



University of the
Sunshine Coast

Centre for Human Factors
and Sociotechnical
Systems

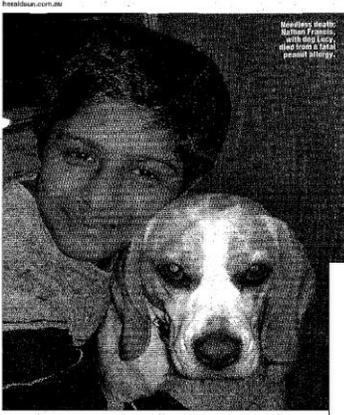


BEYOND LIKELIHOOD AND CONSEQUENCE: DEVELOPING A SYSTEMS APPROACH TO RISK ASSESSMENT IN THE LED OUTDOOR ACTIVITY CONTEXT

Clare Dallat

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)



We want answers

DAVE HEWITT
The parents of a Scottish College student who died on an army cadet camp after being fed peanut butter want the school to be held responsible for his death. They have launched a lawsuit against the college and the Department of Children, Youth and Families but to find who was responsible for getting the boy into an illegal restaurant of his severe peanut allergy, Nathan French, 11, was on a...

Parents grieve as storm kills daughter

Hundreds of grieving Queenwood students returned to the protective embrace of school and family in Mosman yesterday after a senior student died in a wild storm during an annual camping trip in the Southern Highlands. And Claudette Clausen spoke last night of her grief when she learned she had been robbed of her only child and best friend. She was told her daughter, schoolgirl Klara Clausen, had been killed in a freak accident during a wild storm on an annual camping trip in the Southern Highlands. "When you have a knock on your door, to greet you with that, it's the saddest day of your life," Mrs Clausen said. The 16-year-old girl, a student at Queenwood since kindergarten, was killed when a tree fell on the tent she was staying in with another student who escaped unharmed.





ACTIVITY 1

CONDUCT A RISK ASSESSMENT FOR:

- Five-day led outdoor education school program
- Three group program
- Activities are camping and rafting (expected Grade 2 water level)
- The school is subcontracting the rafting component
- Time of year that program will be conducted is late November in Eastern Victoria, Australia
- Participants are year 9 novices – have never been rafting on a school program before

EXAMPLE 1...

http://www.owfc.com.au/Childcarewindow.asp

One World for Children Chil... How to Capture Screen Shots i...

Google one world for children risk assessment Search Share More >> Sign In

ii. Foreword by Charles Eis... Research students Register to apply online - ... Sorry Lance. claredallat Twitter Favorites Bar Facebook Inbox (2) - claredallat@g... Suggested Sites ATLAS

- general agreement (medical)
- emergency contact and phone number for that day
- name and contact of Doctor

Risk Assessment

Explain all requirements expected from parent helpers

Determine the number of staff required to adequately supervise the children (Ideally 1 adult to every 2 children, or 1 adult to every 4 children) this depends on the destination of the excursion

Are any other adults required to supervise the children that need to have specialised skills such as first aid, anaphylaxis or asthma training

The transport to and from the proposed destination for the excursion (bus over 12 seats do not require booster seats)

The proposed route and destination for the excursion

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EXAMPLE 1 CONT'D.

Will there be any water based activities/risks

The proposed activities at the excursion

Proposed duration of the excursion

Date Risk Assessment completed: _____

Staff member completing the Risk Assessment: _____

Approved by the Nominated Supervisor: _____

Team Leader to evaluate the excursion and supervisory practices after the excursion

EXAMPLE 2...

Table Tools NSW DOE Risk Assessment Plan [Compatibility Mode] - Microsoft Word

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Sample Risk Management Plan: Excursion

Name of school: Excursion Plus High School *Number in group/class:* 55
Name of principal: J Citizen *Name of excursion coordinator:* K Citizen
Description and location of excursion: Bushwalk in National Park *Contact number:* XXXX
Date of excursion: 18 October *Accompanying staff, parents, caregivers, volunteers:* 2 class teachers and 4 parent/carer volunteers
Group/class: 6S and 6G

Task/Activity	Hazard Identification & Associated Risk Type/Cause	Assess Risk* use matrix	Elimination or Control Measures	Who	When
Bushwalking in national park	<ul style="list-style-type: none"> - uneven ground surfaces, bites and stings, exposure to sun, wind, rain and dehydration. - allergies to insects, reptiles and plants. - becoming lost or isolated from the group - change in weather conditions 	4	- Notify national park staff of expected arrival and departure times, location of walk and participants, students with medical conditions	Excursion Coordinator	Prior to walk
		3	- National Park staff to lead walk. Adult supervision at front and back to keep group together.	Supervisors	On walk
		3	- Inform excursion participants of National Park safety instructions.	-	-
		5	- Wear enclosed footwear suitable for walking, clothing to protect arms and legs and suitable for changing weather conditions	All	-
		- Wear hats, shirts with sleeves and sunscreen while outdoors.	Teachers	-	
			- Ensure participants carry water bottles	-	-
			- Staff carry insect repellent, additional sunscreen and ensure rest breaks are taken in the shade	Excursion Coordinator	Prior to walk
			- Identify participants with known medical conditions and ensure appropriate medication/treatment is available	Teachers	-
			- Ensure participation of students with known allergies has been considered, implement appropriate risk controls, e.g. a trained staff member is available to provide appropriate first aid (e.g. epipen for student with anaphylaxis)	-	-
			- Ensure staff and students are aware of emergency response procedures.	-	-
			- Check weather forecast on day of excursion	-	-
			- Carry maps and compass	-	-
			- Emergency plans communicated for dealing with potential incidents	-	-
			- Carry first aid kit	-	-

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EXAMPLE 3

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Paragraph

Styles: Normal, Title, No Spacing, Heading 1, Heading 2, Subtitle, Subtle Emphasis, Emphasis

Identified Risks

Event	Inherent Risk Level <i>(Circle)</i>	Hazard Details <i>(Tour leader to complete)</i>	Required Management Strategies	Details of additional Management strategies to be implemented <i>(Tour leader to complete)</i>
Communication				
Lack of mobile phone contact between staff	Low Medium High Extreme	Inability for staff to communicate while participating in activities.	Arrangements should be known in advance. All staff to carry mobile phones with appropriate access. Share contact details with all staff.	
Lack of mobile contact between staff and students	Low Medium High Extreme	Inability for staff to communicate with students while participating in different group activities.	All staff to have all student contact numbers for the duration of the tour. All students to have all staff contact numbers for the duration of the tour. Student phones to be turned on or silent except whilst sleeping.	
Poor E-mail connection	Low Medium High Extreme	Difficult for parents to contact staff in emergency at home.	Staff to regularly check emails for communication from parents or <u>xxxxxxxxxx</u> .	
Poor availability of mobile contact between staff and <u>xxxxx</u> contact person(s)	Low Medium High Extreme	Inability to ask for guidance for behavioural issues, accidents or change of plans	Two <u>xxxxxxxxxx</u> contact persons to be provided. Use email for non urgent contact. Regular reporting to contact person required and prearranged.	

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THE SYSTEMS APPROACH

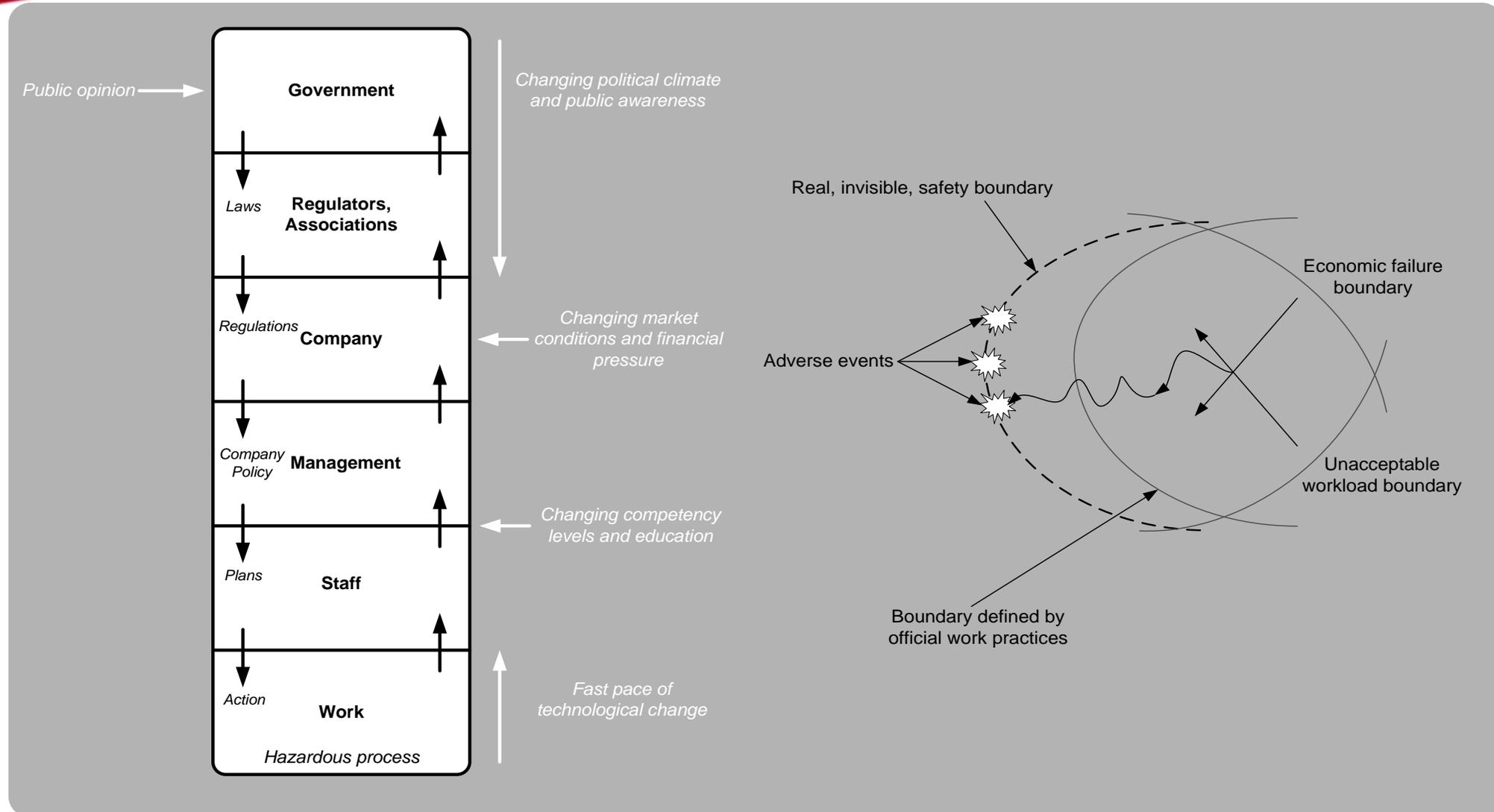
1. Safety is impacted by the decisions and actions of everyone in the system not just front line workers.
2. Near misses and adverse events are caused by multiple, interacting, contributing factors.
3. Effective countermeasures focus on systemic changes rather than individuals.

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 SYSTEMS APPROACH

(RASMUSSEN, 1997)



Mangatepopo Gorge Incident Accimap

Government policy and budgeting

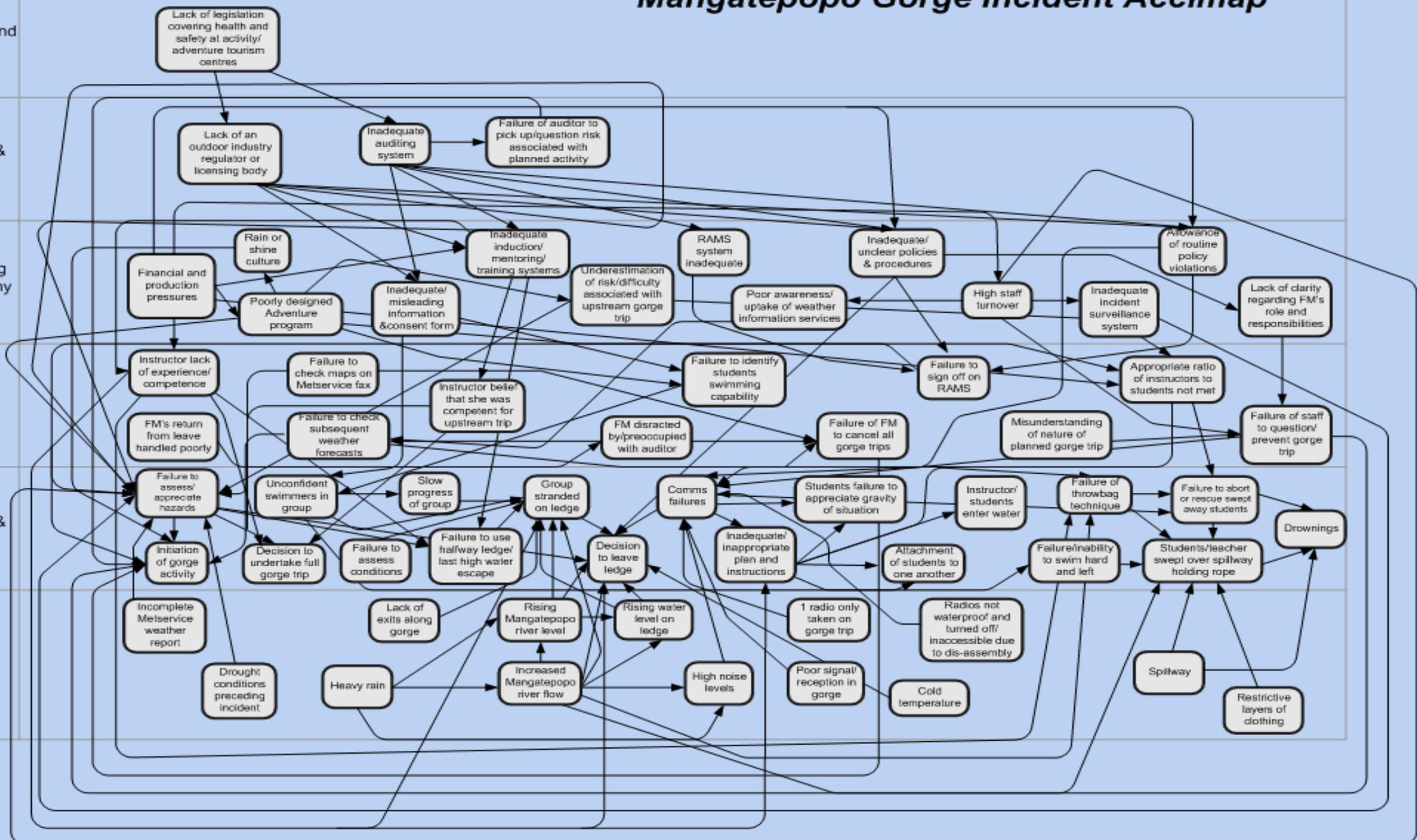
Regulatory bodies & associations

Local area Government planning & budgeting, Company management

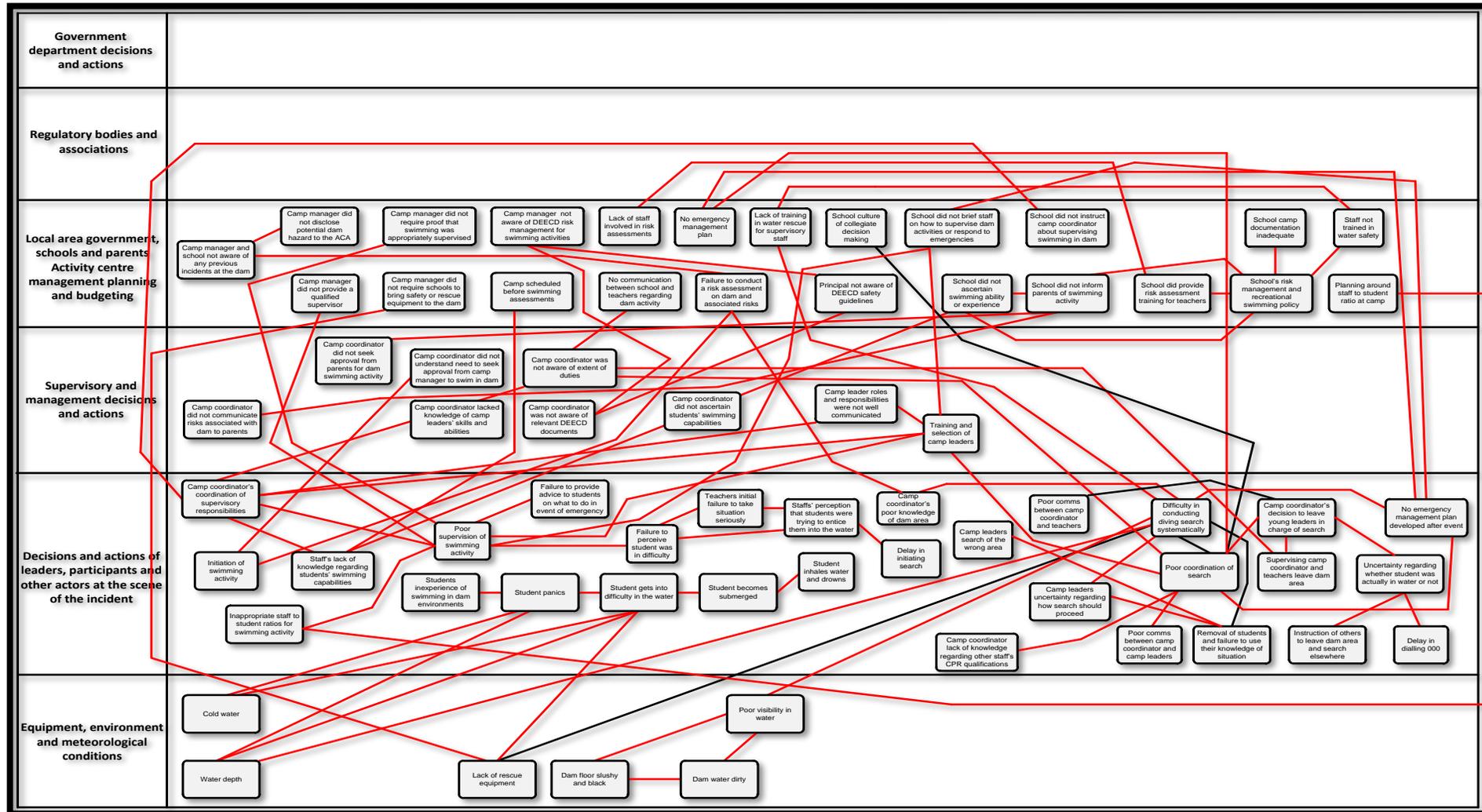
Technical & operational management

Physical processes & actor activities

Equipment & surroundings



KYLE VASSIL



THE RESEARCH PROBLEM

- Inadequate risk assessment frequently highlighted as a contributing factor in deaths and injuries of participants on led outdoor activities (LOA)
- The completion of a risk assessment is a formal requirement in planning LOA's
- The systems-thinking approach to accident causation in LOA domain (and safety critical domains generally) is now prevalent
- The extent to which schools/organisations consider and apply the systems approach to LOA's when conducting risk assessments is not clear.



RESEARCH QUESTIONS

1. To what extent are risk assessment methods in both the LOA sector and other safety-critical domains, underpinned by systems theory?
2. What challenges and barriers exist for LOA practitioners in relation to risk assessments?
3. Can we integrate a systems thinking –based approach to risk assessment design and development?
4. Does a systems thinking-based risk assessment method achieve acceptable levels of reliability and validity?

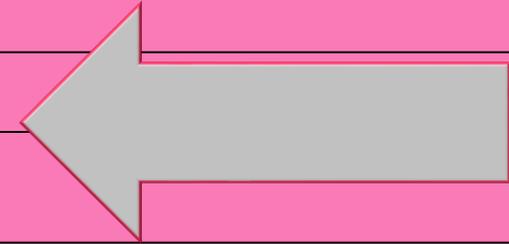


PILOT STUDY 1 – HOW ARE LOA PROGRAMS CONDUCTING RISK ASSESSMENTS (RA’S)?

RQ1: To what extent are risk assessment methods in both the LOA sector and other safety-critical domains, underpinned by a systems approach?

- 4 LOA RA’s analysed to assess the extent to which they were underpinned by contemporary systems thinking.
- The ‘PEE’ approach

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)



STUDY 2 - LOA PRACTITIONER SURVEY (N=97)

Findings:

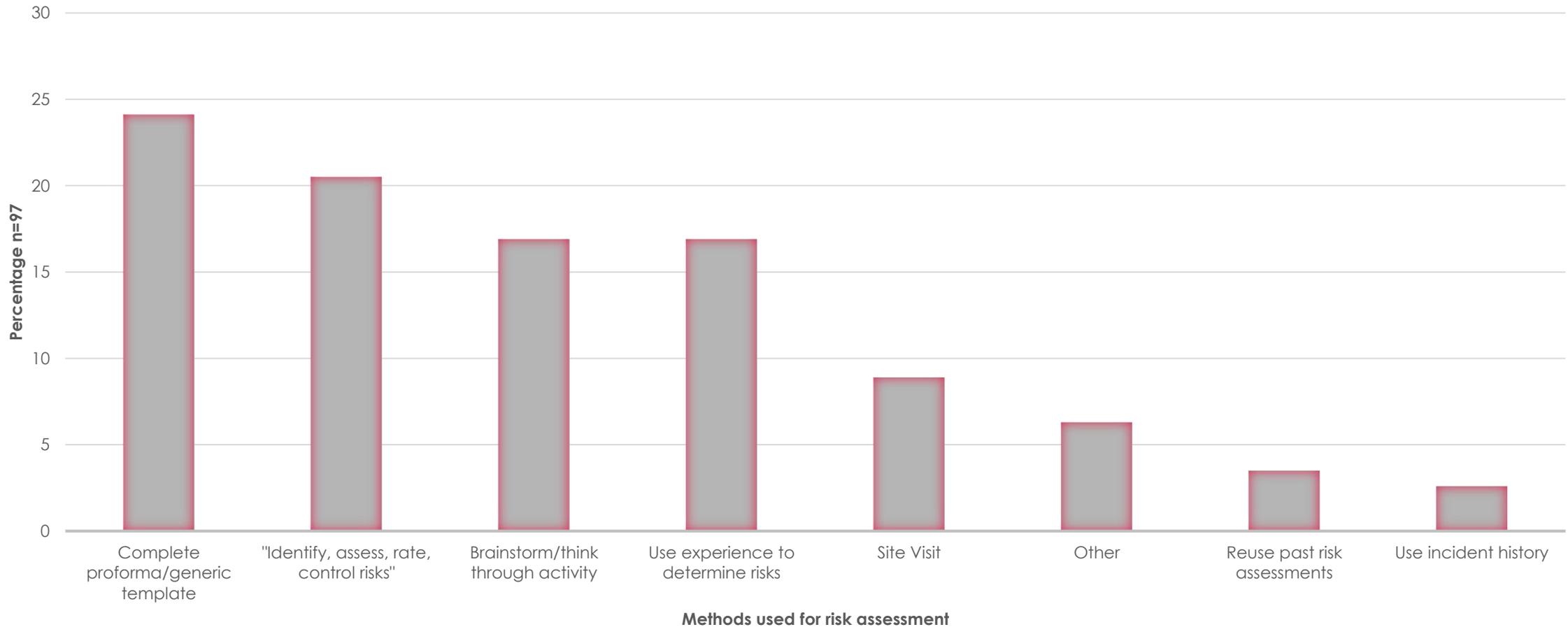
- Systems thinking-based RA methods are not being used in LOA
- Brainstorming, prior experience & 'PEE' process driving RA process
- In general, a picture of confusion and uncertainty in relation to conducting risk assessments, as well as a lack of policy guidance and formal training, was observed.
- Only a small proportion of the potential risks around LOA **program development, planning and delivery** are currently being identified and assessed.

RQ1: To what extent are risk assessment methods in both the LOA sector and other safety-critical domains, underpinned by a systems approach?

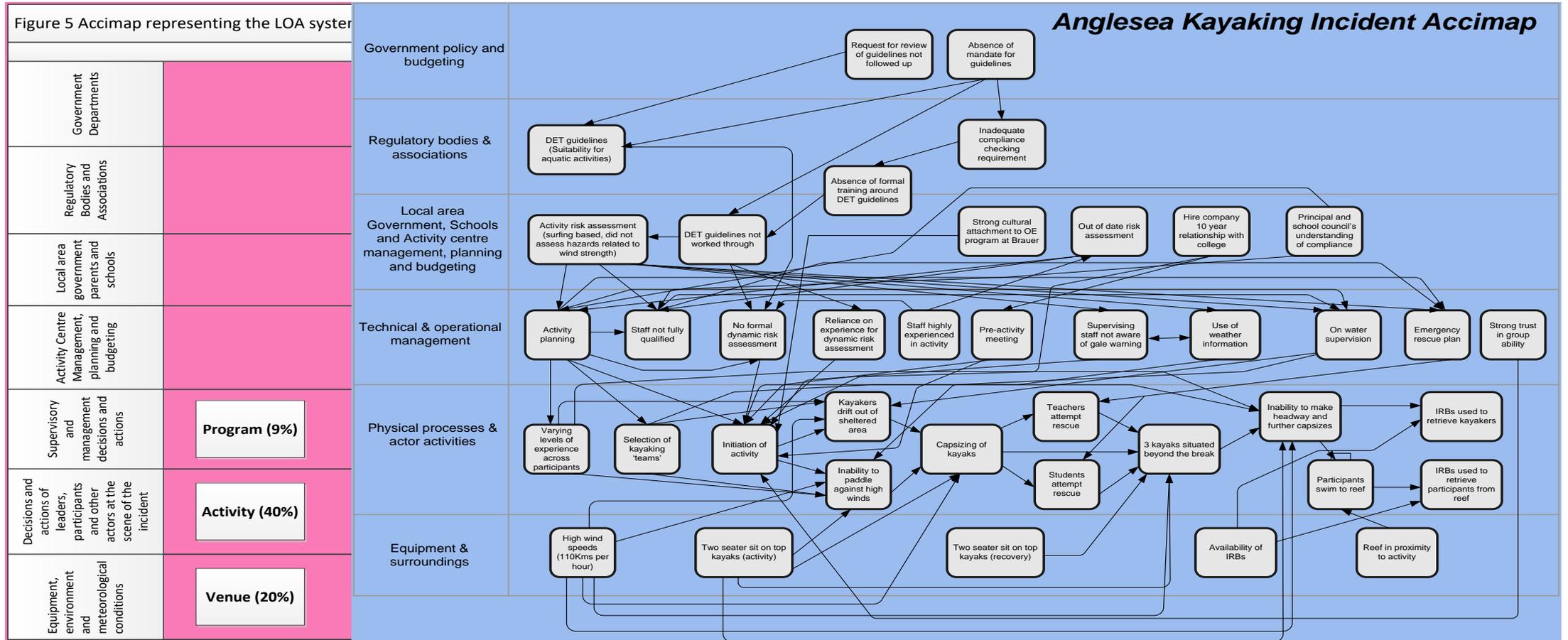
RQ2: What methods, approaches, challenges and barriers exist for LOA practitioners in relation to risk assessments?



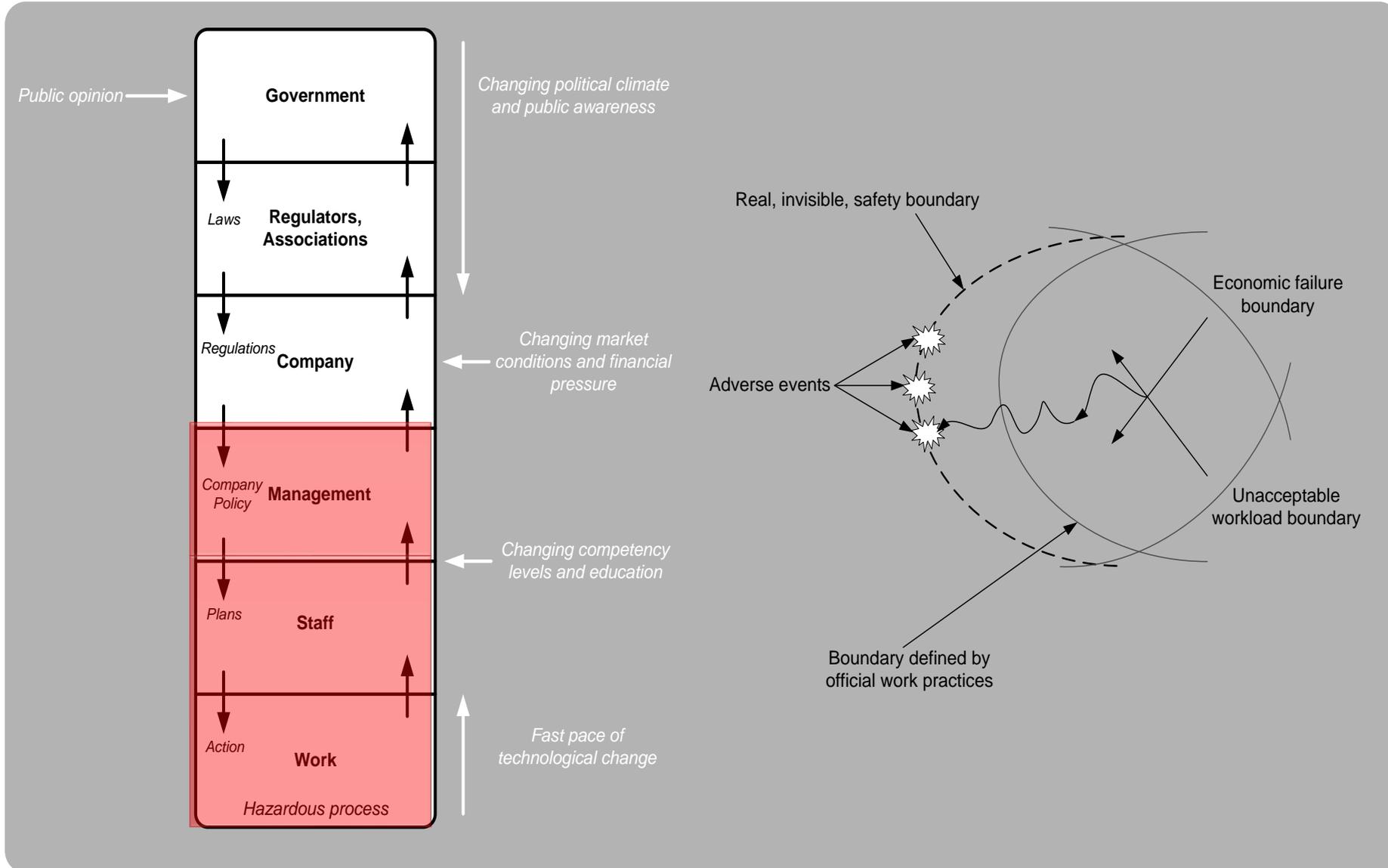
METHODS USED TO CONDUCT RA'S



LOA RISK ASSESSMENT



THE SYSTEMS APPROACH AND LOA RISK ASSESSMENT



STUDY 3 - REVIEW OF THE RISK ASSESSMENT LITERATURE

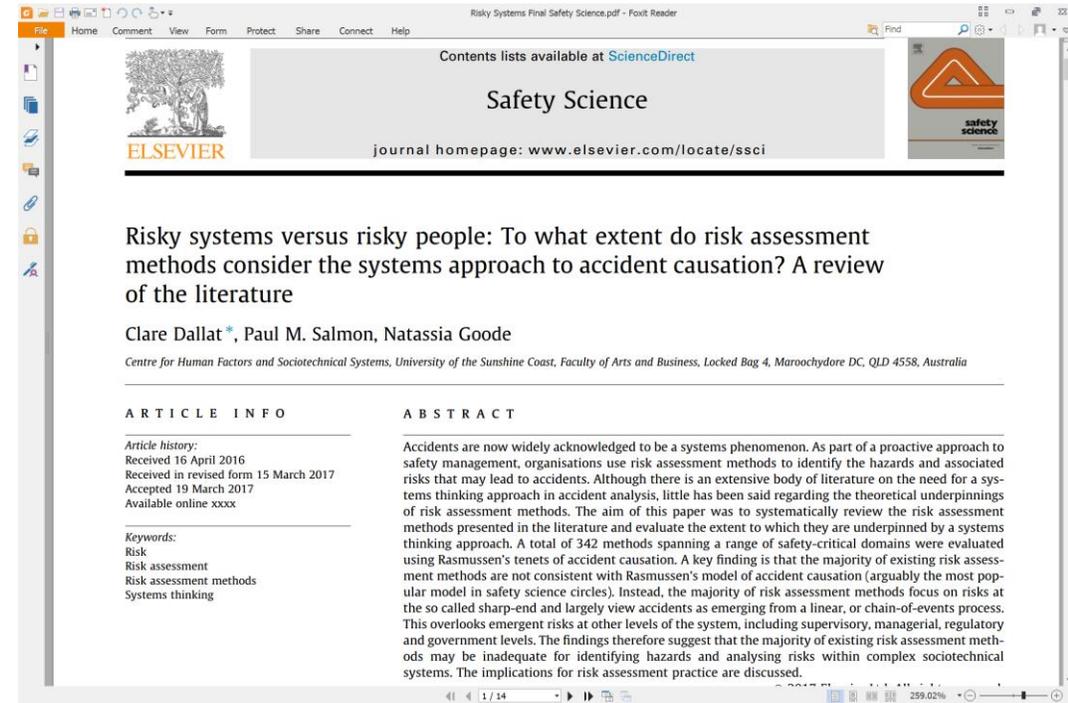
Method:

- n=342
- Rasmussen's (1997) seven tenets of accident causation used to evaluate extent to which methods were underpinned by systems approach

Findings:

- Most RA methods do not use systems thinking-based approach. Rather, they adopt linear, chain-of event perspective
- **Conclusion – majority of risk assessment methods are not aligned with current understanding of accident causation**

RQ1: To what extent are risk assessment methods in both the LOA sector and other safety-critical domains, underpinned by a systems approach?



Dallat, C., Salmon, P.M., & Goode, N. (2017). Risky systems versus Risky people: To what extent do risk assessment methods consider the systems approach to accident causation? A review of the literature. *Safety Science*. <http://dx.doi.org/10.1016/j.ssci.2017.03.012>

STUDY 4 – DESIGN & CASE STUDY APPLICATION OF NEW SYSTEMS THINKING-BASED RA METHOD

- NET-HARMS was designed to support practitioners in identifying a) risks across overall work systems, and b) emergent risks that are created when risks across the system interact with one another.
- First RA method to specifically identify emergent risks
- Uses and/or adapts Hierarchical Task Analysis (Annett et al., 1971), SHERPA (Embrey, 1986) & Task Networks (Stanton et al., 2013).
- Findings show that NET-HARMS is capable of **forecasting systemic** and **emergent** risks, and that it could identify almost all **contributory factors** that featured in the accidents in a comparison dataset (Van Mulken et al., 2017).

RQ3: Can we integrate a systems thinking –based approach to risk assessment design and development?

THEORETICAL ISSUES IN ERGONOMICS SCIENCE, 2017
<https://doi.org/10.1080/1463922X.2017.1381197>



Check for updates

Identifying risks and emergent risks across sociotechnical systems: the NETworked hazard analysis and risk management system (NET-HARMS)

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ABSTRACT

Accidents are a systems phenomenon and multiple methods are available to enable retrospective analysis of accidents through this lens. However, the same cannot be said for the methods available for forecasting risk and accidents. This paper describes a new systems-based risk assessment method, the NETworked hazard analysis and risk management system (NET-HARMS), that was designed to support practitioners in identifying (1) risks across overall work systems, and (2) emergent risks that are created when risks across the system interact with one another. An overview of NET-HARMS is provided and demonstrated through a case study application. An initial test of the method is provided by comparing case study outcomes (i.e. predicted risks) with accident data (i.e. actual risks) from the domain in question. Findings show that NET-HARMS is capable of forecasting systemic and emergent risks and that it could identify almost all risks that featured in the accidents in the comparison data-set.

ARTICLE HISTORY

Received 21 May 2017
Accepted 13 September 2017

KEYWORDS

Systems thinking; risk assessment; emergence; risk decision-making; risk practitioner

Relevance to human factors/ergonomics theory

Methods which both support and enable application of a systems theoretical perspective to risk assessment are extremely limited. This paper outlines the development of a risk assessment method both underpinned by systems thinking and that was consciously designed to facilitate ease of use and application by the risk management practitioner.

Introduction

Downloaded by [University of the Sunshine Coast] at 21:29 12 October 2017

Dallat, C., Salmon, P. M., & Goode, N. (2017). The NETworked Hazard Analysis and Risk Management System (NET-HARMS). *Theoretical Issues in Ergonomics Science*, DOI:10.1080/1463922X.2017.1381197.

STEP 1 - HTA OF A 5 DAY LOA RAFTING AND CAMPING PROGRAM

0. Plan and deliver a five day led outdoor activity program

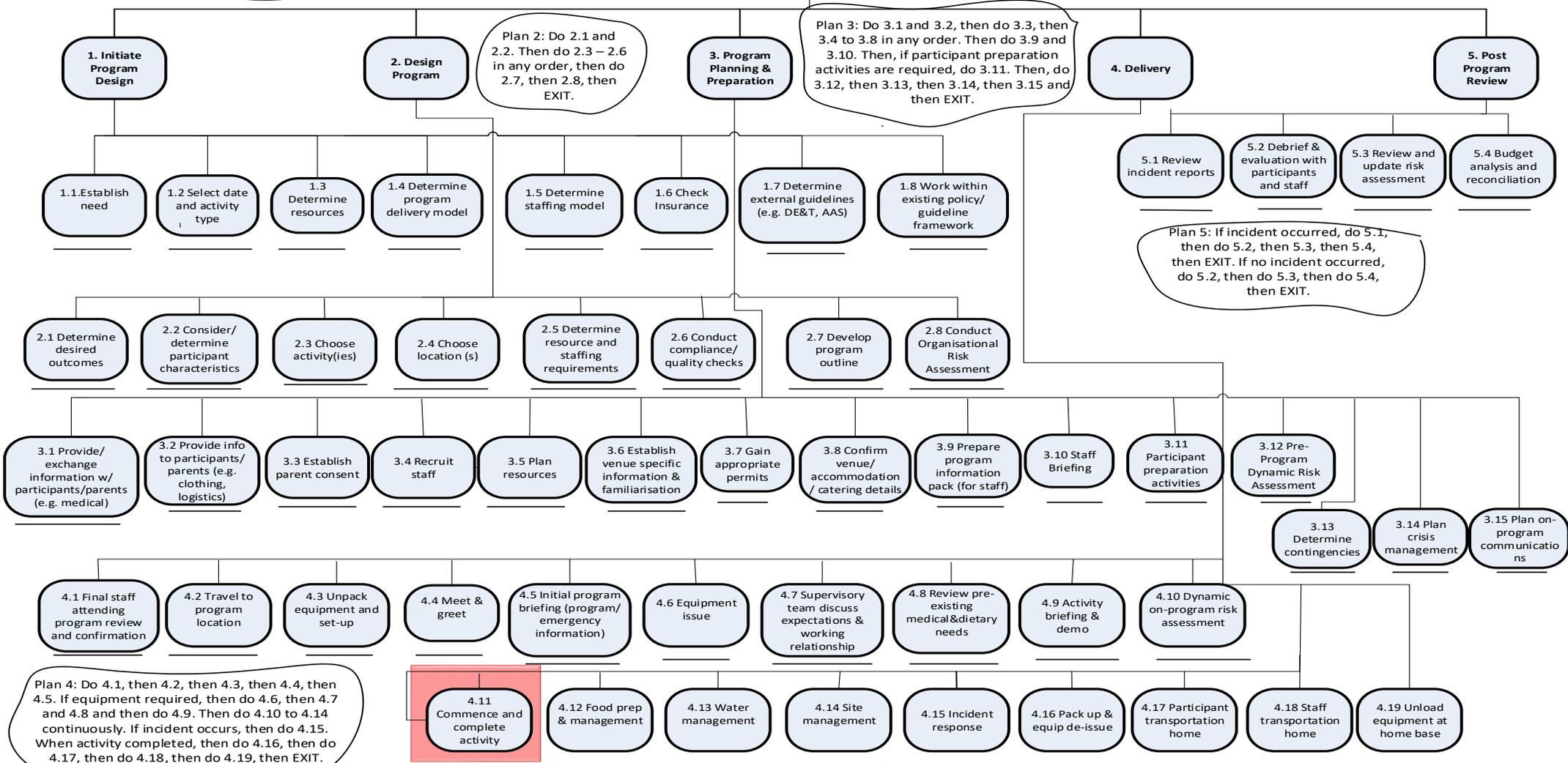
Plan 1: Do 1.1 then 1.2 to 1.6 in any order, then do 1.7 and 1.8, then EXIT

Plan O: Do 1, then do 2, then 3, then 4, then 5 then EXIT.

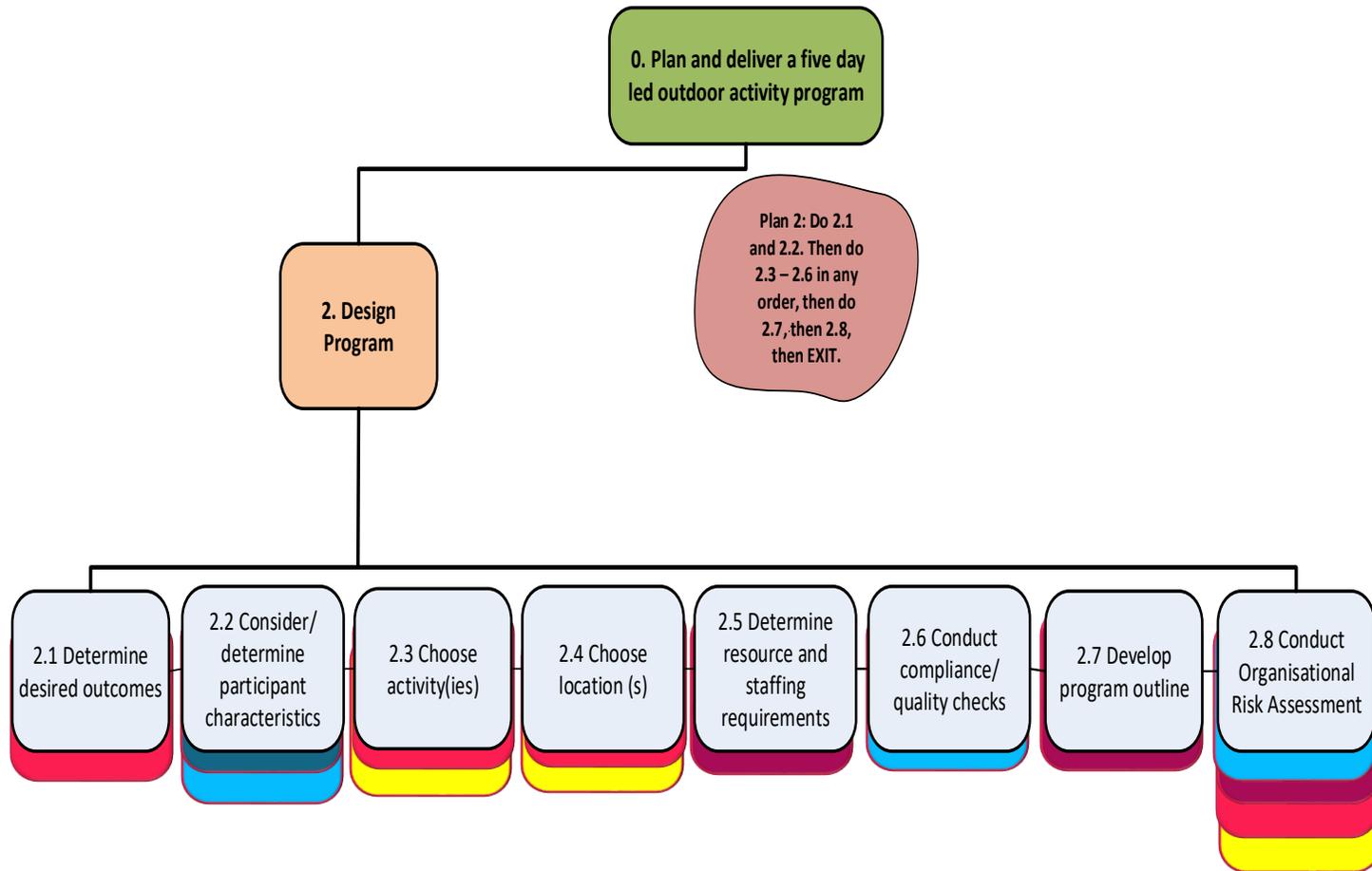
Plan 2: Do 2.1 and 2.2. Then do 2.3 – 2.6 in any order, then do 2.7, then 2.8, then EXIT.

Plan 3: Do 3.1 and 3.2, then do 3.3, then 3.4 to 3.8 in any order. Then do 3.9 and 3.10. Then, if participant preparation activities are required, do 3.11. Then, do 3.12, then 3.13, then 3.14, then 3.15 and then EXIT.

Plan 5: If incident occurred, do 5.1, then do 5.2, then 5.3, then 5.4, then EXIT. If no incident occurred, do 5.2, then do 5.3, then do 5.4, then EXIT.



EXCERPT - PROGRAM DESIGN

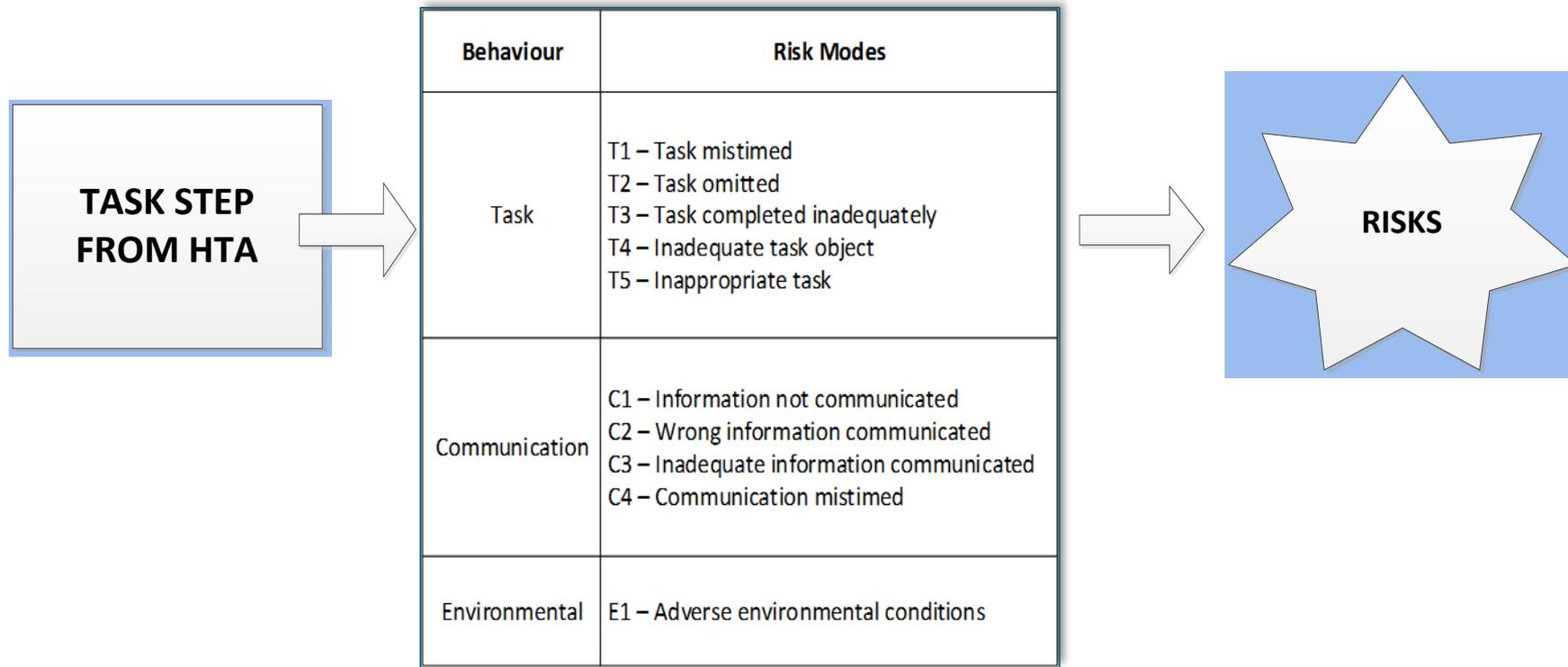


- School Coord
- Client Mgr
- Risk Mgr
- Program Mgr
- Nurse

HTA IN ACTION



STEP 2 – NET-HARMS TAXONOMY



- Based on SHERPA (Embrey, 1986)
- The taxonomy is the consistent filter through which we identify and assess risks

PREDICTING LOA TASK RISKS – EXAMPLES

HTA Task	Risk mode	Risk description	Risk consequence
3.3 establish parent consent	E1	Room too noisy/ env unsuitable/ too much info/ parents busy/ distracted	Incomplete info. Not fully informed. Not understood. Not full consent.
3.10 Staff Briefing	T1	Staff briefing undertaken late (e.g. on the bus, immediately before program)	Staff member may miss important aspects of briefing relevant to management of risk Staff members do not have time to develop/evaluate appropriate risk controls
4.7. Supervisory team discuss expectations and working relationship	T2	Expectations and working relationship not discussed	Potential for key information not to be communicated prior to activity (e.g. how to use satellite phone, behavior expectations, group communication methods, where first aid kit is, epi pen locations) Mismatch in expectations e.g. between provider and school

STEP 3 – EMERGENT RISK PREDICTION



Emergent risks are new risks created as a result of the interaction between task risks and other tasks

ALL ABOUT THE INTERACTIONS...

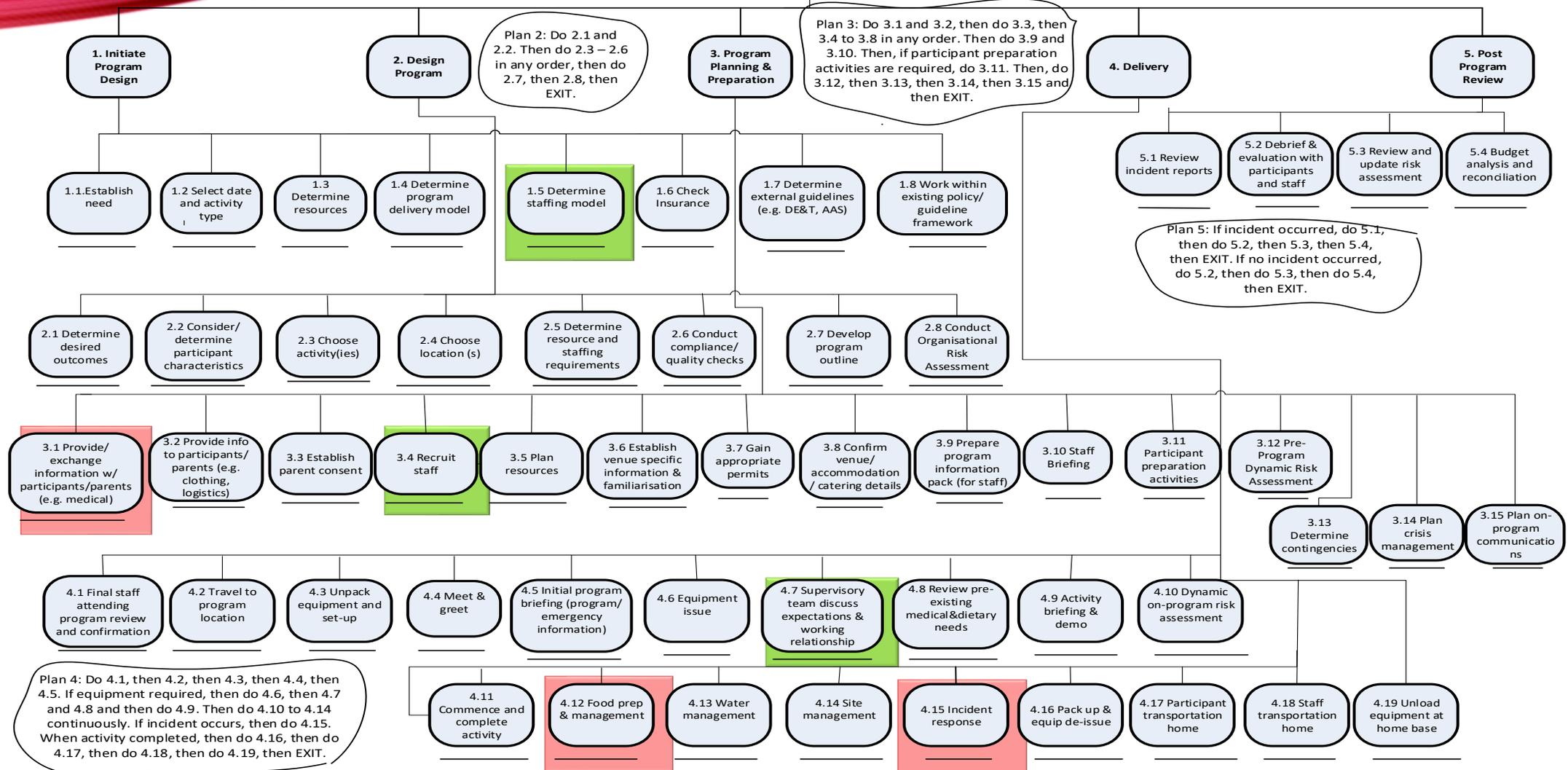
0. Plan and deliver a five day led outdoor activity program

Plan 1: Do 1.1 then 1.2 to 1.6 in any order, then do 1.7 and 1.8, then EXIT

Plan O: Do 1, then do 2, then 3, then 4, then 5 then EXIT.

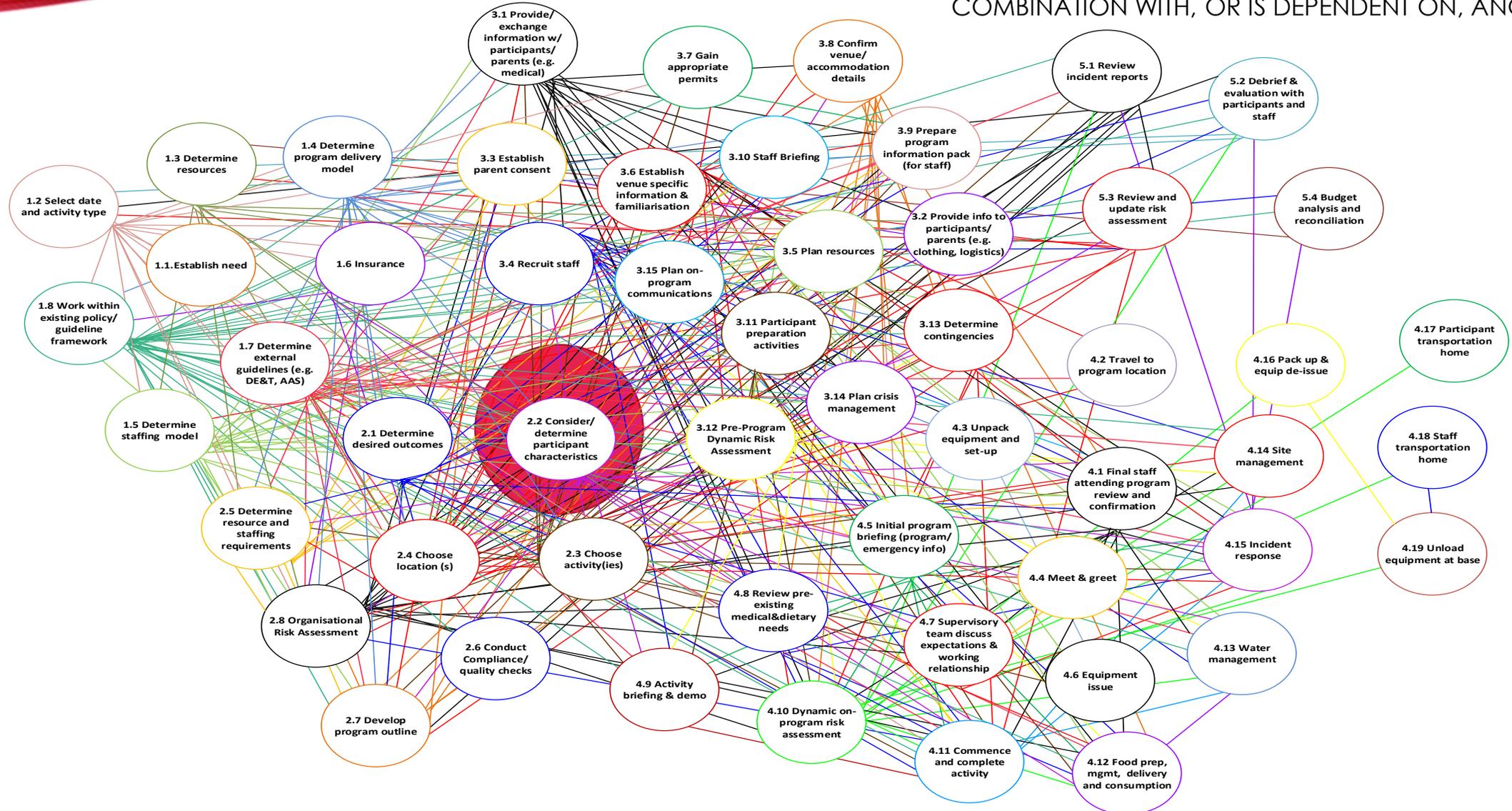
Plan 3: Do 3.1 and 3.2, then do 3.3, then 3.4 to 3.8 in any order. Then do 3.9 and 3.10. Then, if participant preparation activities are required, do 3.11. Then, do 3.12, then 3.13, then 3.14, then 3.15 and then EXIT.

Plan 5: If incident occurred, do 5.1, then do 5.2, then 5.3, then 5.4, then EXIT. If no incident occurred, do 5.2, then do 5.3, then do 5.4, then EXIT.



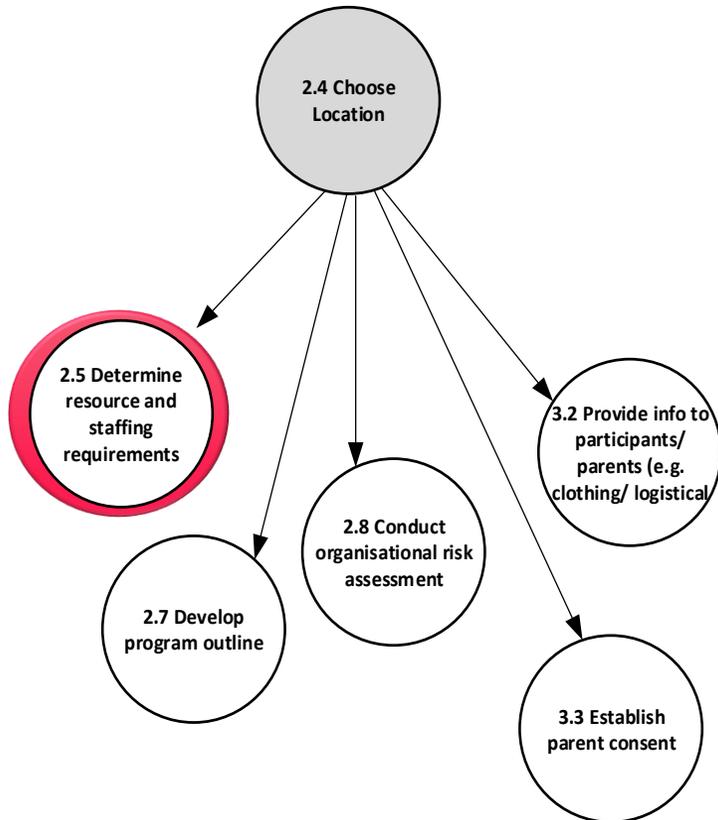
TASK NETWORK

TASKS ARE RELATED WITH ONE ANOTHER IF THE CONDUCT OF ONE TASK INFLUENCES, IS UNDERTAKEN IN COMBINATION WITH, OR IS DEPENDENT ON, ANOTHER TASK



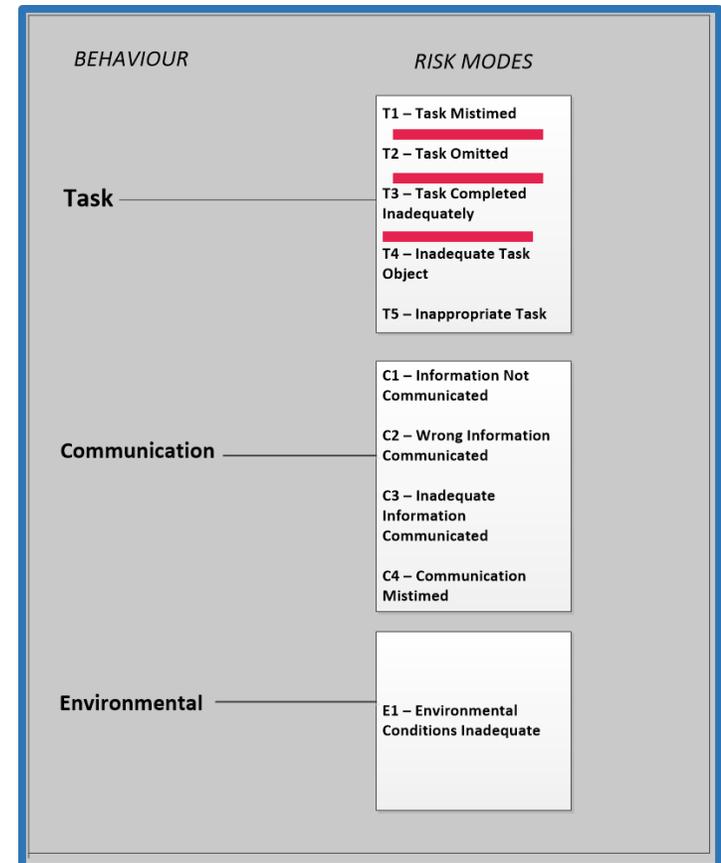
EMERGENT RISK EXAMPLE: 2.4 CHOOSE LOCATION

HTA Task	Risk mode	Risk description	Risk consequence
2.4 Choose Location	T2	Location choice is not considered in the design phase	Location choice may not be suitable for the program.



Because the 'location choice was not considered in the design phase', **is it possible that the task of:**

could be conducted...



EMERGENT RISK EXAMPLE

HTA Task	
3.5 Plan resources	



EMERGENT RISK EXAMPLE

HTA Task	Task Risk Description	
3.5 Plan resources	Adequate resources are not planned for the whole program	



EMERGENT RISK EXAMPLES

HTA Task	Task Risk Description	Linked Task	
3.5 Plan resources	Adequate resources are not planned for the whole program	4.15 Incident response	

<i>BEHAVIOUR</i>	<i>RISK MODES</i>
Task	T1 – Task Mistimed T2 – Task Omitted T3 – Task Completed Inadequately T4 – Inadequate Task Object T5 – Inappropriate Task
Communication	C1 – Information Not Communicated C2 – Wrong Information Communicated C3 – Inadequate Information Communicated C4 – Communication Mistimed
Environmental	E1 – Environmental Conditions Inadequate



EMERGENT RISK EXAMPLES

HTA Task	Task Risk Description	Linked Task	Risk Mode	Emergent Risk Description
3.5 Plan resources	Adequate resources are not planned for the whole program	4.15 Incident response	T3	Insufficient resource planning for inclement weather and therefore an inadequate ability to respond to incident in a timely fashion (e.g. no spare vehicles for quick response for whole group evacuation – buses are gone)

BEHAVIOUR	RISK MODES
Task	<ul style="list-style-type: none"> T1 – Task Mistimed T2 – Task Omitted T3 – Task Completed Inadequately T4 – Inadequate Task Object T5 – Inappropriate Task
Communication	<ul style="list-style-type: none"> C1 – Information Not Communicated C2 – Wrong Information Communicated C3 – Inadequate Information Communicated C4 – Communication Mistimed
Environmental	<ul style="list-style-type: none"> E1 – Environmental Conditions Inadequate



EMERGENT RISK EXAMPLES

HTA Task	Task Risk Description	Linked Task	Risk Mode	Emergent Risk
2.5. Determine resource/ staffing requirements	Resourcing/ staffing requirements determined too late	3.5 Plan resources	T2	There are insufficient resources for the rafting program leading to increased risk
	Resourcing/ staffing requirements determined too late		T3	There are inadequate resources for the rafting program leading to increased risk

HTA Task	Task Risk Description	Linked Task	Risk Mode	Emergent Risk
2.3 Provide/exchange participant pre-existing medical conditions	Inadequate information is communicated to participants and parents e.g. description of activities to be undertaken, description of physical and psychological requirements, in order to receive pre-existing medical information	3.3 Establish parent consent	T3	Parent consent is not achieved based on an adequate exchange of correct information regarding the program – increased risk of harm

HTA Task	Task Risk Description	Linked Task	Risk Mode	Emergent Risk
3.1. Develop Program Outline	Program outline communication is inadequate (e.g doesn't give full overview of program)	4.11 Commence and Complete Activity	T1	Poor Outline information leads to mistimed activity start - rafting finishes in the dark and participants become hypothermic from being wet on the river as temperatures drop

NET-HARMS CASE STUDY APPLICATION

Stage 1: HTA conducted and mapped 54 tasks throughout LOA program system (44 of which occurred prior to boat in water)

Stage 2: Conducted Task RA and identified 200 task risks (e.g. the 'foot in the boat' / current RA's)

Stage 3: Conducted Emergent RA and identified 1400 emergent risks

- 1200 associated with the design, planning and review tasks
- 200 associated with delivery tasks

Overall, Study 4 demonstrated the existence of 5.8 times more emergent risks in the system than task risks.



STUDY 5 – RELIABILITY & VALIDITY TESTING OF NET-HARMS

RQ4: Does a systems thinking-based risk assessment method achieve acceptable levels of reliability and validity?

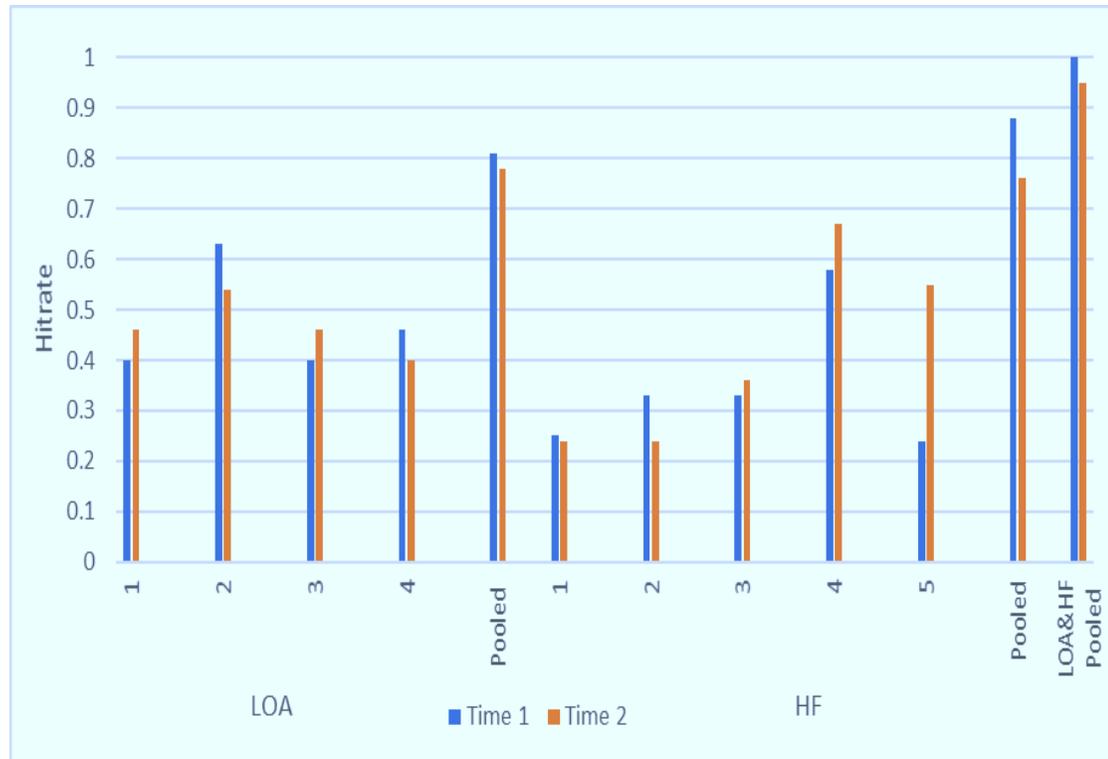
- The study involved comparing the risks identified by two groups of analysts (LOA and Human Factors researchers) with an expert risk assessment of the same work system
- LOA practitioners worked across the LOA system
- Study demonstrated that validity can be enhanced by analyst pooling process (vs. single analyst) (Stanton, 2009; Cornelissen et al, 2014)
- Findings suggest the need for significant rethink in terms of the methods and approaches currently used in RA



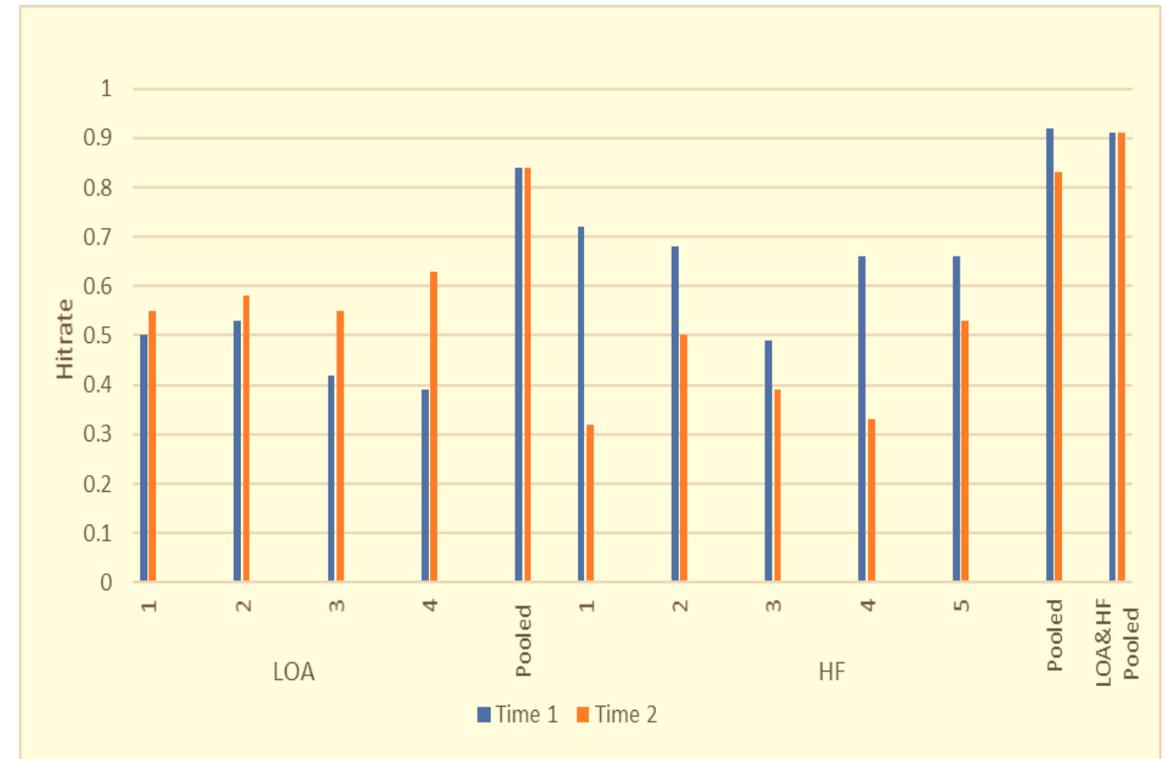
Dallat, C., Salmon, P. M., & Goode, N. (Under review). Testing the validity of a new risk assessment method: the NET-worked Hazard Analysis and Risk Management System (NET-HARMS).

IMPORTANCE OF MULTIPLE ANALYSTS REPRESENTING THE WHOLE SYSTEM

Task



Emergent



RESEARCH CONTRIBUTIONS

- **Theoretical**

- Application and testing of systems theory in a risk assessment context. Results show that risks exist across the LOA system.

- **Methodological**

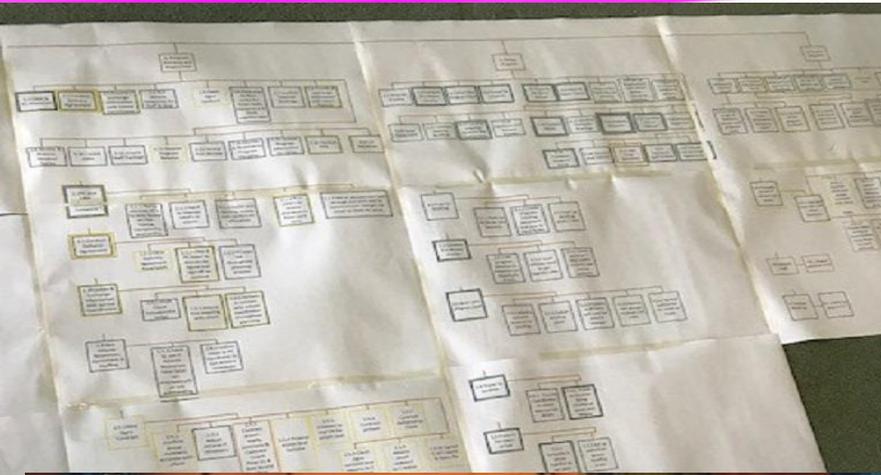
- NET-HARMS
- Pooling of analysts results (Study 2 vs. Study 5)
- Appears that having both domain-specific and human factors expertise leads to more identified risks

- **Practical**

- Practical, easy to use, benefits of HTA to organisation
- Step by step guide available as to how to use NET-HARMS
- Shouldn't be an individual conducting risk assessments
- Importance of involvement from multiple people representing different perspectives from across the work system
- Already being applied in practice



TRANSLATION INTO PRACTICE



“NET-HARMS gave me a much broader and more structured format for the risk identification process, as opposed to the more common brainstorming hazard and risk identification approach. Clare’s tool has made it much easier to identify the many areas of potential risks in the planning processes of outdoor learning programs and to help identify their many flow on effects and potential hazards during the actual delivery of program.” (Katelyn Caldwell, Wodonga TAFE).



LIMITATIONS AND FUTURE RESEARCH



- NET-HARMS not yet tested against other systems RA methods (e.g. STPA, FRAM, EAST)
 - This is planned through upcoming Discovery project
- NET-HARMS case study completed on higher level LOA design, planning and conduct tasks (e.g. Commence and complete activity).
- ALARP
 - How organisation's can practically address risks identified

QUESTIONS/ COMMENTS

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