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More than People, Equipment and Environment: A risk assessment method underpinned by the systems approach.

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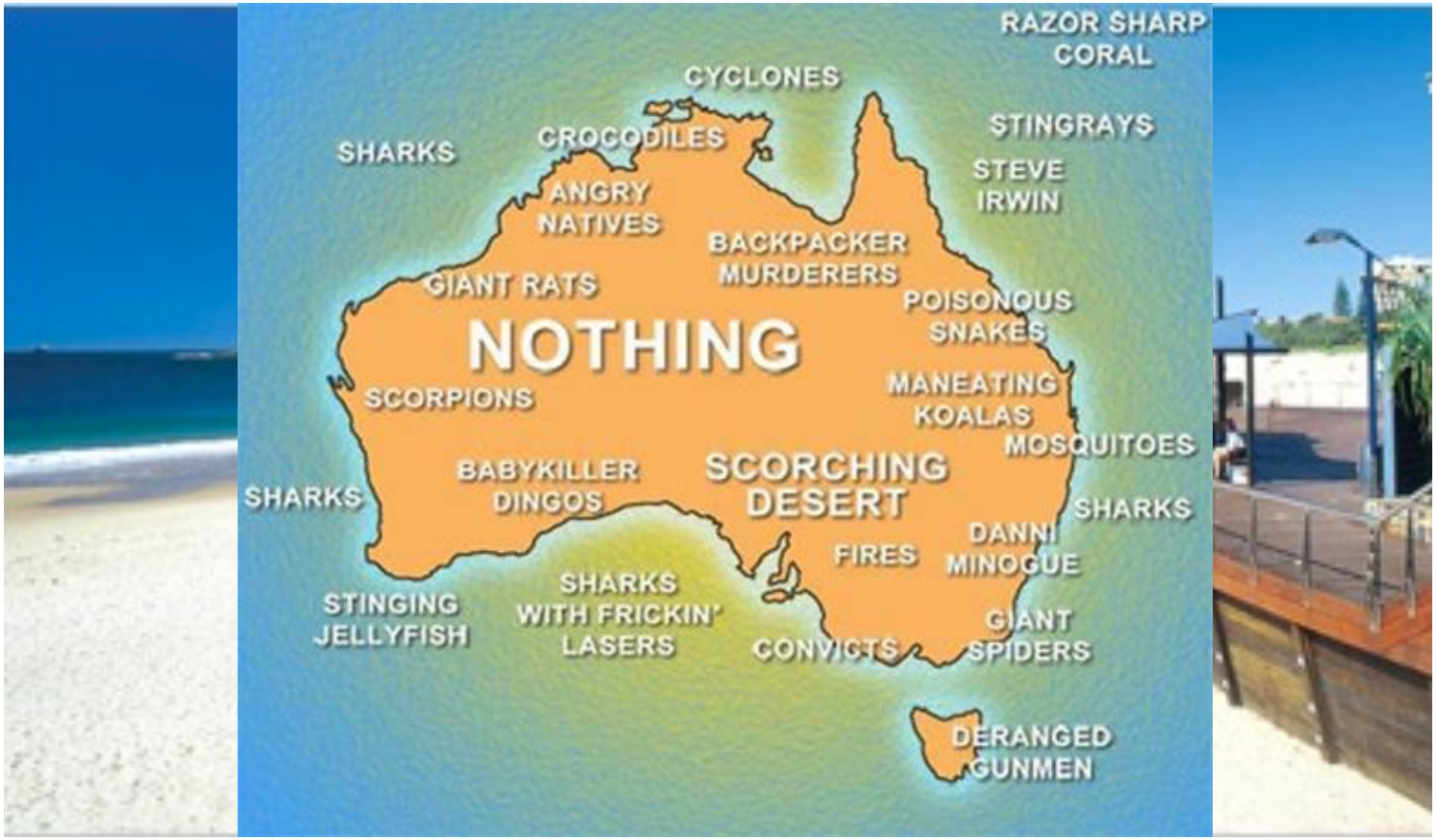

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Workshop Flow

- Evolution of Accident Analysis Understanding
- The 'Systems Approach'
- Accident Prediction (Organizational RA)
- UPLOADS – The Systems Approach in practice within the LOA (Led Outdoor Activity) Domain
- Studies of current practitioner perspectives and practice on RA
- Development of NO-HARMS

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The Research Problem

- Inadequate risk assessment (RA) highlighted as contributing factor in deaths of participants on led outdoor activities (LOA)
- The completion of a risk assessment is a formal requirement in planning LOA's
- Systems approach to accident causation in LOA sector (and safety critical domains generally) is now prevalent
- The extent to which schools/ organizations consider the overall LOA system during RA processes is not clear.

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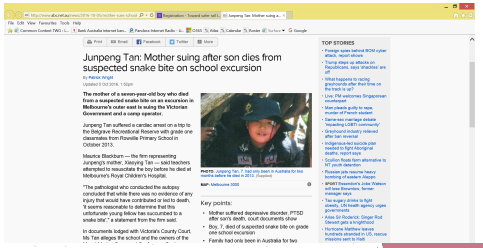
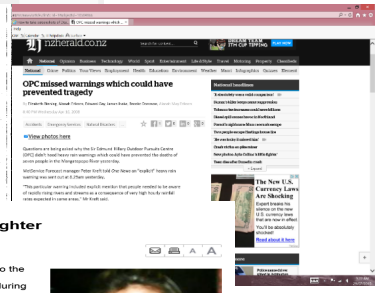
The Coroner's Verdict…

- "It was clear upon the evidence that the **risk assessment** process applied [to the Bells Parade excursion] by Mr Mc Kenzie and his staff was **informal, ad hoc and seriously inadequate**". (Coroner Rod Chandler, 2011 Tasmania).

- "There had been **no substantive analysis undertaken by the school** concerning swimming at this site, and **little or no current advice had been passed on** to the Year 7 homeroom teachers as a group". (Coroner Peter White, 2014 Victoria)

- "The failure to earlier undertake an **appropriate, comprehensive risk assessment**, proved critical". (Worksafe Victoria, 2011)





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What is Human Factors (or Ergonomics)?

Ergonomics (or *human factors*) is the scientific discipline concerned with the understanding of **interactions** among ***humans*** **and other elements** of a system, in order to **optimize human well-being and overall system performance**.

Human Factors and Ergonomics Society

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What is Risk Assessment?

- An organizational process and part of planning;

- According to the ISO 31000, RA involves three stages:
  - risk identification,
  - risk analysis, and
  - risk evaluation (ISO, 2009b).

- In LOA terms, it is a **planning process** implemented **prior** to the program to **identify**, **assess** and take organisational **action** to **prevent harm** to participants and staff.

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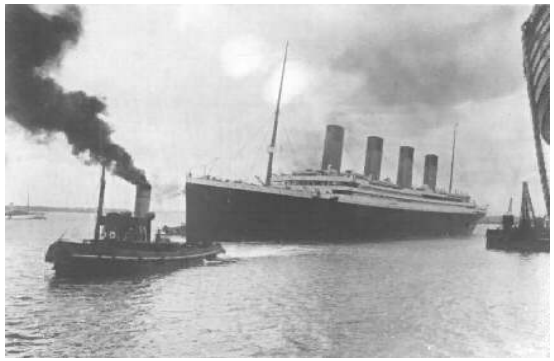
The history of accident analysis



1960s	1970s	1980s	1990s	2000s
Aberfan	Flixborough	Chernobyl	Paddington	Linate
Ibrox	Seveso	Zeebrugge	Long Island	Uberlingen
	Tenerife	Bhopal	Alabama	Columbia
	TMI	Piper Alpha	Estonia	
	MT Erebus	Dryden	Eschede	

Reason (2008)

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The Systems Approach

1. Safety is impacted by the decisions and actions of everyone in the system not just front line workers.
2. Near misses and adverse events are caused by multiple, interacting, contributing factors.
3. Effective countermeasures focus on systemic changes rather than individuals.

The goal is not to assign blame to any individual, but to identify how factors across the system combine to create accidents and incidents.

The goal of accident prevention is to improve the system, not individual workers. Well designed systems allow humans to flourish. Restricted humans enable systems to break.

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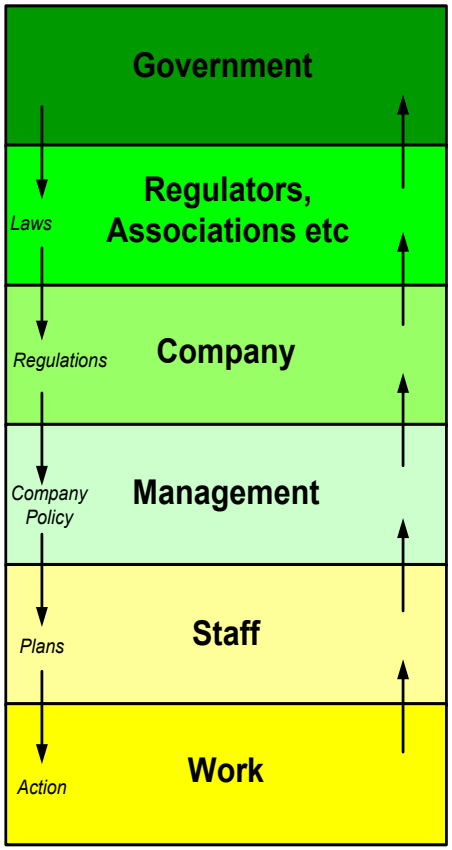
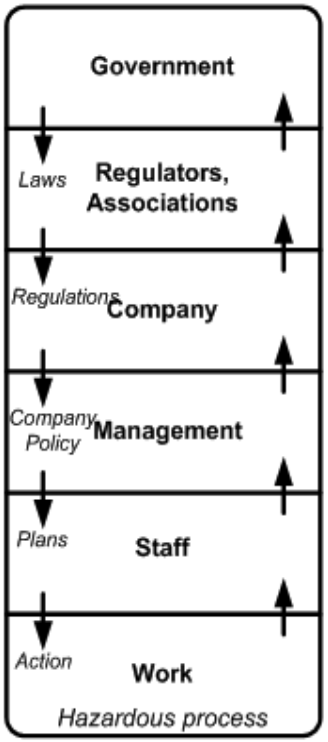
Systems thinking

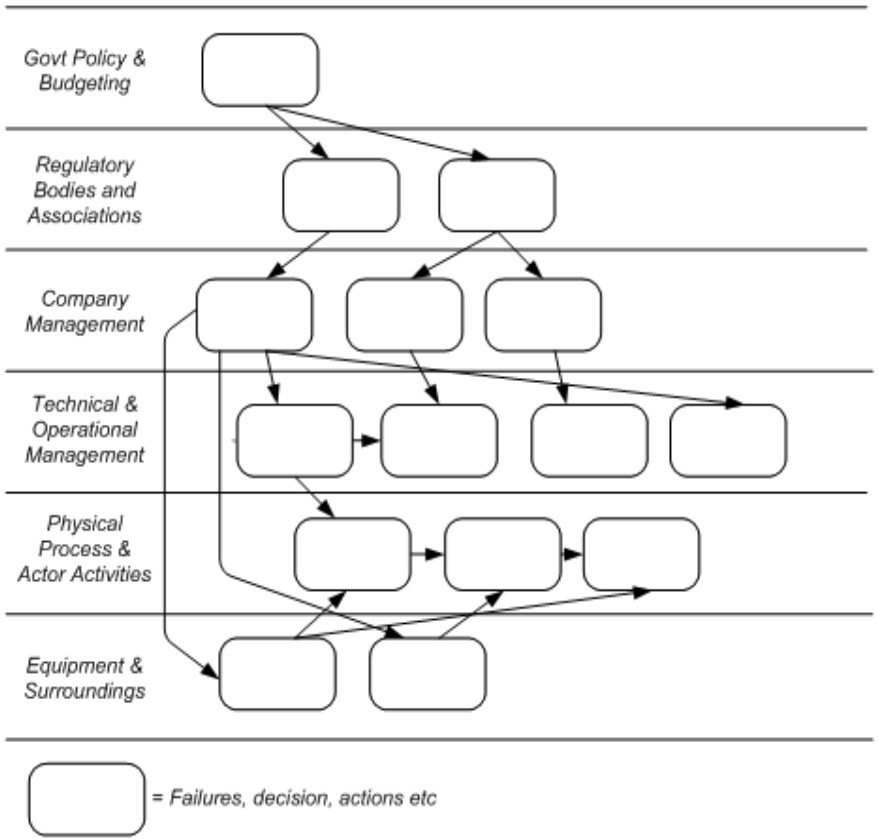


- "Safety is impacted by the decisions of **all actors** – politicians, CEOs, managers, safety officers and work planners – not just the front-line workers alone. Consequently, threats to safety usually result from a loss of control caused by a **lack of vertical integration** (i.e. mismatches) across levels of a complex socio-technical system, **not just from deficiencies at any one level alone**. **All players play a critical, albeit different, role in maintaining safety**". (Cassano-Piche et al, 2009)

- Normal behaviour

Rasmussen's Risk Management Framework and Accimap





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Evolution of thinking

- Human error is the cause of incidents
- To understand failure, you must examine failures only
- Systems are safe
- Unreliable and erratic humans make them unsafe
- Systems can be made safer by restricting humans through procedures, automation etc

- Human error is a symptom of problems across the system (*it is a consequence not a cause*)
- Incidents caused by multiple interacting factors
- To understand 'failure' look at why people's actions made sense at the time
- Systems are unsafe
- Humans create safety through practices at all levels of the system

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Accidents are complex……..

"There is no single cause. Neither for failure, nor success. In order to push a well defended system over the edge (or to make it work safely), a large number of contributory factors are necessary and only jointly sufficient" (Dekker, 2006, pg. 80)

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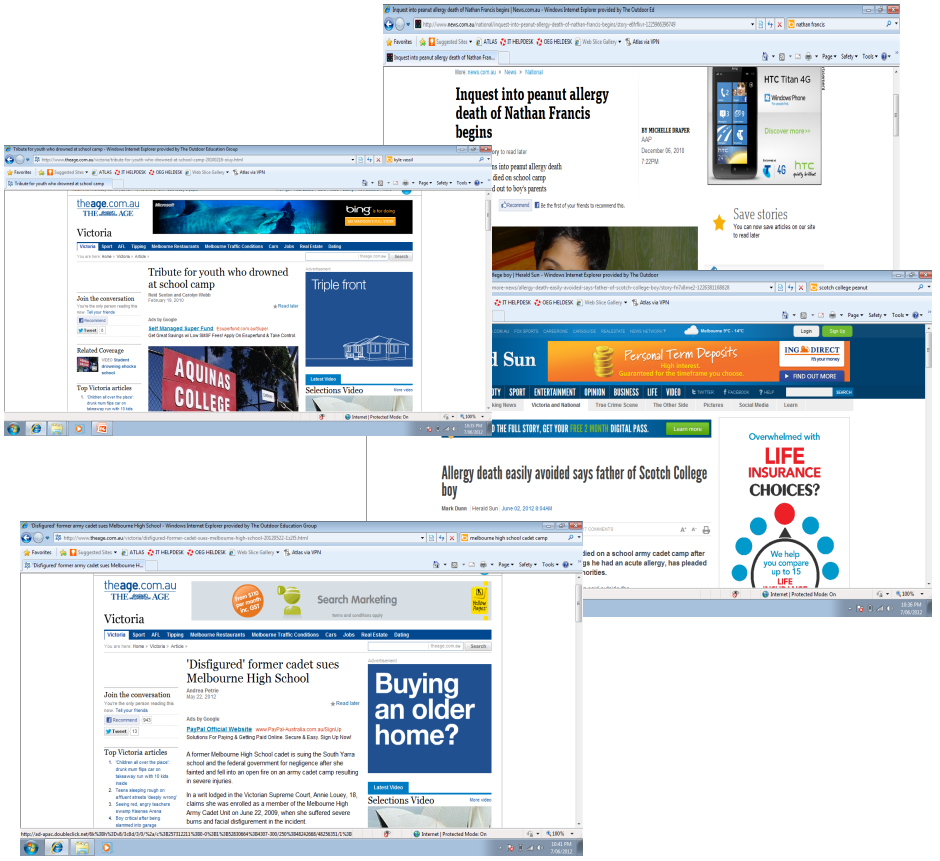
Is what WE do Complex?



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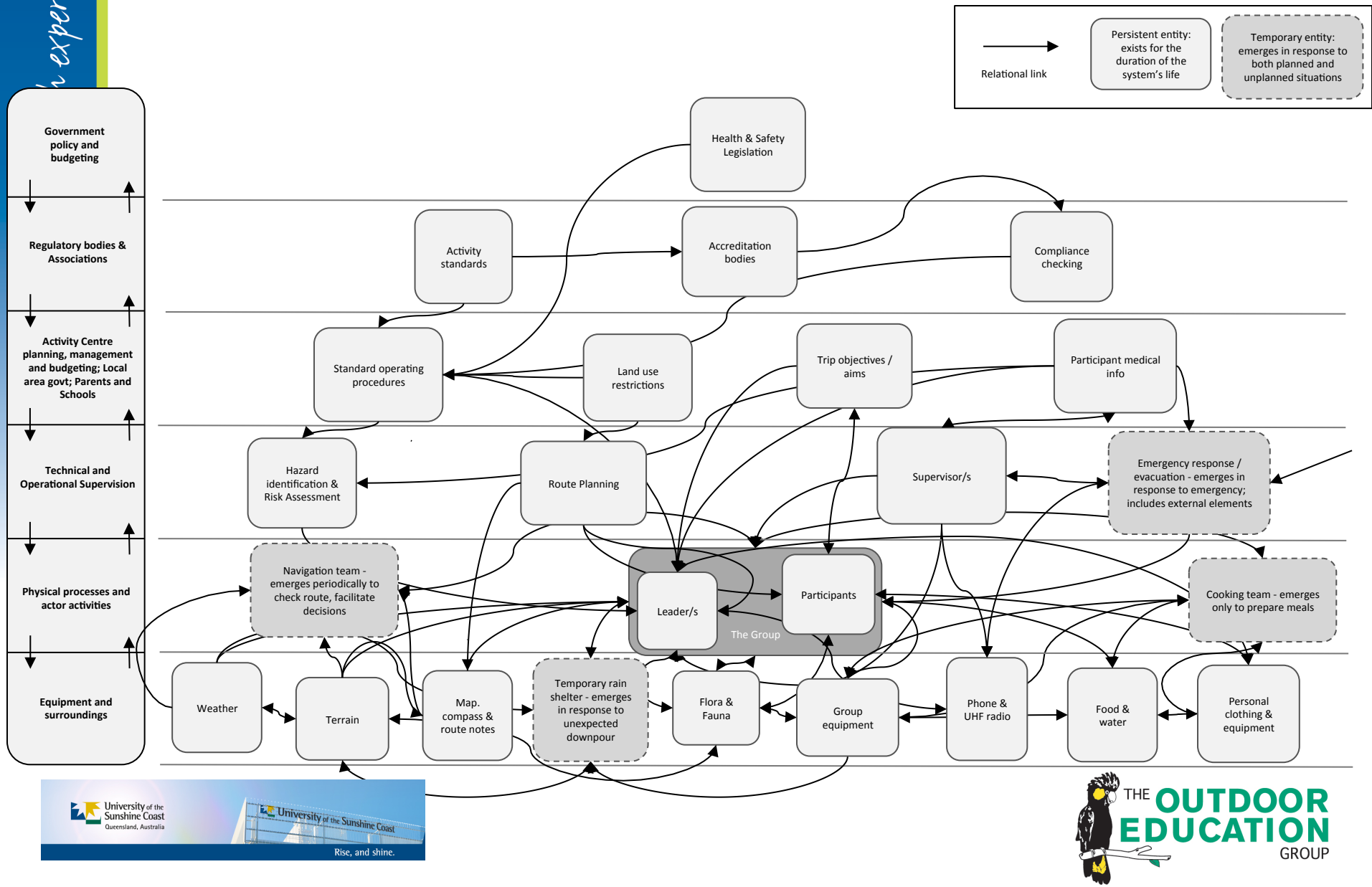
A typical three day LOA program

Carden et al, 2016



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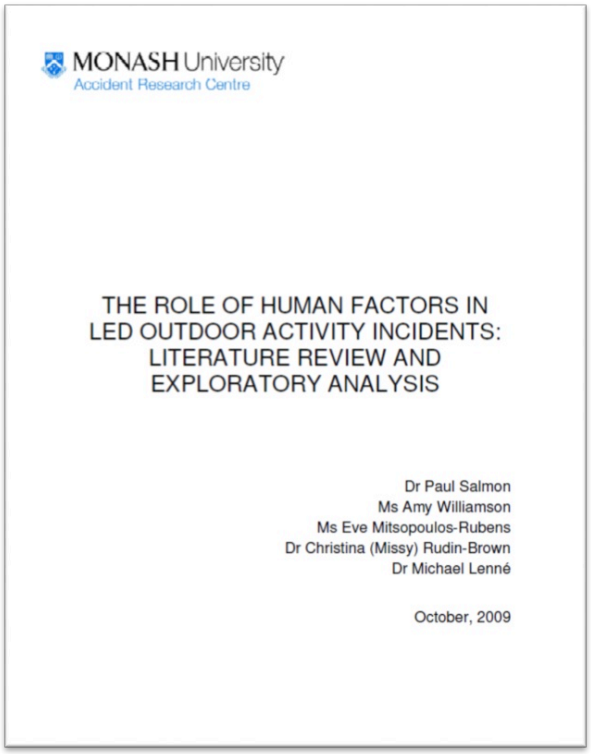
UPLOADS: The beginning


MONASH University
Accident Research Centre

THE ROLE OF HUMAN FACTORS IN LED OUTDOOR ACTIVITY INCIDENTS: LITERATURE REVIEW AND EXPLORATORY ANALYSIS

Dr Paul Salmon
Ms Amy Williamson
Ms Eve Mitsopoulos-Rubens
Dr Christina (Missy) Rudin-Brown
Dr Michael Lenné

October, 2009

Report made the following recommendations:

1. Development of a unified, theoretically underpinned accident and incident reporting system;

2. Development of a National led outdoor activity accident and incident database;

3. Development and application of a theoretically underpinned, systems-based accident analysis method;

4. In-depth analysis of led outdoor activity accident and incidents; and

5. Development of a led outdoor activity accident causation model and associated failure taxonomies.

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The UPLOADS Project

Australian Government
Australian Research Council

Goal: develop a standardised, national approach to incident reporting and learning for the outdoor education sector in Australia, and a corresponding national incident dataset

Support:

1. Organisations to learn from incidents; and
2. The sector to understand the risks it faces, and take appropriate action.

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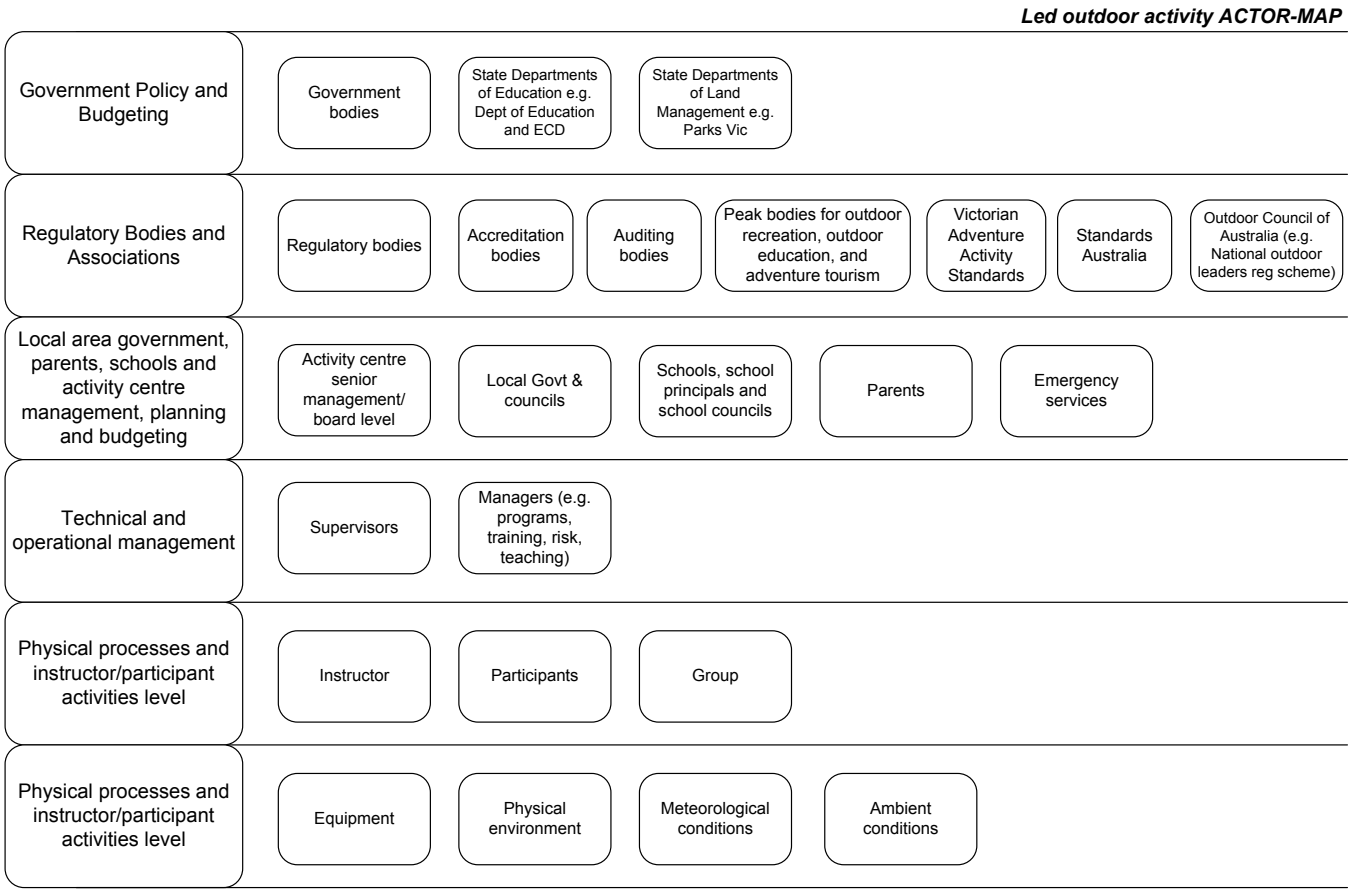
The Outdoor Education System



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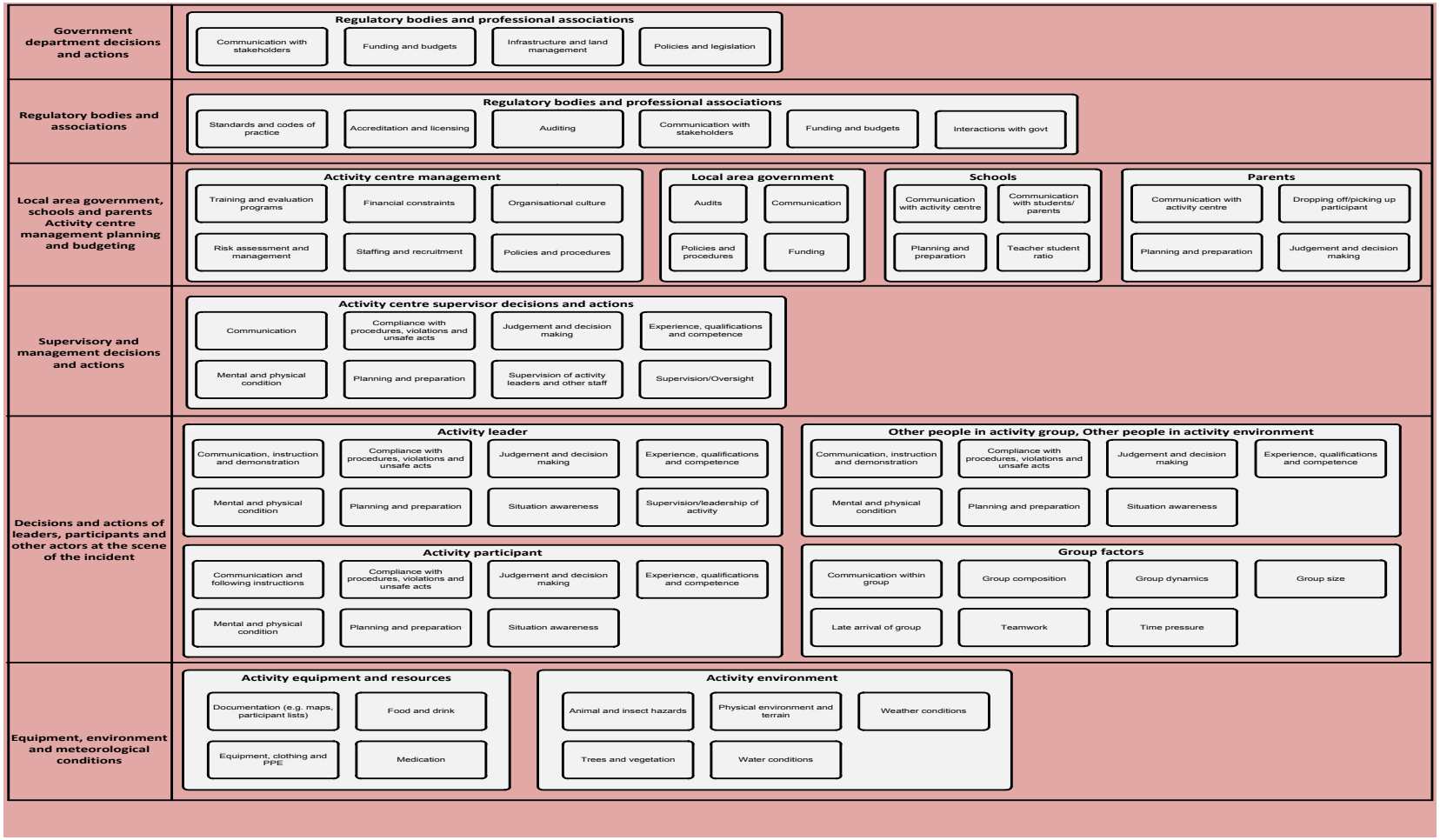
UPLOADS Causal Factor Taxonomy



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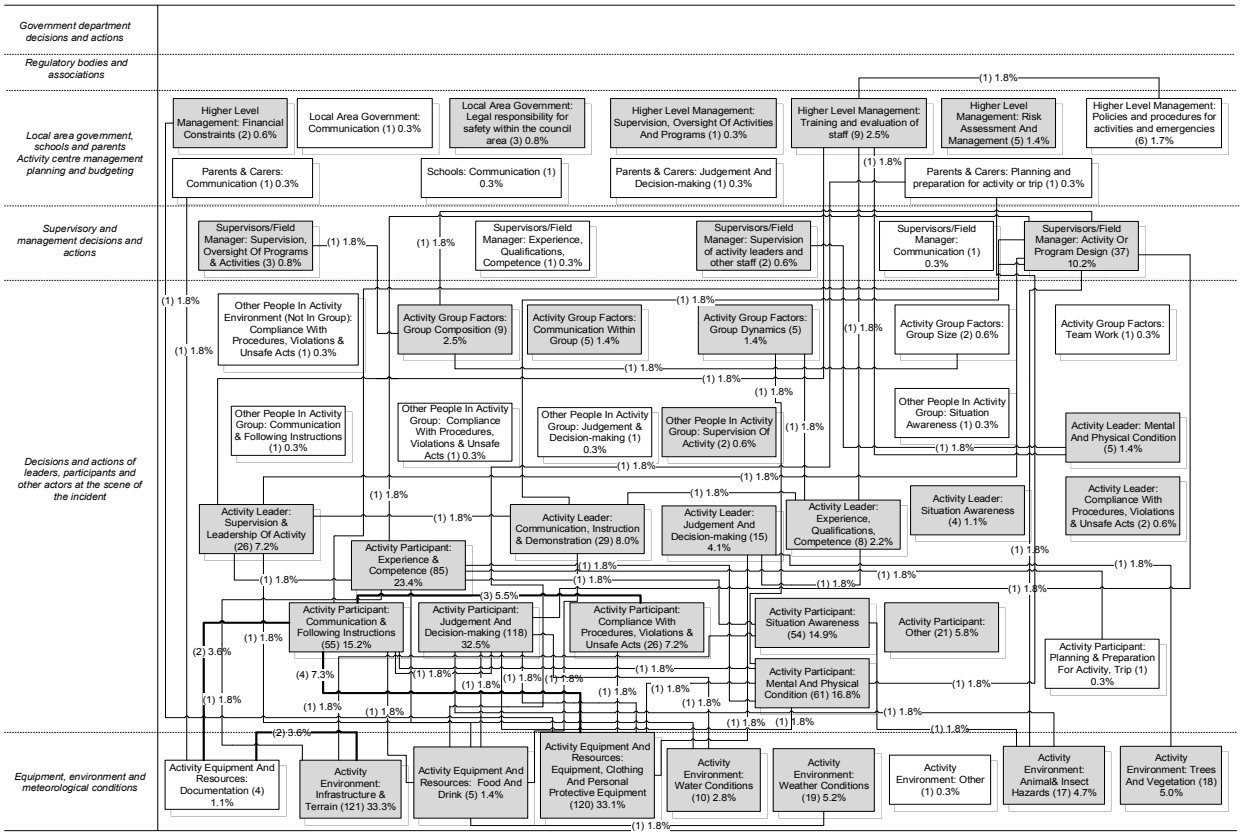
Factors influencing injury causation

Source: UPLOADS 12 month trial



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Summary of contributory factors

Local area government, schools, parents, activity centre management planning and budgeting

- Inadequate risk assessments
- Policies and procedures for activities and emergencies (e.g. management procedures for designing activities)
- Interactions between activity center, schools and parents

Supervisory & management decisions and actions

- Lack of supervision of staff in the field
- Issues relating to activity/program design
- Groups with variable abilities requiring higher levels of supervision

Decisions and actions of leaders, participants, and other actors at the scene of the incident

- Activity Participant: Communication & following instructions
- Activity Participant: Symptoms related to pre-existing injury (e.g. knee injury, wrist injury)
- Activity Leader: Supervision & leadership of activity
- Activity Leader: More instruction or briefing required for activity
- Activity Leader: Mental and physical condition (not fit for work)

Equipment & Environment

- Lack of appropriate equipment (i.e. participants not bringing equipment)
- Documentation
- Activity Environment: Infrastructure & terrain

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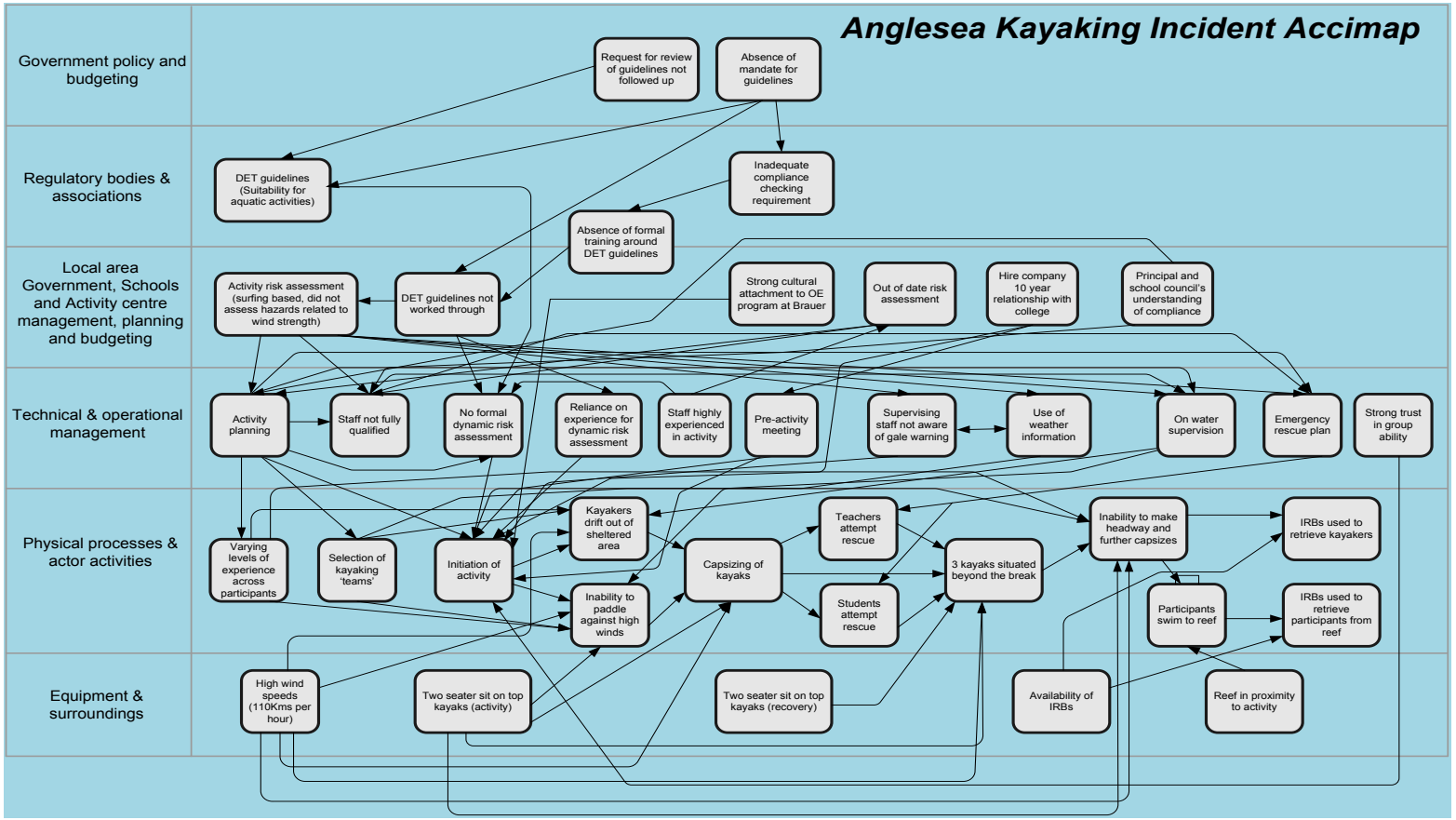
Application of Accimap to LOA Domain



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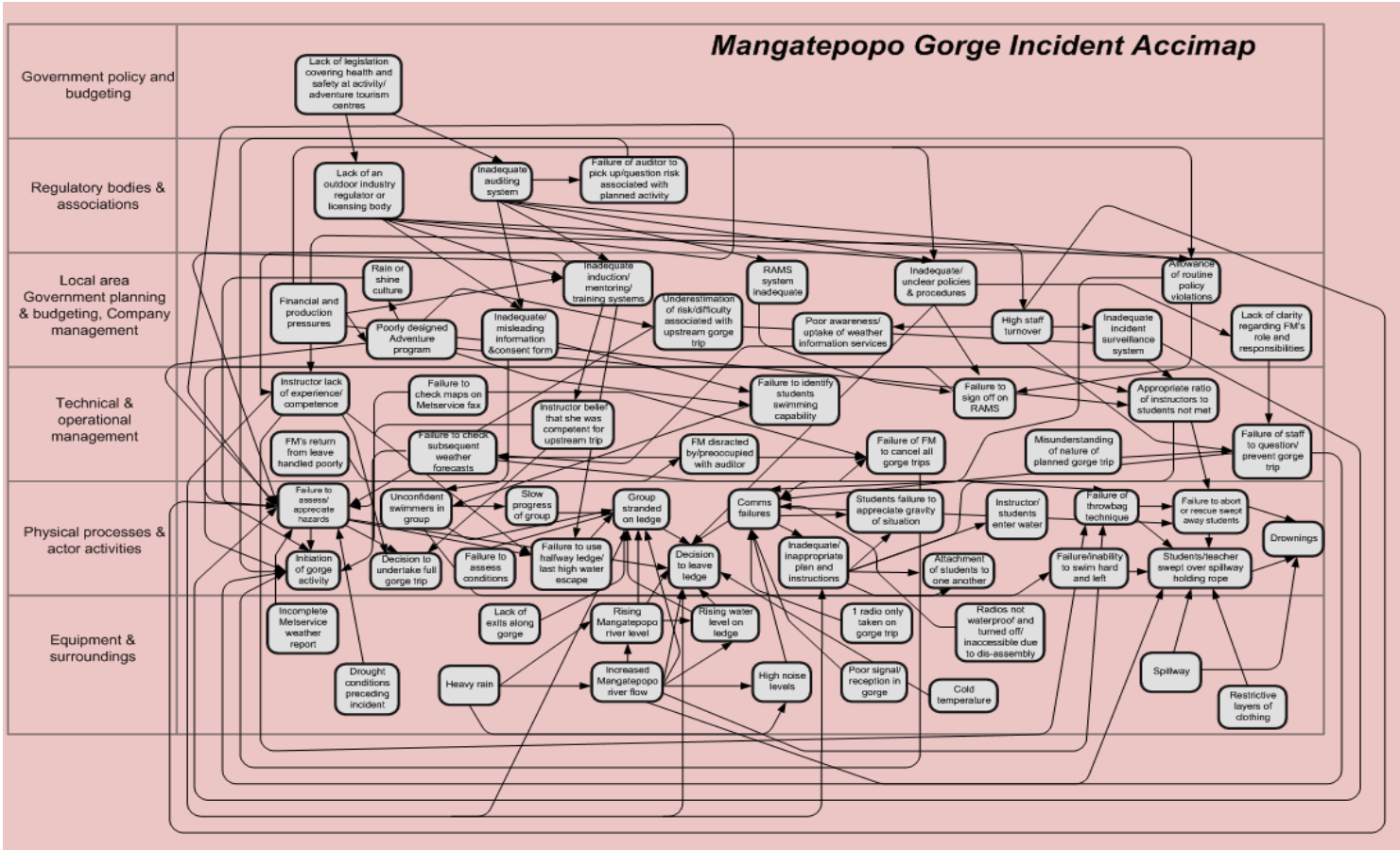
Mangatepopo Gorge Accimap



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The Obvious Challenge

- "In order to prevent incidents and accidents, it is necessary to predict them" (Hollnagel, 2004).

- "In modern complex, hazardous organizations, risks are rarely self-evident" (Macrae, 2016).

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Risk Assessment using a Systems Approach

Outcome: Hazards across the **entire** system would be identified, and consequent risks to participant (s) harm assessed and managed.

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Study 1 – Industry Survey Findings

Gender Split

- Male – 76%
- Female – 24%

Type of Organisation

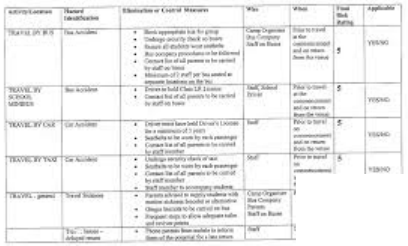
- OE Provider – 55%
- School – 30%
- RTO – 17%

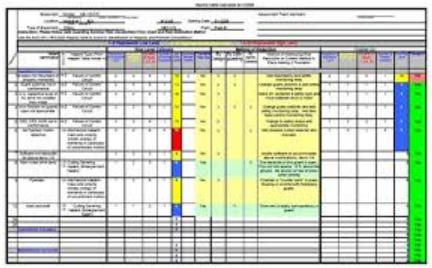
Experience (Years)

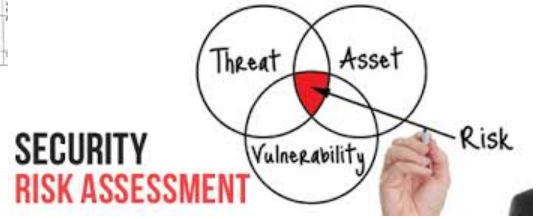
- 0-1 – 11%
- 2-3 – 24%
- 4-5 – 14%
- 6-10 – 16%
- 10+ – 35%

Do you believe there are any issues regarding the application of risk assessments to the outdoor activity/ program context?

- **Yes – 79%**
- No – 21%


RISK ASSESSMENT GRID FOR EACH IDENTIFIED RISK





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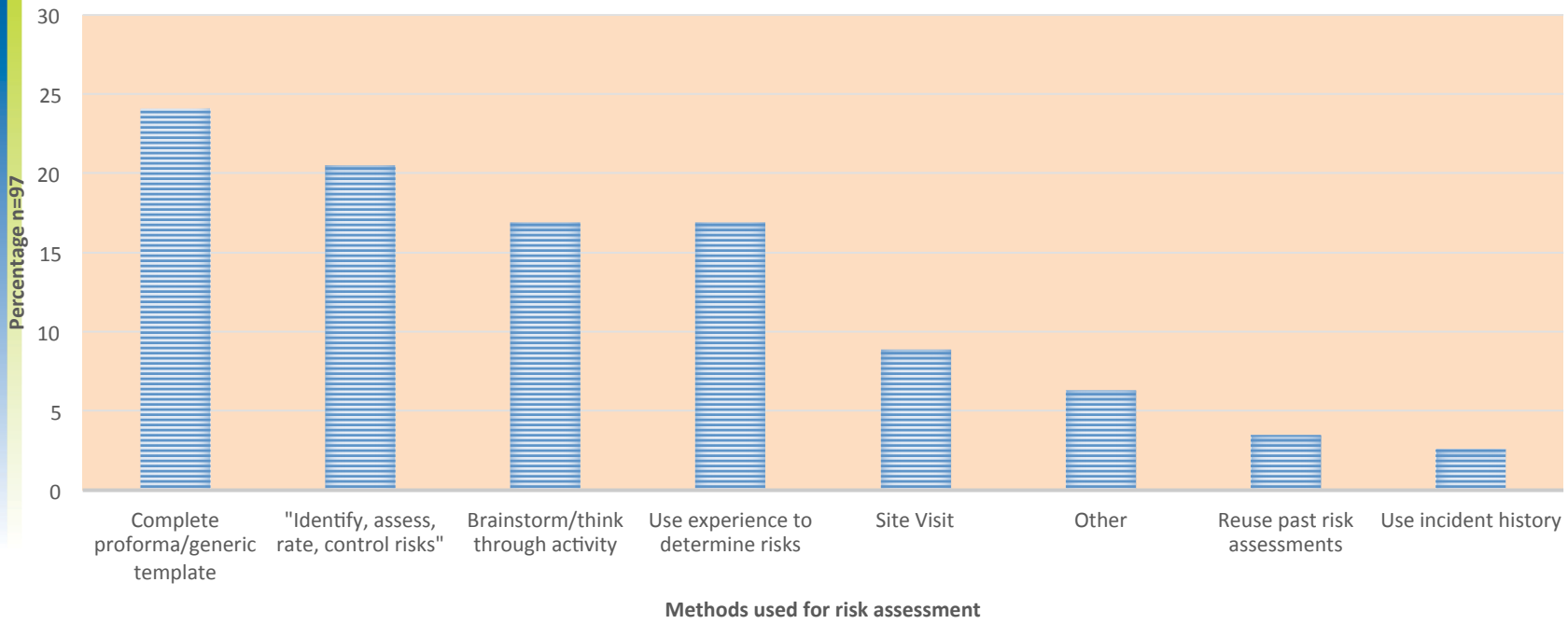
Methods used to conduct RA's



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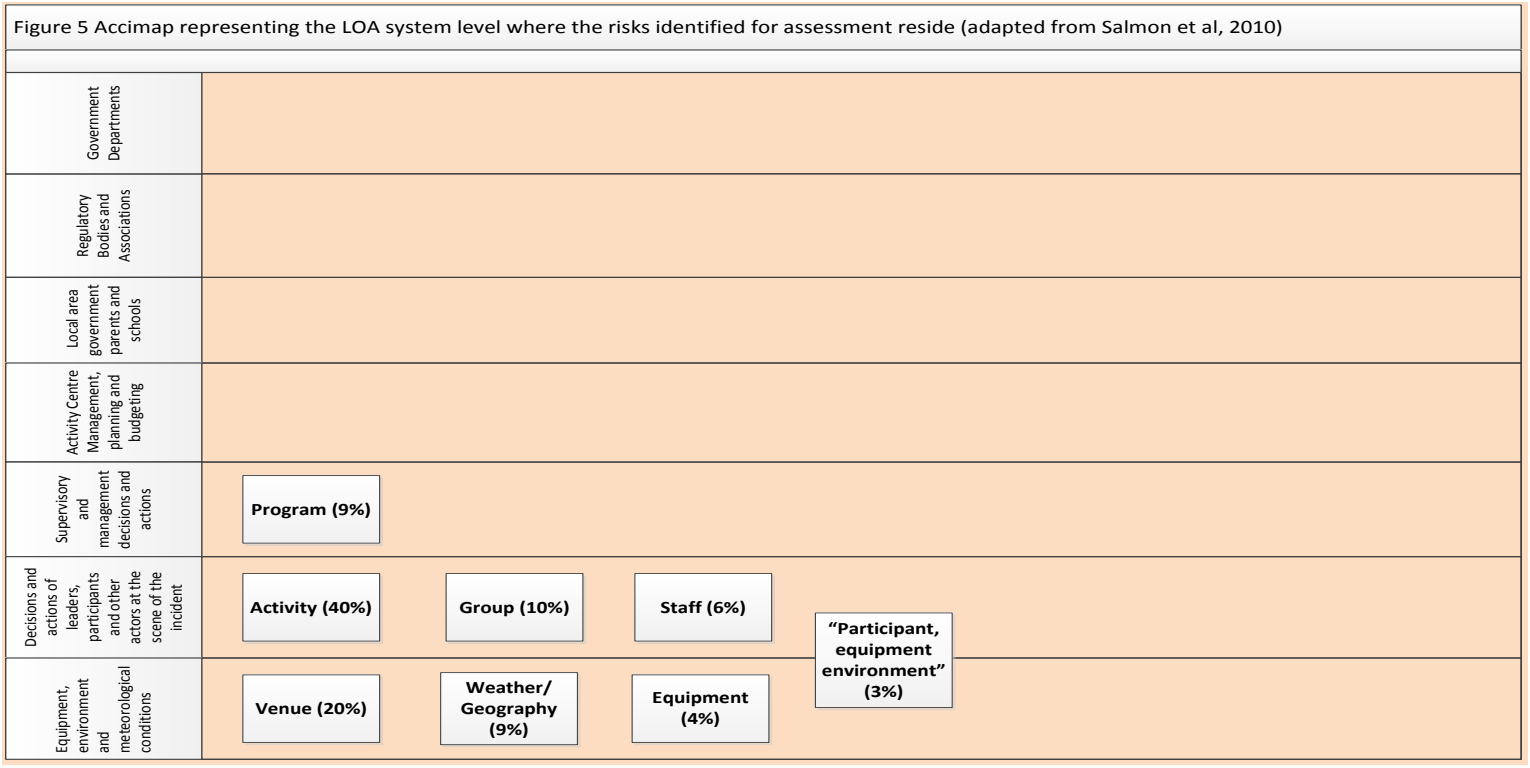
What risks are you assessing?

Figure 5 Accimap representing the LOA system level where the risks identified for assessment reside (adapted from Salmon et al, 2010)



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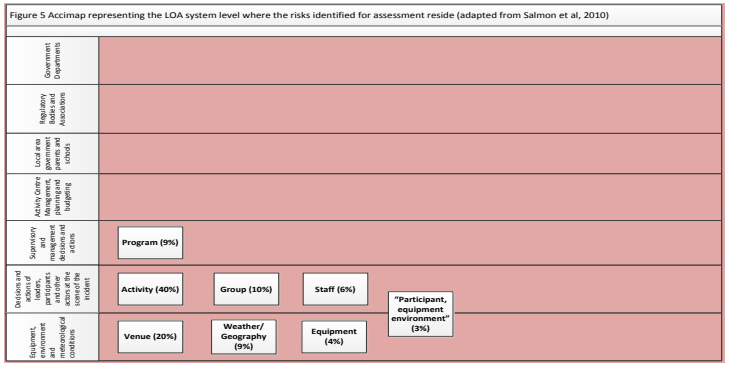
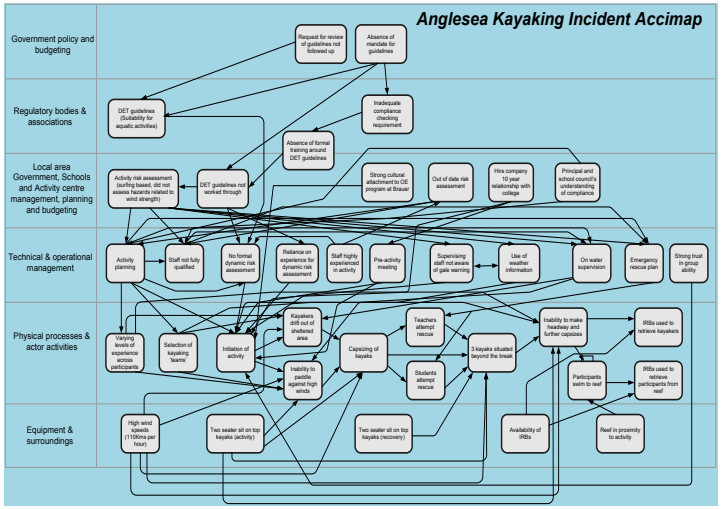
Key Findings

- Risks assessed related to the activity, the venue or site, staff, the group, the weather, and the category of program.
- Accident causation research demonstrates that factors also related to schools/centers/orgs, organization management, parents, activity leader supervision, risk assessment, and program design.
- **Only a small proportion of the potential risks around LOA program development and delivery are currently being assessed.**





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Key Findings Cont.d

- 57% of respondents learned organisational risk assessment ‘on the job’;
- 27% of organization’s have no policy or guidelines around organizational risk assessment;
- 35% use brainstorming or thinking up risks as a method of risk assessment;
- 70% of respondents currently ‘confused’ in relation to organizational risk

Overall, the risk assessment methodologies available to practitioners are difficult to appropriately adapt to the LOA context.

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Not a new problem, nor country specific…

"The basic problem is that for several years people have not understood what they have been trying to do when writing risk assessments" (Bailie, 1996, pp. 6).

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Study 2 – How are we conducting Risk Assessments?

- Four outdoor education program risk assessments analysed to assess the extent to which they were underpinned by contemporary systems thinking.

- UPLOADS Accident Analysis Framework and Accimap used to analyse and map hazards and actors.

- 77 Hazards identified
- 8 Actors
- 3 States
- Multiple activities (n=21)
- Camp and Journey Based Programs represented

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An Accimap displaying the identified hazards within the four risk assessments

Government department decisions and actions							
Regulatory bodies and associations							
Local area government, schools and parents Activity centre management planning and budgeting							
Supervisory and management decisions and actions	Student numbers						
Decisions and actions of leaders, participants and other actors at the scene of the incident	Limited skill (1)	Medical conditions (3)	Exhaustion (1)	Special needs group (1)	Abrasions (1)	Lost student (1)	
	Dehydration (1)	Burns (3)	Fatigue (1)	High risk behaviour (1)	Fractures (3)	Infection (1)	
	Chafing (1)	Slips and trips (1)	Strains and sprains (2)	Abduction (1)	Injury from arrow (1)	Negative impact with another group (1)	
	Trailer reversing (1)	Jumping (1)	Diving (1)	Falls (3)	Allergic reaction (3)		
Equipment, environment and meteorological conditions	Steep terrain (1)	Sloping ground (1)	Tree fall (1)	Temperature hot/cold (3)	Falling objects (1)	Sharks (1)	Bike failure (1)	Vehicles (1)
	Unknown site (1)	Environment being harmed by human (1)	Road hazards (1)	Weather conditions (2)	Heights (1)	Exposure (1)	Communication device failure (1)	Jewellery (1)
	Treed campsite (1)	Wild animals (1)	Lightning (2)	Water visibility (1)	Drowning (3)	Fire (1)	Clothing entangled in bike (1)	Arts and crafts material (allergic reaction to) (1)
	Exposed ridges/hollows (1)	Cattle grids (1)	Animal bites/stings (3)	Rips (2)	Water quality (2)	Sunburn (1)	Trailer decoupling (1)	Equipment failure (1)

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Dominant model of Risk Assessment in the Led Outdoor Context

- The “People, Equipment and Environment” approach.
- Focuses predominantly at risks/actions at the immediate context of, and within, the confines of the activity.

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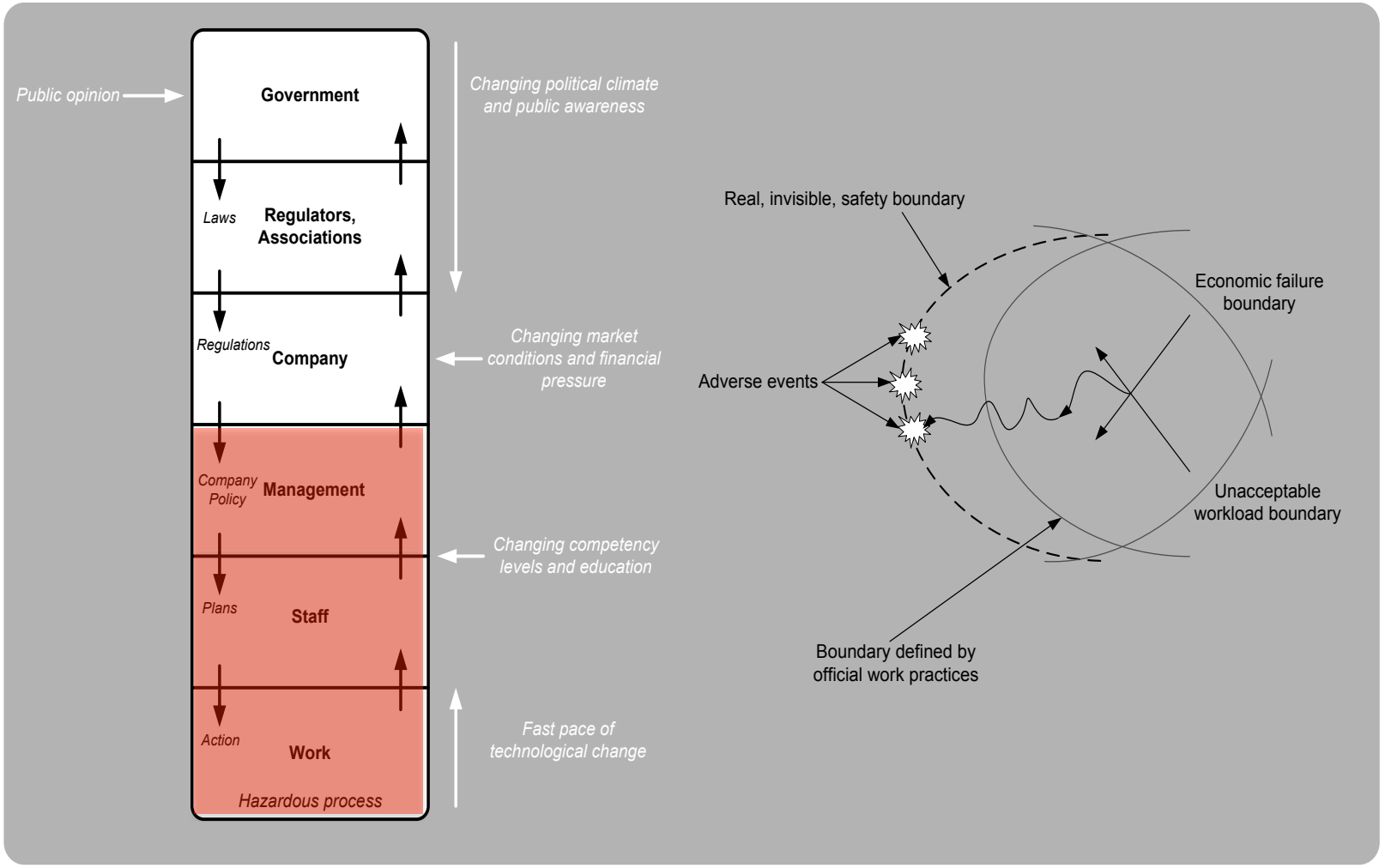
The systems approach and risk assessment



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‘NO-HARMS’ Design Principles

- Organisational RA Tool
- Can predict emergent risks (the risks that arise when risks interact with each other).
- Used by teachers/ planners
- Planning tool (‘Proceed or Not’)
- WHS Compliant
- Time efficient
- Range of experience levels
- Incorporate existing RA’s
- Identify new hazards/risks
- Identify range of controls
- Could be data-based
- All activity types
- Low cost
- Multiple end users

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‘NO-HARMS’ Design Process – Stage 1

- Hierarchical Task Analysis (HTA) of a Led Outdoor Activity Program;
- Task analysis is a way to plan all phases of work, from bottom to top;
- A useful way of looking at how people interact with equipment and with various aspects of their working environment;
- ‘Typical’ LOA program.

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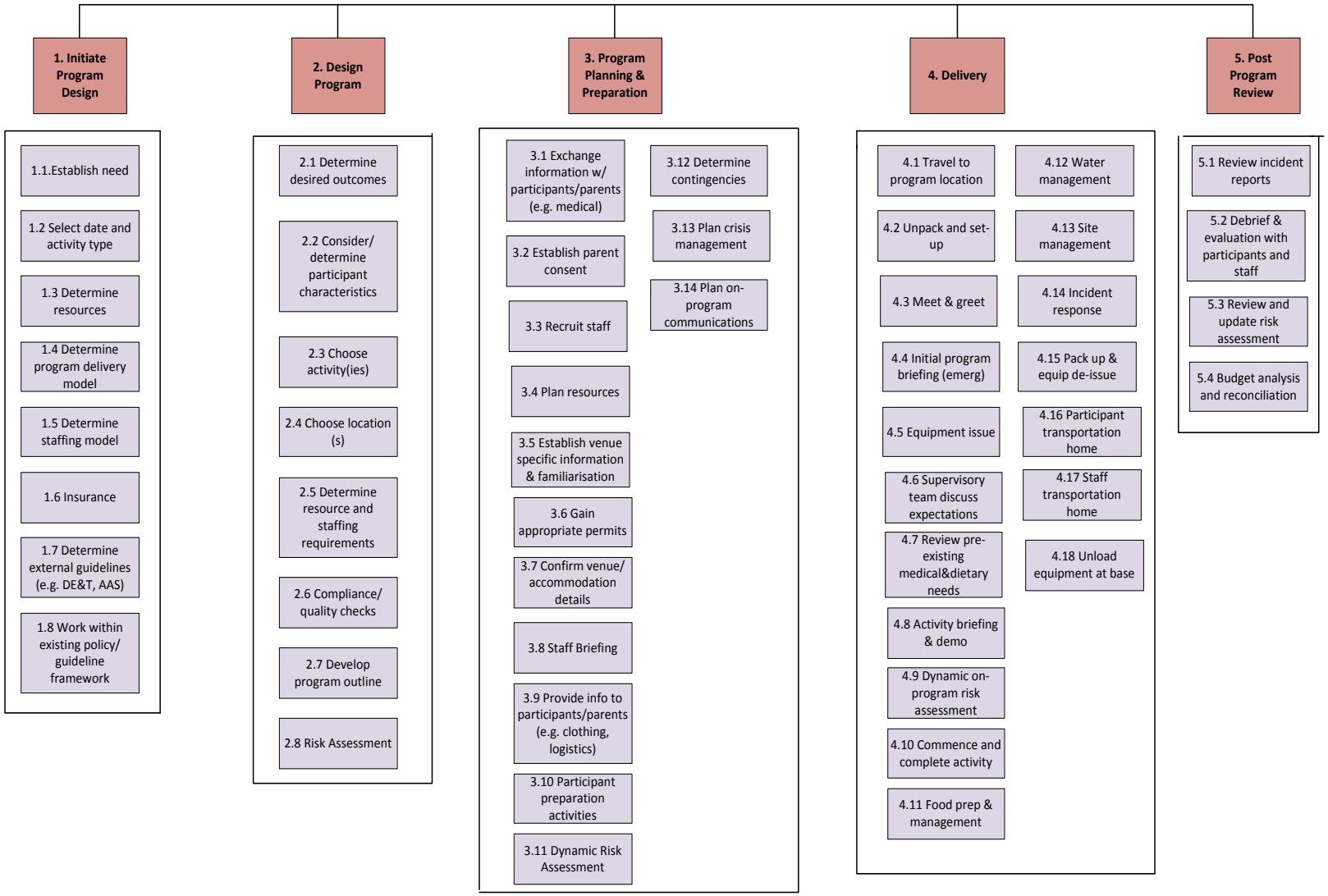
Hierarchical Task Analysis of a Led Outdoor Activity Program



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Stage 2 - SHERPA (Embrey, 1986)

Systematic Human Error Reduction and Prediction Approach

- SHERPA is an error prediction tool;
- Works on the premise that an understanding of work task and the characteristics of the technology being used allows us to identify potential errors that may arise from the resulting interaction (Stanton and Baber, 1996);
- Previous applications to identify pilot errors, errors during laparoscopic or keyhole surgery and errors which occur during the use of consumer products such as ticket machines;
- First application in the LOA domain.

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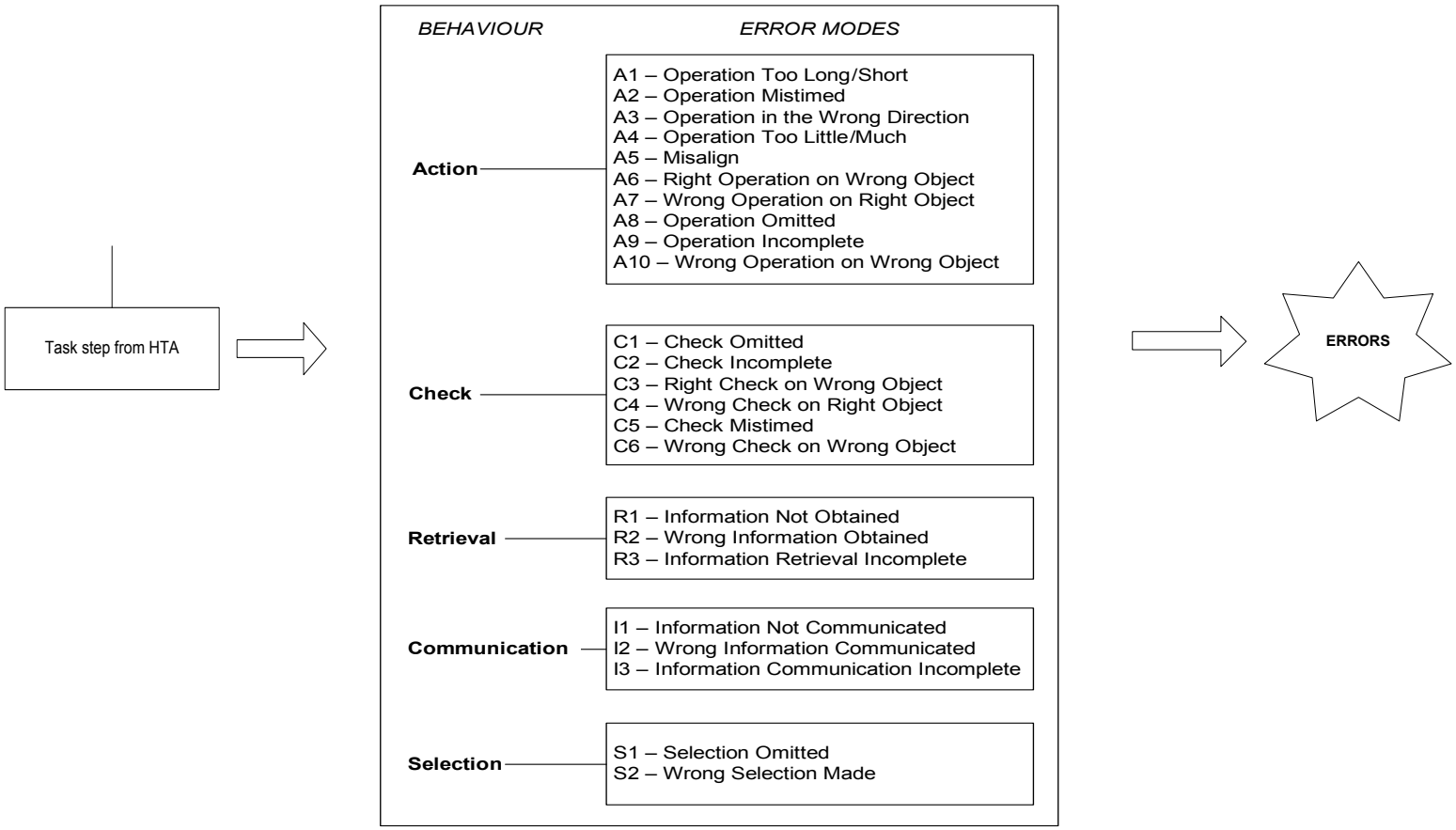
SHERPA Methodology



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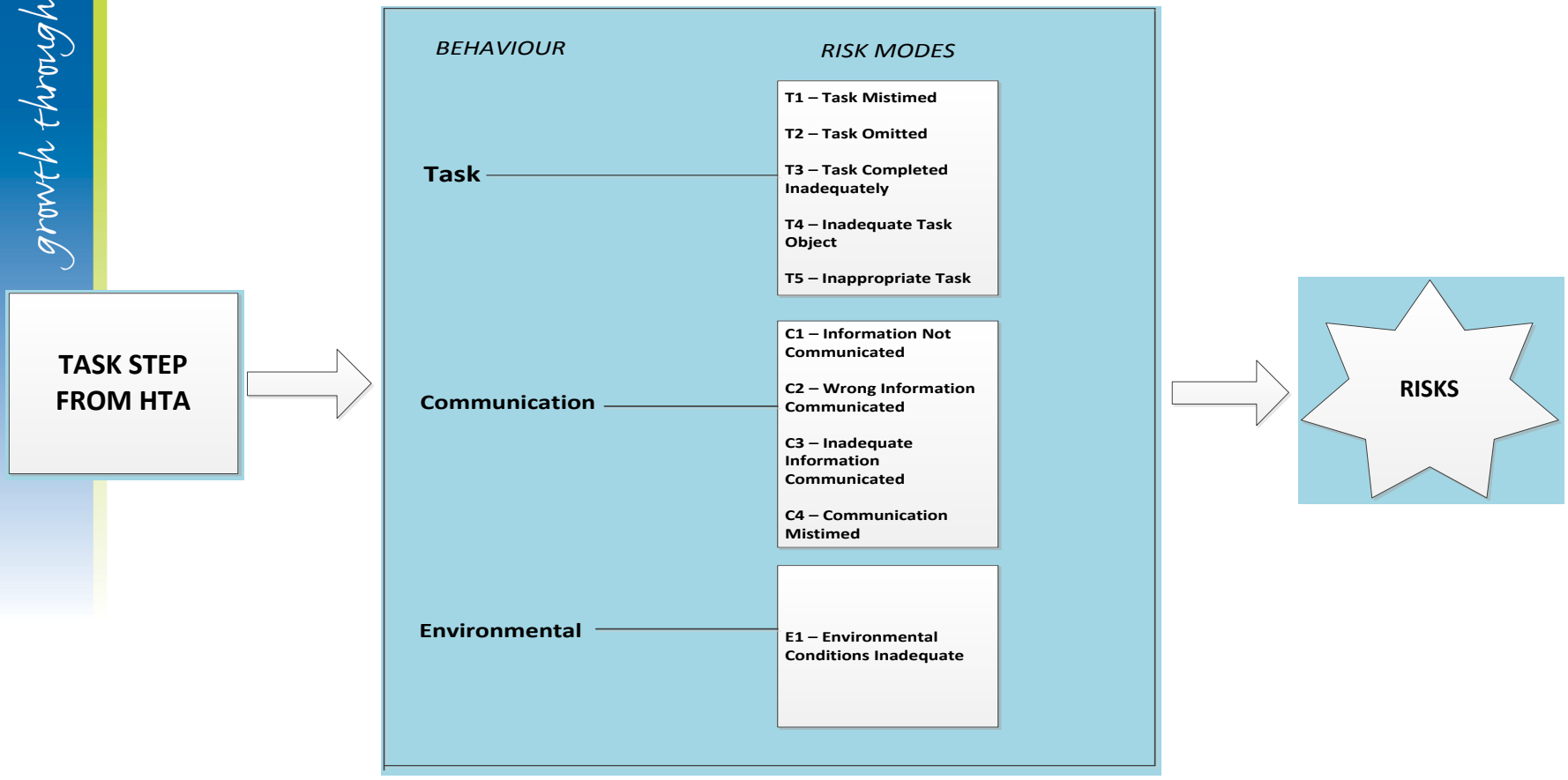
SHERPA Adapted for LOA Use



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Process

- Assign each task in HTA to one of the classes of behaviour provided in the SHERPA taxonomy;
- Each class has associated with it a number of risk modes which may or may not occur in a given context.
- For all credible risk modes associated with a task, the analyst notes:
  - a description of the risk;
  - any associated consequences;
  - the ordinal probability of it occurring;
  - its criticality/consequence and;
  - any proposed remedial/ control strategies.

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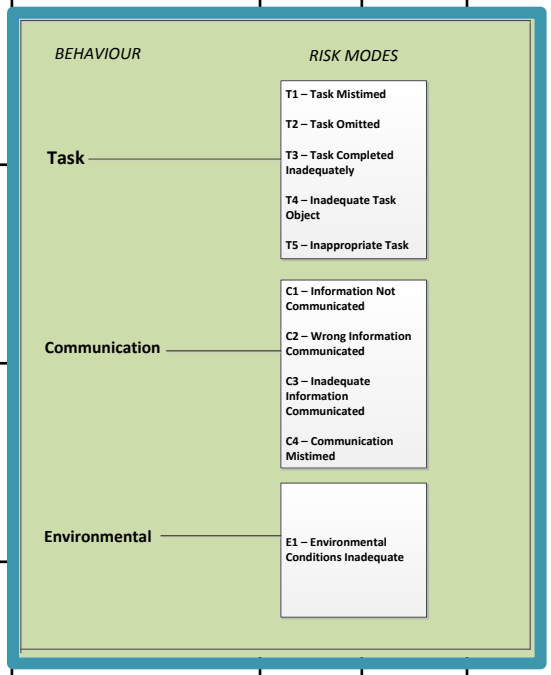
NO-HARMS examples

Activity step	Risk Mode	Risk Description	Risk Consequence(s)	P	C	Risk Control	Post control P	Post Control C
3.12. Determine contingency	T2	Failure to work out contingency plans (no plan Bs) e.g. get to campsite and see overhanging trees but have no plan B so end up camping there	- No plans for dealing with emergent risks e.g. tree falls, bad weather - Position becomes forced	H	H			
	T1	Contingency planning is left too late (not done as part of program planning and design)	- Contingency options are limited - Poor/ineffective contingency plans	H	H			
	T3	Contingency planning is inadequate	- No plans for dealing with emergent risks e.g. tree falls, bad weather - Position becomes forced	H	H			
	C1	Contingency plans not communicated	- Not all staff members aware of contingencies	H	H			



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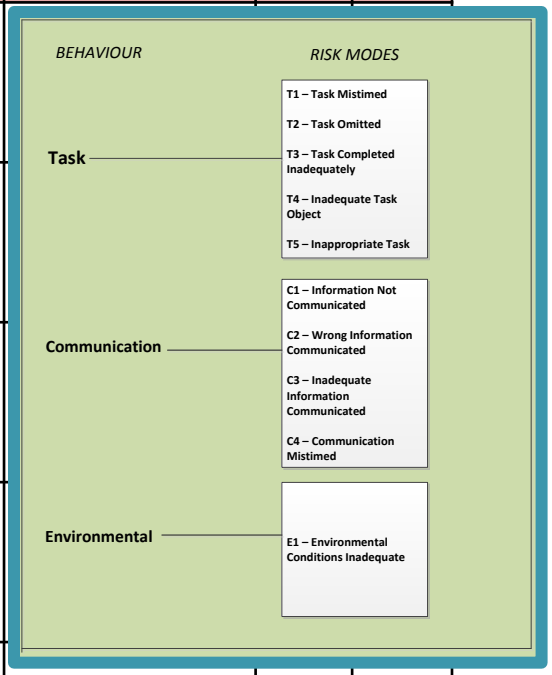
NO-HARMS examples

Activity step	Risk Mode	Risk Description	Risk Consequence(s)	P	C	Risk Control	Post control P	Post Control C
3.1. Provide/ exchange information to participants and parents e.g. medical, logistical	C2	Wrong information is given to participants and parents e.g. description of activities to be undertaken	- Parents/participants not fully aware and therefore are unable to provide informed consent - Parents/participants not aware of potential risks	H	M			
	C3	Inadequate is given to participants and parents e.g. description of activities to be undertaken	- Parents/participants not fully aware and therefore are unable to provide informed consent - Parents/participants not aware of potential risks	H	M			
3.2. Establish parent consent	C2	Wrong information is given to participants and parents e.g. description of activities to be undertaken	- Parents/participants not fully aware and therefore are unable to provide informed consent - Parents/participants not aware of potential risks	H	M			
	C3	Inadequate information is given to participants and parents e.g. description of activities to be undertaken	- Parents/participants not fully aware and therefore are unable to provide informed consent - Parents/participants not aware of potential risks	H	M			
	T3	Consent is established but not for all activities within program	- Parents/participants not fully aware and therefore are unable to provide informed consent - Parents/participants not aware of potential risks	H	M			



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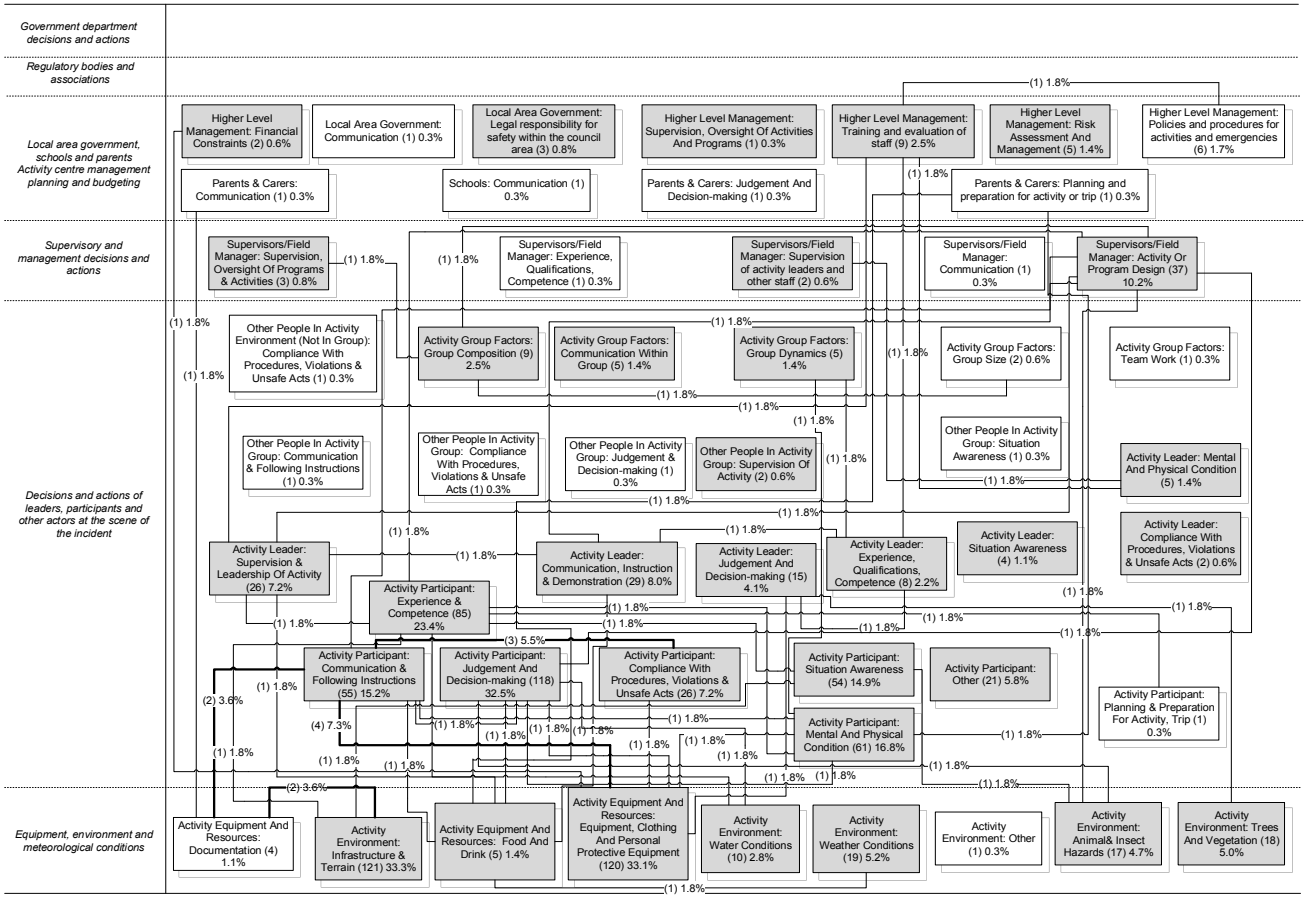
Can it predict these factors/ risks?

Source: UPLOADS 12 month trial



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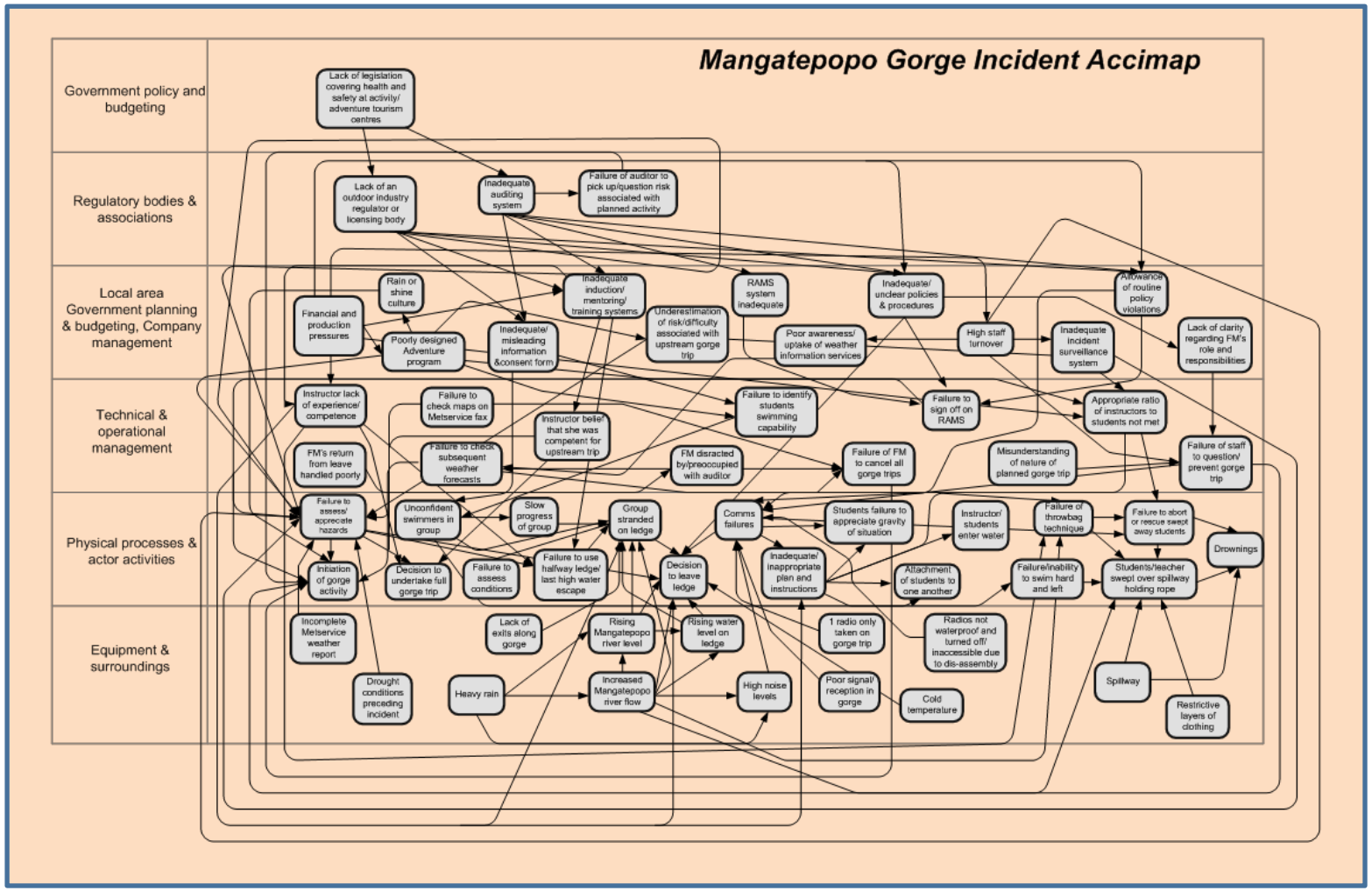
Or these?



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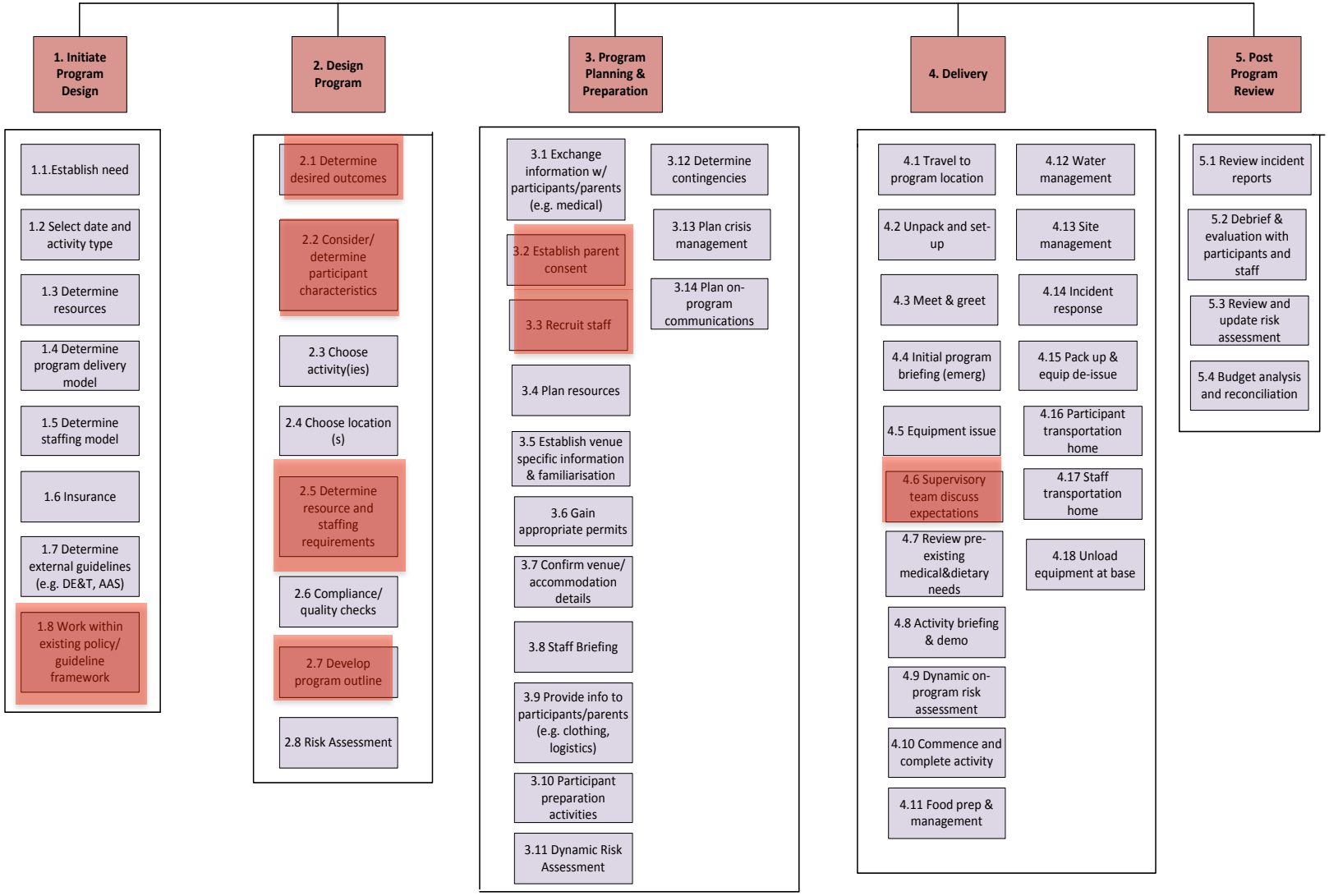
Hierarchical Task Analysis of a Led Outdoor Activity Program



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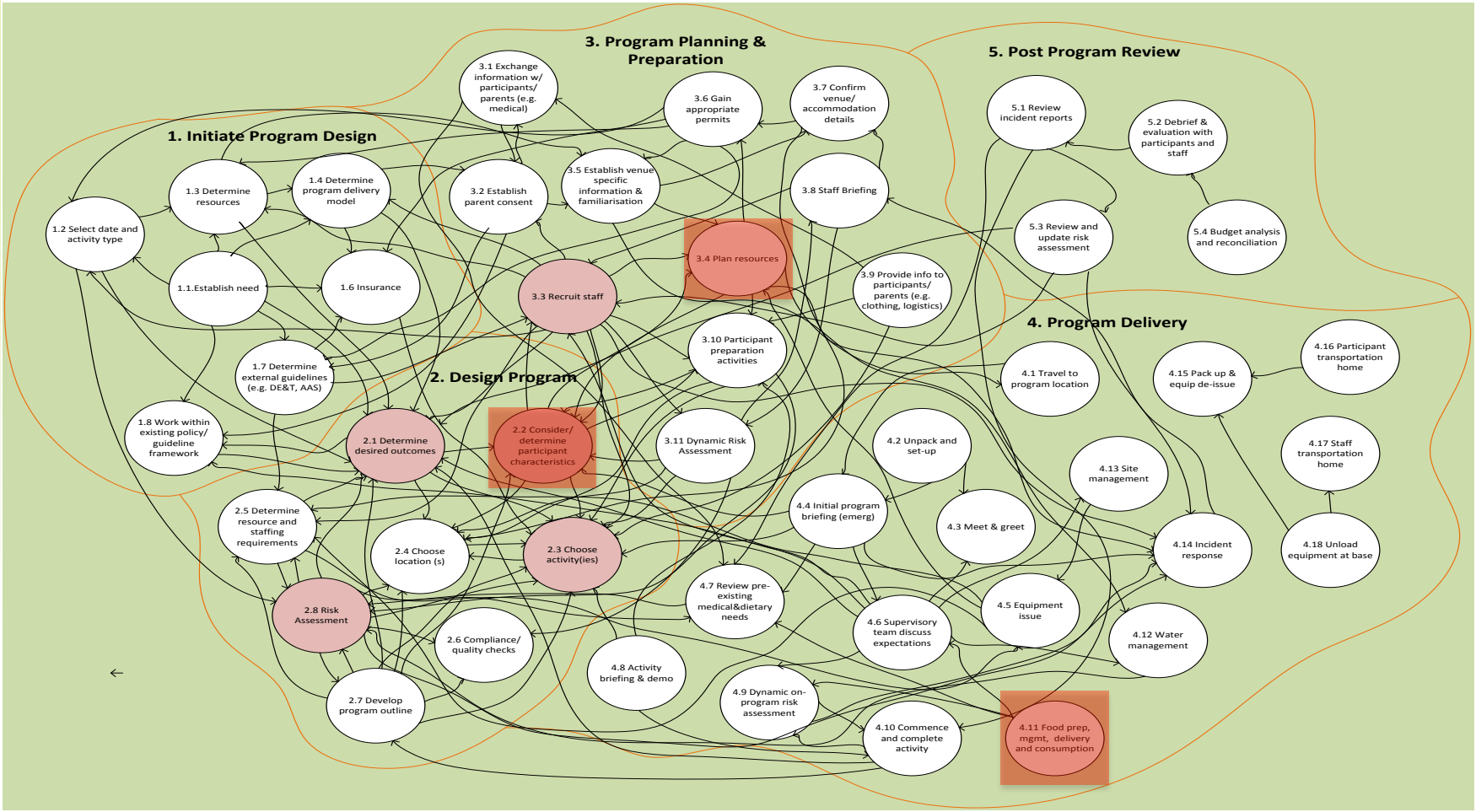
HTA indicating networked tasks



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Early Days but…

- This method shows how the technique can be applied to the process of identifying system risks associated with the design, planning and delivery of an LOA program;
- Displays the importance of the HTA to the risk assessment process;
- Aligns with multiple other complex domains in displaying the benefits of applying human factors to risk/error prediction and prevention;
- Increases awareness of the limits of human performance and importance of **system** changes to accommodate these limits.

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In Short…

- Key to accident analysis is understanding the network of contributory factors;

- Key to accident prevention (risk assessment) is identifying and managing the network of risks.

- Key to accident prevention (risk assessment) is identifying and managing emergent risks.

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Action Steps – Your sphere of influence

- With members of your organisation's team, sit down and identify the network of 'actors' involved at all levels of your organisation (e.g. parents, field staff, program managers, legal, regulators, school board, environmental conditions, equipment, external/sub contractors). Using the UPLOADS framework, map actors to 'levels' and show their relationships;

- Using the HTA, discuss and identify which hazards and risks may relate to your program during the design, planning and preparation stages.

- Using the NO-HARMS system, discuss and identify risk control measures with your team that enables management of these risks at the 'level' which they appear (e.g. allergy management systems involving parents, camp catering management and appropriate medication supplies brought on program).

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Thank you!

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