultural Competence of Staff (training & experience)

Safety Briefing (How to take care of yourself)

Environmental Factors: Sunburn, Exhaustion, Dehydration, Hypothermia

Participants, Staff, The Organization, The Field

Pre-existing Medical History: Depression, ADHD, Anxiety

Medical Screening that includes clinical factors

Curriculum (How to run activities)

Activity Related Risks: Fatal Falls, Falling Rocks, Drowning, twists, strains

Ongoing Client Assessment

Medical Screening

PHYSICAL RISK FACTORS

Individual Client History: Effects of Racism, Marginalization, or oppression that clients have been exposed to

Safe Container (Including Full Value Commitment)

Ongoing Client Assessment

Pre-existing Medical History: HIV, diabetes, HBP, Thyroid

BEHAVIORAL RISK FACTORS

Factors that threaten Emotional Well-being: Anything that threatens clients feeling supported & emotionally safe

Factors that threaten Physical Well-being: Anything that compromises clients feeling rested, well-fed, comfortable, hydrated

Roberts, Gray, Moeller copyright 2010
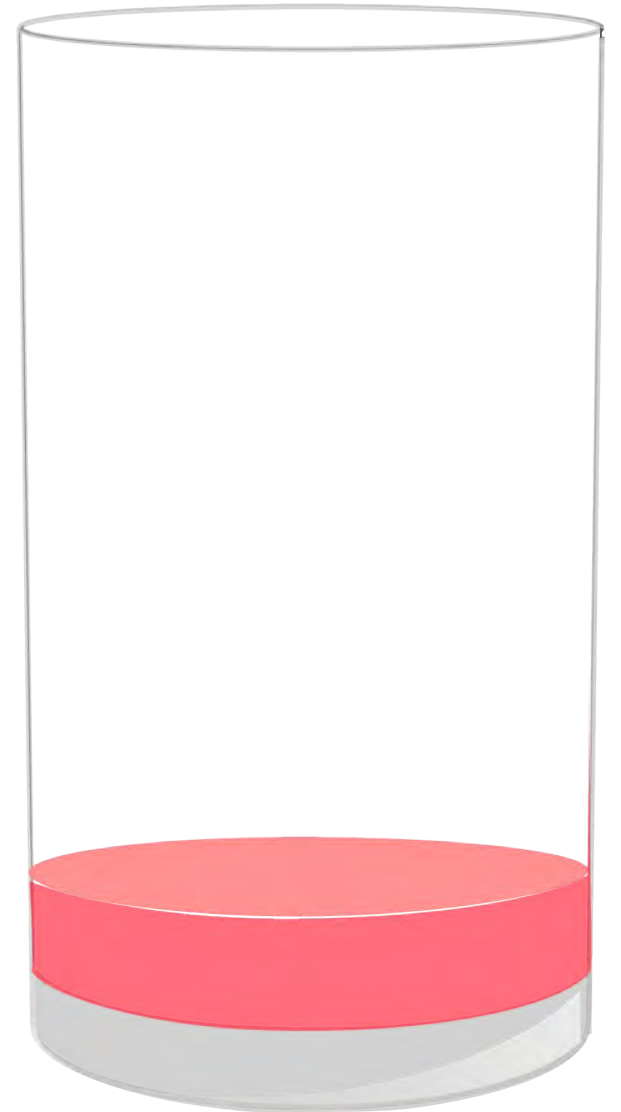
Concepts

Systems Thinking

Safety-I

Safety-I

What's Going Wrong?

We are safe if there is as little as possible of this...

Hollnagel, E. Wears, R., Braithwaite, J. - *From Safety-I to Safety-II (A White Paper)*

Safety-I	
Definition of Safety	As few things as possible go wrong
Safety Management Principle	Reactive, respond when something happens or is categorized as unacceptable risk
View of Human Factors	Humans are predominantly seen as a liability or hazard. They are a problem to be fixed.
Accident Investigation	Accidents are cause by failures and malfunctions. The purpose of an investigation is to identify the causes.

Safety-I

- 1. Hollnagel, E. Wears, R., Braithwaite, J. - EUROCONTROL (2013). *From Safety-I to Safety-II (A White Paper)*. Brussels.

Risk Assessment & Safety Management (RASM)
Contributing Factors

Contributing Factors

High ← Risk Level → Low
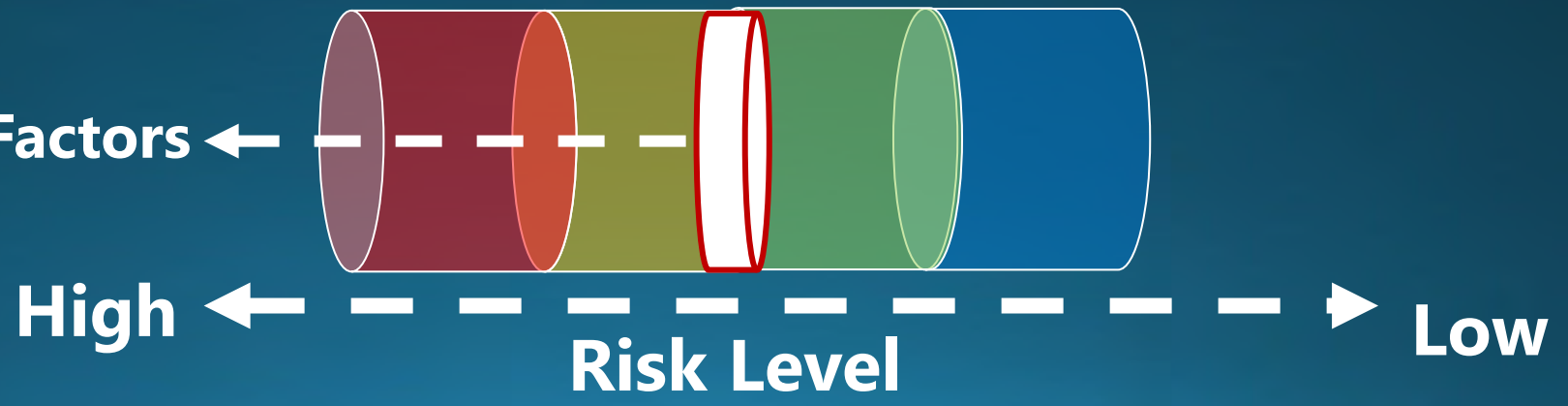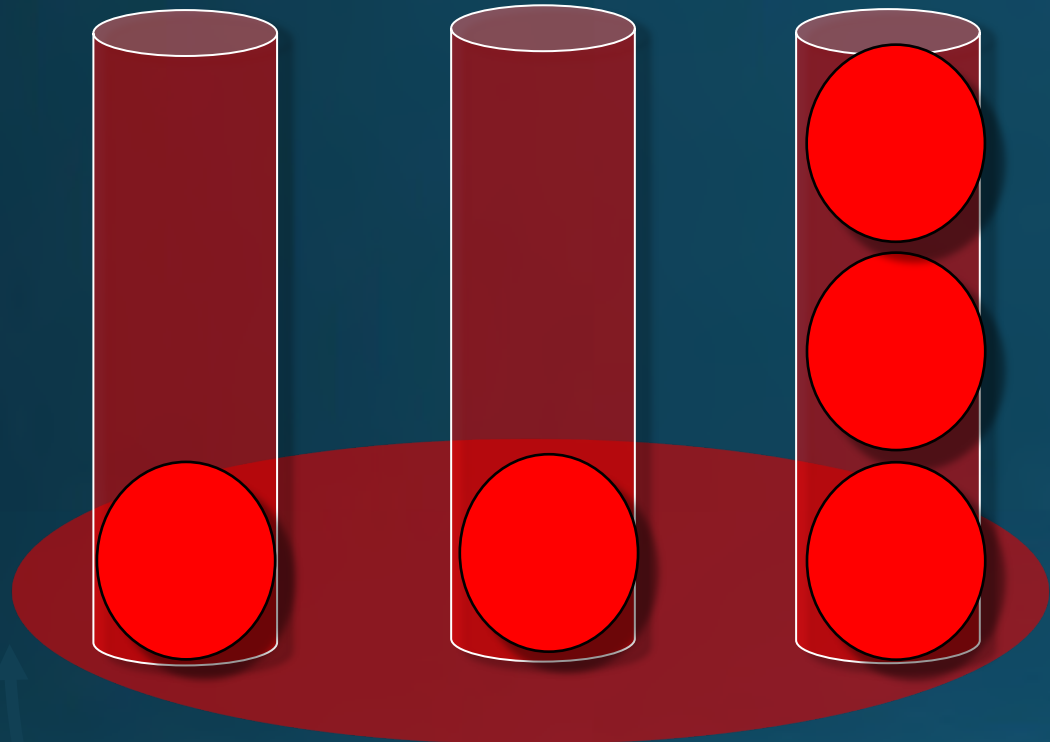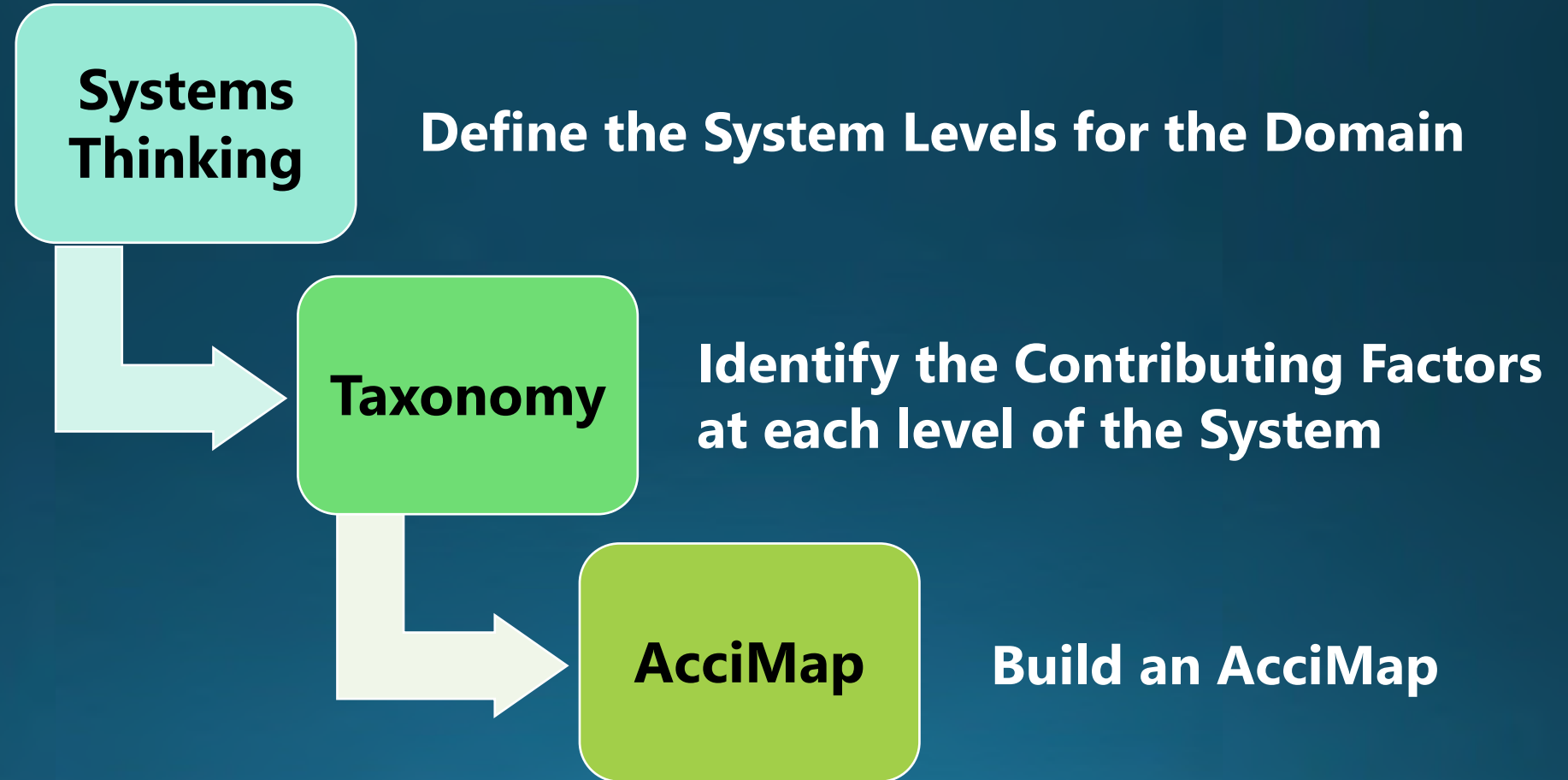
AcciMaps

- Map of a Sociotechnical system
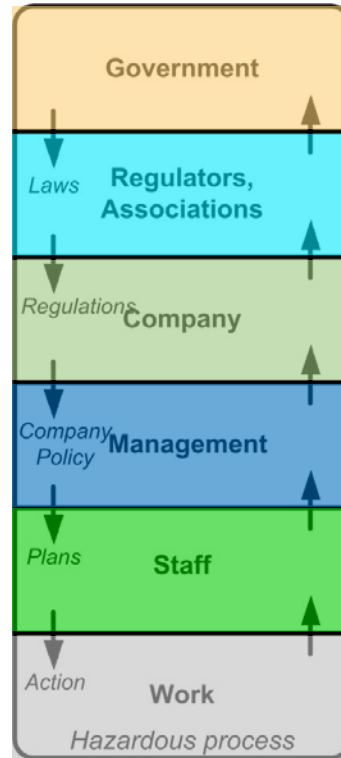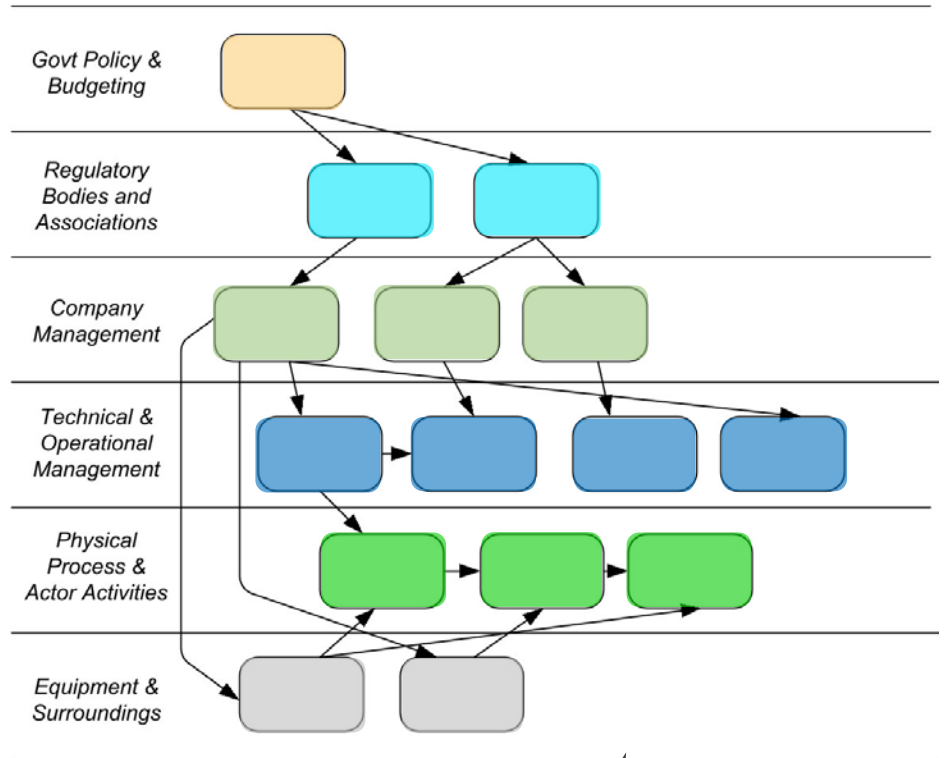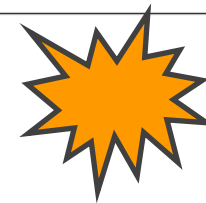
Larry Nassar Case

- AcciMap based on Rasmussen's Systems Thinking Model

AcciMap: Nassar Sexual Abuse Case – Based on Vox Article
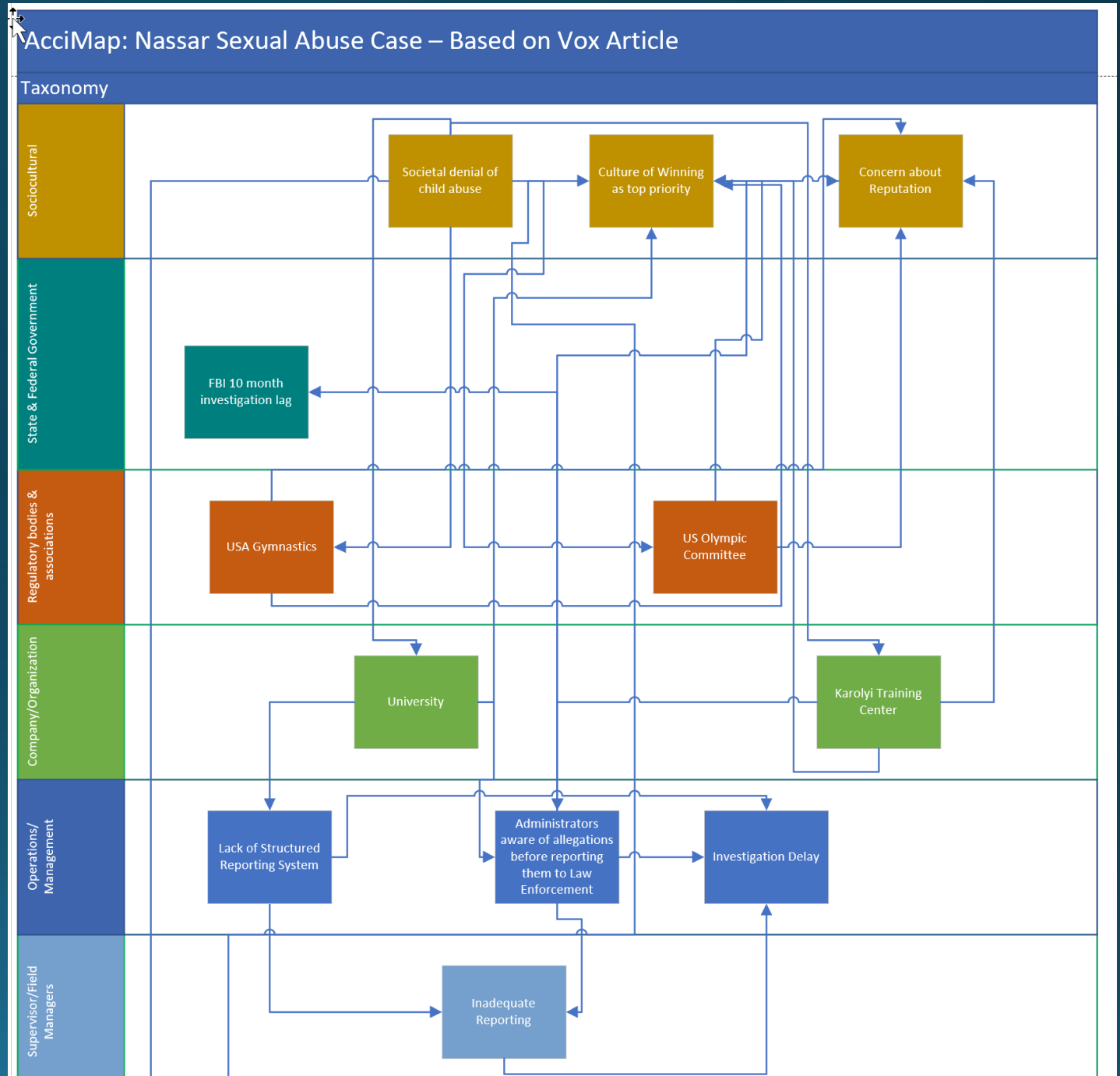
Taxonomy Examples

Sample Taxonomy

From Translating Systems Thinking Into Practice:
A Guide to Developing Incident Reporting
Systems - By Natassia Goode, Paul M. Salmon,
Michael Lenne, Caroline Finch
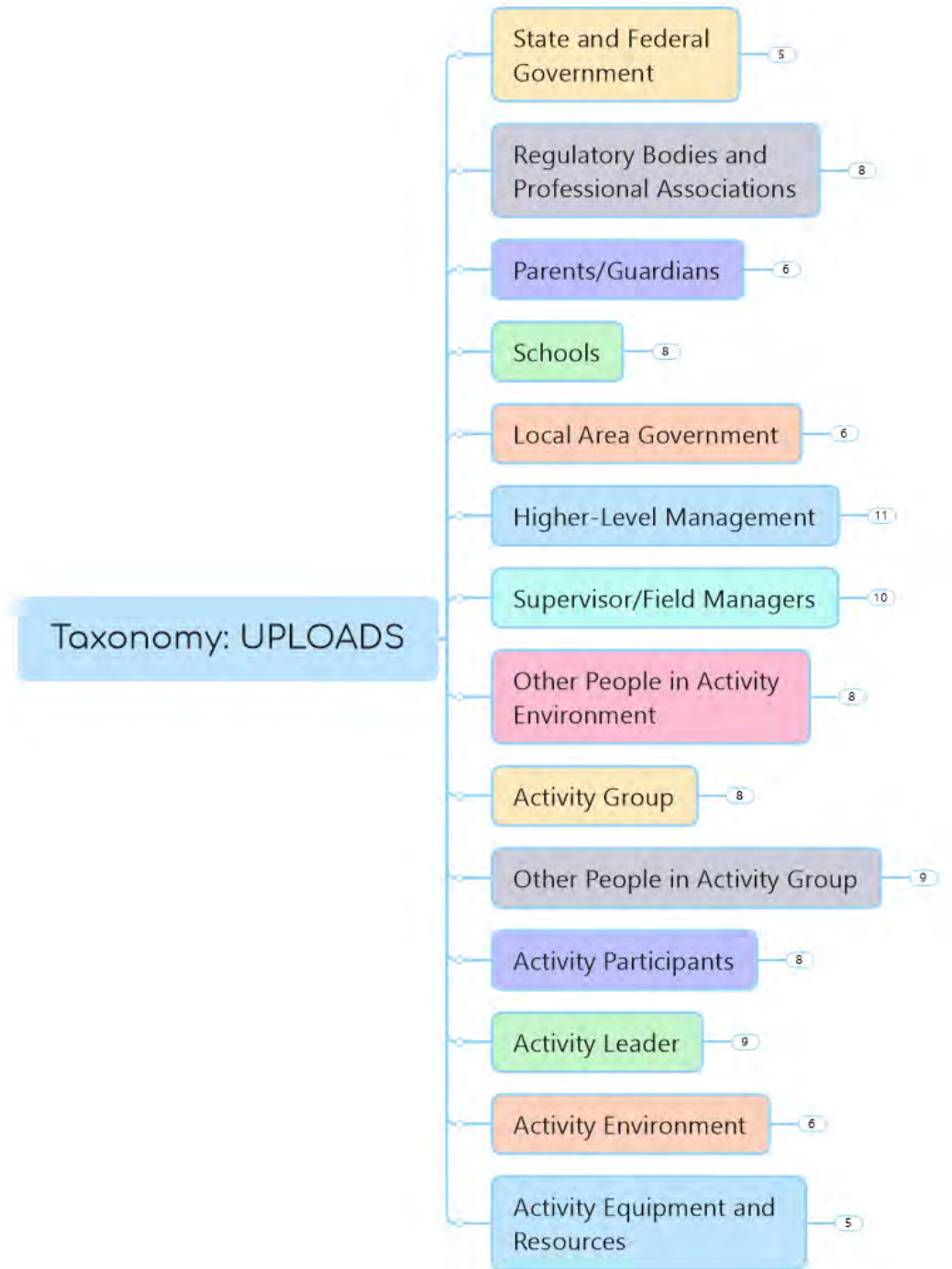
6 students and a teacher drown in a canyoning accident in April 2008

Mangatepopo Tragedy - NZ

Case Study

Building an AcciMap

Domain	Taxonomy	Factors	Relationships	Analysis
Identify the levels of your Socio-technical System based on your Domain	Determine the Taxonomy of Contributing Factors at each level of the System	Identify Contributing Factors in the Incident	Identify any Relationships between Contributing Factors. Look for Emergent Risks	Formulate Recommendations

Building an AcciMap

1. Create a blank AcciMap with the System Level headings on the left sidebar in hierarchical order
2. Identify the outcome(s) and enter at the bottom
3. Enter the Contributing Factors at each System Level
4. Identify if there are any Relationships between Contributing Factors
   - Had A not occurred, B would (probably) not have occurred
     - AND
   - B is a direct result of A (no other factor in between, otherwise link A to C and C to B)
5. Formulate Safety Recommendations
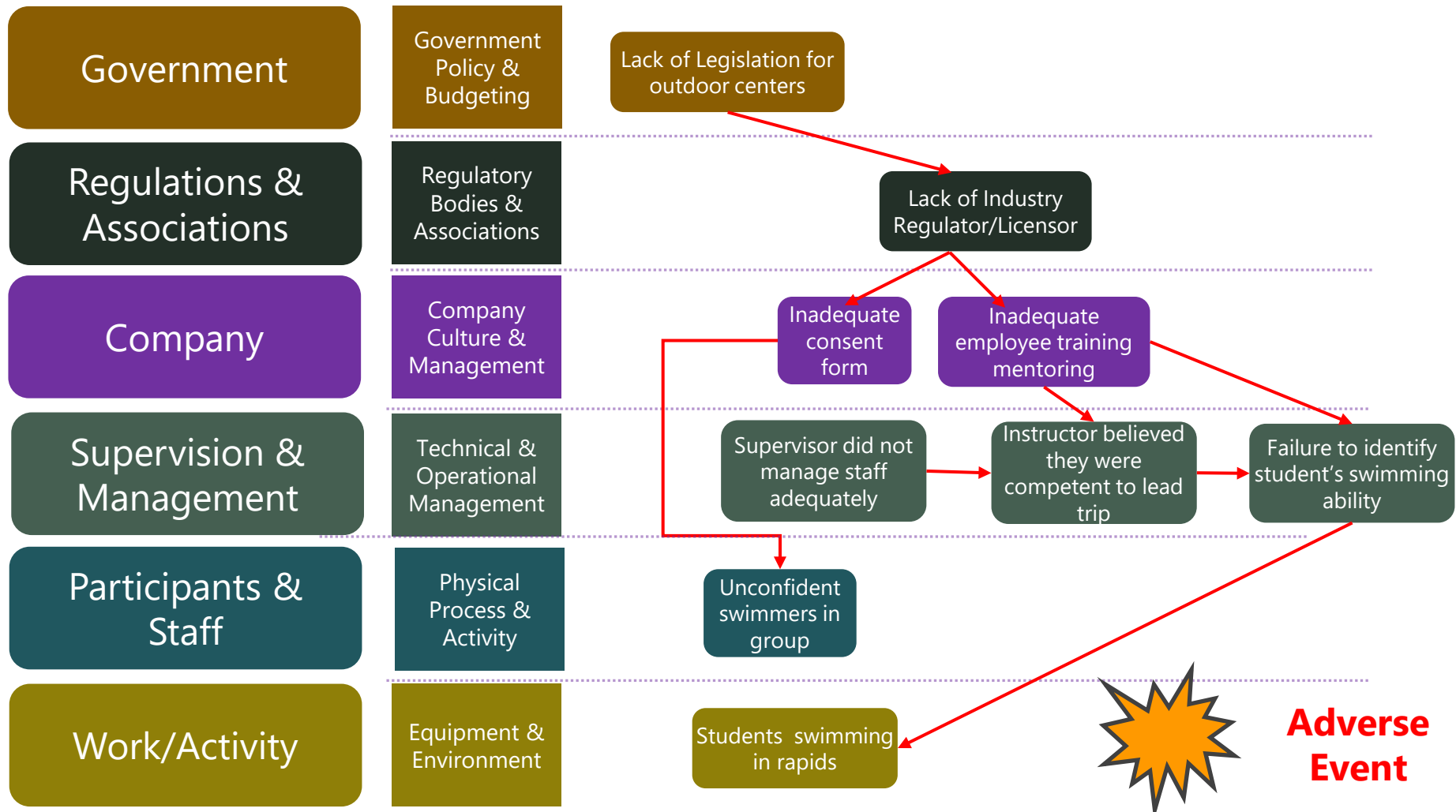   - What is In Scope?
   - What is Out of Scope

Analyze in small groups

Report your findings

Mangatepopo River Accident, NZ from Salmon et al

Category	Subcategory	
Government	Government Policy & Budgeting	
Regulations & Associations	Regulatory Bodies & Associations	
Company	Company Culture & Management	
Supervision & Management	Technical & Operational Management	
Participants & Staff	Physical Process & Activity	
Work/Activity	Equipment & Environment	

- Lack of Legislation for outdoor centers
- Lack of Industry Regulator/Licensor
- Inadequate consent form
- Inadequate employee training mentoring
- Supervisor did not manage staff adequately
- Instructor believed they were competent to lead trip
- Failure to identify student's swimming ability
- Unconfident swimmers in group
- Students swimming in rapids

Adverse Event

Mangatepopo Gorge Incident Accimap

Government policy and budgeting
- Lack of legislation covering health and safety at activity/ adventure tourism centres

Regulatory bodies & associations
- Lack of an outdoor industry regulator or licensing body
- Inadequate auditing system
- Failure of auditor to pick up/question risk associated with planned activity

Local area Government planning & budgeting, Company management
- Rain or shine culture
- Inadequate induction/ mentoring/ training systems
- RAMS system inadequate
- Inadequate/ unclear policies & procedures
- Allowance of routine policy violations
- Financial and production pressures
- Poorly designed Adventure program
- Inadequate/ misleading information &consent form
- Underestimation of risk/difficulty associated with upstream gorge trip
- Poor awareness/ uptake of weather information services
- High staff turnover
- Inadequate incident surveillance system
- Lack of clarity regarding FM's role and responsibilities

Technical & operational management
- Instructor lack of experience/ competence
- Failure to check maps on Metservice fax
- Instructor belief that she was competent for upstream trip
- Failure to identify students swimming capability
- Failure to sign off on RAMS
- Appropriate ratio of instructors to students not met
- FM's return from leave handled poorly
- Failure to check subsequent weather forecasts
- FM distracted by/preoccupied with auditor
- Failure of FM to cancel all gorge trips
- Misunderstanding of nature of planned gorge trip
- Failure of staff to question/ prevent gorge trip

Physical processes & actor activities
- Failure to assess/ appreciate hazards
- Unconfident swimmers in group
- Slow progress of group
- Group stranded on ledge
- Comms failures
- Students failure to appreciate gravity of situation
- Instructor/ students enter water
- Failure of throwbag technique
- Failure to abort or rescue swept away students
- Drownings
- Initiation of gorge activity
- Decision to undertake full gorge trip
- Failure to assess conditions
- Failure to use halfway ledge/ last high water escape
- Decision to leave ledge
- Inadequate/ inappropriate plan and instructions
- Attachment of students to one another
- Failure/inability to swim hard and left
- Students/teacher swept over spillway holding rope

Equipment & surroundings
- Incomplete Metservice weather report
- Lack of exits along gorge
- Rising Mangatepopo river level
- Rising water level on ledge
- 1 radio only taken on gorge trip
- Radios not waterproof and turned off/ inaccessible due to dis-assembly
- Drought conditions preceding incident
- Heavy rain
- Increased Mangatepopo river flow
- High noise levels
- Poor signal/ reception in gorge
- Cold temperature
- Spillway
- Restrictive layers of clothing

Scope Assessment

Determining Scope

- Based on the Taxonomy determine what things are:
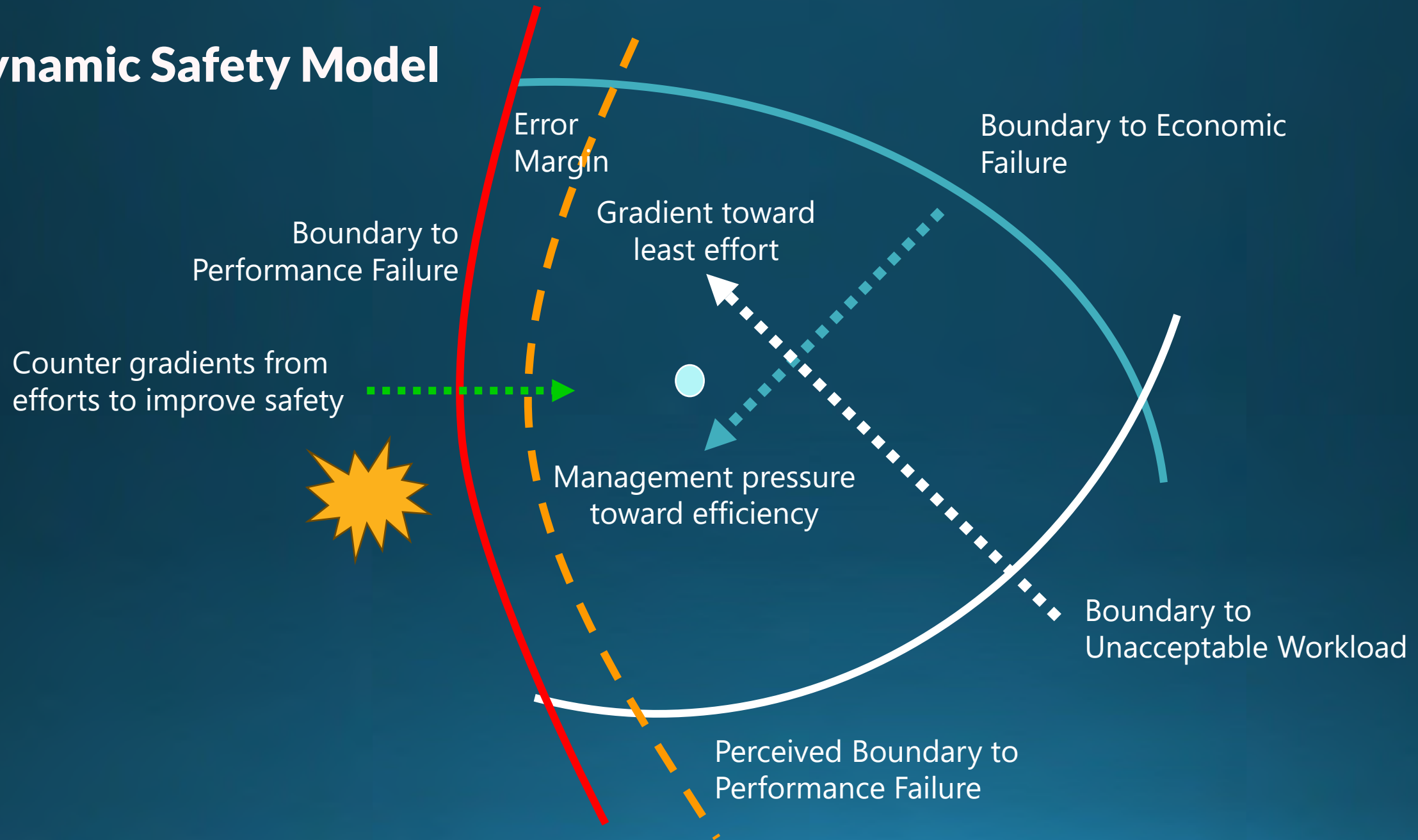 - In Scope
  - Out of Scope

In Scope Prioritization

- Risk Mitigation Impact (RMI)
  - What will get you the greatest impact with the least amount of resources?
  - What is the single most important factor to address that would have a significant impact regardless of resources?
  - If it is resource intense, how will you make the case for getting those resources?
  - Who are your stakeholders to help you?

Dynamic Safety Model

Error Margin

Boundary to Economic Failure

Boundary to Performance Failure

Gradient toward least effort

Counter gradients from efforts to improve safety

Management pressure toward efficiency

Boundary to Unacceptable Workload

Perceived Boundary to Performance Failure

Concepts

Systems Thinking
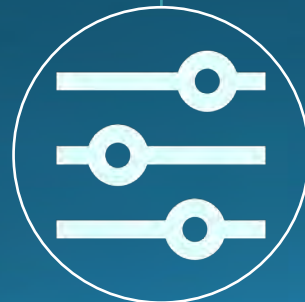
Safety-II

Mitigating Factors

Taxonomy

Safety-II

What's Going Right?

We are safe if there is as much as possible of this…

"Trying to understand safety by only looking at incidents is like trying to understand successful marriages by only looking at divorces."
- Marit de Vos 2018

	Safety-II
Definition of Safety	As many things as possible go right
Safety Management Principle	Proactive, continuously try to anticipate developments and events
View of Human Factors	Humans are seen as a resource necessary for system flexibility and resilience. They provide flexible solutions to many problems.
Accident Investigation	Things basically happened in the same way regardless of outcome (positive or negative). The purpose of an investigation is to understand how things usually go right as a basis for explaining how things occasionally go wrong.

Safety-II

Hollnagel, E. Wears, R., Braithwaite, J. - EUROCONTROL (2013). *From Safety-I to Safety-II (A White Paper)*. Brussels.
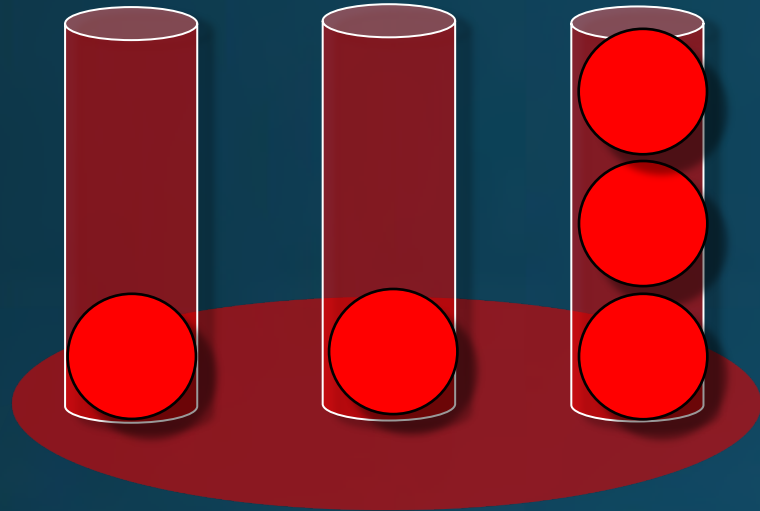
Safety-I vs Safety-II
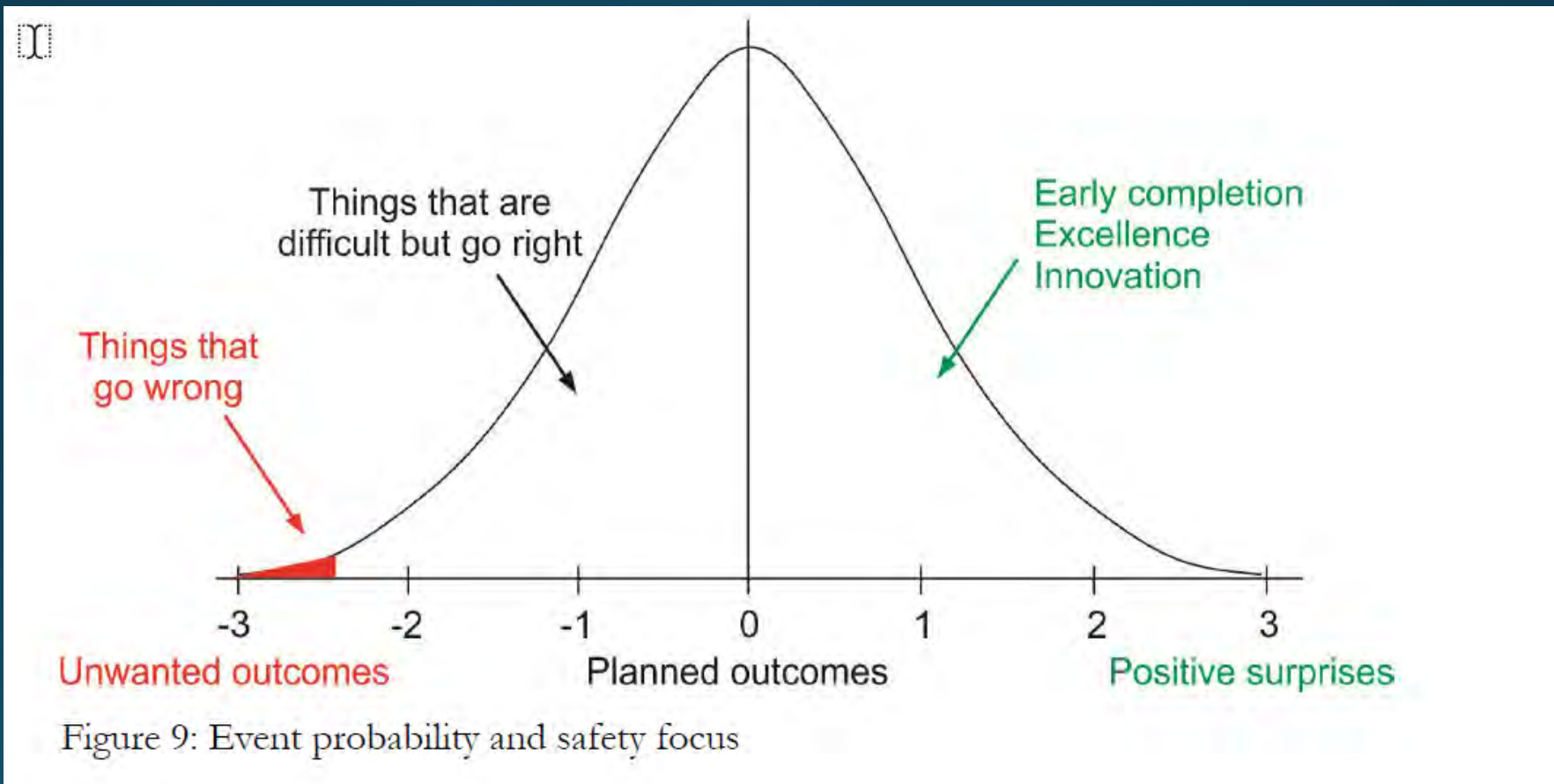
Figure 9: Event probability and safety focus

Hollnagel, E. Wears, R., Braithwaite, J. - EUROCONTROL (2013). *From Safety-I to Safety-II (A White Paper)*. Brussels.

Safety-I Data Approach

- **Reduce number of adverse events**
- **Look for failures & malfunctions, try to eliminate causes and improve barriers**
- **Learning only uses a fraction of the data available**

1 failure in 10,000 events

Risk Assessment & Safety Management (RASM)
Mitigating Factors

Mitigating Factors

High ← → **Low**

Risk Level

Safety-I vs Safety-II

	Safety-I	Safety-II
Definition of Safety	As few things as possible go wrong	As many things as possible go right
Safety Management Principle	Reactive, respond when something happens or is categorized as unacceptable risk	Proactive, continuously try to anticipate developments and events
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Safety-I vs Safety-II
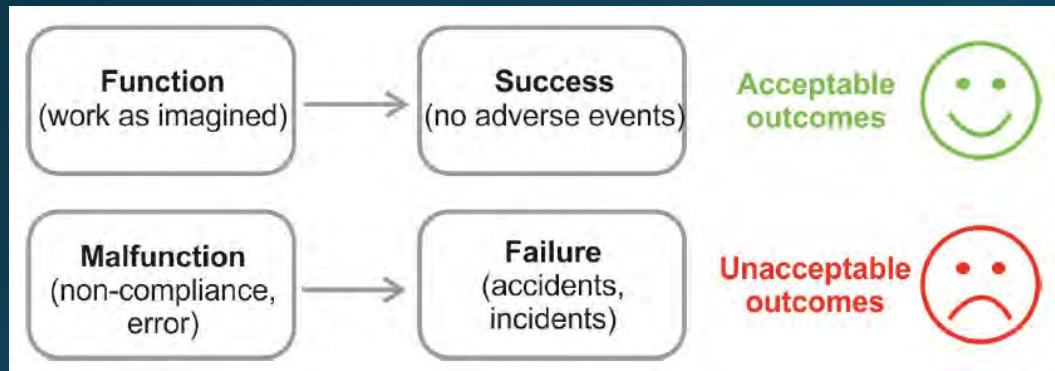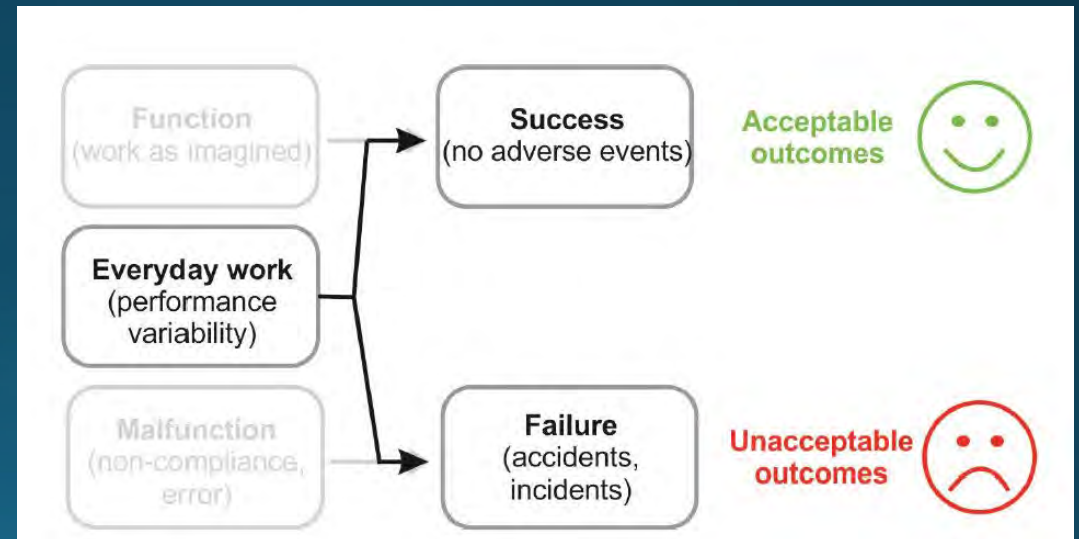
Safety-I

Safety-II

Hollnagel, E. Wears, R., Braithwaite, J. - EUROCONTROL (2013). *From Safety-I to Safety-II (A White Paper)*. Brussels.

Safety-I & Safety-II

- It is not Safety-I **or** Safety-II
- It is Safety-I **and** Safety-II

"Look at what goes right as well as what goes wrong, and learn from what works as well as from what fails."
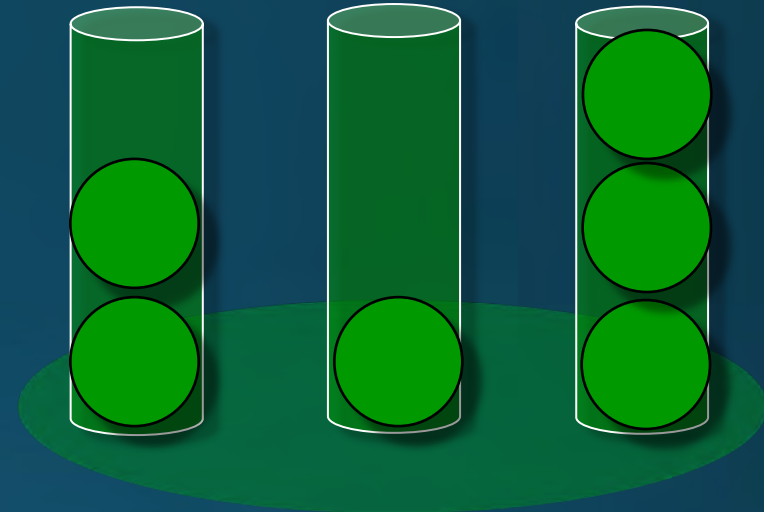
Concepts

Systems Thinking

Safety-I

Safety-II

Safety-II PreventiMaps

- **Safety-I** = **AcciMaps**
  Contributing Factor Analysis of "What went wrong?"

- **Safety-II** = **PreventiMaps**
  Mitigating Factor Analysis of "What went right?"

PreventiMap: Title IX Implementation on Campus
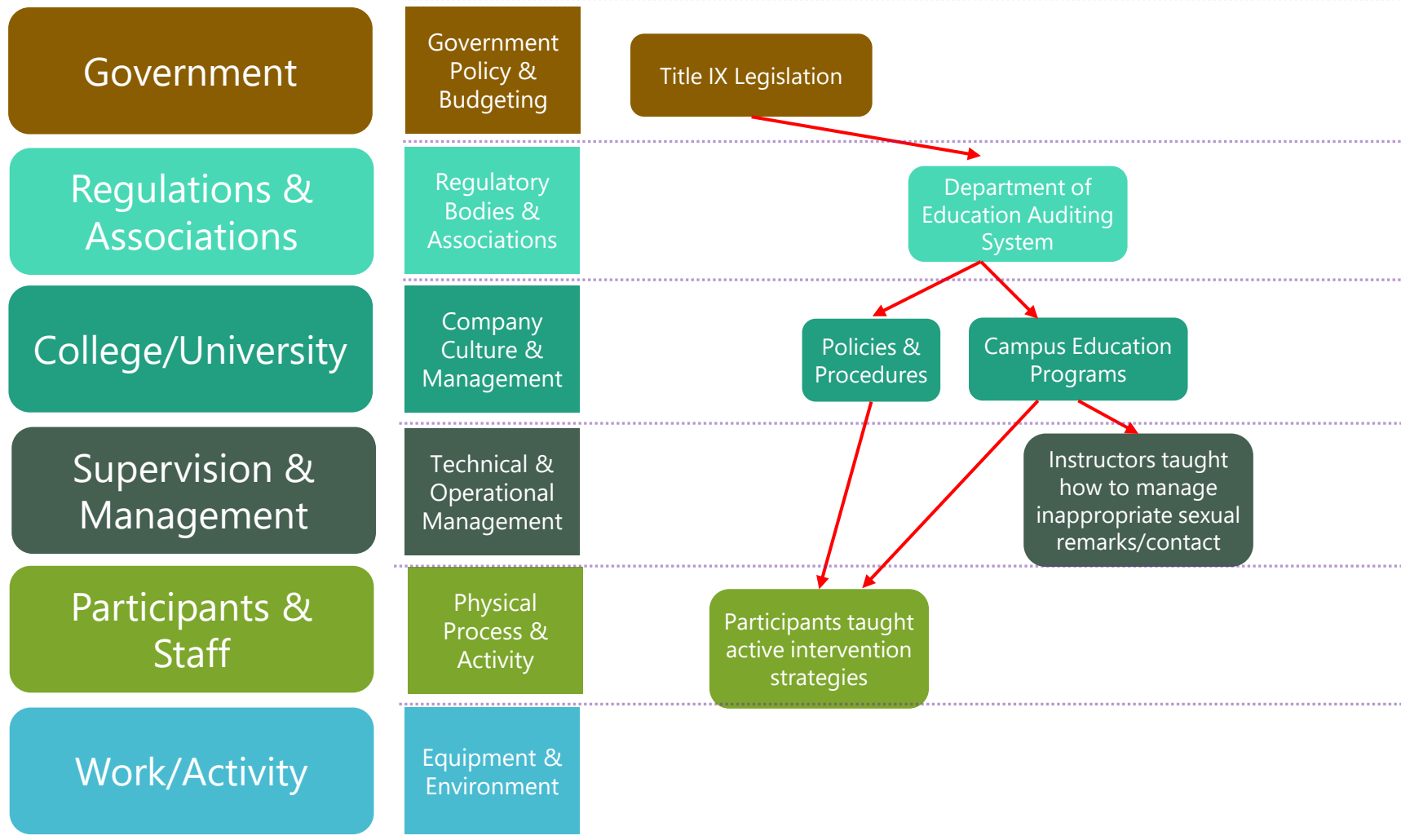
Behavioral Risk Management Model

- Safety I
- Safety II
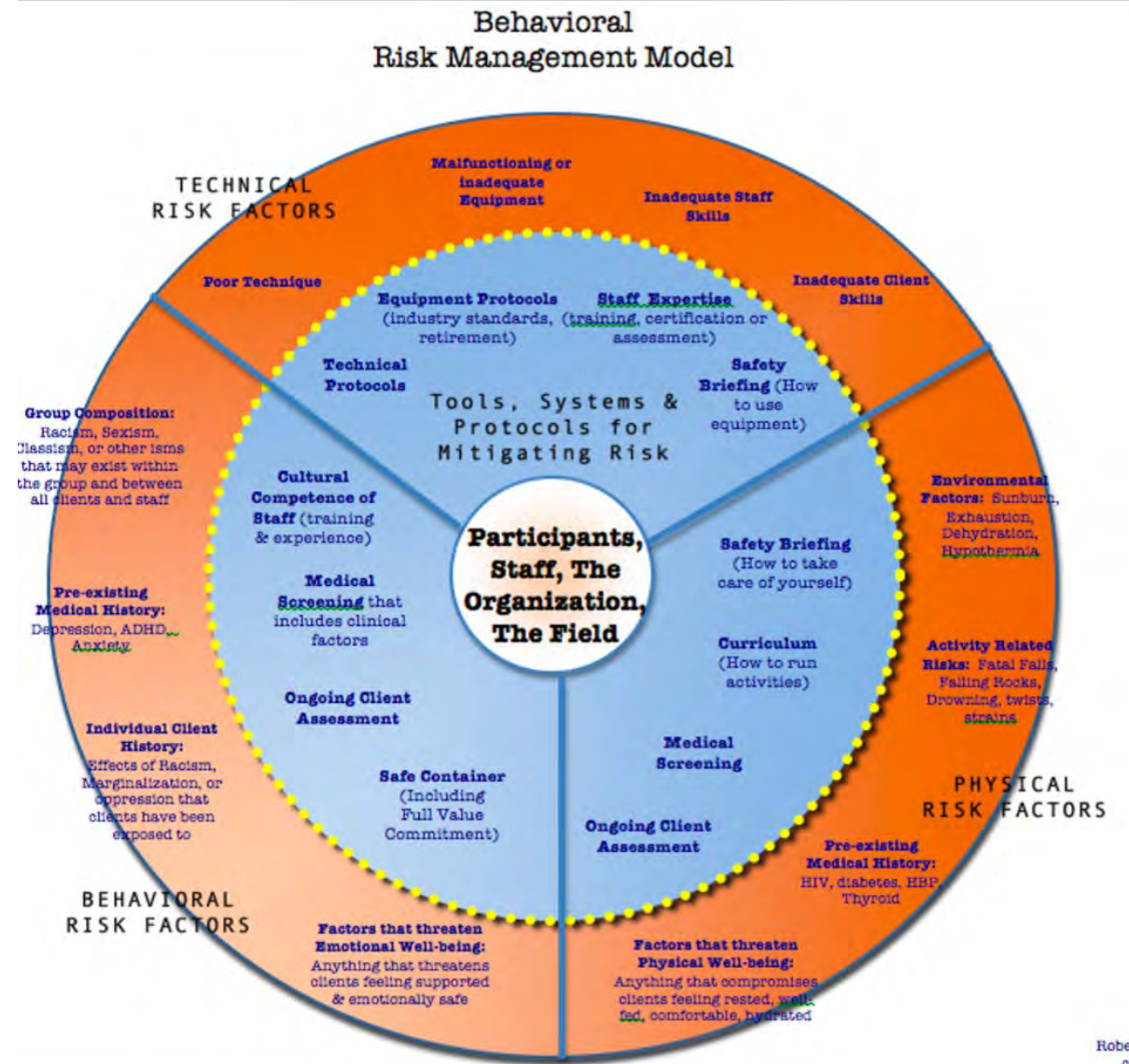
Behavioral Risks

- **Physical Safety** is only one dimension on the Risk Management spectrum
- **Psychological/Emotional Safety** is equally important and Hazards can be equally life threatening
  - Teens committing suicide after bullying
  - LGBTQIA+ individuals being assaulted or killed
- Talk to your staff about where there are Psychological/Emotional Hazards, Assess the Risk Level, and establish the necessary guidelines, structures, protocols, and culture to manage the risk
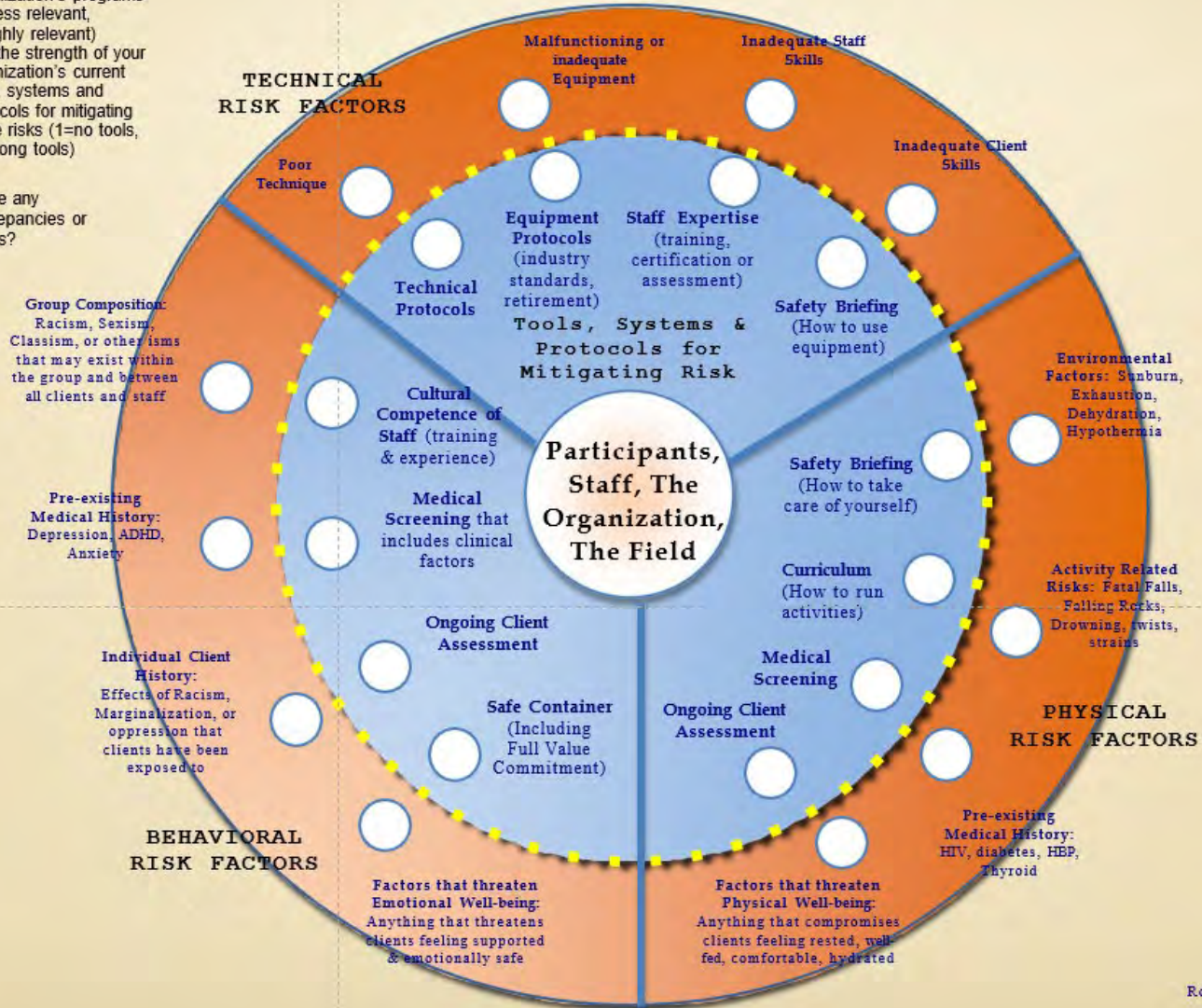
How to Integrate Safety-I & Safety-II?

- There is often a correlative relationship between Contributing Factors in Safety-I and the Mitigating Factors in Safety-II
  - "What is wrong points the way to what should be right"
- Any Incident/Near Miss analysis you do with Safety-I presents a set of targets for Safety-II

Implementing Safety Culture Change

- Responsibility runs up and down the entire organization
- Moves away from 'Blame Culture'
- Individuals need to be held accountable, but only for those things that they have control over
- Encourages incident and close call reporting
- More Data means deeper understanding

Concepts

Top 3 Contributory Factors/Taxonomy

| System Level	Contributing Factor	Contributing Factor	Contributing Factor
Government Policy & Budgeting	Policy, legislation & regulation	Action omitted, failure to act	**Judgment & decision making**
Regulatory Bodies & Associations	Standards, policy & regulation	Communication & coordination	**Judgment & decision making**
Local Area Government planning & Budgeting, Company Management	Risk assessment & management	**Qualification, experience, training & competence**	Policy & procedures
Technical & Operational Management	Planning & preparation	**Compliance violations & unsafe acts**	Personnel management & recruitment
Physical Processes & Actor Activities	**Judgment & decision making**	**Compliance violations & unsafe acts**	**Qualification, experience, training & competence**
Equipment & Surroundings	Physical & natural environment	Equipment, technology & resources	Weather & climate

Meta-analysis of AcciMap Causal Factors

Taxonomy	Contributory Factors	Percent
Equipment, Environment & Surroundings	Physical & Natural Environment Factors	**32.6%**
Equipment, Environment & Surroundings	Equipment, Technology & Resources	**30.8%**
Equipment, Environment & Surroundings	Weather & Climate	15.1%
Physical processes & Actor Activities	Judgement & Decision Making	**20.2%**
Physical processes & Actor Activities	Compliance with Procedures, Violations & Unsafe Acts	**20%**
Physical processes & Actor Activities	Qualification, Experience & Competence	15%

Small Group Discussion

- What System Levels are your greatest areas of risk?
- How can you proactively address those areas through organization-wide approaches?
- What things are In Scope?
- Share your successes and frustrations in addressing these questions
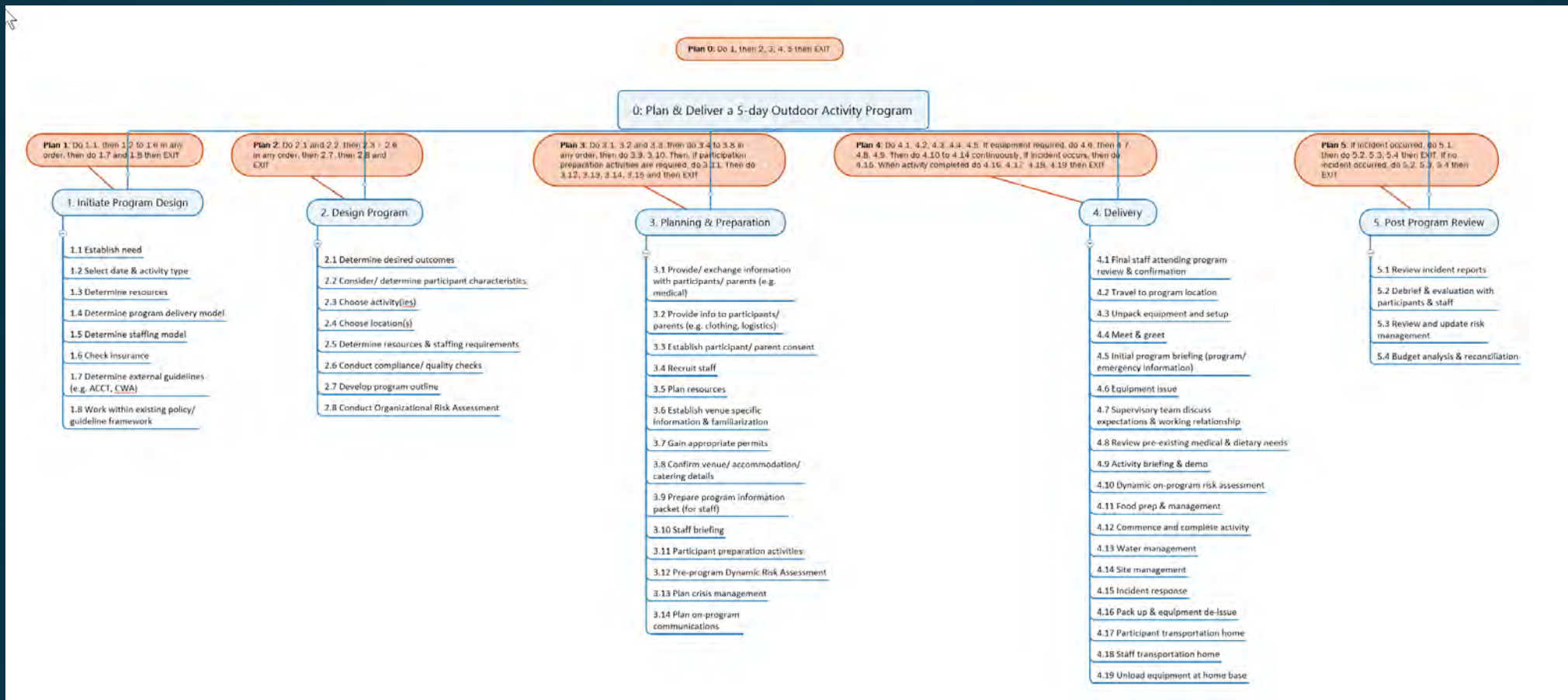
STEP 1 - HTA OF A 5 DAY LOA RAFTING AND CAMPING PROGRAM
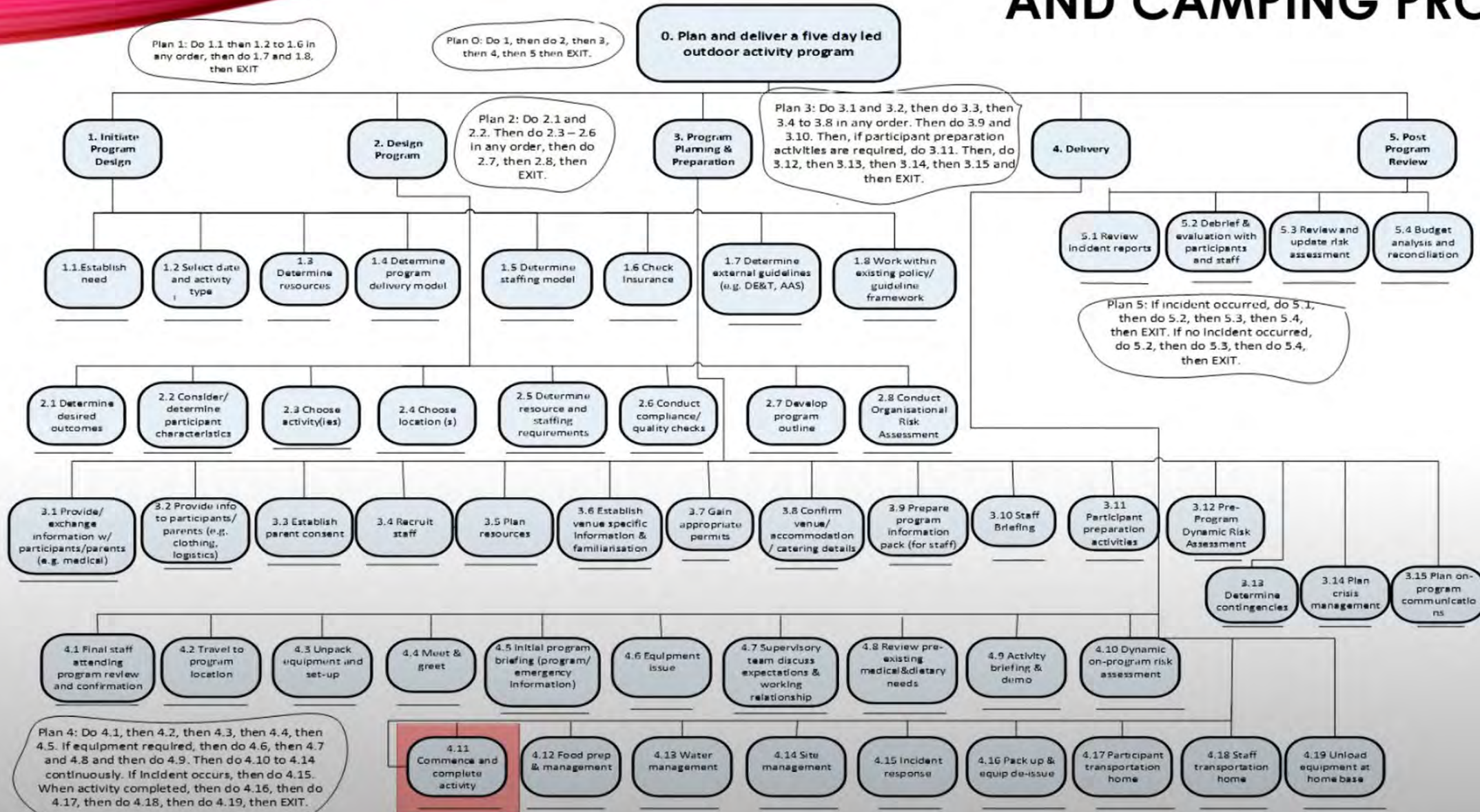
Hierarchical Task Analysis (HTA)

Identifying risks and emergent risks across sociotechnical systems: The NETworked Hazard Analysis and Risk Management System (NETHARMS). Clare Dallat, Paul Salmon, Natassia Goode
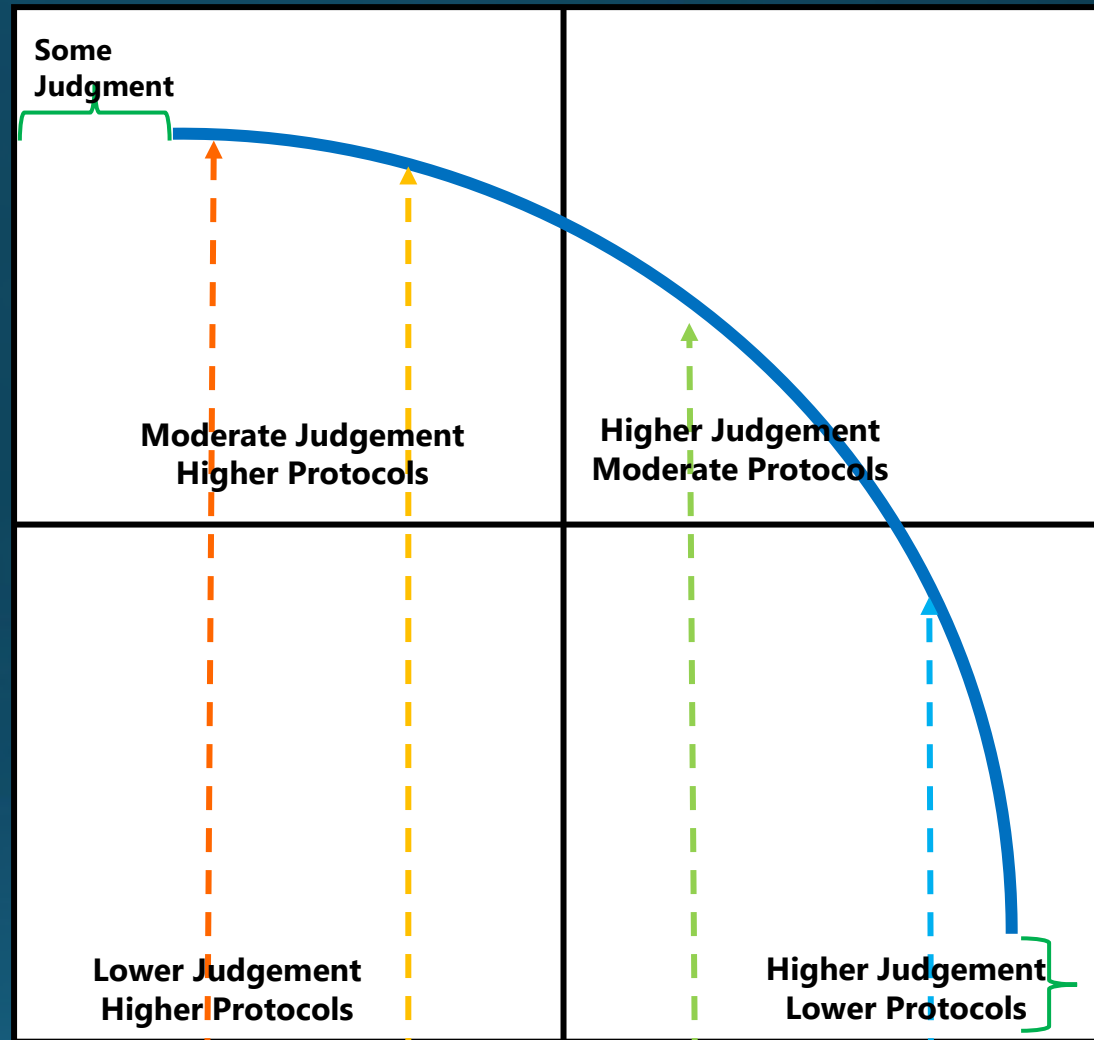
Key Concepts

- Systems Thinking
- Safety-I
- Taxonomy of Causation
- Building AcciMaps
- Safety-II
- Building PreventiMaps
- Scope
  - Identifying In Scope vs Out of Scope
  - Determining RMI for In Scope
- Collecting Incident and Close Call Data

Action Steps

- Do an AcciMap table-top exercise with your staff. Take an accident or near miss and analyze it

- Use the PreventiMap approach to design a System that you feel will protect youth from harm (whatever that may be) and identify all those things that are In Scope for your institution

Action Steps

- Implement Rasmussen's Systems Thinking approach in your organization for both Safety-I and Safety-II frameworks. Analyze adverse outcomes and near misses for the contributing factors that 'led' to the event. Analyze the mitigating factors in place that prevented an incident and determine how to 'expand' these factors.

- Analyze your data and determine when factors are 'in scope' allowing actionable steps to be implemented for managing risk or 'out of scope' limiting organizational response.

Final Thoughts

The biggest mistake
about a mistake
is not learning from it.

Data is safety.

Resources

www.IncidentAnalytix.com/blog
staff@IncidentAnalytix.com
www.OutdoorEd.com

Key Resources

- Risk Management in a Dynamic Society: A modeling problem – Jens Rasmussen (1997) - https://orbit.dtu.dk/ws/files/158016663/SAFESCI.pdf

- From Safety-I to Safety-II: A White Paper – Hollnagel E; Wears RL; Braithwaite J. (2015) - https://www.england.nhs.uk/signuptosafety/wp-content/uploads/sites/16/2015/10/safety-1-safety-2-whte-papr.pdf

- Translating Systems Thinking Into Practice: A Guide to Developing Incident Reporting Systems – Goode, Salmon, Lenne, Finch – Available at Amazon Books

Videos & Articles

- 1.5.5 Safety-I vs Safety-II - https://www.youtube.com/watch?v=WM0LVv9NrhM
- Doing Safety Differently – Sydney Dekker: https://www.youtube.com/watch?v=6gREMV6j2A4
- Safety-II & Safety-II – Erik Hoffnagel: https://vimeo.com/channels/1366431/89492241
- Perceiving what cannot be seen" - the practical side of Safety - II - Erik Hollnagel: https://vimeo.com/159498494
- A story of Safety-II – Jeffrey Braithwaite: https://www.youtube.com/watch?v=gauR843rRNk
- Safety Differently | The Movie: https://www.youtube.com/watch?v=moh4QN4IAPg
- Sidney Dekker — Safety Differently Lecture: https://www.youtube.com/watch?v=oMtLS0FNDZs
- Sidney Dekker — Just Culture short course 1: https://www.youtube.com/watch?v=PVWjgqDANWA
- The New View of Safety with Todd Conklin: https://www.youtube.com/watch?v=IoYUQIWiRgc
- Dr. Todd Conklin speech "Risk Analysis is Fixed in Time - But Hazards Ebb and Flow: https://www.youtube.com/watch?v=X211fU39808

Videos & Articles

- Guidelines for AcciMap Analysis: https://openresearch-repository.anu.edu.au/bitstream/1885/20987/2/01_Branford_Guidelines_for_ACCIMAP_2009.pdf
- Webinar: An Introduction to "New Safety" (HOP, Safety-II, and Safety Differently): https://www.youtube.com/watch?v=zqZVGaFIhyw
- FAA Safety Management Systems (SMS) Fundamentals: Policy: https://www.youtube.com/watch?v=j8N0PZx5YwM
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