TOWARDS UNDERSTANDING THE ROOT CAUSES OF OUTDOOR EDUCATION INCIDENTS

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"As history shows, however experienced the party may be, nature at a particular time and place can deceive even the most cautious."

From Coroner Bradley's written decision on the inquest into the deaths of three mountain guides and one client that occurred on Mt Tasman in Dec 2003 (In Cropp, 2004).

ABSTRACT

Outdoor education involves the interaction of people with the natural environment, often in challenging situations. Because of this there are often real risks involved that must be suitably managed. Despite efforts at managing these risks, incidents are still occurring during outdoor education experiences that sometimes culminate in serious injury and even death. While in the past these injuries and fatalities would have been considered unfortunate acts of misadventure, new attitudes in society seek to ascribe blame in the wake of an accident and those involved, or their families, seek penalties for those blamed. Recent legislation such as the Health and Safety in Employment Act make these penalties easier to apply, while the recent actions of both the police and officers of the Department of Labour show the willingness of public officials to investigate and prosecute outdoor education providers if accidents occur.

The outdoor education sector has been poorly equipped to reply to the public in the wake of serious incidents. There are few if any statistics on incident rates in the outdoor education sector, and there is very little known about the underlying causes of those incidents. To ensure that outdoor education provision can continue into the future such information needs to be available and training programmes developed based on those findings.

This research builds a profile of almost 2000 incidents that occurred in the years 1996 – 2000 at 12 of the 25 larger outdoor education centres in New Zealand that were invited to participate. That profile includes calculating accident rates for the group of organisations sampled and compares these to the rates of accidents occurring in outdoor centres in other parts of the world as well as those occurring in other aspects of life in New Zealand.

Eighteen of the incidents were chosen that had potential for serious injury, and these were studied for the root causes of the incidents using a Delphi technique involving three panels of outdoor experts. From this investigation, and an in-depth review of literature from the fields of safety management and psychology, I developed a taxonomy of root causes of outdoor education incidents and suggest a new model of how these root causes can interact to result in an incident. Not all of the identified types of error in the taxonomy of root causes could easily be

accommodated within the existing frameworks of outdoor decision-making. In order to provide a model that incorporated these error types, theories of cognitive psychology were combined into a new model of outdoor education decision-making in hazardous situations. This shows how personality factors, attitudes and other social factors can act to bias decisions and lead to incidents occurring.

As a result of this research, an ongoing collection of incident data in the outdoor education sector is advocated, as is the adoption of the taxonomy of root causes and model of an outdoor education incident into training programmes for outdoor instructors. Through these processes it is hoped that risk management practices will be improved, incidents reduced in frequency and severity, and therefore participation of young people in outdoor education programmes for personal development outcomes can continue to be promoted and justified.

Suggestions for further research to build the knowledge of the processes leading to incidents in outdoor education activities are made at the end of this thesis.

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This thesis is the culmination of a lengthy and challenging journey – a journey that would not have been completed without the support and encouragement of a large number of people.

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This study would not have been possible without the cooperation of the 12 large NZ outdoor education organisations that were willing to let me access their incident data. Following this, 18 instructors allowed me to question them about incidents that had potentially serious consequences. Both the organisations and instructors showed a high level of trust in allowing this to happen, driven by their belief in the outcomes of this research being useful for the sector in helping to understand and reduce incidents. I hope I haven't disappointed them.

Eighteen outdoor experts agreed to help analyse the various incidents. They gave their time freely while having many commitments of their own. They must have become scared while checking their emails at times as I pestered them to get their results back to me. The quality of the results of this study is a direct consequence of the input of these people.

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CHAPTER ONE

INTRODUCTION AND OVERVIEW

1.1 Introduction

This introductory chapter gives a brief background to the current state of outdoor education in New Zealand and the risk management practices used in this sector. This is followed by a statement of the research problem and the objective of the study. The research methodology and method are introduced and a synopsis of the thesis presentation is given. The chapter concludes by outlining the scope and limitations of the study.

1.2 Aims and Significance

Outdoor education in various forms has been a component of New Zealand education since the 1850s (Lynch, 1998a). What began as school trips and recreational outings run by teachers, parents and volunteers in schools and club settings, has changed in form and delivery over the years. There is now extensive literature outlining theories and practice of outdoor education and delivery is conducted by highly skilled and trained personnel. A massive growth in outdoor education provision has also occurred, beginning in the 1950s (Lynch, 1998a). Knol (2001) estimated that there were over 800 providers of outdoor education experiences in this country including sole operators, schools, tertiary institutions and large outdoor education centres.

It is not surprising that there has also been a huge increase in those offering training, assessment and qualifications for outdoor education leadership. Outdoors New Zealand identified 48 separate organisations in New Zealand offering such training (Grant & Boyes, 2003).

Outdoor education is important for a number of reasons. At a fundamental level it has been argued by some that New Zealanders have a connection with the outdoors that is unique and sets us apart from people of other countries (Palmer, 2004). The rugged competitiveness, drive, individualism and achievements of people such as Sir Edmund Hillary, Sir Peter Blake, Rob Hall, Barbara Kendall and Lydia Bradey (the first woman to ascend Everest solo and without oxygen) have made them icons for this country. We certainly have a number of successes, and expectation as a country of success, on the international stage that is disproportionate to our small population. My belief is that these successes are due in part to childhoods which include exposure to the New Zealand outdoors that builds 'can do' personalities from attempting new experiences, accepting challenges and working through adversity, often in small groups, to attain goals.

There are now significant numbers of people employed in the provision of outdoor education experiences for New Zealanders. There are even more employed in offering outdoor education to international students and in adventure tourism, where overseas visitors come to New Zealand to sample unique outdoor experiences.

It is my belief that outdoor education is important to this country for many reasons: it offers personal development opportunities for young New Zealanders so that they are able to learn skills in communication, trust, teamwork and goal setting; the same young people gain knowledge and attitudes about caring for their environment into the future; through the attitudes developed in young people, New Zealand society retains its unique culture; significant employment results from outdoor education work; and, even more employment results from the spin-offs of international outdoor education students and adventure tourism.

Set against these suggested benefits of outdoor education are negative outcomes that have the potential to inflict significant damage on the sector including injuries and even fatalities among participants whilst under formal guidance and instruction. Society appears to be becoming more risk averse and the adoption of punitive legislation such as the Health and Safety in Employment Act [HSE] (1992) has made the legal environment in which outdoor education providers operate more challenging and even precarious.

Preventing incidents happening to those in their care – especially incidents that result in serious harm – is a critical issue for those involved in outdoor education provision. Beyond the legal and moral reasons for preventing such incidents, the very existence of this form of education could be in jeopardy. Based on over 20 years involvement in outdoor education, much of it in the training and management of outdoor leaders, I believe that the causes of incidents in outdoor education are inadequately understood. For example, I have regularly seen the outcome of incident investigations being that causes of those incidents are attributed to what I would term superficial factors such as: instructor error, faulty equipment, bad weather or a dangerous act from a student. I believe the root causes often remain undisclosed. For example, there are many possible underlying reasons for the instructor making an error: they may be over-worked, under-trained, distracted, stressed, placed with an unsuitable group with unrealistic objectives, etc.; many possible reasons for faulty equipment getting into the field: faulty maintenance systems, poor purchasing policy, no responsibility for checking before use, etc.; reasons that a group may have headed out into unacceptable weather: poor weather information available, inability to vary programme content, etc.; and, reasons that a student wasn't stopped from carrying out a dangerous act: levels of supervision inadequate, lack of knowledge of previous history of such events, etc.

It follows from this that, if the true causes of incidents are not well understood, then training programmes and management systems aimed at reducing incidents are not as effective as they might be. This research addresses this problem.

1.3 Risk Management in New Zealand Outdoor Education

This research is set within a period which I believe will be reflected upon and viewed by historians as an era of safety management reforms in the outdoor education sector.

Prior to the 1980s there was very little in the way of a systematic approach to managing risk in the outdoors. In 1977 an attempt was made by a collective of the major outdoor recreational and educational government and quasi-government organisations to establish a New Zealand Outdoor Training Advisory Board (OTAB) (Priest & Gass, 1997). The aim of OTAB was to encourage competent leadership to improve standards, reduce accidents and promote environmental care (OTAB, 1980). It provided a framework for outdoor leader training and encouraged those involved in outdoor education to log their experience. The suggested curriculum of training made no mention of the terms risk management, safety management or accident / incident investigation. The OTAB scheme met with little enthusiasm from the sector and was abandoned. The only reported study at this time that touched on safety management was a Winston Churchill Memorial Fellowship Study in UK and USA outdoor centres to investigate safety frameworks for New Zealand outdoor education (Allan, 1983). This study appears to have received little attention.

Following the death of a school student in a mountaineering accident while on an outdoor education trip in 1986, an appeal was made by the parents of the deceased to the Ministry of Education for the establishment of standards for those involved in outdoor education instruction with school-aged students (Moodie, 1998). The Ministry responded by establishing a voluntary risk management training course with an accompanying log of experience. Assessment of competence was avoided. In 1987 outdoor instructors established a professional association, the New Zealand Outdoor Instructors Association (NZOIA), to run training and assessment schemes across a range of outdoor activities (Davidson, 1988). These schemes closely followed the British models that existed at the time for mountain leadership and canoeing awards.

The early 1990s saw a number of fatal accidents in the outdoor education sector that received high media profile (Barker, 1990; Bower, 1991; Brett, 1994; Locke, 1990). This attention reflected, perhaps, an increase in the general risk averse nature of society. The HSE Act in 1992 further indicated society's risk aversion reflected in legislation that included the outdoor education sector and posed serious threats to those running outdoor education programmes in the form of potential large fines and jail sentences.

Those in the outdoor education sector responded to this legislation by focusing on risk management techniques in an attempt to reduce the frequency and severity of accidents. The principal risk management tool that was adopted by the outdoor education sector was the Risk Analysis and Management System (RAMS) and subsequent variations (Davidson, 1992). This relied on the identification of hazards prior to an activity and the development of strategies to mitigate those hazards where possible. The Mountain Safety Council published the first ever risk management text in New Zealand (Haddock, 1993) which has recently been updated and reprinted (Haddock, 2003). This text relied heavily on literature published in the United States through the Journal of Experiential Education, and papers presented at annual conferences run by the Association for Experiential Education and the Wilderness Risk Managers Committee. There is very little published on the subject by or for New Zealanders.

Conferences were held in both Australia in 1996 and New Zealand in 2002 with risk management as the principal theme. At the time of writing (2004) risk management is still a critical issue in the outdoor education sector. Serious incidents are still occurring, no system exists for collection of incident data in the sector or for the analysis and dissemination of lessons from those incidents, and there is only rudimentary knowledge of the causal factors leading to those incidents. While some outdoor education proponents have tried to focus attention on the positive aspects of risk (Bailie, 2003a ; Zinc, 2000; Zinc & Leberman, 2001) the public are understandably more focused on the negative aspects when incidents happen.

It is my belief that the proposed 'safety management era' will be ongoing until the shortfalls in our understanding about the 'true' or 'root' causes of incidents in outdoor education are addressed.

1.4 Problem Statement

I believe there are serious deficits in the state of knowledge regarding the root cause or causes of outdoor education incidents. If these knowledge deficits can be filled, then training programmes for instructional staff, and the efforts of managers to implement effective safety systems, can be improved. This should lead to reduced frequency and severity of incidents in the sector.

For the purposes of this study the following definitions are used:

Incident: "Either an accident or near accident. In the broader loss control definition, it refers to an event which could or does result in a loss." (Bird & Germain, 1989, p.36)

Accident: "An undesired event that results in harm to people, damage to property or loss to process. It is usually the result of contact with a substance or source of energy above the threshold limit of the body or structure." (Bird & Germain, 1989, p.36)

Near Accident: "An event which, under slightly different circumstances, could have resulted in harm to people, damage to property or loss to process."(Bird & Germain, 1989, p.36)

Root Causes: "Those causes of accidents which would effect permanent results when corrected. They are those weaknesses which not only affect the single accident being investigated, but also might affect many other future accidents and operational problems." (Petersen, 1988, p.11)

1.5 The Research Objective and Issues

The research objective was to construct a model of an outdoor education incident that increased the understanding of the root causes leading to incidents occurring.

As part of the process of achieving this objective, the research addressed a number of secondary issues:

- An understanding of the current state of knowledge about outdoor education incidents was compiled. This included both theoretical knowledge and empirical evidence.

- A sample of outdoor education incidents was gathered from which an outdoor education incident profile was developed. This profile included the distribution of recorded incidents by variables such as severity of outcome, time of day, gender of instructor, etc. An accident rate was also calculated from this sample and compared to international accident rates and those prevalent in other contexts.
- The sample of incidents was analysed to identify variables that were predictors of those incidents, especially ones likely to result in serious injury.
- A Delphi analysis (an iterative process by which a group of anonymous experts reach consensus) of 18 case studies of serious incidents was used to produce a list of root causes of those incidents.
- The list of root causes from the 18 incidents was supplemented by additional root causes of incidents identified from a literature review from the fields of safety management and psychology to produce a taxonomy of error for outdoor education.
- Possible implications of the findings of this research to the training needs of the sector were also explored.

1.6 Methodology and Method

This research adopted a pragmatist paradigm using a mixed methods approach. A sample of outdoor education incidents was collected for the years 1996 – 2000 inclusive. Quantitative methods were used to analyse this data to build a profile of the incidents and to identify predictors of serious injury. Qualitative techniques were employed to investigate the root causes of a subset of the sample collected. This subset of 18 incidents was chosen to include incidents which had the potential for serious injury but were representative of a broad spectrum of outdoor contexts. The qualitative techniques included instructor interviews about incidents they had been involved in, with the use of Delphi panels of outdoor experts to analyse this interview data.

The research method included a literature review from the fields of industrial safety management and psychology. Information discovered through this review process was incorporated with the empirical data to develop a possible model of an outdoor education incident including a taxonomy of root causes of those incidents.

Biases that could result from these techniques were discussed and the methods taken to minimise them explained.

1.7 Outline of Thesis

The thesis is presented in eight chapters as follows:

Chapter One **An Introduction and Overview**

Chapter Two **Outdoor Education in New Zealand and the Critical Issue of Safety:** This chapter provides a setting for the research topic. Outdoor education is defined and a brief history of the development of outdoor education in this country is explained. The size and coverage of the sector is explored, the current perception of outdoor education accidents explained and the need for a focus on safety within the sector is justified.

Chapter Three **Research Methodology and Methods:** This chapter states the methodological assumptions that guide the research and outlines and justifies the research methods employed.

Chapter Four **Review of Literature – The Development of an Outdoor Education Incident Model, Taxonomy of Error and a Tool to Diagrammatically Represent an Incident:** This chapter provides a comprehensive review of knowledge about incident causation and root causes leading to incidents, from the fields of outdoor education, industrial safety management and psychology. From this information I have developed:

- an interim model of an outdoor incident;

- a taxonomy of root causes from the literature; and,
- a tool to diagrammatically represent an outdoor education incident that aids in identifying root causes.

Chapter Five **Results and Discussion – A Profile of New Zealand Outdoor Education Incidents 1996 – 2000:** This chapter summarises the quantitative phase of the research. Incident rates are presented and compared against other activities. Variables that are predictors of incidents leading to serious injury are identified.

Chapter Six **Results and Discussion – Identifying the Root Causes of Outdoor Education Incidents in New Zealand 1996 – 2000:** This chapter provides a summary and analysis of the qualitative phase of the research. Interviews were conducted with the instructors involved in 18 case studies of serious outdoor education incidents. These interviews were analysed using a Delphi technique for the root causes of the incidents. These root causes were grouped and categorised to provide a list of errors. This list is used to help explain some of the results obtained in Chapter 5.

Chapter Seven **Results and Discussion - A Proposed Taxonomy of Root Causes of Outdoor Education Incidents and a Model of Incident Causation in Outdoor Education:** In this chapter the results of Chapter 6 are compared and contrasted with the model developed in Chapter 4. The result is a proposed model of incident causation for outdoor education, accompanied by a taxonomy of root causes of error.

Chapter Eight **Summary, Recommendations and Conclusion**

1.8 Scope, Limitations and Assumptions

1.8.1 Scope

As will be explained in Chapter Two, the outdoor education sector is diverse, encompassing programmes within schools, individuals contracting their services as sole traders, small companies and large outdoor education centres. The scope of this research was limited to the larger outdoor education centres although it is anticipated that the results will have application to a wider audience.

1.8.2 Limitations and Assumptions

A study such as this has inherent challenges and limitations. These limitations are due principally to the availability of sample data, the bias that can be introduced into retrospective personal accounts of past stressful events and the subjective analysis of those accounts by outdoor experts.

1.8.2.1 Sample data

Sample data were limited in two senses. Firstly the sample was restricted in order to make the study manageable. As explained in the discussion of the scope of this study only larger outdoor education centres were canvassed. In addition, the sample was further restricted to include only those incidents occurring between the years 1996 - 2000 inclusive. The sample was selected from within this group by the willingness of: firstly the organisation in making its incidents' records available; and secondly by individual instructors being willing to discuss incidents in which they had been involved. It was recognised that this could bias results in that organisations with poorer safety records may not have contributed to the statistics and those instructors who were less open to sharing their incidents may have limited the number and type of root causes identified.

1.8.2.2 Retrospective personal accounts of accidents

It was assumed that those instructors who agreed to be interviewed about their incidents would report honestly about their experiences. It was recognised that bias could be introduced into their accounts of the incident by wrongly interpreting key information at the time of the incident, forgetting key information in their retelling of the incident, or omitting or even altering key information in their retelling in order to look better in the eyes of those reading the account. The fact that the researcher is a major employer in the outdoor education sector and involved in the governance structure of several outdoor organisations increases the likelihood of these biases occurring.

1.8.2.3 Analysis of accounts

All of the interview data were analysed by experts in outdoor education for root causes. I collated the individual analyses to send back to the experts for comment. These stages rely on the subjective evaluation of data by individuals and are therefore prone to bias and error.

The limitations in the sample choice and subsequent data were acknowledged and methods (see Section 3.5) were employed to increase the validity of the findings and hence the ability of the results to be generalised to the larger population of outdoor education providers.

Readers will need to make their own judgments about how well these limitations have been overcome, the generalisability of the findings and appropriateness of the recommendations.

CHAPTER TWO

OUTDOOR EDUCATION IN NEW ZEALAND AND THE CRITICAL ISSUE OF SAFETY

2.1 Introduction

This chapter gives a detailed overview of outdoor education in New Zealand and explains why finding appropriate ways of dealing with safety issues are key to the continued growth of the sector.

The chapter starts by defining outdoor education and how this is different from the adventure and ecotourism sectors. The history of outdoor education in New Zealand is then reviewed. The threat to outdoor education from safety issues is explained and the different ways that outdoor educationalists in New Zealand, Britain and the United States have responded to this threat is examined. Finally the knowledge gap is described and what is needed to fill that gap in order for the outdoor education sector to be able to deal effectively with the threat – a better understanding of what incidents are occurring in the sector, the rate at which they are occurring, and a model of an outdoor education incident identifying the root causes that produce it.

2.2 Defining Outdoor Education

Outdoor education is defined as an experiential philosophy of "learning by doing with reflection" that takes place primarily, but not exclusively, through involvement with the natural environment (Priest & Gass, 1997). Historically outdoor education has been considered in two component branches: adventure education and environmental education. Adventure education involves the use of adventurous activities that provide a group or individual with compelling tasks to accomplish from which participants learn about themselves and how they relate to others; environmental education is concerned primarily with learning about ecosystemic relationships (the interdependence of living organisms in an ecological system) and ekistic relationships (the key interactions between human society and the natural resources of the environment) (Priest & Gass, 1997, pp.17-18). Rather than differentiating between component parts, it is now considered more appropriate and effective to incorporate learning about all relationships (interpersonal, intrapersonal, ecosystemic, ekistic) into any programme in a holistic manner. This is consistent with a second definition given for outdoor education, "...a broad term describing education *in* the outdoors, *for* the outdoors, and *about* the outdoors" (Ministry of Education, 2004). This latter definition is based on the pioneering work of early outdoor education theorists such as Hammerman, Hammerman & Hammerman (1985) and Smith, Carlson, Donaldson & Masters (1972). For the reasons outlined here the global term of "outdoor education" is the most appropriate to use in this study.

Outdoor education should not be confused with tourism. While there is potential overlap between outdoor education and aspects of tourism (especially adventure tourism and ecotourism), the goals of the two are often different. A research study by Sung, Morrison & O'Leary (1997) resulted in a definition for adventure travel from a provider's perspective (adventure travel being used by Sung et al. as a synonym for adventure tourism).

> "A trip or travel with the specific purpose of activity participation to explore a new experience, often involving perceived risk or controlled danger associated with personal challenges, in a natural environment or exotic setting" (Sung et al., 1997).

This definition helps to establish the difference between outdoor education and adventure tourism: the goal of adventure tourism is participation whereas the goal of outdoor education is the structured learning that can be derived from that participation.

2.3 History of Outdoor Education in New Zealand

New Zealand has a long history of outdoor education, especially for youth, although the nature and means of provision of this form of education has changed and evolved over the years. Lynch (1998a) has researched the development of outdoor education in the school system in New Zealand. The first recorded references to outdoor educational activities date to school field trips in the 1850s. These school 'treats' and recreational trips, educational visits and curriculum related field trips continued until the term 'outdoor education' came into common usage in the 1940s. This form of education continues today where many schools offer outdoor education activities including tramping, kayaking, orienteering and caving, organised by enthusiastic teachers and supported by parents. There are many schools throughout the country that own and manage their own lodges in remote settings. Although there are few reliable records, it appears that there was a rapid growth in school-based outdoor education from the mid 1950s to the 1990s, with outdoor education programming for forms 3-7 in secondary schools reaching a zenith in 1989 (Gainsford, 1973; Lynch, 1998b).

Organised youth groups such as Boy Scouts, Girl Guides and Sea Cadets have been in existence in New Zealand since 1908. They have had strong followings and used the outdoors extensively, although anecdotal evidence suggests they have declined in support in recent years.

When the Outward Bound programme was introduced to New Zealand from Britain in the 1960s, it was readily embraced by New Zealanders and seen by many as an excellent way for young people to learn about accepting challenges, overcoming adversity and developing character for adulthood. The introduction of the Outward Bound model to New Zealand was influential in that never before had a specifically designed educational programme been offered which was staffed by full-time, trained, experienced and paid instructors operating to a set of standards based on an international model.

Other professional outdoor education providers soon followed the Outward Bound School. The other two important early examples were the Spirit of Adventure Trust which used Tall Ships for their programmes commencing in 1973, and the Sir Edmund Hillary Outdoor Pursuits Centre of NZ which established programmes in 1973 for secondary school students based around activities in the mountain environment.

Table 1

Examples of Outdoor Education Provision in New Zealand, 2004
(NB: See Appendix 1 for a more detailed analysis of these examples).

Outdoor Education Example	Objective	Activities and sites	Staff	Student Numbers	Student Days
Voluntary – Award focused: The Young NZers' Challenge. Began in 1963. (Naresh, 2004)	Developing young people.	Any activity at any site in NZ	None – must be organised by the participant	Approx. 15,000 participating with 1500 finishing each year.	Approx. 16,000 per year.
Uniformed Youth Group: Scouting NZ. Began in 1908. (Knighton, 2004)	The mission of World Scouting is to contribute to the education of young people, through a value system based on the Scout Promise and Law, to help build a better world where people are self-fulfilled as individuals and play a constructive role in society.	Any activity anywhere in NZ	All Scout leaders come from volunteers within local communities.	Approx. 18,000 young people enrolled in Scouting each year doing outdoor activities.	Approx. 90,000 participant days per year
Outdoor Education Centre - Private Training Establishment: The Sir Edmund Hillary Outdoor Pursuits Centre of New Zealand. Began in 1973. (Smith, 2004)	Developing people's potential through: • Challenging outdoor adventures • Environmental education • Fun and support	Outdoor activities mostly concentrated around mountains, rivers, lakes and forests of the Central North Island	Approx. 34 full time equivalent staff of which 18 are instructional.	Approx. 6,600 participants per year.	Approx. 26,000 participant days per year.
Youth Sail Training: The Spirit of Adventure Trust. Began in 1973. (Lister, 2004)	To offer equal opportunity to young New Zealanders to develop qualities of leadership ,independence and community spirit through the medium of the sea.	Sailing and some tramping and beach activities. Carried out around the coast and coastal islands of New Zealand	10 fulltime sea staff, 8 shore staff and 1 part time. Plus approx. 1200 rostered volunteers	Approx. 5500 participants annually.	Approx. 13,750 participant days per year.
Adult Personal Development Centre: Outward Bound NZ. Began in 1963. (Taylor, 2004)	Vision: Helping to develop better people, better communities and a better world.	Mostly sailing, kayaking and tramping in and around the Marlborough Sounds	Approx. 49 staff, 22 of whom are instructional	Approx. 1065 students do 21 day courses annually and 355 do 8 day courses.	Approx. 25,205 participant days per year.
Polytech Vocational Training: Christchurch Polytech Institute of Technology. Began in 1994. (Bailey, 2004)	To provide leadership and scholarship in outdoor education and adventure recreation in order to enrich individuals and society; and to contribute to the sustainability of the natural environment.	Most outdoor activities predominantly run in the Canterbury region	12.5 Full time equivalent staff.	150 students on Certificate, Diploma and Degree courses.	Approx. 15,400 participant days per year.
School Residential OE Programme: Tihoi Venture School. Began in 1979. (Firminger, 2004)	In this unique and challenging environment, through the medium of community living, a quality academic programme and wide ranging outdoor pursuits we aim to provide the best possible opportunities to promote the personal and social development of our students.	Kayak, rock, sail, tramping, caving, solo, alpine skills, survival. Activities are run in the Central North Island.	12 fulltime staff, 10 of these are instructional.	128 students take place each year. This is a compulsory component of school life for year 10 students at St Paul's Collegiate Hamilton.	Approx. 10,240 participant days per year.
School OE Programme: Nelson College. Began in 1964. (Cant, 2004)	To teach students the skills of goal setting, communication, team work and environmental awareness while taking part in outdoor pursuits in New Zealand's outdoors.	Most outdoor activities which are run in the mountain ranges, rivers, bush and sea of the greater Nelson area.	Two specialist OE teachers who also teach other subjects plus contractors	Approx 453 students take part each year..	Approx. 4,280 participant days per year.
Community Programme: New Plymouth YMCA. Began in 2000. (McKee, 2004)	Personal development, recreation skills, training and qualifications - We build strong kids, strong families, strong communities.	Most outdoor activities which are run in the Taranaki and Wharepapa areas.	Four full time staff plus contractors	Approx. 2100 participants per year.	Approx. 8,000 participant days per year.

In New Zealand in 2004 there is significant employment in small businesses, schools and larger organisations using the outdoors as a teaching medium. Henceforth, I will refer to this as the outdoor education sector, which is itself a sub-sector of the sport, fitness and outdoor recreation industry. From a small and unstructured beginning where experiences were offered by a number of schools and a few other groups, there has been an enormous growth in the number of providers (Boyes, 2002; Jesson, 2000). It has been estimated by Outdoors New Zealand that including school camps, private training establishments (PTEs), Conservation Corps Programmes, Polytechnical Colleges, Universities, freelance instructors, charitable trusts and private businesses there are in excess of 800 providers involved in the delivery of outdoor education in New Zealand (Knol, 2001). Although there are no data available, it is assumed that the increase in provider numbers also reflects an increase in the number of student days of outdoor education delivered. There is anecdotal evidence to suggest that the sector may have peaked in about 2000 in terms of provider numbers and student days delivered. Some providers have ceased offering instructor training programmes since 2000 because of declining student numbers. Further research is needed to investigate this perceived trend. Some examples of this diversity of outdoor education providers are shown in Table 1.

2.4 Safety Issues and Attitudes Pose a Threat to Outdoor Education

At the same time as this massive growth in the provision of outdoor education experiences, there is evidence to indicate that attitudes in society are becoming more risk averse (Cumming, 2002; Heeringa, 2004; Jones, 2004; New Zealand Herald, 2004; Stirling, 2004). This trend can also be seen in legislation where, for example, the Health and Safety in Employment Act (1992) and its 2003 amendment, place high standards of care on employers for their employees at work and visitors to the workplace.

It may seem that there is a paradox between the massive growth in the demand for outdoor education experiences and a society that is becoming more risk averse. At least one writer argues that the increased participation in extreme sports is evidence that individuals are actually seeking greater risks in line with a more liberal society where responsibility is shifting from corporate bodies to individuals for the control of risk (Simon, 2002). Assuming that we live in a society that can be described as "advanced liberal" or "neoliberal" (O'Malley & Palmer, 1996; Rose, 1996) another interpretation of this risk transfer exists. Giddens (1991) subscribes to the idea that we live in a "risk society" but believes these risks are mostly those that we personally have little or no control over: stock exchange, global warming, etc. We mitigate these risks, or create a semblance of control, by an increased reliance on "expert systems" be they financial advisors, scientists, doctors, or, as in this research, outdoor experts. Giddens would see the outdoors as being especially applicable as it feeds into the modern project of "identity" formation. Using experts, all of the organisation, skill development, risk assessment and judgment are handed over to those experts and in this way the risk is controlled. This idea of controllable risk is a very desirable product to parents wanting to develop their children on outdoor education programmes, or individuals wanting the outcomes of adventure tourism. As is the case for other expert systems however, if the system fails and loss results, the experts (lawyers, surgeons, financial analysts and outdoor experts) are held accountable to the point of civil and criminal prosecution. This argument goes some way to explain the apparent paradox between increased participation rates in outdoor education and a perceived increase in risk aversion by society: individuals increasingly want to explore and develop their identity through adventure activities and they control the risk in those activities by using experts – hence the increase in participation. The use of experts removes individual responsibility from the risk equation and therefore when accidents happen, those individuals seek redress from the experts who were meant to protect them. The increased safety consciousness, and transfer of responsibility of risk control from individual to expert, is interpreted by many as risk aversion. This transfer of control to experts in order to manage the risk, such that to the participant the risk simply no longer exists, is evidenced by the research of Sung et al. (1997) who found that in a survey about the definitions of "Adventure Travel", the least acceptable definitions involved associations with physical danger.

This lack of personal responsibility for risk is also revealed in negative public reaction to incidents that occur during outdoor education experiences. New

Zealand is not unique in this regard, as there is a trend of increased official and media scrutiny of outdoor education in the wake of high profile incidents, especially those involving young people.

In the United Kingdom in May 1993, a multiple fatality of young teenage children at Lyme Bay provoked nationwide media attention. Criminal charges were brought against the staff and management of the outdoor education centre concerned resulting in convictions, fines and jail terms (Geary, 1995; Laurie, 1996). Justice Ognall made a call for an immediate and thorough appraisal of the running of activity centres as, in his mind, the potential for injury or death was too obvious for safety procedures to be left, “to the inadequate vagaries of self regulation” (as cited in Bradford, 2000). The UK government introduced a specific Act of Parliament [Activities Centres (Young Persons’ Safety) Act 1995] to manage the perceived risk. This is the only Act of its type in the world. The Act imposesd an inspection system on all outdoor centres (excluding schools) dealing with children, with rigorous standards of operation required. Discussions with Marcus Bailie, head of inspection services for the Adventure Activities Licensing Authority (AALA) indicate that there have been no studies done on the effect of the introduction of licensing. He believes that in the UK there may have been some loss of provision as organisations chose to opt out of working with young people and also that provision within schools seems to be under heavy pressure. Bailie described the reaction to the Lyme Bay incident to me as “a true moral panic”, and believes the introduction of licensing was almost certainly an over-reaction in as much as it helped fuel the fire of parental and societal paranoia (Bailie, 2003b).

Another teacher was jailed in 2003 in the United Kingdom for manslaughter following the drowning of a student in a swollen stream as part of an outdoor education trip. The reaction from teaching unions to this further criminal conviction was the threat that all school trips could be cancelled as the personal risk to teachers of running such trips was too high (Wainwright, 2003).

Similar serious incidents have also occurred in outdoor education programmes in New Zealand. Substantial media attention was given to some recent incidents such as three fatalities of diving students while under instruction at French Pass in March, 2000 (New Zealand Herald, 2000a), the drowning of two school students while taking part in an outdoor education camp on the Coromandel Peninsula (New Zealand Herald, 2000b), the drowning of two school children during a canoeing trip operated by a professional contractor on the Clarence River in October, 2001 (Perrott & Black, 2001), and the more recent student kayak death on the Buller River as part of a tertiary education programme in February, 2002 (New Zealand Press Association, 2002). All of these incidents took place under the supervision of instructors purporting to be skilled and experienced. In addition to the loss of life and distress caused to the families of those killed, the negative publicity has potential to be very damaging to the outdoor education sector.

Public attitudes towards such losses have changed radically. Fifty years ago in New Zealand, incidents like these were more readily accepted as part of the vagaries of life. Nowadays, scrutiny from public officials, often goaded by a voracious media, can be intense. When incidents occur the public expect accountability and someone to blame. If incidents continue they expect government agencies such as the police, Occupational Safety and Health (OSH), Maritime Safety Authority (MSA), or the Civil Aviation Authority (CAA) to move in, fine or imprison those responsible and impose further controls to solve the problem. Beedie (1996, p.13) notes that, "...the spectre of potential disaster and the implications an accident may have for the image of outdoor education are constantly present".

While no criminal prosecutions have occurred in outdoor education in New Zealand to date, the atmosphere is ripe for such an event. The prosecution and conviction of Astrid Andersen who had a cycling participant die during a race she organised, is seen as ominous by some outdoor commentators (Lynch, 2002). Certainly incidents occurring on outdoor trips that result in injury or are even near-misses, would not have rated much media attention in the past. Now the media seems keen to follow up and give them major profile (Dye, 2004; New Zealand Press Association, 2004). The reaction of some principals to the threat of liability for themselves and their staff has been to cancel school trips in a very similar move to their British counterparts (New Zealand Herald, 2001; New Zealand Herald, 2003; Quirke, 2003).

As explained earlier, the increasing number of outdoor education providers indicates that people are seeking out adventurous activities for themselves or their children in order to experience challenges and other positive benefits of risk, and yet are less willing to accept the negative aspects of those risks – injury or death.

2.5 The Importance of Measuring Accident Rates in Outdoor Education

In order to judge whether the safety concerns of the public are warranted, it is necessary to know what the accident rate is for outdoor education and how this compares with accident rates for other everyday activities. The increasing number of providers of outdoor education experiences mentioned earlier would indicate that there is growing participation in outdoor education. Without having a measure of accident rates, it is only conjecture whether the increased media reporting of serious outdoor education accidents is due to an increase in accidents, an increase in provision with a similar rate of accidents, a temporary aberration, or a focus by the media on such accidents leading to a perception of higher rates.

To measure accident rates requires data on the number of participant days in outdoor education programmes and the number of accidents occurring in those programmes – preferably sorted by severity. Unfortunately data such as these do not exist in New Zealand. A review of literature for both Australia and the United States reveals that there is a similar lack of data in those countries. What data that do exist is explored in Chapter Four.

This lack of information on accident rates makes it difficult to respond to media attention and limit any imposition of increased legal and bureaucratic constraints on outdoor education practice. However the reality may be that any death or serious injury occurring in outdoor education is unacceptable to the public. Brown (1998) states that public outrage in the wake of an outdoor accident is greatest when:

- Activities are unfamiliar to the community;

- Leaders are professional;
- Children are involved;
- Professional standards are compromised;
- Participants are uninformed; and
- Community is risk averse.

Thus, the majority of outdoor education accidents will result in high public outrage.

Justifying the continued exposure of young people to the risks of outdoor education activities becomes problematic. The list above indicates some strategies that need to be adopted: the community needs continual education about what outdoor education is, the activities involved, and the perceived benefits from taking part (It is noted that while I and others have plenty of subjective, anecdotal evidence of the benefits of outdoor education, there is a shortage of robust empirical evidence that has been subjected to peer review. A number of authors have published lists of research findings on the outcomes of outdoor education, or meta-analyses of this research [see, for example, Barret & Greenaway (1995); Crompton & Sellar (1981); Rickinson, Dillon, Tearney, Morris, Choi, Sanders & Benefield (2004)], however the weaknesses of the individual research studies are often masked by these meta-analyses. While these meta-analyses generally support the hypothesis that there are beneficial outcomes from outdoor educational experiences, the authors of a recent meta-analysis conclude that, "the wide variance in findings raises questions about the validity of quantitative research for this field, the reliability of instruments used for assessment of pre- and post-program changes, and the host of unknown variables that may be influencing both positive and negative effects of adventure programming" (Cason and Gillis, 1994, p.46). Further carefully designed research into the benefits of outdoor education would therefore be valuable to our sector); leaders need to be operating at the highest professional standards; and, participants and their guardians need to be fully informed of the risks. Beyond this the outdoor education sector must be able to present clear accident statistics to show that the risks are being managed well. Furthermore, safety management systems must be developed so that the accident rates decrease even further and serious accidents become rare, otherwise a serious threat is posed to the continuing viability of the sector.

2.6 Sector Response to the Threat

The outdoor education sector has responded to the call for higher standards of operation in different ways in various parts of the world. Priest and Gass (1997, p.6) contend that there is currently no consensus in the profession as to how best to do this but summarise three main approaches: (1) Individual certification – a process guaranteeing that certain minimum standards of competency have been met or exceeded by a candidate; (2) Programme accreditation – a process recognising that a programme or institution has met certain predetermined standards of operation; and (3) Outdoor leader preparation – a process in which an organisation provides one or more training experiences to 'upskill' an outdoor leader and other processes to ensure 'upskilling' continues in the workplace. While the third approach is used in all countries, those same countries vary in their emphasis on the first two approaches.

In the UK the main emphasis until recently has been on the certification of individuals. There have been extensive instructor award / certification systems through National Bodies such as the British Canoe Union and the Mountain Leader Training Board since the early 1960s. The systems for the mountain awards underwent revision and addition in 1972 following a multiple fatality of school children in Scotland in 1971 known as the "Cairngorms Disaster". A review of vocational qualifications within the education system in the UK began in 1986. Under this framework of National Vocational Qualifications (NVQ), standards for the outdoor profession were completed in 1992. This allowed individuals to work through national qualifications in the school system and also through government and privately registered tertiary agencies. Although the NVQs now exist, the Head of Outdoor and Environmental Education at the University of Edinburgh has indicated that they are rarely used as a standard and that the preference is still for the National Body awards along with degree courses from various universities (Higgins, 2005).

As discussed earlier, following the Lyme Bay incident, the UK government imposed a nationwide licensing system for those providing outdoor experiences for young people less than 18 years of age with the introduction of the Activity Centres (Young Persons Safety) Act in 1995 (Bradford, 2000). This licensing system is similar to the accreditation system for organisations involved in experiential education in the United States.

In the United States there is much less emphasis on instructor awards / certification. Their approach has been to opt for a voluntary system of accrediting organisations rather than individuals. The accreditation system, managed by the Association for Experiential Education (AEE), involves an audit by a team of peer reviewers who check the quality of the management systems of the organisations seeking accreditation and the implementation of those systems in the field. A key advantage of accreditation promoted by the AEE to organisations is reduced insurance costs (www.aee.org).

As much of the USA risk management focus is on avoiding civil legal action if an accident occurs, there is significant discussion of client waivers and how they can be effective. Some of the latest writings from the United States on legal defense for outdoor education accidents argue that many types of accidents are due to the inherent risk of going into the outdoors (Gregg, 1999a, 1999b). Inherent risks are those so closely associated with an activity that they cannot be eliminated without altering the nature of the activity. A provider of services can avoid liability for losses caused by such inherent risks by state statutes, case law, or written agreements whereby such risks are assumed. The argument therefore is that an instructor making a wrong judgment is an inherent risk of outdoor activities that can not be eliminated without altering the nature of the activity and therefore must be assumed by the participants.

New Zealand has closely followed the British approach. Prior to the 1980s all that existed were a small number of individual award schemes administered by clubs and agencies (e.g., New Zealand Canoeing Association and NZ Mountain Safety Council) for their members. A training scheme initiated by a group of outdoor groups in 1977, and named the Outdoor Training Advisory Group, failed to capture the interest of outdoor leaders and went into recess in the early 1980s when funding stopped. Following the death of a school student at an outdoor education centre in New Zealand in 1986 there was a call from the parents of the student for a government imposed award scheme for instructors (Moodie, 1998). The outdoor sector in New Zealand took proactive steps to set and assess its own standards of instructor competence by establishing the New Zealand Outdoor Instructor Association in 1987 with a range of instructor awards for various outdoor pursuits. Other award systems are offered by organisations such as the New Zealand Mountain Guides Association, New Zealand Mountain Safety Council, and the Sea Kayak Operators Association of NZ.

Under the Industry Training Act 1992, the Sport Fitness and Recreation Industry Training Organisation (Sfrito) was created. Similar to the British NVQ system, Sfrito was tasked by government with breaking down the competencies required for employment in each of its sectors into assessable Unit Standards and then grouping these into suitable qualifications. This included the outdoor recreation sector. Sfrito is now the fifth largest Industry Training Organisation in the country based on funding for trainees.

None of the qualifications mentioned is mandatory to operate as an outdoor instructor in New Zealand, although commercial concessionaires require minimum standards to operate on Department of Conservation estate.

Just as legislation forced increased standards in Britain following outdoor deaths, the Maritime Safety Authority (MSA) imposed stringent operating conditions and standards on the rafting industry in the 1990s following a number of fatal incidents. Reports into rafting fatalities show a decreased number for the five years following the imposition of the new standards compared to the five years preceding the standards. Whether this is due to the new standards or to other factors is not known. Whatever, fatalities are still occurring (AdventurePro, 2002; Brown, 2003) and I believe that every effort needs to be made to reduce them.

In 2004 Outdoors New Zealand introduced a voluntary licensing system for outdoor education providers called OutdoorsMark based on the AALA scheme.

This was launched by the Associate Minister for Education in Parliament and received a strong endorsement from the Minister in his speech at the launch. It is very early days for the effects of this scheme to be assessed as only five organisations hold the license to date (2004) with seven further organisations moving through the process.

Recent risk management practices in the outdoor sector in New Zealand have been driven by the Health and Safety in Employment (HSE) Act 1992 and its 2003 amendment. This has led to a proliferation of paper-based systems whereby risks are identified and various management techniques recorded for the benefit of the instructional staff working with groups. The recent safety guidelines prepared for schools involved in education outside the classroom (EOTC) activities promote the use of the Risk Analysis and Management System (RAMS) and Safety Activity Plans (SAPS) (Ministry of Education, 2003). These are both good examples of paper based systems. My belief is that while systems such as these are well-intentioned and can be useful, for many organisations they are completed at the behest of management, with the main purpose of protecting the organisation from criticism following incidents. In my experience, active instructors rarely refer to them.

Comment has already been made on the litigious environment that exists in the United States. A no-fault accident compensation scheme was introduced by the Government in New Zealand in the early 1960s that practically eliminated the ability of individuals to sue others for damages in the event of an accident. Revisions of this accident compensation scheme that reduced the cover it offered, the introduction of legislation such as the HSE Act that includes punitive measures, and increased safety consciousness and expectations in society leading to police investigations / prosecutions following outdoor accidents are rapidly increasing the risks to those who take on the roles of experts supervising others.

Despite all the approaches and systems used to manage risk in outdoor education, accidents are still occurring. The public reaction when accidents occur, and the increasing risk of criminal and civil liability, are threatening the viability of offering outdoor education experiences to New Zealanders.

2.7 The Knowledge Gap

I believe there is a lack of knowledge about the relative frequency of outdoor education incidents and their underlying root causes.

This lack of information is due in part to a culture within the sector of not sharing information about mistakes. Experience suggests that when incidents occur, there is a tendency to close ranks, keep heads down, investigate the incident internally, and do what can be done within the organisation to prevent similar incidents occurring in the future. Organisations try to contain knowledge of any incident to avoid adverse publicity, investigation by outside authorities and possible legal action.

Not only are there the legislative and punitive issues to avoid in keeping a low profile when an incident occurs, there are the more subtle negative marketing issues. There is a competitive environment for students within which no organisation wants to concede an edge to other organisations by disclosing information that may be interpreted by the public as suggesting their use of unsafe practices.

This research was an attempt to break through the culture of silence about incidents occurring in outdoor education. The organisations sampled were asked to adopt a shared responsibility approach to the contribution of information for this research project. They were encouraged to contribute information on incidents with the assurance that it would be analysed in such a way that the anonymity of the source would be preserved, while valuable lessons from the cumulative data could be derived for distribution throughout the sector.

2.7.1 Profile of Outdoor Education Incidents

Whilst risk can never be reduced to zero when going into the outdoors, neither is the risk zero in the course of everyday activities. Currently we do not know, and cannot communicate to the public what the accident rates are in outdoor education and how they compare to other everyday activities. We do not know as a sector which activities are producing the most incidents or accidents, or which produce the most serious injuries. Accurate information may reduce some of the public's insecurity surrounding outdoor education safety and create a realistic risk assessment in the community. The lack of this information is a key deficit and its collection and analysis are essential pre-requisites to effective communication among practitioners and with legislators, the public and the media.

Of course being able to quote statistics about injury and fatality rates is pointless if society is not tolerant of any serious incident in outdoor education, and that certainly is the case at present. As eloquently put by one experienced outdoor commentator,

> "Regardless of the facts we choose to paint a picture of risk in our activities, society does not expect people to experience serious injury or death in educational or recreational endeavors. These expectations often have far more power than our data" (Schimelpfenig quoted in Haddock, 2003, p.4).

These same sentiments have been expressed over the years by a number of outdoor experts (Ewert, 1984; Hunt, 1998; Mobley, 1981; Ongena, 1981; Schultze, 1980). This is all the more reason to work on effective ways to reduce incidents, especially ones resulting in serious injuries and fatalities.

2.7.2 A Model of Outdoor Education Incidents and Their Root Causes

As stated above, the risk in the outdoors can never be eliminated but that should not be used as an excuse to prevent those of us in the sector doing all we can to reduce the occurrence of injuries or death in the outdoors. I believe there is potential to learn a lot about preventing future incidents by studying recent incidents for their root causes. By developing a model of how outdoor education incidents occur including the interaction of the root causes, long term solutions to incident producing situations will become apparent.

2.8 Summary

Outdoor education has evolved in New Zealand from activities offered as treats or recreation in schools or clubs run by volunteers, to highly structured learning experiences run by skilled instructors in dedicated outdoor educational organisations. Outdoor education has had a rapid expansion in the last 50 years and is now a large employer, with workplaces ranging from small private businesses to large outdoor centres. As society has become more risk conscious and individuals less willing to accept personal responsibility for risks they face in an educational setting, there is increasing public perception that outdoor education is dangerous and that someone should be found to blame for any accidents that occur. This is a threat to the continued provision of outdoor education. Recent legislation that offers the potential for large fines and jail terms increases this threat.

The outdoor education sector has responded to that threat through the establishment of instructor award schemes and quality assurance schemes but serious incidents are still occurring. My contention is that there is important knowledge missing in the sector. Knowing outdoor education accident rates and comparing these with the rates of accidents in more common daily activities may help dispel the perception that outdoor education is overly dangerous. Having a model of how outdoor education incidents occur and an understanding of the root causes leading to those incidents will provide a more effective means of avoiding such incidents in the future. Also, I believe that using this information, and training instructors based on it, will make instructors aware of root rather than superficial causes, and this will help reduce the frequency and severity of such incidents.

CHAPTER THREE

RESEARCH METHODOLOGY AND METHOD

3.1 Introduction

This chapter explains the approach taken to achieve the research objective; namely how this study constructs a model of an outdoor education incident that increases the understanding of the root causes leading to those incidents occurring.

The chapter falls into two main parts. The first part describes the research methodology. The research methodology outlines the principles by which adherents to any discipline learn to accept or reject knowledge. The methodology is thus the guiding strategy that underlies the research (Aitken, 1980). The second part describes the research method – the process by which data were collected, analysed and evaluated to result in the model.

3.2 The Researcher in the Research

Before discussing both the methodology and the research method, it is important to acknowledge my background as this can provide the reader with an insight into the motivation to address the research questions, clues about bias that may be introduced into the research and possible shortcomings in the findings.

I am a white, second generation New Zealand male with an academic background in the physical sciences. Cause and effect relationships are ingrained in my paradigm of how the world operates through a traditional scientific background, although work in subatomic physics, including knowledge of the breakdown of Newtonian laws and understandings, have evolved attitudes to the post-positivistic frame that not everything can be known at once and that there are various ways to approach the world. A paradigm of cause and effect relationships is apparent in the research title. However, I am aware that any model developed must allow for the wealth of contexts that outdoor education incidents involve and the model will remain open-ended because of this.

I have been involved in the outdoor education sector for over twenty years, and have been the Director of the Sir Edmund Hillary Outdoor Pursuits Centre of New Zealand for 14 years. I hold national instructor qualifications across a range of outdoor activities, was a national assessor of those qualifications for a number of years, was instrumental in forming the New Zealand Outdoor Instructors Association, am currently a board member on the Sport, Fitness and Recreation Industry Training Organisation and New Zealand Outdoors. I recently helped develop a quality assurance scheme for outdoor providers (OutdoorsMark) and am currently the Chair of the Register of Outdoor Safety Auditors.

The motivation for this research comes from being in the role of a Director of an outdoor centre employing 18 instructional staff at any one time and being accountable for the educational and safety outcomes of over 4000 students annually. One fear of any person in my position is having to explain to a parent or other loved-one that his / her son or daughter has been killed or badly injured in an accident while on one of our programmes. Observations made over years of instruction and managing other instructors, and the follow-up of incidents that occurred over those years, gave me indications that common factors often lay behind incidents and that these needed to be formally identified. This research is an attempt to do just that; but this history, while being a motivator, also points to underlying biases and preconceptions that must be guarded against. These preconceptions may cause me to subconsciously ignore, or attach less importance to, certain evidence that does not support my beliefs.

The research is concerned with developing a model of outdoor education incidents and the root causes of those incidents that is derived from empirical data and existing theory. In acknowledging the potential causes of bias explained above, I am more aware of them and can guard against their impact. As will be explained in the research methods section, I have made extensive use of expert peer review of both empirical findings and model development to help limit the impacts of the potential sources of bias on the validity of the outcomes of the research.

3.3 Methodology

3.3.1 Background to the Methodological Framework.

Traditionally it has been thought that the choice of a suitable methodology, "...depends on ontological and epistemological assumptions about the nature of reality and the best ways of gaining access to that reality..." (House, 1994, p.15). Two principle paradigms evolved that had strong advocates for their view; paradigms being defined as the world views or belief systems that guide researchers (Guba & Lincoln, 1994). These two paradigms are the positivist/empiricist approach using what are termed quantitative methods and the constructivist/phenomenological approach using qualitative methods (Cherryholmes, 1992; Guba & Lincoln, 1994).

Lincoln and Guba (1985) ascribed five axioms to both positivist and naturalist (their version of constructivist) paradigms. These axioms are shown in Table 2 along with a sixth axiom, deductive logic, that has been added by Tashakkori and Teddlie (1998) based on the writing of many authors (eg., Goetz & LeCompte, 1984; Patton, 1990).

These contrasts were so black and white that researchers separated into two camps, each rigorously defending their methodological stance. This led to a period of paradigm debates, some referring to this period by the stronger term of "paradigm wars" (Gage, 1989; Tashakkori & Teddlie, 1998).

As the debates continued, social researchers started writing of a continuum of core assumptions, and thus a continuum of approaches, to the investigation of social sciences, rather than simply two discrete categories of positivist versus constructivist / phenomenologist (Hussey & Hussey, 1997; Morgan & Smircich, 1980). Lather (1992) for example, writes of at least four different terrains and boundaries of methodology. The first is a positivist map where a researcher moves about using a realist ontology, detached from everyone and everything. Second is an interpretivist map with hermeneutics, phenomenology and constructivism as some of the landmarks. The researcher tries to find meaning in context and tries to understand the world. Multiple realities and ways of knowing are acknowledged. The third and fourth maps are termed critical map and deconstructionism respectively, both of which are more closely aligned to working with participants to change them and their world.

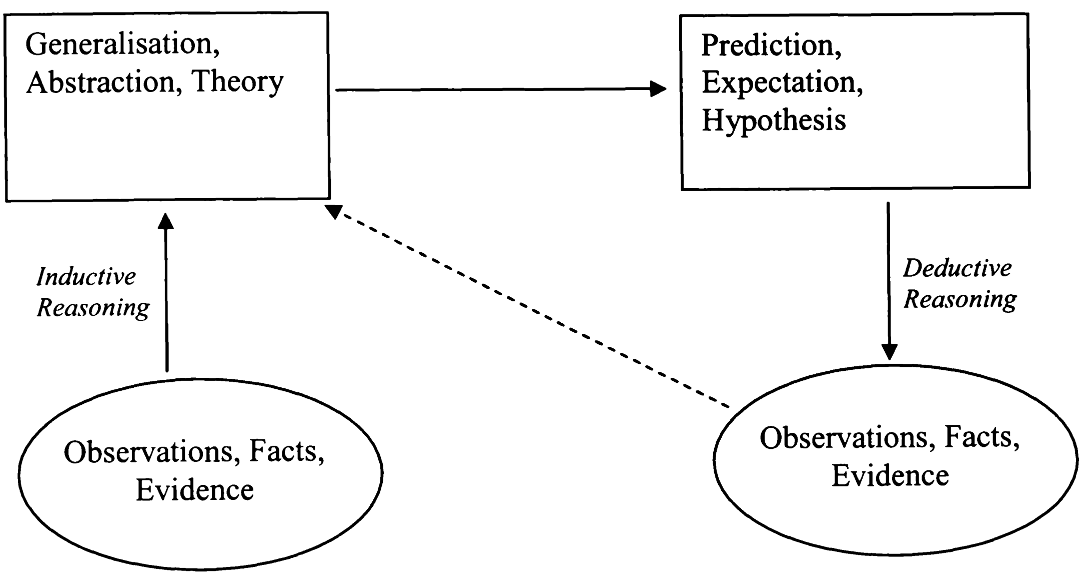
Table 2

Contrasting Axioms Between the Positivist Paradigm and the Constructivist Paradigm (based on Tashakkori & Teddlie, 1998, p. 7 & 10)

AXIOM	POSITIVIST PARADIGM	CONSTRUCTIVIST PARADIGM
Ontology (nature of reality)	There is a single reality	There are multiple constructed realities
Epistemology (the relationship of the knower to the known)	The knower and the known are independent	The knower and the known are inseparable
Axiology (role of values in inquiry)	Inquiry is value free	Inquiry is value bound
Generalisations	Time and context-free generalisations are possible	Time and context-free generalisations are not possible
Causal linkages	There are real causes that are temporally precedent to or simultaneous with effects	It is impossible to distinguish causes from effects
Deductive logic	There is an emphasis on arguing from the general to the particular, or an emphasis on a priori hypothesis (or theory)	There is an emphasis on arguing from the particular to the general, or an emphasis on grounded theory

Out of these debates, a new group emerged calling themselves pragmatists. These people believe that the differences between the two paradigms have been overstated, that quantitative and qualitative methods are compatible and that researchers could make use of both methods in the same research (Brewer & Hunter, 1989; Datta, 1994; House, 1994). Pragmatists believe therefore that not only are quantitative and qualitative methods compatible, but the most appropriate methods should be chosen based on the research questions that are posed. These methods need not be a choice between qualitative and quantitative methods but can be a combination of the two methods as well, using the strengths of each in its appropriate place. They argue that research on any given question at any point in time falls somewhere on the research cycle shown in Figure 1. Research on any substantive matter travels through this cycle at least once before it ends and it therefore it doesn't matter where on the cycle a researcher starts. Pragmatists accept that they have a choice of using either inductive or deductive logic in the course of their research, but they can also use both types simultaneously in a mixed model study (Tashakkori & Teddlie, 1998).

Figure 1. A research cycle



From Tashakkori & Teddlie (1998, p. 25)

Many now accept that the paradigm wars are at an end and a large range of methodologies are accepted as valid by the research world (Cresswell, 2003; Hammersley, 1996). Tashakkori and Teddlie (1998) divided these methods into three broad categories:

- Monomethods where a researcher can adopt a purely quantitative or qualitative approach.
- Mixed method studies where qualitative and quantitative approaches are combined into a single study.
- Mixed model studies where quantitative and qualitative techniques are combined within the different phases of the process from design of the study through data collection to analysis.

Tashakkori and Teddlie (1998) went on to suggest taxonomies of both mixed methods designs and mixed model designs. Other writers (e.g., Cresswell, 2003) on the subject of mixed methods did not differentiate a third category as shown above. These researchers have also produced taxonomies of various mixed methods (Cresswell, 2003; Greene, Caracelli & Graham, 1989; Patton, 1990). Cresswell believed all mixed methods can be described by three general strategies, although there are several variations within each strategy:

- Sequential procedures in which a researcher seeks to elaborate or expand on the findings of one method with another method.
- Concurrent procedures in which the researcher converges quantitative and qualitative data in order to provide a comprehensive analysis of the research problem. This technique includes variations of triangulation techniques referred to by other writers (e.g., Campbell & Fisk, 1959; Denzin & Lincoln, 2000; Jick, 1979) where data sources are combined across methods in an attempt to cancel the biases in each of those respective methods.
- Transformative procedures in which the researcher uses a theoretical lens within a design that contains both quantitative and qualitative data.

This well-documented body of knowledge about mixed method research approaches shows its widespread acceptance and validates the pragmatist paradigm. This provides four predominant paradigms that are used as the foundation for any research as shown in Table 3.

Table 3

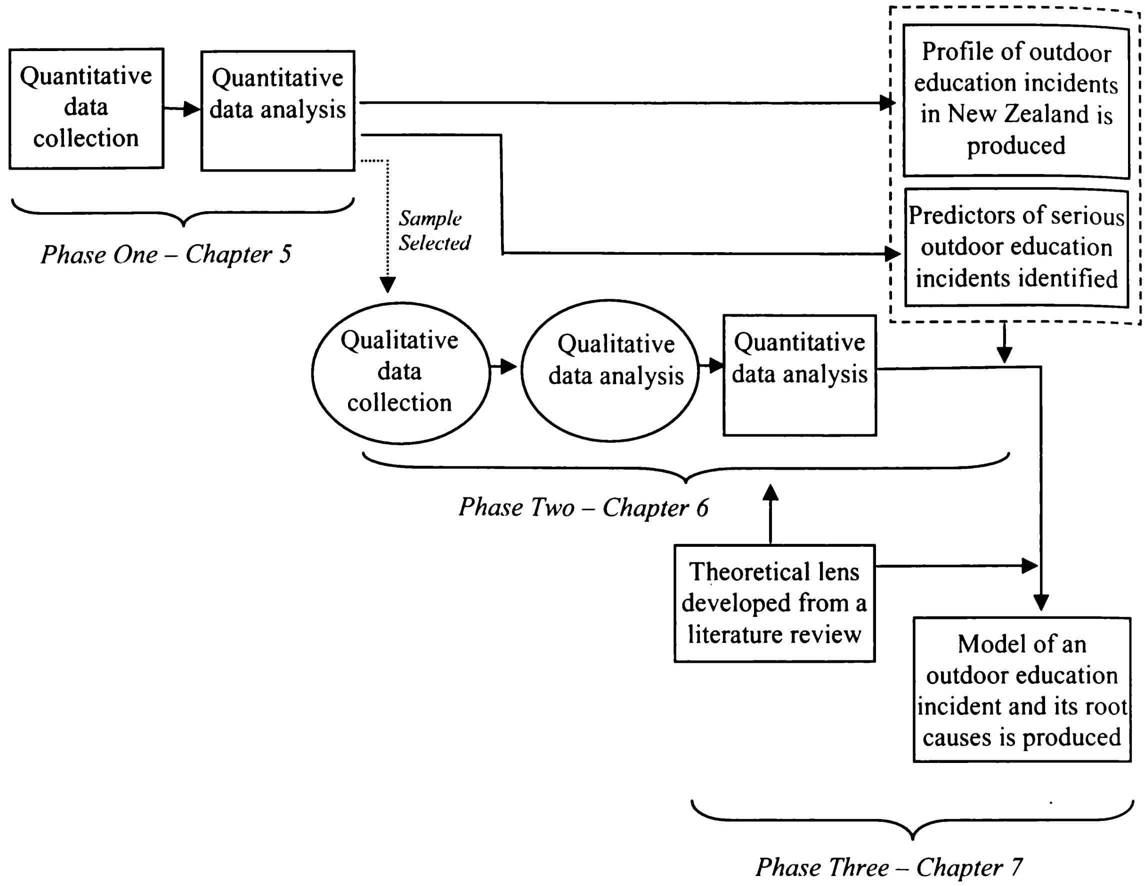
Comparisons of Four Important Paradigms Used in Social and Behavioural Sciences (Tashakkori & Teddlie, 1998, p. 23)

Paradigm	**POSITIVISM**	**POSTPOSITIVISM**	**PRAGMATISM**	**CONSTRUCTIVISM**
Methods	Quantitative	Primarily Quantitative	Quantitative + Qualitative	Qualitative
Logic	Deductive	Primarily Deductive	Deductive + Inductive	Inductive
Epistemology	Objective point of view. Knower and known are dualism	Modified dualism. Findings probably objectively "true"	Both objective and subjective points of view	Subjective point of view. Knower and known are inseparable
Axiology	Inquiry is value free	Inquiry involves values, but they may be controlled	Values play a large role in interpreting results	Inquiry is value-bound
Ontology	Naïve realism	Critical or transcendal realism	Accept external reality. Choose explanations that best produce desired outcomes	Relativism
Causal linkages	Real causes temporally precedent to or simultaneous with effects	There are some lawful, reasonably stable relationships among social phenomena. These may be known imperfectly. Causes are identifiable in a probabilistic sense that changes over time	There may be causal relationships, but we will never be able to pin them down	All entities simultaneously shaping each other. It's impossible to distinguish causes from effects

3.3.2 Methodological Framework and Overview of the Method Used for this Study

In order to construct a model of an outdoor education incident, that increases an understanding of the root causes of those incidents, a pragmatist paradigm was adopted. Pragmatism was appropriate for this study as I believed the best way to achieve the research objective was to incorporate a mixture of quantitative and qualitative data and quantitative and qualitative analysis techniques in the research method. An outline of the methodological approach used is shown in Figure 2.

Figure 2. Outline of methodological design employed in this research.



This methodological approach is an example of a transformative procedure as described by Cresswell (2003) in the last section. Data from phases one and two of the research were transformed into a model of an outdoor education incident by employing a "theoretical lens" of an incident developed through a literature review from the fields of safety management and psychology.

Each of the phases of the research design is explained in concept below to give an understanding of the methodological approach. Each step in the method itself has a detailed explanation in Section 3.4.

Phase One of the research was purely quantitative in nature. In this phase, existing incident data were collected from outdoor education providers throughout New Zealand for a sample period of 1996 – 2000 inclusive. The phase had three outcomes:

- The data were analysed using statistical methods and a profile of outdoor education incidents was produced that included incident rates, frequencies of incidents occurring of differing severity of outcomes, and the ratio of occurrences between those categories of severity.
- Statistical methods were also used to identify a number of variables that can be used as predictors of serious injury if an incident occurs.
- The compiled database of incidents was used to select more serious incidents for further study by other methods.

Phase Two of the research employed mixed methods. A sample of incidents that had the potential for serious injury was selected for further study. The instructors who were leading the groups at the time were asked to provide retrospective accounts of their incidents and their impressions on what had led to those incidents. These narratives and other commentaries from the instructors were reviewed by Delphi panels of outdoor experts. Using their expert knowledge and lengthy experience in the outdoors, the Delphi members were tasked with identifying what they believed were the root causes of the incidents under study. Delphi members were asked to identify any root causes in two categories: those related to errors made by the instructor; and those that could be linked to errors in the organisation's safety management systems. These two categories had been predetermined by a theoretical conceptualisation of an outdoor incident developed through a literature review (Chapter 4) and used as a 'lens' to focus the study. I compiled the results from the Delphi members and sent the compilation back to the Delphi panel for verification of the results. The instructor concerned was also involved in this verification cycle. This continued until no further changes were proposed by the Delphi members.

This analysis by Dephi panel members involved the interpretation of the instructor's perceptions of what occurred which would have been influenced by the instructor's feelings, values and perceptions; both at the time of the event and after. Such an approach demonstrated the following characteristics and benefits of a qualitative approach (my italics in list below for emphasis):

- *Occurs in a natural setting involving human behaviour and events (Cresswell, 2003).* In this case the data consisted of retrospective accounts but these were based on real examples that happened in natural settings as opposed to hypothetical incidents or constructed simulations.
- *The researcher is the primary instrument in data collection rather than some inanimate mechanism (Eisner, 1991; Fraenkel & Wallen, 1990; Lincoln & Guba, 1985; Merriam, 1998)* Although the primary data collection tool was a written narrative of the incident under study, this was done in such a way as to try to preserve the context of the situation and the impressions and subjective views of the instructor concerned. This is very different from a data collection device such as a survey using Likert scales which would be more typical of a quantitative study.
- *The data are reported in words rather than numbers (Fraenkel & Wallen; 1990; Locke, Spirduso & Silverman, 2000; Marshall & Rossman, 1999; Merriam, 1998).* The data in this study were reported in words.
- *The focus is on participant's perceptions and experiences and the way they make sense of their lives (Fraenkel & Wallen, 1990; Locke et al., 1987; Merriam, 1998).* The focus within the data collection of each case study was on the participant's perceptions and experiences and the way they made sense of the incident in which they were involved.
- *Focuses on the process that is occurring as well as the product or outcome. Researchers are particularly interested in understanding how things occur (Fraenkel & Wallen, 1990; Merriam, 1998).* The outcome that is the focus of this study is the process that led towards the incident occurring, not the mere fact that the incident occurred.
- *It is an emergent design in its negotiated outcomes. Meanings and interpretations are negotiated with human data sources because it is the subject's realities that the researcher attempts to reconstruct (Lincoln & Guba, 1985; Merriam, 1998).* Through an iterative Delphi panel process and by involving the instructor concerned in iterations of this cycle, themes emerged to produce a negotiated result.
- *It relies on the utilisation of tacit knowledge (intuitive and felt) because often the nuances of the multiple realities can be appreciated most in this*

way (Guba & Lincoln, 1985). The tacit knowledge of the Delphi members was used to interpret the data.

- *The researcher seeks believability based on coherence, insight and instrument utility (Eisner, 1991) and trustworthiness (Lincoln & Guba, 1985) through a process of verification rather than through traditional validity and reliability (Cresswell, 2003).* The Delphi process exemplifies this approach.
- *It favours purposeful sampling over random sampling (Lincoln & Guba, 1985).* Purposeful sampling was used to select those incidents that had the potential for serious injury but between incidents offered a broad range of activity type, setting and instructor gender.

Once the Delphi process had identified the specific root causes for each case study, I then used a grounded theory approach to categorise general types of root causes to build a taxonomy of root causes that lead to an outdoor education incident.

The original methodologies of grounded theory were developed in collaborative studies by Barney Glaser and Anselm Strauss in the 1960s and their results were first published in their pioneering book, *The Discovery of Grounded Theory* (1967). Glaser and Strauss' work on grounded theory was revolutionary because it ran counter to thoughts at the time amongst researchers that theory and research are separate entities, that quantitative methods are superior to qualitative methods because of the lack of rigour in the latter, and that qualitative research could not result in theory development (Charmaz, 2000). Glaser and Strauss' goal was to, "...empower researchers with an open, generative, emergent methodology ... by giving them an honest approach to the data that lets the natural social organisation of substantive life emerge" (Glaser, 1995, p.7).

Glaser's writing about grounded theory has been described as being dense and full of abstract terms which made it inaccessible to many readers (Charmaz, 2000). The technique also came under attack for the obvious and subtle positivistic premises underlying the logic of the method itself. Later work by Strauss (1987) and Strauss and Corbin (1990) made the techniques more accessible to a wider audience, while developments such as constructivist grounded theory have taken the methodology into the middle ground between postmodernism and positivism, offering accessible methods for a range of research paradigms (Charmaz, 2000; Guba & Lincoln, 1994). Glaser, in later years, became frustrated by what he believed was an overanalysis of the technique. He stated that it is a general method to use on any kind and mix of data and is particularly useful with qualitative data, that it is a simple method, often over-analysed and rewritten in studies to be unrecognisable to him the originator. His advice to researchers wanting to use grounded theory is to, "....just refer to it, and then just do the study" (Glaser, 1995, p.7).

The process of grounded theory involves, "...the researcher alternating between inductive and deductive thought. First, the researcher inductively gains information which is apparent in the data collected. Next, a deductive approach is used which allows the researcher to turn away from the data and think rationally about the missing information and form conclusions based on logic. When conclusions have been drawn, the researcher reverts to an inductive approach and tests these tentative hypotheses with existing or new data. By returning to the data the deductions can be supported, refuted or modified...It is this inductive / deductive approach and the constant reference to the data that helps ground the theory" (Hussey & Hussey, 1997, p.70).

Cresswell (2003, p.14) defines grounded theory as that, "... in which the researcher attempts to derive a general, abstract theory of process, action or interaction grounded in the views of participants in a study. This process involves using multiple stages of data collection and the refinement and interrelationship of categories of information (Strauss & Corbin, 1990, 1998). Two primary characteristics of this design are the constant and emerging categories and theoretical sampling of different groups to maximise the similarities and the differences of information".

The process of grounded theory is used here because as Hussey & Hussey (1997, p.70) state, "The purpose of grounded theory is to build theory that is faithful to and which illuminates the area under investigation. The intention is to arrive at prescriptions and policy recommendations with the theory which are 'likely to be intelligible to and usable by, those in the situation being studied, and is often open to comment and correction by them' (Turner, 1981, p.226)".

In this study detailed information was gathered from instructors based on selected case studies of incidents. This information was examined by Delphi panel members for root causes of the incidents. I identified themes within the collection of root causes allowing me to group the root causes into general types of root causes that are naturally occurring. These findings were fed back to the instructor and Delphi members for their feedback on my interpretation of the information sent to me. In this way the themes or categories that were uncovered from each case study were grounded in information from the Delphi panel.

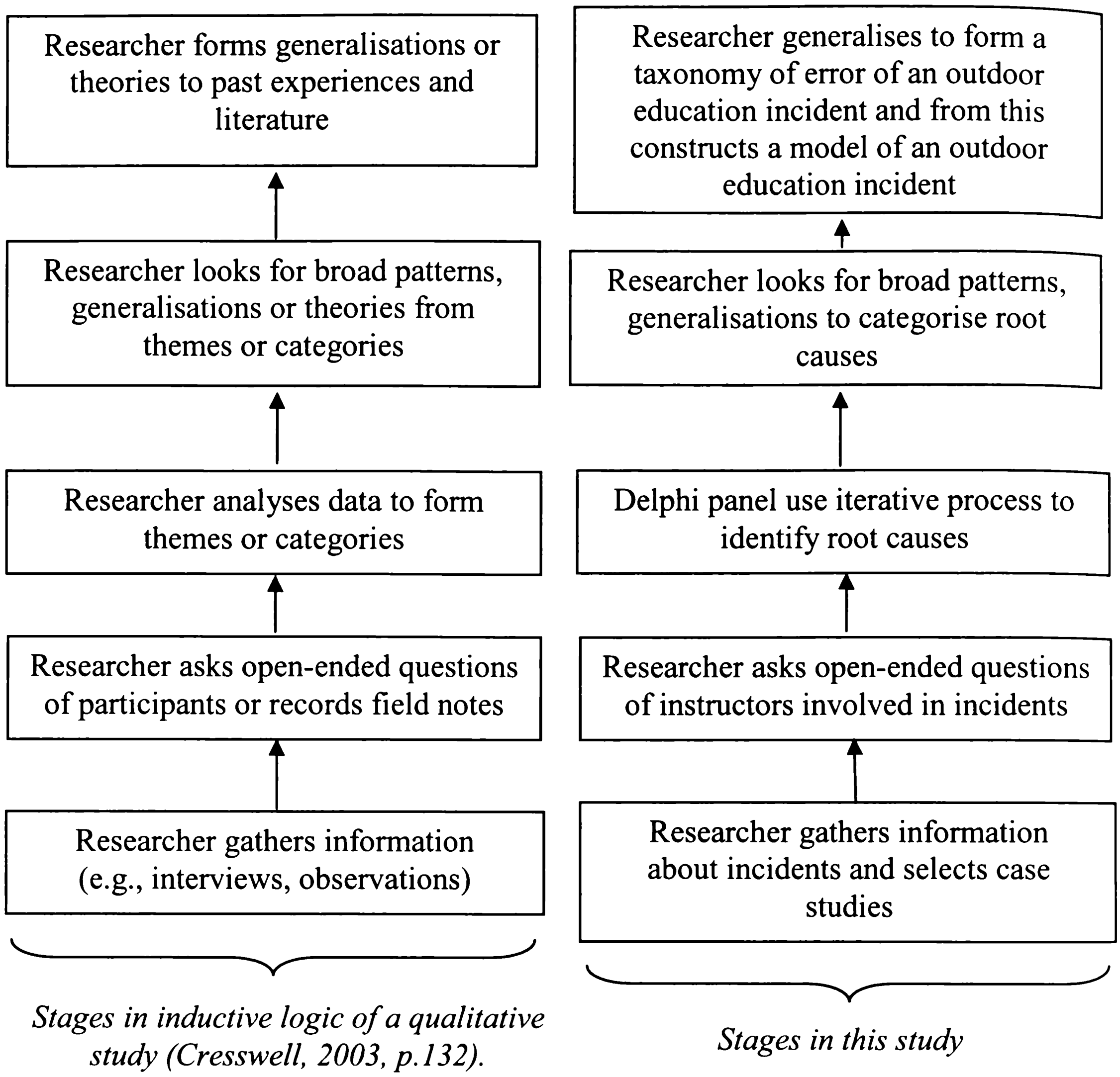
Figure 3 shows how this phase of the research fits the inductive logic of a qualitative study.

Following the identification of the general categories of root causes, quantitative techniques were used to compare the frequency of occurrence of specific categories over the range of case studies to try to establish the importance of the categories in incident causation. This quantification of qualitative data is commonly used in mixed method research (Tashakkori & Teddlie, 1998).

Finally, once these general categories of types of root causes had been identified, they were compared with the predictors of incidents that result in serious injury, that were identified in Phase One of the research, to see if there was compatibility between the results.

In Phase Three, I compared possible root causes of outdoor education incidents, that had been identified through a comprehensive literature review, with those identified in Phase Two, to produce a taxonomy of error for the outdoor education sector. These results were passed through the theoretical "lens" or perspective of the proposed incident model developed from the review of literature. This use of a theoretical lens was applied throughout the research to guide the study, raise questions and decide what issues were important (Cresswell, 2003).

Figure 3. The inductive logic in the qualitative phase of this study



It is recognised that the final taxonomy of error and the model of an outdoor education incident are only frameworks towards understanding the processes involved in such an incident. The study of a finite number of case studies of incidents will not reveal the total number of possible root causes that can result from the interaction of humans with other humans and the environment. However, it will result in the identification of a number of themes or categories of root causes that can be built on and added to by other researchers as more information becomes available. Outdoor educators will be able to take this framework and if it is found appropriate, apply it to specific situations, and suggest additions and alterations as those contexts dictate.

3.3.3 Summary

In summary, this section has justified the use of a mixed method approach to accomplish the research objective. A quantitative approach was used to investigate overall incident rates and to identify factors that have led to past incidents. A qualitative approach, that employed grounded theory techniques, was used to identify the root causes of outdoor education incidents. Quantitative techniques were used with the identified root causes to attempt to gauge a measure of the importance of each root cause. Finally, a model of an outdoor education incident and the root causes of that incident are formulated. It is only through the adoption of the pragmatist paradigm that quantitative and qualitative techniques could be combined in such a manner.

3.4 Method

3.4.1 Overview.

As shown in Figure 2, this research is a mixed methods design that was divided into three phases. The actual design utilised is shown in more detail in Figure 4. The method employed in each phase and the rationale for it will be explained in the following sections:

3.4.2 Phase One – Quantitative data collection and analysis

3.4.3 Phase Two – Qualitative data collection and analysis followed by quantitative analysis

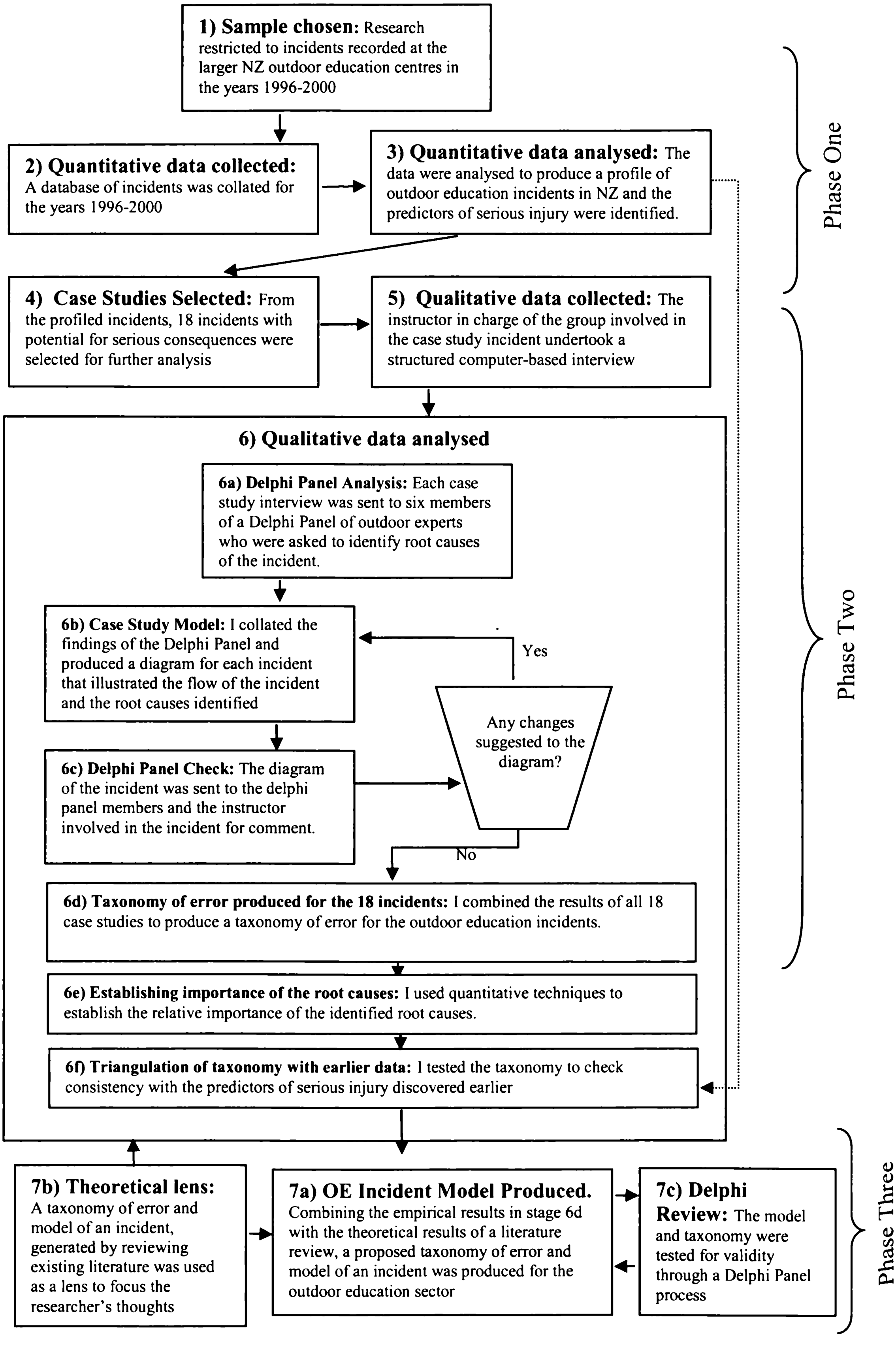
3.4.4 Phase Three – Transformation of results through theoretical lens.

3.4.2 Phase One – Quantitative Data Collection and Analysis

The purpose of this phase of the research was threefold:

- To provide background information on incident occurrence in the New Zealand outdoor education sector by building a profile of such incidents;
- To identify any variables that may be predictors that serious injury is likely to result from an incident where the variable is present; and,
- To act as a database of incidents from which case studies could be selected for further study.

Figure 4. Research method used in this study



3.4.2.1 Sample Selection – Sampling Organisations

The purpose of a structured sampling technique in any quantitative study is to be able to generalise the results of the study to the larger population from which the sample is drawn (Fraenkel & Wallen, 1990; Hussey & Hussey, 1997).

As explained in chapter two, there are probably in excess of 800 individuals and organisations offering outdoor education experiences in New Zealand. Approaching all of those organisations for incident data was beyond the resources of this study and it is highly unlikely that many of those organisations, especially smaller ones, collected incident reports. This study was purposely limited to larger outdoor education organisations (defined for this study as those organisations having three or more full-time paid staff) as these were the organisations most likely to be keeping incident records and have staff available to respond to questions in a timely manner.

Outdoors New Zealand (ONZ), an umbrella membership organisation for outdoor groups, provided a list of 25 outdoor organisations from their database that met these criteria. Each organisation was contacted by mail and asked if they were prepared to contribute their incident data. They were ensured anonymity for their contribution and the details of specific incidents. Of the 25 organisations, 12 offered to contribute their data. The other 13 did not contribute for various reasons: one organisation simply did not want to take part, seven others failed to respond to the initial request and a follow-up request, one believed they did not meet the criteria for contributing organisations, two did not keep incident records, and two indicated that their records did not include any incidents of interest.

The sample studied was therefore a convenience sample (Fraenkel & Wallen, 1990). Because of the convenience nature of the sample, there is a possibility that bias has entered the data which may make generalising to the population of 25 larger outdoor centres invalid. For example organisations with poor incident records may have chosen not to contribute for fear of exposing themselves to criticism, despite the guarantee of anonymity. There did not appear to be any pattern in the organisations that did not take part and therefore no specific issues of non-response bias could be identified.

Although only 12 of the 25 organisations chose to contribute, the 12 organisations contained all of the larger providers and I believe they collectively represent well in excess of 50 % of the outdoor education student days being carried out by this part of the sector. On this basis, I argue that the results are indicative of the population of larger outdoor education providers in New Zealand, but care would need to be taken to extrapolate the results further to the wider population of 800 providers.

3.4.2.2 Data Collection Towards Establishing a Profile of Outdoor Education Incidents

Collection of quantitative data began in late 2001 and was completed by mid-2002. Because of the need to interview participant instructors in selected incidents in Phase Two of the research, the fact that instructors are itinerate by nature and move frequently not just within New Zealand but internationally and therefore may be hard to trace a long time after an incident, and also to make the data collection phase manageable, incidents were restricted to the timeframe of 1996 – 2000 inclusive.

A database was built using Microsoft Access to store the data from the various organisations. The intent was to capture as much richness in the data as possible by having a wide number of fields / variables which would allow greater scope for analysis. A list of potential fields was established from existing incident report forms – the Wilderness Risk Manager's Committee Incident Report Form and the Outdoor Safety Institute Incident Report Form. The data for any field / variable would be useful only if the majority of the organisations who had agreed to contribute actually recorded that information in their incident reports. For this practical reason the fields included in the database were limited to:

- Incident Number
- Organisation (coded and code only known to researcher)

- Year of incident
- Accident outcome
- Pre-existing condition?
- Time of day
- Major injury/illness/other
- Secondary injury/illness/other
- Days lost on programme because of incident
- Person injured (student/instructor/other)
- Gender of instructor
- Whether under instruction at the time of incident
- Brief narrative of incident
- Severity of incident
- Potential severity of incident

It was anticipated that the last two fields / variables would not necessarily be recorded by the organisations. However I considered it was important to attempt to estimate both the actual and potential severity of the incidents to aid later analysis. Safety management experts believe that serious incidents are preceded by different causal factors than less serious ones (Petersen, 1988) however serious incidents are fairly rare and therefore it is also important to investigate those incidents that had the potential for serious outcomes (Bird & Germain, 1989).

To complete these two fields for any incident, I created an accident severity scale based on a partially developed scale by Priest (1996a). The resultant severity scale is shown in Table 4. I presented this scale at the Risk 2002 conference where over 100 outdoor practitioners, managers and theorists were able to review it and present feedback. It was well received and has subsequently been included in the latest edition of Haddock's (2003) Mountain Safety Council Outdoor Safety Manual. I read the narrative for each incident and made a subjective judgment of the actual severity of the outcome of the incident against the severity scale shown, and also the potential severity of the incident scenario. The assumption in doing this is that incidents are the culmination of a number of factors coming together to produce an accident potential. Once the sequence has been initiated, the type and degree of loss are somewhat a matter of chance, depending partly on fortuitous circumstance and partly on actions taken to minimise the loss (Bird & Germain, 1989).

Table 4
Accident Severity Scale

					Losses not related to participants	
SEVERITY RANKING	GROUP DESCRIPTOR	DESCRIPTION OF INJURY	DESCRIPTION OF ILLNESS	DESCRIPTION OF PSYCHOLOGICAL OR EMOTIONAL DAMAGE	DESCRIPTION OF ENVIRONMENTAL DAMAGE	DESCRIPTION OF EQUIPMENT DAMAGE
1	**Minor or short term impact on individual(s) that does not have a large effect on their participation in the programme**	Splinters, insect bites, stings	Minor irritant	Temporary embarrassment	Littering	Minor cost
2		Sunburn, scrapes, bruises, minor cut	Minor cold, infection	Temporary embarrassment with peers	Minor damage to environment that will quickly recover	>$50
3		Blisters, mild hypo/hyperthermia, minor sprain, minor dislocation	Minor asthma, cold, upset stomach, etc	Shown up in front of group	Scorched campsite, plant damage	>$100
4	**Medium impact on individual(s) that may prevent participation in the programme for a day or two**	Lacerations, frostnip, minor burns, mild concussion	Mild flu, migraine	Does not want to participate again in this session	Burnt shrubs, cut life branches to burn, washed group dishes in stream, etc	>$500
5		Sprains & hyperextensions, mod hypo/hyperthermia, minor fracture	Flu, gastroenteritis, vomiting	Wants to leave group. A lot of work to bring back in.	Walked through sensitive ecological area destroying some plant life	>$2,000
6	**Major impact on individual(s) that would mean they were unable to continue with large parts of the programme**	Fractures, dislocations, frostbite, major burn	Serious asthma attack, serious infection, medical treatment required	Leaves group and requires on site counseling	Destroyed/killed some example of flora/fauna	>$8,000
7		Arterial bleeding, severe hypo/hyperthermia	Infection or illness causing loss of consciousness, serious medical emergency	Therapy/counseling required by professional	Killed, destroyed or polluted small area of environment	>$20,000
8	**Life changing effect on individual(s) or death**	Spinal damage, concussion	Major illness requiring hospitalisation	Long term therapy required after incident	Killed example of protected species	>$50,000
9		Single death	Single Death	Suicide because of incident	Fire or pollution etc resulting in area of wilderness being destroyed	> $250,000
10		Multiple fatality	Multiple fatality	Multiple fatality	Major fire or pollution causing serious loss of environment or life	> $1,000,000

Adapted and Expanded from the Accident Frequency Severity Chart (Priest, 1996)

In addition to this incident data, the contributing organisations were asked for a summary of their activity in terms of student days of instruction for the year. Collecting these data enabled incident / accident rates to be calculated.

All 12 outdoor organisations that agreed to take part in this study had a formalised incident recording system. Gaining access to the contents of the incident records at each organisation caused some challenges, mostly with regard to the willingness of the organisations to release their data offsite. Of the 12 organisations only one had a computer database of incidents. The remainder had hard-copy forms. One organisation collated the yearly forms into an annual summary of incidents. Across the 12 organisations, data were entered in the following way:

- One organisation provided a CD of their incident data for the five year period in an Access database. These data were able to be migrated into the new database with minimal problems.
- Eight organisations sent either original incident reports or photocopies of original reports. Each of these had to be read and the data typed into the Access database.
- Three organisations would not release their incident reports. To enter data required a site visit to their offices, original reports read, and data added to the Access database.

Of the 12 organisations, nine had complete records for the five year period, one had records for four of the five years and two had records for only three of the five years.

Arranging to have incident reports couriered, site visits to several of the organisations at a mutually convenient time and the task itself of reading and inputting data, meant the process of data collection took over six months and resulted in 1906 incidents being identified and included in the study.

3.4.2.3 Data Analysis

The quantitative data were analysed using a number of simple descriptive statistics to make comparison with incident statistics from other sources. It was also possible to use non-parametric inferential statistics to look in more depth at the interaction of some of the variables. This will be explained in greater detail when discussing the results in chapter five.

3.4.3 Phase Two – Qualitative Data Collection and Analysis

The purpose of this phase of the research was to identify the root causes of a number of case studies of serious outdoor education incidents. Once these root causes had been identified for the individual case studies, then common groupings of those root causes were classified as general types. The resulting classification was then analysed to see if any of these types were more prevalent across the case studies than others. Finally, the predictors of serious injury identified in Phase One were compared to this list of root causes to assess consistency in the findings.

Collecting data on outdoor education incidents to investigate the root causes of those incidents was not without problems. The data needed to be collected from a natural setting to help ensure validity of the findings rather than, for example, using simulation techniques. Following instructors in charge of groups hoping to observe an incident in progress would be inefficient in time and unethical for the researcher, because once the conditions for an incident were seen to develop, it would be necessary to intercede to prevent harm or injury. For these reasons it was considered that the best way to collect data was to use incidents that had already occurred and gather information from those who were involved in the incident.

3.4.3.1 Sample Selection – Choosing Case Studies of Serious Incidents

From the profile of incidents compiled in Phase One, a sample of serious incidents was taken for further study. Serious incidents were defined for this study as those that had a potential for, or resulted in, loss at level 6 and above on the Severity Scale shown in Table 4.

In considering how many cases to study in this phase of the research, it was important to consider why the data were being collected: I was trying to identify the root causes of outdoor education incidents to construct a model of an outdoor education incident including a taxonomy of the root causes of the incident. As discussed by Patton (1990), there is a big difference between quantitative and qualitative sampling. Quantitative sampling concerns choosing enough cases (n = large number) in a truly random and statistically representative fashion so that the results can be confidently generalised from the sample to the larger population. Qualitative sampling typically focuses on relatively small samples, even single cases (n=1) selected purposefully. The cases are selected on the basis of being information rich and having the potential for significant learning about issues central to the study of the research.

In deciding sample size Patton (1990, p.184) stated that, "There are no rules for sample size in qualitative inquiry. Sample size depends on what you want to know, the purpose of the inquiry, what's at stake, what will be useful, what will have credibility, and what can be done with the available time and resources." Lincoln and Guba (1985) recommend sample selection to the point of redundancy, where the sampling is terminated when no new information is forthcoming. However Patton commented that,

> "sampling to the point of redundancy is an ideal, one that works best for basic research, unlimited time lines, and unconstrained resources… I recommend that qualitative sampling designs specify minimum samples based on expected reasonable coverage of the phenomenon given the purpose of the study and the stakeholder interests. One may add to the sample if information emerges that indicates the value of change. The design should be understood to be flexible and emergent. Yet, at the beginning … one specifies a minimum expected sample size and builds a rationale for that minimum, as well as criteria that would alert the

researcher to inadequacies in the original sampling and / or size." (Patton, 1990, p.186).

Kvale (1996) also states a preference for quality rather than quantity when it comes to the number of subjects studied.

This sample was chosen to create a model of an outdoor education incident and taxonomy of root causes for those incidents. This taxonomy includes the human factors leading to poor instructor judgment and performance, and management system errors. The number of root causes was unknown. I also concede that due to restrictions on time and resource inherent in this study, and the diversity of contexts in which outdoor education experiences occur, that it was unlikely that all root causes would be identified through this study. Any taxonomy produced will remain open for additions in the future as new knowledge and research comes to light. It is acknowledged that taxonomies of error are never static but change as new knowledge is gained (Johnson, 2000). Johnson proposed a technique to overcome this described as 'case based reasoning and information retrieval tools'. Case-based reasoning uses computer searches of accounts of incidents for key words, and their similes, in order to identify new types to be added to a taxonomy. In this way, as a new root cause is added to a taxonomy, large databases of previously analysed incidents can be searched quickly for these key words or 'cases' and statistical analysis carried out. Computer Assisted Interviews (CAI) similar to those that were collected during this research could easily be used in this manner.

The Multiple Causation Principle (Bird & Germain, 1989) of incidents indicates that each incident will be the result of a combination of a number of errors. Therefore, if the incidents were chosen for diversity, I believed that a sample size of twenty incidents would be sufficient to provide a good range of information. Time and resource constraints did not warrant choosing a sample larger than twenty, and subsequent research beyond this study will continue to develop the taxonomy and model that resulted.

For these reasons I restricted collection to a maximum of 20 incidents. The incidents were purposefully selected using what Patton (1990, p.172) described as "maximum variation sampling". This strategy is designed for purposeful sampling aimed at capturing and describing the central themes or principal outcomes that cut across a great deal of participant or programme variation. The apparent weakness of dealing with a small number of samples of great heterogeneity is turned into a strength because, "any common patterns that emerge from great variation are of particular interest and value in capturing the core experiences and central, shared aspects or impacts of the programme" (Patton, 1990, p.172). Patton continued by saying that the results of analysing small samples of great diversity are two key findings: (1) high quality, detailed descriptions of each case which are useful for documenting uniqueness; and, (2) important shared patterns that cut across cases and derive their significance from having emerged out of heterogeneity. This approach seemed ideal for this particular study where the aim was to discover a range of root causes of incidents and also point to specific root causes that are particularly prevalent in an attempt to prevent incidents in the future.

This technique of maximum variation sampling also allowed me to choose cases that are described by Patton as "critical cases" (cases where maximum application to other cases is possible), "politically important cases" (cases where the results will attract attention to the study), and "intensity cases" (information rich cases that manifest the phenomenon intensely). These advantages of purposive sampling had to be weighed against the possible issues of generalising the results, especially as the sample was also based on available subjects (Babbie, 1989). Methods used to ensure the reliability and validity of the results are discussed in Section 4.4.

Patton (1990) stated that the technique for getting maximum variation in a small sample involves identifying diverse characteristics or criteria for constructing the sample. I decided to choose incidents for study that exhibited diversity in the following characteristics:

- Type of activity involved
- Where the activity took place
- Organisation involved

- Gender of instructor

There were no fatalities among the contributing organisations during the study period, but wherever possible incidents with the highest actual or potential severity were chosen while trying to maintain the diversity within the sample as mentioned above. I would have liked to include 'instructor experience' as a variable, but this information was not included in any of the incident reports and would have been almost impossible to determine for the instructors involved in retrospect.

The results of Phase One of the research gave a potential pool of 59 accidents to choose from that occurred while under instruction and that resulted in an injury with a severity rating of six or more. This was not considered a big enough pool to ensure the diversity of sample required, especially with the anticipated problems of getting access to the instructor concerned in any accident and then agreement of that instructor to take part in the study. The sample pool was increased by adding accidents and near misses that occurred while under instruction and that had the potential for serious injury. This provided a pool of 299 incidents from which to choose a sample.

The incidents were grouped by activity type and their potential severity. As discussed in the next section, the data analysis technique utilised three separate expert panels to review incidents. For this reason, it was decided to try to choose three incidents representing an activity type so that the sample of incidents within each expert panel would be diverse but between expert panels would be similar. In the first instance, a sample was chosen of four incidents in each of the following activity types, representing a range of organisations, activity settings and instructor genders:

- Abseiling
- Canoeing
- Kayaking
- Mountaineering
- Rock climbing

- Ropes Course
- Sailing
- Sea kayaking
- Tramping
- Tube rafting
- Miscellaneous (including vehicles)

The rationale for choosing four incidents in each activity type was the anticipation that it might be difficult tracking down the instructors concerned and then getting their agreement to take part in the study. Therefore four were selected in the hope of getting three participants for the study. In a similar way 11 activities were chosen in the hope of getting seven activities with three participants agreeing to participate in each. The expectation was that the sample chosen was large enough to provide 20 incidents for in-depth study.

The resulting 44 incidents occurred across nine of the 12 organisations who contributed data. The nine organisations were contacted and permission was sought to identify the instructor involved and then contact the instructor to see if they would participate in the study. After some time had elapsed, permission was received from seven of the nine. The remaining two prepared legal confidentiality agreements which were later signed and permission was received some months after the others. Incident descriptions of the sample were sent to the relevant organisations and they researched the name and contact details of the instructors involved; ninety per cent of whom no longer worked in the organisation concerned. When and if the name and address of an instructor could be located, the instructor was contacted and asked if they would agree to participate. Anonymity was guaranteed.

A combination of untrackable instructors, those not wanting to participate and those not replying to a request after two follow-ups, resulted in 12 instructors agreeing to take part from the sample of 44 incidents. A further 20 incidents were chosen from the original database to try to increase the number of participating instructors. These were chosen from activities in the list above where it was most likely to get a total of three participants based on those organisations who had responded to requests for instructor details in the timeliest manner. This second batch of incidents resulted in a further eight instructors agreeing to participate, giving the total of 20 participants required. A summary of the incidents that were available for in-depth study is shown in Table 5. There seemed to be no pattern emerging in terms of the characteristics of those who chose not to participate and therefore it was not possible to identify any form of non-response bias introduced by this.

3.4.3.2 Data Collection – Narratives of Serious Incidents

Once the sample was chosen, an appropriate method of data collection was required. The method used for data collection was important in that it needed to maximise the reliability of the data while also employing a collection method that could be replicated beyond this study.

The data that were required for each incident under study was a recollection of the events leading up to the incident that could be analysed for root causes. Interviews of the instructors in charge of the incident therefore became a central method of data collection as they were the most expert observer of the incident. Other potential data sources were the students involved in the incident or a manager within the employing organisation who had the responsibility for internal review of the incident. Students were dismissed as data sources because it was extremely unusual for an incident report to record student details. Even if an occasional name existed, finding contact details would have been a challenge. Incorporating a management person in charge of incident analysis was considered and built into a preliminary research method, however this had to be dismissed when it was discovered that the personnel in each of the organisations in this role had changed at least once between the incidents occurring and data collection.

Table 5

Summary of Serious Incidents Where the Instructor Concerned Agreed to an In-Depth Study

#	DATABASE REFERENCE	ACTIVITY	GENDER OF INSTRUCTOR	ORGANISATION
1	126	Tramping	Female	1
2	576	Tramping	Male	3
3	261	Tramping	Male	1
4	1471	Kayaking	Female	6
5	42	Kayaking	Male	1
6	636	Kayaking	Female	3
7	281	Canoeing	Male	1
8	292	Sit-upons	Female	1
9	1515	Canoeing	Male	6
10	611	Rafting	Male	3
11	43	Tube rafting	Female	1
12	59	Tube rafting	Male	1
13	857	High ropes	Male	11
14	321	High ropes	Female	1
15	1649	Bridge jump	Male	6
16	318	Mtn. Bike	Female	1
17	728	Driving	Male	9
18	845	Rock	Male	11
19	1909	Kayaking	Male	11
20	1911	Rock	Male	11

3.4.3.2.(a) Interview rationale

Interviews take a wide variety of forms. The most common form involves individual face-to-face verbal interviews but they can also take the form of group interchanges, mailed or self-administered questionnaires and telephone surveys.

An interview can be structured, semi-structured or unstructured. The use of interviewing to acquire information is extensive today with increasing focus on how things happen rather than what happens (Atkinson & Silverman, 1997; Fontana & Frey, 2000).

I initially considered a research method that would employ unstructured, face-to-face interviews with outdoor leaders who had been involved in incidents while leading groups. However, keeping in mind that beyond this study incident databases may be kept by agencies with no direct contact with those involved in the incident, this method was seen to have problems for future applications. Also, it is well documented that interviewers can consciously or subconsciously enter bias into their questioning of causes of incidents. This is due to selective perception in that they will see what they want to see and can ignore what does not fit their preconceptions (Hogarth, 1980; Rasmussen, 1990; Slovic, 1966). Rasmussen (1990) discussed this point in describing how causal sequences are arrived at in analysing incidents. The analysis of incidents occurs by way of causal back-tracking until all conditions are explained to the satisfaction of the person conducting the analysis by "abnormal but familiar events or acts" (p.452). What causes an analysis to be considered finished is set by stop rules. Rasmussen argued that "stop-rules" are not usually formulated explicitly:

> "The search will typically be terminated pragmatically in one of the following ways: (a) an event will be accepted as a cause and the search terminated if the causal path can no longer be followed because information is missing; or (b) a familiar, abnormal event is found to be a reasonable explanation; or (c) a cure is available. The dependence of the stop rule upon familiarity and the availability of a cure makes the judgment very dependent upon the role in which a judge finds himself. An operator, a supervisor, a designer and a legal judge will reach different conclusions" (Rasmussen, 1990, p.452).

Scheurich (1995) in his postmodernist critique of research interviewing discussed the dynamics of the interview and how the result can be influenced by both the interviewer and the interviewee, and the interaction between them.

> "Some of what occurs in an interview is verbal. Some is non-verbal. Some occurs only within the mind of each participant (interviewer or interviewee), but it may affect the entire interview. Sometimes the participants are jointly constructing meaning but, at other times, one of them may be resisting joint constructions. Sometimes the interviewee cannot find the right words to express herself or himself and, therefore, will compromise her or his meaning for the sake of expediency. There may be incidences of dominance and resistance over large or small issues....A participant may be saying what she thinks she ought to say; in fact, much of the interaction may be infused with a shift between performed or censured statements and unperformed and uncensored statements" (Scheurich, 1995, p.244).

Mishler (1986) talked about asymmetries of power between the interviewer and interviewee that can distort the outcome of an interview. Lekburg (1997) carried out work that illustrated the biases that different experts introduced when analysing particular incidents.

To get over some of these problems, "We need methods that remain true to the performance of interest with minimal intrusion of the decision analysts preconceptions" (Carroll, 1980, p.70).

Johnson (2000) suggested a system of computer based interviews to help resolve some of these issues. A candidate for interview is presented with a computer programme or email based questionnaire that guides the interviewee through a series of framed questions. This forms the basis of a structured interview. Issues of power plays between the two parties are minimised using this technique and the questions or frames can be addressed at the convenience of the candidate as there are no imposed timeframes or expectations. This form of an interview, termed by some as a 'virtual interview' is predicted to increase in popularity as a research method (Fontana & Frey, 2000).

It was decided to utilise Johnson's technique in this research project as it met the success criteria for this study expressed earlier, of collecting data and also allowing external agencies to collect similar data beyond this study. A computer assisted interview (CAI) tool was developed as outlined in section 3.4.3.2.(b) to carry out this process. The knowledge that computers and email communication are almost universally accepted among the outdoor fraternity, especially as instructors are often global travelers and rely on technology for communication, helped reassure that any resistance to this form of data collection would be minimal.

This form of interview, although not traditional, allowed all the "seven stages of interview investigation" suggested by Kvale (1996) to be met. The seven stages being:

(1) Thematising: formulating the purpose of the investigation and describing the concept of the topic to be investigated before the interviews start;
(2) Designing: Designing the study to obtain the necessary knowledge;
(3) Interviewing: Conduct the interviews based on an interview guide;
(4) Transcribing: prepare the interview material for analysis usually by transcribing oral speech to written text (note: this stage becomes redundant);
(5) Analysing: decide on which methods of analysis are appropriate;
(6) Verifying: ascertain the reliability and validity of the interview findings; and
(7) Reporting: Communicate the findings of the study in a readable product.

3.4.3.2(b) Interview questions and format

The purpose of the interview was to retrieve information about the incident that was as accurate and complete as possible. It was acknowledged that retrospective reports on any event are prone to error. These errors can be due to problems with encoding of the information as the event occurs, the storage of information for later recall, or the retrieval process itself which can be affected by stress, emotion or beliefs (Milne & Bull, 2000). Some respondents may even selectively mask or distort attitudes and responses in order to be seen as what they perceive the researcher desires, or how they would like to be seen by those reviewing the interview (Edwards, 1957; Henderson, 1990; Orne, 1962). These potential sources of error in the information retrieved from the interviews had the propensity to be accentuated in this case where the incidents were often traumatic, involved stress for the instructor being interviewed and where the interpretation of the instructor's actions by third party experts put that instructor at risk of being seen to have poor skills and judgment. It was not the intent of this research to look deeply into the mechanisms of these biases entering the incident recall, but rather to adopt interview techniques and analysis techniques to minimise these effects from invalidating the results.

The Enhanced Cognitive Interview (ECI), developed by cognitive psychologists Fischer and Geiselman (1992) has proven to be one of the most effective techniques in retrieving maximum information (Milne & Bull, 2000). This technique is deemed to be the most applicable with interviewees who are acting in good faith to recall memories and is very suitable for use in outdoor incident review because of the similarity with outdoor education facilitation techniques and ethics (Wright & Merrill, 2003). The structure of the ECI process is shown in Table 6.

The CAI tool used in this study was developed to follow the ECI stages as closely as possible within the limitations of the virtual format. A copy of the CAI tool is included as Appendix 2. The relationship between the stages of the CAI and the phases of the ECI are outlined below:

Table 6
Structure of the Enhanced Cognitive Interview (Milne & Bull, 2000, p.40)

PHASE 1	**Greet and personalise the interview – establish rapport**
PHASE 2	**Explain the aims of the interview** • Report everything • Transfer control • No fabrication or guessing
PHASE 3	**Initiate a free report** • Context reinstatement • Open-ended questions • Allow for pauses • Don't interrupt • Non-verbal behaviour
PHASE 4	**Questioning** • Questions from free report • Concentrate • Report everything • No fabrication or guessing • OK to say "Don't know" • OK to say "Don't understand" • Activate and probe an image • Open and closed questions
PHASE 5	**Varied and extensive retrieval** • Change the temporal order • Change perspectives • Focus on all senses
PHASE 6	**Summary**
PHASE 7	**Closure**

Phase 1: Greet and personalise the interview – establish rapport.

As the CAI is a computer-based tool, establishing rapport between myself and the interviewee was less important. It was important to ensure that the interviewee was receptive to the process and freely giving information. It was also important that my position, as outlined in section 3.1 of this study, did not impact overly on the interviewee responses. For these reasons a personable yet professional approach was taken with any email and mail correspondence with the interviewee, background information on the importance and objectives of the study were included and the introduction in Section 1 of the CAI reinforced the voluntary nature of the contribution, the preservation of anonymity of the interviewee and the ability to ask further questions at any stage to enhance clarity. In Section 3 of the CAI, the interviewee was told that the process would take some time to complete and was invited to set aside enough time to fully complete the interview at one sitting. In addition, they were reminded that they should be in a suitable frame of mind to revisit this incident which could evoke bad memories. No time limit was placed on completing the process.

Phase 2: Explain the aims of the interview

Section 3 of the CAI deals with this phase. The background information that accompanies the CAI explained the objectives of the research. Section 3 of the CAI explained that the interviewee was to write exactly what happened based on their memory of the events – and to be careful not to embellish the facts with what they would have liked to have done with the benefit of hindsight. An advantage of the computer format is that control of the process and pace of the interview had been completely transferred to the interviewee.

Phase 3: Initiate a free report

In this phase of an ECI, the investigator initiates a context reinstatement, helping the interviewee go back to the place or context where the incident occurred. This is believed to help the recall process (Milne & Bull, 2000). After the context reinstatement, the interviewee recollects the events at their own speed, without interruption or questioning by the investigator. The CAI echoed this approach in Sections 4, 5 & 6. The interviewee was reminded of the incident that was the subject of the interview, they were then guided to return to the time of the incident in their memory by trying to recall what was happening for them on that month, week and day. They were then given a series of cues to focus them even more closely on the events, feelings and conditions before the incident. Finally, they were asked to provide a narrative of the events leading up to the incident until a point at which the incident was resolved. The benefit of the CAI approach was that control was firmly in the hands of the interviewee in terms of speed and there were no distractions from the interviewer seeking clarification on any points raised.

Phase 4: Questioning

Phase four of an ECI consists of asking questions concerning missing or unclear information. The lack of immediate interviewer / interviewee interaction made this phase a weakness of the CAI approach compared to a traditional unstructured interview approach. This weakness was partially resolved by the feedback stage of this research design, where the interviewee was sent a summary of the incident based on the expert panel's analysis of the incident. At that time they were able to comment on any perceived inaccuracies in the interpretations.

Phase 5: Extensive and varied retrieval

The ECI technique encourages different strategies to obtain more information. The CAI tool used three techniques to try to elicit more information: In Section 7, the interviewee was asked to construct a timeline of events which may have prompted different memories to surface which would lead them to go back and add to the narrative they had written in Section 5; Section 8 used a temporal order technique (Milne & Bull, 2000), where the interviewee was asked to work backwards through the incident to identify key decision points during the incident. Once again this different perspective on the incident may have prompted different memories of the event; and Section 9 of the CAI allowed for any other comments to be added about the incident that may not have been directly prompted by the other sections.

Phases 6 & 7: Summary and Closure

The ECI technique promotes presenting the interviewee with a brief summary of the information that the interviewee has provided, encouraging questions or correcting anything that does not sound right. Following this, the interview should be closed on a positive note. The CAI technique provided the opportunity for a summary of the event to be forwarded by email (Section 10 of the CAI) so that the interviewee could comment on the accuracy of the interpretation. The interview either stays open if they agreed to this extra stage or is closed at this point

In summary, the 'interview' consisted of two main parts; (1) Interviewees were asked to write a personal account of the incident including all relevant components including planning, preparation, contributing events, etc. They were cued by questions to recall and document their thoughts and decisions at the various stages of the event; and, (2) They were asked to progress backwards through the incident from the time that the incident was identified to identify key moments at which they believed that a different decision would have resulted in no incident or a diminished severity of incident given the benefit of '20/20' hindsight. They were asked to reflect on what factors they believed led them to make the decisions they did.

The two parts of the CAI process are distinct. The first part, a personal written account some time after the incident, may be one of the first times the person has had the opportunity to work through the incident in detail in a structured way. Langer and Applebee (1987) reported that writing shapes thinking and that the more we manipulate information and work with it, the better we understand it. Through writing we are able to transfer the meaning from our minds to a text so that we can review it, reflect on it, and change it. Goody (1977) said that, "writing puts a distance between a man and his verbal acts. He can now examine what he says in a more objective manner. He can stand aside, comment upon, even correct his own creation..." (p.150). Mishler quoted several scholars who claim that storytelling is universal and is, "the primary way ... human beings make sense of their experience" (Gee, quoted in Mishler, 1986, p.68). Through writing a personal account of the incident the interviewee had the opportunity to relive the events, cognitively sort the events and look for contributory causes they may not have considered before in a nonantagonistic, nonadversarial environment.

The second part of the CAI causes them to take a different view of the incident: to think backwards through the incident trying to identify key decision points. It was hoped that this would produce a greater richness of detail for later analysis.

3.4.3.2.(c) Conducting interviews

Before conducting any interviews the interview questions and format were submitted to the University of Waikato's School of Management Human Research Ethics Committee for approval. This study closely followed the University of Waikato's general principals for ethical research involving human participants.

Upon agreeing to take part, each instructor was sent a consent form, further information on the study, a floppy disk with the CAI tool recorded on it that had been personalised to his / her incident, and a self-addressed, stamped package in which to return the completed CAI floppy disk and consent form. As part of the CAI information the instructor was given my email address should they have any questions about the process.

Although some interview participants returned their completed CAI's in a timely manner, the majority required prompting. The most tardy respondents needed multiple follow-up letters, emails and phone calls to elicit the completed CAI.

It should be noted that completed CAI's for Incidents 19 and 20 were never received. The instructor involved in Incident 19 died in an outdoor related accident before he was able to return his interview data. The instructor involved in Incident 20 never completed his interview despite repeated promises from him that this would happen.

This phase of data collection took almost 12 months to complete. The result was 18 fully completed CAI interviews of incidents with serious or potentially serious consequences.

3.4.3.3 Data Analysis

The qualitative data gathered from the instructors involved in serious outdoor incidents needed to be analysed to establish the root causes of the incidents. The intent of this analysis was to compile a taxonomy of the root causes and from this to construct a model of outdoor education incidents.

As explained earlier, the building up of a model or theory from empirical data is termed grounded theory. The data needed to be read and analysed for what were considered to be root causes of the outdoor education incidents under study. This analysis of personal accounts is a common form of qualitative research. Mishler (1986) describes analysis where lines of words are decontextualised and divided into monads of supposedly unambiguous meaning. The reductive monads of meaning are then assembled into discovered aggregates through categorising, that is, "the process of grouping concepts that seem to pertain to the same phenomena"

(Strauss and Corbin, 1990, p.65). These aggregates were compared across interviewees.

Lincoln and Guba (1985) describe this as inductive analysis and compare it to content analysis, a process aimed at uncovering embedded information and making it explicit. Two essential subprocesses are involved with inductive analysis, unitising and categorising (Lincoln & Guba, 1985). Unitising involves a process in which the raw data are systematically coded into units which permit precise description of relevant content characteristics (Holsti, 1969). Glaser and Strauss (1967) describe categorising as sorting the units into provisional categories or broader themes that may arise from this initial coding. Strauss and Corbin (1990) describe the interaction of linking categories and subcategories as a mechanism to produce grounded theory. Grounded theory is therefore inductively derived from the study of the phenomenon it represents. That is it is discovered, expanded, and verified through systematic data collection and analysis of data pertaining to that phenomenon.

The data gathered from each instructor through the CAI interview process, as discussed earlier, were only that one person's perceptions of what occurred at the time. It has already been shown that, through no fault of the interviewee, these perceptions have probably been distorted by the processes of memory and the subjective nature of recall. Any analysis of the interview data needed to be subjectively extrapolated to include root causes that may not have been explicitly included in the interview, but which may have contributed to the event. This extrapolation was done on the basis of expert opinion from people with extensive experience in the outdoor education sector, who had been in similar situations themselves and therefore could envision conditions and events which may have been present but had not registered in the interview material.

Being an expert in the outdoor education sector myself, one possibility for analysis was for me, as researcher to analyse the data. This idea was dismissed as one person's subjective interpretation of the data alone would not lend validity to the final taxonomy and incident model that is the desired outcome of this research.

For this reason a Delphi technique was employed for the analysis of the data.

3.4.3.3.(a) History and application of the Delphi Technique

The technique was developed by Olaf Helmer and Norman Dalkey of the Rand Corporation in the 1950s. The US Airforce was trying to find a way to establish a reliable consensus of opinion among a group of experts about how Soviet military planners might target the US industrial system in an attack and how many atomic bombs would be needed to have a specified level of impact on US Military capability. This was the original 'Project Delphi' (Underhill, 2004). The name was not applied by the founders of the technique, but was labeled 'Delphi' as a joke by colleagues at Rand Corporation; the technique being used to forecast future occurrences was compared to the Delphi temple in ancient Greece which was the seat of the most important oracle of Apollo (Turoff & Hiltz, 2004).

The Delphi technique has evolved over the decades since into a family of techniques rather than a single procedure (Martino, 1983; Underhill, 2004). Linstone and Turoff proposed a view of the Delphi method that they felt best summarised both the technique and its objective: "Delphi may be characterised as a method for structuring a group communication process, so that the process is effective in allowing a group of individuals, as a whole, to deal with complex problems" (Linstone & Turoff, 1975, p.3). The individuals described being chosen for their expertise in the field under study. Turoff and Hiltz (2004) state that the Delphi method is an example of an 'Expert System' used to capture the knowledge of a group of experts and store it for utilisation by non-experts.

The Delphi technique is now widely used and applicable in research studies across many fields of enquiry (Linstone & Turoff, 1975; Mullen, 2000; Rowe & Wright, 1999; Underhill, 2004). It can be used for any purpose for which a committee might be used (Martino, 1983). Linstone and Turoff (1975) describe the techniques and applications of the Delphi method and list as one of the properties of an application that lends itself to Delphi, "The problem does not lend itself to precise analytical techniques but can benefit from subjective judgment on a collective basis" (p.4). This confirms that the Delphi technique is appropriate for the analysis of the data in this study.

3.4.3.3.(b) What is the Delphi technique?

As discussed above, Delphi is a family of techniques rather than one technique. This family of techniques share typical features of:

- An expert panel
- A series of rounds in which information is collected from panelists, analysed and fed back to them as the basis for subsequent rounds
- An opportunity for individuals to revise their judgments on the basis of feedback
- Some degree of anonymity for their individual contributions (Underhill, 2004).

The Delphi Panel is a collection of experts in the area under investigation, but the group members never meet each other or discuss the issue as a collective. Instead they receive information at their individual location, are asked for their expert opinion, this is collated by someone outside the panel and the group results are sent out for further comment by the panel in an iterative loop.

The Delphi panel then is acting as a form of dispersed focus group where the members of the group do not interact directly, for the purpose of maintaining independent thought. The use of focus groups in the formulation and testing of instruments and development of these tools is well documented (Merton & Kendall, 1946; Morgan, 1988; Templeton, 1987). Templeton (1987) defines such a focus group as: "A small, temporary community, formed for the purpose of the collaborative enterprise of discovery. The assembly is based on some mutual interest... 'Grouping' fosters the kind of interaction that penetrates the impression management and uncovers some basic motivations" (p.5).

There are obvious advantages to using a Delphi process. These advantages include a reduction in time and cost in having group meetings, especially when the experts are geographically spread, and individuals being able to contribute their opinions more freely when they are not hindered by the social issues that can prevail in some group situations (Linstone and Turoff, 1975). Turoff and Hiltz (2004) believe the most important and often least understood properties of the Delphi method are the ability for asynchronous interaction and the anonymity of respondents.

- Asynchronous interaction refers to the two characteristics by which respondents may: (1) choose to participate in the group communication process whenever they want to – any time of the day or night; and (2) contribute to that aspect of the problem they feel best able to contribute. In face-to-face approaches the group is forced to take a sequential path through the group problem-solving process. This fails to take into account variety in the individual's approaches, skills and cognitive abilities leading to some of the group not contributing. The Delphi method aims to tackle any problem from a variety of different perspectives and the asynchronous form of interaction helps to ensure this happens.
- Anonymity has the advantages that individuals: can put forward initial expressions of an idea that may not turn out to be suitable without losing face; can change their minds about concepts without having to defend this change; do not get biases about ideas because of who introduced the idea; do not get swayed by influential contributors in the group who are able to argue their point well or who hold status in the community already.

Turoff and Hiltz (2004) comment that the introduction of computers through on-line contribution to the group process has enhanced the Delphi method and allowed further refinement in some cases.

The criteria for choosing experts to join the Delphi panel is left to each researcher, although Helmer & Rescher (1959) suggest that experts are usually selected for their extensive knowledge of the subject of interest and track record as a predictor, while Scheele (1975, p.70) suggests that panel members will normally come from one of four groups:

- Stakeholders – people directly affected by the issue under consideration
- Experts – people with an applicable specialty or known experience
- Facilitators – people with skills in clarifying and analysing

- Individuals with alternative global views on culture and society.

Although the Delphi method has been commonly used for panels of 30 – 100 individuals who could not function well in a face-to-face situation (Turoff & Hiltz, 2004), there are no set rules in the literature for the number of experts comprising a Delphi panel. Studies have used as few as six or seven in a panel (Dalkey & Helmer, 1963; Turner, 1992).

Neither is there a set number of rounds in the iterative loop. Custer, Scarcella & Stewart (1999) suggest it is normal to have three rounds, while other literature suggest anywhere between two rounds as a minimum and five as a maximum (Coy, 1995). In a review of the effectiveness of the Delphi technique, Rowe & Wright (1999) considered 27 different Delphi studies which used between two and seven iterations. While it could be argued that iterations should continue until the result is stable, in that no further change is suggested by the panel members, there is evidence to suggest that no significant improvement occurs after the second round (Dalkey, 1969; Rowe & Wright, 1999).

The researcher has the role of moderating and facilitating the responses from the panel members, putting them into a summary form that can be easily interpreted by the panel in the subsequent round. Turoff & Hiltz (2004) state that this function of analysis is a principal contribution to the improvement of the quality of the results in any study. They suggest the analysis must have these specific objectives:

- Improve the understanding of the participants through the analysis of subjective judgments to produce a clear presentation of the range of views and considerations,
- Detect hidden disagreements and judgmental biases that should be exposed for further clarification,
- Detect missing information or cases of ambiguity in interpretation by different participants,
- Allow the examination of very complex situations that can only be summarised by analysis procedures,

- Detect patterns of information and sub-group positions,
- Detect critical items that need to be focused on.

This concurs with Linstone & Turoff (1975) who state a number of reasons for the Delphi failing. These include: imposing the researcher's views and preconceptions upon the analysis and not allowing for other perspectives related to the problem; poor summarising techniques and presentation of the group response; ignoring the contributions of some panel members so that dissenters drop out of the study; and, underestimating the demanding nature of the Delphi as it is not an integral part of the panel member's job function.

The knowledge of these objectives to help ensure success of the analysis, and the pitfalls that can be encountered, were incorporated into the final Delphi method design used in this study.

3.4.3.3 (c) The Delphi method for this study.

The desired outcome of the Delphi process was an analysis of the 18 CAIs to establish the root causes of the incidents. The workload involved in reading the interview material and making a subjective interpretation of the root causes was estimated to be several hours for the first iteration and less for successive iterations. For this reason, it seemed unreasonable to expect any one expert panelist to analyse all 18 incidents while remaining focused and committed to the task. With this in mind the 18 incidents were divided into three subgroups. It was thought that anyone volunteering their services as a Delphi Panel member would be intrinsically motivated to be involved because they would be interested in the process and the results of the study. Six incidents were considered to be manageable for each expert. Each group of incidents was analysed by a separate Delphi panel. The incidents were divided among the three panels to provide as wide a variety of activity type within each panel as possible and as similar a range of activities between panels as allowed by the data collected. The use of multiple Delphi panels to make analysis more manageable is well documented in the literature (Best, 1974; Custer, Scarcella & Stewart, 1999; Turner, 1992; Turoff & Hiltz, 2004).

Outdoor experts were selected for the Delphi panels based on their depth of experience across a range of outdoor activities and contexts. To make the selection I used the databases of the New Zealand Outdoor Instructors Association (NZOIA) and Outdoors New Zealand (ONZ). The NZOIA is an organisation that assesses outdoor instructors against a set of standards and at different levels of expertise. These NZOIA qualifications are recognised by all members of the outdoor community in New Zealand. Members of NZOIA holding national qualifications in outdoor activities were contacted by email, given details of the research study and asked for registrations of interest in being a member of a Delphi panel. It was stated in this email that an ideal panel member would have at least ten years' experience instructing in the outdoor sector across a range of activities and an understanding of the principles of risk management would also assist in managing the task.

As explained above, there is no set number of experts on a Delphi panel. Linstone and Turoff (1975) discuss the balance in establishing the right number of people for the panel: The more people on the panel, the greater the ability to create a true picture of reality from a combination of subjective views. The decision was made to set up panels of six outdoor experts for the first iteration, plus my input. The instructor who was involved in that particular incident was included in the panel for subsequent iterations in order to give his / her input into the experts' combined analysis of the root causes of the incident. The instructor of the incident was included because he / she was an expert for that particular example. This inclusion of the instructor was to prevent possible misinterpretation of the incident account by the experts. Susan Noffke (1990) describes all research as violence, in that any attempt at interpreting events is bound to introduce change from the reality of those events. Including the instructor in the individual Delphi panel helps reduce the level of this "violence". The "violence" that was trying to be controlled in this case refers to the interpretation of the sequence of events by the experts, rather than trying to limit any extrapolation by the experts from those events to establish root causes. Therefore, the inclusion of the instructor acted as a form of triangulation to reduce bias and increase validity of the results. This will be discussed in greater detail later in this thesis. It was considered that this number of panelists would provide a good spectrum of expert subjective opinion while remaining manageable.

I received 25 expressions of interest from potential expert panel members. Each potential member was then contacted, asked for a brief CV of outdoor experience, given details about the workload, and the need for prompt processing of the interview material. As the Delphi would be conducted by email, access to internet was essential. Based on the responses to this information and the C.V.s of outdoor experience provided, 18 experts were chosen and divided into three Delphi panels: coded green, red and yellow for my benefit. The experts were chosen for the three panels such that each panel had a similar gender mix and included experts with a range of outdoor activity expertise.

CAI data were emailed to each of the experts for the first of the incidents in each group of six incidents. No pre-analysis of the interviews was carried out because I did not want to influence the possible root causes that were to be uncovered by the different experts. Also, as Linstone and Turoff (1975, p.59) point out, "A Delphi should not be undertaken to validate concepts which you have already developed and refined; panelists want to make significant contributions and these will seldom build meaningfully on highly elaborated initial concepts". The experts were asked to identify both conditions leading to the incident occurring and root causes of the specific incident. The instructions sent to the panel members are included in Appendix 3.

Once all six experts had returned their findings for a particular incident, I combined the findings into an Events and Causal Factors Analysis (ECFA) diagram for the incident (Buys, Clark, Kingston-Howlett & Nelson, 1995) (NB: Section 4.7 explains this technique in detail). This provided a diagrammatic representation of what the experts had collectively identified as the causal factors for the incidents and how they were linked chronologically. A diagrammatical representation of incident scenarios is recommended to simplify otherwise complex situations in order to make them more easily understandable to those wishing to learn from them (Pidgeon, 1989; Toft & Turner, 1987). The ECFA technique is used because it is particularly suited to the multifactorial nature of incidents involving employee errors and it: 1) assists the verification of causal chains and event sequences; 2) provides a structure for integrating investigation findings; and 3) assists communication both during and on completion of the investigation (Buys et al., 1995). It was anticipated that the diagram could be easily interpreted by the experts who would identify their contribution to the analysis and how it related to the ideas that other experts contributed.

The timing of each iteration was therefore dependant on the slowest response from any expert in any group. Despite agreeing to a timely response to interview data when joining the Delphi panel, the personal circumstances of the experts changed during the study causing some tardy responses. I received email responses from South America, Europe and North America as individual experts replied from internet cafes while on expeditions and taking part in employment with international outdoor education organisations. Others were involved in giving birth, while yet others had work pressures. The first iteration took over three months to complete.

The ECFA diagram was sent out to the Delphi panel as well as the instructor involved in the incident for comment as the second iteration of the Delphi process. This round was completed with much greater speed and there were often very few changes requested. A third iteration led to stability in response in all cases.

With the time taken to complete the first incident across the three panels being much greater than expected, and with the threat of the study taking years to complete, a different approach was adopted for subsequent incidents. As each expert returned their analysis of an incident, that expert was immediately sent the CAI for the next incident. In this way any expert was able to progress at a rate that was not dependant on other experts for the first, more time intensive, iteration. If any expert did not reply to a particular incident within an eight week period, the analysis continued without their input.

For different reasons, an expert dropped out of both the green and yellow panels, reducing these to five experts plus myself. Achieving stable ECFA diagrams for all 18 incidents took in excess of 12 months.

My frustrations at the Delphi process in having to pass control of the research progress over to the individual motivations and life pressures of the 18 expert panel members, made it easy for me to identify with the warning by Turoff & Hiltz (2004, p.1), "The straightforward nature of utilising an iterative survey to gather information 'sounds' so easy to do that many people have done 'one' Delphi, but never a second".

Once all 18 incidents had been through the Delphi process, I gathered together the final ECFA diagrams. These showed the root causes perceived by the experts for each of the incidents, the relationships between the root causes in any incident and the relationships between those root causes and other conditions leading to the incident. From these 18 incidents, I copied the 227 individual root causes that had been identified onto Post-it notes and separated them into two piles: those related to instructor error and those related to errors in the management system. This separation was based on the theoretical 'lens' for an outdoor education incident which was developed through the literature review and is explained in detail in Chapter 4. Within each of these two categories the root causes were grouped into subcategories which appeared to share similar features. These subcategories became the 'types' of root causes and these are explained in depth in Chapter 6. These identified types of root causes created a taxonomy of error for the 18 case studies reviewed by the Delphi panels.

Some writers argue that an 'inter-rater' or 'inter-coder' should be used to confirm this categorisation (e.g. Bryman, 2001; Silverman, 2000). Other proponents of grounded theory leave the categorisation purely to the researcher. By using the Delphi members to review the final taxonomy produced (as explained in Section 3.4.4.) it was considered that the use of another 'inter-rater' phase was redundant.

The predictors of incidents that would result in serious injuries identified in Phase One (quantitative analysis) of the research, were then compared to the taxonomy of error developed in Phase Two (qualitative analysis). This was to see if the taxonomy could explain those variables influence in increasing the likelihood of serious incidents occurring.

3.4.4 Phase Three – Qualitative Analysis Stage 2

It is acknowledged that the analysis of 18 case studies was unlikely to identify all of the root causes of outdoor education incidents. This was one reason why a review of outdoor education literature and also the more extensive literature from the related disciplines of industrial safety and cognitive psychology was carried out. From this literature review, I compiled a list of all of the factors that were considered by experts in their various disciplines to contribute to incidents. I compared and contrasted this list with the taxonomy of error that had been developed for the 18 outdoor education case studies. The result was a proposed taxonomy of error for outdoor education.

I had also derived a model of an outdoor education incident from the literature review. This acted as a 'lens' to focus the results of the analysis of the 18 incidents; where root causes were grouped into either instructor related errors or errors in the management system (Cresswell, 2003). The ECFA diagrams that resulted from the Delphi analysis in Phase Two showed the chronology of each incident and the relationship between the root causes and the conditions (immediate causes) leading to each incident. A model of an outdoor education incident, based on both existing literature and empirical data, was built based on these results.

This model of an outdoor education incident and the taxonomy of error upon which it was based, were sent to the members of the Delphi panels for their comments.

3.5 Reliability and Validity – Research Trustworthiness

The objective of this research was to help the understanding of the root causes of outdoor education incidents so that through training and knowledge, the frequency of incidents could be reduced. I was therefore concerned with the results of this research being able to be applied to the broader outdoor education sector. The trustworthiness or credibility of the methods and the generalisability of the findings were, by inference, of primary concern.

The study presented here is a mixed methods design involving both quantitative and qualitative methods within a pragmatist paradigm. Within a purely quantitative design, the generalisability of the results can be argued in terms of reliability and validity measures employed in the research design (Fraenkel & Wallen, 1990). In pure qualitative research, researchers are often not interested in the generalisability of their findings to other individuals, settings and times. For these researchers, the working hypotheses are only time and context bound (Tashakkori & Teddlie, 1998). Other qualitative researchers prefer the term *transferability* to the application of their findings in like contexts (Lincoln & Guba, 1995). Tashakkori and Teddlie argue that whatever term is used, some degree of generalisability is desired by all researchers and techniques can be employed in the research design so that this is an outcome for the findings.

The sections below explain the techniques used within the research method already outlined to help ensure the generalisability of the findings so that they have application beyond the sample of incidents chosen.

3.5.1 Reliability

Reliability is defined by various authors to mean the consistency of the results (Fraenkel & Wallen, 1990) or the extent to which studies can be replicated (Cook & Campbell, 1979; Goetz & Le Compte, 1984). In discussing mixed methods design, Tashakkori & Teddlie (1998, p.82) use the term "accuracy" to define reliability. If a measurement is accurate it will be repeatable over time or obtainable with an identical method of measurement. Therefore some forms of triangulation can help confirm the reliability of results.

The reliability of this study was addressed by documenting the detailed design of the research so that any subsequent researcher would be able to faithfully reproduce the study to achieve the same results.

In the quantitative Phase One of this research, sample selection, data collection and analysis techniques were all itemised so that replication would be straightforward. As discussed earlier, the representativeness of the sample means care must be taken in generalising beyond the population of larger New Zealand outdoor education centres employing paid staff.

In the qualitative Phases Two and Three of this research, the empirical data relied heavily on the recall of past events by instructors involved in those events. The potential for these recollections to vary from the events that occurred are acknowledged due to memory recording, storage and retrieval issues with the instructor involved in a stressful situation, and the self-filtering of those memories due to social and values pressures during this study. Attempts have been made to improve the reliability of the data through a voluntary data gathering procedure where efforts were made to reduce any perceived threat, through "interjudge" techniques (Tashakkori & Teddlie, 1998, p.85) and through feedback to the instructor being interviewed so that as accurate a picture as possible of the actual circumstances were being described. The interjudge techniques mentioned are the reviews of the details of a particular incident by a panel of experts, including the instructors themselves. In this way the details of the incident are questioned and agreed on through subsequent rounds of the Delphi process.

By detailing the methods of data analysis, showing quotes from interviews and how these were interpreted by the experts and myself to indicate root causes, this provides the reader of this research with an 'audit trail' to determine the quality of the methods, the theoretical propositions which led to the conclusions, and whether the methods meet the goals (Goetz & Le Compte, 1984; Maykut & Morehouse, 1994; Sarantakos, 1993).

3.5.2 Validity

Validity has been defined as, "...the appropriateness, meaningfulness and usefulness of the specific inferences researchers make of the data they collect" (Fraenkel & Wallen, 1990, p.127). Tashakkori & Teddlie (1998) differentiate between internal validity and external validity. Internal validity is the degree to which conclusions and inferences can be trusted while external validity is the extent to which those results are transferable to a wider population.

Phase One of the research involved the collection and analysis of quantitative data. The validity of the conclusions was tested by what could be termed "peer debriefing" (Cresswell, 2003, p.196; Tashakkori & Teddlie, 1998, p. 91). The conclusions from analysis of these data were presented for review and comment at the 'Risk 2002' Conference. This was attended by over 100 outdoor educators and managers of outdoor education programmes with an interest in risk management theory and practice. The attendees were from New Zealand and overseas. There was no major change suggested by this group with any of the conclusions and inferences made from the data. A copy of the conference paper was subsequently posted as part of the conference proceedings on the ONZ website. I have received many requests to quote from the paper by tertiary level students and lecturers from throughout the world. None of these correspondents has suggested flaws in the conclusions. A paper outlining this stage of the research has been published by the highly regarded UK Journal of Adventure Education and Outdoor Learning (Davidson, 2004). Papers for this Journal are subject to expert peer review before acceptance. The latest reprint of the Mountain Safety Council Safety Manual (Haddock, 2003) quotes extensively from this work. This manual has been widely distributed and there has been no criticism of the quoted findings.

Phase Two of the research was the analysis of interview data concerning outdoor education incidents to identify root causes of those incidents. The research design for this phase involved the incorporation of triangulation techniques and member-checking to help ensure the validity of the qualitative inferences made during data collection. Triangulation is the use of multiple approaches to build a coherent justification for themes (Cresswell, 2003). Denzin (1978) identified four basic types of triangulation:

- Data triangulation: the use of a variety of data sources in a study;
- Investigator triangulation: the use of several different researchers or evaluators;
- Theory triangulation: the use of multiple perspectives to interpret a single set of data;
- Methodological triangulation: the use of multiple methods to study a single problem.

Data triangulation was used to increase the validity of any root causes identified. The 18 incidents were purposefully chosen to be diverse in activity type, setting, organisation and gender. These different sources of data helped confirm and validate root causes.

Investigator triangulation was used through the Delphi process where six expert investigators all agreed on the inferences made from the data to determine root causes of the incidents under investigation.

Member-checking was also employed. Those instructors who had been interviewed regarding their incidents were included in the second and third iterations of the Delphi process. In this way the validity of the inferences could also be checked. Patton (1990) described this technique as a fifth type of triangulation which he referred to as analytic triangulation.

Methodological triangulation was used to compare the results of the quantitative phase of the research with the qualitative phase. Compatibility of these two results helped support the validity of the findings.

Phase Three of the research involved the interpretation of the collective results of Phase Two, to produce a taxonomy of root causes and a model of an outdoor education incident. This stage relied heavily on my subjective judgment of what was and wasn't important to include in the final results, and how categories would be grouped.

To help validate the findings theory triangulation was used. A model of an outdoor education incident was developed from a review of literature in the fields of outdoor education, industrial safety and psychology. This was compared with the results from the empirical data. The final model and taxonomy were then subjected to peer debriefing where they were both sent to members of the Delphi panel. The Delphi members were asked to review the final model of an outdoor education incident and the taxonomy of error and suggest changes or problems with both results.

3.6 Summary

This chapter has described and discussed the research methodology of the study and has justified the implementation of adopting a mixed method approach.

The mixed method design was explained whereby:

- Data were collected firstly through historical records from outdoor education centres and then through interviews with instructors who had been involved in incidents that had potential for serious outcomes.
- The quantitative data were analysed through statistical methods to produce a profile of incidents occurring in outdoor education programmes in New Zealand.
- The qualitative data were analysed through a Delphi process where three concurrent expert panels each interpreted a subset of the total interview data. This resulted in 18 incident diagrams that showed the mechanisms of each incident chronologically and also indicated the relationships between the factors identified as causing the incident. I collated all of the findings of the root causes from these incidents, grouped these into categories of types of root causes based on their similarities and produced a taxonomy of error that could lead to those incidents.
- The empirical results were combined with the results from the literature review to produce a proposed model of causation for outdoor education incidents and a taxonomy of root causes for those incidents.

My own subjective judgment was a crucial component of the final stages of this research in particular. The categorising and naming of root causes was at my discretion. While a different researcher may have finished a similar study with different categories and nomenclature, it is believed that the general model of an outdoor education incident, and the types of root causes in the taxonomy would be identifiable.

Various techniques were built into the mixed-method research design that have given me confidence that the results are credible and can be applied beyond the sample selected.

CHAPTER FOUR

REVIEW OF LITERATURE: THE DEVELOPMENT OF AN OUTDOOR EDUCATION INCIDENT MODEL, TAXONOMY OF ERROR AND A TOOL TO DIAGRAMMATICALLY REPRESENT AN INCIDENT

4.1 Introduction

The aim of this chapter is to review the current literature concerning incident causation and from this review to develop:

a) A model of incident causation.
b) A taxonomy of potential root causes leading to incidents.
c) A diagrammatical representation of an incident that can be used in this study.

The first two of these will be used as a 'lens' to focus the direction of the research in Chapters 6 and 7. The development of a diagrammatic representation of an incident will be used in Chapter 6 to summarise the analysis of incident case studies.

As part of this review, information is uncovered that helps build a profile of outdoor education incidents and their comparison with incident rates in other aspects of life.

This review of literature falls into seven sections.

1) Section 4.2 investigates knowledge that exists in the outdoor education literature about either: (a) describing a profile of outdoor education incidents, or (b) describing the root causes of outdoor incidents (especially serious ones).
2) Section 4.3 investigates contemporary models of incident causation from which an interim model of an outdoor education incident is proposed.
3) Section 4.4 draws from the more extensive worlds of industrial safety management and psychology literature to find clues to the root causes of

incidents. The end of this section divides taxonomies of root causes into two categories:

   a. Those leading to poor instructor performance or judgment
   b. Management system errors

4) Section 4.5 compares the potential root causes of incidents identified in outdoor education literature in Section 4.2, to confirm and expand the taxonomies in Section 4.4.
5) Section 4.6 combines all of the information gained from the earlier sections to present a proposed model of an outdoor education incident including the taxonomies of root causes.
6) Section 4.7 reviews all of the existing risk and incident analysis tools in common usage, in order to identify a suitable tool for the second phase of the data collection. From this review, modifications to the Events and Causal Factors Analysis (ECFA) procedure are proposed that will help outdoor educators understand the development of any incident under investigation and focus on the underlying root causes of that incident.
7) Finally, Section 4.8 provides a summary of the chapter.

4.2 Outdoor Education Literature Review

4.2.1 Profiling Outdoor Incidents

4.2.1.1 New Zealand Outdoor Education Incident Data

There is almost no research in New Zealand that profiles the type and frequency of outdoor education incidents. With the requirement under the Health and Safety in Employment (HSE) Act (1992) to keep a register of all accidents in the workplace, it might be expected that such information would exist, but this is not the case. While individual organisations in all likelihood keep records, no summary and / or analysis of these data has yet occurred. A private company, the Outdoor Safety Institute, attempted to compile a database of outdoor incidents in the early 1990s but had very few contributions; probably due to concerns about confidentiality. The Accident Compensation Commission database does not categorise accidents resulting in claims by the category of outdoor education or anything vaguely similar. The only information that does exist is a compilation of all fatalities that occur in the outdoors. This information is compiled by the New Zealand Mountain Safety Council (MSC) based on Coroners' Reports and at the time of writing (2004) it had not been kept up to date due to the lack of resources in the MSC. A summary of the deaths recorded is shown in Table 7 with the years over which data were collected for this study highlighted. As there were no data attached to the compilation which shows, or even estimates, the number of people or participation hours in the outdoor activities that the fatalities represent, no fatality rate statistics can be calculated.

4.2.1.2 United kingdom Outdoor Education Incident Data

The United Kingdom also lacks an incident database for the outdoor education sector. The Head Inspector of the Adventure Activities Licensing Authority, Marcus Bailie (2003a), compiled comparative statistics from a range of sources in an attempt to compare outdoor education with other risks in life. Some of these comparisons are shown in Tables 8 and 9. The point of Bailie's comparison is not only to indicate that comparatively few fatalities occur in adventure activities, but also that there are a great number of positive benefits from participation in adventurous activities that may reduce fatalities due to other factors including obesity / fitness related deaths, suicide, substance abuse, and even road deaths. In this latter case, he contends that young people are observably more clumsy and less aware of danger today because of their lack of experimentation in an outdoor setting. However, as Bailie is unable to access information about participation rates, it is not possible to directly compare fatality rates in the different UK contexts.

Table 7
New Zealand Mountain Safety Council (1998) Report on Fatalities in Outdoor Recreation where People Were Involved With Instruction, Guidance or Other Professional Care

Year	**Outdoor Recreation Fatalities in activities where people were involved with instruction, guidance or other professional care (IGPC).** *Note: (1)Numbers in square brackets exclude free skiing, adventure tourism and non-educational activities. (2) Shaded area indicates years in which data on accidents was collected for this research.*
1979	2 [2]
1980	8 [6]
1981	9 [4]
1982	4 [2]
1983	1 [1]
1984	7 [5]
1985	6 [2]
1986	5 [2]
1987	4 [1]
1988	6 [5]
1989	8 [5]
1990	5 [2]
1991	10 [7] (NB: Ruapehu Army Incident = 6)
1992	8 [3]
1993	14 [6]
1994	9 [2]
1995	3 [2]
1996	18 [15] (NB: Cave Creek Incident = 14)
1997	6 [2]
1998	7 [5]
1999	Not available at time of writing (2004)
2000	Not available at time of writing (2004)

Table 8
Compilation of the average number of fatalities per year in the UK from various causes (Bailie, 2003a)

Cause	Number	Source
Heart attacks	130,000	Dept of Health
All cancers	>120,000	Dept of Health
Smoking related illnesses	110,000	Home Office
Obesity and unfitness	30,000	National Audit Office
Alcohol related	25,000	Home Office
Breast Cancer	15,000	Dept of Health
Total accidental deaths	10,000	HSE
Suicides	6,000	Samaritans
Asthma	4,000	Dept of Health
Accidents in the home	4,000	DTi HASS/LASS
Road traffic accidents	3,500	Dept of Transport
Asbestosis	3,000	HSE
Sunbathing (skin cancer)	1,400	Dept of Health
Class A drugs	1,200	Home Office
Epilepsy	1,000	Not specified
Drowning	450	RoSPA
Accidents at work	350	HSE
Allergic reaction to aspirin	200	Rescue Emergency Care
Trespassing on railway lines	120	HSE Railways Inspectorate
Do-it-yourself	70	DTi HASS/LASS
Train crashes	8	HSE Railways Inspectorate
Canoeing	5	Dti HASS/LASS
Adventure activities	150	Not specified

<u>Note the following abbreviations:</u>
HSE = Health and Safety Executive
DTi = Department of Trade and Industry
HASS = Home Accident Surveillance Systems
LASS = Leisure Activity Surveillance Systems
RoSPA = Royal Society for the Prevention of Accidents

Table 9
Compilation of the Average Number of Accidental or Sudden Deaths Amongst Young People (up to the age of 19) Per Year in the UK from Various Causes (Bailie, 2003a)

Cause	Number
All accidents	1420
Road traffic accidents	700
Congenital anomalies	470
Cancers	430
Cot deaths and ill-defined conditions	375
Diseases of the nervous system	315
Infectious and parasitic diseases	264
Under 14's from accidents in the home	215
Skin cancer caused by sunbathing	200
Suffocation	140
Poisoning (25% from taking Class A drugs)	125
Suicide	110
Drowning	90
Fire	80
Falls	70
Homicide	50
On school trips – Mostly road traffic accidents	3
All other medical conditions	750
Adventure Activities on school visits	1

4.2.1.3 United States Outdoor Education Incident Data

In the United States, some outdoor organisations have been collecting incident data and participation rates for many years and these have been published from time to time in reports and in the annual proceedings from the Wilderness Risk Management Conference (Leemon, 1999; Paton, 1995). It has been reported that many outdoor programmes demonstrate accident rates below those experienced in normal living (Gentile & Schimelpfenig, 1995; Paton, 1995; Priest, 1996b). Table 10, which was compiled from Cooley (2000) and data from a variety of other sources illustrates this comparison.

Table 10
Comparison of Injury Rates Between USA Outdoor Education Centres and Other Activities

INJURY RATES PER 1,000 PARTICIPANT DAYS AND FATALITY RATES PER 1,000,000 PARTICIPANT DAYS		
ACTIVITY	INJURY/1000 PARTICIPANT DAYS	FATALITY/MILLION PARTICIPANT DAYS
USA Outward Bound Schools (1962 – 1989) (Paton ,1995)	0.49 – 1.14	5.59
US Outward Bound Schools 1998 (Outward Bound, 1998) *	0.34 – 1.7 (NB: Outward Bound counts incidents differently than most. The standard criteria is a person unable to participate in the programme the following day.)	?
National Outdoor Leadership School (NOLS) (1984 – 1994) (Leemon, 1999)	1.99	2
NOLS (1995 – 1998) (Leemon, 1999)	1.29	2
USA High School Football Practice (Zemper, 1998)*	19.74	
USA High School Football Games (Mueller and Cantu, 1998)*	35	.63 (plus 0.63 permanently disabling injuries, mostly paralysis)
USA White Adolescents 15 – 19, all accidental causes (National Centre for Injury Prevention and Control, 1999b)*	?	1.5
USA Adolescent Drivers and Occupants 15 – 19 (National Centre for Injury Prevention and Control, 1999a)*	?	4.5
* As reported in Cooley (2000)		

A national incident database, entitled the Wilderness Risk Manager's Committee Incident Data Project, was initiated in the USA in 1989. A report on the data collected over the 1998 – 2000 period was published in 2002 and a summary of the findings produced by Leemon (2003). Contribution to this database is voluntary, although participation is a condition of accreditation with the Association of Experiential Education. To date, data from only 20 organisations have been analysed. Leemon notes that this sample is small compared to the over 600 organisations that have attended the WRMC Conference since 1994. Even recognising that this is a small sample of the total programmes operating in the USA, it is a good start to producing valuable data.

Table 11 shows a list of activities ranked according to the number of injuries in the 1998 – 2000 sample years. While giving the best information to date, there is no separation of those injuries that were serious compared to those that weren't serious. Therefore comparing activity injury rates could be as meaningless as comparing the number of blisters with the number of broken femurs! There are also some 'non-sensible' injury rates reported because of some activities that had very low participation rates (e.g. 888.89 for the years 1991 – 1997 and then 0 for the years 1998 – 2000). Therefore any data that are taken from this table for the purposes of comparison need to be taken from activities that have useful participation rates from which to calculate an injury rate per 1000 participant days. It is interesting to note that the incident rates over the two cumulative periods (1991 – 1997 compared with 1998 – 2000) have dropped considerably from 2.09 injuries per 1,000 programme days to 0.31 injuries per 1,000 programme days. This could indicate that safety efforts have been working. However, this needs to be interpreted with caution because Leemon notes that only a few organisations have consistently submitted data, so the figures may be showing for example the difference between contributing organisations, their approaches to reporting or even differences in participation rates. Of note is the fact that there were no reported fatalities in the sample years among these 20 contributing organisations.

The information in Tables 10 and 11 allows comparison with results of the first stage of the incident data in this research. This comparison will be fully discussed in Chapter 5.

Table 11
United States Wilderness Risk Management Committee Data of Injuries and Injury Rates by Activity (Rates per 1000 program days)

Activity	*1991 – 1997 # of Injuries*	*1991 – 1997 Injury rates*	*1998 – 2000 # of Injuries*	*1998 – 2000 Injury rates*
Backpacking	29	4.36	39	1.52
Biking (mountain)	2	64.00	10	21.87
Biking (touring)	3	33.33	1	10.90
Boating (power, row)	2	?	0	0.00
Camping (general)	32	0.57	33	0.12
Canoe (flatwater and portage)	16	3.08	28	3.41
Canoeing (whitewater)	1	2.14	0	0.00
Cave	2	888.89	0	0.00
Climbing (rock, ice & rappelling)	7	3.71	7	0.17
Hiking (day, orienteering	10	30.07	10	3.32
Horseback riding	0	0.00	5	4.17
Kayaking (whitewater and sea)	4	5.19	8	3.52
Marathon	1	16.67	0	0.00
Mountaineering	1	18.18	0	0.00
Rafting	2	1.72	0	0.00
Sailing	1	1.43	0	0.00
Skiing (downhill/telemark)	0	0.00	0	0.00
Skiing (touring)	3	22.21	7	2.47
Snowshoeing	0	0.00	0	0.00
Solo	0	0.00	1	0.33
Water (swim, wade, snorkel)	6	22.64	3	7.31
Winter camping	1	8.70	1	3.51
Work projects	0	0.00	1	0.34
Total Backcountry	123	1.56	154	0.41
Climbing walls	n/a	n/a	1	1.03
Initiative team challenges	10	3.26	16	0.10
Rope course high and low	8	2.67	8	0.10
Sports & recreational games	17	79.98	18	7.24
Transportation (to activity)	2	1.11	6	0.16
Miscellaneous	22	?	0	0.00
Total Non-backcountry	59	7.30	49	0.18
Total	**182**	**2.09**	**203**	**0.31**

4.2.1.4 Australian Outdoor Education Incident Data

In Australia, there is also little in the way of formal collection and analysis of incident data. Brown (1998) mentioned the existence of the National Injury Surveillance Unit based at Flinders University in Adelaide, but this unit collects only regional data and is limited in that it groups all outdoor related injuries in a broad category of 'other sport or leisure activity'. Brackenreg (1997) reviewed a number of studies reporting injury and illness in outdoor education programmes, but was hindered by the widely different definitions of medical incidents. The studies he used were mostly those discussed earlier from the USA, a Project Adventure study also from the USA (Furlong, Jillings, Larhette & Ryan, 1995), and the statistics from one Australian outdoor education programme (St Joseph's College near Sydney: Kampen, 1996). There is little to learn about Australian incident rates from this review. Brookes (2003a, 2003b, 2004) carried out a study of 114 outdoor education fatalities that occurred in 72 separate incidents in Australia from 1960-2002. The incidents were identified by doing electronic searches of newspaper archives (1990 or later) using keywords, and microfilm searches of earlier newspaper records. Brookes admits that there was potential for incidents to have been missed in such a limited search. Analysis of the incidents was done based on the documentation rather than any follow-up interviews. No participation rates were available and therefore no fatality rates were able to be calculated. Analysis was limited to the more immediate causes of the incidents such as environment and supervision and therefore root causes as defined in this study were not considered.

4.2.1.5 Summary

This literature review has shown a consistent lack of incident data from the outdoor education sector in New Zealand, the United Kingdom., the United States and Australia. The most comprehensive data has been published in proceedings from conferences of the Wilderness Risk Managers Committee of the United States summarised in Tables 10 and 11. The data shown in these tables will be used in Chapter 5 to compare with New Zealand incident statistics.

4.2.2 Root Causes of Outdoor Education Incidents

This section of the review looks at what information already exists about root causes of outdoor education incidents within the outdoor education literature. There is very little information that speaks directly to the causes of incidents which leaves me to interpret the more extensive writing on outdoor education risk management. One New Zealand study (Haddock, 1999c) investigated ten near misses that had high potential for loss at one outdoor education centre. The causal factors identified from this study are contained in the Mountain Safety Council's Outdoor Safety Manual (Haddock, 2003) and will be considered later in this section.

4.2.2.1 Incident Models

Early models used to explore outdoor incidents are shown in Figures 5 and 6. These models are generally similar, in that they share the basic premise that an accident, or the potential for one, occurs when there is an interplay of human factors within an environment that contains hazards. The model therefore suggests the simplest way to prevent all outdoor incidents is simply to separate the fallible humans from going into hazardous terrain! This is certainly what many land managers attempt to do with fencing, signage and regulations. However the very premise of positive gains from outdoor education lie in the interplay of humans being in the outdoors which makes this solution impractical. We need to retain the challenge and risks of the wilderness rather than trying to change the wilderness into a safe, engineered, adventure park (Batt, 1996; Schimelpfenig, 1995b).

Figure 5. Dynamics of accidents theory (Hale, 1984, p.4)

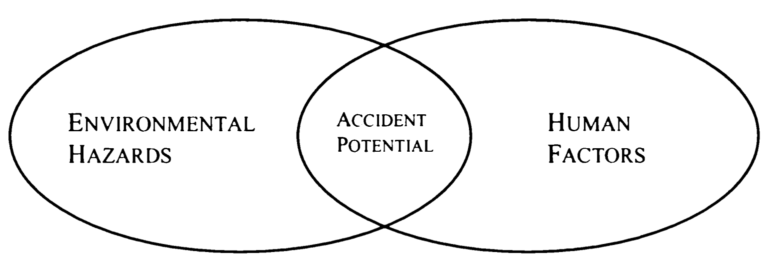
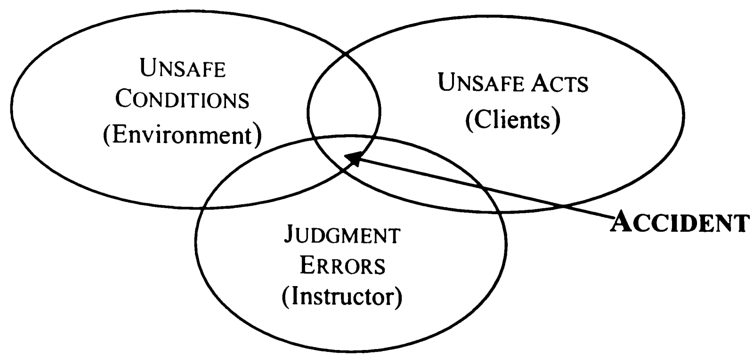


Figure 6. Model of an accident in the outdoors (Meyer, 1979, p.10)



Meyer's model suggests that root causes of outdoor incidents fall under the headings of unsafe conditions, unsafe client acts and instructor judgment errors. My contention is that of these three categories, only judgment errors by the instructor are true root causes of incidents because it is the instructor's role to manage hazards produced by both the environment and by the acts of clients. Both of these categories of hazards are pre-existing in the workplace and must be identified and managed. In Sections 4.3.5 and 4.5 contemporary safety management models of incident causation will be used to support this argument that unsafe conditions in the environment and unsafe acts by clients are immediate not root causes of incidents.

In their book titled "Effective Leadership in Adventure Programming", Priest and Gass (1997) developed Hale's model further and suggested six factors which inhibit an instructor's ability to analyse danger. These are:

- New or unexpected situations – which could include new sites, activities, group dynamics, etc., which an inexperienced instructor would have less competence to deal with. For this reason Meyer (1979) is a proponent of pre-site visits.
- Inappropriate attribution – the psychological tendency of people to take credit for successful outcomes but to transfer the blame for poor outcomes to others. This may prevent instructors from realising incidents can happen to them and therefore cause them to be less alert to dangers.

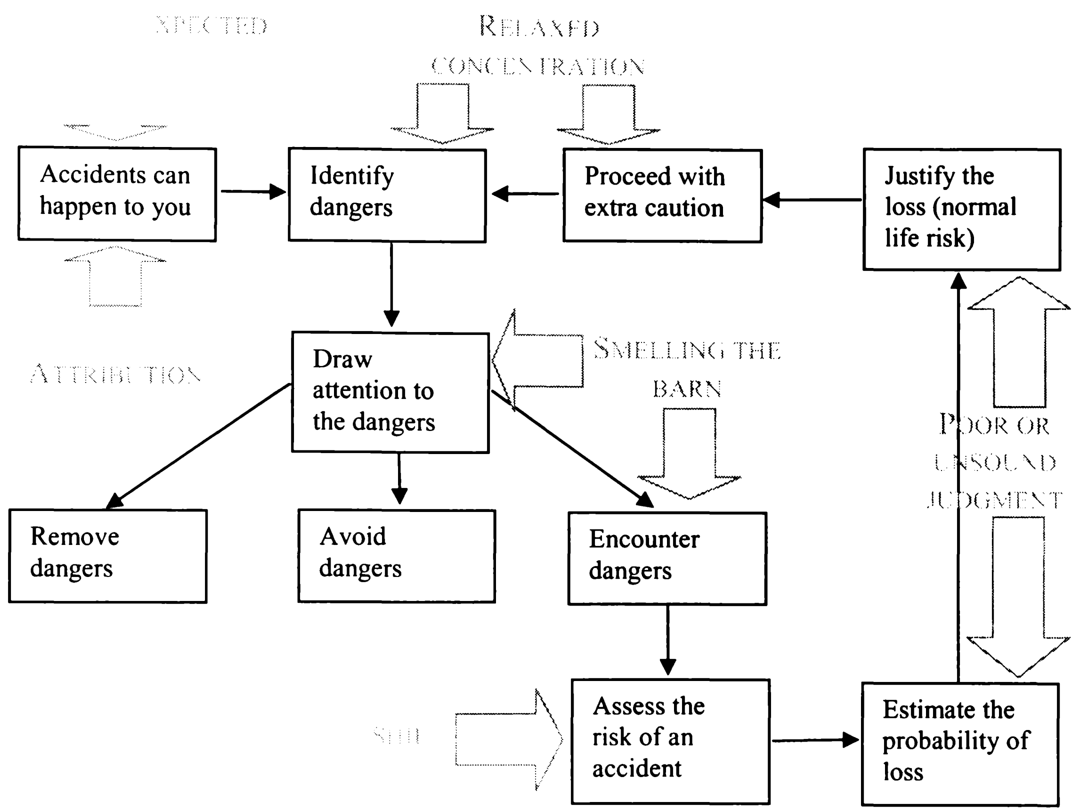
- Relaxed concentration – being less aware to dangers due to fatigue, distraction, familiarity, etc.
- Smelling the barn – the willingness to take greater risks when the end is in sight or in order to meet a schedule.
- Risky shift – the tendency for people in groups to take higher risks than if each were alone. Some participants abandon personal responsibility and transfer the responsibility for taking risks to the group.
- Poor or unsound judgment – often through misperception of what is occurring.

They proposed a procedure for analysing dangers in adventure programmes and how these inhibiting factors could interfere with this procedure. This is shown in Figure 7.

Following discussion of these points, Priest and Gass (1997) pointed out a number of safety measures that should be in place in an organisation to minimise the likelihood or impact of an incident. These include:

- Appropriate safety policies, philosophies, goals, learning objectives, etc., written in a staff manual
- Risk management plans for field activities including crisis response plans.
- Accident report forms and analysis systems to learn from mistakes.
- Safety reviews carried out on programmes by external peers.
- Staff who have the appropriate skills to work in the field.

Figure 7. Five inhibiting factors at work in the danger analysis procedure (Priest & Gass, 1997, p.92).



Priest and Gass also introduced a model of experience-based judgment. They briefly covered the concept of heuristics, which are simple principles or rules of thumb that humans use to make decisions. This is based on the work of Kahneman, Slovic and Tversky (1982). While heuristics can assist in simplifying complex decisions, they can also lead to errors in judgment. Examples given of heuristics are:

- Representativeness – the extent to which information from past situations is useful or relevant to the current situation. If your past experiences are limited, you will have a limited number of solutions to apply quickly to a new situation.
- Availability – the ease which you can bring specific information to mind can influence judgment. For example, media articles about avalanche accidents can cause over-estimation of hazard whereas recent exposure to

travel in hazardous conditions with no avalanches can lead to under-estimation of hazard potential.

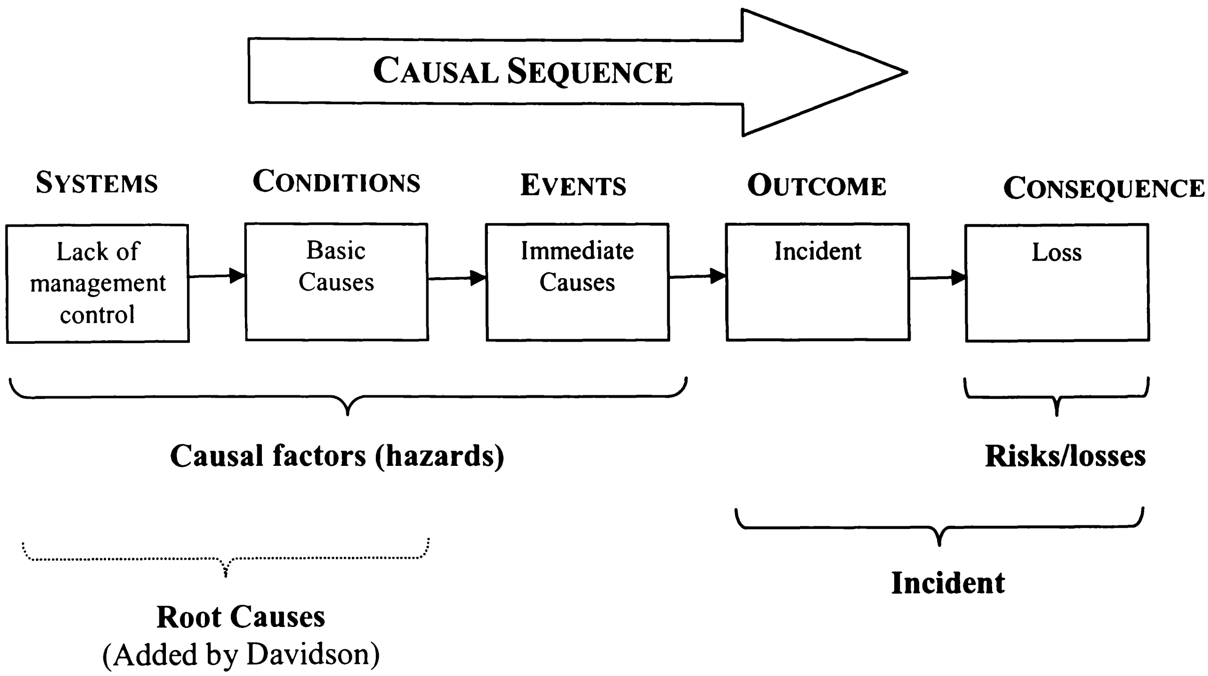
- Simulation – the ability to imagine scenarios from information retrieved. Possible risks can be completely ignored or underestimated if inexperience or lack of information prevents the instructor from imagining certain scenarios.
- Anchoring with adjustment – describes how humans generally weight information's importance in relation to the time it was obtained. Impressions formed based on early information are often hard to change in the light of new information. This can lead to poor judgment if the original information was faulty or incomplete.

The bullet points listed above are the first indication of the existence of root causes of outdoor incidents. Some of these occur at the instructor level leading to poor judgment while others occur at management level in an organisation which lead to instructors being placed in situations which contain serious hazards. These categories of root causes are not obvious from the models of incidents shown earlier in Figures 5 and 6.

In the recently published MSC Outdoor Safety Manual (Haddock, 2003), an incident model is proposed based on the work of industrial safety writers Bird & Germain (1989) and Kates, Hohenemser & Kasperson (1985). This model (Figure 8) suggests that the way to prevent incidents is to block the pathway between the causal factors; it being progressively more difficult to block the pathway as the causal sequence advances.

This model is the first time that the management of an organisation is shown explicitly in a model of an outdoor incident. There is no further development of this model in the text to explore the make-up of the various causal factors in a generic way. The original model as proposed by Bird & Germain (1989) will be revisited in the review of literature from other disciplines when I suggest an alternative model for an outdoor incident.

Figure 8. The pathways to change model (Haddock, 2003, p.84.).



Earlier in her book Haddock lists and explores a number of "Principles of Risk Management." These include:

- Risk assessment – correctly identifying factors that contribute to risk
- Judgment and decision-making – making good decisions in a dynamic environment entails skills in situational awareness, situational assessment, option selection, resource management and reflection on outcomes.
- Having appropriate rules, policies and guidelines
- Using appropriate leadership styles
- Knowing the group
- Offering challenge by choice
- Teaching by progression
- Having competent leaders
- Checking equipment
- Social and psychological factors broadly similar to those discussed above (Priest & Gass, 1997) and "Wild cards" described by Haddock as unpredictable and irresponsible behaviours that threaten the safety by taking the leader by surprise. I believe the name "wild card" is misleading

and that these "wild card" factors can be explained by a number of root causes of incidents that have not yet been classified in outdoor education literature but will be identified at a later stage in this research. Risk homeostasis theory suggests that people adjust the level of risk they are prepared to take upwards if a new safety device becomes available (e.g., cell phones, emergency position indicating radio beacons (EPIRBS)) This theory predicts that improved safety devices will do nothing to reduce accident rates as people tend to take higher risks with the new technology.

Once again, these categories suggest some root causes that will be discussed later in this literature review.

4.2.2.2 Other Outdoor Education Writing on the Root Causes of Outdoor Accidents.

Each year a conference is held in the United States investigating the latest thoughts and research into Wilderness Risk Management. The proceedings from these conferences and papers published in the Journal of Experiential Education give a good overview of contemporary thought in the sector.

Dan Meyer and Jed Williamson have been considered experts in the field of risk management for many years. Annually they publish an updated list of what they believe are the potential causes of accidents in outdoor pursuits. The list is divided into three categories based on Meyer's model shown as Figure 5. The latest version of this list is shown in Table 12.

My contention is that this list is a mixture of immediate causes (environmental hazards and human hazards) and root causes. I believe this leads to confusion in targeting causal factors both in terms of preventing future incidents and also in the appropriate assignation of accountabilities and responsibilities. Table 12 which outlines the potential causes of incidents will be re-visited later in this chapter as the model of an outdoor incident progressively evolves.

Table 12
Potential causes of Accidents in Outdoor Pursuits (Meyer & Williamson, 2003)

POTENTIAL CAUSES OF ACCIDENTS IN OUTDOOR PURSUITS (A matrix designed and revised by Meyer and Williamson 1979 – 2003)		
Potentially Unsafe Conditions due to:	***Potentially Unsafe Acts due to:***	***Potential Errors in Judgment due to:***
• Falling objects (Rocks, etc)	• Inadequate protection	• Desire to please others
• Inadequate area security	• Inadequate instruction	• Trying to adhere to a schedule
• Weather	• Inadequate supervision	• Misperception
• Equipment/clothing	• Unsafe speed (Fast/slow)	• New or unexpected situation
• Swift/cold water	• Inadequate food/drink/medications	• Fatigue
• Animals/plants	• Poor position	• Distraction
• Physical/psychological profile	• Unauthorised / Improper procedure	• Miscommunication of participants and/or staff
		• Disregarding instincts

There is no doubt that from the various references discussed throughout this section, errors in judgment by instructional staff are seen by all writers as the key to causing outdoor incidents. In the causal sequence shown by Haddock in Figure 8, it is not clear where instructor judgment fits, even though the decisions and actions of an instructor working unsupervised in the field with a group of participants can subvert all of management's attempts at setting policy and standards in order to control the risk. It is no surprise then that there are an increasing number of journal articles and conference presentations discussing instructor judgment, the effect that errors in judgment have on outdoor incidents, and how to train staff to make better judgments (Clement, 1999, 2000; Erickson, 2000; Fredston, Fesler & Tremper, 2000; Garrett, 2003; Gookin, 1998; Medred, 1999; Schimelpfenig, 1997). Schimelpfenig (1995b) comments that while errors in instructor judgment are recognised as the cause of many outdoor incidents, judgment is often ignored in the analysis of those incidents. This is because it is easier to deal with more visible and understandable factors such as equipment problems or hazards in the environment than human factors involving the less accessible and more uncomfortable notions of human frailty and states of mind.

In one of the latest books published on incident prevention in the outdoors, Hunt (2000) discussed a number of factors causing instructors to make decisions that lead ultimately to incidents, while discussing the ethical foundations of risk management. These include:

- An instructor may get bored operating with students on activities well below his / her own personal level of skill and challenge. To counter this boredom he / she may choose to undertake an activity with a higher level of risk. This following of personal goals rather than the organisational goals, which are student oriented, can lead to incidents.
- Hubris refers to overbearing pride, presumption or arrogance in a person's character. Hunt believes hubris can lead to incidents when instructors lose the respect they once had for the dangers and seriousness of wilderness areas, often because of their past successes in a particular area and the fact that they now have higher skill levels. However the hazards still exist and can't be ignored. In comparison, Hunt comments on his respect for pilots and their rigorous ritual of preflight safety checks which are always carried out and how the most experienced pilot would be considered foolhardy if they failed to carry out these checks.

There has been a growing interest in the outdoor education literature to the knowledge that can be transferred from the fields of safety management, aircraft safety, psychology, etc. (Boyes, 2000; Clement, 1999; Erickson, 2000; Schultz, 2003). This knowledge will be addressed in the following sections of this chapter.

One recent paper on lessons for avalanche education rates special attention (Fredston, Fesler & Tremper, 2000). In this presentation made at a Wilderness Risk Management Conference, the authors discussed a number of human factors which they believe resulted in many people being caught in avalanches. They state:

> "While some accidents are the result of not recognising potential hazard, most accidents occur because the victims either underestimate the hazard or overestimate their ability to deal with it. Victims tend to make critical

decisions based on human desires and assumptions rather than upon the integration of key pieces of physical data." (Fredston et al., 2000, p.45)

The authors then presented the following list of human factors they believe are key contributors to avalanche accidents:

- Incorrect assumptions – assuming a slope is safe based on prior information. Rather than seeking new information in the field to revise the assumption, people heed only information that reinforces their already held assumption.
- The herding instinct – People take greater risks in a group than on their own, yet in avalanche terrain the more people there are, the greater the hazard.
- Attitude – Pride, ego, hubris can easily produce unyielding behaviour in the face of contrary evidence. People with high risk-taking attitudes can filter information about potential hazards and draw unrealistically optimistic conclusions. Attitude, ego and goal orientation can all lead to tunnel vision.
- Testosterone – Males tend to make riskier decisions than females. In Utah since 1980, there have been 22 fatalities. Although approximately one third of all back country skiers are female only one fatality has been a woman and she was a novice accompanying five males.
- Weather and perception – A disproportionate number of avalanche accidents occur on blue-sky days. The authors believe sunny days make us feel good and we can ignore objective information from the snow pack. In contrast if people are traveling in stormy conditions they can also cut corners in hazard evaluation to get home and expose themselves to higher risk as well.
- City thinking versus mountain thinking – The avalanche doesn't care if we have a meeting to get back to, if we paid a lot of money to fly into the hills, if we are lost in conversation – the hazards have to be assessed continually and on the mountains terms.
- Avalanche skills versus travel skills – Most people (skiers, snowboarders, snowmobilers) getting caught in avalanches are very skilled at the physical

skill of their sport but this skill level has outpaced their avalanche skills, and they often vastly overestimate the former resulting in incidents.

- Communication – Poor communication is a common denominator in almost all mountaineering accidents. This can take one of several forms:
    - People fail to speak up for fear of being labeled cowardly or unadventurous.
    - Incomplete information leads to incorrect assumptions or limited sharing of data
    - Misunderstanding of the plan or the potential hazard
    - No communication at all.

The importance of this paper is that the causes of the accidents have been gathered by experts in the field of avalanche safety from the close examination of a number of avalanche accidents. As will be explained later in this study, the results of their work are root causes of the accidents and the root causes are framed in such a way as to be understandable to the practitioner. In Chapters 6 and 7 of this study, an attempt will be made to describe identified root causes of outdoor education incidents in such a way that outdoor practitioners can understand them.

4.2.3 Summary

There is little information in outdoor education literature that profiles the type and frequency of incidents in New Zealand. There is a similar lack of information in the UK although attempts have been made to look at other activities in life to compare fatality rates in those with adventure activities. Some USA statistics exist in the literature, especially for the two larger outdoor education centres: Outward Bound and the National Outdoor Leadership School (NOLS). An initiative by the Wilderness Risk Management Committee to collect data across a range of outdoor education providers in the USA has been limited by small sample size and inconsistent data retrieval. Nevertheless this initiative has produced some preliminary data that can be compared with those collected in New Zealand .

Models of outdoor education incidents and their causal sequences are poorly developed in the literature. Generally, there is confusion between immediate and underlying root causes evident in both the models and accompanying explanations of the causal factors. This confusion leads to a lack of understanding of causes and difficulties for managers in targeting weaknesses in safety systems.

Some outdoor education writers have incorporated models from safety management and psychology into their work. On this basis, these writers have suggested that a lack of management control is potentially a key initiator of the causal sequence for incidents. This conceptualisation suggests two major root causes namely, lack of management control and errors in judgment by instructors.

The reasons for lack of management control identified in this section include:

- Inappropriate safety policies, philosophies, goals, learning objectives, etc.
- Inadequate risk management plans, including crisis response plans.
- Inadequate accident report forms and analysis systems.
- Inadequate safety reviews.
- Inappropriately skilled staff employed and running programmes.

The factors identified in this section leading to errors in instructor judgment include:

- Being in new or unexpected situations
- Inappropriate attribution.
- Relaxed concentration.
- Taking greater risks when the end is in sight.
- Risky shift.
- Risk homeostasis
- Heuristics.
- Boredom
- Hubris, pride, arrogance, ego.
- Incorrect assumptions.
- Testosterone.

This section both confirms the need for this research and identifies a number of potential root causes that need to be incorporated into any taxonomy of error that results from this research. The two major categories of root causes (lack of management control and errors in instructor judgment) will be developed further in the next section.

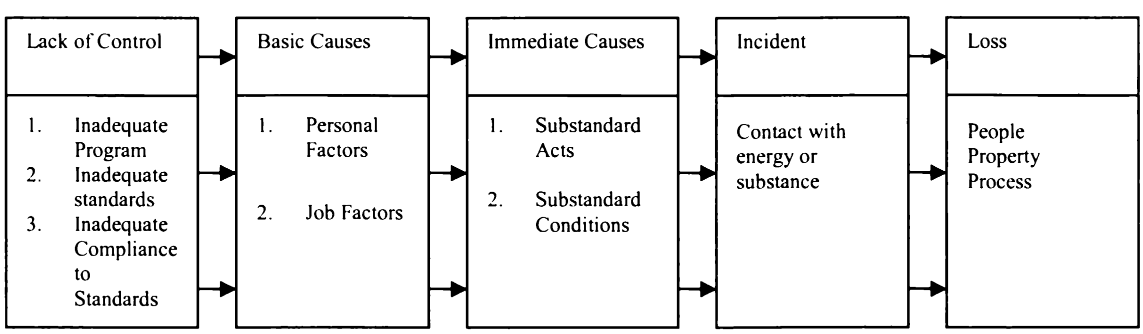
4.3 Incident Models from the Disciplines of Industrial Safety Management and Related Fields

Modern safety texts review the evolution of safety management over the past century. This evolution followed a development from an "Unsafe Act and Condition Era" where safety was a matter of engineering machines to eliminate human mishap and where operators were blamed for unsafe acts, to a "Safety Management Era" where safety engineers found that setting policy, defining responsibilities and clarifying authorities was more effective. Many management tools from other areas were adapted for safety purposes. From the early 1980s to the present we have seen the evolution of the "Human Era" – using the principles of human behaviour in safety programmes and structuring safety programmes out of things that make psychological sense. This new era involves significantly more participation by all workers in the pursuit of safety (Bird & Germain, 1989; Petersen, 1988).

4.3.1 The International Loss Control Institute (ILCI) Loss Causation Model

Bird and Germain (1989) describe the International Loss Control Institute (ILCI) loss causation model shown in Figure 9.

Figure 9. The International Loss Control Institute (ILCI) loss causation model (Bird & Germain, 1989, p.22)



This is one example of a multiple causation model for incidents. It shows that loss is generally not due to one thing, but rather to a combination of factors coming together to cause the incident. Reason (1990) describes this multiple causation concept as major disasters arising from the unforeseen and usually unforeseeable concatenation of several diverse events, each one necessary but singly insufficient. The multiple causation theory is now widely accepted by safety management specialists.

Bird and Germain (1989) suggested that in the wake of an incident, too many investigations focus on the immediate causes. The "Immediate Causes" described in Figure 9 are those easily observable acts and conditions that combine to result in the incident. However, root causes of an incident are "Lack of Control" and "Basic Causes"; those management practices and human factors which, if addressed, would prevent further incidents beyond one specific event that may have occurred.

> "Immediate causes of accidents are the circumstances that immediately precede the contact ... frequently they are called unsafe acts and unsafe conditions... Modern managers tend to think a bit broader and more professionally, in terms of substandard practices and substandard conditions...an increasing number of safety leaders confirm the results from research in quality control that 80% of the mistakes (substandard acts) that people make are the result of factors over which only *management* has control. This significant finding gives a completely new direction of control to the long-held concept that 85-96% of accidents result from the unsafe acts or faults of people. This new direction of thinking encourages the progressive manager to think in terms of how the management system influences human behaviour rather than just on the unsafe acts of the people"(Bird & Germain, 1989, p.26).

While one of the groups of contributing factors to any incident is unsafe acts or human errors, Bignell & Fortune (1984) further argue that any safety system is itself designed and maintained by humans and therefore that school of thought seeks to ascribe the cause of all failures to human errors.

4.3.2 Reason's Model of Human Elements of Accident Causation

In a similar sequence to the ICLI model, Reason (1990) presents a model of the human elements of accident causation shown in Figure 10. The level of decision maker at each stage of accident causation is shown in Figure 11. He differentiates between two types of human failure. Those human failures due to people at the production level of the organisation and which have an immediate impact on the system, resulting in an accident, he terms "active failures". Another type of human failure is developed by those at higher levels of management that he describes as being at the "blunt end" of the system (Reason, 1990). These people put in place the whole organisational safety system, set rules and policies, establish equipment purchasing systems, inspection systems etc. Errors made at this level can lie dormant for some time before their presence is felt and they combine with other factors to produce an accident. Reason (1990) classifies these type of errors as "latent failures".

Both the ILCI model and Reason's model point to the importance of failures in the systems set up by top level management as root causes of incidents. However Reason (1990) believes that it would be naïve to consider that a failure at line management level is purely a function of higher-level decision-making.

> "The native incompetence of any set of line managers could further exacerbate the adverse effects of high-level decisions or even cause good decisions to have bad effects. Conversely, competence at the line management level could do something to mitigate the unsafe effects of fallible decisions, make neutral decisions have safer consequences and transform good decisions into even better ones" (Reason, 1990, p.205).

It seems then that line managers are critical to the safety performance of any organisation. Who are line management in an outdoor education setting? Petersen shows diagrammatically how the hierarchy works in an "Organisational Hierarchy" and in a "Quality Control Hierarchy" (Figure 12).

Figure 10. The various human contributions to the breakdown of complex systems (Reason 1990, p.202)

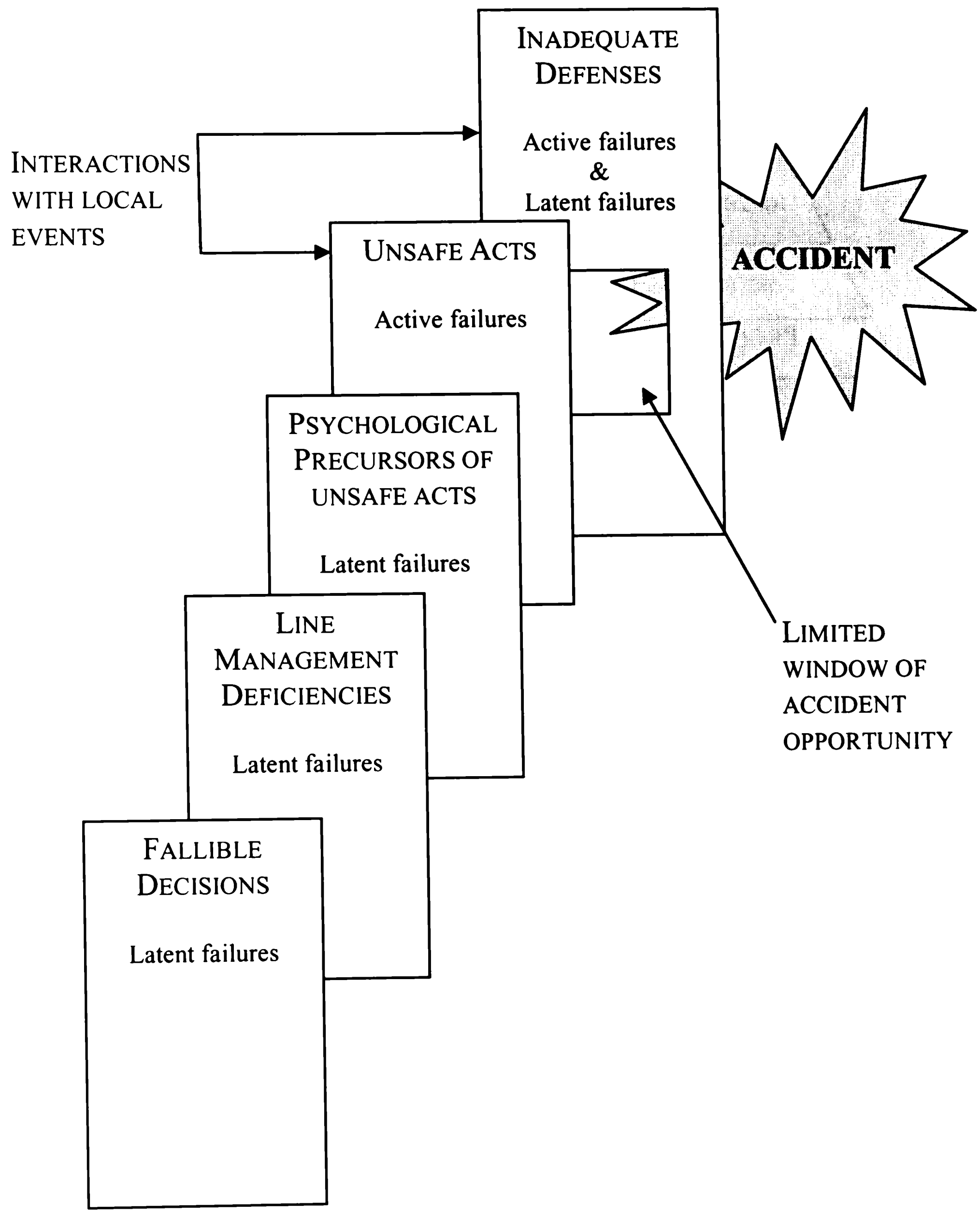


Figure 11. The basic elements of production (Reason 1990, p.200)

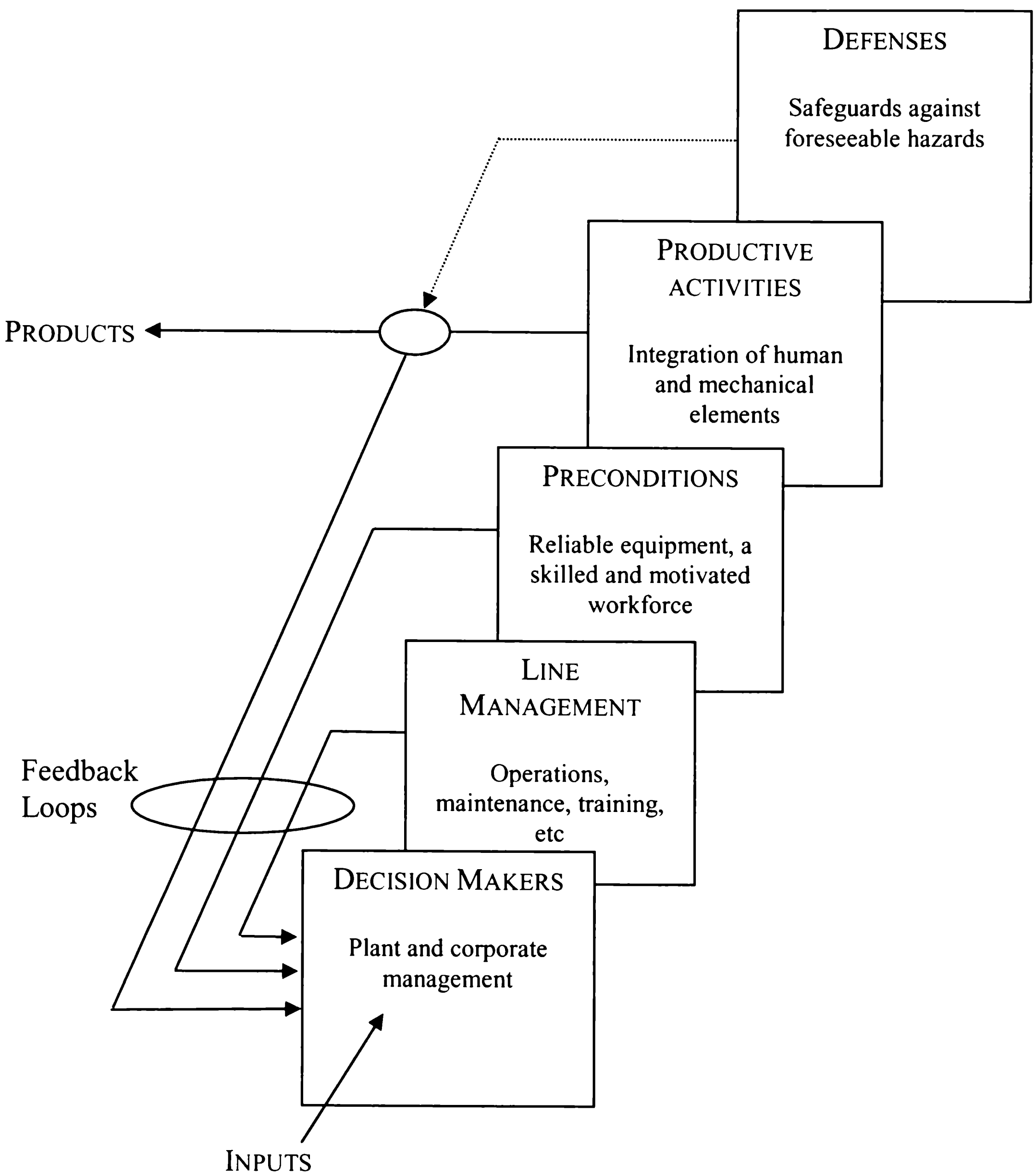
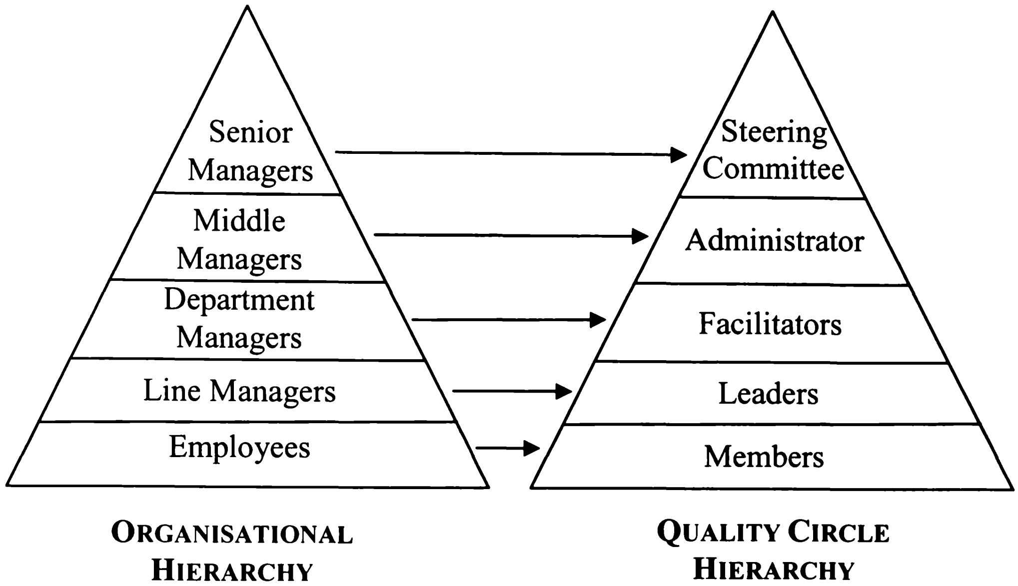


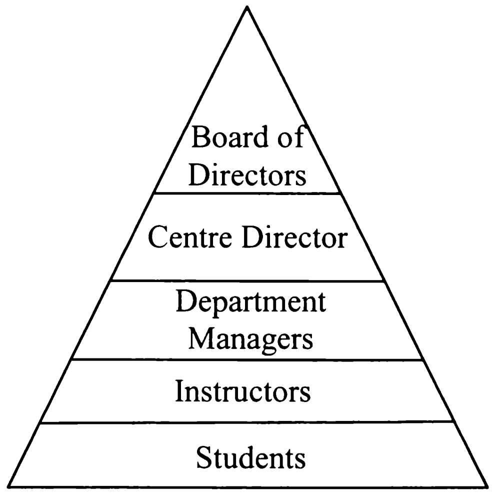
Figure 12. Comparison of organisational heirarchy and quality control heirarchy (Petersen, 1988, p.162)



It is my belief that in an outdoor education setting the hierarchy for a typical organisation would correspond to that shown in Figure 13. This proposed hierarchy shows that "Instructors" in outdoor education operations are the equivalent of "Line Managers" in a standard "Organisational Hierarchy", or "Leaders" in a "Quality Circle" context. This can be justified on the basis that they have the same level of supervisory responsibility and competency requirements in supervising students as a "Line Manager" has managing the safety efforts of a number of employees. Just as line managers in a conventional manufacturing setting supervise employees in hazardous environments, instructors supervise students in similarly hazardous situations involving equipment use and the vagaries of outdoor environments.

Accepting that instructors have a management role, in a truly participative organisation they will be involved in establishing the safety system for the organisation As Reason (1990) has commented above, line managers are critical in implementing the safety efforts of an organisation, and their competence or incompetence can be the difference between safety and disaster. This critical role has been recognised by outdoor educationalists as shown in Figure 14.

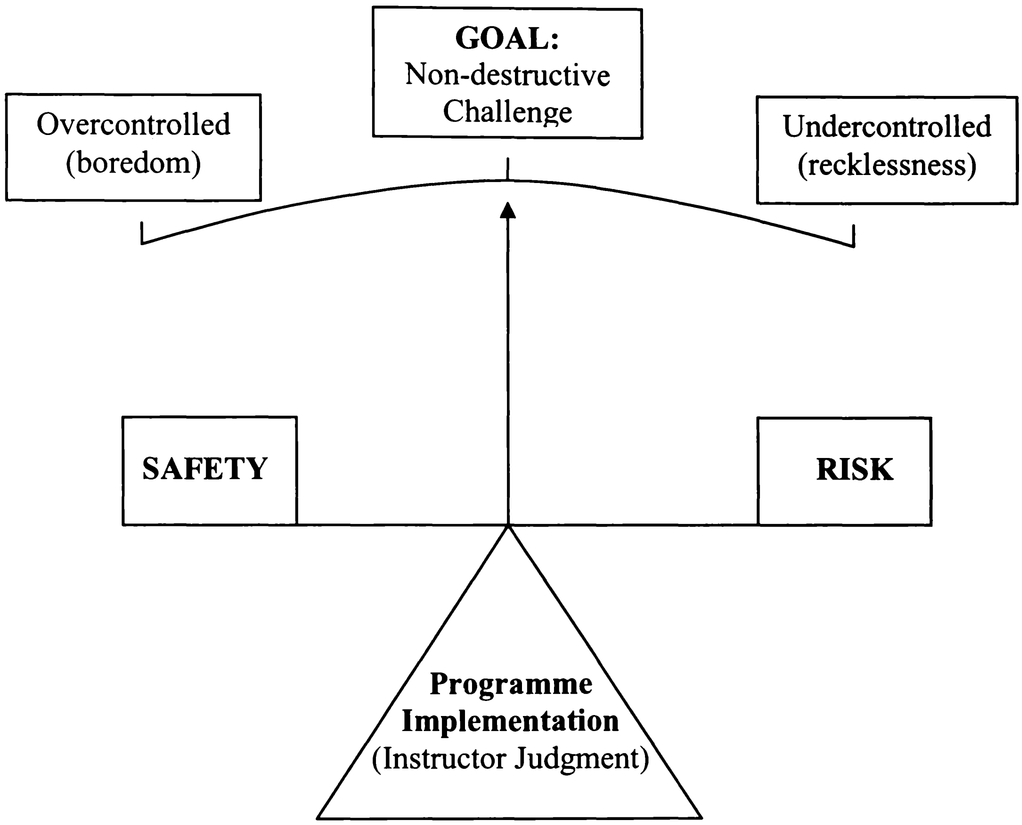
Figure 13. Proposed outdoor education organisation hierarchy



OUTDOOR EDUCATION ORGANISATION HIERARCHY

In Reason's model of the basic elements of production (Figure 11) instructors have the dual role of line management (supervising their students) and productive activities (supervision in a hazardous environment). Thus instructors are prone to both latent and active failures as a result of problems existing in the basic elements of production. In Figure 11 these problems can relate to the latent errors resulting in a lack of reliable equipment, lack of a skilled and motivated staff, inadequate operations systems, inadequate maintenance systems, inadequate training systems, etc. Figure 11 also shows that the problems can equally relate to the integration of human and mechanical elements (instructors in a hazardous environment) leading to active failures. This dual definition of an instructor's role in an outdoor education organisation indicates that to help prevent incidents in an outdoor education setting requires a two-fold approach: it is necessary to ensure that all of the necessary management controls are in place; and, it is equally necessary to identify and assess the psychological precursors leading to active failures of instructors. This leads to the identification of two forms of latent failure in the outdoor education context: the first being errors in the quality management systems; and the second being the underlying precursors of active failures of instructors. These two forms can be termed latent failure (systems) and latent failure (instructor).

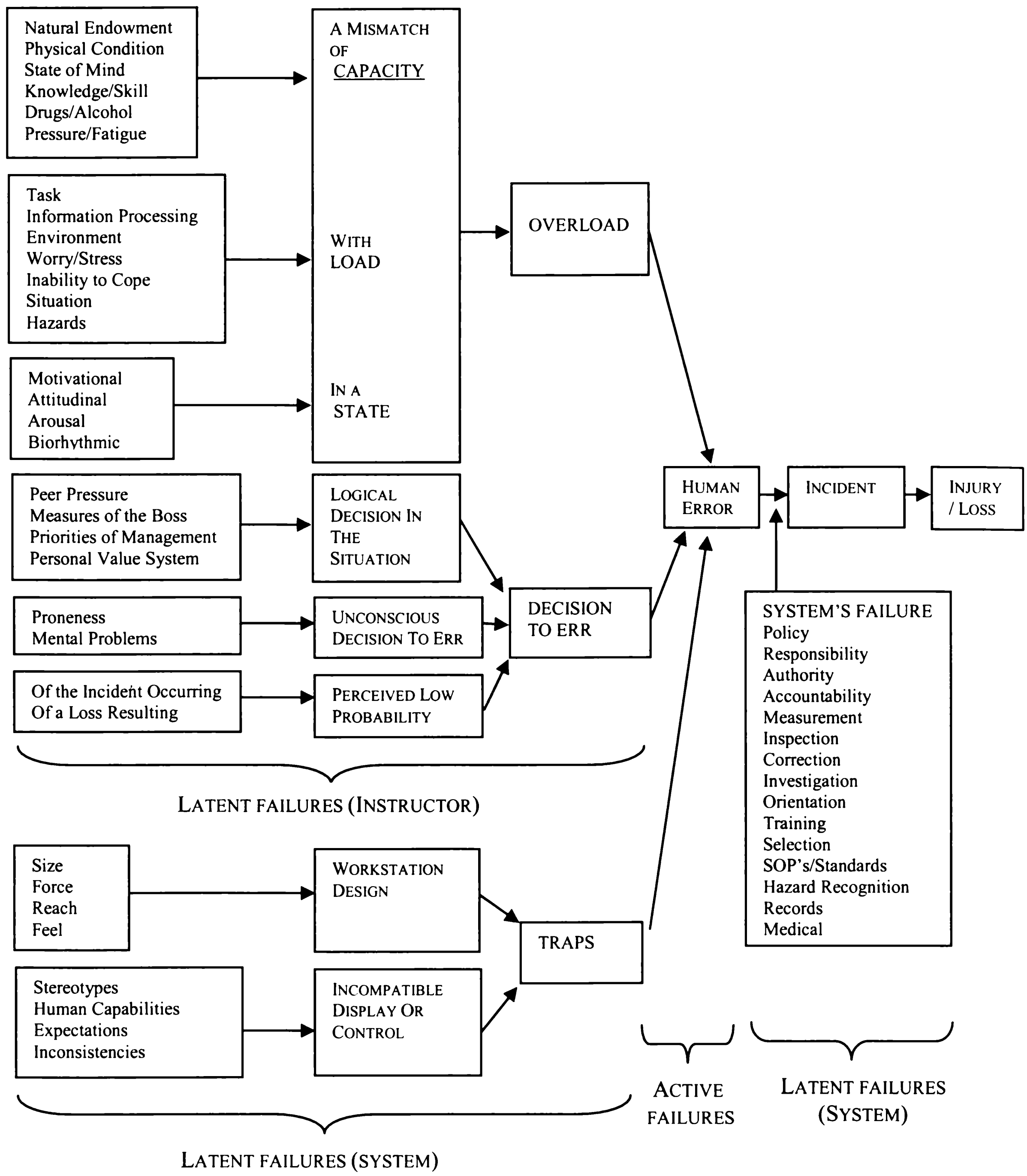
Figure 14. The risk versus safety meter for adventure programmes (Davidson, 1992, p.6)



4.3.3 Petersen's Causation Model

Petersen (1988) described "The Causation Model" (Figure 15) which showed how factors are linked to cause an incident. This diagram helps to show the difference between Reason's active and latent failures.

Figure 15. The causation model (Petersen, 1988, p. 14)
(Note: Bracketed items showing latent and active failures have been added by Davidson)



The Causation Model suggests that incidents are all due to human error. The human errors are a result of one or more of the following pre-conditions: 'overload', 'decision to err' and 'traps'. These human errors are equivalent to Reason's active failures and the conditions leading to the error are equivalent to latent failures (instructor). The model also suggests that for an incident to occur something would have had to go wrong with the organisation's safety system in order for it not to pick up the error before it resulted in the incident. Higher levels of management should have a comprehensive set of systems in place to not only ensure that the staff members are prevented from being overloaded, making bad decisions or being trapped, but also inspecting performance to help ensure good judgments are being made. Any failure of these systems which lead to an incident occurring would also be deemed a latent failure (system) by Reason.

4.3.4 Types and Tokens of Error

Reason and Petersen are not the only experts in safety management to look more deeply at the active failures of front line managers. Hollnagel (1991) has used the metaphor and language of genetic traits to describe human error. An example, using Holnagel's metaphor would be to consider the colour of a flower. The colour is produced by a hidden genetic code. The outward appearance or colour is known by biologists as the phenotype of that trait and is easy to observe, whereas the hidden genetic code which has created the colour is the genotype. The genotype can have several different forms to produce the same phenotype or outward appearance. Discovering the exact form of the genotype is much more difficult. Hollnagel's contention is that many safety experts have been focussing on the phenotype, which reflects the superficial characteristics of incidents, whereas real change can only be brought about by looking at the underlying genotype of the human error. Hollnagel's phenotype can be thought of as a synonym for the immediate causes (substandard acts and conditions), with the genotypes being the root causes: basic causes (personal and job factors), and lack of management control (inadequate programme, standards and compliance to standards) (Refer Figure 9).

As discussed earlier, it is certainly simpler to identify the immediate causes and attempt to prevent incidents at this point. Hollnagel (1991) for example chose only to concentrate on the phenotype of errors, creating an action classification system – a taxonomy of active errors. The trouble with this approach is that it is a behaviourist classification. This classification system, based on exhibited behaviours, is superficial and provides no aid in understanding the underlying mechanisms of the error. Since it provides only superficial information, it cannot be used for correction and improvement (Busse, 1998). Rasmussen (1987) observes that if an analysis is based on the external manifestation of the human error (active failures) a classification system will quickly become large and unwieldy, hindered by what he terms a 'combinatorial explosion'.

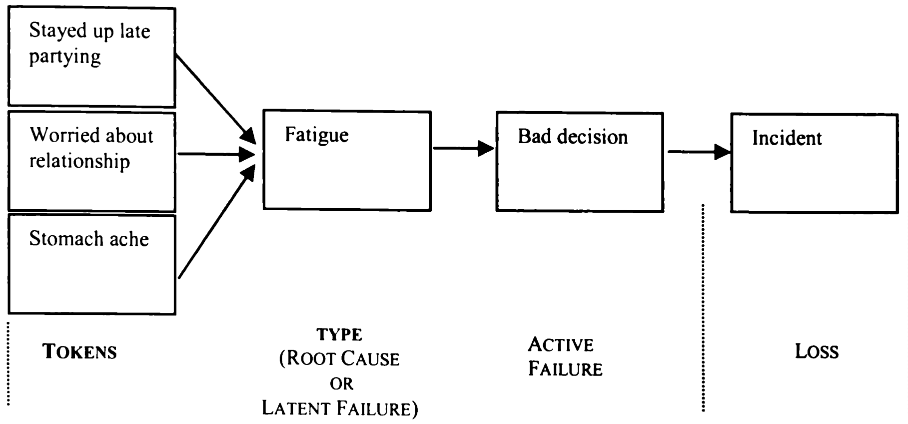
Busse (1998) concluded that what is required is a conceptual categorisation scheme that seeks to identify causal mechanisms underlying human error – in other words taxonomies of the root causes of error. From the discussion above it can be seen that Reason's (1990) latent errors, and Hollnagel's (1991) genotypes, are synonyms for root causes (Refer Figure 17).

However, even categorising root causes may be a trap. Rasmussen (1990) warns of the danger of overspecificity and signals that we should be considering categories of root causes and not extensive lists of individual cases.

Rasmussen (1990) believes that in identifying objective definitions of incident causes, that regularity in terms of causal relations is found between kinds of events which he terms "types" not between particular, individually defined events (which he calls "tokens"). This is because in complex socio-technical systems, each path is a particular token shaped by higher order relational structures. Therefore if changes are introduced to remove the conditions of a particular link in the chain, odds are that this particular situation will never occur again. The concept that the emphasis should be placed on eliminating types, not individual tokens is echoed by others (Reason, 1990; Reason & Wagenaar, 1990).

Figure 16 shows an example of a causal sequence leading to an incident to show the difference between tokens and types.

Figure 16. Example of a causal sequence to show the difference between tokens and types



Rasmussen (1990) argues that it is pointless identifying the individual tokens. Instead we should be identifying the classes of these tokens, the types, as the classes are applicable to any situation and so can fit into a global model. Furthermore, he argues that each type (category of root cause) should be represented by a clear exemplar of that 'type' to aid understanding in a particular context.

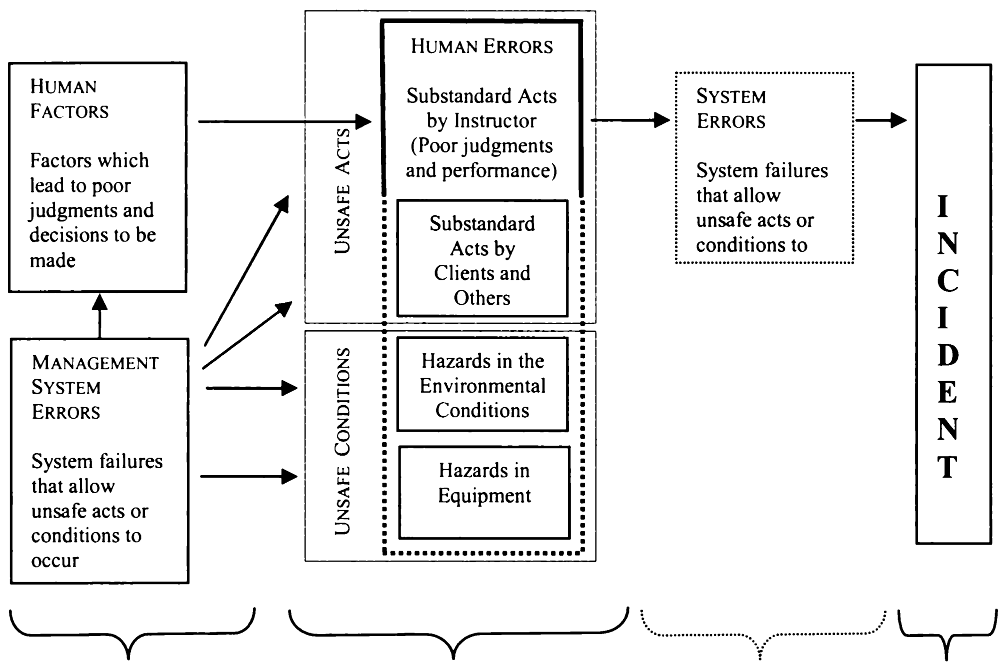
> "The behaviour of the complex, real world is a continuous, dynamic flow, which can only be explained in causal terms after its decomposition into discrete events. The concept of a causal interaction of events and objects depends on a categorisation of human observations and experiences. Perception of occurrences as events in causal connection does not depend on categories that are defined by lists of objective attributes, but on categories that are identified by examples, prototypes (as defined by Rosch (1975)" (Rasmussen, 1990, p.451).

Rasmussen is calling for exemplars of each type so that they can be easily understood by people using taxonomies of error produced for different industries. Rosch's 'prototypes' are therefore practical examples of tokens.

4.3.5 Interim Model of an Outdoor Education Incident

Based on the discussion above, the model shown in Figure 17 is proposed to depict a causal sequence in an outdoor education incident.

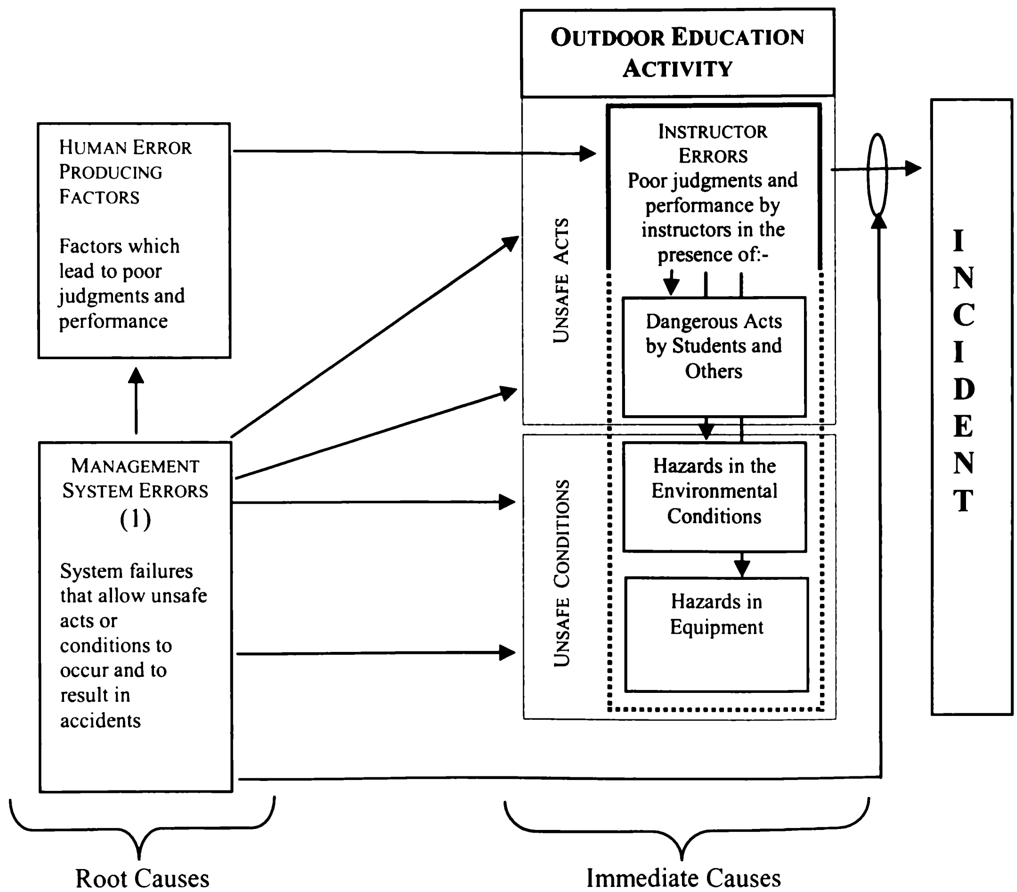
Figure 17. Interim model of an outdoor education incident



Genotypes (Invisible to observer)	Phenotypes (Visible to observer)	Genotypes (Invisible to observer)	
Hollnagel's (1991) Classification of Errors			
Root Causes (Lack of Control + Basic Causes)	Immediate Causes	Root Causes (Lack of Control)	Accident (Incident + Loss)
Based on the ICLI Loss Control Model, Bird & Germain, 1989) and the work of Petersen			
Latent Failures (Instructor + System)	Active Failures	Latent Failures (System)	
Based on Reason (1990)			

This model argues that an incident is the direct consequence of a human error(s) of an instructor. The instructor may be in a situation where they are managing an activity that has hazards in the environment, hazards due to equipment, and even unsafe behaviour by clients or other people in the vicinity; however it is the instructor's role to manage these various hazards. The various hazards (unsafe acts and conditions) would be obvious to a trained observer and might appear to be the actual cause of any final incident and possible loss, however there are hidden reasons for these hazards being present and the human error(s) being made. These hidden reasons are the human factors that lead to poor judgments and substandard performances, and weaknesses in the management systems of the organisation. Putting this model into the language of outdoor education produces Figure 18.

Figure 18. Factors required to produce an outdoor education incident



Note that Management System Errors can impact in two ways at different stages in the causal chain: 1) They can allow the outdoor education group to be exposed to the hazards of unsafe acts and conditions in the first place; and 2) They can fail to pick up and correct a human error made by the instructor therefore resulting in an incident. These hidden reasons are the root causes of the incident. The types and tokens of these root causes are not shown in this diagram but would fit as categories and subcategories within the boxes shown as 'human factors' and 'management system errors'.

This model of an outdoor incident is potentially positive and empowering to those in the outdoor education sector. In the aftermath of any incident, it is a natural tendency to look for blame in the instructor in charge of the outdoor education activity at the time. This model suggests the effort needs to be placed at identifying the root causes in the management systems and other error producing factors that can be changed to reduce chances of a future occurrence.

It remains to validate this model and to identify the root causes.

4.3.6 Summary

There are many existing models of incident causality in the literature of safety management. These models all have the common elements of:

- multiple causality: where an incident is rarely due to one thing but usually due to a number of factors coming together and combining to produce an incident potential;
- levels of causality: where the causes of an incident can be traced back from more easily observable factors to the underlying root causes of error. It is argued that addressing these root causes will lead to more precise and effective management of incidents which will reduce incident potential.

There is a potential trap to identifying the root causes of incidents in that it is easy to be overspecific resulting in a very large list which is confusing and of little practical use. It is therefore much more sensible to try to identify categories of root causes rather than individual manifestations. Thus, it is necessary to focus on 'types' or general categories of root causes, rather than on their multitudinous manifestations or 'tokens'.

It has been demonstrated (Figure 18) that existing models of incident analysis can be adapted to provide a model useful in understanding outdoor education incidents. This analysis suggests that the root causes of any incident fall under the headings of either human error leading to poor judgment or performance by instructors, or errors in the management system within which the instructor is operating. The following sections attempt to identify root causes within these two categories.

4.4 Identifying the Root Causes of Incidents from the Literature of Industrial Safety Management and Psychology

This section seeks to find root causes in the two classes shown in Figure 18: (1) human error producing factors that increase the likelihood of people performing poorly or making judgment errors; and (2) potential deficiencies in the management system of the organisation. The search attempts to find general types of root causes that can be applied across the outdoor education sector.

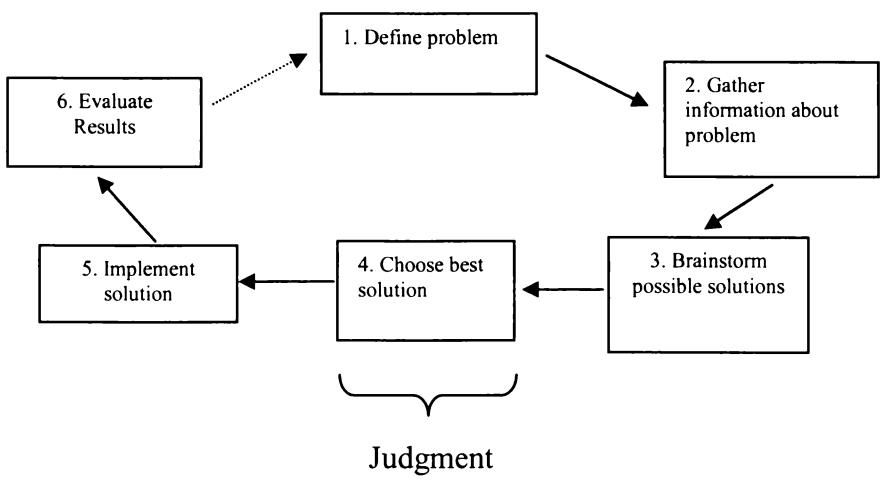
4.4.1 Theories of Judgment and Decision-Making

My assumption is that instructors working with groups of students will be doing their very best to resolve any situation to minimise loss. In other words, they will want to make good judgments in order to preserve the safety of their groups. Based on this premise, it seems reasonable to conclude that even when an incident occurred, the instructor in charge made the best judgments possible given that person's skills, abilities, experience and knowledge at the time. When viewed with the considerable advantages of hindsight and objectivity, experts may consider that a judgment(s) made at the time that led to the incident, was less than optimal. This section looks at what knowledge can be gleaned from the literature that might have led to that less than optimal judgment being made.

Initially it is important to establish the relationship between the terms judgment, problem-solving and decision-making. Although at one level decision-making and problem-solving can be distinguished in that the former places the emphasis on the output of the process (the decision), while the latter places the emphasis on the input (defining the problem), such a distinction serves little use in the analysis of outdoor incidents where the interest lies in errors in judgment. For the purposes of this study, the two terms will be considered as synonymous and only 'decision-making' will be used hereafter. For many people judgment and decision-making are also identical but an important distinction can be made between the two in that judgment is viewed as the 'choice' phase of the decision-making process (Carroll & Johnson, 1990) and this choice is seen by observers as the output of this process.

The role of judgment within the greater decision-making process is seen in the generic model of decision-making (Figure 19). In this model, the role of judgment is clarified by the definition of decision-making by Carroll and Johnson (1990, p.19) as, "... a process by which a person, group, or organisation identifies a *choice or judgment* to be made, gathers and evaluates information about alternatives, and selects from among alternatives." (my italics.)

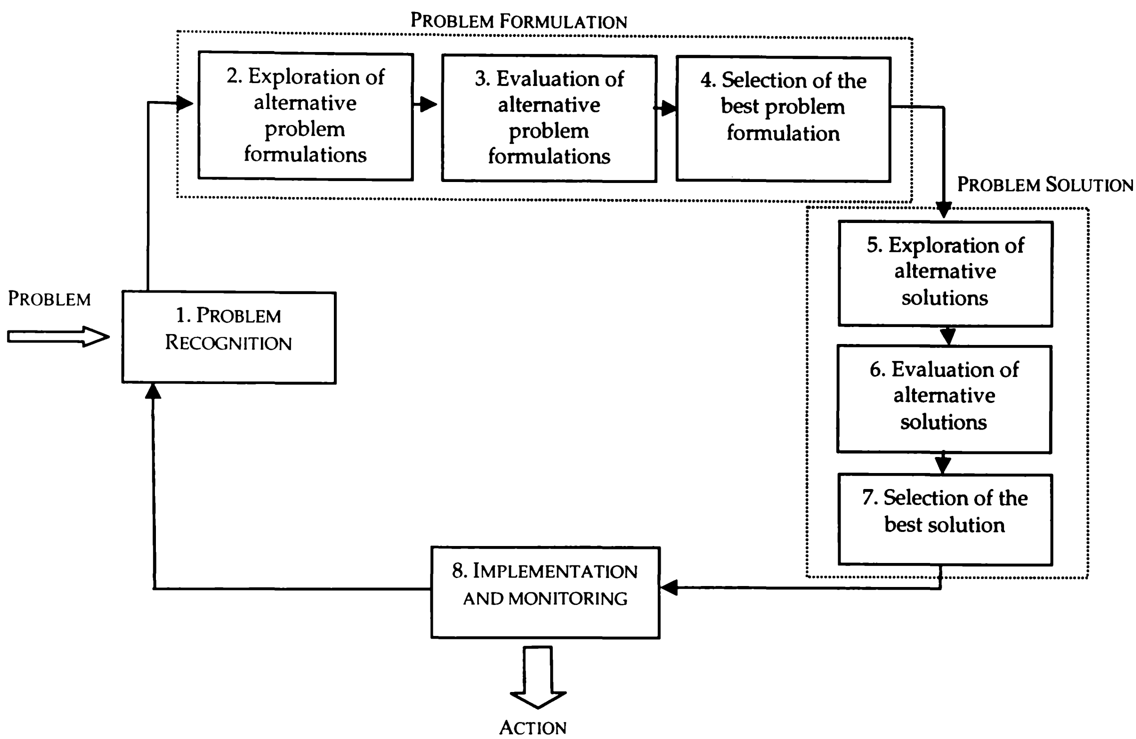
Figure 19. A generic decision-making model (Waters, 1996, p.5)



It might be argued that other steps in the decision-making model of Figure 19 involve judgment as well. For example step 1, 'defining the problem', and step 2, 'gathering information', could both be argued to require choice and therefore judgment. My argument is that these are both decision-making issues in their own right. This position is supported by writers such as Vari and Vecsenyi (1989) who suggest two mini-decision-making stages within their larger decision-making model (Figure 20).

Thus decision-making is the entire process of the identification of the problem, gathering information about the problem and possible solutions to the problem. Judgment is the process of choosing among possible solutions. The output of the decision-making process is seen to be the judgment that is implemented.

Figure 20. Phases of the decision-making process (Vari & Vecsenyi, 1989, p.220)



The literature on judgment and decision-making presents two divergent approaches to decision-making. namely the traditional or classical, and the naturalistic approaches (Azar,1999). The former was based on research and experiments in the 1970s that:

> "...were rooted in elegant but restricted mathematical concepts and models, such as expected utility maximisation of gambling choices, random utility models of pairwise preferential choice, and Bayes' theorem for the revision of probabilities in the light of new information" (Rohrman, Beach, Vlek & Watson, 1989, p.3).

These investigations based on rational, logical and orderly thought enabled the research community to draft the theories of human suboptimality, bounded rationality and heuristic strategies for judgment and decision-making in experimenter-defined situations. Later, the concept of maximised utility as a motive for decision-making was extended by introducing social forms of internalised positive utility such as egoistic incentives, self-esteem and altruism (Dawes, Van de Kragt & Orbell, 1989).

From the late 1970s onwards,

> "...a sense of unease over popular and productive paradigms began to manifest itself. This grew stronger as more and more researchers began paying attention to real problems such as principal decisions in everyday life, managerial decisions in large organisations, or strategic decisions concerning technological developments..." (Rohrman et al., 1989, p.4).

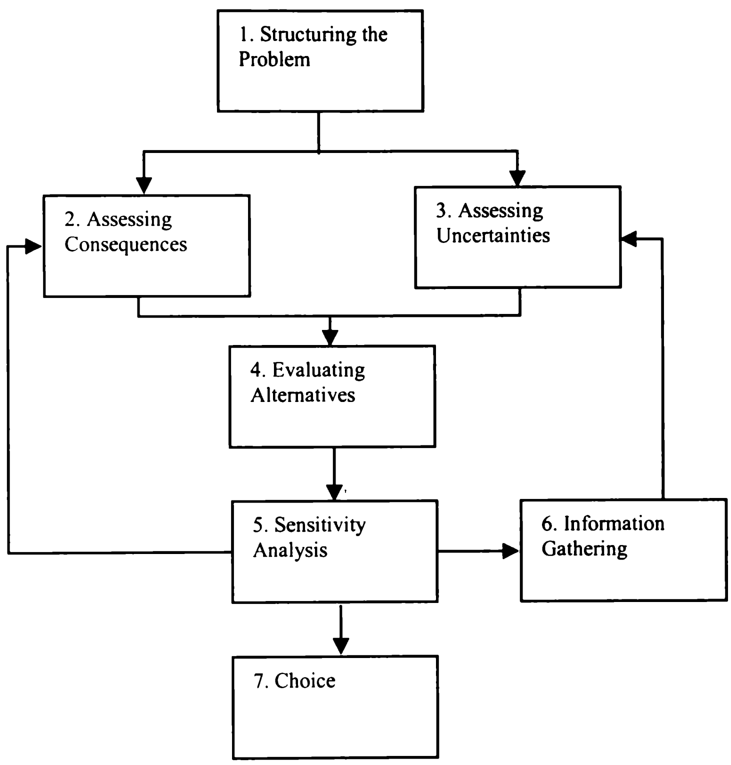
This unease spawned work by researchers such as Tversky and Kahneman (1981) with their "prospect theory", Montgomery (1983) with "dominance search theory", and the development of naturalistic decision-making theories by a great number of researchers.

The following sections elaborate on these major theoretical approaches to decision-making in order to find common threads that merit investigation to establish the root causes of sub-optimal judgments made in outdoor education contexts.

4.4.1.1 The Traditionalist Approach to Decision-Making.

An example of a traditionalist approach to decision-making is the framework of "Decision Analysis" as originally espoused by Brown, Kahr & Petersen (1974) among others. A simplified flow-chart of the Decision Analysis approach is shown in Figure 21 (Hogarth, 1980). Decision Analysis is a tool which aims to provide explicit quantitative representation of a problem and the expected benefits of different courses of action. This theory prescribes choosing the alternative which has the greatest expected utility (expressed numerically wherever possible). Hogarth (1980) defines two types of judgment: value judgments in which people express preferences of one thing over another; and predictive judgments in which people make predictions which reflect what they expect to happen. He then goes on to say that, "...choice reflects both evaluative and predictive judgments. The quality of choice depends upon the extent to which (1) evaluative judgments really translate as true preferences, and (2) predictive judgments are accurate" (Hogarth, 1980, p.3). Evaluating alternatives, therefore, becomes a combined process of assessing consequences (i.e. evaluative judgments) and assessing uncertainties (predictive judgments). It is crucial that one does not influence the other otherwise it is likely to result in the "pitfall of wishful thinking" (Hogarth, 1980, p.135).

Figure 21. Simplified flow-chart of the Decision Analysis approach (Hogarth, 1980, p.131



Note that step 5, sensitivity analysis (Figure 21), is a step to check what degree of variation in the inputs of assessed consequences and uncertainties would change the alternative(s) chosen in step 4. This is based on the maxim that whatever data are used to model a situation, they must be wrong, because many of the inputs are subjective. However, if it can be shown that the choice between alternatives is relatively insensitive to a range of such inputs, this can show how wrong the estimations can be before a different decision would be required.

In summary, a traditionalist would see decision-making as a combination of evaluative and predictive judgments, the final judgment being made according to which option affords the greatest utility for the person making the judgment. It should be noted that Decision Analysis is a technique which attempts to quantify utility and therefore minimise intuitive judgment. However, in outdoor education settings this approach is not often appropriate as time is often a factor and in such contexts assessed consequences and uncertainties are less amenable to quantification.

The traditionalist decision-making approach shows that in order to reach a judgment (choice), requires the initial stages of gathering information (to define the problem and generate possible solutions) and then assessing the identified solutions. Following the judgment, the solution chosen is implemented and the results evaluated for use in further situations.

4.4.1.2 The Naturalistic Decision-Making Approach.

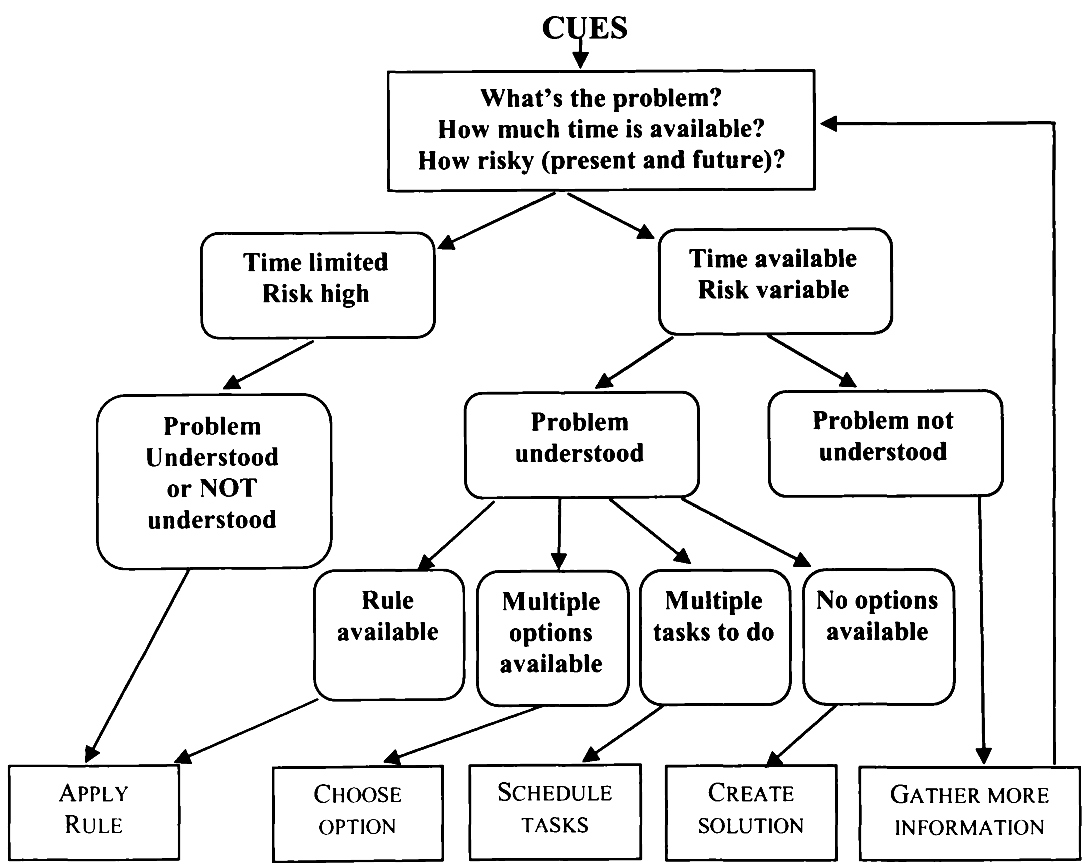
Johnson-Laird and Shafir (1994) discussed the conflict between normative theories of reasoning and decision-making and the real-life, descriptive experiences that were being reported about how humans actually operated. They summed it up by maintaining that:

> "People are not intuitive logicians, intuitive statisticians, or intuitive rational decision theorists. Instead, the precise character of their thoughts and decisions is the outcome of complex and unobservable mental processes, the nature of which researchers in both these areas of inquiry are trying to elucidate" (Johnson-Laird and Shafir, 1994, p.5-6).

From this observation rose the study of naturalistic decision-making (NDM) which confronts the issue of how experienced people, working as individuals or groups in dynamic, uncertain, and often fast paced environments, identify and assess their situation, make decisions and take actions whose consequences are meaningful to them and to the larger organisation in which they operate (Zsambok, 1997). This form of decision-making seems much more descriptive of outdoor instructors in action.

Klein and Woods (1993) indicated that the most important finding of NDM is that; "people are able to use their experience to adopt successful courses of action even without applying rigorous analytical strategies" (p.404). This idea was further developed by Orasnu, Fischer and Tarrel (1993) from research into pilots' decision-making in flight from which they derived a decision process model that showed the range of decision-making options available dependent on time and experience (Figure 22).

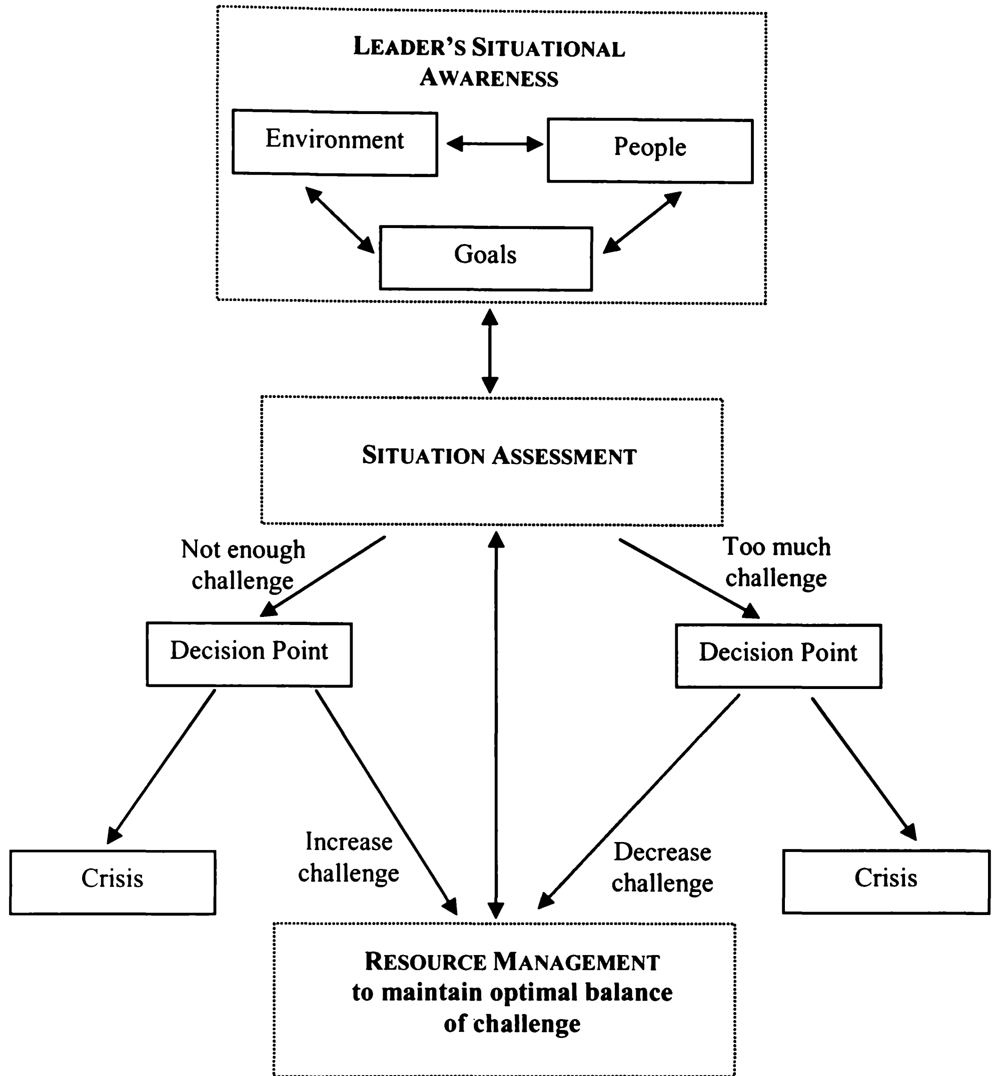
Figure 22. Decision process model (Orasanu & Fischer, 1997, p.352).



A most interesting finding (Figure 22) is that if the risk is high and time is limited, pilots do not spend large amounts of time creating and considering various options based on quantitative measures of utility, but rather, they immediately adopt a rule-based solution whether they understand the problem or not. A rule-based decision is explained by Boyes (2000) to be one where the key factor is situation recognition, because once a situation is recognised, the response is relatively automatic. The quality of the decision in this case is dependent on the experience level of the pilot and the adequacy of the match between the characteristics of the situation and the rule-based solution that is implemented. This focus on situational awareness and then assessment is crucial in understanding how proficient decision-makers call up suitable solutions to problems from past experiences (Endsley 1995, 1997; Klein, 1989).

Boyes (2000) adapted the NDM work to construct a model of how instructors in charge of outdoor adventure activities made decisions. His decision-making model is based around an outdoor leader's situational awareness and an attempt to provide an appropriate level of challenge for participants (Figure 23). He designed a research study to investigate whether his proposed model could be supported through empirical data. The study involved having outdoor leaders making decisions based on a range of simulated outdoor case studies. The results of this led support to the validity of the NDM based model in an outdoor educational setting.

Figure 23. Framework model of outdoor adventure decision-making (Boyes, 2000, p.53)



The NDM models of decision-making rely on judgments being made by those involved often having little time in which to make the decisions, and having to make the decisions in environments that may be hostile. In this case, the judgments may not involve the careful analysis of quantised measures of utility, as is proposed by traditional models of decision-making. Rather, because of time pressures, decision-making may involve the implementation of previously used solutions based on the recognition of similarities in the situations. NDM methods still involve the stages of information gathering (situational awareness) and assessment of that information (situational assessment) before a judgment is made – no matter how quickly. Once the judgment is made, the chosen solution is implemented and the person involved receives feedback on how well that solution works at resolving the problem that has been identified. The decision-making process in this naturalistic model is therefore viewed as essentially iterative, emergent and reactive.

4.4.1.3 A Conceptual Model of Judgment

Many models and theories of the judgment process exist. Hogarth (1980) presents a conceptual model of judgment (Figure 24) that contains the generic elements of many other models. Hogarth's model shows that judgment occurs in a so-called task environment (box 1). Within the task environment is what is called the person's schema (box 2). The schema symbolises the person's beliefs concerning the task environment and his / her representation of it; i.e. how he / she perceives the judgmental task. The schema is created both by the person's memory and the characteristics of the judgmental task.

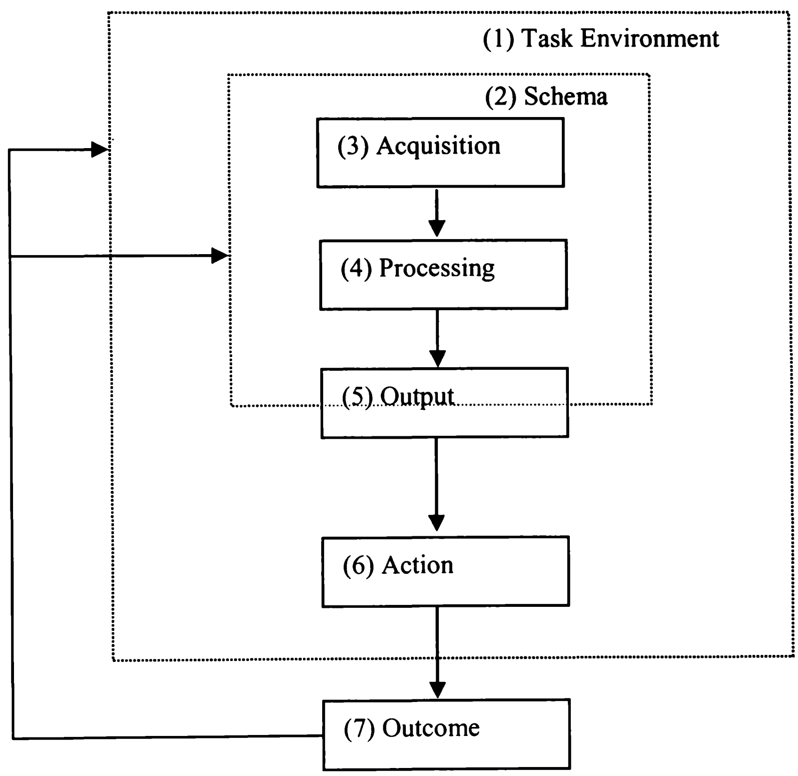
In this model the judgment of the person is seen in the external (task environment) world to be the output (box 5). The judgment itself is the result of information being acquired, processed and then output (boxes 3, 4 and 5). At this stage a decision has been made as to the best option or options available and then an action is taken. The output (judgment) is internal to the person, but may be verbalised – which is why the output box is shown spanning the schema and task environment fields. The external expression of this is the action. To the observers there is often no apparent difference between the output and the action.

The model in Figure 24 demonstrates where bias can enter the judgment process and therefore cause the final judgment to be of lower quality.

> "Bias in judgment can be thought of as intervening at the different stages of information processing outlined above. First, the acquisition of information from both the environment and memory can be biased. The crucial issue here is how certain information does or does not become

salient. Second, the manner in which information is processed can be biased; for example, if the individual simplifies the judgmental situation by using an inappropriate mental strategy. Third, the manner in which the person is required to respond can induce bias... Finally ... outcomes of judgment can induce bias in both (1) interpretation of their significance (for example, is the outcome attributable to one's action or simply a chance fluctuation?), and (2) learning relationships for predictive ability" (Hogarth, 1980 p.158).

Figure 24. Conceptual model of judgment task environment. (Hogarth, 1980 p.157)



4.4.1.4 Summary

This section has briefly looked at two theories of decision-making (traditional and NDM approaches) and a theory of judgment. The key point of this investigation is that common elements have been revealed. Despite differences in terminology and the contexts in which the various models are purported to work; simple or complex task environments, the static or dynamic nature of the environment in which decision-makers find themselves, and whether time pressures are involved, all decision-makers still have to:

- Gather data about the situation;
- Assess these data;
- Choose an appropriate solution to the problem from a range of options and implement it; and
- Reflect on the consequences of that decision (even if this reflection is sometime after the fact).

These four stages in the judgment process indicate places where bias (human errors) can enter that process and lead to less than optimal judgments being made. The following section will look at ways that bias can enter each of these stages of the judgment task. These sources of bias can be considered the root causes leading to errors in judgment. For simplicity, the four stages investigated will be named:

- Acquisition of Information (situational awareness)
- Processing of Information (situational assessment)
- Output
- Feedback

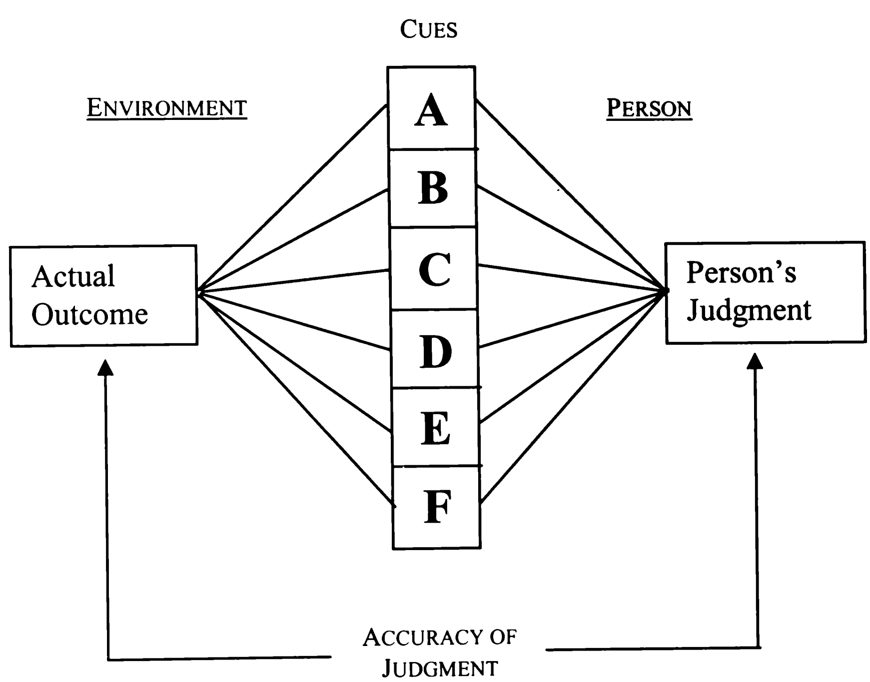
4.4.2 Sources of Bias in the Judgment Process.

In trying to identify the root causes of errors in judgment, the approach I am going to use is to look for sources of bias in the stages of the judgment process identified in the previous section. The following is a list of bias sources summarised by Hogarth (1980) that I have augmented with information from other sources.

4.4.2.1 Sources of Bias in the Acquisition of Information (Situational Awareness)

The issue of bias in information acquisition is about when and why information becomes salient to an individual (Hogarth, 1980). Brunswik (1955) proposes a lens model for judgment shown in Figure 25. Although Brunswik's model is close to 50 years old, it is still firmly embraced in recent literature on judgment in social contexts (e.g., Cookrey, 1996; Slovic & Lichtenstein, 1971; Stewart, 1988). In the Brunswik model a person makes judgments based on 'cues'. The judgment will be accurate to the extent that the individual's picture of reality and judgmental rules match what exists. Brunswik stresses that judgment takes place in a probabilistic environment and so the relationships between cues in the environment and the target outcome can't be represented by strict functional rules but rather by probabilistic rules (Hogarth, 1980). The cues can come from both the individual's memory and the task environment. Thus the salience of information can be a function of both memory and features of the task environment.

Figure 25. Brunswik's Lens Model (Hogarth, 1980, p.8).



One other important concept of searching for cues, is that people attach meaning or emotions to events and concepts. Such meaning can even guide the search process in the first place (Hogarth, 1980). These attachments of personal meanings are the equivalent of the 'schema' in Figure 24.

As the NDM model has shown, good judgment is reliant on people identifying appropriate cues on which to base decisions, especially in time-dependent situations. Bias can therefore enter the judgment process because of the mechanisms by which cues become salient to individuals. These biases include:

4.4.2.1.(a) Availability

The ease with which information can be recalled from memory is a clue people use to predict the frequency of an event. Thus for example, events that are well publicised such as death by lightning strike or in an air crash make people believe these are more common than they actually are.

Tversky and Kahneman (1973) argued that if you can think of or see several instances of one kind of event as opposed to another, you can be led to believe that the former is more frequent than the latter. Therefore if our environment somehow emphasises certain aspects, our judgment will be biased by the ease with which we recall instances and thus estimate their frequency. While this is often a valid rule for prediction (i.e. events which occur frequently will usually occur frequently in the future), research (Estes, 1976) indicated that people often base estimates of proportions on the basis of their experience of absolute as opposed to relative frequencies. Or, to put it another way:

> "If there were a thousand similar events, we would tend to remember them as one composite prototype. If there were just one discrepant event, we would remember it too, for by being discrepant it didn't get smudged up with the rest. But the resulting memory is almost as if there had only been two events: the common one and the discrepant one. The common one is a thousand times more likely, but not to the memory; in memory there are two things, and the discrepant event hardly seems less likely than the everyday one" (Norman, 1988, p.118).

4.4.2.1.(b) Selective Perception

Perception of information is not comprehensive but selective. Because we don't have the ability to perceive all the information our senses are receiving we have to select; however to select it is necessary to know what to select. Anticipation plays a large part in what we actually 'see'. Physical as well as motivational reasons account for why people only see what they want to see. Styles (1997) described this phenomenon as a 'mental set' where a person prepares to respond to a particular set of stimuli, ignoring others at the expense of those that are selected for attentional processing.

People structure problems on the basis of their own experience. There is also the tendency to consider one's own range of experience as normal and thus to make erroneous attributions in judging others behaviour as deviant. People seek information consistent with their own views and hypotheses. In addition people downplay or disregard conflicting evidence. This is confirmed by experiments reported by Slovic (1966).

Legrenzi, Girotto & Johnson-Laird (1994) described this effect as 'focusing'. They believe that people make mental models of how the world works. People make as few models as possible in order to minimise the load on the working memory. Once these models are created people tend to focus on information explicit in their models and fail to consider other alternatives. This is very similar to the work of Pennington and Hastie (1994), who, instead of mental models, talked of explanation-based decision-making. They believe that people create stories to explain facts around them and will choose a best-fit story for the situation and use this to make a decision. Once the best-fit story is chosen then the same aspects of selective perception apply.

> "There is a tendency to see what you expect to find; during one period, technical faults were in focus as causes of accidents, then human errors predominated, whereas in the future the focus will probably move upstream to designers and managers" (Rasmussen, 1990, p.452).

4.4.2.1.(c) Frequency

A cue used to judge the strength of predictive relationships is observed frequency rather than observed relative frequency. Information on non-occurrences of an event is often unavailable and frequently ignored when available. Sampling theory suggests that confidence in judgment should be related to the amount of information sampled. However, this was under the restriction that each item of information sampled was independent of the other. Consistency of dependent data sources is not a good criterion for determining confidence in judgment.

Oskamp (1965) carried out a study where the judgments of clinical psychologists were studied as a function of the amount of information presented to them about various cases. As the amount of information increased, so did the psychologists confidence in their judgments, however there was no corresponding increase in predictive accuracy. Humans don't necessarily discriminate whether information is redundant or not. This is also confirmed by Estes (1976) who carried out several experiments that indicate, for predictive purposes, the frequency of an event is more salient in memory than relative frequency.

4.4.2.1.(d) Concrete information (ignoring base-rate or prior information)

Concrete information or case data (i.e. based on experience / incidents) dominates abstract information (e.g., summaries, statistical base rates, etc). The general finding, albeit with exceptions, is that when people are faced with both base-rate and case data, they ignore the former and predict almost entirely with the latter. In fact probability theory argues that one should modify base-rate data by case data therefore ensuring that the ensuing judgment reflects both (e.g., weather forecast predicts rain, go outside and see blue sky, what do you do?). Evidence indicates that available base-rate data will be incorporated into judgment if they are causally linked (or make sense in relation to) specific data. Otherwise base data are ignored. Therefore whereas people give meaning to information, the laws of probability do not and this is the difference between intuitive and statistical reasoning. (For example when buying a car, advice from a neighbour who has had a positive or negative experience with a particular model is liable to weigh more heavily than more extensive data published about that model in a motoring magazine).

4.4.2.1.(e) Illusory Correlation

This is the belief that two variables co-vary when in fact they do not. Chapman & Chapman (1969) described this tendency to see relationships between variables where none exist. They believe that it is particularly disturbing that people continue to believe in these illusory correlations when it is hoped that people will learn from experience. There are two possible explanations for this. The first is that because of 'selective perception', people will selectively forget instances where their judgment was incorrect, or in other words have a bad memory for their predictive failures. Secondly, where people receive bad feedback concerning their judgments and others share the same illusions, then this illusion is reinforced. Hogarth (1980) noted that in many organisations, common beliefs are precisely of this nature.

4.4.2.1.(f) Data presentation

People are influenced by the order, type and method in which information is presented.

- Order effects (primacy / recency): sometimes the first items in a sequential presentation assume undue importance and sometimes the last items presented do. This effect is also mentioned by Kaplan (1975) who additionally noted the phenomenon of "rigidity of first impressions" (p.144) where it is difficult for people to change a judgment once one has been made.
- Mode of presentation: people find it easier to access sequential versus intact displays for example. Wason & Johnson-Laird (1972) found that information presented in negative statements was more difficult to process and understand.
- Mixture of types of information: some people prefer quantitative over qualitative data, or vice versa. This is confirmed by experiments reported by Slovic (1972).
- Logical presentations: apparently complete 'logical' data displays can blind people to critical omissions (Fischhoff, Slovic & Lichtenstein, 1978).
- Context effects on perceived variability: Assessments of variability, of say a series of numbers, is affected by the absolute size (e.g., mean level) of the numbers.

4.4.2.1.(g) Summary of biases in the acquisition of information

This section has reviewed the forms of bias that can affect the information being gathered that is used in the decision-making process. Biases that affect the information gathered will affect the quality of any judgment in this process.

From the biases identified, those that seem pertinent to the outdoor education sector, especially to judgments being made in the field, include:

- Availability – the ease with which information can be recalled.
- Selective perception – people tend to see what they are expecting to see and not see things that are not expected.
- Frequency – the number of times that something is observed can be a cue to predictive relationships.
- Illusory Correlation – the mistaken belief that relationships exist between variables.
- Concrete information – immediately available information is given more credence than other data.

The way that data were presented has also been shown to bias the relevance of the information to those being presented with it. However, this form of bias is much more relevant to the presentation of quantitative and written data, as opposed to gathering information that relates to the management of an outdoor activity in the field and therefore will not be used in a taxonomy of root causes of outdoor education incidents.

4.4.2.2 Sources of Bias in the Processing of Information (Situational Assessment)

An individual's choice of a decision / information processing rule, or, the series of mental processes that the person applies to the information that has been accessed, can bias the eventual judgment made. Bias in processing can be induced by both memory and task characteristics.

Memory bias is generally due to 'availability' of certain rules or habits as explained above. The bulk of processing biases noted in literature, however, result from either an inconsistency in applying a judgmental rule, task variables, or an unwillingness to expend mental effort.

4.4.2.2.(a) Inconsistency.

This relates to the inability to apply a consistent judgmental strategy over a repetitive set of cases. This is a major source of processing bias and several studies show that the validity of judgment is considerably attenuated by this particular fallibility (Hogarth, 1980).

4.4.2.2.(b) Conservatism

This term refers to the failure to revise opinion on receipt of new information to the correct extent (Bayes' theorem). Edwards (1968) also confirmed that people have difficulty in adjusting base-rate probabilities by specific information in cases where differential meaning is not an issue. Specifically, people in these instances have been found to be conservative information processors in that they fail to allow the specific information to adjust the base-rate sufficiently.

4.4.2.2.(c) Non-linear extrapolation / explaining away hazards

Those in the position of gathering information and making judgments are often unable to extrapolate growth processes and there is a tendency to underestimate joint probabilities of several events. Norman (1988) describes this type of bias as 'explaining away errors' (in outdoor education activities this would be the equivalent of explaining away hazards). He makes the point that mistakes in assessing the importance of information and accumulating errors can take a very long time to be discovered unless a major incident occurs. This is because the cues to an impending incident, might be noticed but are then often ignored or explained away as an anomaly. Most of the time those people making these sorts of misinterpretations are not corrected because no incident results. Norman states that when an incident does happen, explaining away the signs of the impending disaster which seemed logical to those making the decision at the time seem implausible to others reviewing the incident. Afterwards there is a tendency to read about what has taken place and to criticise. Norman uses the example of the Three Mile Island nuclear generator near meltdown. Operators at Three Mile Island made numerous errors and misdiagnoses, but each one was logical and understandable at the time but now their judgment can be seen to be erroneous. The major accident followed a series of breakdowns, yet no single step was seen to be serious. In many of these cases, the people involved noted the problem but explained it away, finding a logical explanation for the otherwise deviant observation.

4.4.2.2.(d) Heuristics used to reduce mental effort

Shanteau (1989) discussed research findings that showed that often decisions made by experts lacked both validity and reliability and furthermore that the experts were unaware of their various shortcomings.

> "One frequent explanation for this low level of performance is that experts reportedly rely on heuristics (or mental rules of thumb) in making judgments. Heuristics are necessary because of the limited cognitive processing capacity of the human brain. These heuristics often lead to biases or judgment errors relative to normative standards. Moreover, similar heuristics and biases have been reported for both novice and expert decision makers" (Shanteau, 1989, p.204).

The NDM models discussed in Section 4.4.1.2 also show how simple rules, or heuristics, are often employed by decision-makers, especially when time is at a premium, to reduce the effort and length of the decision-making process.

Some examples of heuristics are:

- Habit/rules of thumb: Choosing an alternative because it has previously been satisfactory. However there is no guarantee that because that judgment choice has worked in the past that it will work in this particular task environment.

  In fact Rasmussen (1990) argued that if individuals are constrained by an inadequate rule system in their organisation, to get rid of choice or decision-making during normal work, then they will have trouble adjusting

/ adapting to aberrations in the norm and won't be able to handle novel and unique situations.

- Anchoring and adjustment: Prediction made by anchoring on a clue or value and then adjusting to allow for the circumstances of the present case
- Representativeness: Judgments of likelihood of an event by estimating degree of similarity to the class of events of which it is supposed to be an exemplar. Kahneman & Tversky (1972) labelled the mental strategy of stereotyping by degree of similarity, 'representativeness'. Unfortunately it is only valid to the extent that data sources are not redundant or that it doesn't induce you to ignore other information.
- Law of small numbers: Characteristics of small samples are deemed to be representative of the populations from which they are drawn.
- Justifiability: A processing rule can be used if the individual finds a rationale to 'justify' it.
- Regression bias: Extreme values of a variable are used to predict extreme values of the next observation of the variable (thus failing to allow for regression to the mean). In other words people fail to understand that when observations vary irregularly around some average value or trend, then extreme values are likely to be followed by less extreme values.
- Best guess strategy: Under conditions involving several sources of uncertainty, simplification is made by ignoring some uncertainties and basing judgment on the most likely hypothesis. Gettys, Kelly & Peterson (1973) identified this as strategy resulting from the limited information processing ability of humans. They saw people tending to eliminate subjectively some of the uncertainties and focus attention on what they consider to be the most likely different combinations of outcomes.
- Expert opinion: It is common to make a decision based on the opinion of someone who is considered to be an expert by the person in the decision-making role (Petty, Cacioppo, Strathman & Priester, 1994). This heuristic appears quite reasonable as it involves the adoption of a credible source even if there hasn't been careful scrutiny of the arguments (Ajzen, 1992).

4.4.2.2.(e) Consistency of Information Sources

If the same information is 'observed' over time, or through differing sources, this can lead to increases in confidence in judgment but not to increased predictive accuracy. People often like to have more information, even though it is redundant. In their classic study of how people acquire concepts, Bruner, Goodnow and Austin (1956) noted what they termed a 'thirst for confirming redundancy'. This means that once people have acquired a concept, they continue to test it several times in order to really confirm it for themselves, and often redundantly. Thus there is a strong tendency to accumulate several instances of confirming evidence, which are redundant, and in so doing to gain artificially greater confidence in their hypothesis.

Kahneman and Tversky (1973, p.240) have termed this phenomenon "illusion of validity".

> "...factors which enhance confidence, for example consistency and extremity, are often negatively related with predictive accuracy. Thus people are prone to experience much confidence in highly fallible judgments, a phenomenon that may be termed illusion of validity. Like other perceptual and judgmental errors, the illusion of validity often persists even when its illusory character is recognised..."

4.4.2.2.(f) The decision environment:

The environment in which a person has to make a judgment can have a major impact on the quality of the judgment made. Many of the factors identified by Petersen (1988) in his Causation Model (Figure 15) as being root causes of incidents, are factors in the decision environment leading to overload conditions on the decision-maker or other psychological pressures to make certain decisions. Factors in the decision environment that can lead to biases occurring in the judgment process include:

- Complexity: complexity induced by time pressure, information overload, distractions leads to reduced consistency of judgment.
- Equipment traps: Norman (1988) believes that the design of equipment can in itself be a 'trap' that will lead people to make errors. He believes

this occurs because the world is a complex place and the human mind is perfectly adapted to making sense of this changing environment. However the human mind uses simplification and rules of thumb to make sense of this complexity as described in the earlier section on heuristics. Norman believes that the design of many objects, machines and items of equipment cause the human mind to make incorrect assumptions about how to use the objects and this leads to error.

> "The human mind is exquisitely tailored to make sense of the world. Give it the slightest clue and off it goes, providing explanation, rationalisation and understanding... Well designed objects are easy to interpret and understand. They contain visible clues to their operation. Poorly designed objects can be difficult and frustrating to use. They provide no clues – or sometimes false clues. They trap the user and thwart the normal process of interpretation and understanding....the result is a world filled with frustration, with objects that cannot be understood, with devices that lead to error." (Norman, 1988, p.2)

Norman works on the principle that when using a device,

> "If an error is possible, someone will make it. The designer must assume that all possible errors will occur and design so as to minimise the chance of the error in the first place, or its effects once it gets made. Errors should be easy to detect, they should have minimal consequences, and, if possible, their effects should be reversible." (Norman, 1988 , p.36)

Interestingly, having studied people making errors with mechanical devices, Norman notes that people feel guilty and either try to hide the error or blame themselves for stupidity or clumsiness. Even if it is pointed out that the design is faulty and others make the same error, if the task appears simple or trivial then people blame themselves. This is a direct result of causality, where people will assign a causal relationship if two things happen in close succession (If I do some action A just prior to some result R, then I conclude that A must have caused R). This relationship may not exist at all; it may in fact be due to the design. However, because people perceive that they should be able to use an everyday device easily, they perceive the fault to be theirs, and this creates a, "...conspiracy of silence maintaining the feelings of guilt and helplessness among users" (Norman, 1988, p.41). Strangely, this tendency to blame ourselves for failures with everyday objects goes against normal attribution theory discussed earlier where people attribute their own problems to the environment and those of other people to their personalities.

Norman believes that the equipment traps can be avoided by adopting design characteristics that will lead to clear interpretation by the human brain.

- Emotional Stress: Emotional stress reduces the care with which people select and process information (panic judgments). A major emotional aspect of behaviour is the individual's psychological regret for taking or failing to take an action. In an interesting series of experiments, Kahneman and Tversky (1979) showed a mirror image of regret in cases where people were faced with certain losses. Confronted with a choice between a certain loss, on the one hand, and a probabilistic prospect of either avoiding that loss or incurring a slightly larger one, people tended to opt for the choice of avoiding the loss. That is, when confronted with losses, the regret of failing to take an option that could possibly extract one from the situation is too strong. Emotional factors such as anxiety, for example fear of potential outcomes of one's actions, can also cause people to block out relevant arguments, over-emphasise different arguments in favour of preferred alternatives, fail to search for new alternatives, and even psychologically prepare themselves for negative consequences of their decisions.

Kaplan (1975) discussed what he called "Transient situational states" (p.152) where a person in a judgment situation will make different judgment choices based on states bought about by situational conditions. Kaplan described these states as "moods". He quoted experimental manipulations that have been shown to temporarily influence levels of evaluative judgment. The transient states in these experiments were induced by: prior expectations (Kelley, 1950); instructions to assume certain roles (Jones & De Charms, 1958); physical discomfort (Griffitt, 1970); crowding (Griffitt & Veitch, 1971); and overheard propaganda (Kaplan & Major, 1973).

- Social Pressures: Social pressures, (e.g., of a group), can cause people to distort their judgments (The majority in a group can unduly influence the judgment of others). Norman (1988) stated that social pressure is a subtle issue that can lead to misinterpretation, mistakes and accidents in industrial settings. The pressures from peers and colleagues to either do something you shouldn't, or not do something you should, is strong and has been shown to contribute to incidents. An example that Norman gives is the 1983 flight of Korean Flight 007. Flight 007 strayed over the Soviet Union and was shot down, probably because of an error in programming the flight path into the inertial navigation system (INS). Although each checkpoint was discrepant, apparently the deviations were easily explained away if the crew substituted for each point the checkpoint reading for the previous INS point. But there were significant social pressures operating as well.

  The crew of flight 007 probably misprogrammed the INS, but the INS couldn't be reprogrammed in flight: if an error was detected the aircraft would have to go back to the original airport, land (jettisoning fuel to get a safe landing weight), and then reset the INS and take off again – an expensive option. Three Korean Air Flights had returned to the airport in the previous six months and the airline had told its pilots that the next pilot to return would be punished.

Fazio and Roskos-Ewoldson (1994) described social 'norms' where beliefs about how one should or is expected to behave in a situation, "can exert a powerful influence upon behaviour" (p.76).

Rasmussen (1990) addressed the issue of social pressures on those making judgments, especially when there is a boss versus worker pressure. He discussed the issue whereby operators are often conditioned by the conscious decisions made by work planners or managers. This will influence their "power of control" when making decisions in the "dynamic flow of events" (p.453). He also states that this conditioning of response is often missed in causal analysis of incidents because it is not in the main branch of the causal tree of the dynamic flow.

It is easy to imagine that other social interactions such as power issues between instructors, especially if there is a gender difference in a co-instructor situation, could influence judgments being made.

- Beliefs or Values: Hogarth (1980) discussed the effect of individual's schemas in a task environment. A person's beliefs or values can alter the preferred goal for the individual which can lead to judgments being made that seem erroneous when compared to the original goal. Karlsson (1989) discussed this in his study of decision and choice, describing the phenomena of a 'conflicting project' and the 'motive in decisiòn-making'.

In considering how decision makers resolve the conflict when faced with choice between equally attractive options Shafir, Simonson & Tverky (1994, p.14) found evidence that rather than random choices, people tended to choose the alternative that was, "...higher on the dimension that the subject considered more important". Slovic (1975, 1990) also discussed the influence of values and beliefs when making choices.

Kaplan (1975, p.144) talks of, "differences in information valuation" where those in the position of making judgments already have predefined subjective valuations placed on different categories of data and their sources.

In a lecture I attended on ethics in the outdoors, Jasper Hunt raised the issue of people making decisions based on their perception of the *"summum bonum"* or greatest good, as they see it, in terms of the outcome. Their values will affect their decision choice. In much the same way Upshaw (1975, p.204) stated that,

> "An issue, then, is resolved for the person when he discovers a satisfactory strategy for achieving whatever goals and maximising whatever values have been aroused in the situation." And further (p.218), "These goals and values, when directed to an issue, define the person's attitude. Hence, attitude is probably the most important determinant of the precise way in which the person combines stimulus attributes to produce a preference ordering."

- Ego: Other writers (e.g., Dawes, Kragt & Orbell, 1989) discussed the drive to maximise internal positive utilities such as egoistic incentives, self esteem and altruism in making decision strategies. In enhancing these internalised utilities, the benefits to the group or group process may be lost.

- Risky Shift: Because group decisions often require consensus and compromise, it might be expected that the outcomes of a group process would be more conservative, prudent or cautious than individual decisions. Stoner (1961) reported an effect that conflicted with this assumption when he discovered that individual opinions become riskier after group discussions. This phenomenon is now termed risky shift: where the risk taking propensity of individuals is shifted upwards in a group situation. The same individual would make a less risky decision (take a less risky alternative) if they were on their own (Kozielecki, 1981).

Research following the original work of Stoner found that the results of group discussions were not always increases in risk taking. Sometimes the outcomes were more cautious than the individuals would have taken before taking part in the group discussion (Moscovici & Zavalloni, 1969; Myers & Lamm, 1976). The finding of this further research was that, "...discussion leads members to make more extreme decisions in the direction toward which they were initially inclined" (Kitayama & Burnstein, 1994). The term 'group polarisation' was used to describe this effect rather than 'risky shift'. However, in the discussion of biases involved in judgment affecting decision-making in the outdoors, more cautious decisions are not relevant, as conservative decisions are not likely to lead to incidents. Thus, risky shift is still the appropriate term to use in the discussion of this bias.

- Illusion of Invulnerability: Various writers have identified the concept of the illusion of invulnerability whereby a person, through many successes in the past, can come to believe they can take bigger and bigger risks without any negative outcome. This can even become part of a group or organisational mentality. For example it is believed that the illusion of invulnerability was a factor in the Space Shuttle Challenger disaster as there was a blind faith within NASA in the ability of the organisation to overcome any obstacle (Pidgeon, 1989; Janis, 1972).

- Individual Risk Taking Preference: Coombs (1975) discussed the shortcomings of Expected Utility Theory and proposed an alternative theory that he termed Portfolio Theory (Also: Coombs, 1969; Coombs & Bowen, 1971a, 1971b; Coombs & Meyer, 1969). Portfolio Theory is an alternative theory of risky decision-making and states that a choice among risky decisions is a compromise between maximising expected utility and optimising the level of risk. The assumptions of this theory include the premises that each individual has an individual optimum risk taking level and that the there is a single-peaked preference function over risk when expected value is constant.

> "The psychological idea here is that for a fixed expectation an individual has an optimum level of risk and that his preference falls

> off as risk increases or decreases...With expected value fixed then, a gamble reflects a conflict between greed and fear, an approach-avoidance conflict, and this condition means that for each individual there is an optimum level at which greed and fear are in unstable balance – at a lower level of risk greed drives him on, and at a higher level of risk fear holds him back – so preference falls off in either direction from the optimum level" (Coombs, 1975, p.71).

Coombs carried out two experiments, both of which produced results that supported Portfolio Theory. Translated to outdoor instruction this theory indicates that an individual will have a preference for an optimum risk level. Whether this is high or low will have an impact on decisions made in activities. It is likely that incidents will occur to those whose risk taking optimum level is high and exceeds their skill level for the situation.

4.4.2.2.(g) Summary of biases in the processing of information

The literature review has identified a number of biases that can impact on the processing of information in the decision-making process leading to impaired judgments. Those that are applicable to outdoor education activities are:

- Inconsistency – the inability to be consistent in applying judgment strategies over a number of cases.
- Conservatism – failure to revise an opinion or judgment based on the receipt of new information.
- Explaining away hazards – making mistakes in assessing the importance of information or failing to extrapolate properly.
- Heuristics – techniques of simplification of the problem or the use of simple rules to reduce the effort of decision-making.
- Consistency of information sources – if a number of information sources suggest a certain outcome then this can lead to increased confidence in a certain judgment.
- Factors in the decision environment. These factors fall into two main areas: those causing overload conditions on the person making the judgment

(Complexity, equipment traps, emotional stress) and those placing psychological pressure on the person making the judgment to alter their decision in a manner that results in increased risk (social pressures, personal beliefs / values, ego, risky shift, illusions of invulnerability, individual risk taking preferences).

4.4.2.3. Sources of Bias in the Output Process:

The way in which people express their choice or judgment can also bias the judgment that they are expressing. The literature identifies the following biases in judgment due to the output process.

4.4.2.3.(a) Question Format and Scale effects

People's estimates of probabilities have been found to differ according to the method with which people have been asked to respond as well as the scale used to measure responses (Hogarth, 1975, 1980).

4.4.2.3.(b) Wishful thinking

People's preferences for outcomes of events affect their assessment of the events. People sometimes assess the probability of outcomes they desire higher than their state of knowledge justifies.

Savage (1954) discusses the well developed theory of rational choice (or decision theory) under conditions of uncertainty. Three pertinent practical aspects of the theory are: (1) it embodies a number of commonsense principles that are worth emphasising; (2) it states that if a person is coherent, then his or her beliefs (predictive judgments) and preferences (evaluative judgments) can be expressed by probabilities and utilities; and (3) maximising expected utility is the sole criterion of rational choice. The theory is built upon the principles that people are capable of expressing both consistent preferences and consistent beliefs. Furthermore, preferences and beliefs should be independent of each other in the sense that you should not allow what you are think is going to happen (beliefs) to affect what you would like to happen (preferences) and *vice versa.* In other words, independence of preferences and beliefs is a statement for realism, for warning people against engaging in 'wishful thinking' or conversely 'persecution mania'. People do not necessarily follow these principles. Perhaps the most striking feature of this discussion is that although people are willing to accept the principles when they are stated abstractly, they do not realise that they violate them through their actual expressions of choice.

4.4.2.3.(c) Illusion of control

Activity concerning an uncertain outcome can, by itself, induce in a person feelings of control over the uncertain event. Activities such as planning or even the making of forecasts can induce feelings of control over the uncertain interplay of humans in a hazardous environment..

Pidgeon (1989) discussed this phenomenon in the context of individuals or groups carrying out intensive risk analysis or problem structuring techniques where there are incomplete, ill-defined or complex risk issues. Once the structure is finally formalised the model may engender undue confidence; what is out of sight is effectively out of mind (Fischhoff, Slovic & Lichtenstein, 1978). In current risk assessment practices this tendency towards overconfidence in spite of many unknowns is guarded against by building probability distributions into any assessment. Levi (1981, p.408) suggested that an essential safeguard against overconfidence in the modeling effort is to, "be mindful of our ignorance even when it hurts".

4.4.2.3.(d) Summary of sources of bias in the output process

A number of biases have been identified that are associated with how an individual communicates the judgment in the decision-making process, such that the judgment itself is affected. Two of these biases have application in the outdoor education sector:

- Wishful thinking – where people's preferences for outcomes affect their assessment of events and their communication of the final option chosen.
- Illusion of control – where so much effort has been put into the planning of the event that the result is undue confidence in the final judgment.

A third bias was identified which related to the scales used to measure responses. This bias is more applicable to situations involving quantitative measures of probability which is not the case in this study.

My own belief is that these biases that have been linked to the output process could equally well be considered factors that influence the processing of information and be included in Section 4.4.3.2.

4.4.2.4. Sources of Bias in the Feedback Process

Future judgments a person makes are affected, or biased, by feedback received following judgments, especially in what is identified by that person as appearing to be a similar situation. If no feedback occurs, or that feedback is itself biased in some way, then learning will be affected and future judgments based on that feedback may be inappropriate.

4.4.2.4.(a) Outcome irrelevant learning structures

If observed outcomes of experiences yield inaccurate or incomplete information concerning predictive relationships, this can lead, inter alia, to unrealistic confidence in ones own judgment.

Estes (1976) has emphasised that in order for learning to occur about predictive relationships, then there is the need for what he calls the 'alternative event' to occur and for people to pay attention to and encode 'all the alternative events with equal efficiency'. However Estes' conditions clearly cannot apply in situations where judgments lead to actions which preclude observation in the alternative event.

Goldberg (1968) listed three conditions for learning predictive relationships: (1) Feedback – which is necessary but not sufficient; (2) ability to rearrange cases so that hypotheses can be verified or discounted – however this condition is of limited practical value to decision makers faced with a range of essentially non-repetitive predictive situations: and (3) the ability to record one's predictions and their outcomes.

Castellan (1977) concluded that research indicates that feedback based on observation of outcomes in learning situations is ineffective. Some studies (Hammond, Summers & Deane, 1973) have shown that feedback that emphasises the process, i.e. the structure of the judgmental task, is more effective than mere outcome feedback. The suggestion is to record in writing not only the prediction but the cues they used in the judgment, causal assumptions, etc. This forces people to consider both the basis of their judgment and the structure of the task.

Einhorn & Hogarth (1978) carried out a simulation study that indicated if a person has only a modest degree of judgmental ability, then positive feedback and high confidence in judgment will often be the result of predictive activity. This is not necessarily due to emotional factors such as 'motivated forgetting', but can be accounted for simply by the structure of the judgment task where there are more often positive outcomes than negative.

4.4.2.4.(b) Misperception of chance fluctuations

Also known as Gambler's Fallacy. After seeing a sequence of successes or failures in a situation known to be random in nature, people tend to believe that the event that has not appeared recently becomes more probable

4.4.2.4.(c) Success/failure attributions

The tendency to attribute success to one's skill and failure to chance or bad luck. (also related to illusion of control). Langer (1977) observed that in chance-skill situations there is a strong tendency to assign observation of success to skill and the observation of failure to chance.

4.4.2.4.(d) Logical fallacies in recall

Inability to recall details of an event leads to 'logical' reconstruction which can be inaccurate. This is typical in eyewitness testimony (Hogarth, 1980).

4.4.2.4.(e) Hindsight bias

In retrospect people are not surprised about what has happened in the past. They can easily find plausible explanations.

Hogarth (1980) contended that looking forward or prediction requires considerable powers of imagination and both the willingness and ability to entertain several hypotheses simultaneously. Keeping one's options open is not a tidy exercise and can induce considerable anxiety. Post-diction or hindsight on the other hand, requires little imagination and is an invitation to impose causal structure on a sequence of past events. Furthermore, subjectively there is less uncertainty than in prediction problems concerning the events that 'caused' what happened. One can believe any chain that seems plausible since it was seen to precede the event.

Because of this it is easy to judge others with hindsight and the decision in question may seem to have been a terrible mistake. At the time the decision was taken however it might have been quite reasonable given what was known and interpreted by the person on the spot.

Hogarth explained that there are several implications in the inability to learn from experience by people failing to be surprised by outcomes. The first, if people are not surprised this means that they apparently thought they had little to learn in the first instance. In other words, outcomes are not instructive. However, predictive 'track records' often indicate considerable inconsistencies and the expression of excessive confidence in predictive judgment is a common human failing. Learning from experience is thus not evident, and memory distortions may also often be functional for the individual.

A second implication of lack of outcome surprise concerns people's ability to construct causal explanations. There can be little doubt that the ability to construct good causal explanations is important in prediction, since accurate prediction depends on identifying the variables in the environment and their relationship to the event predicted. However, if people are unduly influenced by knowledge of outcomes in explaining the past, this means they will accept sufficient (although not necessary) explanations too easily; and if people accept outcome explanations too easily, this reduces the discipline of seeking alternative explanations for phenomena observed in the past and, as a consequence, the ability to imagine and create alternative causal schemes for predicting the future. As already discussed people rarely seek information that could negate their preconceptions, rather they look for possible confirming evidence. This tendency clearly interacts with the fallibility of memory discussed here in producing biased conceptions of the world

> "Analysts come in well after the fact, knowing what actually did happen; with hindsight, it is almost impossible to understand how the people involved could have made that mistake. But from the point of view of the person making the decision at the time, the sequence of events is quite natural" (Norman, 1988, p. 43).

Fischoff (1975) studied explanations given in hindsight, where events seemed completely obvious and predictable after the fact but completely unpredictable beforehand. He presented people with a number of situations and asked them to predict what would happen. They were only correct at the chance level. He then presented the same situation along with the actual outcome to another group of people, asking them to state how likely the outcome was. When the actual outcome was known, it appeared to be plausible and likely, whereas the others appeared unlikely. When the actual outcome was unknown, the various alternatives had quite different plausibility. It is a lot easier to determine what is obvious after it has happened.

> "Acts that are quite rational and important during the search for information and test of hypothesis may appear to be unacceptable mistakes in hindsight, without access to the details of the situation" (Rasmussen, 1990, p.456).

Hogarth (1980) concluded that making consistent judgments, determining whether or not information sources are redundant and handling apparently inconsistent information is a difficult task and often beyond the intuitive information processing capacity humans. Add to this complexity, time pressures and the results can be even worse. He advocated the use of mechanical means or computers to give more consistent results. In fact he quoted research (Libby, 1976) where statistical models had been constructed to represent the judgment of people and were found to predict uncertain events more accurately than the judgments of the people they were supposed to represent.

However , it is hard to imagine these mechanical models replacing intuitive judgment in the outdoor sector. Although it may be feasible to programme decision-making models into palmtop computers that would query an outdoor leader for specific cues and then suggest a best judgment for that situation, the number of possible decision-making situations and variants, would make this nigh impossible in practice. Hogarth recognised the limitations of these mechanical means when he conceded that,

> "...there are of course, many situations where statistical models cannot be built and information combination must be done intuitively. For example, many actions have to be taken on the basis of so-called 'snap judgments'. What advice can be offered here? First, it is necessary to be aware of the nature of judgment and the kinds of biases that have been described ... It is also necessary not to be under illusions about one's judgmental ability ... Second it is unlikely that you will make good judgments unless you have thought about the process of judgment and consciously tried to avoid some of the traps..." (Hogarth, 1980, p.50).

4.4.2.4.(f) Summary of biases in the feedback process

This literature review has identified a number of issues that can arise in feedback following judgments that can bias future judgments by that same person or others observing the situations. These problems in feedback that can bias future judgments include:

•Outcome irrelevant learning structures – If a certain judgment leads to success in a situation, but in fact a failure was a strong possible outcome of that judgment, the person who made the judgment receives reinforcement that they made the correct choice in the situation and will likely use the same judgment strategy in a similar situation in the future.

•Misperception of chance fluctuations – wrongly believing that a success must follow a series of failures, or vice versa, without changing the strategy.

•Success/failure attribution – the tendency to attribute success to one's skill and judgment while attributing failure to chance or other external factors.

•Logical fallacies in recall – inability to recall details of an event which results in an inaccurate reconstruction of that event.

•Hindsight bias – finding plausible explanations for what occurred after the fact.

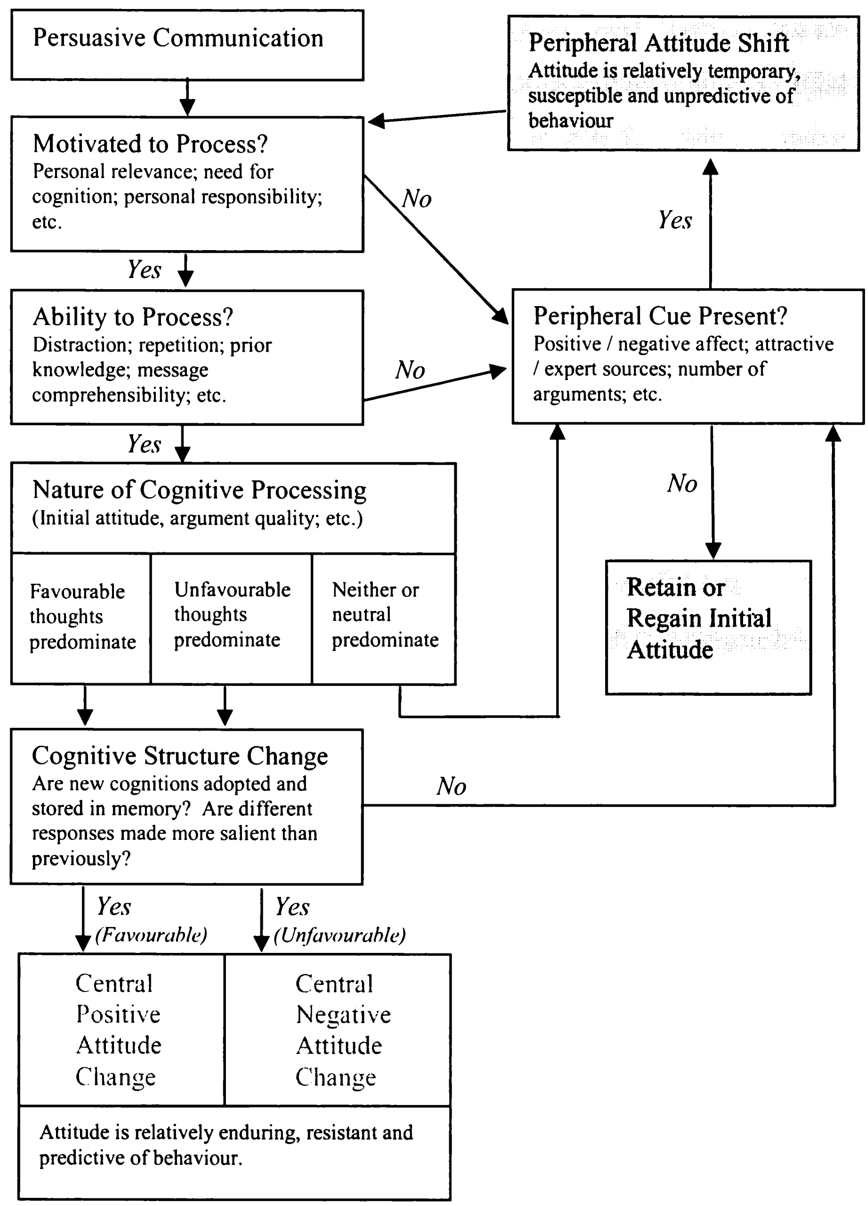
4.4.3 The Elaboration Likelihood Model

Much of Section 4.4.2, where various sources of bias were identified that impacted the quality of judgments, was based on research that is over twenty years old and carried out in the time when the traditional approach to decision-making was dominant. Although the research results, and therefore the identified biases, are still valid today and many have been supported with research from the NDM era, it is useful to look at another contemporary model from cognitive psychology to see if further support can be lent to the approach adopted to identifying biases in the judgment process.

Judgments that individuals make, and the subsequent actions based on those judgments, can be considered to be behaviours. There is a well documented pool of research that behaviour is often influenced by the attitudes held by that person (Manfredo, 1992). Equally there are times when attitudes do not influence behaviour. Vincent and Fazio (1992) argue that there are times when attitudes are not retrieved from memory and at these times situational and normative influences will dominate. A large amount of research has been carried out in the field of cognitive psychology as to what influences behaviour in the light of pre-existing attitudes. This is the study of persuasion. Understanding the way individuals and groups of people can be influenced to carry out certain behaviours is the study of persuasion and is important across all forms of human endeavour and business from sales and advertising campaigns, to mass media persuasion in electioneering, to trying to influence individual social judgments and behaviours when people visit environmentally sensitive wilderness areas. In this study the relevance is in understanding what would influence an experienced outdoor instructor to make a judgment that was less than optimal.

One theory that has attained prominence among contemporary theories is the Elaboration Likelihood Model of Persuasion (ELM) (Petty & Cacioppo, 1981, 1986). The ELM is based on the concept that people want to have correct attitudes and beliefs since these will normally be the most helpful in dealing with everyday problems. However the model describes two different ways in which a person might come to hold an attitude that seems reasonable or right to the person and then act on that belief (Petty, Cacioppo, Strathman & Priester, 1994).

Figure 26. The two routes to persuasion according to the Elaboration Likelihood Model (ELM). From Petty, Cacioppo, Strathman & Priester, 1994.



The two different ways in which a person might come to hold a reasonable attitude are shown in Figure 26. The 'central route to persuasion' involves carefully thinking about and examining information that is pertinent (or central) to the topic. The second strategy, called the 'peripheral route to persuasion', involves less effort and the person often relies on a simple cue in the situation to come to a decision. The name of the model (ELM) refers to the likelihood of the person to carefully consider (elaborate) the information presented in order to come to a decision.

The ELM model suggests that careful consideration of an issue is more likely to occur when the problem has high personal relevance to that person, where he / she has a good level of intelligence in relation to the problem and where there are few distractions. If these factors aren't present it is likely that the peripheral route is chosen and any decision will be based on cue recognition and the implementation of a simple rule (heuristic). Furthermore experimental research into the ELM model shows that biased attitudes are more likely to result when the person is forewarned of the intent of any message or the issue is relevant to them through their already developed schema (Petty, et al., 1994).

This model and theory of persuasion has relevance to the search for biases in the judgment process. The following points are transferable and support earlier biases identified in this chapter:

- Although any instructor in charge of an outdoor education experience will be motivated to think about the situation (high personal relevance, high personal responsibility), that instructor will often be in a situation where they don't have the ability to expend a high degree of cognitive thought on a problem situation that may eventuate. ELM theory suggests the following issues could affect an instructor's ability to process: there may be multiple distractions, time pressures, he / she may be in an inappropriate state of mind or mood, or may not even have the necessary intelligence for the situation. In this case the instructor will not be able to take the central route (high degree of thinking) to come to a judgment on the best solution for that situation. When these conditions are present (time pressures and multiple distractions are regularly present in outdoor education environments) an instructor is more likely to adopt the peripheral route to making a decision, rely on cue recognition and the implementation of an heuristic solution. This is very similar to the prediction made by the NDM model in Figure 22 for the way someone under time pressure, or with a 'rule' available will choose a solution. The issues affecting the ability of a person to take the 'central route' to a decision, have already been identified in Section 4.4.2.2.(f) as those factors in the decision environment that can bias a judgment.

- Biases that affect the search for appropriate cues and then biases affecting the assessment of those cues are both very relevant according to this model and are reflected in Sections 4.4.2.1 and 4.4.2.2 respectively.
- If the individual has an existing personal schema of the situation, or appropriate solutions for such a situation, then this will introduce biases into the decision-making process. This reinforces the concepts of personal values and beliefs affecting the assessment of situations in Section 4.4.2.2.(f).
- After any incident has occurred and the instructor has time to reflect on the incident, then the central route to persuasion will be followed. If the instructor implemented a solution that resulted in a positive outcome, even though that solution may (unbeknown to the instructor) in similar circumstances lead to unfavourable outcomes, the ELM model suggests that this result will reinforce the attitude that the solution is good and will be predictive of future behaviour. This supports the biases that can affect judgment in the feedback process that have been identified in Section 4.4.2.4.

In summary, the ELM model, which is a contemporary theory of cognitive psychology that is regularly applied to social judgment theory, supports the approach taken to search for the root causes of errors in judgment by outdoor educators.

4.4.4 Categorising the Types of Root Causes of Poor Judgment.

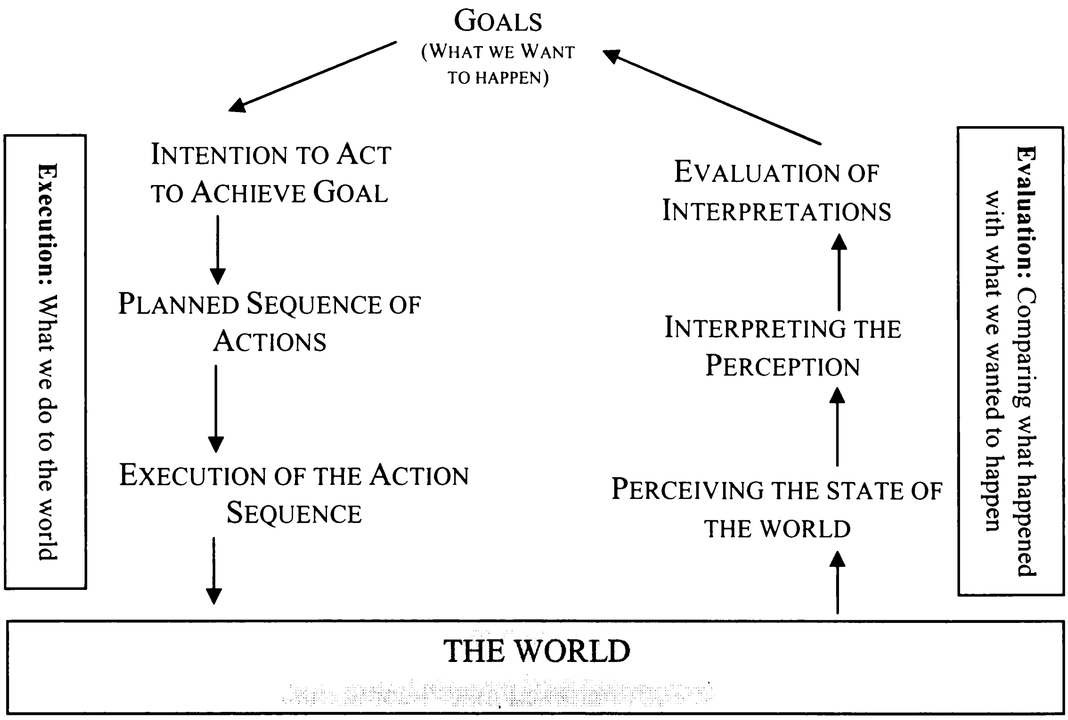
The discussion in Section 4.4.2 has identified a large number of potential biases that can enter the process of making a judgment. These biases can be thought of as potential root causes of the instructor errors shown in Figure 18 as the biases can all lead to inappropriate judgments being made. These biases have been identified through both the traditional theories of judgment and decision-making, based largely around statistical/numerical models, theories and experiments, and the more recent NDM research on human behavior in time critical situations. One of the more recent and highly regarded models of human behaviour, the Elaboration Likelihood Model of persuasion, also supports these findings. The language describing these biases is far from appropriate for outdoor educators to be able to understand and apply, and many are at the level of tokens as opposed to types of root cause. It is necessary to identify major types of root causes from the discussion above and put these into language that can be easily interpreted by an outdoor educator.

The approach used in this research is to categorise the basic types of error and group the root causes under these headings.

4.4.4.1 Slips and Mistakes

Norman (1988, p.105) believed that "People make errors routinely" and that those errors could be broken down into two types: slips and mistakes. Using Figure 27 it is easy to explain the difference between a slip and a mistake: Form an appropriate goal but mess up the performance and you've made a slip. Slips result from automatic behaviour, when subconscious actions that are intended to satisfy our goals are waylaid enroute. Slips are almost always small things, a misplaced action, a desired action undone; they are generally easy to detect or monitor. Form the wrong goal and you've made a mistake. Mistakes can be major events and can be difficult or impossible to detect as the action performed is appropriate to the goal.

Figure 27. The seven stages of human action.
(Based on Figures 2.2-2.5 Norman, 1988, p.47)



4.4.4.1.(a) Types of slip

Norman categorises slips into six categories:

1) Capture errors: where a frequently done activity takes charge instead of (captures) the one intended. Capture errors appear when two different action sequences have their initial stages in common, with one sequence being unfamiliar and the other common. The common one "captures" the uncommon. (e.g., get into your car on the weekend to go to the store and end up at the office).
2) Description errors: This occurs where the intended action has much in common with several other actions. As a result, unless the intended action sequence is completely and precisely specified, it might fit a range of other actions. (e.g,. Planning to pour orange juice into a glass but pour it into a coffee cup beside it). They are called description errors because the internal description of the intention was not sufficiently precise and result from performing the right action on the wrong object.
3) Data-driven errors: Many actions are automatic in reaction to some input (sensory data). But sometimes data-driven activities can intrude into an ongoing sequence, causing behaviour that was not intended. (e.g., phoning

someone, but dialing in the number that is on the cardboard box in front of you by mistake).

4) Associative activation errors: Just as external data can sometimes trigger actions, so too can internal thoughts and associations (e.g., the phone rings, you pick it up and say "come on in").
5) Loss of activation errors: One of the more common slips is forgetting to do something. Even more interesting though, is forgetting part of the act while remembering the rest (e.g., going across the house to the bedroom, and then forgetting why you went there in the first place). Lack of activation errors occur because the presumed mechanism, the 'activation' of the goals, has decayed.
6) Mode errors: Caused when devices have several different modes, and the action for one mode has different meanings in other modes. These are inevitable in equipment that has more possible actions than controls, so the controls have to double up. Mode errors are common with digital watches, videos, computers, etc. Several accidents in commercial aviation can be attributed to mode errors, especially in the use of automatic pilots which have a number of complex modes.

4.4.4.1.(b) Mistakes as errors of thought

Mistakes are the result of the choice of an inappropriate goal. These mistakes are commonly described as,

> "...making a poor decision, misclassifying a situation or failing to take all the relevant factors into account. Mistakes arise from the vagaries of human thought, often because people tend to rely upon remembered experience rather than on more systematic analysis... memory is biased towards overgeneralisation and overregularisation of the commonplace and overemphasis on the discrepant" (Norman, 1988, p.114).

Norman makes the point that too much emphasis is placed on human thought being rational, logical and orderly. He argues that life is not neat and orderly. It does not proceed smoothly and gracefully in neat logical form. Instead it hops, skips and jumps its way from idea to idea, tying together things that have no business being put together; forming new creative leaps, new insights and concepts. Human thought is not like logic; it is fundamentally different in kind and spirit. The difference is neither worse nor better. But it is the difference that leads to creative discovery and to great robustness of behaviour.

He believes that the structure of the task influences the response and effort we put into problem solving. Tasks can be divided into shallow / deep and wide / narrow categories. Shallow task structures are those where there are few decisions to make after the single top-level choice. Deep task structures have a cascading number of decisions. Wide task structures are those with many alternatives at each level as opposed to narrow structures where there are few alternatives at each level. For example, choosing an ice cream cone from an ice cream shop offering good choice of flavour is a wide, shallow task. A recipe to bake a cake is an example of a narrow deep structure.

Norman's point is that most tasks in daily life are routine and involve little thought or planning. These tasks are either shallow or narrow. They are done relatively quickly with little mental effort. Much of this effort is done subconsciously. Norman believes these decisions are made by 'matching patterns', by finding the best possible match of one's past experience to the current one.

> "Subconscious processing is one of our strengths – we are good at detecting general trends, at recognising the relationship between what we now experience and what has happened in the past. And it is good at generalising, at making predictions about the general trend based on few examples. But subconscious thought can find matches that are inappropriate, or wrong, and it may not distinguish the common from the rare. Subconscious thought is biased toward regularity and structure and it is limited in formal power" (Norman, 1988, p.125).

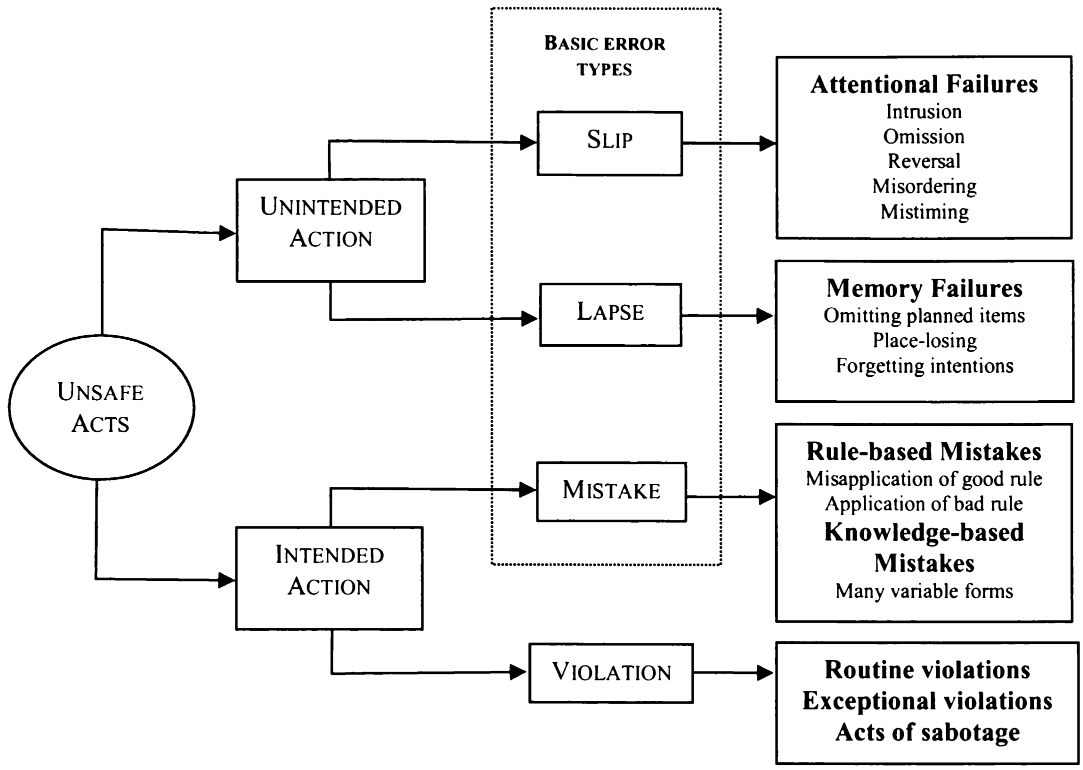
"Recreational activities should be wide and deep, for we do them when we have the time and wish to expend the effort" (Norman, 1988, p.125). Wide and deep tasks require considerable conscious planning and thought. Conscious thought is different in that it is slow and laboured. It is serial and rational. Conscious thought tends to involve short term memory and is therefore limited in the amount of information that is readily available. Norman (1988) believes that five or six items are all that can be kept available at any one time. The way this limitation is overcome is by organising them into a structure and in this way only one structure must be kept in the memory. As a result of this power of organisation to overcome the limits of working memory, explanation and understanding become essential components of conscious thought. Mistakes are made by mismatch, by taking the current situation and falsely matching it with something in the past, and by falsely bringing to mind either regularities in the past or discrepant events that stand out in the past. Also if we come across a rare / uncommon event, we can't classify and have trouble dealing with it.

4.4.4.2 Lapses and Violations

Reason (1990) has further developed the work of Norman in categorising error types as shown in Figure 28. Rather than Norman's two categories of slips and mistakes, Reason now suggests four categories (i.e. slip, mistake, lapse and violation) based on the "intention" to act or not and then by the "cause of failure".

The direction of the arrows in Figure 28 are used by Reason to show an error classification system; from unsafe acts to their root causes. It is more sensible to reverse the arrows if contemplating the diagram to understand the sequence of cognitive error to unsafe act.

Figure 28. A summary of the psychological varieties of unsafe acts.
(Reason, 1990, p.207)



Reason uses the following definition of terms:

> "Error will be taken as a generic term to encompass all those occasions in which a planned sequence of mental or physical activities fails to achieve its intended outcome, and when these failures cannot be attributed to the intervention of some chance agency" (Reason, 1990, p.9).
>
> "Slips and lapses are errors which result in some failure in the execution and / or storage stage of an action sequence, regardless of whether or not the plan which guided them was adequate to achieve its objective" (Reason, 1990, p.9).
>
> "Mistakes may be defined as deficiencies or failures in the judgmental and / or inferential processes involved in the selection of an objective or in the specification of the means to achieve it, irrespective of whether or not the

actions directed by this decision-scheme run according to plan" (Reason, 1990 ,p.9).

"Violations can be defined as deliberate – but not necessarily reprehensible – deviations from those practices deemed necessary (by designers, managers and regulatory agencies) to maintain the safe operation of a potentially hazardous system" (Reason, 1990, p.195).

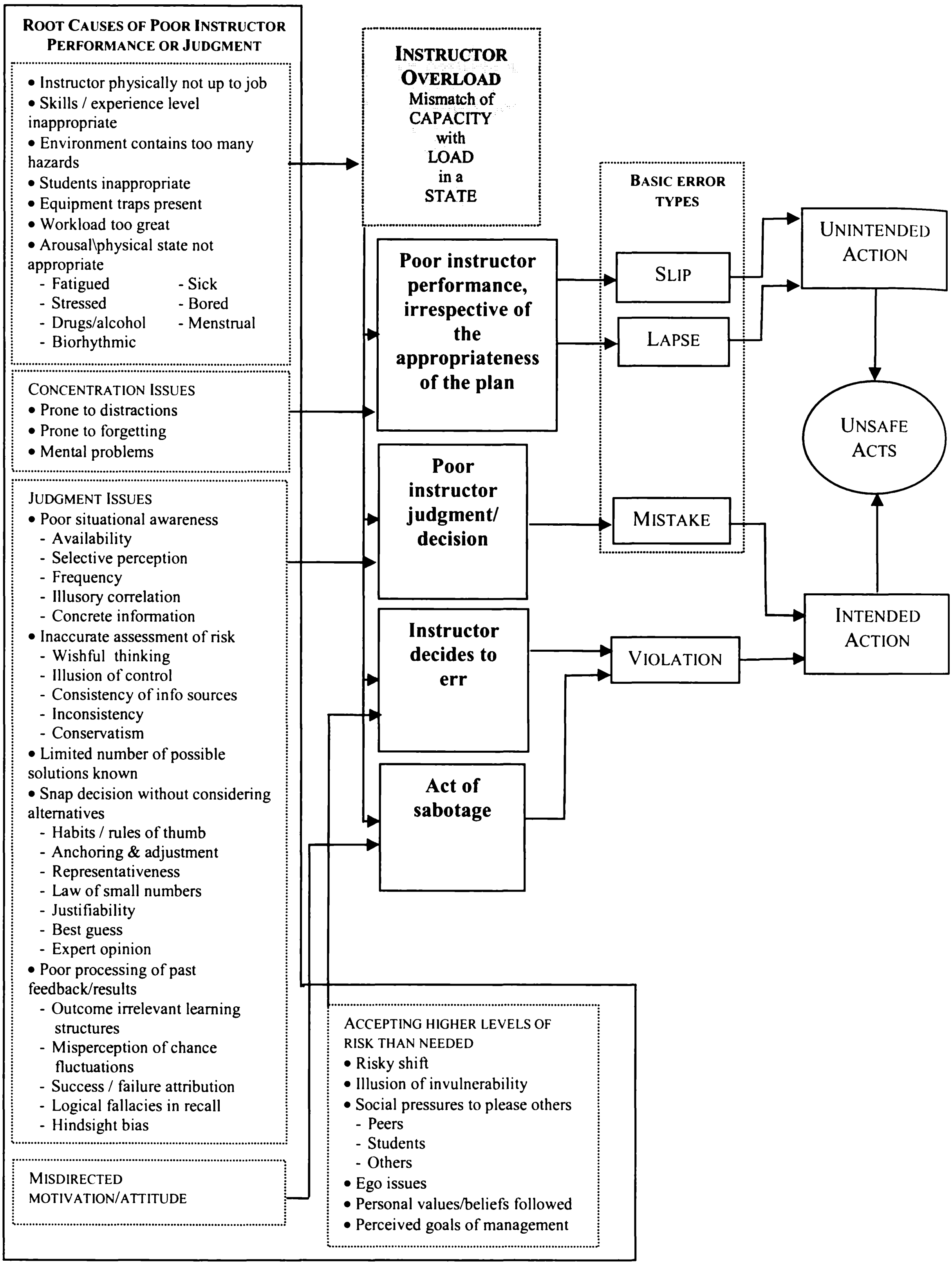
4.4.4.3 A Categorisation System for the Root Causes of Poor Judgment

Reason's (1990) model of the psychological varieties of unsafe acts (Figure 28), and the earlier discussion of Norman (1988), are the first time that 'slips' and 'lapses' have been discussed. Until now this literature review has been looking at reasons underlying poor judgments (a mistake or violation) rather than why a good judgment / decision was not implemented correctly. Petersen's (1988) causation model of an incident (Figure 15) hints at this through the category described as 'unconscious decision to err'.

Combining the factors affecting human error from Petersen's causation model in Figure 15, the discussion on biases in judgment / decision-making in the previous section and Reason's summary of psychological varieties of unsafe acts in Figure 28, identifies the categories of root causes of poor instructor judgment or performance as shown in Figure 29.

Figure 29 is the first attempt at providing the contents of the box labeled "Error producing factors" in the proposed model of an outdoor incident shown in Figure 18. A number of types of root causes are described that will lead to instructors making slips, lapses, mistakes or violations.

Figure 29. The root causes of poor instructor judgment or performance.



The types of root causes are shown with round bullet points, and the tokens of those types are indicated as indented lists where appropriate. For clarity, I have retained the original names used for the tokens while recognising that more suitable names may be necessary for application in the outdoor sector.

The role of instructor overload is also shown. It is a factor which increases the likelihood of an instructor making an error in judgment. Overload is defined as a mismatch of capacity with a load in a state. Thus the overload can be due to lack of capacity (physically or mentally not up to the task), the load or task itself can be too large (environment, students, environment or work time) or the state of the instructor can be inappropriate (fatigue, stress, etc.) These overload factors can lead to poor performance of skills, poor judgment and can aggravate motivational problems. Thus the factors leading to overload can be considered to be root causes of outdoor incidents. As shown in Figure 18, there may be problems in the safety management system that can lead to instructor overload occurring. The safety management errors will be identified in the following section.

4.4.5 Identifying Management System Errors

Identifying errors in the quality management system of an organisation is a much simpler task as the components of a good quality management system are well documented.

In March 2004, Outdoors New Zealand launched a quality assurance scheme for the safety management systems of organisations offering outdoor educational and recreational experiences. This voluntary scheme is known as OutdoorsMark. To be accredited with the OutdoorsMark, an organisation must meet minimum standards in a comprehensive range of components of a structured safety management system. This compliance to a minimum standard is vetted by an auditor from a pool of outdoor experts trained in auditing skills. All expert auditors are registered in the Register of Outdoor Safety Auditors (ROSA) run by Outdoors New Zealand. The OutdoorsMark programme is based on the licensing documentation used by the United Kingdom's Adventure Activity Licensing Authority. The OutdoorsMark criteria for a comprehensive safety management system have therefore been scrutinised by experts from both the United Kingdom (in the AALA form) and in New Zealand by the ROSA pool.

It seems reasonable to assume that the management system errors that need to be identified can be detailed as those that could be classified as "less than adequate" in the components of the OutdoorsMark scheme.

Table 13 shows the audit components of the OutdoorsMark scheme and my interpretation of the management system error that would be an indication of a "less than adequate" quality management system being in place.

Table 13

Management System Errors Derived from the OutdoorsMark Quality Assurance Components.

OUTDOORSMARK COMPONENT	MANAGEMENT SYSTEM ERROR
A1 Safety management administration	No one accountable for safety efforts of organisation
A2 Activity leader qualifications	Less than adequate (LTA) systems to ensure each activity is supervised by appropriately skilled staff
A3 Approved technical advisors	
A4 Staff qualifications and experience matrix	
A5 Task analysis or activity specifications matrix	
A6 Daily Assigning of leaders for activities	
A7 Clarity of responsibility	Responsibilities not clear
A8 Recruitment of activity leaders	LTA Staff recruitment systems
A9 Induction of activity leaders	LTA Induction of staff
A10 Monitoring and appraisal	LTA Staff monitoring and appraisal systems
A11 Activity leader and instructor training	LTA Staff training systems
A12 Support staff training	
A13 Recording of professional development	
A14 Contract and volunteer staff	
B1 Operational activity procedures	LTA policies and procedures
B2 Updating operational procedures	
B3 Formal risk assessment	LTA Risk assessment systems
B4 General meetings for activity leaders	LTA Meetings\participation to discuss safety issues

matters	
B6 Emergency procedures	LTA Emergency procedures
B7 Hazard identification and reporting	LTA Hazard reporting procedures
B8 Incidents reporting	LTA Incident reporting and analysis systems
B9 Incidents investigation and review	
B10 Ease of contact and communication between management and activity leaders	LTA Communication systems
B11 Communications with expeditions	
B12 Location of overdue activity groups	See above – LTA policies and procedures
B13 Modification of site or activity	
B14 Modification of site of activity because of weather, etc	
B15 Reviewing management and field activities	
C1 Activities	LTA Activity range for needs of group
C2 Range of equipment	LTA Equipment systems – not enough, in poor repair, unsuitable or contains traps.
C3 Hired equipment	
C4 Participant equipment	
C5 Use of activity leader's personal clothing and equipment	
C6 Inspections and maintenance of equipment	
C7 First aid equipment	
C8 First aid qualifications	See above for qualified staff
C9 Supervision of activities	See above – LTA policies and procedures
C10 Unaccompanied activities management	
C11 New or unfamiliar sites	
C12 National Standards Body accreditation and approval schemes	See above for qualified staff
C13 Other safety related statutory requirements	LTA Compliance to statutory requirements
NB: LTA = Less than adequate	

This list of management system errors covers all of the system errors identified by Petersen (1988) in Figure 15 with the exception of the category identified as 'medical'. While this might be covered under the broad category of policies and procedures, Petersen believes it is worthy of special mention and therefore I will add a management system error to the list: Less than adequate (LTA) screening of medical / health information – staff and clients.

Also intrinsic in the OutdoorsMark programme is that the organisation undertakes regular external review of its safety management system. Not having such a review process would also indicate a substandard safety management system.

Following this analysis, the identified management system errors that are root causes in the model of an outdoor incident in Figure 18 are shown in Table 14.

Table 14

Root Causes of Outdoor Incidents from Management System Errors

ROOT CAUSES - MANAGEMENT SYSTEM ERRORS
LTA Accountability for safety system
LTA Clarity of safety responsibilities
LTA Staff recruitment systems
LTA Staff induction systems
LTA Staff training systems
LTA Staff monitoring and appraisal
LTA Risk assessment systems
LTA Emergency systems
LTA Incident reporting and analysis
LTA Hazard reporting procedures
LTA Activity policies and procedures
LTA Activity range for client group
LTA Systems matching of instructor to activity/group
LTA Communication systems
LTA Equipment systems
LTA Meetings / participation to discuss safety
LTA Medical / health screening staff and clients
LTA Compliance to statutory requirements
LTA Regular review of safety management system by external experts
NB: LTA = Less than adequate

4.4.6 Summary

Following careful analysis of the literature I have identified that the root causes of outdoor incidents fall within two major categories of either: errors leading to poor instructor performance or judgment (instructor error); and, management system errors.

Study of the literature of safety management and the psychology of decision-making revealed a number of biases that can lead to judgments that are less than optimal. These biases were considered to be either tokens or types of root causes of instructor error. Furthermore the instructor error itself could be classified as either: slips, lapses, mistakes or violations depending on the intention of the person involved. The root causes of instructor error were able to be listed in Figure 29.

The root causes due to management system errors were much easier to identify and were available from a range of sources. The categories used in the OutdoorsMark quality assurance system were used as it was felt that this would offer a better match with the outdoor education application than any industrial version.

Through the process outlined above a first version of a taxonomy (or list) of error for outdoor education incidents has been produced (Figure 29 and Table 14).

4.5 Testing the Root Causes of Incidents Identified Through Outdoor Education Literature with the Proposed Taxonomy

In section 4.2.2 a number of possible root causes of outdoor incidents were identified through a study of outdoor education literature. Each of these is considered in turn in Table 15 to identify if they are in fact types or tokens of already identified root causes in Figure 29 and Table 14, or if they represent types or tokens of new root causes.

Table 15.

Comparison of the Possible Root Causes of Incidents Identified through Outdoor Education Literature with the Proposed Taxonomy of Root Causes.

POSSIBLE ROOT CAUSE FROM SECTION 4.1.2	ALREADY IDENTIFIED?	EXPLANATION.
New or unexpected situations – which could include new sites, activities, group dynamics, etc., which an inexperienced instructor would have	Yes	This is a token of the root cause, "Lack of skill and experience".

less competence to deal with. For this reason Meyer (1979) is a proponent of pre-site visits.		
Inappropriate attribution – the psychological tendency of people to take credit for successful outcomes but transfer the blame for poor outcomes may prevent instructors from realising accidents can happen to them and therefore be alert to dangers.	Yes	This is a token of the root cause, "Poor processing of past feedback / results".
Relaxed concentration – being less aware to dangers due to fatigue, distraction, familiarity, etc	Yes	Fatigue = token of root cause, "arousal / physical state not appropriate" Distraction = root cause, "prone to distractions" Familiarity = token of root cause, "Inaccurate assessment of risk."
Smelling the barn – Willing to take greater risks when the end is in sight or in order to meet a schedule.	Yes	This is a token of the root cause, "Accepting a higher than normal level of risk".
Risky shift – People in groups tend to take higher risks than if they were by themselves. Some participants abandon personal responsibility and transfer the responsibility for taking risks to the group.	Yes	This is a token of the root cause, "Accepting a higher than normal level of risk".
Poor or unsound judgment – often through misperception of what is occurring	Yes	This is an example of either, "Poor situational awareness", and/or, "Inaccurate assessment of risk".
Appropriate safety policies, philosophies, goals, learning objectives, etc., written in a staff manual	No	Management system error – see discussion (1) below
Risk management plans for field activities including crisis response plans.	Yes	Management system error
Accident report forms and analysis systems to learn from mistakes.	Yes	Management system error
Safety reviews carried out on your programme by external peers.	Yes	Management system error
Staff who have the appropriate skills to work in the field.	Yes	Management system error
Risk assessment – correctly identifying factors that contribute to risk	Yes	Root cause, "Poor situational awareness."
Judgment and decision-making – making good decisions in a dynamic environment entails skills in situational awareness, situational assessment, option selection, resource management and reflecting on outcomes.	Yes	Various root causes leading to "Poor instructor decision/judgment".
Having appropriate rules, policies and guidelines	Yes	Management system error
Using appropriate leadership styles	No	See discussion (2) following
Knowing the group	Yes	Token of the root cause, "Poor situational awareness".
Offering challenge by choice	N/A	This is an organisational value or belief which may or may not

		be held by a particular organisation it is not a root cause of accidents.
Teaching by progression	No	See discussion (2) following
Having competent leaders	Yes	Management system error
Checking equipment	Yes	Management system error
Social and psychological factors such as: being too familiar with the situation, risk shift (sic), dropping your guard, get home-itis, wild cards, attribution theory, and risk homeostasis.	Yes	All tokens of previously identified root causes with the exception of "Wild cards", which I don't believe exist. See discussion below.
Meyer & Williamson's "unsafe conditions" listed in Table 6	N/A	These are not root causes but are in fact hazards in the environmental conditions and resources which must be managed appropriately by the instructor, as shown in figure 13
Meyer & Williamson's "unsafe acts" listed in Table 6	N/A	These are not root causes but instead are the "Immediate causes" shown in figure 13, and reinforces the base contention of this study that in the outdoor sector we tend to focus on the obvious/visible causes of accidents rather than the root causes
Meyer & Williamson's "errors in judgment" listed in Table 6. (Note: only errors not already listed above in this table are shown) • Trying to adhere to a schedule • Miscommunication • Disregarding instincts	 Yes No N/A	 This is a token of the root cause, "Accepting a higher than normal level of risk". See discussion (2) following I don't believe this is a root cause any more than, "following an incorrect instinct", would be.
An instructor may get bored operating with students on activities well below their own personal level of skill and challenge. To counter this boredom they may choose to undertake an activity with a higher level of risk. This following of personal goals rather than the organisational goals, which are student oriented, can lead to accidents.	Yes	Either a token of, "Arousal / physical state not appropriate", or , "Personal values / beliefs followed".
Hubris refers to overbearing pride, presumption or arrogance in a person's character. Hunt believes hubris can lead to accidents when instructors lose the respect they once had for the dangers and seriousness of wilderness areas, often because of their past successes in a particular area and the fact that they now have higher skill levels.	Yes	Either a token of, "Inaccurate assessment of the risk", or, "Ego issues".
Incorrect assumptions – assuming a	Yes	This is a token of the root cause,

slope is safe based on prior information which may be incorrect. Rather than seeking new information in the field to revise the assumption, they look for other information that reinforces their already held assumption.		"Poor situational awareness".
The herding instinct – People are more bold in a group than on their own, yet in avalanche terrain the more people the greater the hazard.	Yes	Another name for the token, Risky shift
Attitude – Pride, ego, hubris can easily produce unyielding behaviour in the face of contrary evidence. People with high risk-taking attitudes can filter information about potential hazards and draw unrealistically optimistic conclusions. Attitude; ego and goal orientation can all lead to a tunneled vision.	Yes	This is a token of, "Inaccurate assessment of the risk
Testosterone – Males tend to make riskier decisions than females.	Yes	This is a token of "Ego issues"
Weather and perception – A disproportionate number of avalanche accidents occur on blue-sky days. The authors believe sunny days make us feel good and we can ignore objective information from the snow pack. In contrast if people are traveling in stormy conditions they can also cut corners in hazard evaluation to get home and expose themselves to higher risk as well.	Yes	This demonstrates two tokens. One of "Inaccurate assessment of risk", and the other of, "Accepting higher levels of risk than normal".
City thinking versus mountain thinking – The avalanche doesn't care if we have a meeting to get back to, if we paid a lot of money to fly into the hills, if we are lost in conversation – the hazards have to be assessed continually and on the mountains terms.	Yes	This demonstrates two tokens. One of "Inaccurate assessment of risk", and the other of, "Accepting higher levels of risk than normal".
Avalanche skills versus travel skills – Most people getting caught in avalanches are very skilled at their sport (skiing, snowboarders, snowmobilers) but their skill level has outpaced their avalanche skills, and they often vastly overestimate them.	Yes	This is a token of the root cause, "Inaccurate assessment of risk".
Communication – Poor communication is a common denominator in almost all mountaineering accidents.	No	See discussion (2) following

Table 15 confirms that the types of root causes identified from the outdoor education sector have, in the main, been identified by studying the literature of safety management. There are some root causes identified through the outdoor education literature however, that currently don't fit under the current list of types of root causes. These are:

(1) Appropriate safety policies, philosophies, goals, learning objectives, etc., written in a staff manual. While having appropriate safety policies is covered under the current list of Management System Errors, having an appropriate match of philosophies, goals and learning objectives to the client abilities is not covered. This needs to be included as an addition to the list.

(2) The outdoor education literature refers to inadequacies in the instructor's use of leadership style, teaching progression and communication as root causes of outdoor incidents. While it could be argued that these are covered as tokens of the root cause, "Skills / experience level inappropriate", leading to an overload situation for the instructor, I don't believe this is completely valid. If overload was to occur, according to Figure 29 this should lead to the instructor making either a slip, lapse, mistake or violation. In this case however, we are addressing the misapplication or lack of skill causing an instructor performance issue, resulting in what may have been a good plan failing. For this reason I believe clarity will be improved in the model of root causes in Figure 29 if a further basic error category is introduced. I will term this category of error a <u>failure</u>.

<u>Failure</u> is defined for this research as a plan not achieving the desired objective due to the misapplication of a skill on the instructor's part. The skill misapplied may be any of hard skill, soft skill or metaskill. Priest & Gass (1997, pp. xvi-xvii) offer definitions of these three skill types:

a. Hard skills being the technical skills that are tangible, measurable and easier to train and assess. Examples given are abilities of leaders to climb, paddle, and peddle; to find their way from origin to destination without getting lost or injured; and to camp along the way without leaving a mess.

b. Soft skills are more amorphous, intangible and harder to measure. They include the ability to instruct, organise and facilitate goal achievement in people.
c. Metaskills are those areas that combine hard and soft skills into a workable design. Examples given include leadership style, effective communication, ethical behaviour, etc. (Note: judgment is also considered a metaskill but this is being treated separately in this study).

Because of the importance of this facet in the outdoor education context, it is essential to add this new category 'failure' as a root cause of instructor error.

4.6 Proposed Model of an Outdoor Education Incident Including an Interim Taxonomy of Root Causes

Based on the combined knowledge gained from the literature review, a simplified model of an outdoor education incident is presented in Figure 30, with a more detailed version in Figure 31. These models are adapted from those already in existence in safety management literature, with modifications to allow for the inclusion of specific knowledge unique to outdoor education contexts.

Figure 31 not only shows a model of an outdoor incident, it also provides a taxonomy of error leading to that incident. As discussed in Chapter 3, phases two (Chapter 6) and three (Chapter 7) of this research investigate the validity of this model by comparing it to the analysis of the root causes of actual incidents that have occurred in the outdoor education sector.

Figure 30. Proposed model of an outdoor education incident (Simple version)

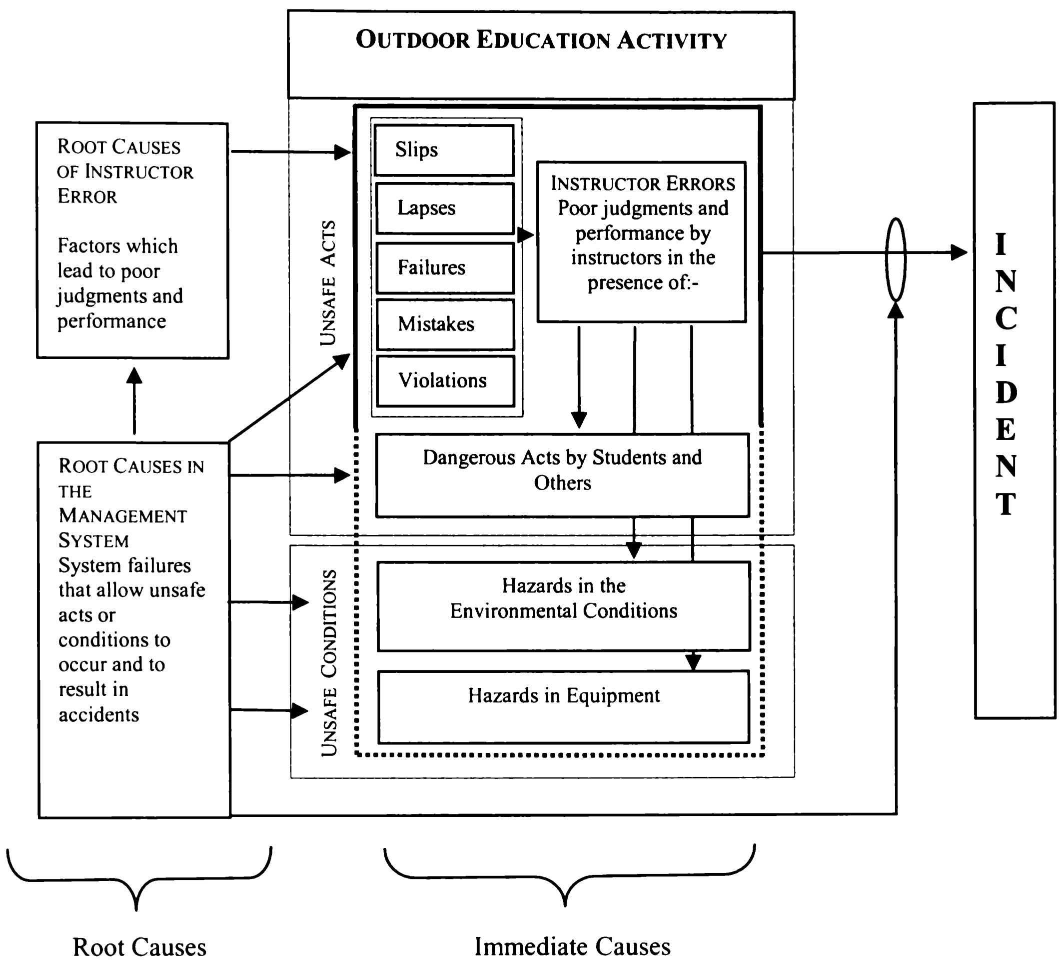
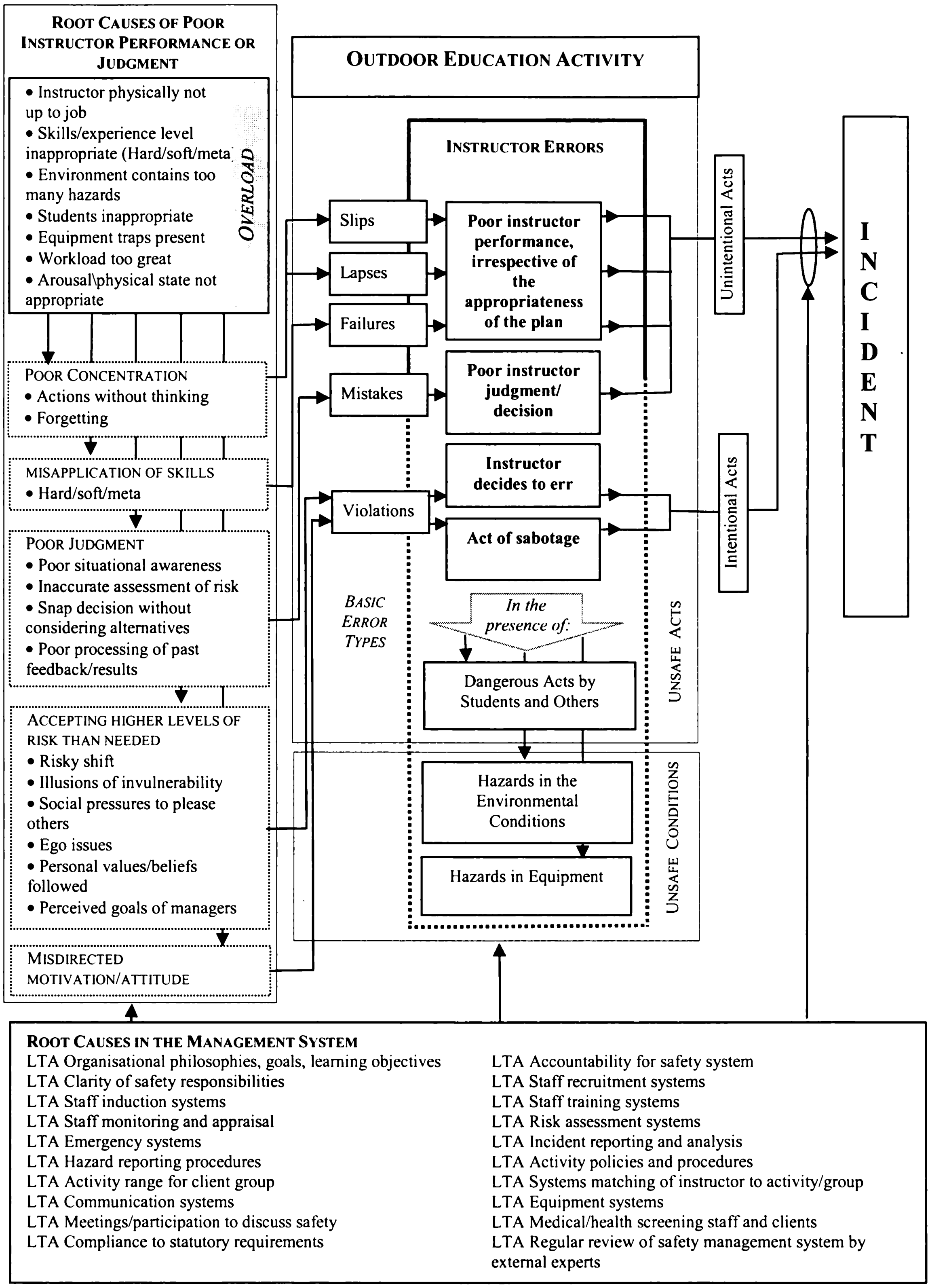


Figure 31. Proposed model of an outdoor education incident (Full version)



4.7 A Tool to Analyse Root Causes in Outdoor Education Incidents.

4.7.1 Criteria for an Effective Incident Analysis Tool

In order to carry out the analysis of root causes of actual outdoor education incidents, it is necessary to have a way of depicting any incident so that those analysing the incident can understand the interplay of events and immediate causes, and how these lead to identifying the root causes. It is widely held in safety management literature that the right tool applied in the right situation can make a significant contribution to the efficiency and effectiveness of that investigation (Frei, Kingston, Koornneef & Schallier, 2004). As explained in the earlier sections of this literature review, the immediate causes of incidents are more easily identified by practitioners and therefore these causes need to be included in any analysis. Subsequently, those viewing the depiction of the incident can be forced to look further for the root cause leading to those immediate causes.

The tool that is required must be easily interpreted by an outdoor education practitioner with little in-depth knowledge of safety theory. For this reason it should include a chronological flow of events that occurred, should document the immediate causes as explained above and should lead the reader to look for the root causes in the two categories of instructor performance / judgment and the management system (Figure 30), which lead to instructor and management system errors.

4.7.2 Existing Tools in the Field of Safety Management

It seems logical to look for an appropriate tool from the extensive literature in the field of safety management that can be adapted for use in the outdoor education sector. A number of risk analysis and accident analysis techniques exist that are in common usage. These techniques are many and diverse. Keong (2004a; 2004b) classifies most of the common tools under the respective headings as shown below:

<u>Risk Analysis Methodologies</u>

- Qualitative Methodologies
    - Preliminary Hazard Analysis (PHA)
    - Hazard and Operability Studies (HAZOP)
    - Failure Modes and Effects Analysis (FMEA)
- Tree Based Techniques
    - Fault Tree Analysis (FTA)
    - Event Tree Analysis (ETA)
    - Cause-Consequence Analysis (CCA)
    - Management Oversight Risk Tree (MORT)
    - Safety Management Organisation Review Technique (SMORT)
- Techniques for Dynamic Systems
    - Go Method (GM)
    - Digraph/Fault Graph (DFG)
    - Markov Modelling (MM)
    - Dynamic Event Logic Analytical Methodology (DELAM)
    - Dynamic Event Tree Analysis Method (DETAM)

<u>Accident Analysis Techniques</u>

- Traditional Approaches
    - Sequence of events (Domino effect)
    - Known precedent
    - Hartford EMP
    - Multilinear Events Sequencing
    - Technique of Operations Review (TOR)
    - Change Analysis
- System Safety Approach
- Accident Framework

4.7.2.1 Qualitative Methodologies

These are a group of qualitative techniques that focus on possible hazards and causes of failure with individual components or entire plants. These methodologies are generally centred on hardware issues rather than incorporating the causes of human error. FMEA is a more time intensive analytical technique that explores the effects of failures or malfunctions of individual components in a system and can be used to give quantitative results (Institution of Electrical Engineers, 2004c; Petersen, 1980).

4.7.2.2 Tree Based Techniques

Although these can be used to analyse incidents in retrospect, these diagrams are more usually employed to assess risks and assign quantitative measures to statistical likelihood of major events occurring (Institution of Electrical Engineers [IEE], 2004a, 2004b; Johnson, 1980; Petersen, 1980). These techniques employ either binary or Boolean arithmetic and assign quantitative statistical probabilities to events occurring.

4.7.2.3 Techniques for Dynamic Systems.

These are extensions of tree based techniques that can be applied to dynamic systems that allow probabilities of loss events to be calculated; although they require significant computer power.

4.7.2.4 Traditional Approaches

This is a group of well used analytical techniques that are employed to identify incident sequence and seek unsafe acts and conditions leading to the incident event.

- Sequence of events (Domino effect) analysis can be shown to date back to the early work of Heinrich in 1929 (Ferry, 1988). It seeks to trace underlying factors back through the causal chain illustrated in Figure 8. It does not give an overview of the chronology of the incident or show how multiple root causes interact to produce the incident.

- Known precedent. This technique uses historical data of similar events to identify clues for the new mishap. It is based on the precept that there are no new causes that can be identified.
- Hartford EMP. This technique asks questions to identify causal factors under the headings of equipment, material and people. Although causal factors will be identified, there is no chronological depiction of the incident produced and root causes are not established using this technique.
- Multilinear events sequencing. This technique charts incident process with every event and condition leading to the incident charted in chronological sequence. Root causes can be investigated by examining each of the individual events to understand what may have brought them about and what changes could be introduced to alter the process. Two of the more common examples of this technique are:
    - Cause and Effect Diagrams - Known variously as Ishikawa diagrams after their creator, or fishbone diagrams after their appearance, these establish an hierarchical relationship between the effect, the main causes of the effect, and their subsequent relationship to the sub causes. Cause and effect diagrams provide a systematic graphical representation of the trail that leads ultimately to the root cause of a quality concern or problem (Brigham Young University, 2004; Mindtools, 2004). Although this sounds suitable for use in this research, the technique is most commonly used as a brainstorming tool for a team wanting to analyse possible causes for problems, often before any event.
    - Events and causal factor analysis (ECFA) is a stand alone technique for the investigation of incidents but can be used in conjunction with other tools for very powerful results. It is specifically designed so that incident investigators can probe deeply into both the events and conditions that create incident situations so that root causes can be identified.

- Technique of operations review is generally used as a diagnostic training and mishap prevention tool directed at finding management oversights.
- Change analysis compares the incident situation with a comparable incident-free situation, analyses the differences and from this suggestions for change are made.

4.7.2.5 System Safety Approach

This approach uses a combination of FTA, FMEA, PHA and MORT to investigate a system for causal factors and remedies.

4.7.2.6 Accident Framework

Pate-Cornell (1993) has developed an analytical framework to establish the causal relationship between the basic events, decision and actions, and organisational factors leading to an incident. From this risk reduction methods can be formulated based on the causal relationships between the stages.

4.7.2.7 The Most Applicable Tool for the Investigation of the Root Causes of Outdoor Education Incidents

As explained in the introduction to this section, a successful tool for use in this study is one that: shows the chronological flow of events leading up to the incident itself; documents the immediate causes of the incident; and, allows the identification of the root causes of the incident in the two categories shown in Figure 30 (Instructor judgment / performance error and management system error).

Of the techniques outlined above, most may be discounted:

- 'Qualitative Methodologies' focus on hardware issues rather than human errors and are therefore inappropriate;
- 'Tree Based Techniques' and extensions of these for 'Dynamic Systems' are concerned with calculating mathematical probabilities of loss occurring through sophisticated statistical methods. This is not the aim of this research.

- 'Systems Safety Approaches' and the 'Accident Framework' use combinations of the methods already discounted. The inappropriateness of the individual methods for use in this study remain in combining the methods.

The only group of methods that can not be discounted as being applicable for use in this study are the 'Traditional Approaches'. Of these the 'Known precedent' technique does not allow for new causes to be identified and is therefore unsuitable, and both the 'Hartford EMP' and 'Cause and Effect Diagrams' do not produce a chronological sequence and can therefore be eliminated. The 'Sequence of Events' technique meets many of the criteria for use in this study and has been used by Haddock (2003) in examples of outdoor education incidents. It is inadequate in its ability to direct an incident investigator to the categories of root causes as required in this study. Both the 'Technique of Operations Review' and 'Change Analysis' do not seek to identify the categories of root causes of incidents.

The one remaining 'Traditional Approach' is the 'Events and Causal Factor Analysis' (ECFA). This meets all of the criteria established to be useful in this study.

4.7.2.8 Summary

A comprehensive review of incident investigation tools has shown that the ECFA tool is the most applicable for use within outdoor education as it best meets the criteria identified for a successful outcome in establishing root causes in outdoor incidents.

4.7.3 Events and Causal Factor Analysis (ECFA)

4.7.3.1 Uses and Advantages of ECFA

ECFA is a tool designed to identify root causes by understanding the interaction of events and causal factors through a chronological chain of activity starting with an initiating event through to the final loss-producing occurrence. The incident causing factors emerge through this process as sequentially or simultaneously occurring events that interact with existing conditions. This tool is able to deal with and express logically the multifactorial causes of any incident and define the sequences of events which could involve performance errors, changes, oversights and omissions (Buys, Clark, Kingston-Howlett & Nelson, 1995).

Buys et al. (1995) believe this tool is ideal for the investigation of incident causation and presenting factual findings, probable causes and contributing factors in a logical sequence that can be used to validate or dismiss ideas among those investigating the incident. The events and causal factors will usually not be uncovered in sequence and so a skeleton chart will be produced initially which can be augmented as more information is collected. The chart will also indicate further areas that should be investigated. Buys et al. (1995, pp. 7-8) point out that the specific purposes of the ECFA technique include:

- Aiding in developing evidence, in detecting all causal factors through sequence development, and in determining the need for in-depth analysis;
- Clarifying reasoning;
- Illustrating multiple causes. As previously stated, incidents rarely have a single "cause". Charting helps illustrate the multiple causal factors involved in the accident sequence, as well as the relationship of proximate, remote, direct and contributory causes;
- Visually portraying the interactions and relationships of all involved organisations and individuals;
- Illustrating the chronology of events;
- Providing flexibility in interpretation and summarising collected data;
- Communicating empirical and derived facts in a logical and orderly manner;
- Linking specific incident factors to organisational and management control factors.

The above attributes recommend the ECFA technique over other common approaches in investigating the root causes of outdoor education incidents.

4.7.3.2 Description of the ECFA Technique

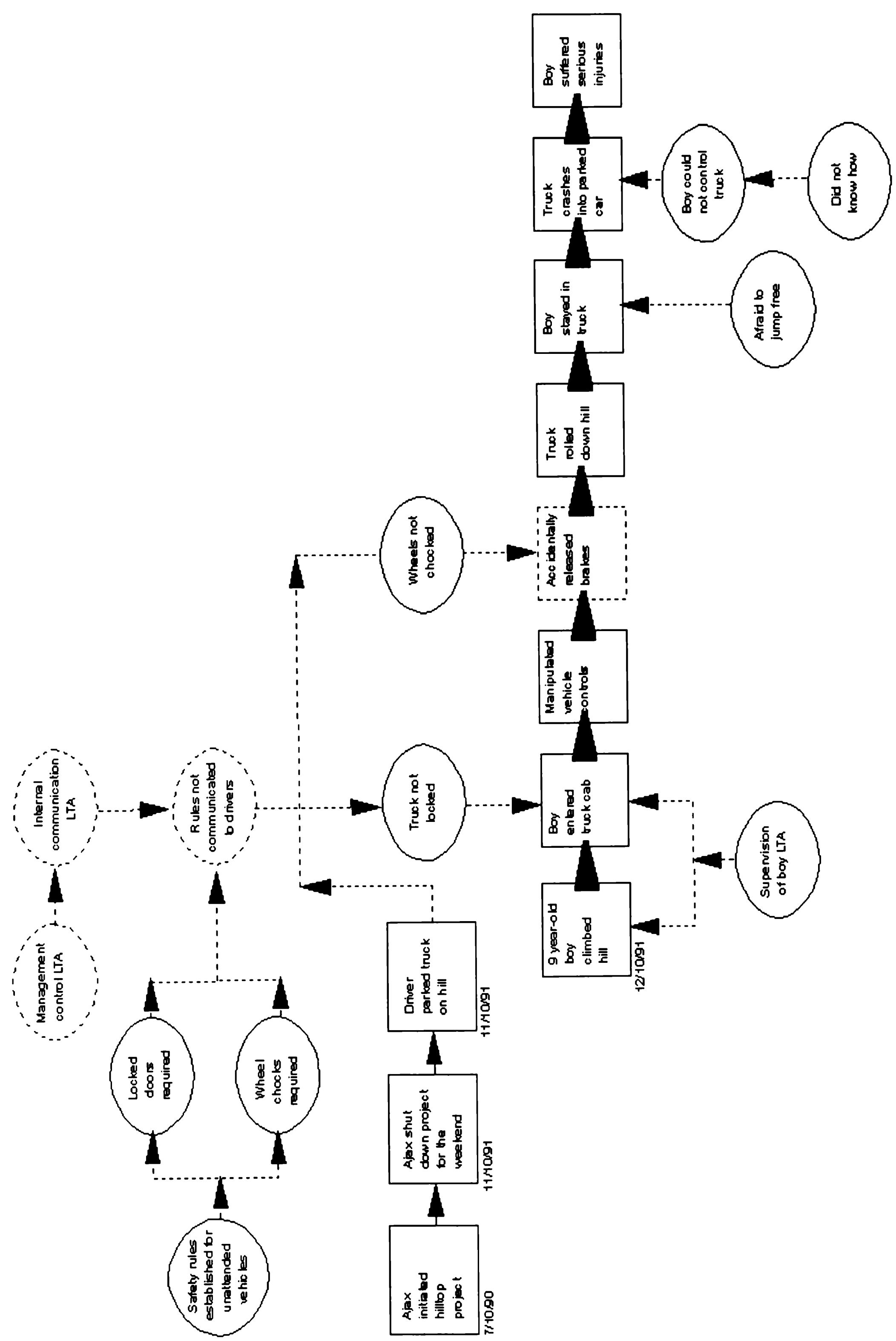
The ECFA technique produces a chart or diagrammatic interpretation of the incident by utilising a set of stringently applied conventions to depict the various events, and causal factors, and how they are linked.

Buys et al. (1995) used the terms 'event' and 'condition' in a different way than these terms have been used earlier in this thesis (e.g., Figure 8). An 'event' is described as an occurrence or happening (pipe ruptured) and not a condition, state, circumstance, issue, conclusion, or result (pipe had a crack in it). In an ECFA diagram each 'event' should describe a single discrete occurrence and be expressed precisely in a short sentence with one subject and an active verb.

Buys et al. (1995) discussed 'conditions' which differ from 'events'. 'Conditions' describe states or circumstances rather than happenings or occurrences and are passive rather than active. In the terms identified in Figure 8 to describe the causal sequence of any incident, 'conditions' are equivalent to the 'causal factors' of incidents. For consistency, the term 'causal factor' will be used in this study rather than 'condition' in the description of the ECFA technique. As far as practical, when producing an ECFA diagram, the causal factors should be described, quantified, posted with time and date and be derived from the causal factors preceding them.

'Events' are depicted by rectangles and 'causal factors' by ovals. Solid objects represent 'events' or 'causal factors' that are known to be factual while dashed-line objects represent those that are presumptive (See example in Figure 32). 'Events' are arranged chronologically from left to right and joined by solid arrows. The primary sequence of events should be depicted in a straight horizontal line (or lines in confluent or branching primary chains). Secondary event sequences, contributing factors, and systemic factors should be depicted on horizontal lines at different levels above or below the primary sequence. 'Causal factors' are connected to each other and to events by dashed arrows.

Figure 32. Example of ECFA Chart (Buys et al., 1995, p.10)



Buys et al.(1995) described key elements in applying the ECFA tool to achieve high quality incident investigations:

- Start a "working chart" of events and causal factors as soon as you start accumulating factual information on events and conditions related to the incident.
- Use the conventions described above for reconstructing the sequence of events but remember that they are not hard and fast rules and if a unique situation presents itself then be prepared to deviate from the guidelines for the sake of clarity and simplicity.
- It is usually easiest to use the incident or loss event as the starting point and reconstruct pre-incident and post-incident sequences from that vantage point. Initially there will be many gaps and deficiencies in the chart. Efforts to fill these gaps will lead to deeper probing by investigators that will uncover the generally agreed 'facts' involved.
- As additional events and causal factors are uncovered and analysis of these identify further causal factors, the working chart will need to be updated. Choose a format which displays emerging information in an easily modified form. The use of post-it notes has proved a useful technique to accomplish this goal.
- Select the appropriate level of detail and sequence length for the chart. Whether the chart finishes at the loss-producing event or whether the amelioration phase should be included will depend on the incident. Certainly, if further incidents occurred during rescue attempts or emergency action, or if there were other specific or systemic problems revealed, then the ECFA should include this phase.
- The ECFA chart will generally contain much more detail than required for an investigation report. An executive summary chart can be prepared showing the major issues to be addressed if this is relevant for clarity.

4.7.3.3 Adapting the ECFA Technique for the Analysis of Outdoor Education Incidents

The ECFA technique was used in the second phase of the data collection of this research to establish the root causes of a number of outdoor incidents. These root causes were then compared to the taxonomy of root causes contained within the proposed model of an outdoor education incident shown in Figure 31.

I modified the conventions of the ECFA chart to improve the clarity of the final analysis and to make it easier for an outdoor educator reading the chart to recognise immediate causes, root causes leading to poor instructor performance or judgment, and root causes that are management system errors.

Causal factors were differentiated into immediate causes, root causes due to instructor performance / judgment errors and root causes due to errors in the management system.

From the discussion earlier in this chapter (e.g., Figure 30), immediate causes can be either unsafe acts (instructor, students or others) or unsafe conditions (equipment, resources, or environment). The unsafe acts of instructors were treated differently from other immediate causes in this study and placed in the 'event' sequence using a unique shaped box. This was done to pay special attention to the instructor judgment / performance in order to analyse this special event for root causes, and to separate instructor actions from other 'immediate causes' that are within the instructor's role to manage (consistent with Figure 30). Any unsafe act by the instructor in the event sequence was represented by an octagonal box. I chose to use this symbol because it is also the shape used in traffic stop signs and so subliminally conjures a warning message.

All other classes of immediate causes were shown as ovals according to the standard ECFA conventions.

Root causes that lead to poor instructor performance or judgment were represented by parallelograms and those root causes representing management system errors were represented by rectangles with rounded corners.

The event sequence was linked with solid arrows, chronologically from left to right, while immediate causes and root causes were linked by arrows with dotted lines.

Any causal factors (immediate or root causes) that had factual confirmatory evidence were shown as solid shapes, while those that were speculative or subjective in nature were shown as dotted-line objects.

An example of this is shown by producing an ECFA chart (Figure 33) for the simple incident described in Haddock (2003).

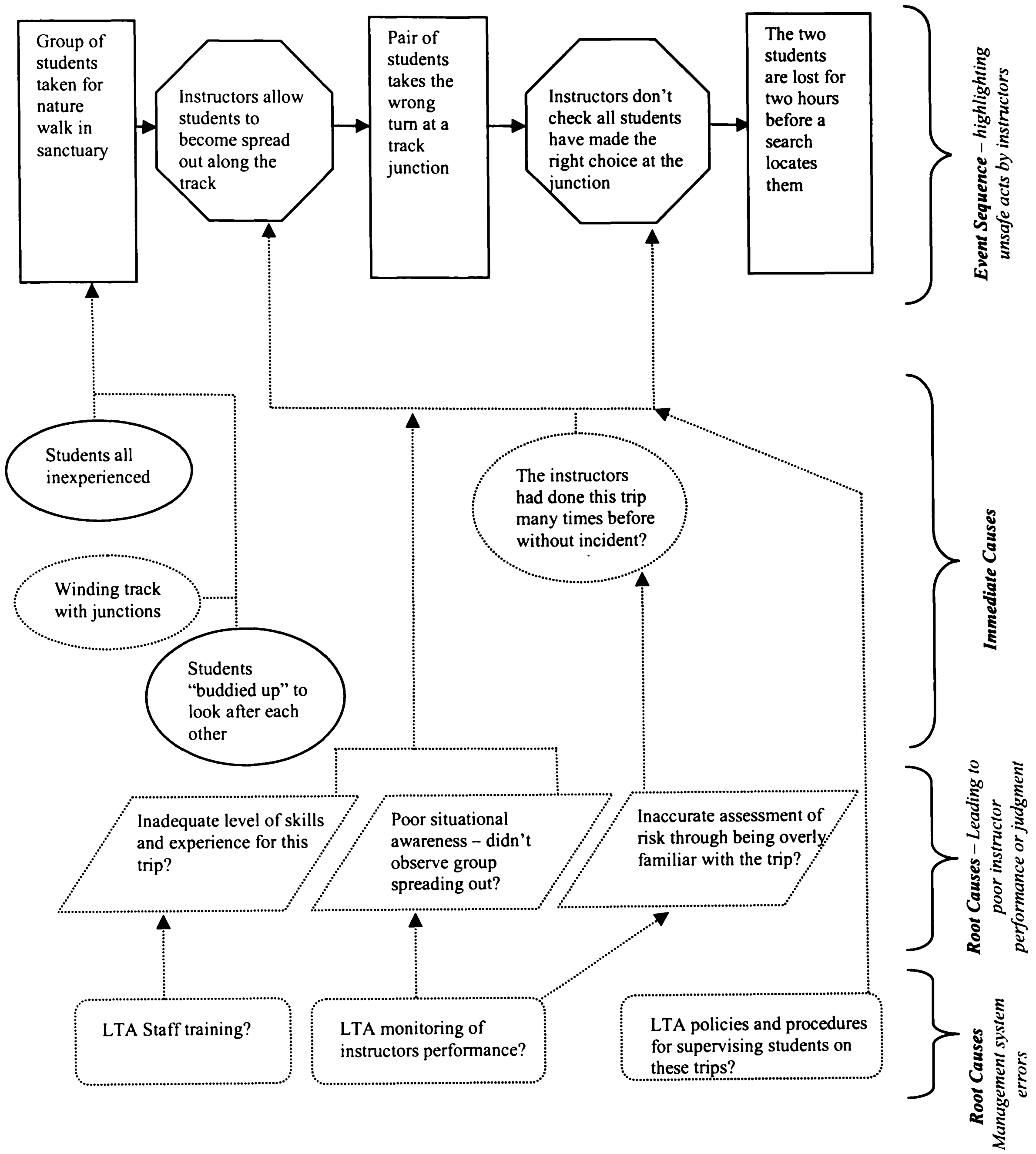
> *"A pair of children was missing at the end of the walk through the sanctuary. Although the children were buddied-up, and adults were assigned groups to look after, some children couldn't see anyone in front or behind them as the party spread out near the end of the walk. Consequently, one pair took a wrong turn at a junction"(Haddock, 2003, p.56).*

Note that in Figure 33 all of the root causes and two of the immediate causes were considered to be speculative (shown as dotted-line objects) because the narrative did not give any firm evidence of their 'factual' status. If further evidence became available to support these causes, they could have been drawn as solid objects.

4.7.4 Summary

A large range of tools exist to analyse the causes of incidents or to manage risk leading to incident potential. Some of these are more suitable for pre-activity analyses, while others are more suitable for post-incident evaluation. Careful investigation of the range of available tools led to the Events and Causal Factors Analysis (ECFA) system being adopted for use in this research. This tool was chosen from the many on offer because it most closely represented an incident in a way that was understandable to an outdoor educator while allowing the depth of causal analysis required for the study of outdoor education contexts. The ECFA technique was adapted to make it more usable in outdoor education situations and more suited to the identification of root causes in this setting.

Figure 33. Example of modified ECFA for use with outdoor education incidents



4.8 Summary of the Literature Review

Little information could be found in the outdoor education literature from any part of the world that profiles the type, occurrence and frequency of outdoor incidents. There was almost no literature that was specific to New Zealand outdoor education. An initiative by the Wilderness Risk Management Committee to collect data across a range of outdoor education providers in the USA has been limited by small numbers and sampling inconsistencies. Nevertheless, this initiative has produced some preliminary data that can be compared with New Zealand statistics compiled as part of this study.

The outdoor education literature also shows that models of outdoor education incidents and their causal sequences are poorly developed. There is a general mixing of events, conditions and underlying root causes in both the models and accompanying explanations of the causal factors. This confusion leads to a lack of understanding of causes and a difficulty for managers in setting priorities to correct weaknesses in their safety systems. This lack of literature confirms the need for the present research.

Contrasting with the outdoor education literature, there are many existing models of incident causality in the literature of safety management. These models all have the common elements of:

- multiple causality: where an accident is rarely due to one thing but usually due to a number of factors coming together and combining to produce an incident potential;
- levels of causality: where the causes of an accident can be traced back from more easily observable factors to the underlying root causes of error. Addressing these root causes will lead to long-term solutions for removing incident potential.

These existing models were adapted, taking into account specific information on outdoor education incidents, to provide a model of an outdoor education incident. This model (Figure 31) provides a diagrammatic representation of how the root causes of error combine to produce an incident. The root causes of any incident are shown to fall under the headings of either: factors leading to poor performance or judgment by the instructor, or; management system errors. In Chapter 7 of this research, the model is compared with the root causes of actual outdoor education incidents identified in Chapter 6 to test the validity and completeness of the model.

A potential trap was discovered in trying to list root causes of outdoor education incidents: In identifying the root causes of incidents it is easy to be overspecific and the list of root causes can then become very large and of limited practical use. It is therefore more sensible to try to list categories (types) rather than the many possible individual (tokens) root causes.

Finally, a tool to diagrammatically represent an outdoor education incident was required for this study. The Events and Causal Factors Analysis (ECFA) system was chosen and adapted because it diagrammatically represents an incident in a chronological sequence while clearly identifying the events, the immediate causes, and the root causes leading to the incident. This should make the causal factors of the incident understandable to an outdoor educator while allowing the depth of analysis required for this study.

The results of this literature review will be used in the chapters that follow. The statistical information gathered about the outdoor education incidents will be compared against empirical data about New Zealand outdoor education incidents in Chapter 5. The ECFA system developed in this chapter will be used in Chapter 6 to combine and share the thoughts of a number of experts involved in a Delphi process to analyse serious outdoor education incidents. Through this process the root causes of a number of serious outdoor education incidents will be identified and collated. In Chapter 7 the taxonomy of error (Table 14) and model of an outdoor education incident (Figure 31) will be used as a 'lens' to focus the results of Chapter 6 into a proposed model and taxonomy of error for outdoor education incidents.

CHAPTER FIVE

RESULTS AND DISCUSSION: A PROFILE OF NEW ZEALAND OUTDOOR EDUCATION INCIDENTS 1996 – 2000

5.1 Introduction

In this chapter the incident data gathered from outdoor centres for the period from 1996 – 2000 are analysed.

The sample of the outdoor education sector studied was restricted to larger outdoor education centres that were more likely to have incident reporting systems and employ full-time staff who would be able to respond in a timely manner to enquiries. Of the 25 centres that were identified from the Outdoors New Zealand database that met the criteria of having three or more full-time staff, 12 agreed to contribute incident data. That data was input into a specifically designed Access database.

These data were analysed using quantitative techniques to establish a profile of outdoor education incidents for the period studied. The same techniques were used to identify factors that are predictors of incidents with high potential for serious injury.

5.2 A Profile of New Zealand Outdoor Education Incidents 1996 – 2000

5.2.1 Breakdown of Data According to Incident Type

When all data had been entered from the 12 contributing organisations, 1908 incidents were recorded and classified according to "Incident Type" as shown in Table 16.

As already discussed in Chapter 3, the data in Table 16 and the analysis that follows, is a self-selected sample from the outdoor education sector in New

Zealand. Also, each organisation recorded incidents according to its own criteria, and these varied from one centre to another. The potential for bias in the results is thus considerable and any generalisations to the greater population of outdoor education providers in New Zealand need to be made with caution.

In terms of completeness of data for each of the 12 organisations surveyed, it is assumed that the data for deaths and injuries are likely to be more accurate as a complete record than for any of the other categories. This belief is based on the premise that all organisations collecting data would believe it important to record data on deaths and injuries, especially injuries of moderate or major severity. Other categories of incident type mentioned above are less likely to be recorded unless either the organisation has a rigorous reporting process in place, or the loss is significant. For example, the one reported incident of environmental damage resulted in fire destroying a large area of vegetation and the fire had potential for even worse consequences. Many other environmental incidents with less serious outcomes may have occurred without being reported. Recording of near misses comes down to the openness of instructional staff to share these incidents with others and this openness can be significantly affected by the culture in the organisation concerned and what is done with the data. Most of the following analysis is restricted to the top three rows of Table 16 (Deaths, Injuries and Near misses) because of the assumed incompleteness of the other data.

Table 16
Number of Recorded Incidents Grouped According to Incident Type for the 12 Participating Organisations (1996 – 2000)

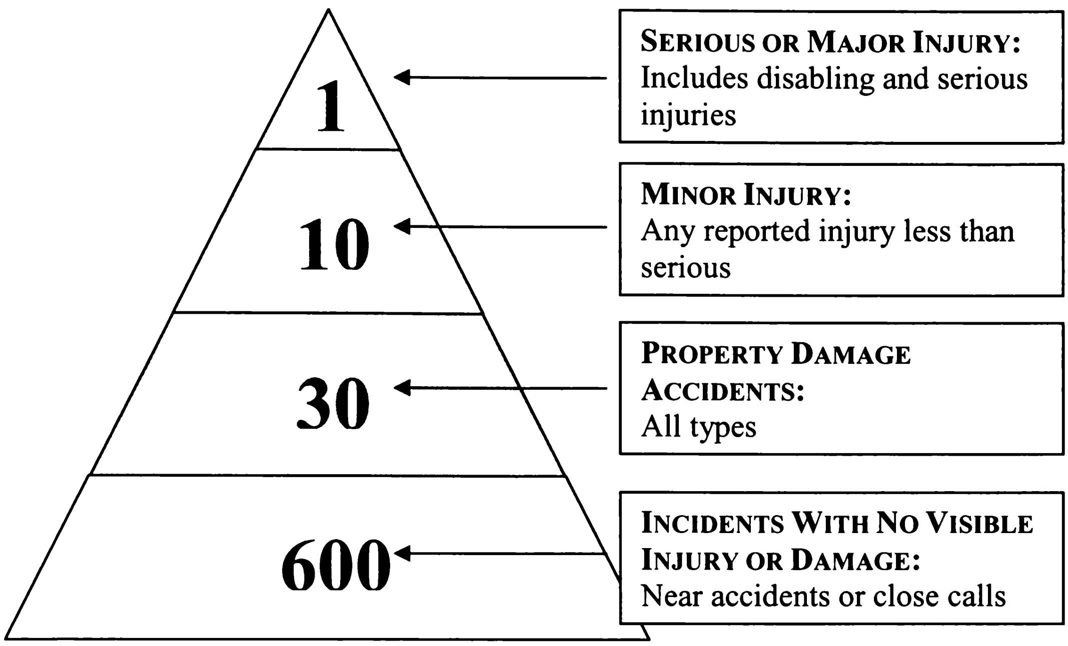
Incident Type	**Number of Recorded Incidents 1996 - 2000**
Death	0
Injury	1154
Near Miss	448
Illness	219
Loss of Process	2
Emotional/psychological	25
Damage to Equipment	59
Environmental Damage	1
TOTAL	1908

There were no recorded deaths in the years surveyed. This may be an anomaly of the survey years rather than any global measure of success in managing risk, as there have been deaths and other very serious incidents in some of the contributing organisations outside the surveyed years. As shown by Table 7 in Chapter 4, The New Zealand Mountain Safety Council (MSC) keeps records of all deaths in the New Zealand outdoors. These records are compiled from the findings of Coronial Inquests. At the time of writing the records have been completed only up to the year 1998. Coroners' reports have been collected for 1999 and 2000 but there has been no human resource available to update their records. The data to 1998 record 140 deaths in the category of Instruction, Guiding or Professional Care (IGPC) over the 20 year period: an average of seven per annum. However, when allowance is made for two exceptional tragedies in 1991 (Ruapehu) and 1996 (Cave Creek) that may be regarded as statistical outliers, the average reduces to 120 deaths or six per annum. Furthermore, when non-educational IGPC incidents are excluded the total is 59 (excluding the Ruapehu and Cave Creek accidents) or three per annum.

5.2.2 Ratios of Accident Severity – The Accident Triangle

Often quoted in the safety management literature is a landmark study of industrial accidents undertaken in the USA in 1969 (Bird & Germain, 1989). This study was an analysis of 1,753,498 accidents reported by 297 cooperating companies. The companies represented 21 different industrial groups employing 1,750,000 employees who worked over three billion person-hours during the exposure period analysed. The study revealed the ratio shown in Figure 34.

Figure 34. Industrial accident ratio study (Bird & Germain, 1989, p.21)



The authors of this study emphasised that the ratios listed represent only those incidents that were reported, rather than the number that actually occurred and also that the ratio may not hold for any particular occupational group or organisation. Further, the authors pointed out that the significance of this study is that major incidents are rare events and that there are many more opportunities to study less serious incidents and take actions to prevent the major losses from occurring. An important corollary to this statement is that action is most effective when effort is directed at incidents that have a high loss potential.

Unfortunately this study, and the diagram shown in Figure 34 is sometimes misrepresented. At safety seminars and risk management courses, tutors have been observed explaining to students that 600 near accidents lead to 30 property damage incidents, which lead to 10 minor injuries, which in turn leads to 1 major injury. They summarise by stating that the way to stop major incidents is therefore to study and stop the minor incidents. For example,

> "The importance of such a triangle is that many lessons can be learnt from the bottom line and no one has suffered any injuries. If we can prevent the near misses from occurring then we can also prevent the minor or major injuries from occurring" (Wharton, 1996).

What Figure 34 was intended to indicate is that accidents are the culmination of a number of factors coming together to produce an accident potential. Once the sequence has been initiated, the type and degree of loss are somewhat a matter of chance, depending partly on fortuitous circumstance and partly on actions taken to minimise the loss (Bird & Germain, 1989). What is needed to prevent serious accidents therefore, is to look not only at the causes of the serious accidents that have occurred, but also at incidents that have high potential for serious loss.

Unfortunately, of all the organisations surveyed for the New Zealand outdoor education sector, only one recorded some form of severity rating for the incident concerned and its potential outcome. Even this organisation did not systematically categorise incidents according to potential severity and analyse those incidents with high potential severity in a different manner to other recorded incidents.

For all 1908 incidents recorded, a rating of the actual severity of the outcome was assigned and also its potential severity. The potential severity ranking that was assigned was the author's subjective view of what might have eventuated due to the sum of hazards present at the time. To assign a severity rating, the Severity Scale shown in Table 4 in Chapter 3 was used. This scale was developed based on a model devised by Priest (1996a).

Restricting the cases to only those where an actual injury occurred while a group of students was under instruction, produces the severity distribution shown in Table 17.

The results shown in Table 17 represent the New Zealand outdoor education sector's version of the accident ratio study and can be compared with the top two sections of Figure 34. The ratio of serious to less than serious incidents is fairly comparable between the major USA safety study and the outdoor education sector analysed in the current study. The outdoor education sector has produced a ratio of 1:16 (Actual data 6:94), which is in a similar order of magnitude to the 1:10 ratio shown in Figure 34.

Table 17
Number of Injuries, Sorted by Severity, for Incidents Occurring While Under Instruction for the 12 Participating Organisations (1996 – 2000)

RATING OF THE ACTUAL SEVERITY OF INJURY	NUMBER OF INJURIES REPORTED	SEVERITY GROUPING	NUMBER	PERCENTAGE OF TOTAL
1	26	Any injury less than serious	929	94
2	228			
3	323			
4	165			
5	187			
6	55	Serious or major injury	59	6
7	1			
8	3			
9	0			
10	0			
NB:N = 988 of the 1154 injuries indicated in Table 16. The remaining 166 were injuries that occurred outside of the time supervised by an instructor. Also, 7 of these injuries were to accompanying teachers or the staff member **Serious Injuries:** 32 fractures, 21 dislocations, 2 spinal damage, 2 burns, 1 concussion, 1 contusion				

Table 18
Near Misses Grouped According to the Potential Severity of their Outcomes, for Incidents While Under Instruction for the 12 Participating Organisations (1996 – 2000)

RATING OF THE POTENTIAL SEVERITY OF INJURY	NUMBER OF NEAR MISSES REPORTED	SEVERITY GROUPING	NUMBER	PERCENTAGE OF TOTAL
1	0	Potential for an injury that is less than serious	228	51 (Near misses <u>without</u> potential for serious injury)
2	12			
3	38			
4	44			
5	134			
6	104	Potential for a serious injury	220	49 (Near misses <u>with</u> potential for serious injury)
7	35			
8	33			
9	46			
10	2			

There have been at least two attempts to measure this ratio for the outdoor education sector in the past. Wharton (1996) suggested a ratio of 1:50 based on a subjective interpretation of an industrial study by Heinrich (1980). Wharton produced no empirical evidence to support his estimate. Brackenreg (1997) produced what he termed an 'indication' of the ratio by comparing the ratio of assisted evacuations to overall medical incidents on National Outdoor Leadership School (NOLS) courses over a ten year period. The assumption is that all serious incidents would require an assisted evacuation. This comparison produced a ratio of 1:49.

For each incident recorded I also assigned a potential severity rating. This used the same severity scale (Table 7) but was based on my subjective view of the potential outcome that could have been reasonably expected given the hazards that were encountered. By doing this it is possible to assess the value of investigating incidents with minor injuries as a way of preventing major injuries.

Of the 742 incidents that resulted in an actual injury with a severity rating of four or less, only 27 had the potential to result in an injury with a severity rating of six or more. This is only 3.6 per cent of all cases. It seems clear that there is little point in studying minor injuries in general as a means to prevent major injuries. Intuitively it makes sense that studying 300 stubbed toes is not going to prevent someone falling off a cliff. It seems useful to discriminate among accidents and restrict our efforts to those that warrant investigation by virtue of either causing major injury, or having the potential to do so.

Some researchers suggest that the probability of occurrence of the high severity outcome should also be considered (Bird & O'Shell, 1969; Haddock, 1999a; Johnson, 1980). My contention is that rating probabilities of occurrence is not a useful exercise other than through the simple test: Is there a reasonable probability that a serious injury could result? Once a hazard potential passes this test, every effort should be exerted to reduce the hazard. Another way of looking at this is by considering the Four Windows Matrix (Haddock, 1993) shown in Figure 35, which is commonly used to discuss risk management strategies in the outdoor sector.

Figure 35. Four windows matrix (Haddock, 1993, p.26)

Frequency of Occurrence		**LOW**	**HIGH**
	HIGH	**I** **Reduce Avoid**	**II** **Reduce Avoid**
	LOW	**III** **Retain**	**IV** **Reduce Transfer Avoid**

Severity of Condition

My contention is that those incidents producing situations where the potential severity is high (Types II and IV) should be treated differently from those where the potential severity is low (Types I and III), irrespective of frequency. Certainly there is a case for acting on recurrent, low severity injuries (Type I), especially where a common cause can be established, but not with the same urgency or rigour. It is important to classify the different types of incidents after they have been reported as either having high potential severity or low potential severity. None of the accident / incident recording systems surveyed in this study discriminated between these two categories.

As shown in Table 16, there were 448 near misses recorded. These near misses were also rated for their potential severity and the results of this analysis are shown in Table 18. Table 18 shows the value of reporting near misses. Those reported have an almost 50 per cent chance of signaling conditions that might lead to serious incidents as opposed to investigating all actual injuries where, as Table 17 shows, only 6 per cent were serious. It seems that instructors are reporting incidents that left an impression on them and which they realised at the time had potential for serious consequences. This is to be encouraged and management should be following up on these incidents.

Assigning severity ratings to incidents and comparing the percentage of reported incidents in each severity category, shows distinct differences in the reporting protocols of the different organisations.

The organisation profiles are shown in Figure 36. Figure 36a suggests that organisations F and K don't report many minor incidents, only major ones. This is further evidence to support the establishment of a common, standardised reporting protocol across the entire sector. Figure 36b shows that organisations E, G & I have a history from 1996 – 2000 of running activities that have not resulted in reported incidents that had the potential for serious injury. Organisations C and H on the other hand, are either running higher risk activities, or managing them poorly.

Figure 36. The number of incidents of differing severity as reported by the 12 participating organisations (1996 – 2000)

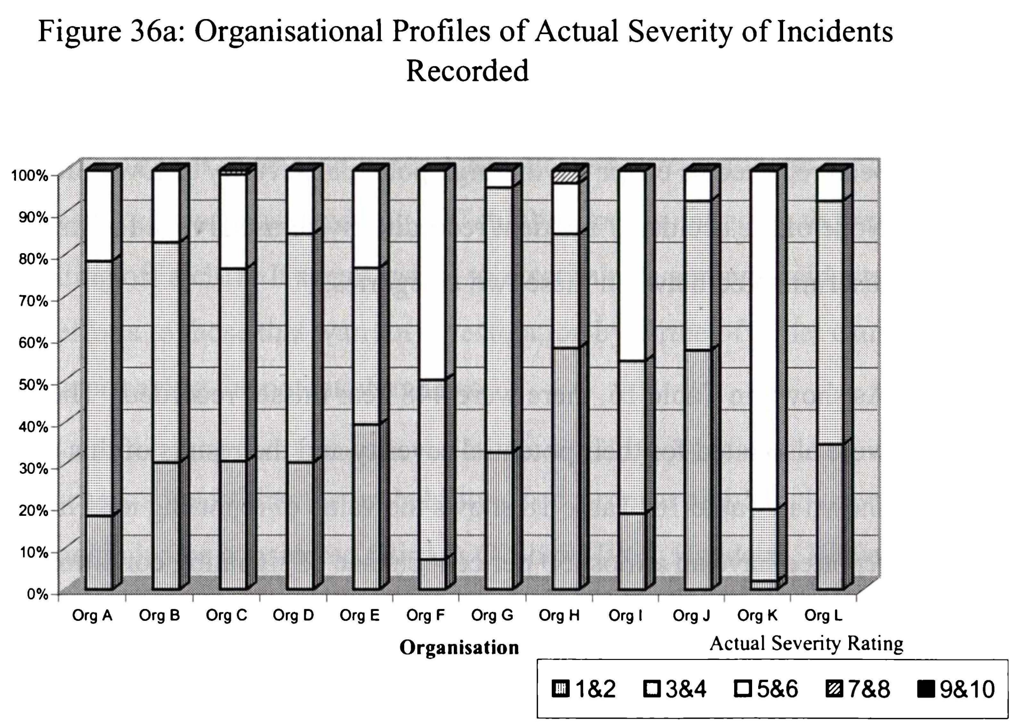
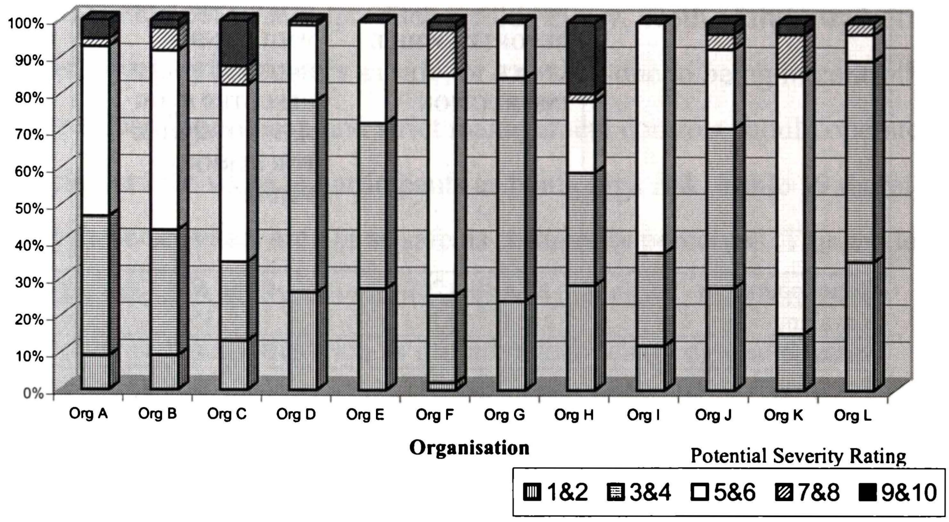


Figure 36b: Organisational Profiles of Potential Severity of Incidents Recorded



In summary, while the Accident Triangle is supported as being valid for the outdoor sector (for the top two rows of the triangle), it has been shown that if the aim is to prevent serious incidents, it is neither effective nor efficient to follow up all minor incidents. To prevent serious incidents, all reported incidents should be classified according to potential severity of the outcome, and those incidents that show a potential severity rating of greater than six should be studied in more detail for underlying causes.

5.2.3 Activities as a Predictor of Injury

Table 19 shows a list of activities surveyed across the participating outdoor education centres that are ranked in order of those that either caused, or had the potential to cause, the most serious injuries. Unfortunately incident records analysed did not track the number of students taking part in any particular activity nor an overall estimate of student days. For this reason injury rates for the various activities cannot be calculated and compared to the WRMC results shown in Chapter 4, Table 11. The results shown in Table 19 must be interpreted with caution as some activities will take place with much more frequency than others.

Table 19

Activities Ranked by Number of Serious Injuries, or those with Potential for Serious Injury for the 12 Participating Organisations (1996 – 2000)

Activity	**SERIOUS INJURIES REPORTED WHILE UNDER INSTRUCTION**	**INJURIES REPORTED WHILE UNDER INSTRUCTION THAT RESULTED IN OR HAD POTENTIAL FOR SERIOUS INJURY**	**ALL RECORDED INCIDENTS THAT RESULTED IN OR HAD POTENTIAL FOR SERIOUS INJURY** (Note: This column includes near misses not shown in the previous columns)
Ropes course	2	2	43
Kayaking	13	15	38
Rockclimbing	4	6	32
Tramping	7	11	29
Sailing	1	5	27
Vehicle	0	0	22
Snowsports	12	19	19
Abseiling	3	4	17
Camping	1	3	16
Mountaineering	3	6	16
At Base Facilities	1	2	15
Rafting	0	2	12
Tube Rafting	0	3	11
Cooking	0	1	9
Swimming	3	4	9
Gorging/canyoning	1	2	7
Canoeing	0	1	6
Other	0	0	6
Sea Kayaking	0	2	6
Games	4	5	5
Cycling	2	4	4
Flying Fox	1	3	4
Free Time/Play	0	0	4
Rock Wall (Artificial)	0	0	4
Running	0	0	4
Maintenance	0	1	3
Community Work	0	0	2
Office	0	0	2
Bridge Swinging*	0	1	1
Caving	0	0	1
Initiatives	1	1	1
Solo	0	0	1
Tyrolean*	0	0	1
Bio/Field Trip	0	0	0
TOTAL	**58**	**103**	**377**

NOTES:

Shaded areas indicate the ten activities with highest (top) and lowest (bottom) incidence of actual or potential serious injury

* denotes activities carried out by only a small number of the sampled group.

One of the surprising aspects of Table 19 is that activities such as ropes courses and abseiling that would not be expected to appear as significant incident-producers, irrespective of the numbers taking part, are both in the top ten activities for incidents with the potential to produce serious injury. Both of these activities are considered by many instructors as safe, or low risk, due to being in controlled settings where close supervision and strict management controls should operate, while appearing at face value to participants as being high risk. Table 19 therefore suggests that these activities are not as safe as commonly perceived. This evidence is supported by the USA study shown in Chapter 4, Table 11. In this research supposedly lower risk activities such as initiative team challenges and ropes courses still produce a significant number of injuries. Further research will be required to establish if this is generally true and what factors combine to produce the incidents reported here. It is interesting to note a similar conclusion being reported by the Adventure Activities Licensing Authority where they note that, "most accidents, even most serious and fatal accidents, occur on activities which were considered beforehand to be the lowest risk" (Bailie, 2003a).

If, as these data suggest, the instructor's judgment of the risk present in any activity cannot be used as an accurate predictor of potential for serious injury, is there anything that can? Petersen (1988) stated that in industrial safety management, there were certain sets of circumstances which could be predicted to produce severe injuries. These circumstances are shown in Figure 37 and Petersen believes they can be identified and controlled.

Figure 37. Predictors of serious injury

CIRCUMSTANCES WHICH CAN BE PREDICTED TO PRODUCE SEVERE INJURIES IN INDUSTRIAL SETTINGS (PETERSEN, 1988)

1. Unusual, nonroutine activities
2. Non-productive activities
3. High energy sources
4. Certain construction situations.

PREDICTORS OF SERIOUS INJURIES IN OUTDOOR EDUCATION ACTIVITIES

Extrapolated by the author from Petersen (1988)

1. Activities run by instructors new to an activity, or overly familiar with an activity
2. Activities with low levels of supervision or no supervision at all
3. Activities involving high energy sources such as height, speed, extreme weather, moving water, fire or heat
4. Any activity involving water

NB: While there are some preliminary data in this research to support the validity of predictors 2,3 and 4, all of these predictors need further research.

Examination of Petersen's categories in relation to the outdoor sector, if extrapolated, reveal some parallels

1. Unusual, non-routine activities: Unfortunately the data recorded in incident records do not include information about the experience level of the instructor in charge or how familiar they were with the activity or the setting. A hand poll of participants at the Risk 2002 Conference in New Zealand showed that the vast majority of those attending believed that newer staff have higher incident rates than those who are more experienced. As a corollary to this however, they also believed that overfamiliarisation with an activity could also lead to higher risk. Any relationship between the level of experience and incident rates needs further research.

2. Non-productive activities: From Table 19 it can be seen that the cumulative impact of students being around Base Facilities, Free-time and Games add up to a significant number of incidents (24 potentially serious incidents). This is likely to be due to a lack of supervision. Inspection of the incident reports for many of the serious incidents that occurred during other activities in Table 19, including the activities such as ropes courses mentioned above, did so when supervision was reduced or non-existent. The concept that reduced levels of supervision is a predictor or serious injury or fatality is supported by the work of Brookes (2003b). His analysis of 114 fatalities that have occurred in Australian outdoor education in the years 1960-2002 led him to make 'strong considerations for fatality prevention,' which included (p.38):

   > "Indirectly supervised (i.e. not directly supervised) expeditions for teenagers present a clear fatality risk if there is a possibility of the group encountering moving water or steep ground." And

   > "The tight supervision that organised instruction necessitates (in activities such as abseiling or canoeing) should be in place while students are near steep ground or moving water, i.e. not only while the activity is in progress. The fact that students may actively escape supervision or take advantage of a supervisor's inattention should be considered."

   Not only do these comments support the findings from this research about reduced levels of supervision, but they also lend weight to categories (3) and (4) below when combined with the other findings of Brookes about the impact of water and cold on fatalities.

3. Petersen's third category, High Energy Sources, seems especially pertinent to the outdoor sector. Incidents that result, or could result in serious injuries seem to be the downstream effect of one or more of the following factors (high energy sources) being present:
   3.1. Height – Ropes courses, abseiling, mountaineering and rock climbing incidents generally result from people being exposed to falls or objects

falling from heights. Tramping incidents often occur when cliffs or steep terrain are encountered.

3.2. Speed – Snowsports and traveling in vehicles – are two examples where speed can lead to serious injuries in outdoor education.

3.3. Changes in weather resulting in cold, wind, lightning, etc., – of unexpected severity – most sailing and sea kayaking incidents occurred when wind increased. Strong winds are also an important contributory factor in incidents in mountaineering, tramping and other activities.

3.4. Moving water where activities such as kayaking, rafting and have the potential for people to be trapped under water against obstacles.

3.5. Fire or other heat sources – burns are common across activities.

4. Certain construction situations – generally irrelevant to outdoor education. However outdoor education activities carried out in water environments warrant special attention as water accentuates any risk due to the potential for hypothermia and drowning. There is also very little time to resolve a serious situation in a water environment.

The WRMC results shown in Table 11, Chapter 4, can be used to test the validity of these suggestions. The highest injury rates recorded over the study periods are in: caving [889], sports and recreational games [79.98], biking (mountain) [64], biking (touring) [33.33], water (swim, wade, snorkel) [22.64], skiing (touring) [22.21] and mountaineering [18.18]. The extremely high incident rate in caving is due to only two recorded injuries and is indicative of the very low participation rate. Therefore caving is an infrequent activity and thus fits into predictor category 1 (Figure 37). Sports and recreational games, as already discussed, tend to have lower levels of supervision and involve participants running at high speed near each other; fitting into predictor categories 2 and 3. Biking and skiing are activities involving speed and fit into predictor category 3. Mountaineering involves height and possible falls fitting into predictor category 3. Water activities fit into predictor category 4.

While further research is required to validate these suggestions, these data indicate that there may be certain outdoor circumstances that are more prone to serious injuries. However, the foregoing analysis suggests that the conditions prevailing in these various circumstances can all be identified in advance and mitigated.

These broad predictors can be used as an indication of those activities in which extra management and higher supervision are required. They should not be used as a reason to avoid a particular outdoor activity as that would remove the very media in which outdoor educators work – cliffs, mountains, rivers, lakes and caves.

In summary, while further research is required, preliminary analysis suggests that a safe experience cannot be guaranteed by choosing activities that have traditionally been seen as having high perceived risk for participants and low real risk as judged by instructors (e.g., high ropes courses). Instead there are predictors that have been suggested in Figure 37 where the potential for serious injury is increased. In activities where one or more of these predictors is encountered, greater care and supervision is required.

5.2.4 Gender of Instructor as a Predictor of Injury

There is some difficulty in exploring the effect of gender on incident rates because of the lack of data. Although ten of the 12 contributing organisations kept records of the gender of the supervising instructor, none recorded the number of student days run by female versus male instructors in a given period. The data do allow a comparison of the number of serious versus non-serious incidents by gender. As the reporting protocols are established by the organisations concerned and are not gender specific, it is reasonable to assume that the reporting characteristics of both genders is the same for the data being compared.

If there was no difference in the risk-taking propensity of men and women instructors, then we would expect the same ratio of serious to non-serious incidents for groups instructed by men and women. The comparative results are shown in the cross-tabulations of Tables 20a - 20d.

Table 20
Effect of Instructor Gender on the Severity of Injury or the Potential Severity of Injury for the 12 Participating Organisations (1996 – 2000)

20a. Gender by Actual Severity of Injuries for Incidents under Instruction, grouped by Severity

	Less Serious Injury (Severity Rating <6)	Serious Injury (Severity Rating >=6)
Male Instructor in Charge (n = 369)	329	40
Female Instructor in Charge (n = 215)	201	14

(Chi-square result p = 0.004)

20b. Gender by Potential Severity of Injuries for Incidents resulting in Injury while under Instruction, grouped by Severity

	No Potential for Serious Injury (Severity Rating <6)	Potential for Serious Injury (Severity Rating >=6)
Male Instructor in Charge (n = 369)	299	70
Female Instructor in Charge (n = 215)	191	24

(Chi-square result p < .0001)

20c. Gender by Potential Severity of Near Misses while under Instruction, grouped by Severity

	No Potential for Serious Outcome (Severity Rating <6)	Potential for Serious Outcome (Severity Rating >=6)
Male Instructor in Charge (n = 238)	104	134
Female Instructor in Charge (n = 90)	48	42

(Chi-square result p = 0.004)

20d. Gender by Actual Severity of Final Injury for All Injury-causing Incidents where there was Potential for Serious Injury

	Cases where there was Potential for Serious Outcome but only Non-serious Injury Resulted (Severity Rating < 6)	Cases where there was Potential for Serious Outcome and Serious Injury Resulted (Severity Rating >=6)
Male Instructor in Charge (n = 70)	30	40
Female Instructor in Charge (n = 24)	10	14

(Chi-square result $p = 0.808$)

Considering only those reported incidents that resulted in an actual injury, Table 20a shows that there is a significant difference between the ratio of serious to less serious injuries reported among groups led by male (40:329 or 1:8) compared to female (14:201 or 1:14) instructors, with men leading groups where a greater proportion of serious injuries occurred. This is further confirmed by Table 20b where there is an even stronger indication that men put their groups in situations where the potential for serious injury is greater (male 70:299 or 1:4 compared to female 24:191 or 1:8).

Table 20c compares the ratio of those incidents with no potential for serious outcome to those with potential for serious outcome for all reported near misses across the two instructor genders. Again there is a significant difference suggesting that male instructors are exposing their groups to a greater proportion of potentially serious situations (134:104 or 1.3:1) than female instructors (42:48 or 0.88:1).

Table 20d looks at the number of injury-causing incidents that had the potential for serious injury by gender. There is no significant difference indicating that neither gender is better at resolving an incident that is likely to result in serious outcomes.

In summary, the data collected for this study suggest that groups instructed by men have a greater ratio of high severity injuries compared to low severity injuries compared to groups instructed by women. Once a group is in a situation of high potential injury, both genders of instructors have the same likelihood of resolving the situation successfully. A significant body of research exists that shows there is no difference in the vigilance performance between men and women (Berch & Kanter, 1984). One possible explanation for the findings in this study is that male instructors are prepared to accept higher levels of risk with their groups than women instructors. This is conjecture at present and requires further research to investigate any relationship between gender and risk-taking preference with groups. As noted earlier, more convincing analyses would be possible if records were available documenting overall time involved in instruction differentiated by gender.

5.2.5 Time of Day as a Predictor of Injury

Of the 12 organisations contributing data, seven consistently recorded the time of day of the incident, four sometimes recorded the time and one almost never recorded the time. Table 21 shows the breakdown of incidents versus time of day.

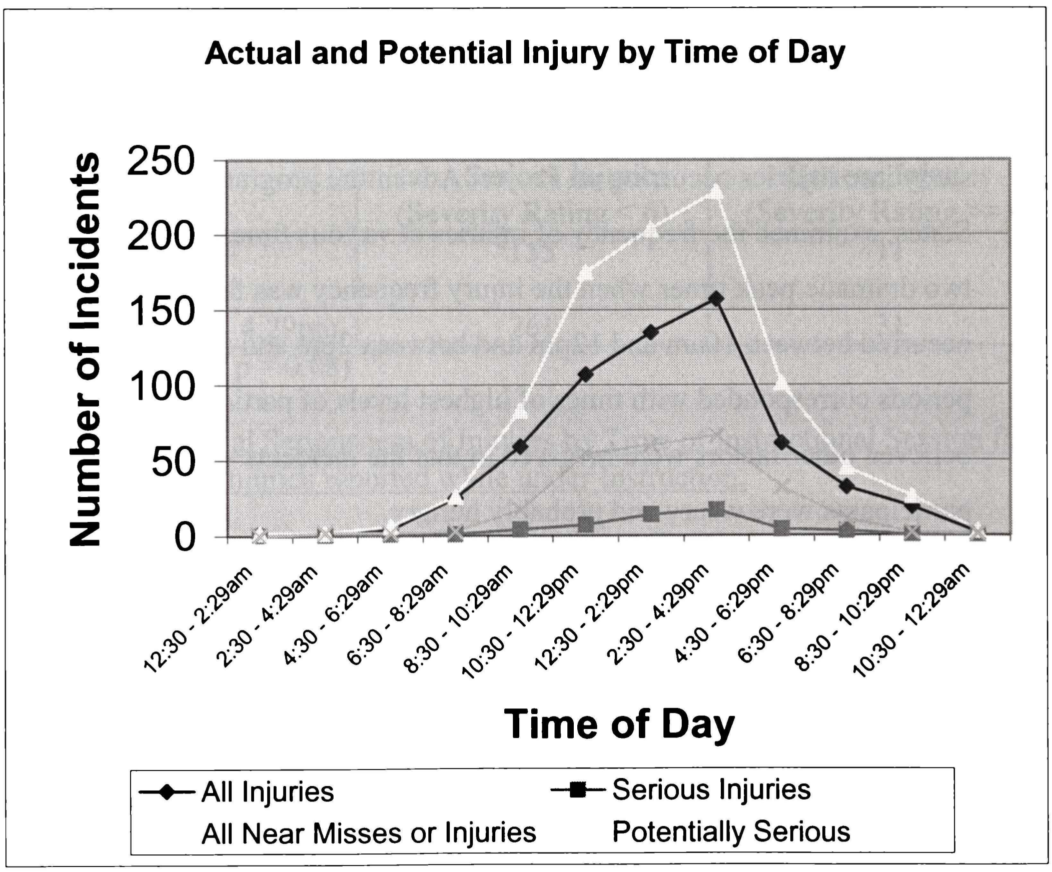
Figure 38 shows these results in graphical form. Most incidents occur during the period between 9am and 5pm when the majority of activity in outdoor education takes place. However, there is a discernable peak evident in all categories in the two-hour time slot between 2:30pm and 4:29pm.

If it is assumed that most activities will take place between 8:30am – 12:29pm and 12:30 – 4:29pm in the afternoon, then it is possible to compare incident numbers in these two, four-hour time slots.

Table 21
Effect of Time of Day on Incident Frequency for the 12 Participating Organisations (1996 – 2000)

	INJURIES UNDER INSTRUCTION		NEAR MISSES OR INJURIES WHILE UNDER INSTRUCTION	
TIME OF DAY	ALL INJURIES	SERIOUS INJURIES	ALL NEAR MISSES OR INJURIES	POTENTIALLY SERIOUS
12:30 – 2:29am	2	0	2	0
2:30 – 4:29am	1	0	2	2
4:30 – 6:29am	4	1	6	2
6:30 – 8:29am	25	1	26	3
8:30 – 10:29am	59	4	83	17
10:30 – 12:29pm	107	7	175	54
12:30 – 2:29pm	135	14	204	60
2:30 – 4:29pm	157	17	229	66
4:30 – 6:29pm	61	4	101	32
6:30 – 8:29pm	32	3	45	11
8:30 – 10:29pm	19	0	26	2
10:30 – 12:29am	2	0	3	1

Figure 38. Graph of incidence of actual and potential severity of injury versus time of occurrence



The results shown in Tables 22a and 22b show that there is a greater likelihood of having an incident while being instructed in the afternoon compared to the morning. This suggested correlation between time of day and frequency of incident needs more study as it may relate to other variables. For example, groups could be spending more time walking or driving to activities in the morning, whereas they may be more actively involved in the activity in the afternoon. If this was the case then the number of incidents may not vary in frequency in proportion to the number of students on an activity, with the peak in Figure 38 merely mirroring a peak in the number of students involved in activity. My own experience causes me to reject this second explanation however as I believe almost all students would be involved in activities by 10:00am in the centres surveyed.

Table 23 analyses the ratio of serious to non-serious incidents occurring by time of day. Despite the increased number of incidents occurring in the afternoon, Tables 23a and 23b show that there is no significant difference between the seriousness of incidents that occur in morning and afternoon sessions.

These results both support parts of, and vary from parts of, earlier research carried out in both the USA and Australia. Furlong et al. (1995), as part of a twenty year study into injuries occurring on Project Adventure programmes in the United States, examined the frequency of injuries at various times of the day. They found two dramatic peak times when the injury frequency was far higher. These occurred between 10am and 12pm and between 2pm and 5pm. While these periods corresponded with times of highest levels of participation, they also believed other factors were involved in that the incidents were occurring when participants were weary and probably hungry.

Table 22

Comparison Between Number of Incidents Occurring in Morning and Afternoon Activity Sessions for the 12 Participating Organisations (1996 – 2000)

Table 22a Number of Incidents occurring by Time of Instructional Session for Injuries Reported while under Instruction.

	All Incidents
Morning 8:30am – 12:29pm	166
Afternoon 12:30 – 4:29pm	292

(Chi-square result $p < .0001$)

Table 22b Number of Incidents occurring by Time of Instructional Session for Near Misses and Injuries reported while under Instruction.

	All Incidents
Morning 8:30am – 12:29pm	258
Afternoon 12:30 – 4:29pm	433

(Chi-square result $p<.0001$)

Table 23

Comparison of the Seriousness of Incidents by Time of Instructional Session for the 12 Participating Organisations (1996 – 2000)

Table 23a Seriousness of Injuries by Time of Instructional Session for Injuries reported while under Instruction.

	Less Serious Injuries (Severity Rating < 6)	Serious Injuries (Severity Rating >= 6)
Morning 8:30am – 12:29pm	155	11
Afternoon 12:30 – 4:29pm	261	31

(Chi-square result $p = 0.08$)

Table 23b Potential Seriousness of Injuries by Time of Instructional Session for Near Misses and Injuries reported while under Instruction.

	Less Potentially Serious Incidents (Severity Rating < 6)	Potentially Serious Incidents (Severity Rating >= 6)
Morning 8:30am – 12:29pm	187	71
Afternoon 12:30 – 4:29pm	307 (71%)	126

(Chi-square result $p = 0.58$)

Research carried out by Outward Bound Australia in the late 1980s and reported by Brackenreg (1997, p.12), found that:

> "...different ages had different, distinct peak times. School groups (10-16 years old) had peaks at 12pm, 2pm, and 6pm, while standard course participants between 17 and 29 years old had peaks at 10am and 2-3pm. Of interest here is that the older group generally start their day about two hours earlier, so that the time since breakfast was consistent. Outward Bound Australia consequently recommended that instructors consider actions such as having a substantial break a couple of hours after breakfast, or having an earlier lunch rather than pushing on for an extra hour. The 6pm peak for school aged participants was probably due to their higher rate of incidents while cooking."

The lack of a peak in incident occurrence in the mornings in this research contrasts with the findings of the earlier research, while the afternoon peak is similar. At the Risk 2002 Conference, a national conference for outdoor educators on risk management, Rick Curtis of Princeton University Outdoor Action and OutdoorEd.com in the USA suggested an hypothesis that the British tradition of morning and afternoon teas, which has been extended to the colonies, may explain the difference. Stopping for a substantial break and snack at morning tea time is enough to boost blood sugar levels and concentration spans. The cumulative effect of a lengthy day of activities, and possibly less food and desire to eat nearer the end of the day does not have the same restorative effect. The recommendation from the Outward Bound Australia research quoted above would indicate that morning breaks were not commonplace in those programmes and would therefore lead to a morning peak in accident occurrence.

The researchers mentioned above all suggested the incidents occurred because of students' tiredness, hunger and subsequent lack of attention. They did not discuss a similar lack of food and tiredness impacting on the instructor and therefore leading to reduced levels of attention and situational awareness, etc., resulting in increased incident rates. The factors leading to these higher incident rates at certain times of the day requires further research but it seems sensible to ensure food and rest breaks are included into any outdoor education programme at regular intervals.

In summary the data collected here provide evidence that incidents are more likely to occur in the late afternoon compared to earlier in the day in outdoor education programmes in New Zealand. However, there seems to be no evidence to suggest that the outcome will be any different in severity between morning and afternoon sessions. I would suggest that the increased rate of incidents is due to general weariness and lack of blood sugar in both students and instructors. These factors will lead to decreased concentration and increased incidents.

There was no corresponding peak in incident occurrence in the late morning that had been shown to exist in overseas research. This lack of a morning peak may be due to the New Zealand practice of stopping for morning tea breaks. The cumulative effect of the day's activities and possibility that most of the food carried has been eaten by the time for an afternoon break, means that incidents occur later in the day.

Further research will be needed to investigate the factors leading to the afternoon peak in incident occurrence but it would be prudent for those leading outdoor education programmes in New Zealand to ensure that regular food and rest breaks are taken throughout the day.

5.2.6 Outdoor Education Accident Rates

There is a common public perception that outdoor education in New Zealand exposes students to unnecessary risks. This is not surprising as most media attention is generally negative in the wake of an accident. Research on accident rates in outdoor education in New Zealand is not available, however statistics have been published for American organisations in the various Wilderness Risk Management Conference Proceedings and are summarised in Tables 10 and 11 in Chapter 4.

The data collected in this New Zealand study for the five year period 1996 – 2000 correspond to 532,912 student days of instructing over the 12 contributing organisations. This converts to 4.3 million student hours (assuming a conservative eight hour day). The combined data for the 12 outdoor education centres that contributed to this study produces incident rates as shown in Table 24.

Table 24

Injury Rates for the 12 Participating Organisations (1996 – 2000)

INJURY RATES PER 1,000 PARTICIPANT DAYS AND FATALITY RATES PER 1,000,000 PARTICIPANT DAYS		
ACTIVITY	INJURY/1000 PARTICIPANT DAYS	FATALITY/MILLION PARTICIPANT DAYS
Outdoor Education in NZ: Results from the study of 12 large centres for the years 1996 – 2000 (All Injuries)	2.165	0
Outdoor Education in NZ: Results from the study of 12 large centres for the years 1996 – 2000 (Serious Injuries only)	0.11	0

As can be seen by comparing Table 24 with Tables 10 and 11, the New Zealand outdoor education accident rates are comparable with the organisations in the USA that are regarded as being of the highest standard – the National Outdoor Leadership School (NOLS), and the five Outward Bound Schools (OB). The injury and fatality rates are less than training or playing American Football and adolescents driving in the USA.

New Zealand Accident Compensation Corporation (ACC) statistics for 2001(Accident Compensation Corporation, 2001) state that the rate of claims for all non-work related injuries was 2,639 per 100,000 people. The rate of claims for all work-related injuries was 1,726 per 100,000 people. Assuming that the 100,000 people could be exposed to both work and non-work related hazards 365 days of the year (which is conservative as an individual cannot be at work and not at work for all of the same day) this translates to a claims rate of 0.11 per 1000 participant days. To make a claim to ACC, the injury would need to be relatively serious. The serious injury rate recorded in the study of NZ outdoor education centres is also 0.11 per 1000 participant days. It seems then that outdoor education in New Zealand is no more dangerous than the cumulative risks encountered in normal, everyday living.

5.2.7 Further Discussion and Recommendations

Attempts to analyse the available data to identify factors that might be predictors of outdoor education incidents were hindered by the lack of information currently recorded by outdoor education organisations in their incident reports. Almost all of the 12 participating organisations had their own unique form for recording incident data, although several used the Outdoor Safety Institute's (OSI) reporting form (Davidson, 1993) for more serious incidents. In all cases the incident forms were completed by the instructor who was in charge of the group at the time of the incident, with seemingly little quality control by management over the standard of completion. This lack of quality control was manifested in incomplete information, scanty detail in narratives of incidents and, in some cases, illegibility. The variety and incomplete nature of many of the incident forms provided only a limited amount of data common to all incidents. Similarly, having no consistent organisation-wide protocols for deciding which incidents, and what characteristics about them should be recorded, produced data of limited usefulness.

It is clear that in order to be able to carry out meaningful research into trends in incident occurrence in the outdoor education sector, and communicate it throughout the sector, a consistent approach needs to be adopted to the recording of incidents. What is required is a National Incident Database (NID) for the outdoor education sector that is administered by a recognised impartial body. That body will need to be empowered to set national protocols for the collection of such data and be adequately resourced to analyse and communicate findings widely, both within the outdoor sector and to wider audiences. As part of such a data collection system, each incident should be rated for potential severity by the organisation reporting the incident as that organisation is most able to assess the various hazards at play. The annual trends from the NID should be distributed throughout the outdoor education community and beyond to provide information to improve risk management practices and develop understanding among the public and politicians of the positive aspects of outdoor experiences, dispelling the idea that participation is unduly dangerous.

While presenting the preliminary findings from this research at the New Zealand Risk 2002 Conference, I made the case for the establishment of such a database. A collective of outdoor organisations led by the NZ Mountain Safety Council (MSC), Outdoors New Zealand (ONZ) and Education Outdoors New Zealand (EONZ) has recently (2004) committed to establishing such a database which is likely to be administered by the MSC. Data from contributing outdoor education organisations will be entered through a web-based interface.

5.3 Summary

This study has collected and analysed data about incidents based on a sample of the larger outdoor education centres in New Zealand. This has enabled the calculation of accident rates for the outdoor education sector which can be compared with accident rates in other countries, sectors and with everyday living. Although the quality of the data restricts the level of analysis, there is some evidence to suggest variables that might be used as predictors of outdoor incidents, and therefore managers could develop strategies based on these to reduce those incidents. These findings are summarised:

1. The outdoor education sector follows the Bird & Germain (1989) Accident Study Triangle at least in part, with one serious accident for every 16 non-serious accidents reported.
2. Studying non-serious accidents to try to prevent serious accidents is wasteful of time and energy. Non-serious accidents are not necessarily a predictor of serious accidents with only 3.7 per cent of accidents with an actual severity rating less than five having the potential for resulting in a serious injury with a rating of six or more.
3. Near misses and accidents should be assessed for their potential for serious outcomes. Those that are assessed as having the potential for serious injury should be studied in greater detail to help prevent further serious accidents.

4. While more research needs to be carried out, some evidence is presented in this study to suggest that we can extrapolate Petersen's (1988) model to the outdoor sector. This model suggests that serious accidents are more likely to occur in activities:

   i. where there is limited or no direct supervision;

   ii. involving high energy sources such as:

      a. Height
      b. Speed
      c. Unexpected changes in weather - Wind, cold, lightning, etc
      d. Moving water
      e. Fire or other heat.

   iii. that involve a water environment.

   Instructor training programmes and centre managers should be cognisant of these predictors and act to minimise the increased hazard whenever one or more of these factors is present.

5. Activities such as high ropes course, abseiling and tramping, which are often used in outdoor education as they are considered low risk by instructors while challenging participants mentally and physically, can have potential for serious injury if one or more of the above predictors is present.

6. The ratio of reported serious to non-serious injuries is higher for groups supervised by male instructors compared to female instructors. The data suggests that neither gender is better than the other at resolving potentially serious situations once they have been encountered. One possible explanation for the higher ratio of serious to non-serious injuries for male instructors is that they are prepared to place their groups in situations of higher risk. If this is true then special attention needs to be given in the training of male instructors to their assessment of risk, and subsequent management of that risk, in various situations. Further research is required to investigate any relationship between gender and risk taking preference with groups.

7. Injuries happen more often during afternoon sessions compared to morning sessions, with the segment of the data between 2:30pm and 4:29pm having the greatest number of injuries. While more research is needed to investigate the causes of this suggested peak in incident rate, it would be prudent to

ensure that adequate rests are incorporated into any outdoor education programme to eat and recuperate before further activity. These regular breaks are desirable for both instructors and students. There is no evidence to suggest that an incident will be more or less serious if it occurs in the morning or the afternoon.

8. The overall injury rate for NZ outdoor education centres is comparable with USA counterparts that tend to be conservative due to the threat of litigation. This rate is comparable with the risk faced in everyday life when compared to ACC statistics.
9. These results indicate several areas for future research including:
   - The relationships between the familiarity of an instructor with a particular activity and site and incident rates;
   - The relationships between gender and incident rates;
   - The relationships between gender and risk-taking preference while in a leadership role;
   - The relationships between the predictors of serious accidents extrapolated from Petersen's model and incident rates; and
   - Exploring the factors causing the observed correlation between time of day and incident rate.
10. There is a need, a) for the outdoor sector to be better informed to help prevent further incidents, and b) to provide the community with a more realistic understanding of the risks of participation in outdoor education experiences. The lack of available data on outdoor education incidents, and the lack of consistency in reporting of the data that does exist, frustrates the achievement of these goals. The formation of a National Incident Database for outdoor education activities, which was empowered to collect data from the range of organisations in New Zealand and distribute annual and trend data throughout the sector and to interested decision makers and community members, would go a long way to addressing these needs.

CHAPTER SIX

RESULTS AND DISCUSSION: IDENTIFYING THE ROOT CAUSES OF OUTDOOR EDUCATION INCIDENTS IN NEW ZEALAND 1996 – 2000

6.1 Introduction

This chapter presents the results of the qualitative investigation of 18 case studies of outdoor education incidents that had the potential for serious injury. The aim of this phase of the research method is to identify the root causes of the 18 incidents by using a Delphi technique, and from the combined results compile a taxonomy of the root causes of error for the 18 incidents based on empirical data.

This is Phase Two of the research method. A detailed description of this phase of the research method is given in Chapter 3. Briefly, from the database of incidents gathered in the first phase of the research, 18 incidents were selected that represented:

- A range of outdoor education activities;
- A balance of instructor gender;
- A spread of organisation / settings of incidents;
- Incidents that had the potential for serious injury; and
- Incidents where the instructor concerned was willing to be interviewed.

The instructor of each selected incident was sent a computer assisted interview (CAI), which asked questions about the sequence of events leading to the incident under study. Each interview response was analysed for root causes by a Delphi panel of six outdoor education experts in an iterative process until all experts agreed on the results of the analysis. The instructor was involved in later iterations of this process so that they could have input and give feedback on the panel members interpretations of events.

The outcome for each incident studied was an Events and Causal Factors Analysis (ECFA) which gave a diagrammatic representation of each incident where events that occurred leading up to the incident were listed in chronological sequence. The immediate and root causes identified were listed in layers under the event sequence and linked to the events by arrows.

This chapter is structured in the following way:

- Section 6.2 gives an in-depth example of the analysis of a CAI for one of the incidents so that the analysis process can be thoroughly understood. The way Delphi panel members provided feedback and the method used to sort this feedback to generate an ECFA diagram is explained.
- Section 6.3 provides the ECFA results for the further 17 incidents studied along with observations made during the Delphi process.
- Section 6.4 provides an analysis of the combined results from all ECFA diagrams to provide the first attempt at establishing an outdoor education taxonomy of error derived from empirical sources.
- Section 6.5 provides a summary of the Chapter.

6.2 The Delphi Analysis of CAI Data – A Case Study of Incident 1471

6.2.1 Introduction

The instructor in charge of each group at the time of the selected 18 serious incidents was sent a computer assisted interview (CAI). The interview questions and format are enclosed as Appendix 2. Instructors were asked to ensure that they allocated adequate time and were in an appropriate frame of mind to revisit this potentially stressful event.

They were prompted with a brief description of the incident under study and then asked to:

- Give their thoughts on the background leading up to the activity;
- Write a narrative of the incident as it appeared to them;
- Put together an incident timeline;

- Go backwards through the timeline to identify key decisions that they made that, with the benefit of hindsight, they would change; and
- Provide any other relevant comments.

Each incident had a unique identification number within the greater incident database generated in Phase One of the research. The following case study details the analysis of Incident 1471. All identifying information of individuals and places have been removed to preserve anonymity of the respondent and the organisation involved.

6.2.2 The CAI Data – Incident 1471

6.2.2.1 Setting the Scene

The instructor was asked to reflect on the following incident:

Incident 1471: The incident in question happened around December 1998. It was described as students trying to land from a sea kayaking journey. Conditions quickly changed to large surf; ten students were thrown out of their kayaks and one student was washed against rocks.

The instructor was requested to cast their mind back to the incident which had taken place at least two years ago. They were asked to try to remember as much as they could about what was happening for them that month, week and then on the day that the incident took place.

Instructions continued as follows: 'Write down as accurately as you can what the background was for you going into that activity. Some cues to help...

- How were you feeling?
- How did this activity fit into the programme?
- Had you done this activity many times before?
- What was the group like?
- Were you looking forward to this activity?
- What were you hoping to get out of the activity?

- Were there any particular issues you had on your mind?
- Were there any time constraints?
- What was the weather like?
- What were your equipment/resources like?'

Your thoughts on the background here….

"This was one of my 'first instructs', I had the lead, with a senior instructor observing me. It was the last day of a kayak programme. We had been out on flat water and rivers. The final day was to be at the beach. There was no surf, so the preferred option of surf kayaking was out. A paddle along the shore line and exploring of sea caves was the logical alternative.

I remember discussing it with the senior instructor. We observed the conditions - slight swell and a light on-shore wind. I had done this trip before during my induction the month before. I was feeling okay about going out although I also remember a feeling of being slightly 'on guard'. The distance is not very long (approx. one km.), but the coastline is exposed with not many places to land.

The group was a mixed bunch. I still remember three students quite clearly: A young water-confident, blond long-haired surfie; a quite solid, very shy young Maori woman, battling with a low self esteem; and a very slight Singaporean girl, who was always cold, and did not have a very good grasp of English. They all got on okay, however the Maori girl was the only student sent by WINZ and in general was a bit on the outside of the group.

I am trying to remember what I was hoping to achieve, and right now I don't seem to get any further than that it was the logical thing to do. We were there, the surf was no good, and so a little journey it was. A beautiful and impressive environment and it would be good for the group to work on their group management skills.

> Things on my mind: one was the Maori girl; she was quite unstable and would rather be swimming than sitting in a kayak. The students were buddied-up (a confident one with a not-so-confident). The other instructor stayed very close to her in particular.
>
> I was hoping to go through one of the sea caves. This is quite exciting, and you had to get out of your boat and pull it through the cave and exit on the other side. I remember getting to the first bay and deciding that it would be better to approach the cave from the other side. The Big Bay [name changed by researcher] has a bigger beach to land on and when you get out of the cave you can see the waves and time your exit, as opposed to being pushed into this narrow opening with waves coming from behind. I discussed this with my co-instructor and we both agreed. It is also one of those trips where when you come around the corner, you have to assess whether it is okay to continue. We decided it was fine to continue.
>
> There were no time constraints and I believe the kayaks and other equipment we had were adequate for the trip."

6.2.2.2 Narrative of the Incident

The instructor was then asked to: 'Write a narrative of the incident as it happened through your eyes. Start at whatever point in the activity you think is appropriate and finish at the time when control was re-established.'

Your narrative here ....

> "We were sneaking our way through the big rocks in our approach to The Big Bay. This was quite sheltered. When we arrived there I called the group together and told them what the plan was - which was to land on the little beach and exit via the cave. I was surprised to see the waves breaking on the beach. I told them that we would go in one by one and as soon as they landed to get out and help other students coming in. I told them that as they surfed in they might fall out but that that would be fine. I asked

them if they felt okay about it. They had all demonstrated their wet exits and felt okay about doing this.

The most confident and skilled student would go first (the surfie); he had done quite a bit of paddling before. I told the rest to stay well behind the break, raft up in little groups and wait for my signal.

The first student went on shore and he capsized. I think he did an endo (kayak looped end over end) and I vaguely remember being a little surprised at this. Anyway he came out quickly and got on shore with his gear and gave us the thumbs up.

I was sitting between the students and the beach at this stage, with my back to the beach facing the students, giving them their final instructions. The next thing I remember is this wave rolling in, breaking a lot earlier and being a lot bigger then I expected. The next thing I see is almost the entire group, some in little rafts of three, being picked up and dumped. The Singaporean girl was surfing backwards towards the beach. I got endoed backwards, and when I rolled up I saw most of the students swimming and the Singaporean student still in her boat being washed onto the rocks.

The other instructor was a little further back and had escaped the break - she was still rafted up with the Maori girl. I remember frantically counting heads and yelling instructions to people to swim for shore and not worry about the equipment, and try to avoid the rocks. I can't remember how the Singaporean girl got herself off the rocks but she did. Pretty quickly (maybe 5-10 minutes) all students were on shore. We collected all equipment, nothing was lost and no one was physically hurt".

6.2.2.3 Incident Timeline

The instructor was then asked: 'Now put together a simple timeline of the event, as accurately as you can, by building a list of approximate times with key events that were happening.'

Your timeline here….

"0 mins	Decision was made to continue around to the Big Bay.
10 mins	Students were gathered and plan explained.
15 mins	First student goes on shore and swims.
17 mins	Final instructions to other students to stay behind the break.
18-19 mins	'The Wave' 10 students swimming, one boat on rocks, one student still upright and two instructors still in one piece.
20-30 mins	All students on land."

6.2.2.4 Decision Point Identification

The instructor was then asked: 'With the benefit of hindsight, can you identify points on the timeline at which key decisions were made that influenced the outcome in this case? Work backwards through your timeline and list the decision points, and for each decision point consider:

- What decision you made at the time;
- What you were trying to do in making that decision;
- What information you had that led you to make the decision;
- What you would do differently, if anything, at that decision point given the benefit of hindsight;
- What other information / skills could you have had at the time that would have helped make the decision you would make given the benefit of hindsight.'

List your decision points here….

"Decision 1:
Going out on a little sea paddle.
Good alternative for surf kayaking.
Observing the sea and weather conditions and ability of group.
I would do this again; conditions were definitely fine to go out.

Decision 2:

Continue around to The Big Bay.

To try and make the passage through the cave friendlier and easier to manage.

Based on the amount of swell that was present.

I think that was a good decision.

If I had more knowledge / experience of the effects that this size of swell (approx. half a metre) had at The Big Bay, we might have changed the approach route to going out wider / further away from the rocks, and thus avoid the break and as a result being able to fully assess the situation at The Big Bay.

Decision 3:

Send a student in first.

Based on the presence of relatively small breaking waves, the skill and confidence levels of the students, and to prevent having more than one student swimming at the same time. Also an opportunity for them to help each other getting onto the beach and making this process more efficient. The information I had, was based on what I could see, and more importantly my interpretation of this information. The other thought I had was that by sending a student first (one who was confident and relatively competent) I could stay on the water, this would free up the other instructor to keep an eye on the Maori student, and I would be of more use on the water.

Maybe with hindsight it would have been better for me to go and check it out first, but I don't think this is where the problem arose. As the students were already in the wrong place, it just would have changed my position, but the result would have been the same.

Decision 4:

To continue the plan of sending students in one by one.

I think that at this stage I was focused on achieving the physical goal of getting everybody on land so that we could continue through the cave. Not

> based on the events of that particular moment, but clouded by my desire to achieve the goal. It was the logical next step in the plan.
> In hindsight, seeing my most competent student flip should have made the alarm bells ring, made me realise that this surf was bigger than I thought, and that altering the plan might be in order.
> At this stage I did believe that the students were in a safe place in relation to the breakers.
> Knowing what I know now I should have told the students to retreat to a greater distance from shore, or paddle back the way we had come, raft up at a safe place, then me going on shore and checking out my beached student."

6.2.2.5 Other Comments

The instructor was then asked: 'If you have any other comments you want to make about the incident in general that you haven't had the opportunity to do so already, then please do so here...'

> "Looking back at the incident, I remember my genuine surprise at the change in conditions at the time and that in my eyes this wave appeared out of nowhere as a freak of nature. Looking back at it now however, I am more inclined to say that this incident happened as a result of my inexperience with the conditions in this area, resulting in bad judgment. Not so much by going out there but by taking the wrong approach route and not recognising this.
>
> Maybe there might have been an element of pressure, placed on myself by myself, to give the students a challenging experience - after all that is what this programme was / is about. I could not have had a more supportive senior instructor so I think this pressure definitely did not come from her. But I guess partly by the reputation / expectation and more importantly my interpretation of the programme. Although this would have added to the sequence of events, I would like to stress that this was in this scenario a smaller contributing factor to the incident."

6.2.3 Delphi Panel Analysis of the CAI Data – Incident 1471

6.2.3.1 First Delphi Iteration

6.2.3.1.(a) Instructions to Delphi Panel

The panel of six outdoor experts were sent the CAI data for the interview in an unaltered form. The instructions given to the Delphi panel members are included as Appendix 3. They were asked to identify 'conditions' that were present that contributed to the incident being investigated: the conditions falling into categories of 'people', 'equipment' and 'environment'. 'Conditions' in this case are the 'immediate causes' of the incident (Figure 30). However it was thought that the outdoor expert would better understand the term 'conditions' rather than explaining what 'immediate causes' were. The experts were also asked to identify what they believed were the 'root causes' of the incident. They were asked to think as widely as possible in interpreting the CAI data and to use their intuition based on years of outdoor experience. If the root cause was identified through evidence in the CAI then they were to quote the passage from the CAI that signaled that root cause. If however, the root cause was identified through a subjective interpretation of the overall incident, then they were to indicate in their feedback that this was the case.

6.2.3.1.(b) Response from Delphi Panel

The response from the six experts follows:

<u>Expert One:</u>

Conditions:

1. Mixed group, some not confident.
2. Exposed coastline, not many places to land.
3. Some students unstable in kayak.
4. Some students did not have a very good grasp of English.
5. Waves breaking on the beach – bigger than expected.

Root Causes (supported by evidence):

6. First time being in charge of the group. (First 'instructs')
7. Instructor not familiar with the area and conditions (surprised to see waves breaking, surprised to see student capsize and said the waves were bigger than expected).
8. Instructor couldn't clearly identify what they were hoping to achieve (instructor goals vs. group goals?).
9. Instructor identified that they had minimal knowledge and experience of the effects of swells, and general inexperience with the conditions in the area.
10. Order of landing (most confident first), and then action taken when that student capsized – instructed rest of group to go ahead instead of stabilising group and checking out the situation indicated poor judgment.

Root Causes (subjective):

11. Procedures for matching group ability vs. goals should be clearly set prior to any trip leaving – is there such a process in place by the organisation?
12. Staff training prior to leading a group – may not be sufficient.
13. Instructor experience in the conditions was lacking – if a senior instructor was present why did they not offer more advice and guidance? What are the organisational criteria relating to the role of the senior instructor when safety issues are concerned?
14. Instructor interpretation of programme goals vs. sound practice did not match, indicating a missing link in the training process for new instructors.

Other Comments:

15. The instructor observations on their own performance were very perceptive and serve as a useful learning / evaluation opportunity, however the organisation's procedures that allowed a new instructor to become involved in this incident, with a senior instructor present (what were they doing all the time the students were falling out?) would have to be questioned.

Expert Two:

Conditions:

1. Fine weather (a 'nothing can go wrong' day).
2. Party keen, but of diverse skill range.
3. Length of paddle journey (fitness).
4. Not taking the 'safe option' when faced with a choice.

Root Causes (supported by evidence):

5. Instructor inexperienced as a leader, by his own admission.
6. A change in conditions will often be a signal to change plan.
7. Activity and route not suited to the whole group.
8. Lack of local knowledge – a change in coast topography can mean a change in the wave action.
9. Decision point – take the 'safest' option, it's always the best for health.
10. While it's a team thing, the judgment of the students should not affect the decision of the leader (Deal in facts!).

Root causes (subjective):

11. Instructor / leader admitted a lack of experience for the leadership role.
12. The instructor did not refer to any safety management process, RAMS etc.
13. There was no mention of a contingency plan.
14. It was one of the instructors 'first instructs'. An experienced leader should have accompanied the group.
15. If described as 'exciting' by the instructor, that may mean terrifying for the students?!

Other Comments:

16. Being tipped over while sea kayaking is always a strong possibility for any participant. Taking a 'dip' is not always a serious incident.

17. A similar incident could easily happen to a much more experienced leader and may even go unreported.
18. Having a sound plan and contingency action is very valuable.
19. What was the main role of the co-instructor and how senior were they?
20. While the instructor was inexperienced the narrative was focused, detailed and did deal with the facts.

<u>Expert Three:</u>

Conditions:

1. Weather / water; slight swell with a light on shore wind.
2. Inexperienced instructor.
3. Mixed bag group of students.

Root Causes (supported by evidence):

4. Undefined outcomes; "I am trying to remember what I was hoping to achieve....."
5. Lack of knowledge of the environment; "I had done the trip before during my induction a month before" and, "... all I remember is this wave rolling in, breaking a lot earlier and being a lot bigger than I expected."
6. Student requiring exclusive attention of one instructor; "this would free up the other instructor to keep an eye on the Maori student" and "the other instructor was a little back and behind the break, she was still rafted up with the Maori girl."
7. Not completely inspecting beach / hazard; "The information I had was based on what I could see" and "Maybe with hindsight it would have been better for me to go and check it out first."
8. Collecting students in the impact zone; "...I remember is this wave rolling in, breaking a lot earlier and being a lot bigger than I expected." and "I did believe that the students were in a safe place in relation to the breakers."

9. Not responding to a change in situation / condition; "The first student went on shore and capsized."
10. Instructor decision "To continue the plan of sending students in one by one."

Root Causes (subjective):

11. No escape plan.
12. In the narrative no mention is made of what students were to do to avoid the rocks or of any other plan for multiple capsize.
13. Insufficient experience of the supervisor. Why didn't the Senior Instructor identify the potential for an incident and intervene?
14. Insufficient documentation; Activity guidelines / procedures, operating parameters for wind / swell, description of environment / location.

Expert Four:

Conditions:

1. Unpredictable shore.
2. Beginners in sea kayaks.
3. Inexperienced instructor(s) in their roles.

Root causes:

4. Senior instructor not experienced to either identify the hazard or step in and take over – management issue with identification of people and roles of senior instructors.
5. Failure to alter plan even when strongest student was capsized on the beach and it seemed unlikely other were going to succeed.
6. Possible management failure to identify or collate collective experience from that particular beach.

Expert Five:

Root Causes:

1. I agree with all of the comments the instructor made "in retrospect".
   In particular, the statement where he should have landed first.
   Also the notion of moving further along the beach to get a better look at the surf seemed a good idea.
2. I'm interested why the second "more senior" instructor didn't proffer an opinion! Seems a lack of leadership on their part. After all they were there for a reason.
3. It appears to me that the organisation had not properly prepared the instructor.
4. The senior instructor should have taken charge earlier - may have been a different result.
5. If the senior instructor didn't feel the need to take charge she should have been more assertive.
6. I'm unsure whether her local knowledge was any better than the new instructor's.
7. I guess there is a common thread of management inadequacies between the two incidents so far.
8. I would have thought more information would have been available to the new instructor, both from the senior instructor and the organisation.
9. It is a common failing to want to give people an experience by risk taking and not being properly informed and prepared.

Expert Six:

Conditions:

1. Instructor experience.
2. Perceived mixed ability / motivation group, participant level of experience.
3. "Coastline is exposed with not many places to land."

4. "Slight swell and a light on-shore wind."

Root causes (supported by evidence):

5. Instructor inexperience..."This was one of my 'first instructs', I had the lead with a senior instructor observing me." And, "If I had more knowledge / experience of the effects that this size of swell (approx ½ m) had at The Big Bay, we might have changed the approach route to going wider / further away from the rocks..." "feeling slightly 'on guard'." "I am trying to remember what I was hoping to achieve, and right now I don't seem to get any further than it was the logical thing to do...it would be good for the group to work on their management skills." See also below.
6. Nature of programme...1. "The final day was to be a beach day." "A paddle along the shoreline and exploring of the sea cave was the logical alternative." "Maybe there was an element of pressure, placed on myself by myself, to give the students a challenging experience - after all that is what this programme was / is about....But I guess partly by the reputation / expectation and more importantly my interpretation of the program." 2. "The group was a mixed bunch...quite solid...low self esteem...sent by WINZ...in general a bit on the outside of the group, very slight...always cold, water confident surfie."

Root causes (subjective):

7. A little bit of an extension of the 'Nature of the programme' above...a culture that is both explicit and implicit, formalised and informal, leading to a training or induction pathway done 'by the numbers, join the dots approach' i.e. 'If you do this or follow this procedure, then this will / won't happen' to the extent that even senior instructors might let some 'growth' happen for the instructor at the expense of client physical and emotional safety?

6.2.3.1.(c) Researcher sorting of Delphi results

I sorted the comments from all six experts and collated them into the three categories of conditions (immediate causes), and the two major classes of root causes (Instructor and Management system errors). Table 25 shows a summary of this collation for Incident 1471. Table 25 should be read with an understanding of the following:

- Column one shows the responses from the various Delphi panel members coded in relation to the order of responses above in section 6.2.3.1(b). For example code 3(2) is interpreted as Expert Number 3, Comment 2.
- Column two is my summary of those particular comments for inclusion in the resultant ECFA diagram. Often the same underlying immediate or root cause will be explained in different ways by different experts. My job was to provide a summary that captured the meanings of the various experts in clear language.
- Column three allows for any explanatory text.
- The particular column in the table (either: immediate cause; root cause – instructor error; or, root cause – management system error) that I chose to place feedback from a particular Delphi panel member in may be different than that used by the Delphi member.
- My role was also as an extra member of the Delphi panel. If I believed that a particular immediate cause or root cause had been missed, based on my expert knowledge, this was included and coded "R" for researcher.

Table 25

Summary of Delphi Comments for Iteration One of Incident 1471

Delphi Panel Comment	Summary for ECFA Diagram	Explanation
IMMEDIATE CAUSES		
1(1) Mixed group, some not confident. 1(3) Some students unstable in kayak. 1(4) Some students did not have a very good grasp of English. 2(2) Party keen, but of diverse	Mixed ability group, some not confident and one student has poor English.	This immediate cause is pertinent because any planned trip needs to cater for all group members in all encountered conditions.

skill range. 3(3) Mixed bag group of students. 4(2) Beginners in sea kayaks. 6(2) Perceived mixed ability / motivation group, participant level of experience.		
1(2) Exposed coastline, not many places to land. 4(1) Unpredictable shore. 6(3) Coastline is exposed with not many places to land.	Coastline is rocky with very few places to land safely.	Self explanatory.
1(6) First time being in charge of the group. 4(3) Inexperienced instructor(s) in their roles. 6(1) Instructor experience.	First time being an instructor in charge of a group.	Self explanatory.
1(5) Waves breaking on the beach – bigger than expected. 1(7) Instructor not familiar with the area and conditions.	Instructor not familiar with local conditions.	Self-explanatory.
2(1) Fine weather – a nothing can go wrong day. 3(1) Weather/water; slight swell with a light on-shore wind. 6(4) Slight swell and a light on-shore wind.	Fine weather. Slight swell with light on-shore wind. Almost no surf.	Prevailing conditions like this would encourage a person to continue, even if some aspects of the trip may be in doubt.
3(6) Student requiring exclusive attention of one instructor; "this would free up the other instructor to keep an eye on the Maori student," and, "the other instructor was a little back and behind the break, she was still rafted up with the Maori girl."	One weak student was being closely looked after by the senior instructor.	This may have diverted the attention of the senior instructor.
3(12) In the narrative no mention is made of what students were to do to avoid the rocks or of any other plan for multiple capsize.	Lack of thorough briefing of the students.	Briefing of students on emergency plans may have helped prevent further capsizes.
R	Had all demonstrated wet exits previously and instructor was happy about their skills.	This gave the instructor confidence in the group's ability.
R	Last day of kayaking and instructor wanted to give them a really good challenge.	This introduced a pressure to produce a challenging experience.
R	Instructor had done	This reinforced in the

	this trip once before and it had gone okay.	instructor's mind that the trip was safe.
R	Instructor wanted the group to be able to help each other and develop teamwork.	This may have added to the instructor wanting to provide a challenging trip.
ROOT CAUSES (INSTRUCTOR ERROR)		
1(6) First time being in charge of the group. 2(5) Instructor inexperienced as a leader, by his own admission. 2(11) Instructor/leader admitted a lack of experience for the leadership role. 6(1) Instructor inexperience, etc.	Lack of skills and experience.	Increased experience in leadership style, reassessing current risks and changing activities because of them, could have prevented this incident.
1(7) Instructor not familiar with the area and conditions. 1(9) Instructor identified that they had minimal knowledge of the effects of swells and general inexperience with the conditions of the area. 2(8) Lack of local knowledge – a change in coast topography can mean a change in wave action. 3(5) Lack of knowledge of the environment; "I had done this trip before during my induction a month before," and, "I remember this wave rolling in, breaking a lot earlier and being a lot bigger than I expected."	Lack of skills and experience of local conditions.	Increased knowledge of local conditions other than one previous trip in presumably good conditions could have prevented this incident.
1(8) Instructor couldn't clearly identify what they were hoping to achieve – instructor goals versus group goals? 2(10) While it's a team thing, the judgment of the students should not affect the decision of the leader. 3(4) Undefined outcomes. 6(6) Nature of the programme … "Maybe there was an element of pressure, placed on myself by myself, to give the students a challenging experience – after all that is what this programme was / is about… but I guess	Focus on personal goals or perceived organisational goals of providing a challenging trip over-riding the safety goals for the group.	It seems that a higher level of risk was taken to meet either the personal goal of doing this trip, goals of the students in continuing the trip, or the perceived goals of management to provide challenge on the course.

partly by the reputation / expectation and more importantly my interpretation of the programme"….		
1(10) Order of landing (most confident first) and then action taken when that student capsized – instructed rest of group to go ahead instead of stabilising group and checking out the situation. 2(6) A change in conditions will often be a signal to change plans. 2(9) Decision point – take the safest option, its always best for health. 3(9) Not responding to a change in the situation / condition; "The first student went on shore and capsized." 3(10) Instructor decision "To continue the plan of sending the students in one by one." 4(5) Failure to alter plan even when strongest student was capsized on the beach and it seemed unlikely others were going to succeed.	Unwilling to change a plan based on new information coming to hand.	Easier to continue with existing plan, even though risks are demonstrably higher, than to change the plan. Changing the plan to not land other students on the beach would have reduced the potential severity of this incident.
1(13a) Instructor experience in the conditions was lacking – if a senior instructor was present why did they not offer more advice and guidance? 3(13) Insufficient experience in the supervisor. Why didn't the senior instructor identify the potential for an incident and intervene? 4(4) Senior instructor not experienced enough to either identify the hazard or step in and take over – management issue with the identification of people and roles of senior instructors. 5(2) I'm interested why the second "more senior" instructor didn't proffer an opinion! Seems a lack of leadership on their	Inappropriate leadership style. The senior instructor was unwilling to step in and exert authority over a less experienced staff member who has been placed in a position of responsibility.	Senior instructor should have used a more directive leadership style with the less experienced instructor when the group started making their hazardous approach to the beach.

part. After all they were there for a reason.		
2(13 & 18) There was no mention of a contingency plan. 3(11) No escape plan.	Lack of planning ahead by the instructor.	Having other contingency plans in place for bad weather / conditions would have made it easier to change plans and avoid the incident.
3(7) Not completely inspecting the beach/hazard; "The information I had was based on what I could see," and, "Maybe with hindsight it would have been better for me to go and check it out first." 3(8) Collecting students in the impact zone; "I remember this wave rolling in, breaking a lot earlier and being a lot bigger than I expected," and, "I did believe that the students were in a safe place in relation to the breakers." 5(1) I agree with all the comments the instructor made 'in retrospect'. Particularly the statement where he should have landed first. Also the notion of moving further along the beach to get a better look at the surf seemed a good idea.	Lack of good situational awareness by the instructor. Failed to fully gather all necessary information to be able to assess the risk.	Taking time to properly assess the conditions may have led to the trip being changed and the risk averted.
R	Risky shift? Two instructors prepared to make a riskier decision than if they had been there by themselves?	Self explanatory.
R	Familiarity – Incorrect appraisal of current hazards due to having successfully completed the trip at another time?	Even one previous successful trip can reduce the situational awareness and risk assessment abilities of an instructor.
ROOT CAUSES (MANAGEMENT SYSTEM ERRORS)		
1(11) Procedures for matching group ability vs. goals should be clearly set prior to any trip leaving – is there such a process set by the organisation?	Lack of vetting of the planned activity by management to ensure a match between activity, students and	Having the instructor declare their plans to management before the trip and contingencies

2(7) Activity and route not suited to the whole group. 2(15) If described as 'exciting' by the instructor, that may mean terrifying for the students. 3(4) Undefined outcomes. 6(6) Nature of the programme .... "The group was a mixed bunch ... quite solid ... low self esteem ... sent by WINZ ... in general a bit on the outside of the group, very slight ... always cold, water confident surfie."	environmental conditions, etc.	planned in case of poor weather, would allow poor choices and planning to be seen in advance and corrected.
1(12) Staff training prior to leading a group – may not be sufficient. 1(14) Instructor interpretation of programme goals vs. sound practice did not match, indicating a missing link in the training process for new instructors. 5(3) It appears to me that the organisation had not properly prepared the instructor. 6(7) A little bit of an extension of the 'Nature of the Programme' [in 6(6)] ... a culture that is both explicit and implicit, formalised and informal, leading to a training or induction pathway done 'by the numbers', 'join the dots' approach ...	LTA staff training.	Training of staff in matching activity to students' abilities and managing groups in sea kayaking situations appears to be inadequate.
1(13b) What is the organisational criteria relating to the role of the senior instructor when safety issues are concerned? 2(19) What was the main role of the co-instructor and how senior were they? 4(4) Senior instructor not experienced enough to either identify the hazard or step in and take over – management issue with the identification of people and roles of senior instructors. 5(4, 5, 6) The senior instructor	LTA assigning of responsibilities and accountabilities?	When two instructors are with a group it should be clear as to who has ultimate accountability and that person's responsibility to step in if risk is present.

should have taken charge earlier – may have been a different result, etc.		
2(12) The instructor did not refer to any safety management process, RAMS, etc. 4(6) possible management failure to identify or collate collective experience from that particular beach.	LTA risk assessment and management system by management.	Organisation should have thorough set of risk management plans for activities / venues.
2(14) It was one of the instructor's first instructs. An experienced leader should have accompanied the group.	n/a	Discounted as a root cause as a senior member of staff had been assigned to accompany the group by management.
3(14) Insufficient documentation; Activity guidelines / procedures, operating parameters for wind / swell, description of environment / location. 5(8) I would have thought more information would have been available to the new instructor, both from the senior instructor and the organisation.	LTA policies and guidelines for the activity.	Policies and guidelines should be in place for activities / venues to state under what conditions they are allowed to be carried out.
6(6) Nature of the programme. "The final day was to be a beach day…. A paddle along the shoreline and exploring of the sea cave was the logical alternative."	Set activities in a structured programme can lead to trips that don't necessarily take into account instructor experience, student ability and environmental conditions.	The focus of an instructor can be placed on carrying out the prescribed activity rather on adapting to the current conditions and changing activity completely.
R	LTA monitoring of instructor performance in the field?	It is only through observing actual performance of staff in real situations that corrections can be put in place. In this case the role of senior instructor should have been to correct the situational awareness and decision-making inadequacies of the less experienced

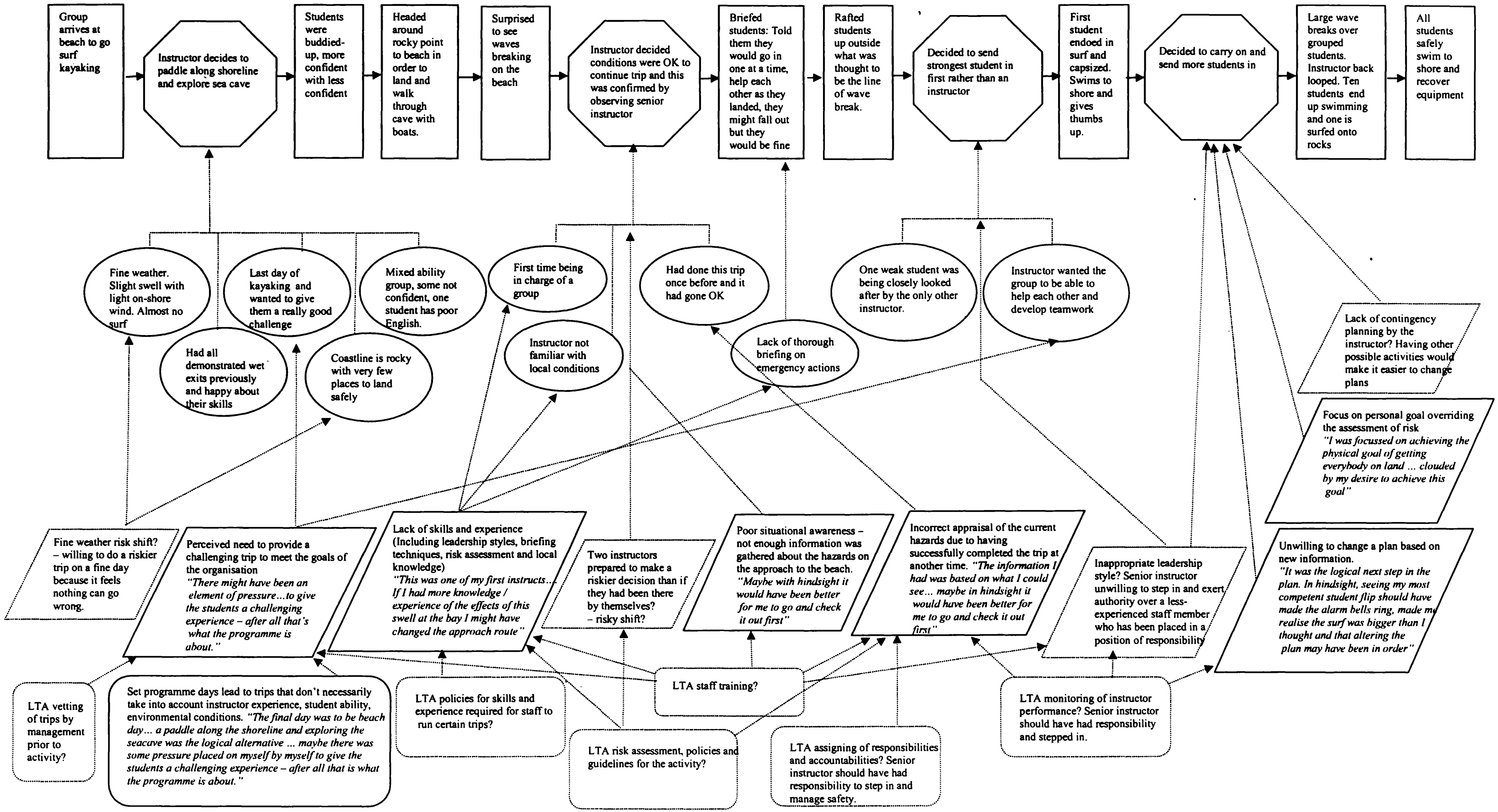
		instructor. However the real issue that needed observing was the leadership style of the senior instructor while supervising the less experienced instructor.

6.2.3.1.(d) Compilation of an Events and Causal Factors Analysis (ECFA) for the incident

An ECFA diagram was then prepared for Incident 1471. This included a chronological list of events leading up to and including the actual incident. The identified immediate causes and root causes of the incident were then added to this chronological list of events with the relationships indicated by arrows. Immediate causes and root causes that had evidence to support them based on the CAI, were enclosed in solid objects. Those that were the subjective view of a Delphi panel member(s) were enclosed in dotted objects.

The ECFA diagram compiled from this Delphi analysis is shown in Figure 39.

Figure 39. ECFA diagram representing the Delphi analysis of Incident 1471 – Second Iteration Diagram
(Incident 1471: 10 students capsized by waves on sea kayaking trip with one student swept onto rocks)



6.2.3.2 Second Delphi Iteration

The ECFA diagram was emailed to all of the Delphi panel members and the instructor involved in Incident 1471 for feedback. The instructions given to the Delphi panel members to help interpret the diagram are shown in Appendix Four. Five of the experts indicated that no changes needed to be made to the ECFA diagram. One expert asked that a further management system root cause be included:

> "Having reviewed the diagram I agree with the analysis but on reflection it seems to me that the corporate culture in the organisation may not be making it clear that safety goals come before educational goals. It might be worth including something about that."

This additional root cause at management system level was included in the revised ECFA.

The instructor for Incident 1471 made the following comments:

> "Line 2: First time being an instructor etc., this is incorrect. It should say something like: first time instructing for that particular organisation on that particular activity in that location."

This change was included in the revised ECFA.

> "Line 3: Risk is lower on a fine day for that activity – I was not thinking 'nothing could go wrong'. I had enough experience to be aware of the dangers of coastal paddling"

If this psychological factor had any effect on the decisions of the instructors concerned, it is likely to be at a lower level of consciousness. Therefore it may have been present in this incident despite the comment by the instructor. As the aim of this research is to identify potential root causes by the analysis of a number of outdoor incidents, this remains a valid potential root cause. In the revised version of the ECFA this root cause is shown in grey rather than black to indicate there is some disagreement among those reviewing the incident that this potential root cause contributed to this particular incident.

> "Line 3: Lack of skills and experience – same thing as my comment before. There was definitely a lack of local knowledge and conditions and I guess a lack of experience within the organisation, as this was my first instruct for this organisation. I definitely had lots of related experience."

This is accepted but no change is thought to be required to the ECFA diagram.

> "Line 4: Set programme days – the decision to go to the beach was ours (the instructors'), based on student abilities and group needs. The organisation does not decide this. The organisation does decide that you are kayaking – where, what and how is the instructors' decision. However there is an expectation to deliver a challenging course."

This is noted and the root cause is shown in grey to signify some doubt among reviewers as to the place of this potential root cause in this particular incident analysis.

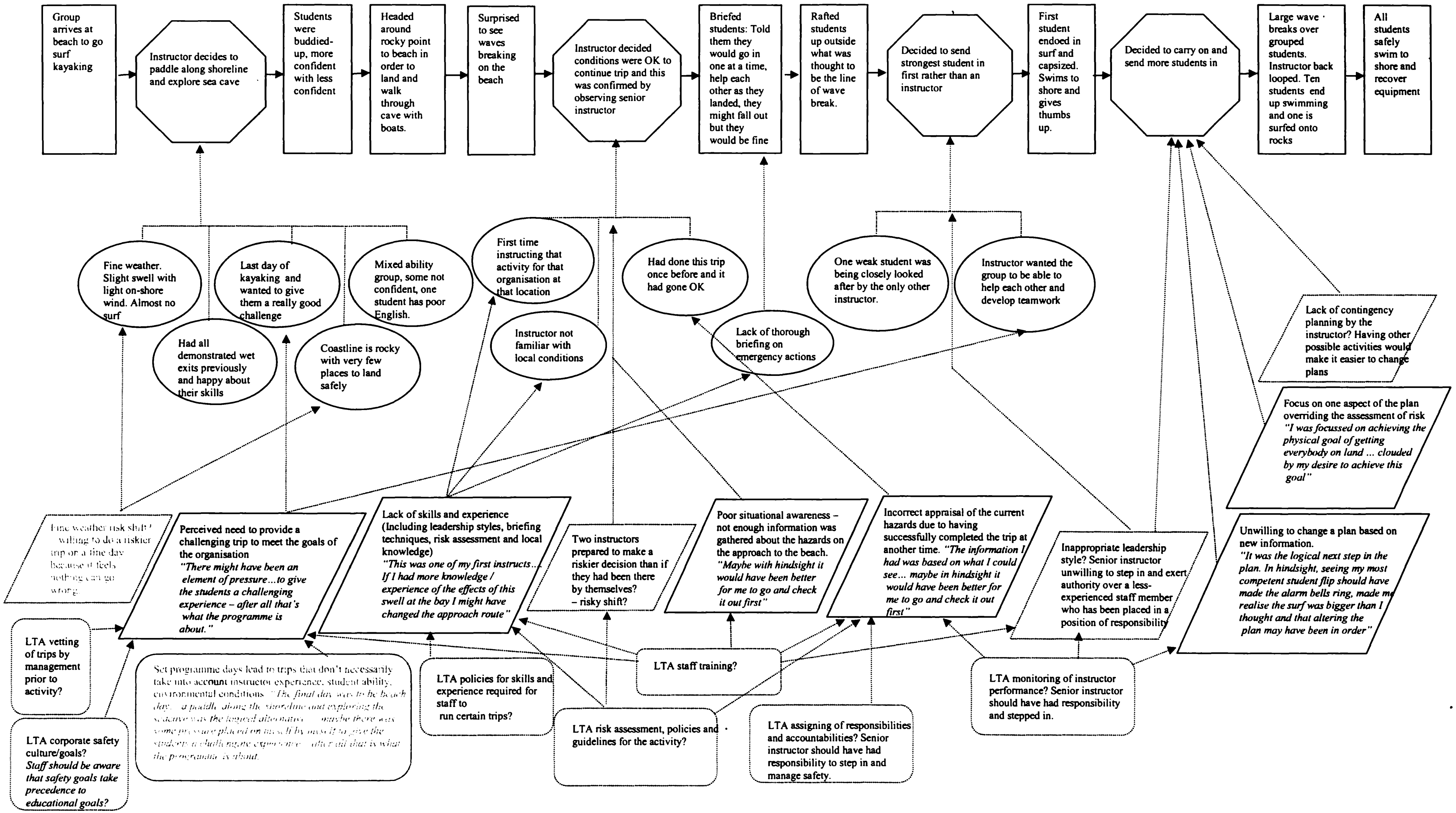
> "That's it. All looks very professional…"

These changes were incorporated into a revised ECFA diagram for Incident 1471. This revised version is shown as Figure 40.

6.2.3.3 Third Delphi Iteration

No further changes were suggested by any of the panel members and therefore stability had been reached in the analysis process for Incident 1471. The ECFA diagram representing the result of the third iteration of the Delphi process is shown as Figure 40.

Figure 40. ECFA diagram representing the Delphi analysis of Incident 1471 – Third Iteration Diagram
(Incident 1471: 10 students capsized by waves on sea kayaking trip with one student swept onto rocks)



6.3 Results of and Comments on the Delphi Analysis of 18 Serious Outdoor Education Incidents

The other 17 incidents selected for further study were analysed in a similar manner to that explained in the case study of incident 1471 in Section 6.2. The completed ECFA diagrams for these incidents follow in Figures 41 – 57. The following observations were noted during the Delphi process:

- The Delphi process itself was extremely valuable in bringing together a range of expert views of root causes of the incidents. As shown in the case study of Incident 1471 where no root cause was identified by all six experts and no single expert identified all of the root causes in the final ECFA, the combined analysis was far more thorough than simply using one expert – no matter the experience level of that one expert. Each expert brought to the analysis a different background and set of experiences from which to view the incident, often surprising other experts in the second iteration with their insights.

  One Delphi member commented on the structure that I had suggested for the feedback they were to give on the incidents. He believed it was too rigid and may have impacted his ability to think widely on root causes:

  > "I struggled with the structured way you wanted us to respond and so I free-formed it... it seemed to me that the structure you wanted kept us locked into the current way we view risk management and I was under the impression we were trying to look at the whole thing in a new light...if I was wrong I apologise but that's what it was for me."

  The purpose of the Delphi exercise was to get as wide a range of opinions as possible from a cross-section of outdoor experts. Whatever form the opinions arrived in was accepted without comment. Some adopted this "free-form" approach and others appreciated and followed the guidance of a structure for the feedback.

- Because none of the experts identified all of the root causes, and some identified smaller subsets of the final number than others, individual panel members suffered self-doubt early in the Delphi process. I received emails such as:

  > "I have just received the first incident summary from you. It looks great but .... I realise how few of the root causes I managed to identify compared to the analysis you sent me. I must admit to feeling a bit inadequate and if you want me to pull out just let me know."

  > "Boy, the diagram of the first incident just came through – it looks very thorough! I am a bit in awe of how other people giving feedback to you came up with such in-depth root causes. I just hadn't thought of them! If you don't think I'm pulling my weight then please feel free to get someone else in."

  I was able to reassure them that their feelings were shared by others and that everyone's contribution built up the final picture of the incident pathway. In this way all panel members stayed motivated and became educated through the process to look at different aspects of an incident to identify root causes.

- The ECFA representations of incidents were very well received. After sending out the first incident summaries to panel members I received unsolicited feedback from both panel members and the instructors involved in iteration 2 and 3 of the process:

  > "Great format, easy to read and follow."

  > "Thanks for sending though the review of my incident. I like the format used."

  > "Looks great – so easy to follow!"

> "It all fits and sounds right. It makes me realise how many mistakes I made and how I could improve in the future. The diagram was really easy for me to follow and makes it really easy to see how the events flowed to create the final accident. Thanks and good luck with your study."

There was only one negative comment received from the 18 members of the Delphi panel and 18 instructors involved:

> "…the big diagrams were a nightmare for me to read and printing them off helped little...unusual as I am normally pretty visual...this didn't help to bolster my enthusiasm either."

One instructor commented that it took a little bit of adjustment to get used to the diagrams and then they were very useful:

> "I found it a bit confusing to start with, especially at the deeper levels, but after I did a couple it was easier. I think if I was actually using it as a tool it would become easier again. The advantage that the diagram has over a written narrative or a list is that it allows you to see at a glance the key areas of the incident, it just takes a while to remember what the dotted parallelogram etc. represents."

Some concerns were simply about the size of the diagrams making it difficult to read on a computer screen until it was printed out.

> "…it was kind of annoying that I couldn't read it easily on one screen without having to print it out - having to flip all over the place, but you get that… but all the information was there and easy to follow if printed out."

This feedback was vindication of the choice of the ECFA diagram as an incident evaluation tool for the purpose and target audience. A suggested incident analysis system for managers of outdoor education programmes that uses the ECFA tool will be explained in Chapter 8.

- There were very few changes suggested to the ECFA analysis by Delphi panel members after receiving the first combined result at the end of iteration one. The most changes were suggested by the instructors involved in the incidents. At times this instructor feedback concerned factual changes that were required to the analysis based on the misinterpretation of the CAI data and these changes were straightforward. More contentious at times were the critical judgment points signaled in the analysis and the root cause analysis. While some instructors viewed the analysis as a learning tool from which they could extract points for improvement based on feedback from expert peers, others became quite defensive and wrote justifications of their decisions and actions. This was to be anticipated given the fact that the analysis was delivered electronically without one-on-one guidance throughout to explain the rationale of the causal factors. Once changes had been made to the analysis and some areas were "greyed out" as shown in the case study of Incident 1471 to indicate doubt about the applicability of the identified cause, there were no requests for further change.

- The first iterations of the early incidents studied by the Delphi panels contained more feedback on root causes due to instructor error than management system error. This is not surprising considering the history of outdoor education incident analysis where often the immediate search is for someone to 'blame'. By the time of the later incidents there was more of a balance in their feedback as the Delphi members educated themselves through successive incident analysis on areas to consider for root causes.

- Analysing six incidents was reaching, and in some cases had reached, the saturation level for panel members. Interest levels, which had been high at the beginning, were beginning to wane, response times increased and the quality of some responses deteriorated.

Figure 41. ECFA diagram representing the Delphi analysis of Incident 126
(Incident 126: Student swept away while crossing swollen river. Rescued before injury)

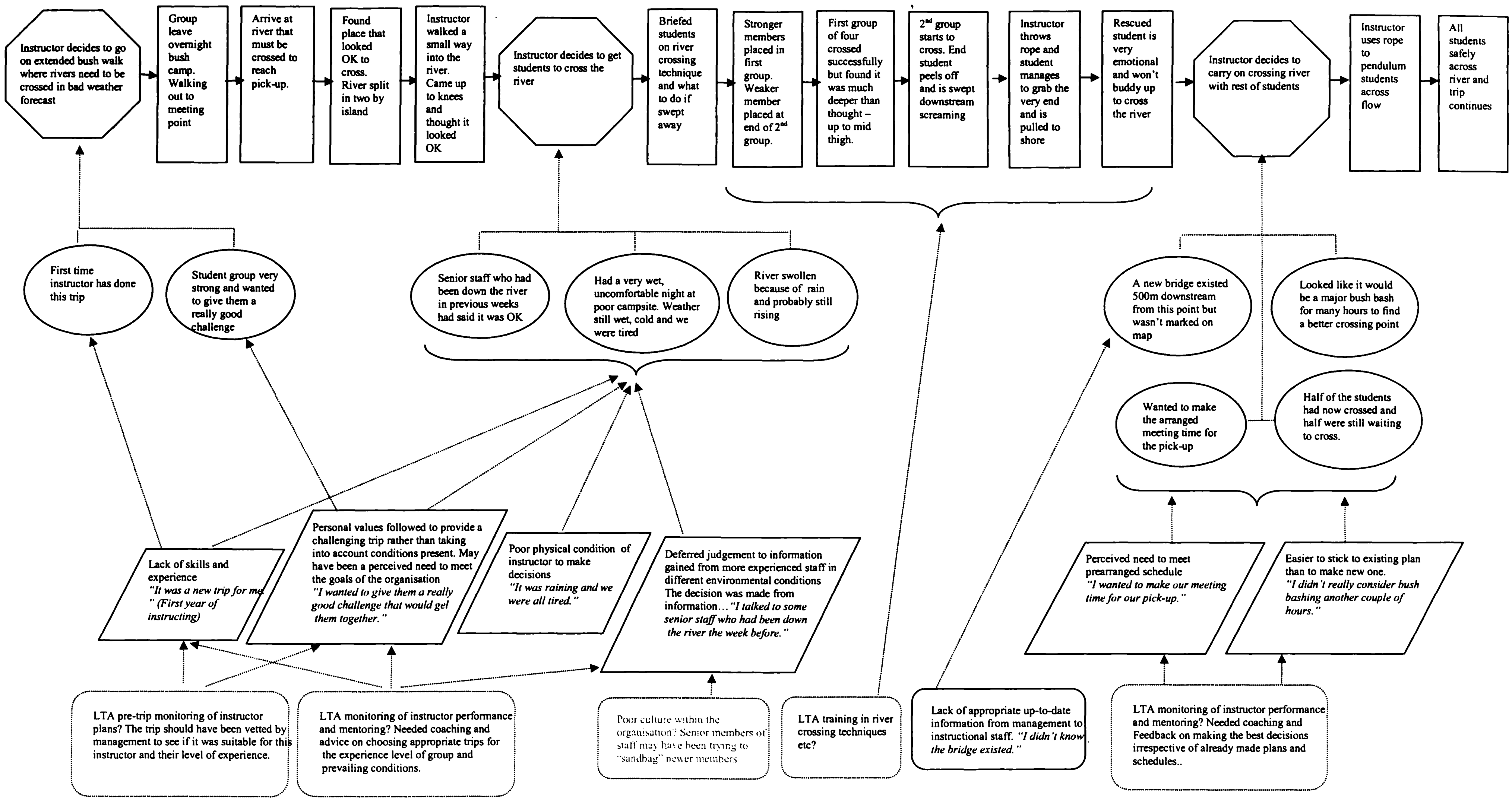


Figure 42. ECFA diagram representing the Delphi analysis of Incident 281
(Incident 281: Students canoeing in canal. Multiple capsizes and pushed against bridge pillars. Equipment damage only)

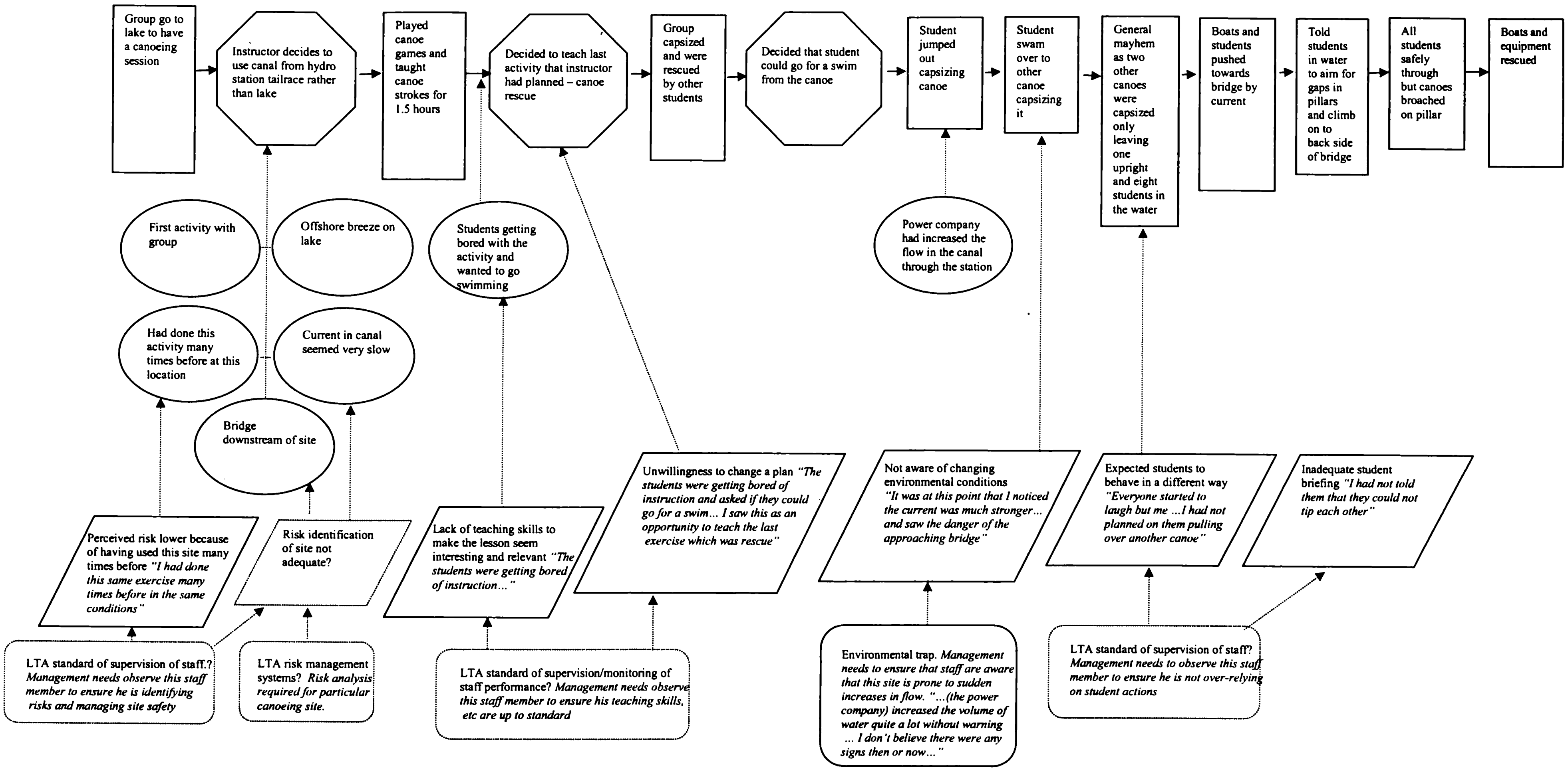


Figure 43. ECFA diagram representing the Delphi analysis of Incident 1649
(Incident 1649: Student jumped off high bridge into river against instructions)

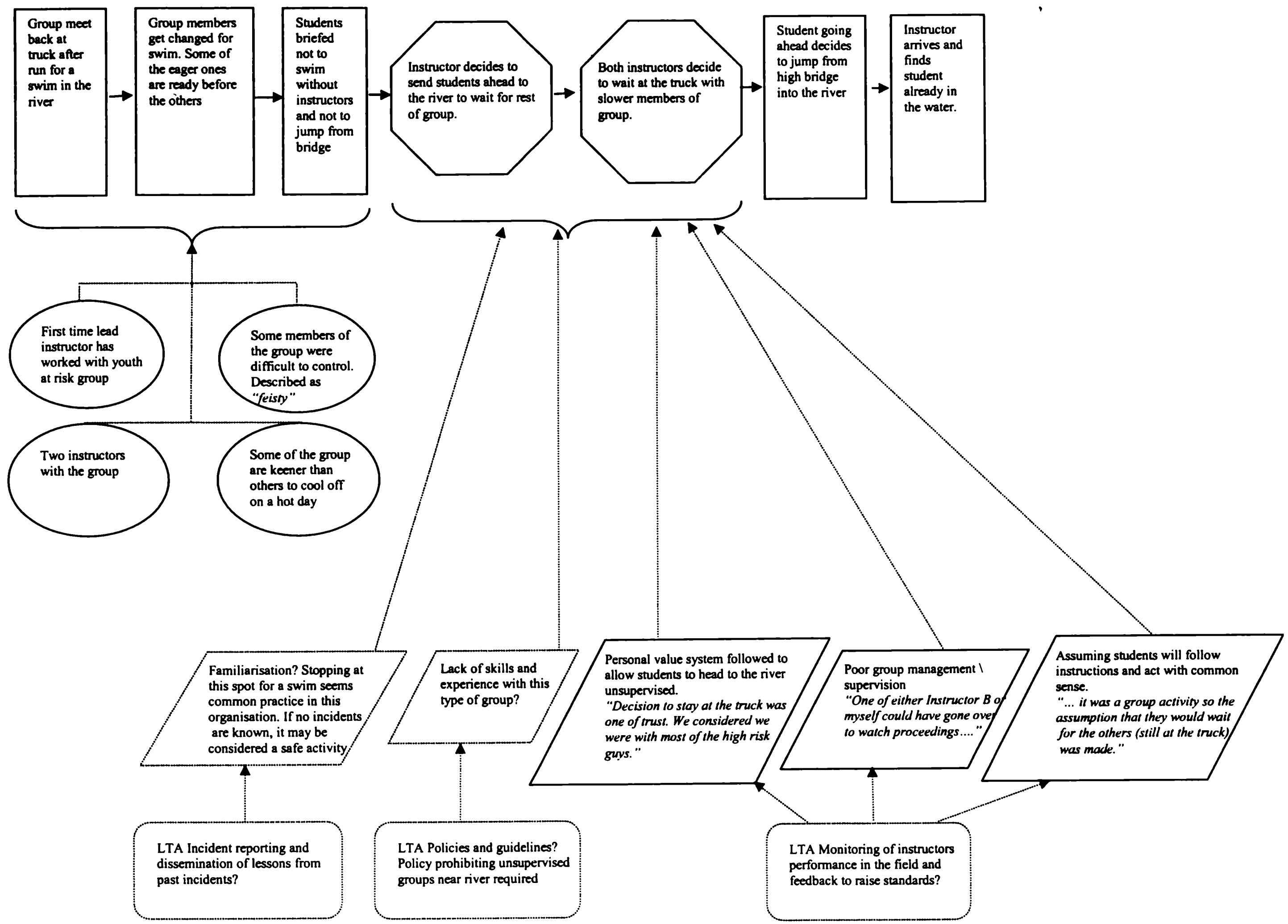


Figure 44. ECFA diagram representing the Delphi analysis of Incident 611
(Incident 611: Student fell off raft with rope around neck. Rope causes bruising and burns)

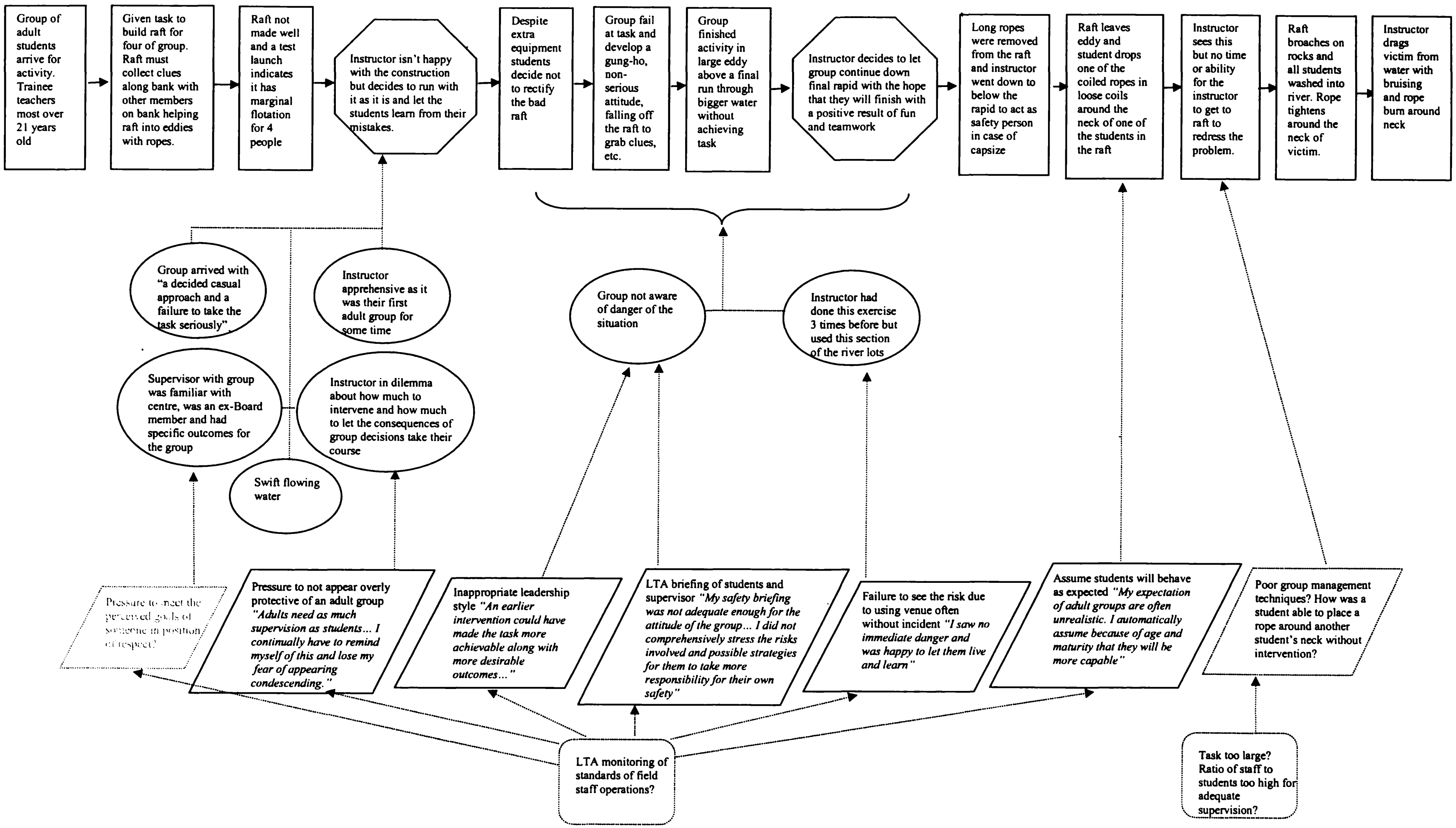


Figure 45. ECFA diagram representing the Delphi analysis of Incident 292
(Incident 292: Student jumped off wharf, breaking leg in shallow water)

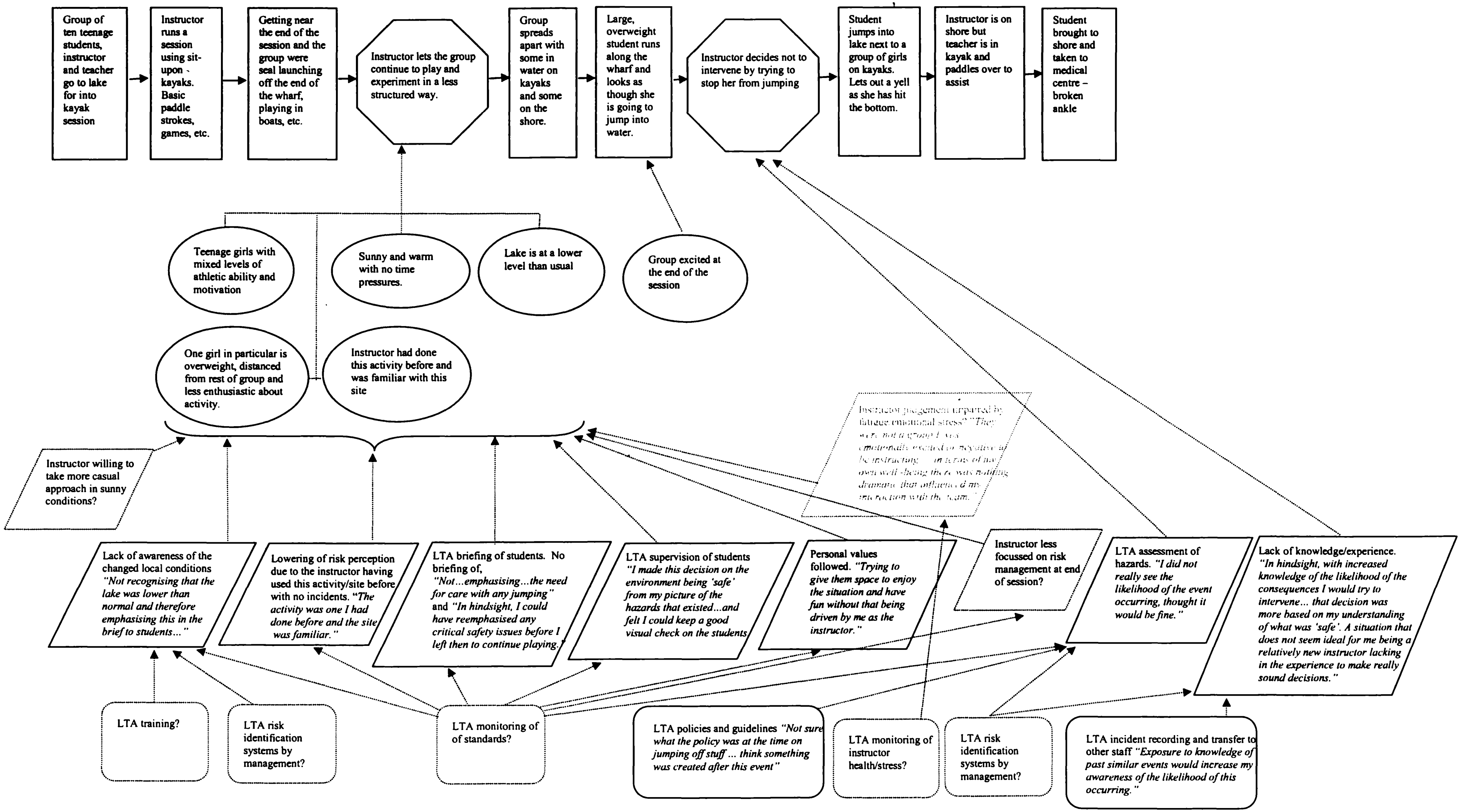


Figure 46. ECFA diagram representing the Delphi analysis of Incident 318
(Incident 318: Student falls on bike while doing jump and ruptures spleen)

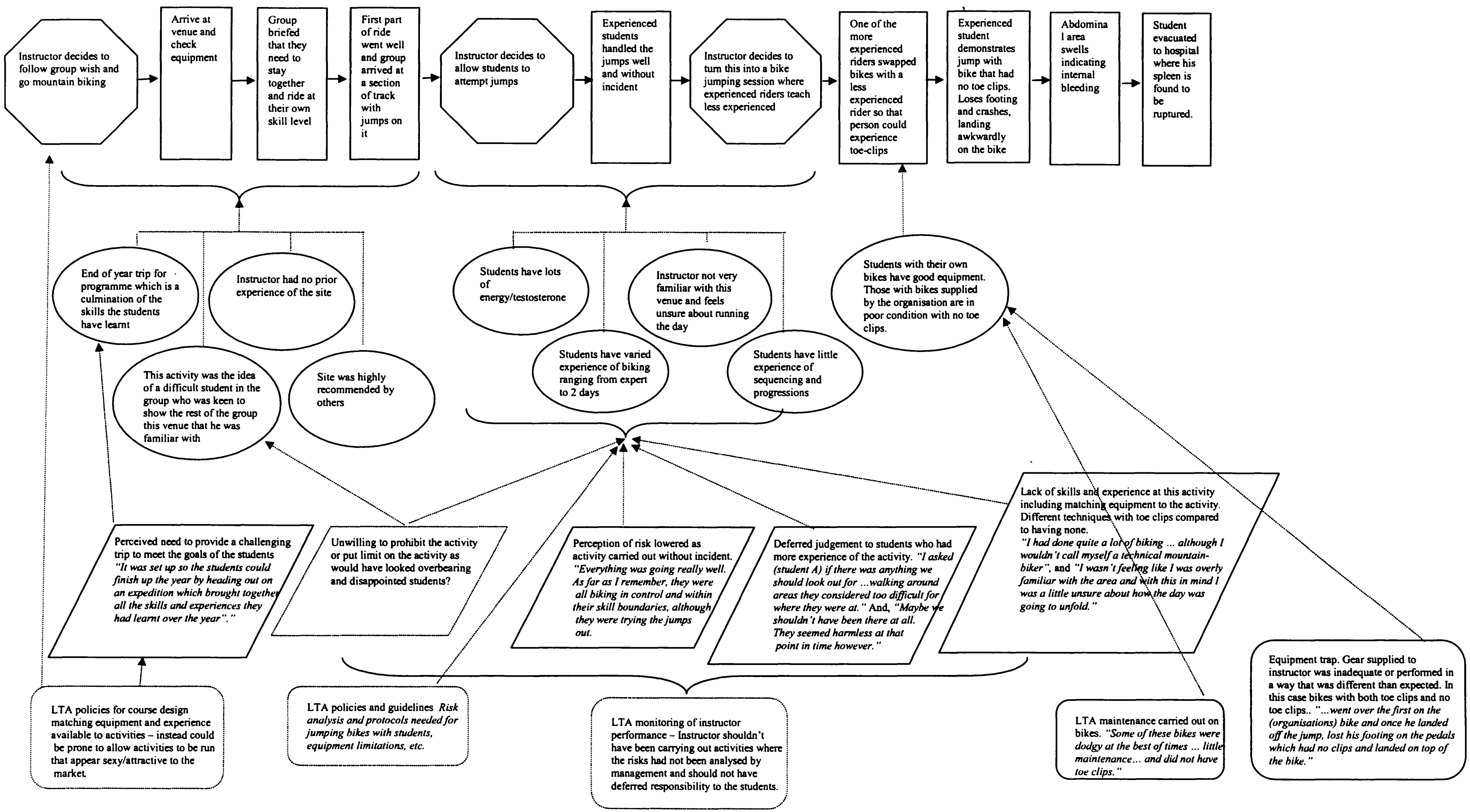


Figure 47. ECFA diagram representing the Delphi analysis of Incident 857
(Incident 857: Student climbing on dangle-duo is taken off belay and put at risk)

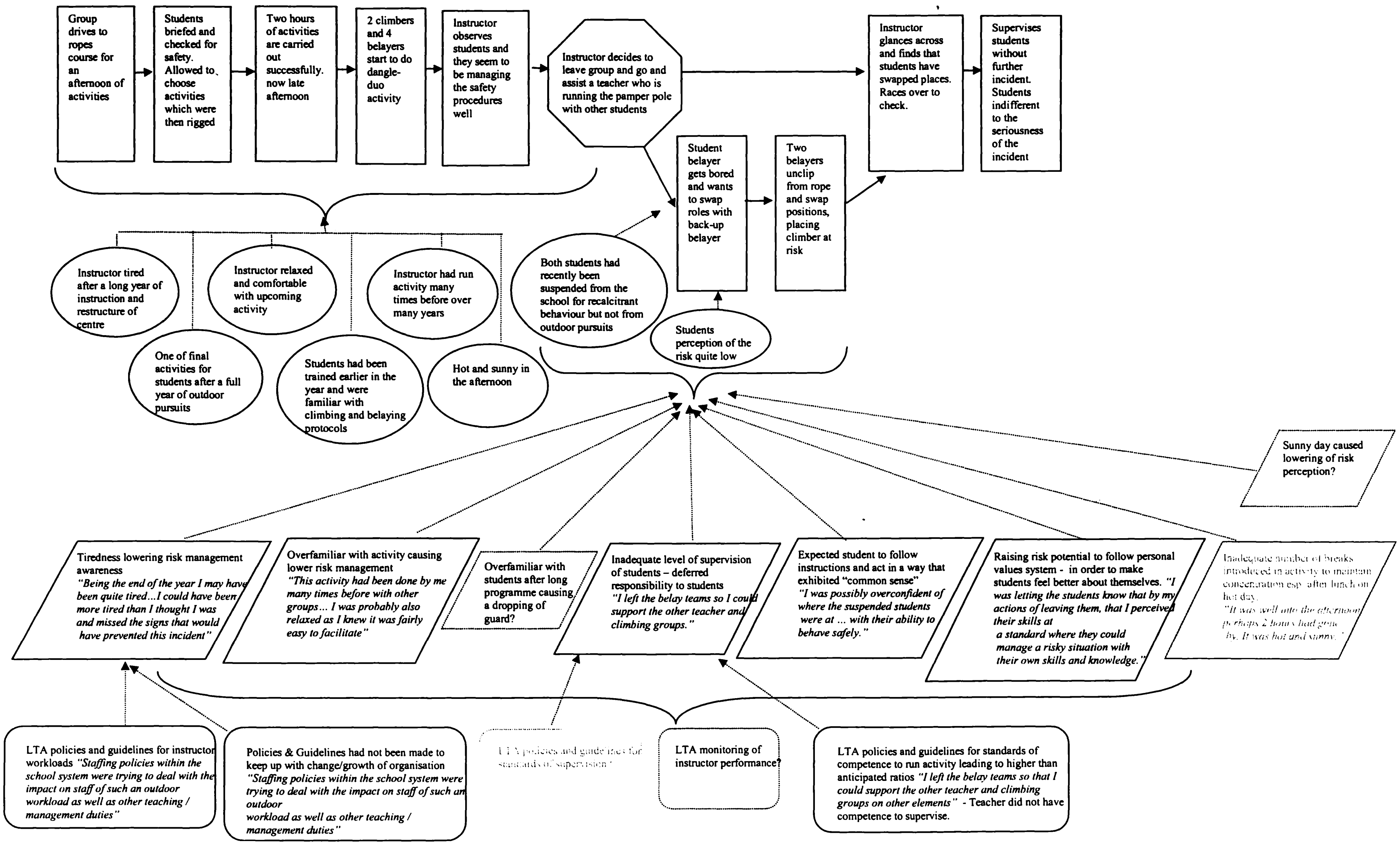


Figure 48. ECFA diagram representing the Delphi analysis of Incident 42
(Incident 42: Potential student pin on log during kayak instruction. Rescued without injury but paddle lost)

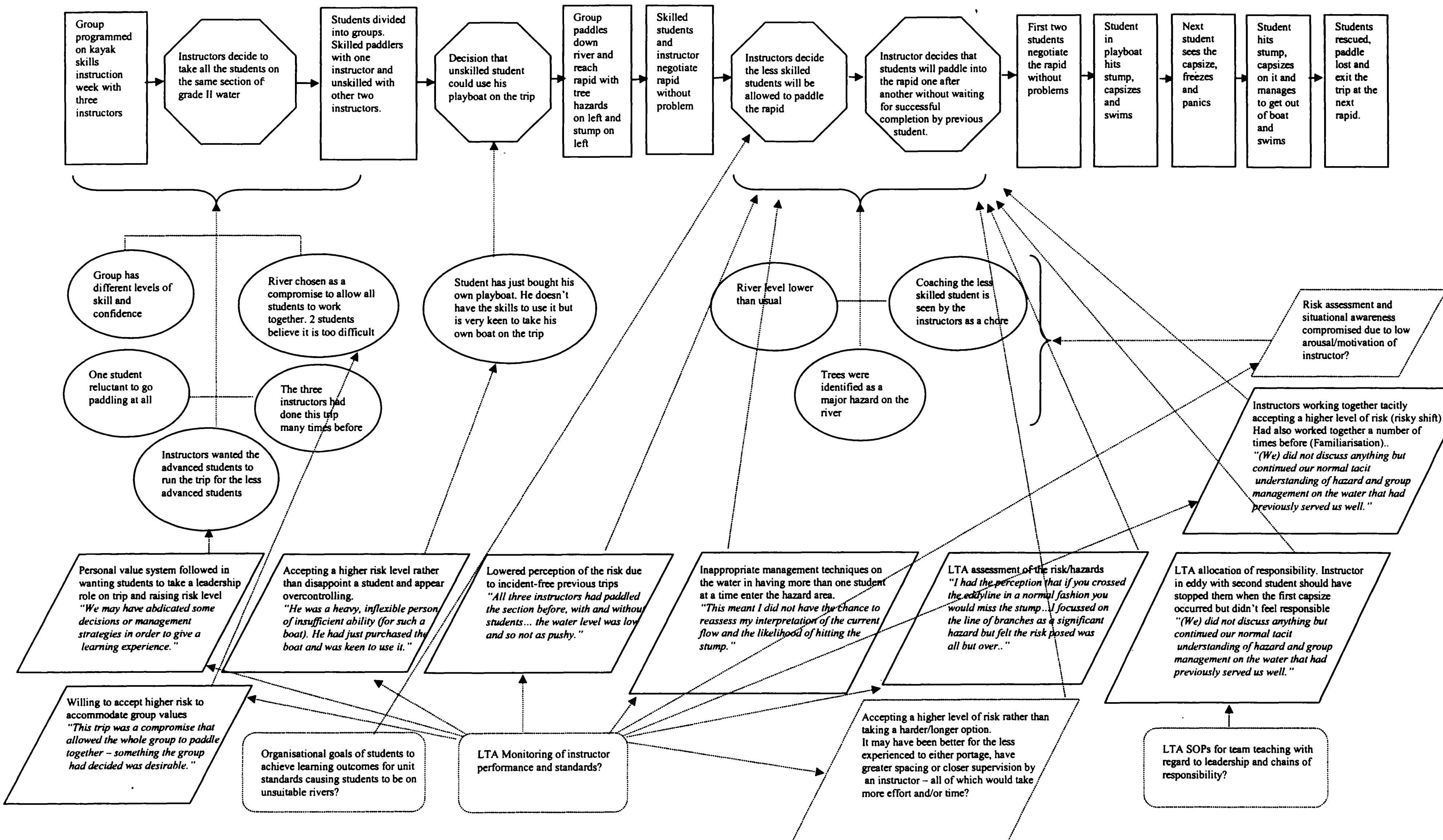


Figure 49. ECFA diagram representing the Delphi analysis of Incident 43
(Incident 43: Student trapped by foot in pinned tube raft. Rescued without injury)

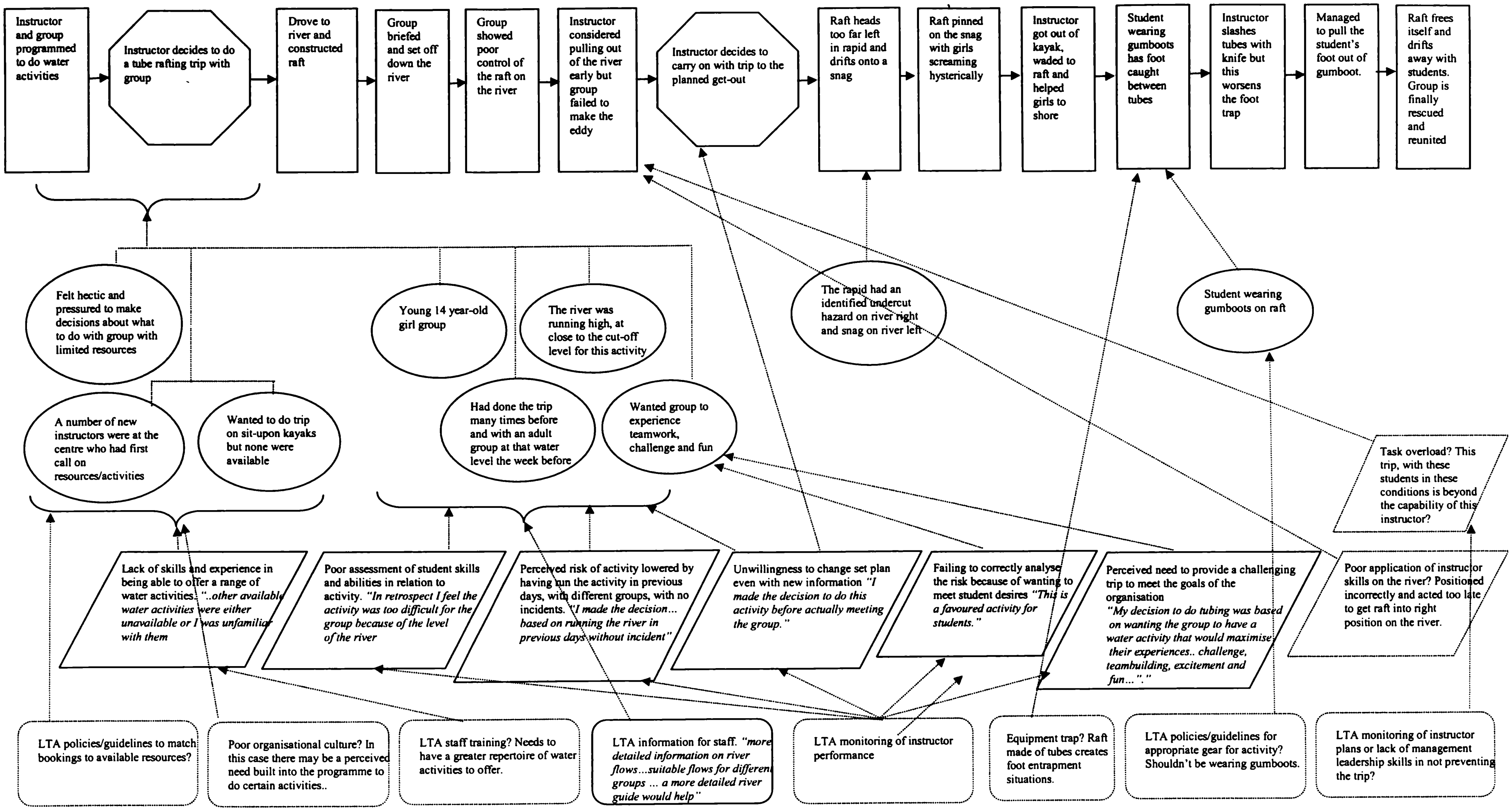


Figure 50. ECFA diagram representing the Delphi analysis of Incident 576
(Incident 576: Student falls down cliff onto rocks and breaks femur)

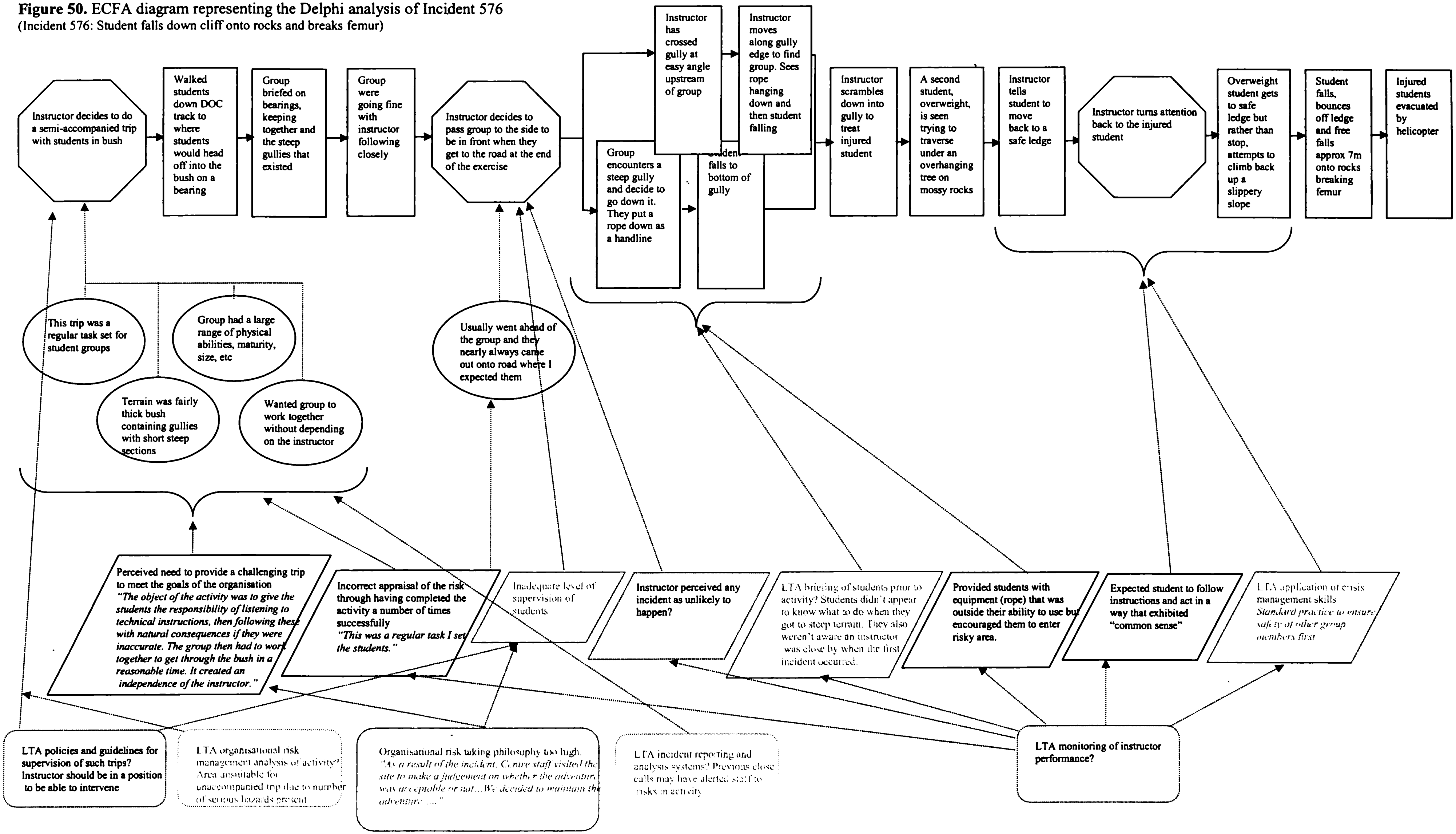


Figure 51. ECFA diagram representing the Delphi analysis of Incident 728
(Incident 728: Instructor allocated a vehicle in unsafe conditions and then continued to use it with a group in less than an optimal state)

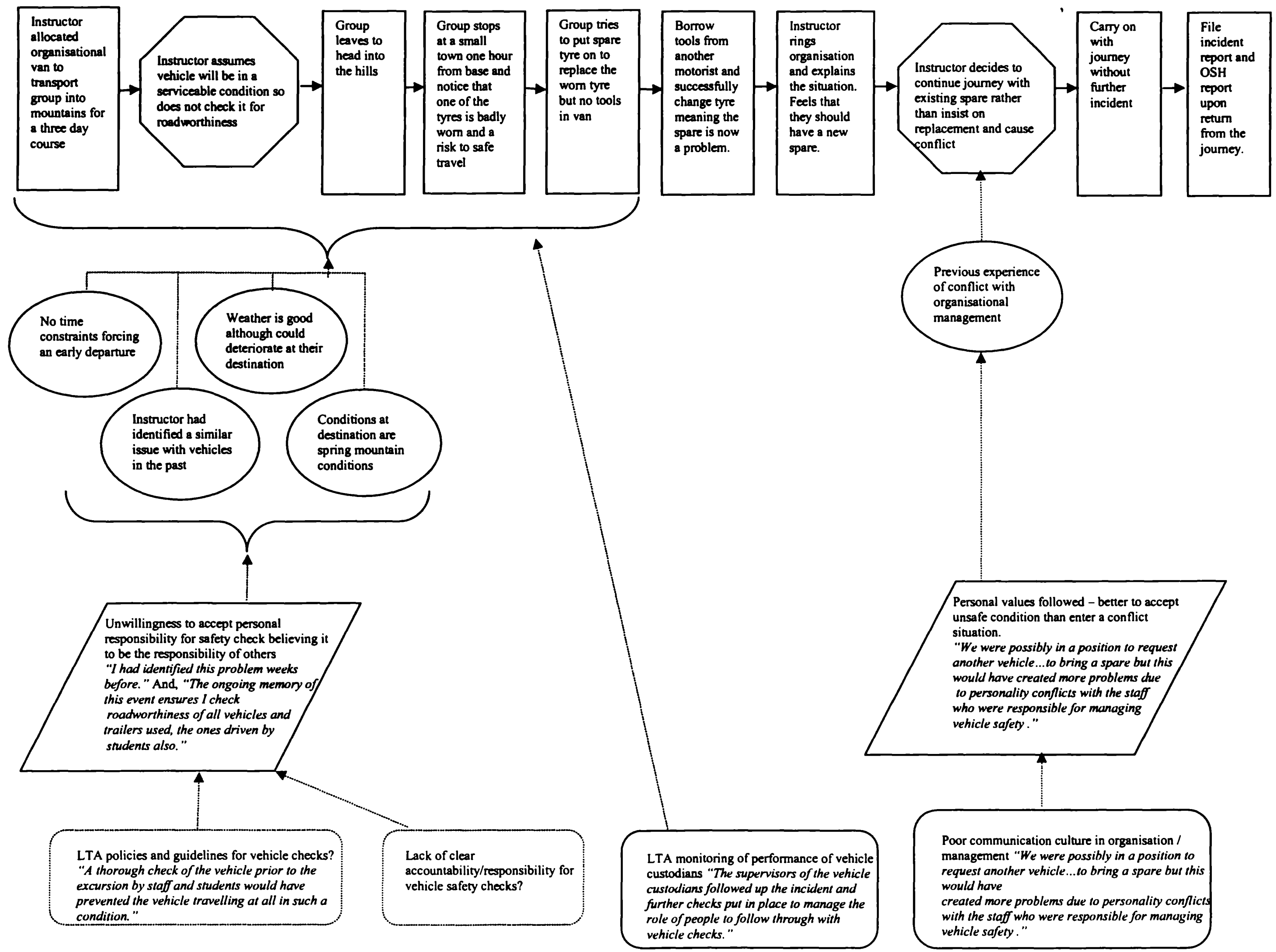


Figure 52. ECFA diagram representing the Delphi analysis of Incident 261
(Incident 261: Student bush-bashing in lead walks over cliff and hangs from edge. Falls to river without injury before he can be rescued)

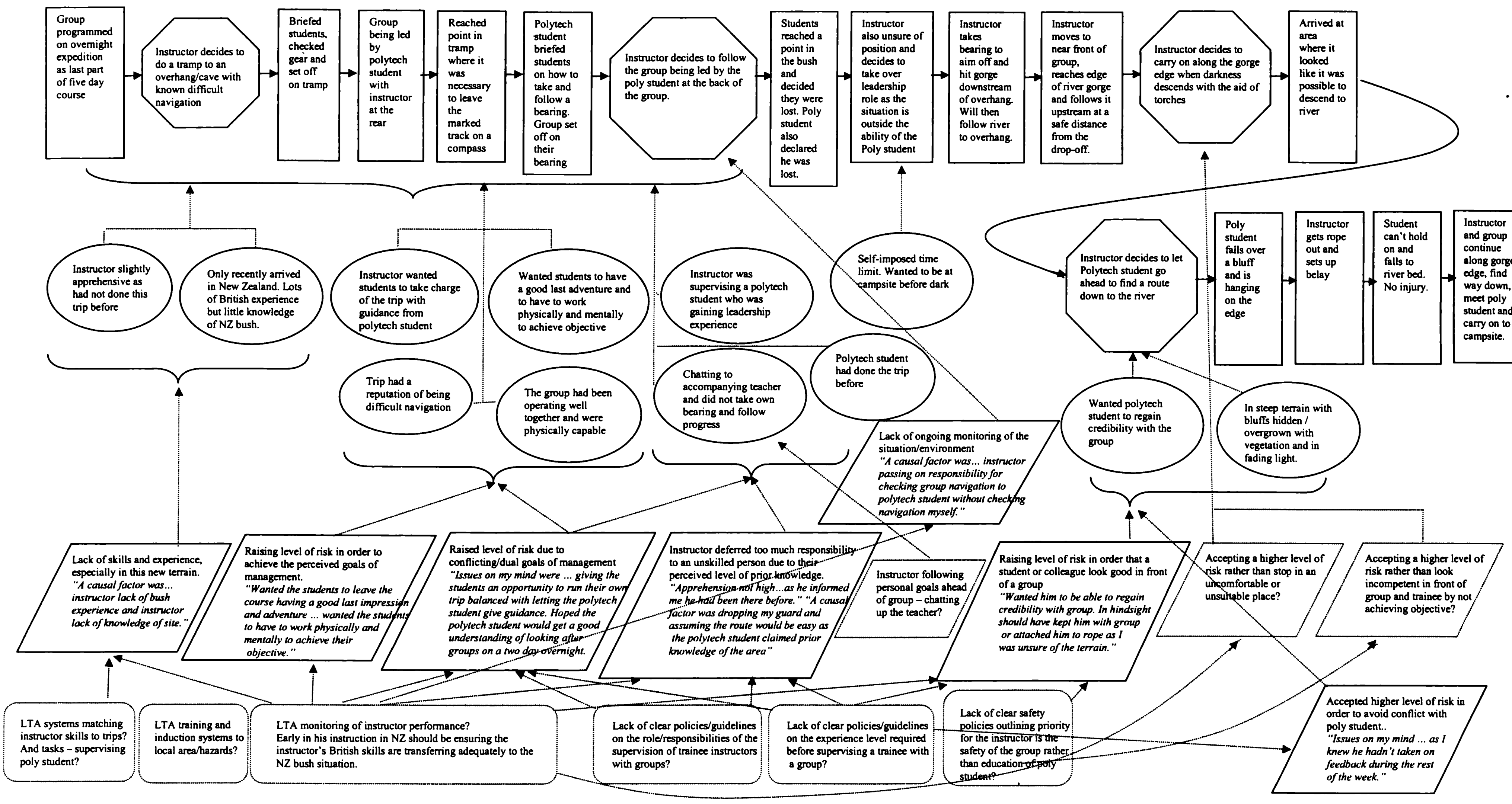


Figure 53. ECFA diagram representing the Delphi analysis of Incident 636
(Incident 636: Student broached in kayak on tree in moving water. Rescued before injury)

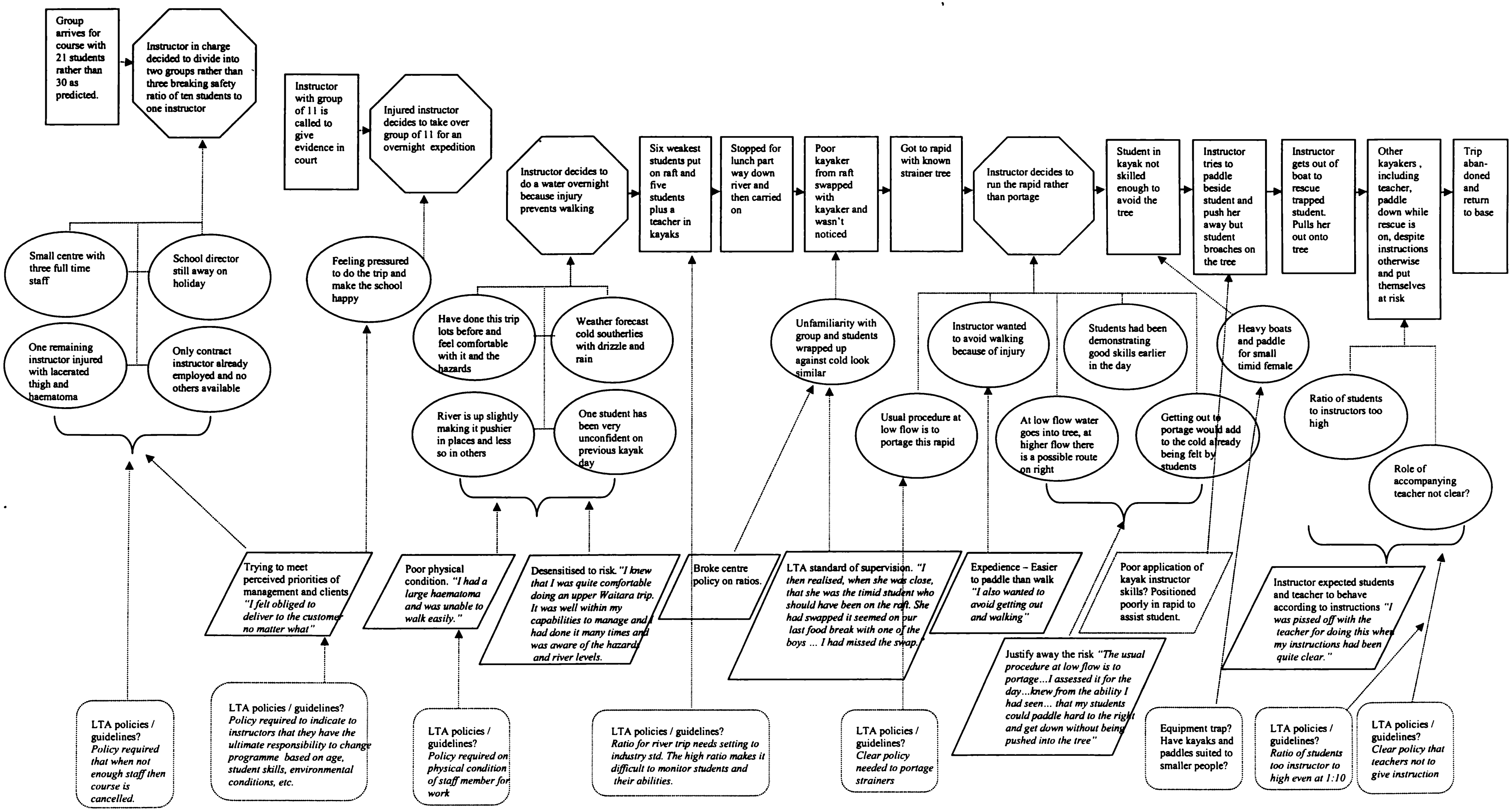


Figure 54. ECFA diagram representing the Delphi analysis of Incident 845
(Incident 845: Two students solo up large loose cliff with dangerous run-out)

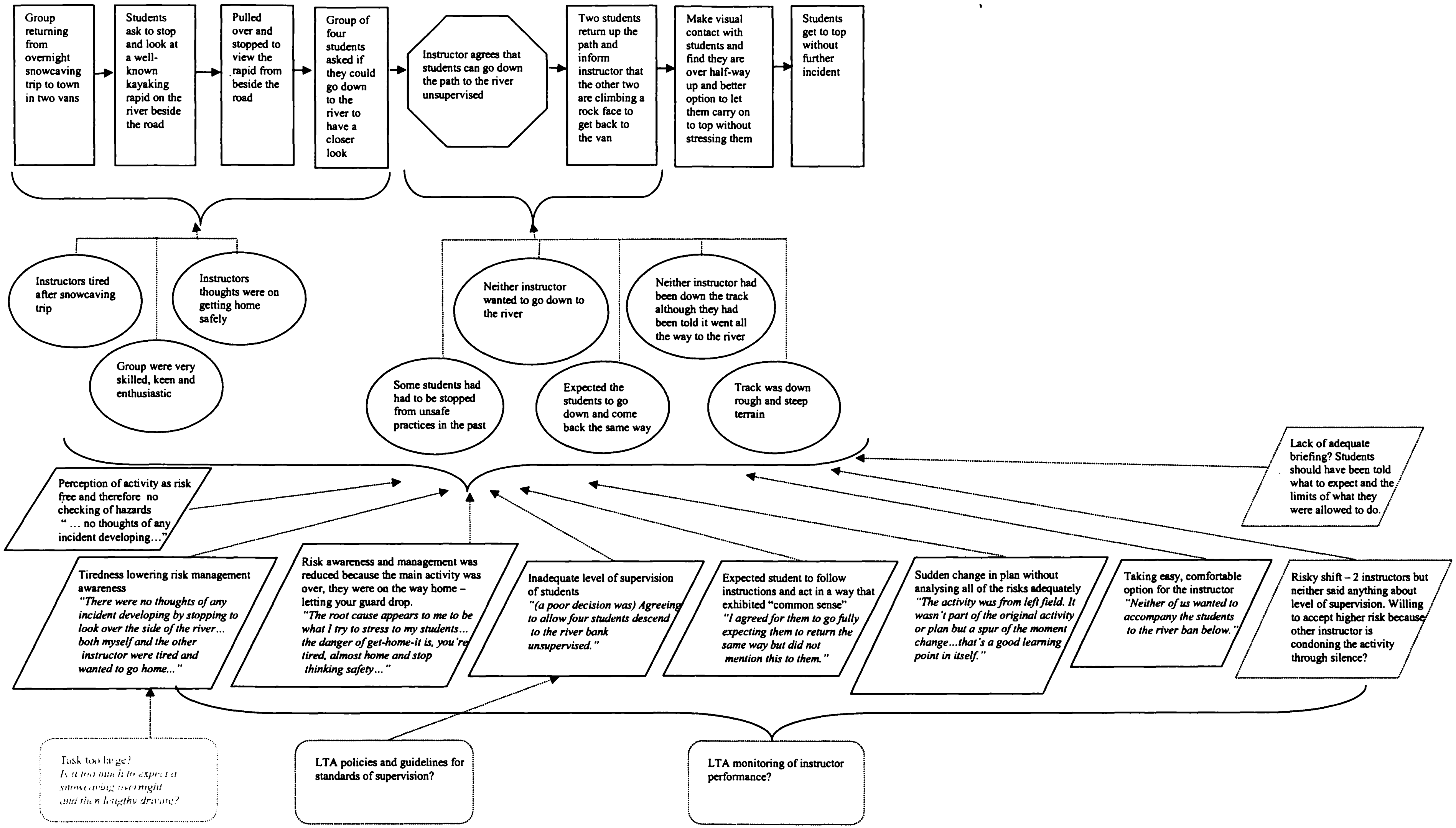


Figure 55. ECFA diagram representing the Delphi analysis of Incident 1515
Incident 1515: Canoe broached on willow in moving water. Student trapped in water against canoe. Rescued before injury)

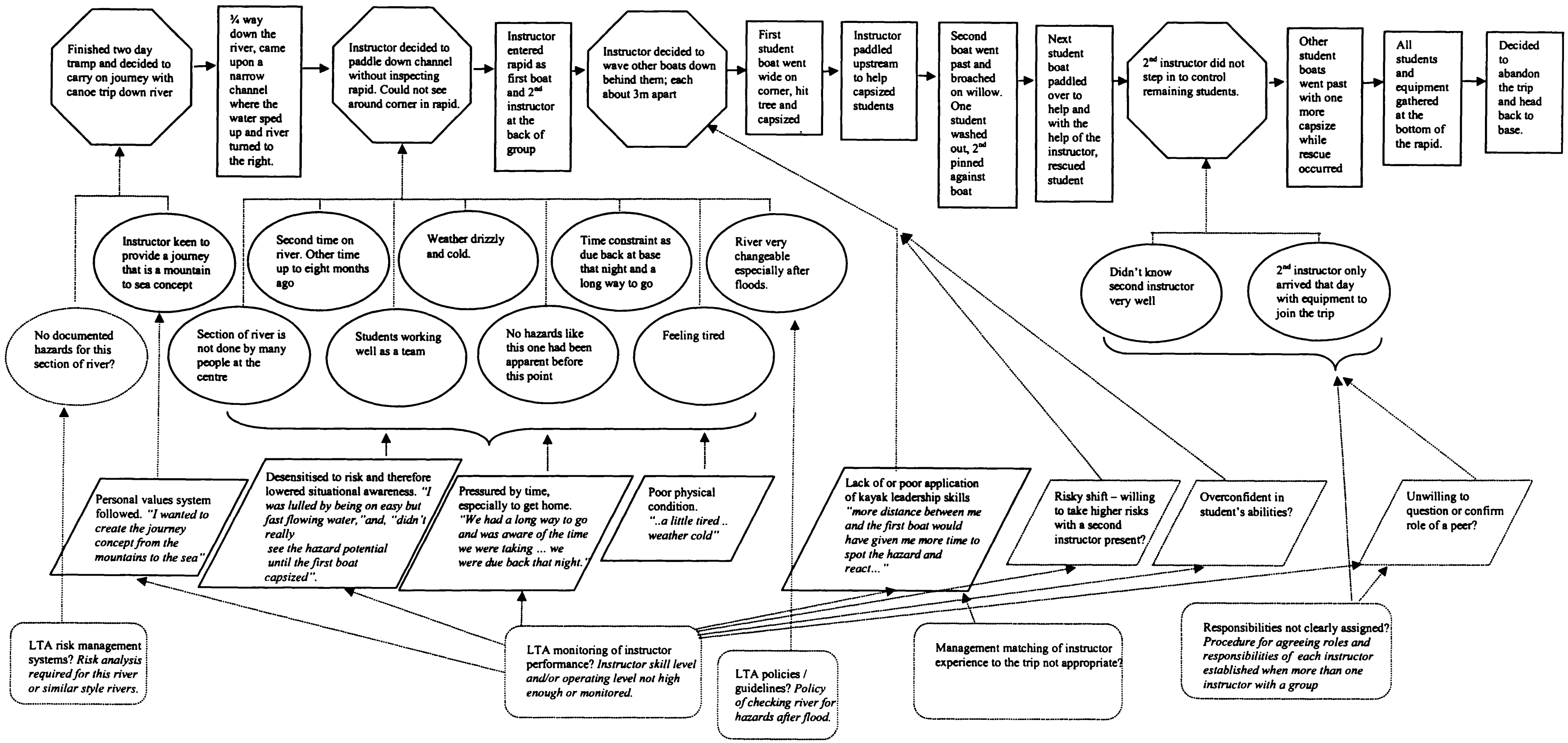


Figure 56. ECFA diagram representing the Delphi analysis of Incident 59
(Incident 59: Students on tube raft go into trees. One student goes under trees before being rescued)

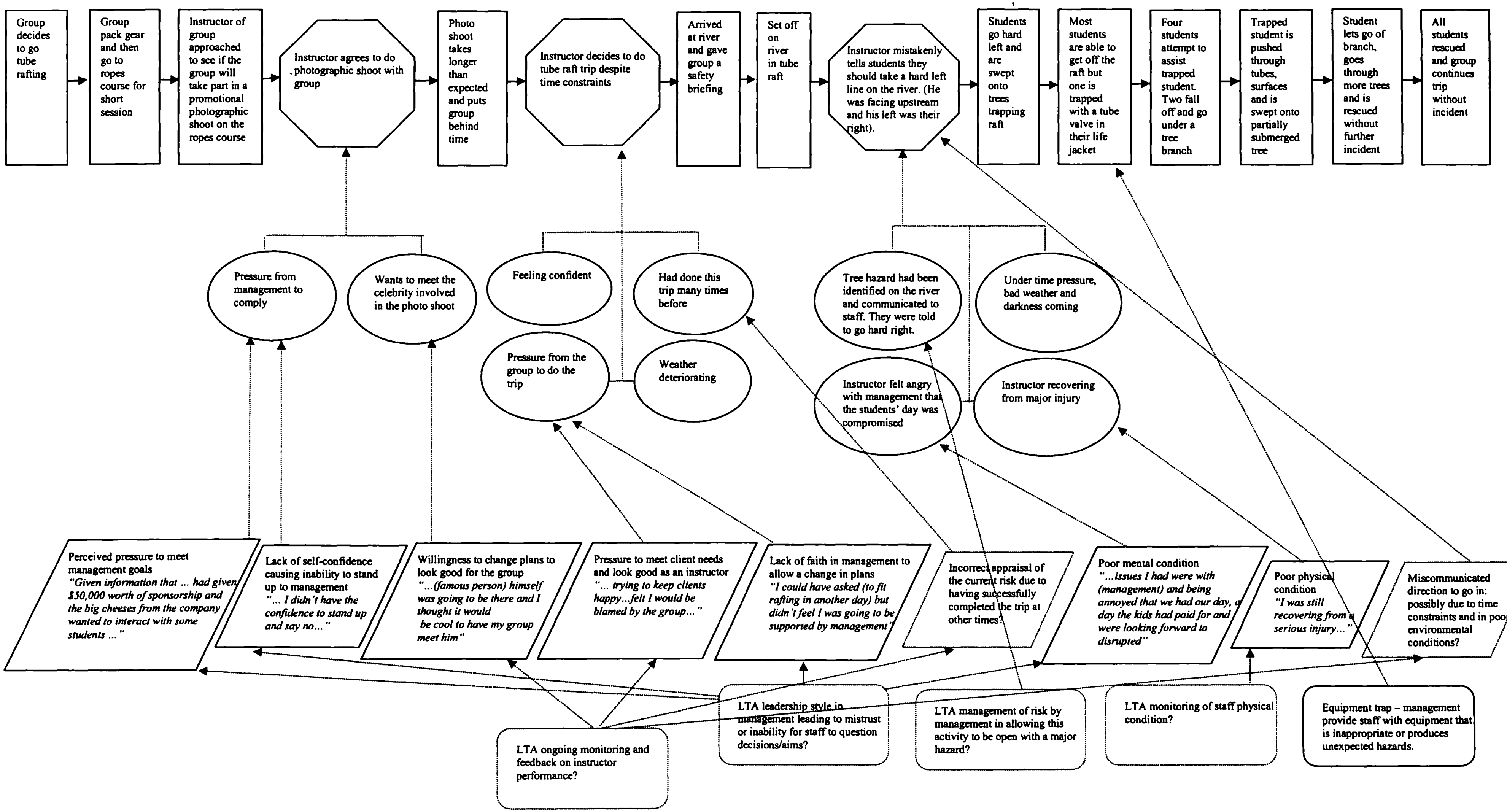
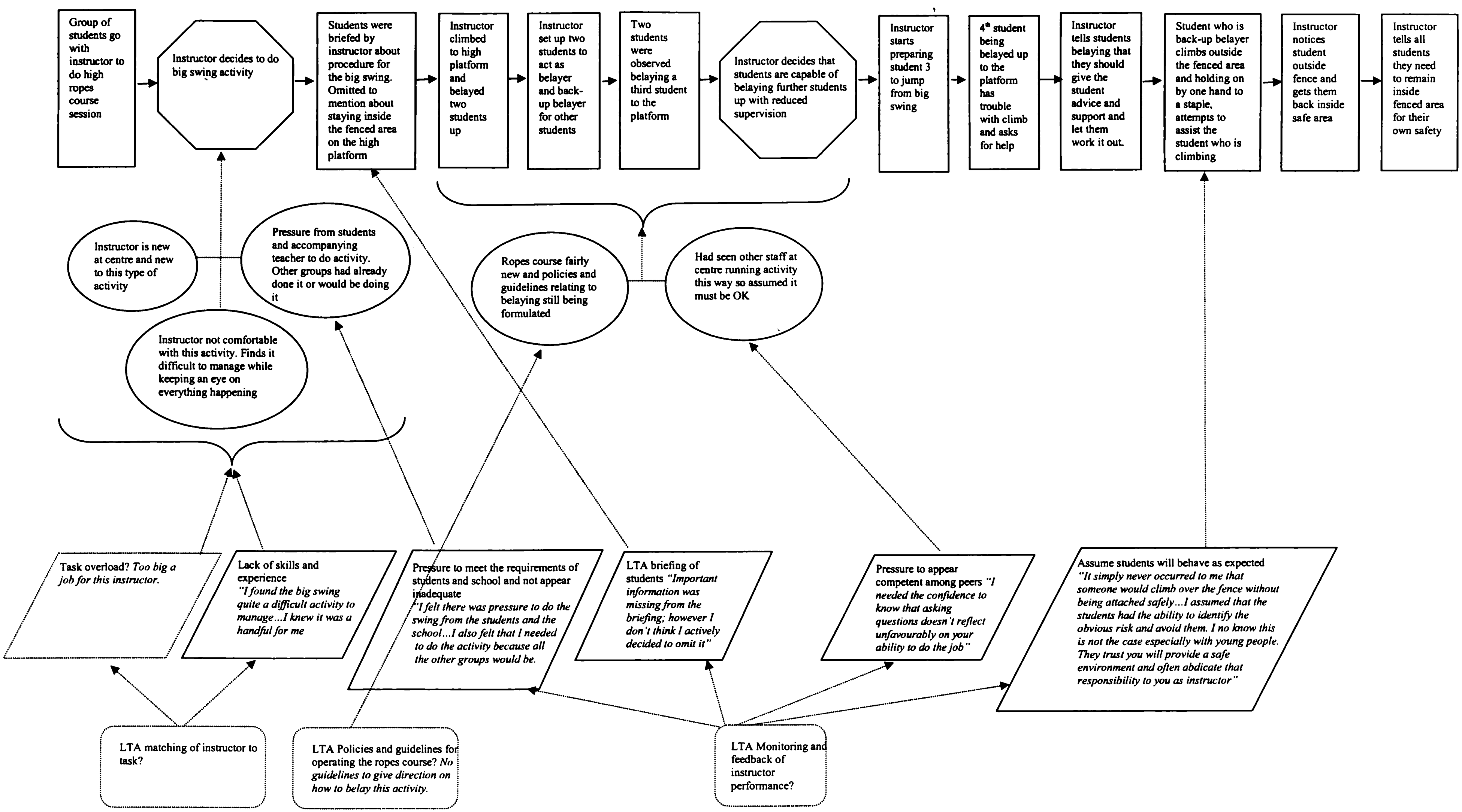


Figure 57. ECFA diagram representing the Delphi analysis of Incident 321
(Incident 321: Student steps outside fenced area on high platform and risks 13m fall.)



6.4 Establishing a Taxonomy of Error for the 18 Serious Outdoor Education Incidents

From the completed ECFA diagrams shown in Figures 40 – 57, the identified root causes of the various incidents were transferred onto Post-it stickers so that they could be sorted into categories. There were 227 individual root causes for the 18 incidents studied: 97 of these were root causes that were related to management system errors; and 130 were root causes due to instructor (front line manager) error. These results reinforced the concept of multiple causation discussed in Chapter 4, with an average of approximately 13 root causes per incident.

6.4.1 Root Causes due to Instructor Error

The 130 identified cases of root causes due to instructor error were grouped into categories based on similarities in the identified root causes. This process produced the 'types' of root cause shown in 6.4.1.1 – 6.4.1.10 Any incident where a particular root cause is cited as being contributory is shown in parentheses immediately following the named root cause.

6.4.1.1 Poor Condition of Instructor to Supervise and Make Judgments (Incidents: 42, 59, 126, 292, 636, 845, 857, 1515)

In all of the incidents listed, the instructor either entered the instructional session with conditions that impaired performance or judgment making ability, or those conditions developed during the course of the activity. The conditions were either:

a) Physical – injuries, tiredness, cold, etc. (59, 126, 636, 857, 845, 1515).
b) Motivational – lack of motivation to perform (292, 42, 59).

These physical or motivational conditions resulted in the instructors failing to properly apply an existing skill or adequately monitor the situation around them and assess the risks present, or accepting a higher level of risk than would normally be the case.

It is a management responsibility to monitor the physical and mental state of the instructors prior to entry into the field, but it is also incumbent on the instructor to disclose any existing conditions to management. It is often impossible for management to intervene if an instructor's condition deteriorates in the field. The instructor must be aware of the possible consequences of such deterioration and take steps to minimise the impact of any reduction in capability.

6.4.1.2 Lack of Skills and Experience
(Incidents: 43, 126, 261, 281, 292, 318, 321, 1471, 1649)

Although this root cause is also linked to management system errors that would mismatch the skills of an instructor with an instructional task, the instructor, as a front line manager, must be willing to admit that his / her skill level is not up to a particular task or task environment and extricate him / herself from that situation. In the incidents discussed here, the instructors concerned did not do this and the lack of skills and experience placed them in situations beyond their ability, or increased the hazard potential so that an incident became more likely.

The lack of skills and experience fell into the following sub-categories:

a) Knowledge of the local area (126, 261, 318, 1471).
b) Hard skills – the skills required to physically carry out any particular outdoor activity (43, 126, 261, 318, 321).
c) Soft skills – the interpersonal skills to instruct, organise and facilitate a particular group (321, 1471, 1649).
d) Meta skills – the skills required to combine the hard and soft skills into a workable design (281, 292, 1471).

6.4.1.3 Mental Slips and Lapses
(Incident 59)

In Incident 59 an instructor communicating with his group gave them a wrong direction, sending them 'left' down a dangerous channel in a river rather than 'right' down a safe channel. This was a temporary mental slip that had potentially serious consequences.

6.4.1.4 Poor Application of Existing Skills / Experience
(Incidents: 42, 43, 281, 292, 321, 576, 611, 636, 845, 857, 1471, 1515, 1649)

Often instructors had the necessary training, skills and experience, but misapplied those skills leading to, what was in hindsight, an inevitable progression towards the incident. The misapplication of skills and experience could have fallen into one of the three sub-categories of hard skills, soft skills or metaskills.

a) Hard skills: Lack of contingency planning (1471), poor crisis management skills (576); lack of appropriate levels of supervision (292, 576, 636, 845, 857, 1649); poorly managing safety with the group (42, 175, 611, 636, 43); not enough breaks taken (857).
b) Soft skills: Inadequately briefing the group (281, 292, 321, 576, 611, 845); poorly allocating responsibility among instructors (42).
c) Metaskills: Inappropriate leadership style (611, 1471); assuming students or others will follow instructions or act with common sense (261, 281, 321, 576, 636, 845, 857, 1649).

The reason these misapplications of existing skills have occurred may be due to the physical and /or mental condition of the instructor, time pressures and other factors mentioned as root causes in this analysis. The fact remains that instructors have been screened by management as possessing the necessary skills to be supervising groups. However, the instructors themselves must also be conscious of the need to apply these critical skills appropriately to avoid an incident occurring.

Assessing that students in their care have the skills to follow instructions given to them, or will act with what is termed by the general population as 'common sense', (or simply assuming they will) is identified as one of the root causes in a significant number of incidents. Common sense is a term used to describe the ability of someone without expert skills to identify hazards in everyday situations, assess the severity of the risk and take appropriate actions to avoid them. This is a complex set of skills and is generally only done successfully by those who have age, maturity and experience; the latter often gained through events in the past that have gone wrong. Instructors, with the benefit of hindsight have summed up the issue:

> "It simply never occurred to me that someone would climb over the fence without being attached safely... I assumed that the students had the ability to identify the obvious risks and avoid them. I now know this is not the case especially with young people. They trust you will provide a safe environment and often abdicate that responsibility to you as an instructor." (321)

> "I was possibly overconfident of where the suspended students were at ... with their ability to behave safely." (857)

> "My expectations of adult groups are often unrealistic. I automatically assume because of age and maturity that they will be more capable." (611)

The metaskill of judging a student's skill level, likely behaviour and ability to accept responsibility is difficult. Certainly the consequences of making an incorrect judgment on any of these factors can be serious. It is the instructor's role to ensure that the consequences of misjudging a student do not result in serious injury to that individual or to any others.

6.4.1.5 Poor Situational Awareness
(Incidents: 43, 261, 281, 292, 845, 1471, 1515)

Critical to managing the risks of taking groups of people into hazardous environments, is the need to constantly re-evaluate the hazards posed by the environment, individuals and the group as a whole (situational awareness). An incorrect understanding or mental model of the existing 'situation' can result in a lack of information, or misinterpretation, resulting in a flawed assessment of prevailing risks and strategies to manage those risks. It is hard to make the right decision if you don't even know there is a decision that needs to be made.

In a number of the incidents under study, there was a lack of appropriate situational awareness. This was due to the subcategories of:

a) Relaxing attention due to being on the way home, getting near camp, end of session, etc. (292, 845).
b) Relaxing attention because of being comfortable / familiar with the situation and not allowing for changes in the local conditions (281, 292, 1515).
c) Relaxing attention because of the belief that someone else is monitoring conditions (261).
d) Failing to gather information on all aspects of the situation because of undue concentration on one particular aspect or part of the plan (1471).
e) Relaxing attention due to being overly confident in the students' abilities (43, 1515).

6.4.1.6 Poor Risk Assessment

(Incidents: 42, 59, 281, 292, 318, 576, 611, 845, 857, 1471, 1649, 845)

Even if the instructor has an accurate mental image of the current situation, he / she still has to make a correct assessment of the risk in order to formulate an appropriate management strategy. The analysis of the incidents in this study showed that an incorrect assessment of the prevailing risk was a regular occurrence. This incorrect assessment of the current risk was due in these cases to a number of factors:

a) Focusing on one hazard and therefore underestimating others or missing them entirely (42, 1471).
b) Perceptions of the activity itself as being risk free (845).
c) Justifying away the risk – talking oneself into believing that a match existed between the competence of the students and the challenge presented and therefore not planning for any contingencies (636).
d) Sunny days lowering the perception of the scale of the risk (292, 857).
e) Inability to see the hazard potential – believing an incident is unlikely (292, 576).

f) Sudden changes in plan leading to inadequate consideration of the risks (845).
g) Over-familiarity leading to a lowered perception of the risk. The over-familiarity can be with one or any combination of the following: activity (42, 59, 292, 318, 576, 857, 1649), site (42, 43, 59, 281, 292, 611, 1471), students (857) and co-instructors (42). For example, it is evident in Incident 42, that the activity, site and co-instructors were all familiar to the respondent. Although not identified as a root cause in the analysis, it was also the end of a four day kayak module and the students were well known to the staff (the kayak module was in itself a part of a year-long certificate programme). All of these factors combined in this case to cause a lowering of the perceived risk.

6.4.1.7 Failed to Make Own Judgment or Deferred the Responsibility to Others (126, 261, 318)

Instructors are assessed by management to have the hard, soft and metaskills to manage the educational and safety outcomes for the groups they are working with. Those instructors must therefore make decisions based on their skills and their knowledge of their group and the prevailing conditions. While information can be gathered from colleagues, students and others, this information must be sorted by the instructor and a decision made on the appropriate course of action. In the incidents studied, a contributing root cause of the incidents has been found to be when the responsibility for critical judgments has been handed over to:

a) Students (261, 318).
b) Colleagues (126).

6.4.1.8 Accepting a Higher Than Required Level of Risk
(Incidents: 42, 43, 59, 126, 261, 281, 292, 318, 576, 611, 636, 728, 845, 857, 1471, 1515, 1649)

In all but one of the incidents (321) it was found that the instructor in charge of the group had accepted a higher level of risk than the expert panel believed would normally have been required to meet the goals of that activity, given the benefit of hindsight. Instructors took this higher level of risk for a number of reasons:

a) Taking an easier option for the ease / comfort for the instructor / students (42, 126, 261, 636, 845).
b) To avoid entering a conflict situation with another member of staff or student (261, 728, 1515).
c) For reasons of personal ego:
    - To look good / competent / friendly in front of the students (42, 59, 261, 318, 321, 611).
    - To look good / competent to peers (321).
d) To meet client needs / desires (42, 43, 59, 318, 321, 611).
e) To meet peer needs (261).
f) To meet the perceived goals of the organisation or management (43, 59, 261, 576, 636, 1471).
g) To achieve personal goals or values not explicitly held by the organisation:
    - To provide very challenging trips (126).
    - To provide certain types of trips, e.g., journeys (1515).
    - To give students trust / responsibility (42, 292, 857, 1649).
h) Sticking with an existing plan even when circumstances / conditions have changed or new information has come to light (43, 126, 1471).
i) When pressured by time / schedule to get home or make a meeting point (126, 1515).
j) When two or more instructors working together take a higher risk decision than they would when solely responsible for the group – risky shift (42, 845, 1471, 1515).

An issue is whether the instructor, at some level of consciousness, believed that he / she was making a judgment that would expose his / her student(s) to a higher level of risk by virtue of the actions following that judgment. My belief is that this is the case with all of the examples given. If the instructor did not have doubt about the decision he / she was making, then that would signal that a different root cause, such as the adequacy of his / her skills and experience or training, would be a factor in the incident.

6.4.1.9 Breached Organisational Policies
(636)

Management have carefully analysed the risks of various activities in certain venues and set policies and standard operating procedures that signal what is an acceptable level of risk to undertake with a group. It is contingent on instructional staff to be aware of these policies and follow them. Breaches of policy are serious. If instructors breach policy knowingly then it shows that they are: a) prepared to place their personal values ahead of organisational ones (Section 6.4.1.7.g), b) have motivational issues (Section 6.4.1.1.b.) or c) are willing to sabotage the efforts of the organisation (Section 6.4.1.10).

If an instructor breached policy unknowingly it would signal that training and induction systems are inadequate.

6.4.1.10 Sabotage
(728)

This is an extreme case where an instructor works actively against the safety management system of the organisation. The organisation's clearly stated safety responsibilities are ignored, often for reasons of conflict or dissatisfaction with the organisation or management staff in that organisation.

Incident 728 demonstrates an example of sabotage although not as blatant and premeditated as is possible in this category. In this case the instructor understood the need and requirement for carrying out a safety check on vehicles before use, but because of his / her belief that the responsibility for such checks should be carried out by others, refused to do the check and put the group at risk.

6.4.2 Root Causes due to Management System Errors

The 97 identified cases of root causes due to management system error were grouped into categories based on similarities in the identified root causes. This process produced the 'types' of root cause shown in 6.4.2.1 – 6.4.2.13. Any incident where a particular root cause is cited as being contributory is shown in parentheses immediately following the named root cause.

6.4.2.1 Poor Organisational Safety Philosophy (261, 576, 1471)

The organisation must clearly state its philosophy in relation to safety, how much risk is acceptable and the priority safety takes over educational goals. If this is not done, the level of risk accepted by instructors becomes a matter of their personal philosophies or values. In the incidents studied the following subcategories of this error type were identified:

a) Safety goals did not adequately state that safety took precedence to educational outcomes (261, 1471).
b) Organisational risk taking philosophy was excessive (576).

An in-depth debate of the relevance of an appropriate safety philosophy in relation to Incident 576 is carried out in Section 6.4.3

6.4.2.2 Poor Documentation of Safety Responsibilities and Accountabilities (728, 1471, 1515)

In three incidents there seemed a lack of clear responsibilities and accountabilities for safety in the organisation concerned. Employees and management need to be clear where various aspects of responsibility and accountability lie within the organisation. In these cases:

a) Job descriptions were not clear about safety responsibilities and accountabilities (728).
b) Standard operating procedures were not specific. It was not clear who had the ultimate responsibility for safety decisions in a situation when two or more instructors were working simultaneously with a group (1471, 1515).

6.4.2.3 Less than Adequate Risk Management Systems
(281, 292, 576, 1471, 1515)

In these five cases the organisation appeared not to have systematically identified the hazards for programmed activities and put in place documented management systems to eliminate, isolate or reduce any risk arising from those hazards.

6.4.2.4 Less than Adequate Policies and Guidelines
(42, 43, 261, 292, 318, 321, 576, 636, 728, 845, 857, 1515, 1649)

In the incidents listed, there were inadequate documented policies and guidelines for staff that clearly pointed out organisational standards or instructor responsibilities, limitations, or required actions in various situations:

a) Less than adequate documented standards of supervision of students (576, 845, 857, 1649).
b) Inadequate documentation of competencies required in order to supervise a training instructor or work experience student (261).
c) Inadequate documentation of competencies required in order to run various activities (857).
d) Inadequate documentation of the required physical / mental condition in order to be able to work (636).
e) Inadequate documentation of the roles of external staff (e.g., teachers) and trainee instructors accompanying groups (261, 636).
f) Inadequate documentation of the roles of the various staff in team teaching situations (42).
g) Lack of a policy giving the instructional staff the ability to stop or change programmed activity if students / conditions / equipment make the activity unsafe (636).
h) Lack of a policy assigning the responsibility to cancel programmes if resources, including staff, are not adequate (636, 43).
i) Inadequate policies outlining workload limits for staff (857).
j) Inappropriate or missing staff to student ratios for various activities (611, 636).

k) Inadequate activity related policies (43, 292, 318, 321, 636, 1515).
l) Inadequate policies for course design, ensuring a match of chosen activity to the available organisational resources and organisational goals (318).
m) Inadequate or missing policies to ensure vehicle and maintenance checks (728).

6.4.2.5 Less than Adequate Systems to Provide Up-to-date Knowledge of Conditions
(43, 126)

In these two cases the failure to pass on to staff working with groups in the field important up-to-date local knowledge of river flows, river rapid changes (43) and the existence of a bridge not marked on the map (126) contributed to the incident.

6.4.2.6 Less Than Adequate Training Systems
(43, 126, 261, 292, 1471)

The induction of staff to local conditions, training of those staff to the required standard to supervise others in hazardous conditions while taking part in hazardous activities is self-evident. The issue raised in this study is not the number of incidents where staff did not have the required training, but the number where the skills the instructor already possessed were misapplied leading to an incident.

6.4.2.7 Less than Adequate System to Match the Instructor to the Task.
(42, 43, 126, 321, 845, 857, 1515, 1471)

A number of incidents showed that adequate system were not in place to ensure a match between the instructor's workload, skills and experience to the activity, environmental conditions and students' abilities. The incidents indicate that a vetting process by management needs to occur:

a) At the time instructors are programmed to run a course; and,

b) In the morning before activities start to ensure instructors, environmental conditions, equipment and the group are appropriately matched to the planned activity.

6.4.2.8 Less Than Adequate Monitoring of Instructional Staff
(42, 43, 59, 126, 281, 292, 318, 321, 576, 611, 728, 845, 857, 1515, 1471, 1649)

The Delphi members believed that in almost every incident under study, there was inadequate monitoring of instructors' performance. Through observation of performance issues and then feedback and coaching, they believed that many of these incidents may have been avoided. This monitoring, feedback and coaching would be in areas of:

a) Instructor workload, stress, physical condition.
b) Instructor performance in:
    - Hard skills;
    - Soft skills;
    - Metaskills.

6.4.2.9 Less Than Adequate Incident Recording and Analysis Systems
(292, 576, 1649)

For three incidents it is believed that if knowledge learned from similar incidents in the organisation had been passed on to instructors, this may have prevented the incident.

6.4.2.10 Less Than Adequate Maintenance Systems
(318, 728)

In these cases it was identified that better maintenance systems in the respective organisations may have changed the outcome of the incident.

6.4.2.11 Equipment Traps – Less Than Adequate Equipment Selection Systems (43, 59, 318, 636)

In these incidents, it is believed that equipment supplied to instructional staff created hazards that remained undetected and, as a result, were difficult to control.

6.4.2.12 Environment Traps – Less Than Adequate Site Selection Systems (281)

In this incident it is believed that management programmed staff to use a site that contained unrecognised hazards which, as a result, were difficult to control.

6.4.2.13 Poor Application of Management Skills (43, 59, 126, 728)

Just as instructors can create hazards by the poor performance of skills in running activities with groups as front-line managers, poor performance by senior managers in the application of a quality management system can also produce hazards leading to incidents. Analysis of incidents in this study revealed poor performance in the following areas that were believed to be a root cause of the incident in question:

a) Inappropriate leadership style (43, 59).
b) Poor communication techniques (728).
c) Poor facilitation of an appropriate safety culture (126).

6.4.3 The Error-Free Incident

In incident 576 a student fell approximately seven metres over a cliff and broke his femur. He was not under direct supervision at the time of the incident as the instructor had separated some distance from the group to allow the students to gain experience in using navigational skills and making decisions on their own. The organisation concerned reviewed the incident and considered it was acceptable to continue to run similar exercises in this type of terrain.

The Delphi analysis of Incident 576 resulted in agreement from the experts, in the first iteration of the Delphi process, that the organisation's risk taking philosophy was too great and that allowing students to have such a level of responsibility in terrain containing significant hazards was not appropriate. In the second iteration of the Delphi process, where the instructor concerned was asked for feedback on the analysis, the instructor responded to this proposed root cause with the comment,

> "I believe that true adventure is being lost from outdoor education. This organisation has successfully maintained a high adventure level with a very good safety record, and I'm happy with it."

While this reads like a personal value held by the instructor, it also seems reflective of the organisational values / philosophy as indicated by the outcome of the incident review carried out by the organisation and discussed above. If such a philosophy was to be accepted throughout the sector, then such incidents would be deemed as acceptable outcomes of the inherent risk of outdoor educational activities. The issues therefore become: (1) What level of risk is justifiable for an outdoor education organisation? And, (2) Is there such a thing as a justifiable incident that is due to inherent risks rather than errors that should be controlled?

This research is based on the premise that outdoor education, by its nature, needs to be able to continue to use the mountains, rivers, lakes and forests that are the contexts that make outdoor education unique and a powerful learning medium. However, wherever the hazards of an activity are analysed and found to produce a high potential for serious risk, the contention is that those hazards must be managed – regularly this is done by placing a skilled and experienced instructor in place to supervise the activity and the interaction of the group with the identified hazards. If the risks are too great and can't be controlled, then the activity should not go ahead.

On the other hand, if the risks posed by an activity are not too great, and those hazards cannot be controlled without significantly changing the very activity that is being proposed, then the activity can justifiably continue. The responsibility then sits with the instructor to disclose the risks to the students and the organisation must have already disclosed those risks to any parents or guardians concerned. In such a case the incident is not one due to lack of management control at either line manager or senior manager level but rather is due to the inherent risks in the activity. Such error-free incidents are recognised in safety management literature (Senders & Moray, 1991).

In Incident 576, the contention of the Delphi panel is that the environment contained significant hazards in the form of cliffs of at least seven metres in height, and that these should have been controlled by management. To allow teenage students the responsibility of successfully negotiating these hazards was inappropriate and supervision should have been provided that was available when needed. This was not an error-free incident.

Incident 318 on the other hand is an example where, with slightly different conditions, a situation could be imagined where an incident could be described as being error-free. Incident 318 involved a group of tertiary-level students carrying out mountain biking in a tracked forest situation. Mountain biking is an activity that contains inherent risks: people are travelling at speed, through terrain containing obstacles. It is easy to envisage falling while biking and striking trees, rocks, roots, the ground, the bike or other solid obstacles. Nonetheless, the activity has merit in that it involves challenge, skill, is fun and allows distance to be covered in a journey context. If the hazards are evaluated, students informed of the risks, appropriate clothing and protective gear worn, and speed controlled then the risks become acceptable. A spill from a bike under these conditions would be considered error-free and an inherent risk of the activity. Incident 318 was not error-free because extra risk was added through extending the activity to bike jumping. This extension had not been analysed by management and the activity was not condoned, or as it turns out, within the skill range of the supervising instructor.

This discussion confirms the need for organisations to have clear and appropriate safety philosophies and goals. It also clarifies for the need to include a category of 'error-free incidents' in any model of outdoor incidents developed.

6.4.4 An Interim Taxonomy of Error for Outdoor Education

Based on the Delphi Analysis of 18 outdoor education incidents that resulted in, or had the potential for, serious injury, it is now possible to summarise the identified root causes of those incidents. This summary is the first attempt at establishing an interim taxonomy of root causes of error (taxonomy of error) to be applied to other outdoor education incidents. The resulting interim taxonomy of error is shown in Figure 58.

Figure 58. Interim taxonomy of error for outdoor education incidents

INSTRUCTOR ERRORS [18]

1) Poor instructor condition [8]
- Physical
- Motivational

2) Lack of skills and experience [9]
- Hard skills
- Soft skills
- Metaskills

3) Mental slips and lapses [1]

4) Poor application of existing skills and experience [13]
- Hard skills
- Soft skills
- Metaskills

5) Poor situational awareness [7]
- Relaxing attention near end of session / home / etc
- Relaxing attention when familiar with activity
- Relaxing attention in the belief that someone else is monitoring conditions
- Failing to gather information on all aspects because of undue attention on one aspect
- Relaxing attention when overly confident in students' abilities

6) Poor risk assessment [12]
- Focusing on one hazard and underestimating others
- Perception of activity as risk free
- Justifying away the risk
- Sunny days lowering perception of risk
- Inability to see hazard potential
- Sudden changes in plan without considering risk
- Over familiarity with activity, site, students, or co-instructors

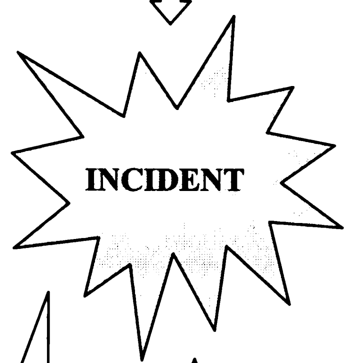
7) Failing to make a judgment or deferring to others [3]

8) Accepting a higher than required level of risk [17]
- Taking an easier option for comfort / ease
- To avoid conflict situations
- For reasons of personal ego
- To meet client needs/wants
- To meet peer needs
- To meet perceived goals of management
- To achieve personal goals / values
- Easier to stick to an existing plan
- Pressured by time
- When working in an instructional team

9) Breached organisational policies [1]

10) Sabotage [1]

ERROR – FREE INCIDENTS [0]
Inherent risks of outdoor activity that are justifiable and can't be controlled without adversely affecting the activity and its outcomes.



MANAGEMENT STAFF ERRORS [4]

1) Poor application of management skills

MANAGEMENT SYSTEM ERRORS [18]

1) Poor organisational safety philosophy [3]
2) Poor documentation of safety responsibilities and accountabilities [3]
3) Less than adequate risk management systems [5]
4) Less than adequate policies and guidelines [13]
5) Less than adequate systems to provide up-to-date knowledge of conditions [2]
6) Less than adequate training systems [5]
7) Less than adequate systems to match instructor to the task [8]
8) Less than adequate monitoring of instructional staff [16]
9) Less than adequate incident recording and analysis systems [3]
10) Less than adequate maintenance systems [2]
11) Equipment traps [4]
12) Environment traps [2]

Note: Numbers in square brackets indicates the number of incidents in the study that demonstrated that particular error type

6.4.5 Discussion

The method employed to derive the taxonomy in Figure 58 has its limitations as discussed in Chapter 3. In addition to the already identified limitations, it should also be noted that the method did not involve any representation from the management of the organisation concerned in the incident, which may impact on the validity of the management system errors and management staff errors identified for any particular incident. Generalisation of these results to the wider outdoor education sector needs to be done with care. Nevertheless the results obtained in Figure 58 give insights into the errors leading to the group of incidents studied in this research that are not obvious from studying the individual incidents. These include:

6.4.5.1 Multiple Causation

As already mentioned in the introduction to Section 6.4, the concept of multiple causation has been supported in this study with an average of 13 separate root causes per incident. In addition to this though, Figure 58 shows that every incident resulted from a combination of both instructor errors and management system errors. In no incident was the error due solely to front line management (instructors) or senior management; both needed to err in some way for the incident to occur.

6.4.5.2 Most Frequently Occurring Root Cause(s) of Instructor Error

I believe that if most people in the outdoor education sector were asked what instructor factors would be the most prevalent in the cause of incidents, the replies would be either a shortage of skills and experience for the conditions, or poor judgment. While both of these root causes were present in a significant number of the incidents, both were overshadowed by two other identified root causes. While nine incidents were linked to a lack of skills and experience, 13 were linked to a poor or misplaced application of existing skills (hard, soft and meta) and experience; and while 15 incidents were linked to either poor situational awareness or poor risk assessment leading to poor judgments for the situation, the greatest single type of instructor error was the instructor purposely choosing to take a higher level of risk than was required for the educational outcomes required by the organisation.

The research findings that the most common root causes of serious outdoor education incidents are the misapplication of skills by instructors, and their choice to undertake higher risk options, is not currently recognised in this sector.

In general, the major training emphasis in outdoor education is on getting instructional staff to a required skill level and assessing them as having reached that standard. Once they have been deemed competent they are often left unsupervised with groups while effort is directed at training newer staff. The research finding here suggests that a shortage of skills and experience in instructional staff, if known, is not as likely to lead to an incident as instructors who believe they have the skills and experience but are misapplying them in the field. Management should take from this that it is equally, or even more, important to continually monitor that all instructors are applying their skills correctly.

The finding, that instructors are purposely choosing to undertake higher risk options, is also significant. The literature review in Chapter 4 hints at some of the tokens of this error type but nowhere is this type of error stated to be a major concern. I believe that part of the reason for this is that the pressures leading to an instructor choosing a riskier option over a more conservative option are subtle, and even after the fact may not be recognised or accepted. However the cumulative effects of these subtle pressures, as recognised by the experts on the Delphi panels, are shown to be significant.

Some might argue that the instructors purposely choosing higher risk options is another example of poor judgment. While this is technically correct, in that it is the outcome of a process of choice, I am intentionally separating this judgment process from others. In this case instructors are aware that they should be adopting the more conservative option and when they bow to the subtle pressures mentioned above, are left with a nagging feeling that they have taken a riskier option. Because of this, there is not so much a problem with their judgment skills, but rather that the decision they made in applying this judgment has been put aside.

6.4.5.3 Major Inadequacies in the Management System

With the major sources of front line manager error being identified as poor application of existing skills, poor judgment and the wilful acceptance of higher levels of risk, it is not surprising that the failures identified in the management system with the greatest frequency were those that might have alleviated the front line errors. These include:

- Less than adequate monitoring of instructional staff (attributed to 16 out of 18 incidents). The only feasible way to identify if instructors are correctly applying their existing skills to the groups they are working with and the conditions they are encountering in the field, is for senior members of staff to observe them working with groups and providing feedback to the instructors in question. This also applies to the situational awareness, risk assessment and choice of action plan by the instructors. The expert panel believed that this was probably not occurring, or not occurring regularly enough in the incidents being studied.

- Less than adequate policies and guidelines (attributed to 13 out of 18 incidents). A second method commonly employed by managers of outdoor education programmes to help control risks when they can't be present, is to analyse the risks and stipulate policies and standard operating procedures for the instructors that set parameters that those instructors should operate within. This takes away some of the judgment required by instructional staff in various situations, making the role clearer and the task itself easier. Care must be taken that the policies do not stifle the instructor's ability to provide an enjoyable educational experience. In 13 of the incidents studied the experts believed that the policies and other guidelines for staff were probably inadequate.

- Less than adequate systems to match instructor to the task (attributed to eight out of 18 incidents). One further method of management control of risk is to ensure there is an appropriate match between the instructor's skills, the educational goals of the programme, student abilities and expectations, equipment / resources, and the environmental conditions. A system must be in place to ensure this match is achieved both before a course begins with the programming of staff and activities, and on a daily basis as conditions within the group, the environment and the instructor change. A failure of this system of ensuring a good match by management was believed by the Delphi experts to be a causal factor in eight of the incidents under study

All other management system errors were attributed to five or less incidents.

6.4.5.4 Management Staff Errors

The Delphi analysis has raised the issue of how the performance of senior management in implementing the management system of an organisation can have an impact on safety. Just as the instructors, as front line managers, are susceptible to a number of errors as shown in Table 58, the senior managers are susceptible to the same list of errors. These can be due to slips, lapses, failures, mistakes or violations; or indirectly due to task overload which increases the likelihood of any of the former error types occurring. It is clear from these results that in the wake of any incident, managers should also review their performance to see what can be learnt to help prevent future incidents.

6.4.5.5 Comparison of Findings with those from the Quantitative Results in Chapter 5.

A number of conclusions were suggested in Chapter 5 regarding predictors of serious incidents in the outdoor education sector. It is worth reviewing these in light of the identified root causes of a number of specific outdoor incidents to see if further insight can be drawn as to the possible validity of those predictors:

6.4.5.5.(a) Extrapolation of Petersen's model of predictors of serious injury

In Figure 37 I extrapolated the predictors of serious injuries that Petersen (1988) listed for industrial settings, to the outdoor education setting. While there were no data in this study on the first of these (instructor experience levels), the preliminary data indicated support for the validity of the other three. The root causes of the 18 incidents that were analysed in this study can be considered in relation to these proposed predictors of serious injury:

- Activities run by instructors new to an activity, or overly familiar with an activity. The root causes identified show that a lack of skills and experience, the misapplication of existing skills, poor situational awareness, poor assessment of risk and deferring to others for judgment all lead to the occurrence of serious incidents. All of these factors are likely to be present in less experienced instructors who are new to an activity.

  The root causes also show that overfamiliarity with an activity is a token of both the root causes: 'poor situational awareness' and, 'poor risk assessment'. This would indicate that as instructors become more familiar with activities it is possible that their judgment in those activities becomes less astute and incidents would occur.

- Activities with low levels of supervision or no supervision at all.
  Figure 58 shows that incidents are the result of a combination of instructor errors, management staff errors and management system errors. If instructor supervision is removed then all of the instructor roles are passed over to the students. The skill, experience and judgment abilities of the students are much less than that of an instructor and therefore an incident is much more likely.

- Activities involving high energy sources.
  This is not an issue to do with the root causes of incidents, but rather a factor of the context. It is worth noting that all incidents under study here involved high energy sources: Seven involved height, nine involved moving water, and two

involved travelling at speed.

- Any activity involving water.

  Once again this does not involve the causal sequence leading to the incident but rather the need for speed in resolving the situation, otherwise people will drown or succumb to hypothermia. Nine of the 18 incidents involved water.

6.4.5.5.(b) Groups being supervised by male instructors are likely to have more serious injuries than those supervised by female instructors.

In Chapter 5 quantitative evidence was given that supported this statement and it was suggested that the reason for this may be due to testosterone and ego effects leading to males being less likely to correctly assess the risk of activities and being willing to proceed with higher levels of risk.

The root causes identified in Figure 58 do not include any factors that could be put down to testosterone influenced 'gung-ho' attitudes, although the root cause, 'Poor risk assessment,' and the tokens of: 'For reasons of personal ego', and 'To achieve personal goals / values', are associated with such attitudes.

The gender breakdown for the 18 incidents according to the root cause of "Poor risk assessment,' shows that this root cause has been identified as a causal factor in nine of the 11 incidents involving male instructors (82%) and in only three of the seven incidents (43%) involving female instructors were related to this root cause. While the small sample size of this study means that this difference is not statistically significant, the need for further research is signalled.

6.4.5.5.(c) Injuries happen more often in the afternoon

It can be seen from the results in Figure 58 that the root causes of incidents include: physical and motivational level of the instructor, mental slips and lapses, poor situational awareness (due to relaxing concentration near the end of a session / getting near home, and becoming familiar with the activity, site and group) and poor risk assessment (For similar reasons to those just listed). All of these root causes will come into play more in the afternoon as the instructor becomes physically tired, less motivated by the activity and more familiar with the group, site and activity.

6.5 Summary

This study made an in-depth analysis of 18 incidents that have occurred in the outdoor education sector in the years 1996 – 2000 for the root causes of those incidents. All of the incidents selected for this analysis had resulted in, or had the potential for, serious injury. The incidents were reviewed by panels of objective outdoor experts who were able to use their skill and experience to identify what they believed were the underlying root causes. The findings from this process were:

1) The Delphi process was a valuable way of focussing a broad range of expert outdoor opinion on an incident, without those experts being influenced by others' views. No one expert ever identified all of the root causes that were the outcome of the panel analyses, and no one root cause was identified by all experts. Thus the final analysis was far more comprehensive than would have been obtained had any one expert been used, no matter the extent of their previous experience.

2) The ECFA diagrams used to represent the causal sequence of the incidents were well received by the experts and proved to be a useful tool to express the combined input of the group.

3) The analyses of the 18 incidents were combined to produce a taxonomy of error for those incidents. This taxonomy, shown in Figure 58, lists 10 types of root cause due to instructor error, 12 types due to management system errors, and one type due to management staff errors. Within any type of root cause there may be any number of tokens of that cause. Many tokens were identified during the analysis.

4) The concept of an 'error-free incident' was posited. Such an incident is due to the inherent risks of the outdoor education experience and is acceptable as long as the risks have been analysed, found to be at a defensible level and cannot be controlled without altering the very medium of the outdoor education experience. None of the 18 cases studied in this research was found to be an error-free incident.

5) The multiple causation principle for incidents was supported for the outdoor education sector. For the 18 incidents studied, 227 root causes were identified, making an average of 13 root causes per incident. The root causes for all incidents involved a combination of instructor errors and management system errors.

6) The root causes of instructor error occurring with the most frequency were, in descending order:
   - Accepting a higher than required level of risk
   - Misapplication of existing skills
   - Poor risk assessment
   - Lack of skills and experience

   The first two root causes are not currently recognised by the sector as being the leading contributors to serious incidents. This points to the need for monitoring of instructor performance in the field (even those instructors deemed to be skilled and experienced) and subsequent feedback, as well as the more traditional focus on training.

7) The root causes associated with weaknesses in the management system occurring with the greatest frequency were, in descending order:
   - Less than adequate monitoring of instructor performance
   - Less than adequate policies and guidelines
   - Less than adequate systems to match the instructor to the task

   All of these relate to ensuring that management has greater control in minimising the likely occurrence of the instructor errors mentioned above and those errors resulting in harm.

8) Management staff making a poor job of implementing the safety management system can also lead to incidents. Although the only type identified in this category was the misapplication of existing skills, it is logical to assume that any of the root causes identified that could impact upon instructional performance could also apply to senior management in the execution of their duties.

9) The identification of root causes of outdoor education incidents in this phase of the research gives some insight into the reasons why the proposed predictors of serious injury shown in Figure 37, Chapter 5, may be valid:
- Instructors new to an activity will be more susceptible to the root causes of error of: Lack of skills and experience, poor application of existing skills, poor situational awareness, poor assessment of risk and deferring to others for judgment. This would make these instructors more prone to being involved in serious incidents.
- Overfamiliarity with an activity is a token of both the root causes: 'poor situational awareness' and, 'poor risk assessment'. This would indicate that as instructors become more familiar with activities it is likely that their judgment in those activities becomes less astute and incidents would occur.
- Activities with reduced or no instructor supervision of students result in the role of the instructor being passed to the students. The occurrence of error due to the lack of skill and experience of those students, especially at making astute assessments of risk and strategies to minimise the risk, greatly increases the likelihood of incidents occurring.
- The concept that activities involving high energy sources may result in serious injury, is not related to the root causes of incidents, rather it is due to the principle that if an incident happens, the likelihood is that the energy involved will transfer to the person involved to result in serious harm.
- Activities involving water are more likely to result in serious injury, not because water is critical in the causal sequence leading to the incident, but because of the need for speed in resolving the situation once it has developed otherwise people will drown or succumb to hypothermia.

10) No statistically valid data existed in the analysis of root causes to indicate why groups supervised by male instructors should be more prone to serious injuries than those supervised by female instructors. This may be due to the small sample size. It is interesting to note however that the gender breakdown for the 18 incidents according to the root cause of "Poor risk assessment,' shows that it has been identified as a causal factor in nine of the 11 incidents involving male instructors (82%) while only three of the seven incidents (43%) involving female instructors were related to this root cause.

11) Incidents may occur more often in the afternoon than the morning due to the increased likelihood of these root causes being a factor later in the day: physical and motivational level of the instructor, mental slips and lapses, poor situational awareness (due to relaxing concentration near the end of a session / getting near home, and becoming overfamiliar with the activity, site and group) and poor risk assessment (For similar reasons to those just listed). All of these root causes will come into play more in the afternoon as the instructor becomes physically tired, less motivated by the activity and more familiar with the group, site and activity.

CHAPTER SEVEN

RESULTS AND DISCUSSION: A PROPOSED TAXONOMY OF ROOT CAUSES OF OUTDOOR EDUCATION INCIDENTS AND A MODEL OF INCIDENT CAUSATION FOR OUTDOOR EDUCATION

7.1 Introduction

The third phase of this research brings together the empirical results of Chapters 5 and 6 with the theoretical overview developed in Chapter 4.

Chapter 6 identified a number of the root causes of serious outdoor incidents based on the analysis of 18 case studies from outdoor education in New Zealand. These were tested against a list of predictors of serious incidents identified in Chapter 5 as a test of validity. This chapter compares and combines these root causes with a list derived from theory in Chapter 4 and results in a proposed taxonomy of error for outdoor education. The taxonomy lists root causes of outdoor education incidents and describes their relationships in producing the potential for creating an incident.

In Chapter 4 a model of outdoor education incidents was developed from the literature. Chapter 6 identified the causal sequence of 18 incidents with the assistance of Delphi panelists and this revealed the relationship and interaction between the causal factors. Using these two main sources, a proposed model of an outdoor education incident is developed in this Chapter.

The draft taxonomy of error and model of outdoor education incident causation were sent to the Delphi panel members for review and to seek their assessment of the validity of the proposals. The comments from the Delphi members are reported and discussed.

Finally, the significance of these results is discussed in terms of how knowledge in the outdoor education sector has been advanced. This includes a proposed new model of outdoor education decision-making that was needed in order to incorporate the findings from the development of a taxonomy of error.

7.2 A Taxonomy of Error for Outdoor Education

7.2.1 The Nature of Taxonomies of Error

Many taxonomies of error already exist in the safety management literature. Senders & Moray (1991, p.86) note that, "...almost a dozen proposed taxonomies of error have been published," and that there is, "... no agreement about a single taxonomy which would serve all purposes of error research" (p. 41). They state that there is no generally accepted singular taxonomy and that it seems unlikely that there will ever be one.

A conference in 1991 of the leading world experts in the fields of safety management and safety theory reached the conclusion that a successful taxonomy must be related to the theoretical and practical purposes of those wishing to use it (Senders & Moray, 1991). For this reason the existing taxonomies which have been developed for industrial applications, while having some elements of transferability, are not suited to, and do not meet the needs of the outdoor education sector.

In developing any taxonomy a decision needs to be made as to how errors will be classified and at what level. In Section 4.3.4 a differentiation has already been discussed between 'types' and 'tokens' of error, where 'types' are general categories of error and 'tokens' are individually defined events or cases of the particular 'type'. While the delineation between types and tokens of error sounds straightforward, it is not that simple in practice and requires judgment to be made as to an appropriate level of detail that differentiates the two. For example a basic classification system suggested by Senders & Sellen (1987) suggests a binary taxonomy where all errors can be classified as either endogenous (arising within the actor) or exogenous (arising outside the actor within the environment). Reason (1990) proposes a generic error-modeling system (GEMS) that is also a binary taxonomy where all errors are seen as either slips or mistakes. Such a high level classification of types of error would not result in a taxonomy for outdoor education that would be practical in developing a language to discuss errors and to consider ways to prevent future incident occurrence.

Senders & Moray (1991) believe there are four basic levels of analysis and that all error taxonomies are based on one or more of these levels. Using this premise they have produced what they term a "taxonomy of taxonomies", listing the ways in which data can be organised (pp. 43-44 and p.84):

a) Phenomenological taxonomies (what happened?). Describing errors superficially with terms that refer to the events as they were observed. Typical categories include omissions, substitutions and unnecessary repetitions.
b) Taxonomies of internal processes or cognitive mechanisms (how did it happen?). Errors are classified according to the stages of human information processing at which they occur. These processes may be such things as diagnosis, decision-making, hypothesis formulation, activation, choice of tactics, etc.
c) Taxonomies based on biases or deep-rooted tendencies (why did it happen?). These are fundamental psychological mechanisms and can divide errors in terms of: perception, decision, attention, distraction, available response choices, capacity limitations and the like.
d) Taxonomies based on neurological events. NB: All experts believe it is fruitless to look at classifications based on this level.

These are all taxonomies targeted at endogenous errors. Levels b) and c) are supported by the greatest mass of research from modern experimental psychology. Senders & Moray add another type of taxonomy (p. 84 and Table 2, p. 91):

e) Taxonomies of external processes – such as poor equipment design.

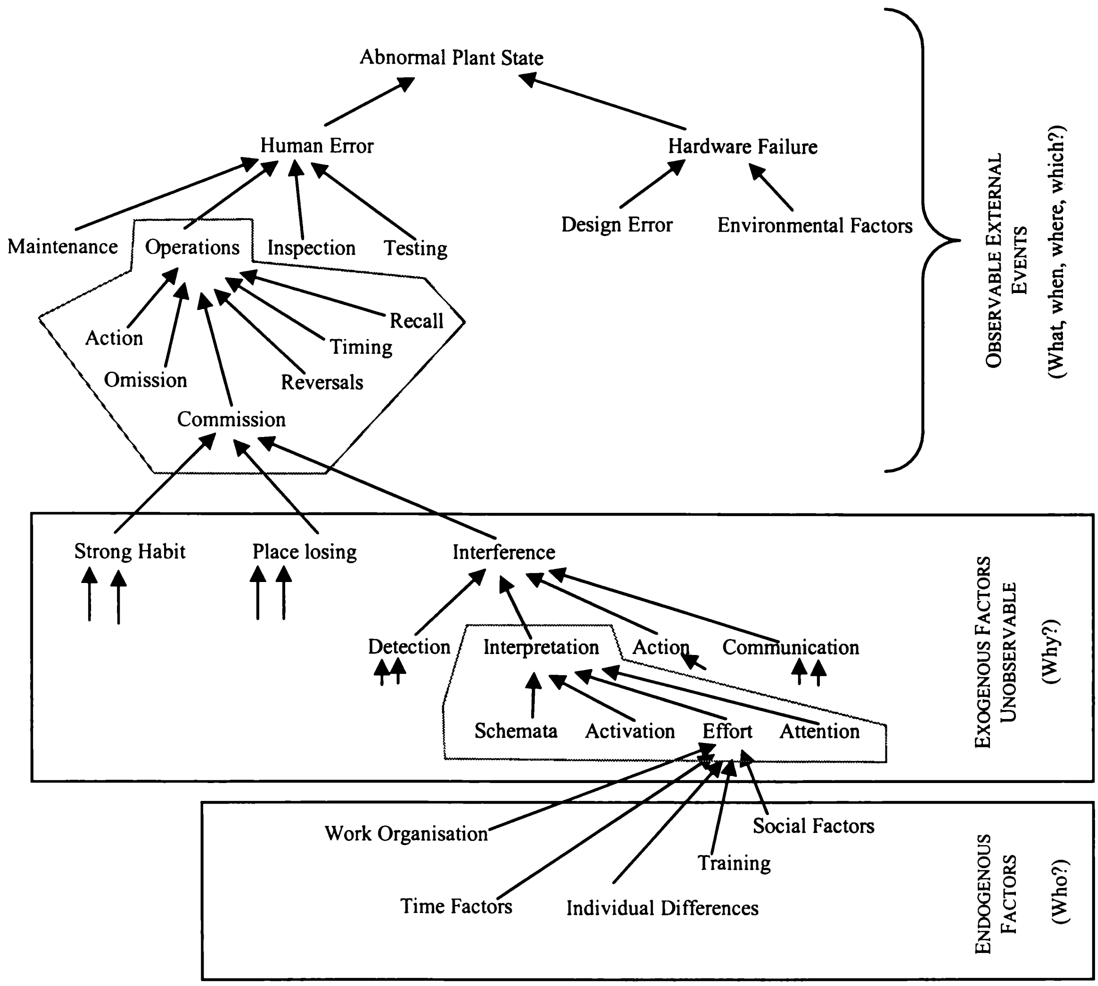
This last type of taxonomy is one that deals with exogenous errors.

Senders & Moray believe that the type, or mix of types of taxonomy, that is best to use depends upon the situation and the problem. However, they believe that if the goal is to predict or understand errors of decision, a taxonomy at the level of information processing (cognitive mechanisms) is more suitable. They also believe that a, "… 'natural' taxonomy will emerge from the data; the whole concept of taxonomy is based on the idea that there is a natural and discoverable orderliness in the environment" (p. 85). Senders & Moray have developed the "Causal network for error analysis" shown in Figure 59 to show the relationship between the levels of taxonomies and what they term, "the natural history of errors" (p.94). Figure 59 is one example of a causal chain drawn to demonstrate the relationships whereby each factor at a higher level has a similar network of causes feeding into it from below. In this case study, several factors led to a lack of effort, this lack of effort combined with other factors leading to an interpretation problem, the interpretation problem and other factors were the cause of interference, and the interference was a cause of commission errors in operating the plant. Many other examples of causal chains could have been chosen to demonstrate this network of errors.

From this discussion it can be seen that there are a number of existing taxonomies of error in existence. These have been developed for various industrial situations and are not directly applicable to the outdoor education sector. In developing a new taxonomy, there are various levels of analysis at which the taxonomy can be positioned. Because the taxonomy being developed in this study is designed to show the root causes of outdoor education incidents, or the 'why' of incidents at a fundamental level, the taxonomy is best placed at the level of cognitive mechanisms for the endogenous types. The classification system of types of root causes of error will be at this level, whereas tokens of those root causes will be examples of cases of the type in question or lower levels (for example biases, deep-rooted tendencies or possibly even neurological issues).

With the context (outdoor education) and the positioning of the taxonomy decided by virtue of its aim to document root causes (cognitive mechanisms), theory suggests that a natural order will flow from an analysis of the data.

Figure 59. The Causal Network for Error Analysis



From Senders & Moray, 1991 p.95

7.2.2 The Types and Tokens of Root Causes of Outdoor Education Incidents.

A comparison of the root causes of outdoor education incidents obtained from the empirical analysis of 18 incidents (Figure 58, Chapter 6) with the theoretical root causes obtained from a review of safety management and psychology literature (Figure 29, Table 14 and Figure 31, Chapter 4) shows close similarities. In general terms, the empirically derived root causes are a subset of the theoretically determined collection. This result is logical as the limitations of the research method, which have already been discussed, make it unlikely that a full complement of root causes would be empirically derived from the study of only

18 incidents. In contrast the comprehensive research base from the fields of industrial safety management and psychology is likely to have identified more of the major types of root causes of incidents.

The combined results of Chapters 4 and 6 produce the following taxonomy of root causes of error. The taxonomy contains root causes leading to poor performance or judgment (7.2.2.1 – 7.2.2.6) and those due to errors in the management system (7.2.2.7 - 7.2.2.10). The types of root causes will be discussed, grouped by major category. 'Tokens' of that root cause will be listed after the 'type' of root cause.

For those root causes linked to human performance error, wherever possible an exemplar of that particular type of root cause or token will be given from the empirical data. Some of the listed 'types' of root causes and their 'tokens' have been identified through the literature review in Chapter 4 without any confirming evidence from the outdoor education data. For these cases an anecdotal or hypothetical example will be given to show how they are applicable to the outdoors.

As previously discussed, the way senior management can act to control safety in the organisation is through the creation and implementation of a comprehensive safety management system. Deficiencies in the safety management system can lead to incidents occurring. These deficiencies are self-explanatory in terms of their impact and to prevent unnecessary repetition, no exemplars are given but examples can be referred to in section 6.4.2.1. Once again some of these 'types' of root cause will have empirical evidence to support them from the analysis of 18 case studies of outdoor incidents in Chapter 6, while others have been identified from the literature review in Chapter 4 without any supporting outdoor evidence.

While the following list may repeat information already conveyed in Chapters 4 and 6, this is the first time that a comprehensive list of root causes is stated from the combination of empirical and theoretical sources. Since a complete list of root causes in the one place is an important contribution of this thesis, I believe the repetition is justified.

7.2.2.1 Root Causes Attributable to the Category of 'Overload' of an Individual in their Role

Petersen (1988, p.298) defines overload as, "... the state in which the demands around you exceed your capacity to meet these demands." As discussed in Chapter 4, if an individual is placed in a position such that the job he / she is given to do is greater than that individual is capable of, or greater than someone with the skills for the described role could reasonably be expected to carry out, then there is an increased possibility of errors occurring. Often the overload conditions are due to failures in the safety management system of the organisation. In Figure 58 the identified instructor errors of: (1) Poor instructor condition; and (2) Lack of skills and experience, are considered overload conditions. The Delphi experts also identified the management system errors: (11) Equipment traps; and (12) Environment traps as management system errors. In this collation of results they will be treated as overload conditions on the instructor and the fact that they were not picked up and corrected by management will be considered a failure of the risk management systems - Management system error (3) in Figure 58.

The types of root causes of overload are:

7.2.2.1.(a) Lack of personal capacity (Literature review only - no verification by empirical data)

Any job has a minimum set of physical and mental requirements to be able to carry out the role. These are rarely defined explicitly in a job description but are real requirements to be efficient in carrying out the tasks dictated by the role. Outdoor instruction is at the extreme end of the spectrum in terms of physical and mental fortitude required. It is necessary to carry out physical work in sometimes extreme environmental conditions, and often critical decisions must be made under these trying and stressful conditions. If a person is appointed to such a role and does not have the required physical stamina or mental tenacity then overload will inevitably result with the possibility of incidents arising. Tokens:

- Insufficient physical capability for role (e.g., a person with poor physical fitness may get overly tired on a strenuous trip with students and because of this make poor decisions that lead to incidents).

- Insufficient mental capability for role - including confidence and self-esteem (e.g., An instructor with poor self-esteem is more likely to make decisions that are intended to please the group he / she is with rather than make hard decisions, that might upset the group, but lead to safe outcomes).

7.2.2.1.(b) Poor physical or mental condition

A person may temporarily be reduced in physical or mental capability making it difficult to meet all the requirements of the role given to them and therefore increasing the risk of incidents occurring. This can occur in any of the following ways:

- Physical injuries (e.g., Incident 636 involved an instructor working with a large haematoma. Because of the instructor's inability to walk far the choice was made to do a kayaking trip in conditions where rain was forecast. The river flooded and a serious incident occurred).
- Sickness. (Literature review only - no verification by empirical data).
- Physical fatigue / tiredness (e.g., Incident 126 involved an instructor on a journey, camping in poor conditions and getting little sleep. In hazardous environmental conditions, while tired, poor decisions were made leading to potentially serious outcomes).
- Mental fatigue / tiredness (e.g., Incident 857 involved an instructor who was mentally tired at the end of a long year of instructing. This caused a lowering of situational awareness and a serious incident resulted).
- Arousal / motivation state impaired by:
  - Drugs / alcohol
  - Biorhythmic
  - Menstrual
  - Bored (e.g., Incident 42 involved instructors who considered coaching the less able students to be a chore. Situational awareness and risk assessment were reduced because of this leading to a serious incident).

7.2.2.1.(c) Mismatch of skills / experience with task

If the task is not matched appropriately to the skills and experience of the individual, then task overload will occur and there will be increased likelihood of incidents occurring. The mismatch of skills and experience can fall into any of these areas:

- Knowledge of local area including knowledge of alternative sites (e.g., Incident 1471 involved an instructor who had sea kayaking skills and experience, but local conditions at the area where the group were taken contained hazards that surprised the instructor).
- Hard skills (e.g., Incident 318 involved an instructor who carried out mountain bike jumping with a group, without understanding the skills required and risks involved in the activity. Serious injury resulted).
- Soft skills (e.g., Incident 281 involved an instructor who had a limited repertoire of teaching skills. The inability to make the lesson relevant led to the students carrying out dangerous actions in order to prevent boredom and this resulted in a potentially serious incident).
- Metaskills (e.g., Incident 292 involved an instructor who did not know that it would be more effective to adopt an autocratic leadership style to control an activity when the risks increased).

7.2.2.1.(d) Task too large (Literature review only - no verification by empirical data)

The task itself can be too large for someone with the required skills and experience appropriate for the role specified.

- Hours required to work per day too great.
- Days programmed without adequate breaks too great.

7.2.2.1.(e) Traps present in the work environment

Management may place the instructor inadvertently in situations where undisclosed or unmanageable hazards are present. This will result in overload conditions resulting. Such traps can involve:

- Equipment traps – Where equipment is supplied that contains hazards that aren't obvious. These traps may be ergonomic in nature (e.g., Incident 318 involved an instructor being sent on a mountain bike activity with a mixture of bikes, some of which had toe clips and some which didn't. The different skills required for the different equipment posed a hazard that wasn't identified and when students swapped bikes an incident resulted).

- Environment traps – Where the environment in which an instructor is scheduled to work contains unexpected hazards (e.g., Incident 281 involved an instructor running a canoeing session in a canal. Upstream of the canal was a power station that increased the flow in the canal without warning which led to a potentially serious incident).
- Student traps – Where the students in the group possess characteristics that pose hazards to an instructor (e.g., students with undisclosed medical conditions or behavioural problems could pose hazards).

7.2.2.2 Root Causes Attributable to the Category of 'Poor Concentration'

If individuals fail to maintain concentration on the job at hand, inadvertent slips may occur. The different types of common slips are described in Section 4.4.4.1(a). Rather than using the six different types described, I have chosen to condense these into two types of root causes which will be more useable in the outdoor education sector:

7.2.2.2.(a) Actions without thinking

Where a frequently carried out action sequence is used without thinking whereas a different action sequence was required in the specific case (e.g., Incident 59 involved an instructor giving directions to a group of students to send them down a safe channel rather than a dangerous one. He told them to go left, but failed to take into account that he was sitting in his kayak facing upstream so that his left was their right. This led to the students heading into the dangerous channel and a potentially serious situation).

7.2.2.2.(b) Forgetting (Literature review only - no verification by empirical data)

Forgetting to do something, or one part of a greater process, leading to increased likelihood of incident (e.g., forgetting to leave intentions with the office on where you plan to go for the day).

7.2.2.3 Root Causes Attributable to the Category of 'Misapplication of Skills'

If a person has the appropriate skills for a task but misapplies those skills in the task environment, then that produces the same result as not having the skills in the first place. However it is easier to be aware that someone doesn't have the skills to start with and institute training so that the individual can 'upskill', rather than to be aware that an individual misapplies a known skill. Observation of staff is one of the few ways that this will become apparent. This can't be considered an overload situation because the person has been shown to have the skills and experience in the past to carry out the task.

7.2.2.3(a) Misapplication of Skills

This root cause has the following tokens:

- Hard skills (e.g., Incident 42 involved an experienced instructor who chose to use an inappropriate river running technique with students in their care).
- Soft skills (e.g., Incident 845 involved an instructor with plenty of prior skills and experience who failed to fully brief his students).
- Metaskills (e.g., Incident 611 involved an instructor knowledgeable about leadership styles who chose not to step in to exert his authority early in the incident and therefore the incident became more serious) and (e.g.2., Incident 321 involved an instructor running a session who assumed students would behave in a certain manner, but the assessment of their skills and behaviours proved to be incorrect).

7.2.2.4 Root Causes Attributable to the Category of 'Poor Judgment'

As discussed in Chapter 4, any judgment involves the four steps of: acquisition of information (situational awareness); processing of information (situational assessment); output (decision-making); and feedback. Errors can occur at any of these stages of the judgment process to lead to poor judgment.

7.2.2.4.(a) Poor situational awareness

This is the process of staying actively in touch with what is happening in order to gather the necessary information for decision-making. If the individual involved doesn't gather any information that a decision / judgment is required then an incident is likely to arise. Similarly, gaps in the necessary information will lead to poor or inappropriate decisions being made. Theoretical sources of bias in the acquisition of information are discussed in Section 4.4.2.1 and six tokens of this root cause are discussed. Seven incidents were identified as having this as a root cause in Chapter 6. The tokens listed below are a combination of the two sources, restructured into plain language that should be useable by an outdoor educator. Purely theoretical tokens that do not seem immediately applicable to the outdoor sector have been excluded.

- Availability – The ease with which certain information can be recalled can be confused with frequency of an event and therefore used as a predictor (e.g., I am aware of an incident where an instructor was told of a problem that had been encountered using a certain prussic knot as a self belay on an abseil. Despite that prussic knot being used successfully by hundreds of other users, the one recent comment meant the instructor used a different type of prussic knot which led to an incident occurring).
- Selective perception – There is a tendency to see what we anticipate seeing and people seek information consistent with their own views and hypotheses (e.g., Incident 292 involved an instructor who failed to see that the lake level was lower than normal – perhaps they arrived at the session, took a quick glance at the lake and 'confirmed' an already held belief that the lake level was appropriate for the activity to proceed).
- Selective focus – If a lot of attention is placed on executing one aspect of a plan, then situational awareness can tunnel-vision to that one aspect and other key information requiring attention is not gathered (e.g., Incident 281 involved an instructor who was so focused on rescuing a swimmer from a canoe that he failed to recognise that the whole group were being swept onto bridge pillars).
- Frequency desensitisation (Familiarity – type 1) – Often people predict future occurrences based on the observed frequency of events. They can't take into account non-occurrences of events. Thus as people become more familiar, through successful experience, with any of the items listed below, then the belief becomes that there is little danger and situational awareness decreases (e.g., Incident 1515 involved an instructor going on a river trip with a group. After a long period of easy river conditions, the instructor's situational awareness dropped and an incident resulted when unseen hazards were encountered). The frequency desensitisation effect can result from familiarisation with:

  - Students,
  - Activity,
  - Environment, and
  - Equipment.
- End of session / Going home – Situational awareness can also decrease at or near the end of a session or in the hurry to get home or to camp (e.g., Incident 292 occurred at the end of a session when the instructor had almost stopped monitoring the situation).
- Transferred responsibility – If it is believed that someone else with skills is monitoring the situation, then personal situational awareness can decrease (e.g., Incident 261 involved an instructor passing on the responsibility for navigation to a student who was observing the group from a Polytech programme. The instructor stopped monitoring the situation and an incident resulted).
- Concrete information – Immediate information is accepted as a better predictor than long-term, less tangible, information (e.g., I am aware of an incident where an instructor committed herself to a mountain trip in spite of a poor weather forecast, based on the fact that it was good weather when the group left. The resulting incident required the hospitalisation of a student).

Pilots are very aware of the loss of situational awareness being a major factor in many aviation incidents. Of the estimated 80 per cent of the accidents that are ascribed to pilot error, it is believed that a large proportion of these are due to loss of situational awareness (Vector, 2003). One study of aircraft maintenance errors found that 18 per cent were due to lack of situational awareness (Hobbs, 2002). One model that pilots use to ensure they are monitoring the situation is Y.O.Y.T.T. (Vector, 2002). Yourself – know your limits, abilities and how well you are performing on a given flight; Other People – know about other people you have to deal with, what they do, problems they have, what they are like as individuals; Your Aircraft – systems, performance, handling and emergency procedures; The Environment – physical, regulatory and organisational; and Task, Customer, Risk – know the task you have to do, what the customer wants and the risks inherent in the job.

This model is readily transferable to the outdoor education sector as a reminder of the importance of situational awareness.

7.2.2.4.(b) Inaccurate assessment of the risk

Once information has been gathered, it must be processed and an accurate assessment of the risk made. The theoretical factors affecting this situational assessment are discussed in Section 4.4.2.2.(a) – (c). In Chapter 6, 12 incidents were identified where poor risk assessment was found to be a root cause. The tokens listed below are an amalgamation of the two sources of information, but couched in non-technical language that will be useful to an outdoor educator.

- Inconsistency – the inability to apply a consistent assessment strategy. A good risk assessment may be made of one hazard while others are underestimated (e.g., Incident 42 involved instructors working with novice students on moving water. Both a stump and a line of branches were recognised as hazards, but a focus on one of the hazards reduced the perceived risk posed by the other, "I had the perception that if you crossed the eddyline in a normal fashion you would miss the stump... I focused on the line of branches as a significant hazard but felt the risk posed was all but over." A student ended up pinned against the stump with potential serious consequences).
- Failure to review (conservatism) – often there is a failure to revise opinion when new information is received, or plans are changed (e.g., in a recent outdoor education incident in Australia a school organised a parent / son tramp to demonstrate to the parents the skills their child had accrued during their time in the programme. The participants on the trip were not accompanied by an experienced instructor. Conditions at the start included drizzling rain. Weather reports received just prior to the trip had changed to indicate heavy rain was expected with possible flooding. The school did not re-evaluate the risk, the trip continued and a student drowned (Stevenson, 2001)).
- No-risk perception – a perception that the activity being undertaken is risk-free causes an underestimation of the risk (e.g., Incident 845 involved an instructor stopping to allow the students to walk down a steep track to see a rapid. The concept of a track walk was perceived as risk free and the

students were therefore unsupervised. Two students decided to solo up crumbling cliffs beside the track putting themselves at significant risk).

- Perceived as unlikely to happen – despite identifying the hazards, the potential for those hazards to result in an incident is not recognised or is seen as improbable. This is similar to the concept of 'non-linear extrapolation' in Section 4.4.2.2(c) (e.g., Incident 576 involved students traveling without direct supervision in bush-covered terrain containing cliffs. While understanding the hazards, there was a perception that the risk of students choosing a route through the cliffs and falling was highly unlikely. However they did and serious injury resulted).
- Justifying away the risk – a person can convince themselves that the risk present is lower than it actually is (e.g., Incident 636 – the instructor assessed that a serious hazard existed on the river but convinced herself that the risk was low due to the skills that had been demonstrated by the students. The actual risk was high and an incident occurred).
- Sunny day syndrome – the perception of the risk can be lowered if other conditions are favourable – such as when the sky is blue and the sun is out (e.g., Incident 292 – the Delphi panel believed that the instructor's perception of the risk may have been lowered because it was a sunny day and everything was going well).
- Negative event feedback (Familiarity – Type 2) – just as situational awareness can decrease with continued exposure to the situation, familiarity with a situation can also affect the assessment of the risk, even if all of the hazards have been identified (e.g., in the early 1980s an article on avalanche travel described this tendency as negative event feedback. In this article (which I read at the time but have never been able to find again) the author described the tendency of a back-country traveler getting to a snow slope, gathering all the necessary data and gauging that the slope had a high potential for avalanche. The first person in the party tentatively steps onto the slope, roped up, prepared to quickly retreat at the first sign of trouble. When they get over without incident, the second person in the party sets off to cross the slope with more confidence. When that person is safely across the rest of the party cross believing it to be safe and an avalanche occurs. The immediate feedback received by those in the party of no-event, caused

those people to re-evaluate the risk potential down, when in fact people crossing the slope had actually increased the hazard).

- Illusion of control (over-confidence) – If a person spends a great deal of time and effort analysing the risk and planning for it, these activities can engender a feeling of control over the events and lower the perception of the actual risk. See Section 4.4.2.3.(c).
- Wishful thinking - People's preference for the outcomes of events can affect their assessment of the events. Thus a mere desire for the activity to be successful can diminish the correct assessment of risk. See Section 4.4.2.3.(b).
- Risk homeostasis – The tendency for some people to assess the level of risk present in a situation down, due to having in their possession 'safety' technology that can aid in the outdoor activity. This is termed risk homeostasis because people tend to want to take the same level of risk. As a device enters the market that seems to reduce the risk, then people will take higher levels of risk assuming that the level of risk they are taking is unchanged (e.g., people have been known to head into untracked territory with students, where they would not normally travel, because they are carrying a global positioning system (GPS) and rely on this device for navigation. When the GPS failed they were left in a very serious situation).

7.2.2.4.(c) Snap decision made without considering alternatives (Literature review only - no verification by empirical data)

When humans make decisions in complex environments, often under time pressures, they tend to take short-cuts to simplify the decision-making process. Once a situation is recognised, a general rule is recalled to use in that recognised situation that may have worked in a similar situation in the past. These short-cuts to decision-making are known as heuristics (see Sections 4.4.1.2 and 4.4.2.2.(d)). The problem is that the heuristic approach is a general solution applied to a situation that may be different than previous applications and therefore the solution inappropriate.

- Habits / rules of thumb – a solution to a past situation is recalled and applied to a new situation without cômpletely considering its appropriateness (e.g., I am aware of an incident where an instructor had been running a number of kayak training sessions on slow moving water. When someone tipped out he hooked his tow line onto the kayak and towed them to shore without incident. When he took a group on more difficult rapids and a student tipped out above the rapid, without apparently changing his thinking he hooked his towline on, drifted into the rapid hooked to a kayak, tipped upside down and was injured. The changed situation of faster moving water had not been considered in choosing a solution for the problem of the capsized student).

- First impressions (Anchoring with adjustment) – These are predictions made by anchoring on some clue and not adjusting for changed circumstances. First impressions of student abilities are a good example of this. I know of an incident where students on a journey into the mountains were initially observed walking confidently on snow. When the snow became firmer and the terrain increased in steepness, the instructor made a judgment based on the earlier impression of student competence without adjusting for the new situation and an incident occurred.
- Expert opinion – Although the use of expert opinion has been identified in Section 4.4.2.2.(d) as a heuristic (use a solution suggested by an expert rather than take the time to think of a suitable solution yourself), I have chosen to treat this error as a token of the type, 'deferring judgment to others' (Section 7.2.2.5.(b)).

7.2.2.4(d) Poor processing of past experiences (Literature review only - no verification by empirical data)

If people have made poor judgments in the past, but not learnt from those past experiences, then poor judgments may be continued into the future. For anyone to learn from past experiences feedback needs to occur with the individual absorbing lessons to use in future situations. There are a number of common reasons for lack of appropriate and timely feedback. Many of these have already been discussed previously in Section 4.4.2.4.

- No-accident errors (Familiarity – Type 3); also referred to as outcome irrelevant learning structures in the literature review in Chapter 4) – if someone adopts a poor judgment in a particular situation, and yet no accident results, then this can reinforce the appropriateness of the 'poor' judgment. In this way, a habit / rule may form for that situation and when a similar situation is recognised in the future, that habit / rule is put into place – see Section 7.2.2.4.(c). This is very similar to the token 'negative event feedback' in section 7.2.2.4.(b) and may seem on first reading to be identical. The difference is that 'negative event feedback' happens at the time of the incident and results in a lowering of the perception of the risk, whereas 'no-accident errors' happen during the internal processing following successfully completing an activity containing hazards, and results in habits / rules being formed that will be used in future similar activities – perhaps with unfavourable outcomes.

- It must go right next time (Gambler's fallacy) – it has been noted that some people believe that if a sequence of failures are observed, then it is likely that the next event will be a success.
- Success / failure attribution – people tend to attribute success to skill and failure to bad luck or other factors. Because of this some people can fail to learn from past events.
- Rebuilding of events (Logical fallacies in recall) – following any event it is common for people to rebuild the event in their minds, omitting or adding details, such that this new version of the event becomes reality for them and may prevent learning of key decisions and the cues they received to make those decisions.
- Hindsight bias – people are often not surprised by past events and can find plausible explanations not related to their poor judgments.

7.2.2.5 Root Causes Attributable to the Category of 'Failing to Meet the Judgment Responsibilities of the Role'

An individual, in accepting a management position in an organisation (whether that be an instructional frontline management role or more senior manager), accepts certain responsibilities. These include making decisions / judgments that will result in actions that fit within the safety philosophies of the organisation and not to delegate those responsibilities to others without permission from an appropriate person in the organisation. If these responsibilities are not met then it can lead to hazards developing in the work environment.

7.2.2.5.(a) Choosing to take a higher level of risk than needed

In both the theoretical review of safety management theory in Chapter 4 and the qualitative results in Chapter 6, it was found that once people had a good situational awareness and correctly assessed the risk to form a judgment of a strategy to progress safely, subtle and not-so-subtle pressures can come into play to shift the risk taking levels higher and a new judgment being made on an acceptable action plan to adopt.

As explained in Chapter 6, it could easily be justified in placing this as a subcategory of 'Poor judgment'. The reason I have not taken this approach is that I believe the person has either: considered risk-taking options, including those that would meet the safety goals of the organisation, but has opted for an activity that meets personal attitudes / values towards acceptable risk and challenge instead of the organisational ones; or, have opted for an activity option based on established personal behavioural norms without taking care to think through the consequences in terms of acceptable risk (See Section 7.2.8.5 for further discussion of this). This changes the basic error type from a 'mistake' to a 'violation' in Figure 31. Although the term 'violation' may seem harsh, because the individuals concerned did not proceed knowing an incident would happen, by choosing to take a higher level of risk than was required, they have effectively increased the likelihood of such an incident and have thus violated the tenets of the safety management system of the organisation. This is an important differentiation.

Some of these pressures to adopt a riskier judgment are discussed in Section 4.4.2.2.(f) as part of the decision environment. As already pointed out, choosing to accept a higher level of risk was identified as a contributing factor in 17 out of the 18 incidents analysed by the Delphi panel members.

The pressures on an individual to 'violate' the safety goals of the organisation include:

- Physical comfort / ease – It may be physically easier to take a course of action that presents a greater level of risk than a more difficult, lower risk option (e.g., the instructor chose not to portage the rapid in Incident 636 with students because it was easier to stay in the boat than to get out and walk).

- Mental ease – It may be easier to stick to an existing plan or course of action when new information comes to light, even if that seems to be riskier than previously thought (e.g., the instructor in Incident 43 actually made her plans for the day before meeting their group and weren't willing to revise these even when new information made the choice of activity seem inappropriate).
- Emotional comfort / ease – Similar to the previous token, it may be easier to take a course of action that presents a greater long term level of risk than deal with difficult interpersonal issues such as conflict, prejudice, etc. (e.g., the instructor in Incident 728 chose to drive a vehicle in dangerous condition rather than enter a conflict situation with the manager who was responsible for the vehicle maintenance).
- To meet personal ego needs – Individuals have varying requirements of external approval in order to maintain or boost their self-image or feelings of self-worth. Some people will choose to take part in activities that are beyond their skill level in order to look competent in front of others (e.g., Incident 321 involved an instructor who carried on running a high ropes course activity that she felt uncomfortable about, rather than ask for help and advice from peers and risk looking incompetent). Alternatively instructors may allow those in their care to undertake risky activities rather than intervene and look bad in the eyes of some of their students for being too overbearing (e.g., the instructor in Incident 318 allowed the group to continue jumping their mountain bikes, even though it was beyond the instructor's skill level and expertise, rather than look too restrictive of the students fun). Those people from whom approval may be sought to meet ego needs can be any of:
    - Management
    - Peers
    - Students
    - Any other person whose opinion is respected.

  Meeting personal ego needs is often linked to the following two tokens of meeting others' needs / values or meeting personal needs / values. In order to 'look good' in front of others and hence increase feelings of self-worth, there needs to be a gauge of what is desirable behaviour – and these are often values held personally or by a peer group. For example, there is an unwritten code in kayaking that it is very 'uncool' to tip out and swim while on a kayaking trip, and even worse to lose your kayak and paddle while swimming. I have seen some horrible head injuries result from upturned kayakers doggedly staying in their kayaks, attempting to roll upright multiple times in shallow water rather than swim. I have also seen kayakers take a horrible swim down a rapid rather than leave their equipment and swim to the side. Both of these examples are attempts to build or retain ego based on group values. The ultimate example of this is explained in Maclean's (1999) analysis of the death of 14 firefighters while attempting to control a forest fire on Storm King Mountain in Colorado. A contributing cause to some of the deaths was a reticence to drop heavy equipment such as chainsaws while firefighters were running up a ridge to escape the blaze. Leaving equipment such as this behind was considered amongst firefighters to be very poor form. Others who dropped their gear and ran managed to survive.

- To meet others' needs / values – often a lot of pressure is exerted to meet other people's needs. Arguments may be made to reverse an earlier judgment / decision to a riskier option with justifications that include: other groups already having done the activity; it is important for educational outcomes; they have paid money for the course and demand value (e.g., a contributing factor in Incident 42 was allowing all students to paddle on the same stretch of water, despite some of the group having marginal skill levels for that difficulty of river, because the group wanted to stay together at the end of their programme). This token is discussed under the heading 'Social pressures' in Section 4.4.2.2.(f). These needs can even extend to individual ego needs within the greater group (e.g., a student training as an instructor was with the group in Incident 261. This person had failed at a previous task in front of the group and the supervising instructor raised the risk level in order to give the trainee a chance to rebuild his ego, "Wanted him to be able to regain credibility with the group. In hindsight I should have kept him with the group or attached him to a rope as I was unsure of the terrain").

  The people whose needs are being served can be any of:

- Students
- Peers
- Contracting organisation
- Others

- To meet personal goals / values – Any organisation should have stated philosophies / values, educational goals and safety goals. Individuals working for that organisation will have their own philosophies and goals / values in relation to education and safety. Often there will be a close alignment between the organisation and the individual on these issues. When the individual has personal philosophies, goals and values which promote a higher level of challenge and risk than the employing organisation, then issues can arise where trips are run beyond the scope of the organisation's safety management system and place students at risk (e.g., the instructor in Incident 857 left the students unsupervised on the high ropes course. This was so that the students would perceive that they were trusted to have the skills to manage a risky situation on their own. It was considered by the Delphi panel unlikely that the organisation would condone this lack of supervision and that it was the instructor's values / goals being demonstrated. In this case the students put themselves at serious risk while unsupervised). Other personal goals and values can also distract the instructor from focusing on his / her primary role with students and therefore placing those students at risk (e.g., the Delphi panel believed that the instructor in Incident 261 may have neglected his safety responsibilities with the students in order to follow a personal goal of 'chatting-up' the accompanying teacher).
- To meet the perceived goals of management – For various reasons an individual may not have a good understanding of the organisation's safety and educational goals. If he / she misunderstands or is ignorant of these goals he / she may run activities in order to try to meet his / her perceptions of management's goals, even if those activities seem riskier than he / she would normally choose to undertake. It is that individual's responsibility to ensure he / she has a very good understanding of the organisation's position on the acceptable level of risk to achieve educational outcomes (e.g., in Incident 1471 the instructor believed that one reason she chose to carry out

the activity was, "There might have been an element of pressure... to give the students a challenging experience – after all that's what the programme is about." In other words, she increased the level of challenge in order to achieve what was perceived as the programme objectives).

- Pressured by time or conditions – When there is time pressure to achieve a part of the programme, which may include meeting for a rendezvous for example, even though the supervising individual is situationally aware and has correctly assessed the risks, she / he will accept higher levels of risk to meet those time constraints (e.g., a contributing factor in Incident 1515 was that the instructor pushed the group onwards down the river in canoes because, "We had a long way to go and was aware of the time we were taking ... we were due back that night"). Weather and other conditions can also add pressures to increase the risk.
- Risky Shift – It is a well documented social phenomenon that individuals can shift their risk taking propensity higher in a group situation. The group in question is generally made up of peers. The examples of 'risky shift' seen in this study occurred when instructors were team-teaching with groups and chose to undertake activities with students that they probably would not have chosen had they not been team-teaching. This can happen without any communication between the instructors, where lack of questioning of a decision for the group is seen as tacit approval of that decision (e.g., the Delphi panel believed that the instructors in Incident 42 chose to adopt a poor management strategy during the kayaking instruction because of a risky shift process).
- Illusions of invulnerability (It can't happen to me) – (see also Section 7.2.2.4.(d)). The belief, often achieved through many successes in the past without mishap, that bigger and bigger risks can be taken and no incident will result. Thus people believing this will accept higher risks than wanted by the employing organisation believing they and their decisions are sound. (No verification by empirical data).
- Natural risk takers – Often linked to illusions of invulnerability, some people have higher risk taking propensities than others. This has been referred to as the 'testosterone' effect in Section 4.2.2.2 where males are noted as tending to make and accept riskier decisions than females. (No verification by

empirical data from the Delphi analysis of incidents, although the quantitative data in Chapter 5 lend support to this).

- Gender and other social interactions – Although closely linked to the listed tokens of meeting personal ego needs and meeting other's needs / values, various social interactions that can contribute to higher levels of risk being accepted. For example, when instructors are working in a team situation with a group, a gender mix among the instructors can cause higher risks to be taken: some women may not feel confident to over-ride a high-risk decision made be a male instructor; and similarly, some males may be reticent to over-ride a high risk decision made by a woman instructor for fear of being considered overbearing and controlling. Other issues of power and experience inequities between co-instructors could also lead to this same outcome.

7.2.2.5.(b) Deferring judgment to others

People are employed in positions of responsibility on the basis of their skills and experience and are expected to make judgments reflecting this capability. Some people avoid this responsibility by deferring / abdicating to others. Those deferred to can include peers, students and others. Often these people may have or be perceived to have more skills and experience than the instructor in that situation,. Whatever the case, it is the instructor's role to verify the information and make the final decision (e.g., the instructor in Incident 318 invited a student to make the decision about the suitability of the activity and terrain. In Incident 261, responsibility for route choice was deferred to a trainee instructor without being checked and in Incident 126, the instructor deferred to the judgment of peers).

7.2.2.5.(c) No judgment / Decision

Similar to deferring judgment, but much more difficult to identify, is making no judgment or decision – just allowing an activity to proceed, irrespective of the hazards present and making no intervention. It is possible that some of the incidents where root causes were identified as 'poor assessment of risk' or 'choosing to take a higher level of risk than needed' may actually be examples of no judgment being made at all.

7.2.2.6 Root Causes Attributable to the Category of 'Misdirected Motivation / Attitude'

If an individual has a total mismatch of personal goals and philosophies to the organisation, or becomes disenfranchised or demotivated in some way with the organisation for which he / she works, then the extreme result is the purposeful disregard for the organisation's safety systems, or in fact actively working contrary to those systems. All forms of management control of safety efforts have become irrelevant if this occurs.

7.2.2.6.(a) Breaks organisational policies

Any organisation makes a statement of the level of risk that is acceptable through its documented policies and procedures. These set operational limits to activities based on management's analysis of the risk present in an activity at any particular venue. The health and safety policy of any organisation will make it mandatory for its staff to understand and follow these policies. A breach of the policies means that person is operating outside the agreed safety parameters of the organisation while management in the organisation believes such actions will make an incident more likely (e.g., the instructor in Incident 636 broke the centre policy on instructor to student ratios which led to a potentially serious incident occurring).

7.2.2.6.(b) Sabotage

There are degrees of culpability in the breach of policies. If the breach occurs because the individual temporarily forgot the policy or believed that the breach would be working in the best interests of the organisation, this is still serious but not as severe as actively working against a policy for personal reasons or encouraging others to do the same (e.g., an incident bordering on sabotage is Incident 728, where the instructor chose not to undertake the vehicle safety checks as a personal protest about lack of performance by another individual in the organisation. This placed students in that instructor's care in serious risk).

7.2.2.7 Root Causes Attributable to the Category 'Senior Management System Errors'

At a governance, or senior management level, the philosophies and standards need to be established that set the framework that all other safety efforts in the organisation are based on. In addition to this the accountability for safety to the governance level of the organisation must be clear to ensure safety efforts are implemented at all lower levels. Reviews of the safety system should be a senior management responsibility.

7.2.2.7.(a) Less than adequate (LTA) organisational safety philosophy, goals and learning objectives

These must be clearly stated and available to all employees including volunteers. They set the over-riding philosophies for the organisation, establish where the balance lies between safety objectives and educational objectives and state the learning objectives for all programmes.

7.2.2.7.(b) LTA accountability for the safety system

One person in the organisation must be clearly accountable for the management of the safety system, its implementation and review.

7.2.2.7.(c) LTA review of safety systems

An organisation should conduct internal reviews of its safety system but can become blinkered in its view of its own systems. The only way to minimise this, and to ensure it is staying contemporary with changing external standards, is to have regular audits of its systems by external experts.

7.2.2.8 Root Causes Attributable to the Category 'Staff Recruitment and Training System Errors'

The staffing systems have been separated from other management systems because the selection, training and monitoring of staff has been shown to be critical to the organisational safety effort.

7.2.2.8.(a) LTA staff recruitment systems

The organisation must have documented job descriptions and specifications of skill sets for each role. These must be complemented by systems to verify past experience, safety records and screening for other factors that may affect successful employment (physical, mental, criminal histories).

7.2.2.8.(b) LTA staff induction systems

A thorough system of induction into the organisation's systems and procedures must exist to ensure a working knowledge of what is expected by that staff member to achieve their role.

7.2.2.8.(c) LTA staff training systems

A system must be in place that identifies deficits in each employee's skill and experience, prioritises these, establishes a training pathway to remove these deficits and then ensures the training occurs.

7.2.2.8.(d) LTA staff monitoring and appraisal

Systems must be in place to monitor the actual performance of staff in their role, as opposed to the theoretical performance based on documented skills and experience, and give feedback based on this monitoring.

7.2.2.9 Root Causes Attributable to the Category 'Middle Management System Errors'

Middle management in any organisation is responsible for the creation and implementation of systems that manage risk within that organisation.

7.2.2.9.(a) LTA documentation of safety responsibilities and accountabilities

All members of staff need to know what their roles, responsibilities, and to whom they are accountable, and the chain of command when working in teams.

7.2.2.9.(b) LTA risk management systems

The organisation must analyse the risks identified for all of its work situations and document appropriate methods to manage those risks. This includes all outdoor education activities in the different settings in which they occur.

7.2.2.9.(c) LTA policies and guidelines

The organisation must have clearly written and easily accessible policies and guidelines for its staff which give direction about levels of risk that are acceptable and ways to manage those risks. Many of these policies will be the result of the risk management systems in 7.2.2.9(b).

7.2.2.9.(d) LTA hazard reporting systems

If employees identify hazards in the workplace, there must be a system to ensure these are reported to management and the staff member is able to refuse to work in the environment containing such unmanaged hazards.

7.2.2.9.(e) LTA communication systems

The organisation must have appropriate systems of communication to be able to pass on necessary safety information both within the office and in the field. These might involve safety bulletin boards, written memos, radio and mobile phone technology for example.

7.2.2.9.(f) LTA emergency systems

The organisation should have a documented emergency response plan that covers all major types of crisis.

7.2.2.9.(g) LTA incident reporting systems

The organisation needs to have a system in place that is capturing information from all incidents (especially those with potential for serious harm), analysing the incidents, and putting in place recommendations to prevent recurrence of similar events.

7.2.2..9(h) LTA equipment / resource systems

Systems must be in place to identify equipment needs, appropriate equipment that meets that need, purchasing systems to procure the equipment, maintenance systems to ensure the equipment is kept serviceable, and retirement systems to remove inappropriate equipment from circulation. These systems should extend to vehicles, buildings and any other resources that will be used by staff.

7.2.2.9.(i) LTA compliance to statutory requirements

The organisation must ensure it has systems in place to meet all statutory requirements placed on it by local, regional and national government agencies. These will include standards and codes for buildings, drinking water, swimming pools, etc.

7.2.2.10 Root Causes Attributable to the Category – Operational System Errors

Some systems that are critical to safety performance are implemented at the operational, day-to-day, level of the organisation.

7.2.2.10.(a) LTA client screening mechanisms

Clients must be screened to ensure there is an appropriate match with what the organisation can and is willing to deliver. This includes health, medical history, social issues, etc. There should also be a disclosure of risk to the clients so that they are enrolling in the programme with risks stated explicitly..

7.2.2.10.(b) LTA systems to match an instructor with a task

The organisation must ensure that the skills and experience of each instructor match the task being assigned. This includes consideration of activity, venue, weather, client group, etc. This match must be considered when an instructor is initially assigned to a group and also on a daily basis to ensure planned activities are suitable.

7.2.2.10.(c) LTA safety meetings

Regular meetings need to be held to discuss safety issues and concerns. Information can be shared between staff members from their experiences at these meetings.

7.2.3 A Taxonomy of Error for the Outdoor Education Sector

The root causes of error leading to outdoor education incidents described in Section 7.2.2 are proposed as a taxonomy of error for the outdoor education sector. This taxonomy is shown in Figure 60. Those items in the taxonomy that have been verified by empirical evidence from the analysis of outdoor education incidents in Chapter 6 are shown in black, whereas those that have been identified from the literature review in Chapter 4 and have no support from the empirical data in Chapter 6 are shown in grey.

The result, as indicated by Figure 60, is the identification of 37 root causes of outdoor education incidents. Eighteen of these are root causes that lead to poor performance or judgment by those with safety responsibilities, while 19 are inadequacies in the safety management system of the organisation. All of these root causes can, either by themselves, or more usually in combination, lead to accident potential and eventually to accidents.

The actual groupings of root causes into categories of type, and the differentiation of levels between types and tokens have been done according to subjective criteria. This is one of the limitations of the study and is recognised as an issue in the formulation of any taxonomy:

> "...Identifying these clusterings and matching them with phenomena and mechanisms calls for judgment by the statistical analyst, and thus to a greater extent depends upon the concepts and models the analyst already possesses. In short, the analyst's expectations of possible phenomena and mechanisms greatly influence the development of the taxonomy" (Senders & Moray, 1991, p.85).

Figure 60. Taxonomy of error for the outdoor education sector

Root Causes Leading to Poor Performance or Judgment

OVERLOAD
1. Lack of Personal Capacity
   a. Physical
   b. Mental
2. Poor Physical or Mental Condition
   a. Injury
   b. Sickness
   c. Physical Fatigue/Tiredness
   d. Mental Fatigue/Tiredness
3. Arousal/Motivation Impaired
   a. Drugs/alcohol
   b. Biorhythmic
   c. Menstrual
   d. Bored
4. Mismatch of Skills/Experience to Task
   a. Local knowledge
   b. Hard skills
   c. Soft skills
   d. Metaskills
5. Task too large
   a. Hours per day too great
   b. Days without break too great
6. Traps in Work Environment
   a. Equipment traps
   b. Environment traps
   c. Student traps

POOR CONCENTRATION
7. Actions without thinking
8. Forgetting

MISAPPLICATION OF SKILLS
9. Misapplication of Skills
   a. Hard skills
   b. Soft skills
   c. Metaskills

POOR JUDGMENT
10. Poor Situational Awareness
   a. Availability
   b. Selective perception
   c. Selective focus
   d. Frequency desensitivity
   e. End of session / Going home
   f. Transferred responsibility
   g. Concrete information
11. Inaccurate Assessment of the Risk
   a. Inconsistency
   b. Failure to review
   c. No-risk perception
   d. Perceived as unlikely to happen
   e. Justifying away the risk
   f. Sunny day syndrome
   g. Negative event feedback
   h. Illusion of control
   i. Wishful thinking
   j. Risk homeostasis
12. Snap Decision Without Considering Options
   a. Habits/rules of thumb
   b. First impressions
13. Poor Processing of Past Experiences
   a. No-accident errors
   b. It must go right next time
   c. Success/failure attribution
   d. Rebuilding of events
   e. Hindsight bias

FAILING TO MEET JUDGMENT RESPONSIBILITIES
14. Choosing to take a Higher Level of Risk then Needed
   a. Physical comfort/ease
   b. Mental ease
   c. Emotion comfort/ease
   d. Personal ego needs
   e. Others' needs/values
   f. Personal goals/values
   g. Perceived goals of management
   h. Pressured by time/conditions
   i. Risky shift
   j. Illusions of invulnerability
   k. Natural risk taker
   l. Gender and other social interactions
15. Deferring Judgment to Others
16. No Judgment Made

MISDIRECTED MOTIVATION/ATTITUDE
17. Breaks Organisational Policies
18. Sabotage

Root Causes in the Management System

STRATEGIC SYSTEM ERRORS
1. LTA Organisational Safety Philosophy, Goals and Learning Objectives
2. LTA Accountability for the Safety System
3. LTA External Review of Safety Systems

STAFF RECRUITMENT AND TRAINING ERRORS
4. LTA Staff Recruitment Systems
5. LTA Staff Induction Systems
6. LTA Staff Training Systems
7. LTA Staff Monitoring and Appraisal Systems

MIDDLE MANAGEMENT SYSTEM ERRORS
8. LTA Documentation of Safety Responsibilities and Accountabilities
9. LTA Risk Management Systems
10. LTA Policies and Guidelines
11. LTA Hazard Reporting Systems
12. LTA Communication Systems
13. LTA Emergency Systems
14. LTA Incident Reporting Systems
15. LTA Equipment/Resource Systems
16. LTA Compliance to Statutory Requirements

OPERATIONAL SYSTEM ERRORS
17. LTA Client Screening Mechanisms
18. LTA Systems to Match an Instructor to a Task
19. LTA Safety Meetings

NB: LTA = Less Than Adequate

NB: Items shown in black have been verified by empirical evidence while those shown in grey are theoretical constructs only at this stage, derived from a literature review in the fields of outdoor education, industrial safety and psychology.

This limitation is mitigated to some extent by seeking review of the final taxonomy by the Delphi panel members and adjustments made based on that feedback.

This taxonomy should not be considered to be a final and definitive list, it is a base from which the sector can discuss, add, change and delete as cases are put and evidence decrees. This fluid approach to the taxonomy is its strength and the taxonomy must be able to change in order to take into account new information that will inevitably come to light.

7.2.4 The Application of Case-based Reasoning and Information Retrieval Tools to Extend the Taxonomy

When designing the method to address the research questions, it was realised that any taxonomy produced must remain open for additions in the future as new knowledge and research comes to light. It is an identified fact that taxonomies of error are never static but change as new knowledge is gained (Johnson, 2000). Johnson proposed a technique to deal with this issue of changing taxonomies which he described as 'case based reasoning and information retrieval tools'. Case-based reasoning uses computer searches of written incident narratives for key words, and their similes, in order to identify new types added to a taxonomy. In this way, as a new root cause is added to a taxonomy, large databases of previously analysed incidents can be searched quickly for these key words or 'cases' and statistical analysis carried out. The concept was that incident narratives that were collected in any future incident database could be searched for keywords in this fashion as the taxonomy was updated.

The experience of carrying out the Delphi analysis on the 18 outdoor education incidents proved that such a concept was overly optimistic. The identification of root causes often relied on the interpretation of subtle messages in the narratives by expert outdoor practitioners. A simple word search of narratives for key words, phrases and their similes would fail, except for trivial cases where words such as "tired" and its similes might gain some reward in a search for the root cause, "poor physical condition". Word searches of documents for root causes such as, "Choosing to take a higher level of risk than needed", and its tokens seems a daunting task at present.

As the taxonomy of error for the outdoor education sector changes in the future as more information and research comes to light, there seems no easy way to retrospectively review incident narratives for examples of that root cause unless it can be identified with some key words and phrases. The experience shown in this research is that such a search would require an intensive revisit of each incident by an expert or experts. Such a time commitment would be hard to justify and the incorporation of any new root cause to the taxonomy would probably only be applied to incidents recorded from that point in time forward.

7.3 A Model of Outdoor Education Incident Causation

In Chapter 4 a proposed model of an outdoor education incident was produced from a literature review and shown as Figure 31. In Chapter 6 a Delphi technique was used to produce the causal sequences for 18 case studies of New Zealand outdoor education incidents. The Delphi panel was sent the narratives from the instructor who had been in charge of the incident at the time and were asked to identify prevailing conditions (immediate causes) that were pertinent to the incident in question and also to identify what they believed were the root causes of the incident. The results of this qualitative analysis of 18 outdoor education incidents supported the incident model (Figure 31) in the following ways:

a) All of the root causes identified by the Delphi analysis could be satisfactorily accommodated within the two major categories of root causes i.e. either: errors due to inadequate performance / judgment of instructors (although this had to be extended to include errors by senior management – see below); or errors in the safety management system of the organisation.
b) All of the immediate causes identified that were pertinent to the incident could be categorised as either environmental hazards, equipment / resource hazards or hazards due to dangerous acts by students or other people.

c) In the review of the incident diagrams by the Delphi panel members, there was no request for the immediate causes described in (b) to be included at the level of root causes.

d) Although management system errors were identified in all of the 18 incidents as being contributory, in every case the actions of an instructor in the field had more direct effects, and different actions could have averted the incident despite any inadequacy in the safety management system.

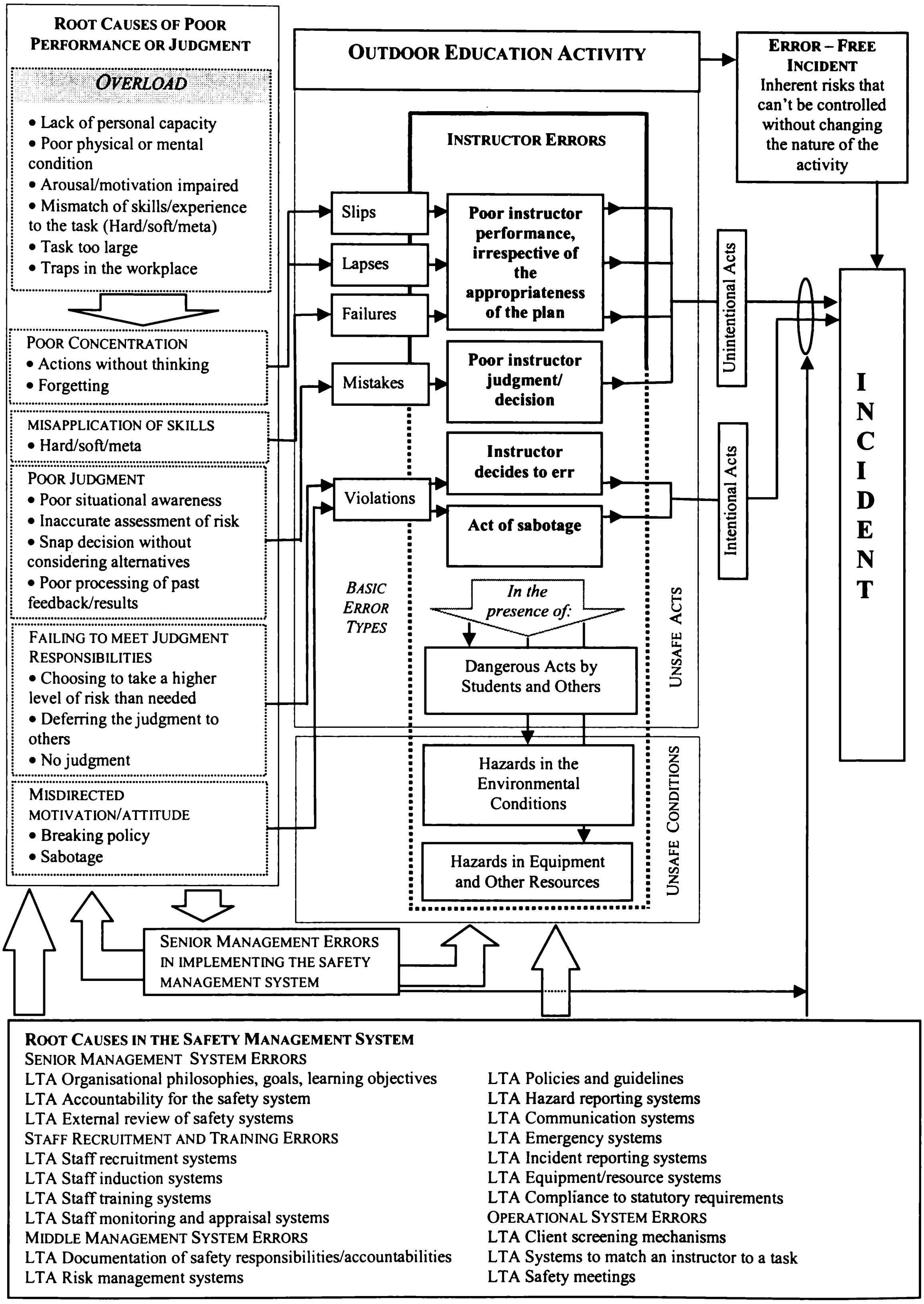
The qualitative analysis did however reveal two important additions that were not shown in Figure 31:

a) Management Staff Errors. While the focus in Chapter 4 had been on identifying the root causes of poor performance or judgment of instructors, errors made by the organisation's senior and middle managers developing and implementing the safety management system had not been considered. Empirical evidence of these factors leading to incidents showed that such a category should be included. There is no reason to believe that any category of root cause that could affect instructors' performance could not equally affect the performance of more senior managers.

b) Error–Free Incidents. Discussion about the appropriateness of an organisation's safety philosophy prompted the development of the concept of an 'error-free incident'. An error-free incident is one where the risks of an activity have been analysed, found to be acceptable, and the hazards identified could not be controlled without adversely affecting the very nature of the activity. The incident is therefore due to the inherent risks of the activity.

Incorporating these two concepts, and the final taxonomy of root causes shown in Figure 60, into the model of an outdoor education incident in Figure 31, results in the model of outdoor education incident causation shown in Figure 61.

Figure 61. Model of outdoor education incident causation



The structure of this model is built around root causes in two main areas: Poor performance and judgment in either instructors or more senior management; or, failures in the safety management systems. These two groupings of error have not been previously identified in outdoor education literature. They are based primarily on the work of industrial safety managers such as Petersen (1988) and Bird & Germain (1989) whose focus is on behavioural / participative approaches to safety. As explained in detail in Chapter 4, outdoor education writers have concentrated in the main on the immediate causes leading to incidents and failed to identify the more important root causes of those incidents. Haddock (2003, pp. 84-86) has introduced the concept of a "lack of management control" to outdoor incident causal sequences based on her reading of Bird & Germain. The model presented here goes further than this as it identifies the role of the instructor as a front-line manager and therefore the factors leading to that front-line manager making errors become root causes of any incident.

The model of incident causation shown in Figure 61 can be explained by working backwards from the incident occurrence in the following way:

a) Any incident (accident or near accident) occurring in an outdoor education activity can be the result of either the inherent risks of the activity or an instructor error – either unintentional or intentional. Any instructor error occurs in the context of an organisation's safety management system which may also contain errors.
b) Some incidents are therefore beyond the control of management (Error-free incidents) and must be accepted as part of working in the outdoors.
c) When supervising an outdoor education activity the instructor is working in an environment that often contains a range of hazards including dangerous acts by students and others, hazardous environmental conditions and hazards in equipment or other resources. It is the instructor's role to manage these hazards. These hazards are not the root cause of any incident – they are merely conditions that exist and must be taken into account. They are considered to be immediate causes of the incident that have underlying root causes that allowed those immediate causes to exist.

d) An instructor may fail to adequately manage the hazards through one or more basic error types – slips, lapses, failures, mistakes or violations.

e) The instructor makes these errors in performance or judgment due to one or more root causes of error in the categories of: poor concentration; misapplication of skills; poor judgment; failing to meet judgment responsibilities; or, misdirected motivation / attitude.

f) If the instructor is overloaded in the task environment, then any of the root causes mentioned in (e) are more likely to occur. Therefore, a number of overload conditions are also considered to be root causes of the incident.

g) The instructor is working within the framework of an organisational safety management system. If there are inadequacies in this system they can lead to an incident in a number of ways, indicated by the arrows heading away from the box titled, 'Root causes in the safety management system'.

   i) The management system errors can lead to task overload conditions for the instructor, increasing likelihood of instructor error, or poor induction, training and monitoring of the instructor can lead to the other root causes of instructor error.

   ii) The management system errors can lead to increased hazards existing in the instructor's workplace in the form of unsuitable clients, environmental hazards and equipment / resource hazards.

   iii) A good safety management system can sometimes prevent incidents progressing, even once instructor errors have begun to occur. This can happen through the intervention of more experienced staff while monitoring instructor performance, the vetting of instructor plans, etc.

h) Senior managers, even working with a perfectly adequate safety management system, can make errors in the implementation of that system due to the same root causes that result in instructor error. These senior management errors will result in the same impacts on the instructor's work environment indicated in (f) as if errors did exist in the safety management system itself.

This model is the first time in outdoor education literature that the relationship between unsafe acts, unsafe conditions, basic error types, and the types and tokens of root causes due to human error and system error are explained. Through such a model it is possible to focus on a training mentality in the aftermath of an incident, rather than on a mentality of looking for someone to blame.

7.4 Delphi Panel Response to the Taxonomy of Error and Model of Incident Causation

The Delphi panel members were sent copies of the proposed taxonomy of error (Figure 60) and model of outdoor education incident causation (Figure 61) with accompanying explanations. They were asked to review these two documents and comment on:

- Does the model fit within your experience of incidents that occur in the outdoor education sector?
- Does the taxonomy of root causes make sense within your experience of outdoor education?
- Is the grouping of the root causes within the taxonomy logical?
- Any other comments?

Thirteen of the 18 Delphi panel members provided feedback. Two of the five non-respondents were overseas on expeditions and three simply failed to respond to email requests. The feedback below is coded by the Delphi member's team colour (red, yellow or green) and the member's number within that team (1-6). Thus Red 3 would be the third Delphi member of the Red team.

The feedback from the 13 Delphi members was generally very positive. A number of responses simply indicated that both the model and taxonomy fitted the experience that person had of outdoor education incidents:

> "Yes, it makes sense. It fits with my experience of accidents in the outdoors. Yes, the list of root causes makes sense and yes, the grouping is logical." (Yellow 1)

> "The model and list make sense. They seem to fit well with my experience of accidents in the outdoors. The list and grouping of root causes seems logical and makes sense." (Red 4)

> "Overall the information and the documents are logical, are complete based on my experience and with the involvement that I've had with the review process they are understandable. All the groupings of root causes mesh well and it all fits with the experience that I have as an outdoor instructor." (Red 6)

Even though Delphi members were not asked directly, many were already considering whether this model could be used in their work environments. Various people made comments that the model itself was complex and would be difficult to use in this form as a tool to introduce within any outdoor education organisation.

> "It would be hard to introduce into an organisation as a tool. It depends how you see it being applied. There is a difference between a tool for analysis and communication at the factory floor level... The diagram is a bit of an horrendogram. The whole thing doesn't lend itself to a piece of A4 paper as I can imagine you would agree with." (Green 2)

> "Is the model supposed to be used as an actual tool for institutes, etc.? If it is to be an applied thing then I've got to say, putting it all on one page is pretty confusing. It would have to be the A3 wall version with some space to make it all useful." (Red 5)

These points are valid. The model as it stands is being used to summarise a number of theoretical concepts. If the model was to be used with practitioners it would need to be adapted and simplified for that audience.

Other feedback suggested that the model may be easier to understand if the flow was reversed. In other words they suggested that the box containing the word "Incident" was placed on the left hand side of the page in Figure 61 and that flow should progress from this towards the root causes. I believe that people are suggesting this change because they are finding it easier to read the diagram in this direction for two reasons. Firstly, I chose to explain the diagram in the documents sent to the Delphi members in reverse order, and secondly, because I believe these Delphi members are reflecting on incidents that they have experience of, and mentally working backwards from the incident to possible root causes. My intention with the model in this instance is to indicate the flow from root causes towards incident as a causal sequence and therefore I believe that the current flow is appropriate.

One result that was personally satisfying was that the model caused some of the experts to review their concepts of incident causation and provided them with insights that they hadn't considered before.

> "I felt there became an overwhelming key component of instructor judgment that your Figure 61 impacted on me. It brought home the vital role of instructor decision-making even in the light of a sound management system… this diagram was very visual in this regard." (Red 2)

> "It would seem that accidents are maybe more as a result of the pressures that the instructor puts on themselves than the more usual 'obvious' causes of outside factors like weather…" (Yellow 1)

Comments such as these are good endorsements of the model in that it is creating realisation in experienced outdoor educators that their previous mental models of incident causation need to change.

Other experts commented on the fact that they had seen models of incident causation in other literature, but this was the first model that specifically dealt with outdoor education.

> "I've seen concepts similar to this before but I've never seen anything that is specific to the outdoor sector. The model makes more sense in an outdoor environment than other (non-outdoor) ones I have seen." (Green 1)

> "Personally I think there's not much out there to read that is specific to the outdoors. What there is either deals with specific cases and fails to draw any general patterns or deals with surface level, hands-on, how to manage risk and fails to provide any underlying analysis. This is great!" (Green 3)

> "Seems to work with most accident scenarios that spring to mind. Its certainly more comprehensive than anything else I've seen." (Red 5)

Feedback about the taxonomy of error was almost all positive. Only one expert stated that,

> "Yes, the root causes make sense but I would need some good clinical psychology skills to work with the person concerned to whittle down to the difference between some of them. I wonder if they could be broader?" (Green 2)

All of the other experts thought that the language was appropriate and wasn't overly academic. The use of exemplars from the case studies was found to be particularly useful.

> "The taxonomy and root causes are excellent." (Green 3)

> "The taxonomy provides substantive material and analysis reinforcing and / or changing intuitively held thoughts and unsubstantiated anecdotal debates. The examples make it a very useful teaching resource providing meaning and application to the theory. Students will be able to use this material, especially at (NZQA) levels 6 and 7. It will provide more direction for management practices, supervision, training and induction." (Yellow 5)

> "I haven't seen root causes explained as comprehensively in any reading I have done and certainly not with outdoor examples. I also wasn't aware of some of the root causes you have described. For me there was a considerable amount of new information in the types and tokens of root

> causes... The explanations are pretty clear and in a language that's not too academic. The examples help lots. I think they reflect that this stuff happens in the outdoors." (Green 1)

> "It was fascinating and illuminating reading! The language was pretty user friendly and not too over-the-top academically. I believe the outdoor instructor / educator community will find lots of value in it." (Red 4)

> "The list of root causes is more extensive than anything I've seen previously and the grouping is clear and logical." (Red 6)

A number of the experts did suggest minor changes to the explanations of root causes to remove ambiguities. These have been made where appropriate but none affected the structure of the taxonomy. Others sought further explanation of the types or tokens to increase their own understanding. Some of the experts suggested additions to the taxonomy but each addition suggested was simply a practical example of a token of an already listed type of error. An example of this is the suggestion by one expert that the use of inappropriate learning progressions could be a factor. Using appropriate learning progressions with students is an example of a metaskill under the type of root cause, "Mismatch of skills / experience to the task". It would not be helpful to go through all of the suggested changes and explain how the suggestions are tokens of existing types, or practical examples of those tokens, as future training and discussion of the taxonomy in the sector will make this self-evident.

When asked for other comments, there was widespread endorsement of the value of the work.

> "The information is logical and seems complete from my perspective. This seems to be coming together as a great piece of work." (Red 6)

> "I have run risk management courses for a number of years now and have read a lot of the stuff that is out there related to accidents in the outdoor world. This is the first time I have read such a comprehensive compilation

of root causes along with a model that demonstrates the relationships of causal factors within an accident. If I was able to I would use this stuff in my risk management courses tomorrow!" (Green 1)

"Do you mind if I use this with my outdoor leadership students? I'll ensure you are appropriately credited as the source. The information is great and goes well beyond anything currently out there – well done." (Yellow 5)

"There must be potential for this work to impact on the training of instructors significantly - rating the important skills, knowledge and experience that equals judgment; and the importance of self-reflection on performance." (Red 2)

In general this feedback is comforting endorsement from outdoor experts to the validity of the research outcomes.

7.5 Further Discussion – Significance of the Research

7.5.1 The Current State of Knowledge

When this research began in 2000, a new text had recently been published that outlined the combined knowledge about incident causation in the outdoor education sector. This text was titled *Lessons learned: A guide to accident prevention and crisis response* (Ajango, 2000). It was compiled by staff of the University of Alaska, Anchorage, outdoor and experiential education program in the wake of a serious incident that occurred on their program. Fourteen climbers fell over 1000 feet down a steep mountainside in Alaska, killing two of the students. The intention was to compile a comprehensive summary of what was known about incidents, and how they occur, in order to help prevent them. It contained seven separate sections written by recognised experts on outdoor education safety management. The first section titled, "How Accidents Happen", claimed in the table of contents (p.xiii) to,

> "…explores the current state of thinking on how accidents happen in outdoor adventure activities. The authors explain several methods for analysing outdoor accidents and use real case studies to demonstrate the practical application of these methods."

The Vice President of Outward Bound USA tasked with the portfolio of 'Safety and Program', Lewis Glenn, reviewed the book and stated:

> "*Lessons Learned* is comprehensive in its look at the design and delivery of outdoor adventure programs from the standpoint of managing the risks to participants…" (Ajango, 2000, p.iii)

Based on these comments there seemed little doubt that the contents of this text contained the current state of knowledge within the outdoor education sector at the time of publication.

The information within *'Lessons Learned'* related to the mechanisms and models of incident causation have all been reviewed in Chapter 4 of this thesis. The accident model shown in the text is Hale's and shown in this study as Figure 5. This is a simple model showing that accident potential is created when environmental factors interact with human factors. To discuss the causes of accidents, the Meyer & Williamson matrix is used which appears in this study as Table 12. This matrix divides the potential causes of accidents into the three categories of: Unsafe conditions, unsafe acts, and errors in judgment.

As I have explained in Chapter Two these models and explanations are simplistic and of limited use in explaining the complex interactions of humans in hazardous situations. Very little of the extensive work from the fields of industrial safety management and psychology has been used and incorporated into the outdoor education literature. The suggested 'deeper causes' of outdoor accidents are not root causes as I am defining them in this study but are a mixture of prevailing conditions, and types and tokens of root causes.

After this study had commenced, Haddock (2003) released her updated version of the Mountain Safety Council, Outdoor Safety Manual. Again, this was representative of the combined knowledge within the outdoor education sector of incident causation at the time of writing. This manual introduced the work of Bird & Germain (1989) in terms of a causal sequence for incidents that is shown as Figure 9 in this study. This points to root causes of all incidents being due to a lack of management control, which is a systems approach to safety. Haddock listed a number of causal factors in her book under categories of people, equipment and the environment. Once again there was a tendency through this process, language and categorisation to confuse root causes with prevailing conditions (immediate causes) and therefore not focus on the underlying reasons for incidents developing.

Paralleling the development of the knowledge of incident causation in the outdoor education sector, there has also been the development of an understanding of the processes of judgment and decision-making. A comprehensive summary of this knowledge is also contained in Chapter 4. Boyes (2000) conducted research into outdoor adventure decision-making as a PhD study at Otago University. He identified a need to, "understand more about an outdoor leader's decision-making to improve the quality of performance and to develop instructional curricula and technologies to aid and support training" (Boyes, 2000, p.ii). Boyes came up with a framework model of outdoor adventure decision-making (OADM) that is shown as Figure 23 in Chapter 4. This model is based on the work of naturalistic decision-making (NDM) theorists such as Endsley (1997), Klein & Woods (1993), Orasanu & Fischer (1997) and others. Boyes' study acknowledges foundation work done in the outdoor education sector on decision-making and judgment (Martin & Priest, 1986; Mortlock, 1984; Priest & Chase, 1989; Priest & Gass, 1997) and builds on this. This model suggests that outdoor leaders make decisions based on wanting to achieve, "an ideal balance of challenge, through the identification and correction of over-challenging and under-challenging situations" (Boyes, 2000, p.309). Boyes' explained that challenge is defined using Martin and Priest's (1986) Adventure Experience Paradigm as an interaction of risk and competence. Thus Boyes' model suggests that outdoor leaders make ongoing decisions in an effort to balance the risk present with the competence of the group in order to achieve an ideal level of challenge.

These models and theories are the most recently developed and summarise the current state of knowledge in the outdoor education sector about incident causation and the role of instructor judgment. The research in this study takes these concepts and develops them along new lines to enhance the understanding of incident causation within the sector.

7.5.2 A Language and Categorisation System for Outdoor Education Error

Perhaps one of the most important outcomes of this research is a structured language for the discussion of root causes of error. In the editorial comment introducing a special edition of the Journal of Adventure Education and Outdoor Learning with a focus on risk and safety, Loynes (1996, p.4) stated that, "We still do not have a widely understood language with which to discuss risk." It is my belief that a language helps remove the mystique of any subject and allows the concepts to enter everyday conversation for those involved. Having the words to describe root causes and their concepts will mean that discussions can occur about the causes of incidents in the outdoor education sector. This may raise awareness of those root causes and that awareness might itself help to prevent incidents. While the recent work of authors such as Priest (1990), Priest & Baillie (1987), Priest & Gass (1997) and Haddock (2003) have established and built on a basic vocabulary, I believe the work here goes substantially further than the previous efforts, incorporating elements from recent work in the fields of safety management and psychology.

Through the work presented in this study people throughout the sector will, for the first time, be able to discuss the difference between prevailing conditions that are the immediate causes of incidents, and the underlying root causes that lead to the existence of those conditions. They will be able to discuss the difference between types of root cause and the tokens of those types. Furthermore the root causes and tokens will have names that people can start to use and discuss during their work.

The proposed taxonomy of error shown in Figure 60 shows the language of the root causes of error for outdoor education incidents. The 'types' of root causes are categorised according to how they lead to incidents occurring, and the 'tokens' of the various 'types' are shown to demonstrate the relationships between the 'types' and 'tokens'. This taxonomy, when combined with the model of outdoor education incident causation, clearly delineates a structure of root causes of outdoor education incidents and explain the link between these root causes and higher order 'conditions' leading to such incidents.

A clear demonstration of the value of this new language and system of categorisation of error can be shown in relation to an example from existing outdoor education literature. Haddock (2003) stated that there are a number of social and psychological factors which are at play whenever an outdoor education activity is undertaken and which can contribute to the risk of that activity. Haddock then listed a number of these factors, such as familiarisation, risk (sic) shift, get-home-itis, dropping your guard and attribution theory, with an explanation of each. However the explanation does not include the relationship between the factors mentioned and how they impact on the causal sequence in any incident.

Using Figures 60 and 61 it now becomes clear how these various factors influence the causal sequence of an incident. Haddock's 'familiarisation' can be seen to be three separate effects in the causal sequence due to the ongoing exposure of an instructor to an activity, group of students or activity setting: frequency desensitivity is a token of the root cause 'poor situational awareness'; negative event feedback is a token of the root cause 'inaccurate assessment of the risk'; and, no-accident errors are a token of the root causes 'poor processing of past experiences'. 'Risky shift' and 'Get-home-itis' are both seen to be tokens of the root cause 'choosing to take a higher level of risk than needed'. 'Dropping your guard' is seen to be a token of the root cause 'poor situational awareness' that I have named 'end of session / going home'.

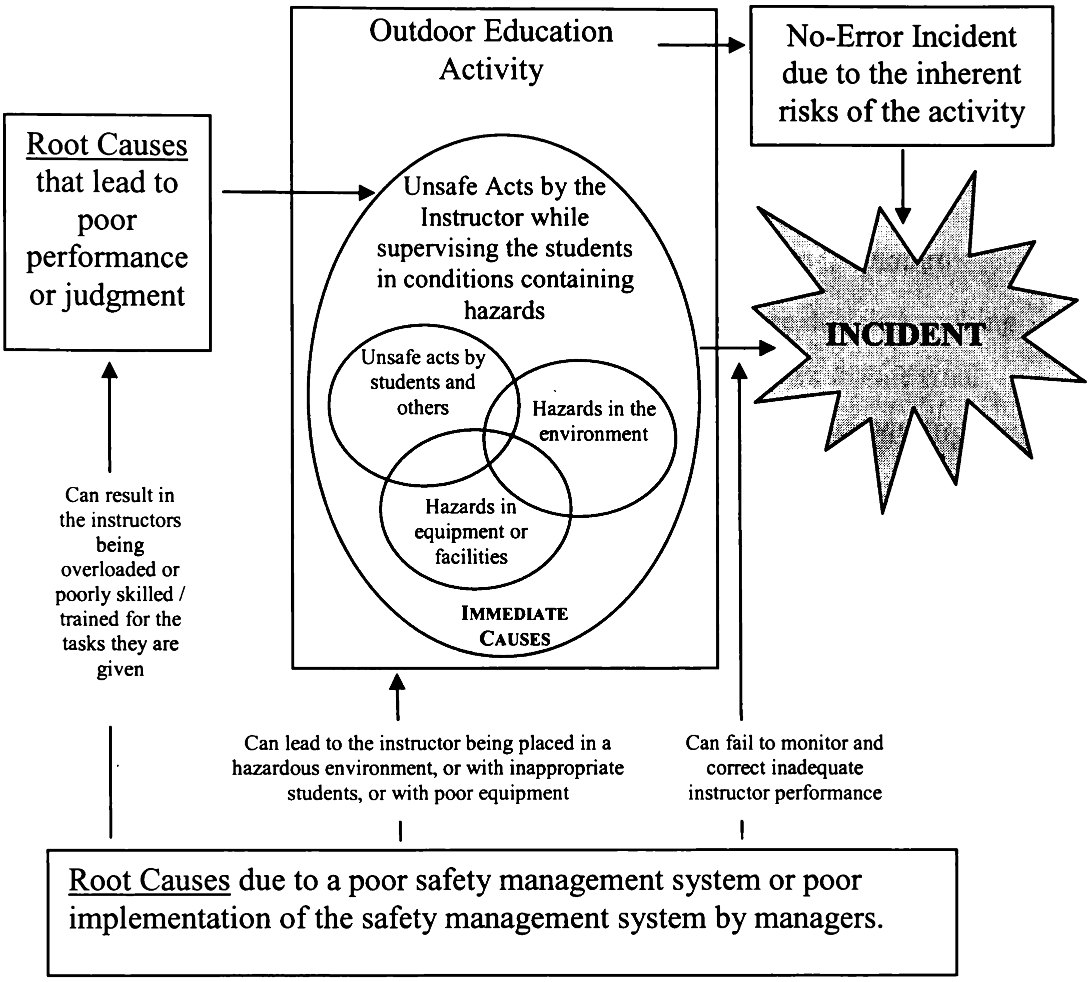
The proposed taxonomy shifts the focus from the individual factors that Haddock mentioned, and which are seen to all be tokens of root causes, to the actual types of root cause. By doing this the emphasis can be placed on actions to prevent the root causes from progressing towards an incident. In the examples mentioned in the last paragraph, this would see any instructor ensuring that he / she maintains good levels of situational awareness, an accurate assessment of any risks, and not taking unnecessary risks with the group in his / her care. Understanding the way in which these various factors interact to produce an incident sequence therefore gives clarity to the emphasis required when managing activities.

7.5.3 Implications for Hale's Model of an Outdoor Accident

Hale's model (Figure 5) and Meyer's extension of it (Figure 6) have their place as very simple depictions of how the potential for an accident is created but are limited in their use. They do not show the relationship between the conditions leading to an incident (immediate causes) and the root causes of the incident. Nor do they explain the function of an organisation and its safety system, compared to the role of the instructor in decision-making and performance of the instructor while looking after the group. Furthermore the concept of a no-error incident by virtue of the inherent risk of outdoor activities is not contained within the model.

Figure 61 has replaced these other two models. All of the deficiencies explained in relation to both Hale's model and Meyer's model have been addressed in the new model. However, the feedback from some Delphi panel members expressed that Figure 61 was too complex for an introduction to practitioners as a tool. For that reason I have developed a simplified version of the model which is shown as Figure 62. This retains the core principles of Figure 61 but leaves the detail to be expanded at a time that is deemed appropriate by anyone introducing the model to others.

Figure 62. A simplified model of incident causation for outdoor education



This model is a significant advance on the previous models by Hale (1984) and Meyer (1979), as it directs the reader beyond the immediate causes to focus attention on the underlying root causes of the incident. Identifying and correcting these root causes will lead to long-term solutions to problems.

7.5.4 Implications for the Meyer and Williamson Matrix

Prior to this study the Meyer / Williamson matrix was the most regularly cited summary of the potential causes of accidents. This summary contained a mixture of unsafe conditions, unsafe acts and errors in judgment. Although containing some of the root causes named in this study, this structure did not solely identify root causes. The taxonomy of error shown in Figure 60 replaces this matrix and offers a significant advance over the previous work. The root causes are identified as falling into two main categories: Management systems errors; and, those factors leading to poor performance or judgment. Within the two major categories there is a structured list of root causes, ordered by subcategory. It is now possible to work through this list with management staff and instructors, or trainee instructors, in a logical manner. The list will both raise awareness of the underlying causes of incidents, and also act as a tool to focus the monitoring and training of staff.

Feedback from experts in the outdoor education field has attested to the comprehensive and useful nature of this new taxonomy.

7.5.5 Implications for Boyes' Outdoor Adventure Decision-Making Model

7.5.5.1. Weaknesses in the Outdoor Adventure Decision-Making Model

As explained earlier, Boyes' (2000) model of how outdoor leaders make decisions when working in an adventure education setting with students is the most recent published model. His outdoor adventure decision-making (OADM) model is based on the theories of naturalistic decision-making which are applicable to complex time-dependent situations such as adventure education experiences.

Boyes OADM model is shown in Figure 23 (Chapter 4). The results of this study both support Boyes' model and also point to some limitations. The OADM model suggests that any leader is continually carrying out the processes of situational awareness and situational (risk) assessment. The situational awareness is in relation to the environment and people while the assessment is in relation to ensuring that the level of challenge presented to the group is appropriate to the educational goals of the programme.

The taxonomy of error presented in Figure 60 can be applied to this OADM model to show how error can enter the decision-making process as it is depicted. In this way the root causes leading to poor performance or judgment numbered 1 – 13 in Figure 60 can be applied to the OADM model. These are all factors that relate to the decision-making environment and implementation of any decision.

However the root causes numbered 14 – 17 cannot be fitted into the OADM model as currently depicted. The root causes that do not fit are 'failing to meet judgment responsibilities' and 'misdirected motivation'. These two categories of root causes have been found in this study to be the most frequently occurring root causes in the 18 case studies. As the Delphi panel has endorsed the taxonomy of error in Figure 60, the fact that they can't be readily placed into the OADM model points to the existence of some significant limitations.

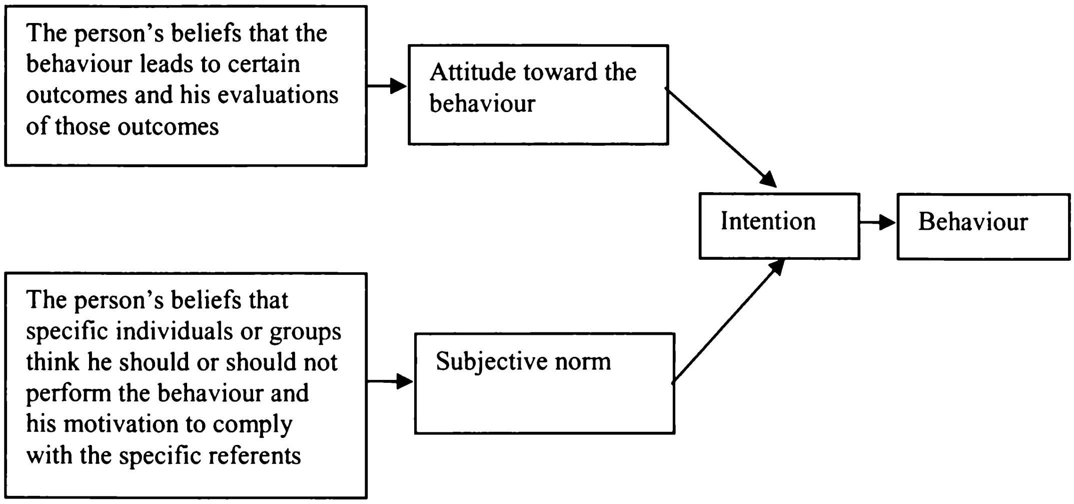
The challenge is to produce another model of outdoor adventure decision-making that retains the basic features of Boyes' OADM model, but allows for the final decision reached (and the behaviours based on that decision) to result in a higher level of risk being taken than is explained by the instructor simply making efforts to optimise the challenge in an activity in order to achieve the educational goals of the programme. I believe the clue to a suitable decision-making model is revealed by contemporary theories on how attitudes guide behaviour. Two such theories can be used to develop a model of outdoor adventure decision-making that is able to explain how root causes 14 – 17 in Figure 60 lead to poor risk-taking strategies being adopted; which is the current weakness in Boyes' model.

7.5.5.2. The Theory of Reasoned Action

Ajzen and Fishbein's (1980) theory of reasoned action is shown in schematic form in Figure 63. According to this theory an individual's eventual behaviour is governed by their behavioural intention. Their intention is arrived at by considering, weighing up and combining two separate factors:

1. His or her attitude toward the behaviour in question; and
2. Subjective norms about the behaviour. These norms involve both the person's beliefs about what important others think that he or she should do and the person's motivation to comply with those wishes (Fazio & Roskos-Ewoldson, 1994).

Figure 63. A schematic diagram of Ajzen and Fishbein's theory of reasoned action. (From Ajzen & Fishbein, 1980, p.8)



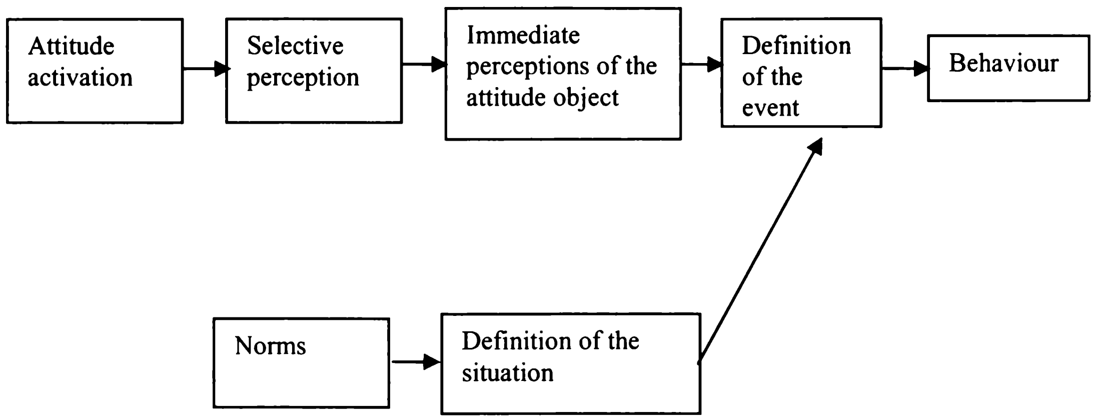
An example of this model in the outdoor education decision-making context will help to explain why it is useful. Consider two instructors deciding whether to undertake an activity that has a higher level of risk than would be dictated by simply trying to optimise the challenge to meet programme goals. According to the theory an instructor faced with making this decision would consider the outcomes that are likely to occur if this higher risk option was taken. Instructor A may believe the higher risk option will result in students that are challenged, who feel really excited by their day's activities and who return with a high degree of personal development. Instructor B however may believe the outcomes could be injury or discomfort from the higher risk option, leading to censure from management and peers. From this information each instructor would adopt a different attitude towards taking the higher risk option: Instructor A would have a positive attitude and Instructor B would have a negative attitude to the more risky option. According to the theory, the instructors would also consider how people who are important to them (management, peers, students, etc.) would feel about them undertaking the higher risk activity and their motivation to comply with those people's wishes. For example, Instructor A is with a group of students who he / she believes are very keen on attempting the high risk option. It is easy to see that this belief (subjective norm) will reinforce Instructor A's attitudes to adopt the higher risk options. In contrast, Instructor B may hold the belief (subjective norm) that it is wiser to follow company policy which prescribes only using the minimum level of risk to achieve educational outcomes and, as a result would reject the higher risk option.

This hypothetical case study shows how the theory of reasoned action can explain how an individual can reach a decision that is based on personal beliefs, social pressures, personal goals / values and their individual motivations. These factors were not present in the OADM model and so an incorporation of this theory into the model would eliminate this oversight. However the theory of reasoned action assumes that people deliberate about the wisdom of a given course of action. The assumption is that they have the time and ability to consciously consider and deliberate about their attitudes and their implications before adopting a specific course of action. As has been discussed earlier in this thesis, and certainly when concerning theories of naturalistic decision-making, there are often times in outdoor education settings when there is limited time and / or ability to carry out reasoned thought. What does the theory suggest happens in these cases?

7.5.5.3 The Attitude-to-Behaviour Process Model

The 'Attitude-to-Behaviour Process Model' developed by Fazio and his colleagues (Fazio, 1986; Fazio, Powell & Williams, 1983) suggests that attitudes can guide a person's behaviour even when they don't actively reflect on and deliberate about the attitude. Fazio's model is shown in Figure 64.

Figure 64. A schematic diagram of Fazio's Attitude-to-Behaviour process model (From Fazio, 1986, p.230)



According to this model an individual's behaviour is triggered by the individual's definition (interpretation) of the event that is occurring. This definition or interpretation of the event consists of two components: the individual's immediate perceptions of the attitude object in that situation and the definition of the situation. The 'definition of the situation' refers to the stored knowledge that the individual has about behaviours that are expected and appropriate in this situation. Furthermore, the model maintains that upon viewing a certain situation, this will activate an attitude from memory which will itself affect the perception of the situation being viewed. This selective perception will impact on the definition of the event and affect the eventual behaviour exhibited. The initial attitude-to-behaviour process is activated from memory as a result of situational cues. If the attitudes are highly accessible from memory due to strong associations then the whole process, from first viewing a situation through to carrying out a behaviour, is automatic and effortless. No conscious thought is required (Fazio & Roskos-Ewoldsen, 1994).

An example in an outdoor education context will help explain the process. Consider Instructor A from the previous example. Assume that he / she has been working for some time with the personal beliefs and attitudes discussed in the previous example (i.e., he / she believes in presenting groups with a high level of challenge / adventure and wants to meet any group's desires / wishes /

expectations to carry out adventurous activities whenever possible). Also assume that the instructor has had no feedback, either from respected peers, or from misadventures / incidents, that would cause them to re-evaluate their past decisions at a time when they had the opportunity to reflect. Strong attitudes and behavioural norms will have been built up over time by Instructor A. Now assume Instructor A is on a river, above a rapid, with a group of students. Part way down the rapid there is a tree across part of the rapid but a clear passage exists to one side. Instructor A has to make a decision on a course of action. The students all say they want to run the rapid. The model suggests that in this case an automatic behaviour will be triggered. The situation will be recognised as one where there is the opportunity to challenge the students and test their skills. This will activate the attitude in Instructor A that adventurous activities are a good thing. Selective perception will cause the instructor to underplay issues such as: the water flow mostly going into the tree, one student in the group who has not been showing good skills, and the navigable passage not being very wide. Furthermore, the instructor has built up behavioural norms in similar situations where running a rapid like this has been successful. Thus for Instructor A the process from being presented with the situation, through to making a decision to run the rapid, is almost immediate and without serious weighing of any alternatives.

These two models present two different processes by which attitudes can guide people to making decisions on which final behaviour to adopt. One focuses on a deliberate, planned, reasoned action in which attitudes exert an impact because of reflection upon the attitude and those of others. The other is a more impulsive reaction, almost a habit, based on one's attitude's influence upon one's perceptions of situations. Just as in the Elaboration Likelihood Model to Persuasion in Section 4.4.3 this suggests there are two possible routes to behaviour. Fazio & Roskos-Ewoldsen (1994) believe that choice between the two routes depends upon both the levels of involvement of the person and the opportunity they have to spend time and energy on the problem. The reasoned approach requires a lot of cognitive effort and therefore both involvement and opportunity must be high. Involvement will be high if the consequences of the behavioural decision are thought to be important and personally relevant. When there is low perceived consequence of unfavourable outcome, behaviour is likely to flow spontaneously from the interpretation of the situation. Situations that require an immediate decision can also deny the chance to engage in reasoning.

7.5.5.4. A Proposed Decision-making Model for Outdoor Education – The Likelihood-To-Think Model (LTT).

A model of outdoor education decision-making is proposed in Figures 65-67 that integrates theories of 'reasoned thinking' and the 'attitude-to-behaviour process' into a naturalistic decision-making framework.

The proposed 'Likelihood-To-Think' model (LTT) is significantly different than the OADM model proposed by Boyes (2000). Based on cognitive theory, I suggest through the LTT model that there are two possible paths by which an instructor can reach a decision as to the appropriate action to take when in charge of a group of students in a hazardous situation. First, the instructor must realise that an action is required. He / she becomes aware of this through an on-going monitoring of the situation (situational awareness). Boyes contends that this involves monitoring the environment, people and goals of the programme. My belief is that the instructor monitors the potential hazards in the environment, people and resources (immediate causes) and makes an assessment that an intervention is required if any combination of hazards registers against their personal assessment that the risk is too high. Then, depending on the instructor's level of involvement in the situation, the opportunity they have for processing and their ability to process, they will either use a 'spontaneous' path or a 'thoughtful' path to reach a decision on the best course of action.

Figure 65. Proposed model of outdoor education decision-making in a hazardous situation – The Likelihood- To-Think Model (LTT)

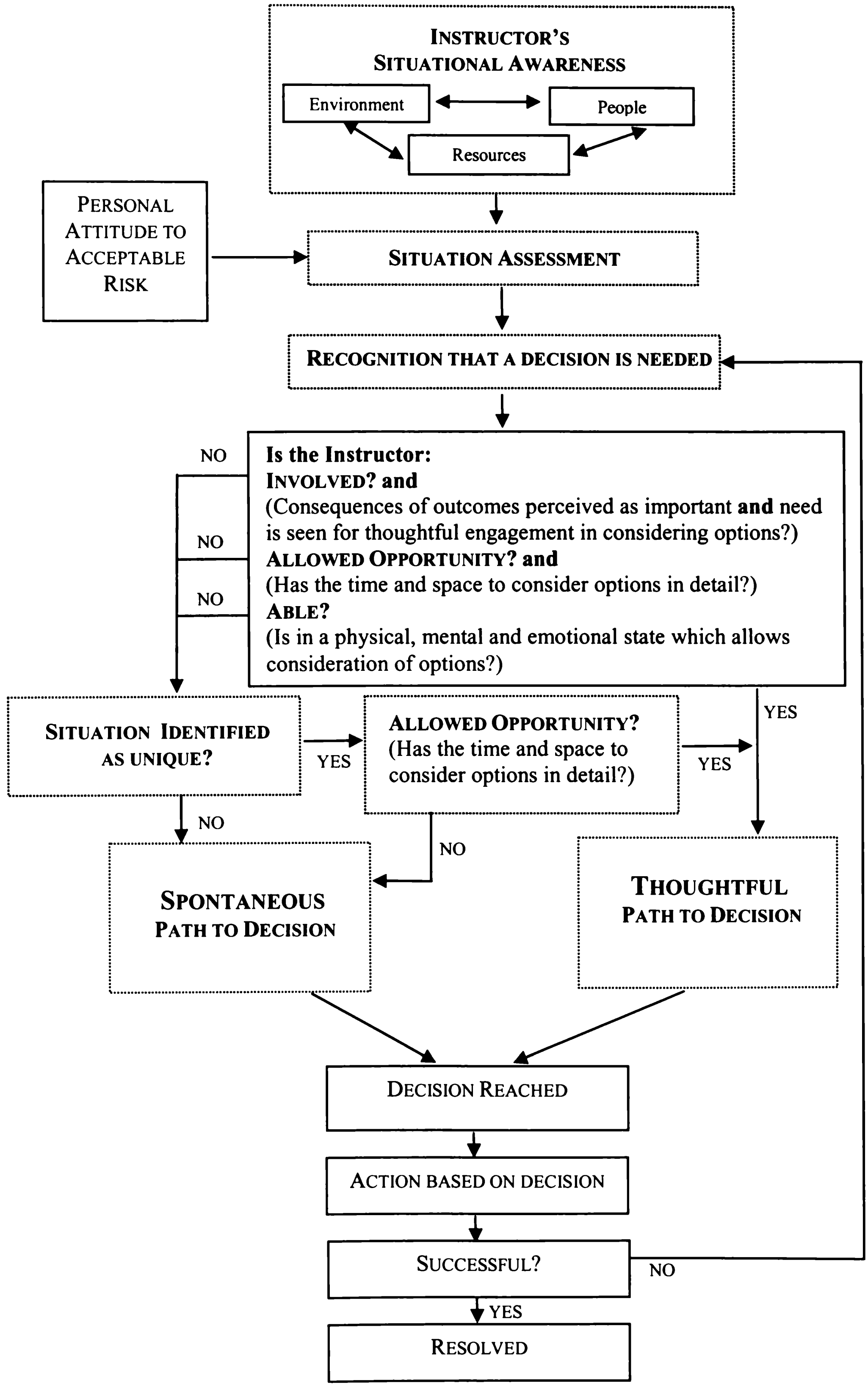


Figure 66. Proposed model of the spontaneous path to decision-making

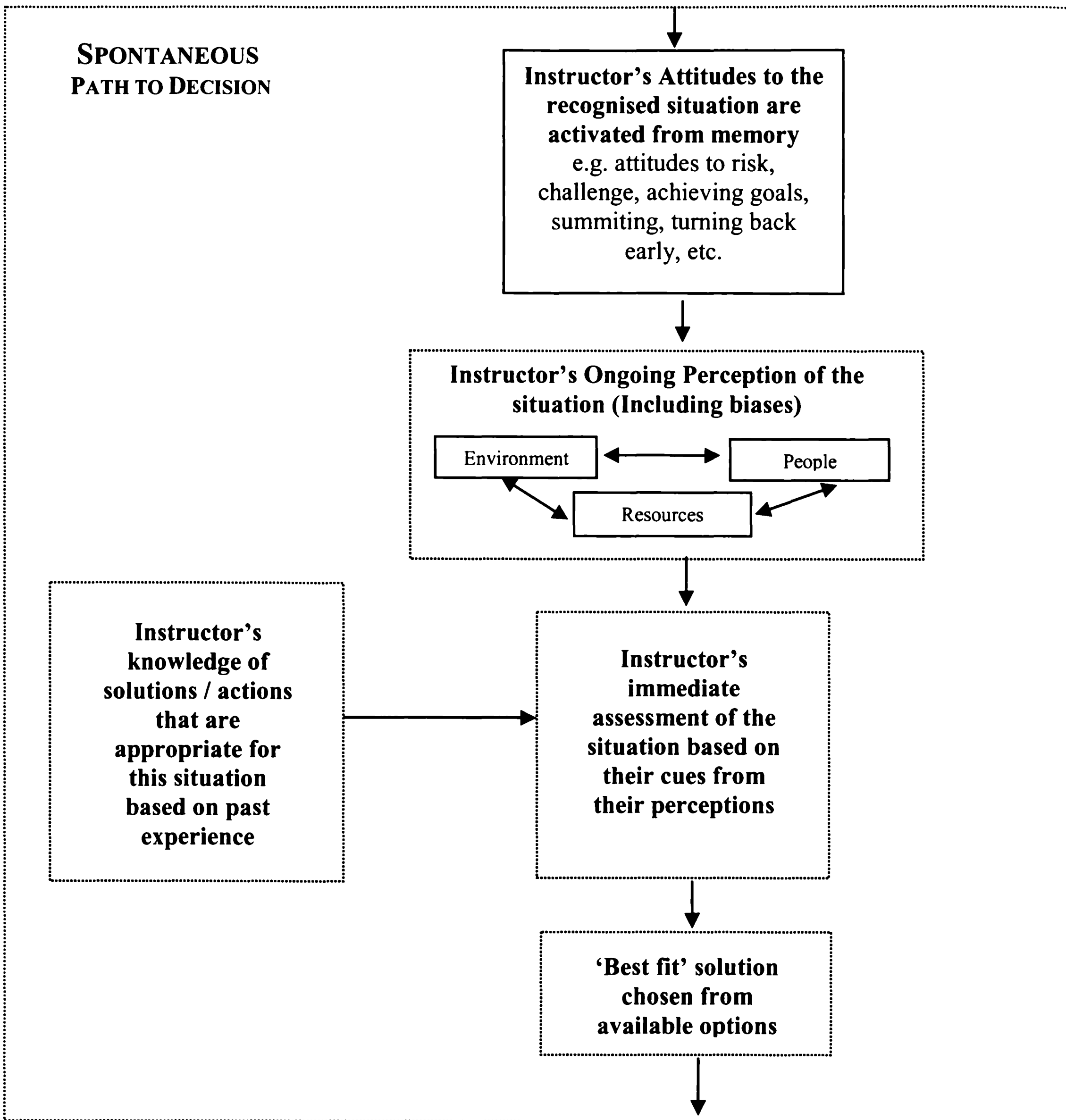
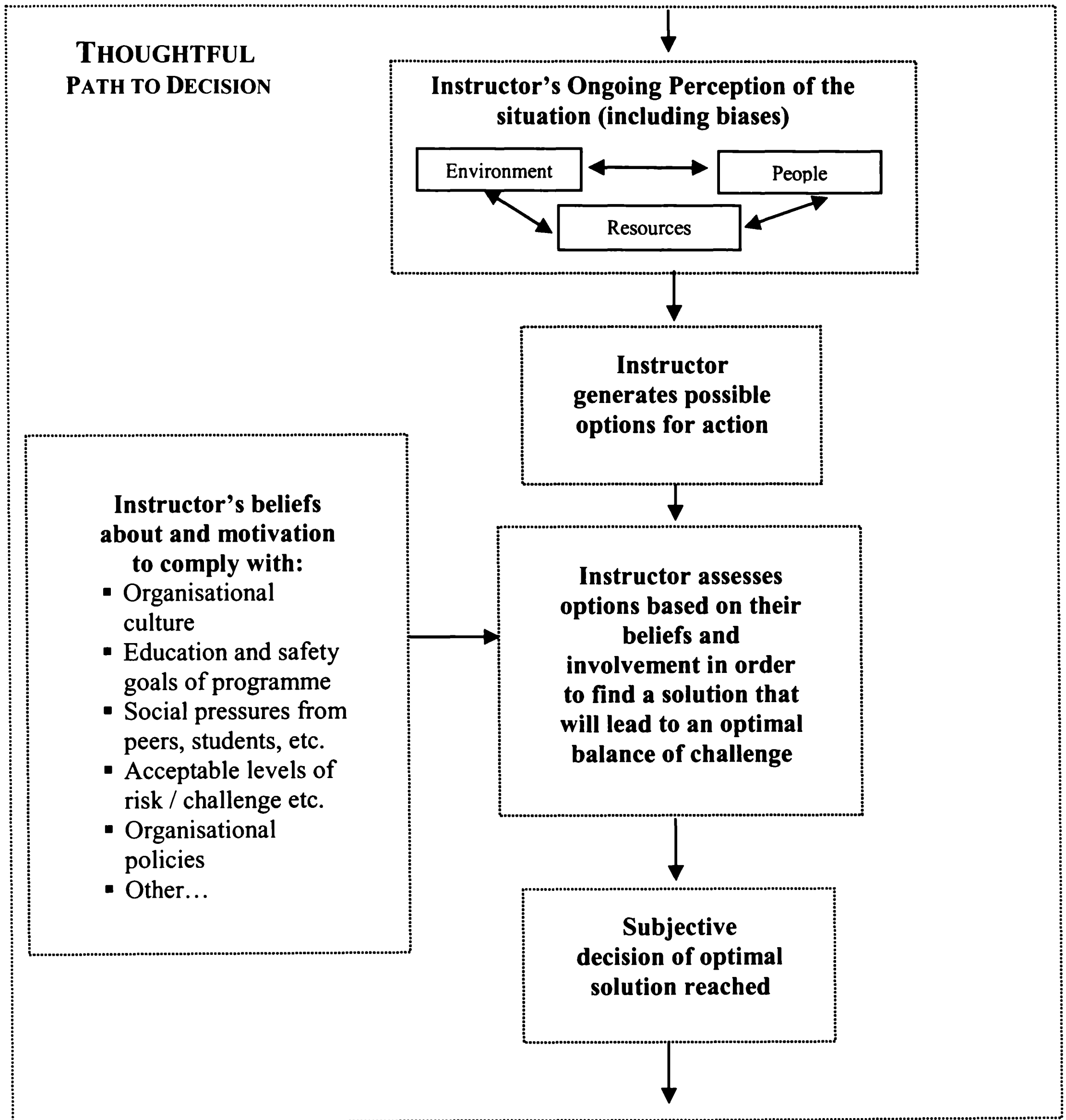


Figure 67. Proposed model of the thoughtful path to decision-making



The 'thoughtful path' will be used if the instructor recognises the importance of the situation in terms of the potential consequences of a poor decision being implemented while at the same time believing there is a need to consider various possible solutions in detail, has the time to stop and consider options, and has the ability (physical, mental, emotional states) to consider the options. Based on his / her perception of the situation, his / her experience and other resources at hand, the instructor will generate a number of possible options for action. The instructor will assess these to determine an optimal solution. However that optimal solution is gauged not only against the instructor's perception of the programme goals set by the organisation, but also against the instructor's beliefs about those goals, the instructor's personal goals, and their motivation to comply with either of these and many other factors. In this way, even though an instructor may be completely cognisant of the organisational safety goals and acceptable level of risk, a higher level of risk may be implemented that is compatible with the instructor's personal beliefs, or the social pressures on him / her.

A further reason that the 'thoughtful path' will be taken is if the situation is so dynamic as to be unpredictable or significantly different to past experiences. In both of these cases Shanteau (1992) believes that a decision based on a recognised solution is not possible. However, even if the situation is recognised as being unique, time pressures may force a spontaneous 'best-fit' path to be taken.

The 'spontaneous path' will be used when involvement, opportunity or ability to adopt the 'thoughtful path' are not present. This path sees the immediate trigger of attitudes held by that instructor to the situation. This will limit their ability to objectively assess the situation and a rule-based solution based on past experience will be chosen and implemented. This is an automatic process and careful consideration of programme goals, etc., will not occur.

This dual pathway model is similar in many ways to the Elaboration Likelihood Model of Persuasion discussed in Section 4.4.3. Theories of dual pathways to attitude change or behaviour are common in cognitive psychology (e.g., Norman & Shallice, 1986; Posner & Snyder, 1975; Shiffrin & Schneider, 1977;) where there is believed to be a difference between 'controlled' and 'automatic' processing.

The LTT model is able to incorporate all of the types of instructor error contained in the taxonomy of error shown in Figure 60. The root causes 14 (Choosing to take a higher level of risk than needed), 15 (Deferring judgment to others), 16 (No judgment made), 17 (Breaks organisational policies) and 18 (Sabotage) can all be accommodated by this model.

I believe the reason that Boyes did not specifically identify the role of personal attitudes / values in his decision-making model was due to a limitation in his research method. Boyes' method can be considered to consist of two phases. The first phase involved the interview of ten highly experienced outdoor experts. The experts were interviewed in a semi-structured manner about past experiences where, "things had gone wrong or had the potential to do so" (Boyes, 2000, p.75). These experiences were explored for what had happened in the task environment in terms of cues that were present that the leader used to make an assessment of the situation and base a decision upon. The second phase of the research involved constructing seven scenarios, based on the incidents discussed by the leaders in phase one, and having other outdoor leaders work through those scenarios using a computer model to make decisions on how they would proceed in the given situations.

The fact that the interviews in phase one were structured around the task environment in determining how the leader established a balance between risk and competence, meant that cues that triggered the introduction of personal attitudes into the decision-making process were probably overlooked. The scenarios for phase two of the research were built on the cues discovered in phase one and, as already mentioned, were unlikely to include issues related to the personal needs, values, goals of, and social pressures on, the leader. In his thesis Boyes mentions that NDM theory, "involves an interaction of the leader's experiences, values and goals with dynamic information from the natural environment and the social group" (Boyes, 2000, p.309). This is consistent with the proposed LTT model in Figure 65.

The LTT model has implications for Boyes' recommendations on the training of outdoor leaders based on his OADM model. He suggested that direct outdoor experience of leadership situations can be supplemented with theoretical and classroom based learning and that case studies can be used to, "expose novices to relatively unfamiliar situations and experiences as well as exploring classical decision situations" (Boyes, 2000, p.311). While I agree with this form of training and have suggested it myself in this study, care must be taken to ensure that case studies include cues that will raise issues of how the leader's beliefs, involvement, abilities and opportunity impact on the final decision that is implemented with the group in that leader's care.

7.5.5.5. Cognitive Dissonance and Implications for the LTT Model

I have chosen to label the proposed model of outdoor education decision-making the "likelihood-to-think" model for much the same reason that Petty & Cacioppo (1981) described their model the "Elaboration Likelihood Model". While Petty and Cacioppo were interested in the likelihood that people would elaborate upon certain messages and be persuaded by those messages, the LTT model is concerned with whether instructors in hazardous situations are likely to think deeply about the options available and the impact of personal attitudes on any final decision.

Neuman (1984) contended that experts are more likely to adopt the automatic process (spontaneous path) because they have a well-developed set of available skills linked to a wide range of recognisable experiences. Styles (1997) made the comparison with a skilled and experienced chess player. As the game progresses, the experienced person recognises cues which activate pre-existing schemata in long-term memory. Actions are chosen automatically and implemented. Novices do not have these pre-existing schemata to aid them. This applies equally to the outdoor education world where experienced instructors will rely less and less on the 'thinking path' as their experience builds and an increasing number of schemata (patterned behaviours in response to cues) are stored in long-term memory. Beare (2001) researched the way that outdoor experts made decisions in hazardous situations and concluded that those experts preferred to use intuitive or recognition-primed strategies over rational decision-making strategies. Furthermore Beare's research showed that experts would try the first available solution to see if this worked and would only search for another possible solution if the first was unsuccessful – a serial approach to decision-making. These findings are consistent with the proposed LTT model.

The use by outdoor experts of recognition-primed strategies (spontaneous path) is appropriate and efficient as long as the schemata are appropriate, and as long as the right cues are being perceived from which to recall stored solutions. Beare

(2001) noted that outdoor experts are using these recognition-primed decision-making strategies regularly, often many times within an hour, and this approach only rarely results in any incident. However, as discussed in this chapter, if either the schemata are inappropriate or there is an error in perceiving situational cues, then incidents are more likely to result. My belief is that we should be encouraging instructors to adopt the 'thinking path' to decision-making whenever possible (even if this is retrospectively through a review process at the end of the day to reconsider key decisions made during activities for alternative and possibly better solutions to problems that arose) and ensuring they have clear understandings of organisational attitudes to acceptable risk-taking to help reach a defendable course of action. While there are many times when the 'spontaneous path' is effective and efficient, and this is especially true in emergency situations, there is an argument that some may overuse this path in the outdoors. My experience is that when instructing it may appear necessary to make fast decisions, but it is rare that time is not available to consider options and the consequences of those options. As has been discussed earlier, root causes that lead to the poor processing of past experiences can lead to unsafe practices being applied automatically in inappropriate contexts. Encouraging regular use of the 'thinking path' will help facilitate the storage of solutions incorporating organisational-approved risk taking levels as schemata to be used in crisis situations.

The LTT model suggests that there are times when instructors will adopt behaviours / actions that follow personal attitudes / beliefs that produce higher risks than the organisation would condone. Is there some way that this mismatch can be rectified / prevented?

Festinger (1957) proposed a theory which has general acceptance in the field of cognitive psychology to explain what would happen in a situation like this (Cooper & Scher, 1994). Festinger's theory, called the theory of cognitive dissonance, states that whenever a person holds thoughts that are inconsistent or in conflict, that the person will feel tension. The tension will be experienced as a drive or need to reduce the inconsistency between the two opposing thoughts. Festinger claimed that the amount of dissonance (and therefore the intensity of the drive to reduce that dissonance) will be related to the number of discrepant conditions one has, divided by the number of consonant conditions one has (each weighted by their perceived importance). Thus producing the equation:

$$D = \frac{w_1(\#\text{ dissonant cognitions})}{w_2(\#\text{ consonant cognitions})}$$

In this equation D stands for the amount of dissonance and therefore the amount of drive to reduce it, while w_1 and w_2 represent the weightings of importance for the two cognitions. To reduce the dissonance in any case there are various options. The most obvious is either to add consonant thoughts or reduce dissonant ones. Festinger argued that people change the one that is least resistant to change.

McCool and Braithwaite (1992) argued that cognitive dissonance will lead individuals to change behaviour and avoid future situations that may produce dissonance. This would be a preferred outcome if the individuals in question avoided taking higher risks in the future. However the equation above shows that by entrenching existing attitudes the dissonance can also be reduced.

Consider again the hypothetical case study of Instructor A who chose to take a higher risk option than would be sanctioned by company policy. This conflict between his action and the moral duty to follow the practices of the employer would produce cognitive dissonance. The way Instructor A can reduce the dissonance is by thinking about all of the positive outcomes of his decision (increasing the consonant cognitions) and perhaps discussing with other instructors the inappropriateness of the organisational risk-taking philosophies (decreasing the dissonant cognitions). If his activity is undertaken without incident, this will further reinforce consonant cognitions, dissonance will be reduced and the attitude will form a regular pattern of behaviour for that instructor. Even in the wake of negative outcomes it has been shown that people will try to reduce dissonance by claiming responsibility for their successes and stating their failures were due to something else. It is believed by some that the more thinking that people do about issues, without being exposed to new influences, leads to strengthening of personal attitudes and is referred to as thought polarisation (Petty & Krosnick, 1995). Some researchers believe that the entrenching of attitudes in dissonance-causing situations is related to the desire to protect self-image or self-esteem (Schlenker, 1982; Steele, 1988).

A good example of the process of cognitive dissonance at work is in the feedback for Incident 576. In this case a student fell approximately seven metres over a cliff and broke his femur. There was no direct supervision at the time as the instructor had removed himself from the group to allow the students to navigate and make decisions on their own. The fact that the incident occurred would have raised dissonance in the instructor's mind: 'my actions were justified in allowing opportunity for the group to develop by making decision on their own,' vs., 'if I had been with the group the incident wouldn't have occurred.' In his narrative of the incident, the instructor reduced the level of dissonance by explaining the benefits of unaccompanied trips for students (increased consonant cognitions), explained that he and the centre staff had reviewed the terrain and their practices following the incident and found this activity to be acceptable, and explained the incident as being due to the student not following instructions. The instructor had therefore justified to himself that this incident was not due to his decision to leave the group unsupervised (decreased dissonant cognitions). When the Delphi panel raised queries about the inappropriateness of that organisation's risk-taking philosophies this again increased the dissonance in the instructor. The response was an attempt to reduce the dissonance through the statement that:

> "I believe that true adventure is being lost from outdoor education. This organisation has successfully maintained a high adventure level with a very good safety record and I'm happy with it."

How can cognitive dissonance theory be used to decrease incident rates? Senior management will be trying to manage risk to minimise the number of times that staff are operating at levels of risk that are higher than is believed to be acceptable. In order to achieve this goal, each individual instructor's personal beliefs and values must be aligned to the same risk-taking level as that held by the organisation. Cognitive dissonance theory states that if dissonance levels are high then instructors will want to reduce the level. Dissonance will be high, thereby signaling the need for change, if the person feels personally responsible and appreciates the moral wrongfulness of any potential negative outcomes (Cooper & Scher, 1994). Attitudes will change as a way to reduce dissonance if that is the easiest thing for the instructor to change to reduce the dissonance. If such a change is seen as a threat to self-image or self-esteem then other avenues will be taken to reduce the dissonance.

The outcome of this discussion of the LTT model and cognitive dissonance is that the safety conscious organisation must therefore ensure its safety goals and philosophies are well communicated to staff in order to maximise any potential dissonance if individual instructional staff hold different attitudes to risk. The management of the organisation must find ways to help that individual to examine and change their attitudes, and therefore behaviours, in a way that preserves their self-esteem, if safety is to be maintained. The expressed attitudes and norms followed by respected peers will aid this process where individuals must reassess their personal attitudes. Another approach to encouraging this change in individual attitudes is suggested by Norman and Shallice's (1986) list of task attributes where deliberate attentional resources are needed:

1) Require planning or decision-making.
2) Involve components of trouble shooting.
3) Are ill-learned or contain novel sequences.
4) Are judged to be dangerous or technically difficult.
5) Require overcoming a strong habitual response.

The task of re-learning a satisfactory response to situational cues in a hazardous situation meets all of these criteria. Therefore the instructor with an inappropriate match of risk-taking attitude should be encouraged to document his / her decision and the process taken to arrive at it. In this way he / she will be encouraged to adopt the 'thinking path' and will start storing new solutions in long-term memory that involve organisationally-acceptable levels of risk.

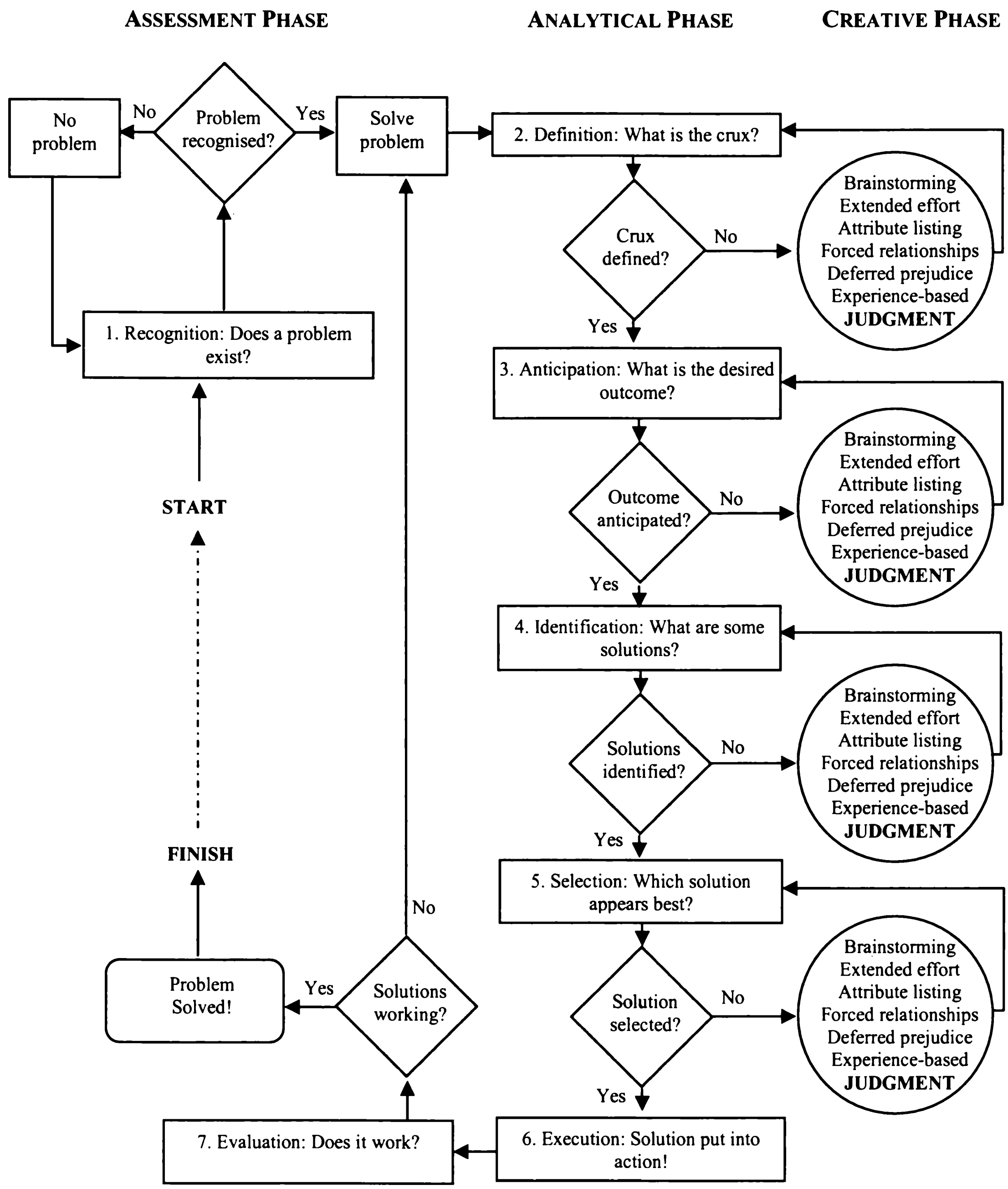
7.5.6 Implications for Priest's Multiphase Problem Solving Model

Priest (1988) proposed a model of how he believed outdoor leaders made decisions (solved problems) that has recently been republished in a text that purports on its back cover to be, "...the first book to provide in-depth information on the key elements of effective outdoor leadership" (Priest & Gass, 1997). Priest's model (Figure 68) has not been mentioned until this stage of the thesis because close analysis of the model shows that, at its core, it is only a slightly embellished version of the traditional model of decision-making (Figure 19). The traditional model has already been shown to have limitations in incorporating knowledge about how decisions are made in real-life, complex, time-dependent situations and been superseded by NDM models.

The reason I have chosen to introduce the model now is that Priest proposed that outdoor leaders use two versions of the multiphase problem solving model: a short form and a long form. At first reading this sounds similar to the two paths proposed in the LTT model derived in this thesis and therefore needs consideration.

Priest and Gass's (1997) explanation of the appropriate use of the two forms relies on the complexity of the problem. They state that the short form of the model is used when the problem is 'simple', where 'simple' is defined as when everything appears known about the problem and therefore there are no 'No' answers coming from the decision boxes in the analytical phase of the model. For the short form of the model only the assessment and analytical phases are used, therefore requiring no creativity and no experience-based judgment; although Priest & Gass (1997, p.267) state that, "Although judgment does not play a formal role in the process, naturally you cannot afford to abandon judgment at any time while solving a problem". They also concede that the short form should also be used if, "...time to consider is limited, the decision is not life-threatening, group resources are predictable, or success is predictable" (p.268). The complex form is used when answers to questions in the analytical phase are negative or don't come easily. They state that judgment plays a large role in this longer form of the model.

Figure 68. Priest's Multiphase Problem Solving Model
(From Priest & Gass, 1997, p.265)



These descriptions of the usefulness of, and the processes involved in, the two forms of decision-making are counter to the empirical evidence gathered by NDM researchers of how real life decisions are made by experts as described earlier in this thesis. Experts tend to use a shorter form of decision-making by preference, based on their long experience of successfully solving similar situations. They tend to choose and employ a solution with little conscious thought, based on the recognition of situational cues that they pick out from the problem environment. The more expert the leader, the greater the number of stored solutions and therefore the less likely that expert is to use a longer form of decision-making. This ability to successfully recall and implement an immediate solution is what practitioners would refer to as experience-based judgment. Thus experts will regularly make 'snap' decisions and put them into action, even when the outcomes are life-threatening, resources are limited and there is time to consider other solutions. Contrary to Priest and Gass's assertions, a longer form of decision-making tends to be used by novices who do not have the benefit of experience and need to carefully weigh the consequences of different possible options before making a decision in the absence of experience-based judgment.

A further problem with Priest's model is that it shares the same limitation as the Boyes model discussed earlier, in that it is not easy to incorporate the root causes numbered 14 – 17 (Figure 60) into the model as currently depicted. The model would need to be altered to allow for the impact of the beliefs, values, attitudes and motivations of the instructor on the various stages of the decision-making process. There is no indication that Priest's model has been built on empirically derived research, but rather has been developed as a theoretical construct, and the limitations of this approach are seen when empirical data fail to be accommodated by this construct.

The identified limitations and weaknesses of Priest's 'Multiphase' model appear to be resolved in the LTT Model that has been proposed.

7.6 Summary

This chapter saw the combination of the empirical results of Chapter 6 with the theoretical results of a literature review in the fields of outdoor education, safety management and psychology from Chapter 4. The outcomes of this were a taxonomy of the root causes of error for the outdoor education sector (Figure 60) and a model of outdoor education incident causation (Figures 61 and 62).

The taxonomy offers a language and system of categorisation of outdoor education error while the model offers a structure for the causal sequence of any incident. Between them, the taxonomy and model provide the outdoor education sector with a means to discuss and debate the root causes of incidents. Even the action of talking about the various root causes is likely to have an awareness-raising function and help prevent some incidents from eventuating.

The taxonomy of error gives the management of any outdoor education organisation a structure by which they can self-audit their safety management system and work towards improvements. It also offers an aid to in-house and off-job training of outdoor leaders where targeted training methods can be employed to correct examples of specific root causes identified following any incident.

Both the taxonomy and the model of incident causation, which contains the taxonomy, are considered to be 'works in progress'. As more information comes to light from the sector, either of these tools can be added to or changed in order to incorporate the new knowledge. Unfortunately, as the taxonomy of error is updated with new information, despite indications to the contrary, it appears there is no easy tool available to look back over previously recorded incidents in any database of incident narratives for occurrences of these new root causes for statistical analysis.

The development of both the taxonomy and the model of incident causation have advanced knowledge in the outdoor education sector in a number of significant ways:

- A structure and language have been developed around the types and tokens of root causes. This language will allow those in the outdoor education sector to discuss the underlying causes of incidents. This knowledge and discussion will hopefully keep those root causes nearer the forefront of people's consciousness and thus, may lead to a reduction in the frequency of incidents.
- Hale's (1984) model of an outdoor accident (Figure 5) and Meyer's (1979) extension of this model (Figure 6) were both found to have serious

limitations. The models mixed prevailing conditions (immediate causes) with the root causes, they did not indicate the relationships between the root causes and the immediate causes, and there was no mention of the role of the organisational safety management system in the model. A new model of an outdoor education incident causal sequence has been proposed (Figures 61 & 62) that has none of these limitations. This model gives greater insight to those in the outdoor education sector wishing to understand the causal pathway following any incident.

- The Meyer / Williamson (1979 – 2003) matrix of the potential causes of accidents in outdoor pursuits is the most commonly cited list of such causes. The matrix was found to contain a mixture of conditions (immediate causes) and root causes. The matrix was also far from comprehensive. In its place is a proposed taxonomy of error for outdoor education (Figure 60). This taxonomy has been reviewed by a group of outdoor experts. The feedback from the experts has been that the taxonomy is well structured and the root causes identified within it are all credible. Many commented that it is the most comprehensive list that they have seen and believe it will be a very useful tool for the sector.
- Boyes' (2000) OADM model of how an outdoor leader makes decisions was found to be inconsistent with the taxonomy of error. Boyes' model is based on the premise that an outdoor leader will make a decision within an activity context whereby they will choose an optimum level of challenge to achieve their programme goals. In order to remove the inconsistency, a new model of outdoor education decision-making has been proposed based on work in cognitive psychology. This model, the 'Likelihood To Think' model (LTT) suggests that there are two possible paths to decision-making. One involves conscious thought but is driven by individual values and beliefs, and the other involves almost no thought and is driven by behavioural norms that the person has that are implemented in response to situational cues. The new model is shown in Figures 65, 66 and 67. Further research will need to be undertaken to see if this model is valid for the outdoor education sector.
- The LTT model predicts that riskier activities will be undertaken than the organisation is prepared to sanction if individual instructors believe those risks are desirable. In order to change those individual's attitudes to risk,

cognitive dissonance theory suggests that the instructors must be very clear on the organisational philosophies, which are at conflict with their own, and provided with ways in which they can modify their attitudes and behaviours while maintaining self-image and self-esteem.

- Priest's (1998) Multiphase Problem Solving Model for outdoor leaders was found to have weaknesses and limitations when compared to the empirical evidence from this study and from other studies into naturalistic decision-making. The LTT model resolves these problems while retaining the concepts of a 'short' and 'long' form of decision-making as espoused by Priest.

It is important to note that the structure and delineation of categories of both the taxonomy and model are likely to be highly influenced by my own preconceptions and expectations. There are many other possible ways the information could have been structured and while it is important to recognise this, the real test is whether the taxonomy and model can be understood and found to be useful by those actually working in the outdoor education sector. These were both tested for validity by sending them to the members of the Delphi panels who are all outdoor experts. Their feedback confirmed that both the model of incident causation and the taxonomy of error fitted their experience of incident occurrence in the outdoors. This suggests that the approach taken to the structure and categorisation of root causes is legitimate.

CHAPTER EIGHT

SUMMARY, RECOMMENDATIONS AND CONCLUSION

8.1 Introduction

This chapter provides a review of the thesis. It summarises the way in which the research objective was addressed and makes recommendations for incorporating the findings into the work of the outdoor education sector in New Zealand. This is followed by an assessment of the opportunities for further research that have been identified by this study.

8.2 Background to the Study and Research Objective

This research was driven by a belief in the benefits that can be gained from outdoor education experiences for the youth of New Zealand, while holding a growing sense of concern that the provision of those outdoor education services is under threat because of perceptions in society that outdoor education is dangerous. This perception is evidenced by growing media scrutiny of any outdoor education incident that occurs, increasing legislation that threatens punitive action should incidents occur if problems are found in the organisation's health and safety plans, and a growing willingness of government agencies such as the Police, Maritime Safety Authority and the Department of Labour to investigate incidents with a view towards prosecution.

In order to counter this threat, I believe the outdoor education sector must be proactive. The sector must be able to provide comparative data indicating that outdoor education is not unduly dangerous. The sector must also have a thorough understanding of the root causes that lead to outdoor education incidents occurring so that practices can be put in place to reduce their occurrence, showing that the sector is acting in a professional manner. I believe that the current knowledge in the outdoor education sector about the root causes of incidents, and models of incident causation are at a primitive stage of development and offer only limited direction in terms of preventative effort.

One objective of this research was to construct a model that increases understanding of the root causes of incidents in outdoor education.

As part of the process the research addressed a number of secondary issues:

- An understanding of the current state of knowledge about outdoor education incidents was compiled. This included both theoretical knowledge and empirical evidence.
- A sample of outdoor education incidents was gathered from which an outdoor education incident profile was developed. This profile included the distribution of recorded incidents by variables such as severity of outcome, time of day, gender of instructor, etc. An accident rate was also calculated from this sample and compared to other accident rates to draw comparisons.
- The sample of incidents was analysed to identify variables that are predictors of those incidents, especially ones likely to result in serious injury.
- A Delphi analysis of 18 case studies of serious incidents was used to produce a list of root causes of those incidents.
- The list of root causes from the 18 incidents was supplemented by additional root causes of incidents, identified from a literature review from the fields of safety management and psychology, to produce a taxonomy of error for outdoor education.
- A model of outdoor education decision-making was developed from theories of cognitive psychology that is consistent with the taxonomy of root causes.
- Possible implications of the findings of this research to the training needs of the sector were explored.

8.3 Research Methodology and Method

A mixed methods approach was used to address the research objective using a pragmatist paradigm.

The first phase of the research involved choosing a sample of the larger outdoor education centres from which to gather information about incident occurrence and then later in the study, to gather case studies of incidents for further analysis.

From 25 identified organisations that met my criteria of being 'larger outdoor education centres', 12 agreed to supply data. Data on their incidents from the years 1996 – 2000 was entered into a database and resulted in a total number of 1908 incidents being recorded.

The data was analysed using statistical techniques to create a profile of outdoor education incidents, including incident and accident rates. A number of predictors of serious injury were also identified.

The second phase of the research involved the in-depth analysis of a number of case studies of serious incidents in order to identify the root causes of those incidents. Incidents that had high potential for severe injury (greater than five on the severity scale) were selected and a sample from those chosen that represented a good cross-section of: organisation involved; gender of instructor; activity type; and activity setting.

Those instructors agreeing to participate were sent a computer aided interview tool (CAI) that guided them to write a narrative of their incident and reflect on key decisions they made during the development of the incident.

Three Delphi panels, each composed of six experienced outdoor experts, were created for the analysis of the qualitative data. The experts were each sent six of the 18 CAI case studies and asked to identify what they believed were the immediate and root causes that led to the incidents occurring. I summarised the feedback from the experts studying each incident using an Events and Causal Factor Analysis (ECFA) diagram for the incident. This gave a visual representation of the incident showing all of the events leading up to the loss-producing event in chronological sequence, and how the immediate and root causes were linked to these events. Through an iterative process consensus was reached among the experts as to the root causes of each incident.

From the completed ECFA diagrams for all 18 case studies, the identified root causes were studied in greater depth. I was looking to identify categories of root causes based on their similarities and produce lists of the types of root causes for the 18 incidents based on whether they were related to instructor judgment / performance errors or errors in the management systems.

Phase 3 of the research took these lists and combined them with a list of potential root causes that had been compiled from a literature review from the fields of outdoor education, industrial safety management and psychology. The literature review had also resulted in a draft model of incident causation for outdoor education being developed. The findings from the analysis of the case studies were used to reflect on the draft model and make changes to that model. The result was a proposed model of outdoor education incident causation. This was given to the Delphi panel members, along with the taxonomy of root causes that had been developed to test their validity in the outdoor sector. Both of these received endorsement from the experts with only minor changes recommended.

8.4 Research Findings and Contributions to Knowledge

As shown by the extensive literature review in Chapter 4, knowledge of the nature of the incidents occurring in outdoor education (their frequency, activities involved, time of occurrence, etc.) is limited. Other weaknesses in current knowledge involve suitable models to explain outdoor education causation, outdoor education decision-making and a knowledge of the root causes of outdoor education incidents. There is also a lack of a common language to discuss outdoor incidents and their causal factors. This research has helped to reduce this knowledge deficit.

The results of Phase One of the research are described in detail in Chapter 5. A profile of outdoor education incidents was created for 12 of the larger outdoor education centres in New Zealand which revealed the following insights into the rate of accidents occurring:

- The overall rate of serious injury resulting from outdoor education experiences among those organisations surveyed was no greater than the rate of serious injury occurring in everyday life when compared to statistics from the New Zealand Accident Compensation Commission.

- The overall injury rate for the outdoor education centres surveyed compares favourably with counterparts from the USA who tend to be more conservative in their choice of activities because of the greater threat of legal action in that country.

These results are encouraging in being able to justify the continued use of the outdoor education medium to achieve positive outcomes with the personal development of young New Zealanders. However the size and make-up of the sample of organisations used (12 larger outdoor centres taken from an estimate of over 800 providers in New Zealand) means that extrapolation of these results to the general population of outdoor providers should be done with care.

A detailed investigation of the 1908 recorded incidents from the 12 contributing organisations in the years 1996 – 2000 revealed that:

- Studying non-serious accidents to try to prevent serious accidents is wasteful of time and resources. This study showed that non-serious accidents are not necessarily a predictor of serious accidents with only 3.7 per cent of non-serious accidents (rating less than 5 on the severity scale) having the potential for serious injury (rating 6 or more on the severity scale). The data showed that it was more useful to look at those incidents (accidents and near accidents) that had the potential for serious outcomes, and study those in more depth as a way of preventing serious injury.
- Preliminary evidence from this data suggests that the following factors are predictive of the possibility of serious injury if they are present in an outdoor education activity:
    - Limited or no direct supervision by an experienced instructor.
    - Containing high energy sources such as:
        - Height,
        - Speed,
        - Unexpected changes in weather,
        - Moving water,
        - Fire or other large heat sources.
    - Carried out in a water environment.

No research currently exists that permits the ranking of these factors in order of importance and it could be argued that their relative importance is programme / activity dependent. While many of the recent fatalities in the outdoor education sector that have achieved significant media attention (listed in Section 2.4) have involved water, and most of these moving water, this should not be seen as indicative of a trend. The two multiple fatality incidents that rate special mention in the New Zealand Mountain Safety Council's report on fatalities in outdoor recreation (Table 7) did not involve water: Six soldiers died while undertaking adventurous training on Mt Ruapehu when they were trapped on the summit in unexpected weather; and, 14 students died on a field trip when a DOC viewing platform collapsed (height). Three mountain guides and one client were recently killed on Mt Tasman when they fell several hundred metres (Cropp, 2004). My own experience from running a large outdoor education centre is that the majority of fractures are due to skiing and snowboarding (speed).

Instructor training programmes and managers need to be aware of these various factors and act to manage the increased hazard whenever one or more of these factors is present.

- Activities that are often used in outdoor education programmes because they are considered low risk, while challenging participants mentally and physically (such as high ropes, abseiling and tramping), can have potential for serious injury if any of the predictors listed above are present.

- The ratio of reported serious to non-serious injuries is higher for groups supervised by male instructors than those supervised by female instructors. Although the reasons for this are not known, one hypothesis is that this may be due to males being prepared to place their groups in situations of higher risk than women. This has implications for the training of male instructors in the assessment and management of risk.

- Injuries are more likely to occur in the afternoons, with the worst time period being between 2:30pm and 4:30pm. Once again more research is needed to understand the reasons for this but one suggestion is that attention and concentration are diminished due to tiredness and lack of food. Stops to rest and eat before afternoon activities would be prudent.

This is the first time that data such as these have been compiled for the outdoor education sector in New Zealand. The compilation of these data revealed a significant weakness in the incident recording systems used in the sector. Information that is being recorded by various outdoor education organisations is not consistent, and in order to be able to draw meaningful inferences from the data, it needs to be more comprehensive.

In Phases Two and Three of the research the root causes of 18 case studies of serious outdoor education incidents were identified. These results were combined with the results of a literature review from the fields of outdoor education, safety management and cognitive psychology to propose a taxonomy of error for outdoor education (Figure 60) and a model of incident causation (Figure 61). The following insights are particularly relevant to the sector:

- Many of the existing models for understanding outdoor education incidents and their causal factors (e.g., Meyer, 1979; Hale, 1984; Meyer & Williamson, 2003) look primarily at what I consider in this study to be 'immediate causes' (see Figure 17) and do not consider the underlying root causes. At best the immediate and root causes are mixed together in any existing model. This failure makes the models and causal factors unclear, and leaves doubt about where effort should be placed in preventing future incidents.

- The root causes of error leading to all outdoor education incidents can be considered under two broad categories:
    - Those due to poor performance or judgment on behalf of a person responsible for the safety of participants (directly by instructors, or indirectly by managers); and

    - Those due to inadequacies in the safety management system of the organisation.

  Based on the work of safety management experts such as Petersen (1988) and Bird & Germain (1989) this is the first time such a formal categorisation of these two major classes of error has been documented and used in the outdoor education sector. This binary classification system has been shown to be useful in the identification of the root causes of outdoor education incidents and is endorsed by comments from the experts on the Delphi panels who analysed the case studies.

- All of the case studies of serious incidents were found to be due to a combination of both performance / judgment errors and management system errors with an average of 13 root causes identified per incident. This supports the theory of 'multiple causation' propounded by Petersen (1988) and others that suggests that an incident is generally the result of a combination of a number of causal factors combining to produce accident potential.

- The taxonomy of error proposed for the outdoor education sector (Figure 60) identifies 18 'types' of root cause leading to poor performance or judgment, and 19 'types' due to inadequacies in the safety management system. Underlying these 'types' are many more 'tokens' which are manifestations of the types.

- Casual enquiry of those involved in the outdoor industry indicated that popular belief was that incidents were occurring in outdoor education due to instructors with inadequate skills and experience being placed in charge of groups, or because of instructors' poor judgment skills. However, the Delphi analysis of 18 case studies did not support this. The most common types of root cause across all incidents studied were those where the instructors in charge of the group either: chose to take a higher level of risk than that needed to achieve the programme outcomes; or, misapplied skills in which they already had been assessed as being competent. These results have significant relevance for instructor training programmes (where emphasis needs to be shifted to include analysis of, and attitudes towards, risk) and for the need to constantly monitor instructor performance and provide feedback.

- The identification of types of root causes of error where instructors: chose to take higher levels of risk than needed; deferred judgment to others; disregarded organisational policies or purposefully sabotaged the safety efforts of the organisation, did not easily fit within the existing decision-making models used in the outdoors (e.g., Boyes, 2000; Priest, 1988). This meant that a new approach to outdoor decision-making should be formulated in order to encompass these findings. Using theories from the field of cognitive psychology I have suggested a new model for outdoor education decision-making which I have termed the Likelihood-To-Think (LTT) model (Figures 65-67). The LTT model takes into account the abilities and level of involvement of the decision-maker, their personal beliefs, and the social and other environmental factors in which they operate. It is also consistent with naturalistic decision-making theory which is applicable in complex, time-dependent situations. Early indications are that this model is useful in order to consider the decision processes undertaken by outdoor education instructors. It helps to explain how the root causes are generated and how they become relevant in an outdoor education incident (Figure 61).

8.5 Limitations

From the outset this study had inherent challenges and limitations. Anyone setting out to study outdoor education incidents, especially ones that resulted in serious injury, or had the potential to do so, should expect to experience difficulty in accessing data, and the possibility of bias appearing in those data. This study was no exception!

In attempting to create a profile of outdoor education incidents which had occurred in New Zealand I received agreement from 12 of the larger outdoor education centres to participate from among the 25 that were identified. This sample is small compared to the estimated 800 providers of outdoor education services in New Zealand.

Of the 1908 incidents that were recorded from those participating organisations, I carried out in-depth analysis of 18 case studies. These 18 were all serious incidents. With a serious incident, getting agreement from the organisation involved to participate, and then agreement from the instructor involved, was a lengthy process. Each instructor had been through a stressful and emotional experience at the time of the incident, and it was recognised that bias could be introduced into their accounts of the incidents by wrongly interpreting key information at the time of the incident, forgetting key information in their retelling of the incident, or even omitting or altering information in their retelling in order to look better in the eyes of any reader of the account. The fact that all participation was voluntary and that a reasonable period of time had passed since the incident (one to five years) was hoped would act to minimise these biases. No patterns of non-participation by either the organisations or the instructors contacted were identified that could have resulted in bias.

A Delphi technique using a number of outdoor experts was used to identify the root causes of the incidents being case-studied. My subjective input as researcher in deciding on the relevance of certain expert comments, and categorising those comments, could have biased the outcome. However the various iterations of the Delphi process and the fact that the resultant taxonomy of error and model of an outdoor education incident were given to the Delphi members for comment, helped ensure the validity of these results.

The final taxonomy of error and model of an outdoor education incident presented in this study are based on the analysis of empirical data from only 18 case studies and a literature review across several disciplines. It is up to the reader to decide how applicable these results are to the wider outdoor education sector.

8.6 Recommendations and Suggestions for Further Research

As a result of this research a number of recommendations and practical implications for the outdoor education sector arose, along with areas that require further research. All of these are beyond the objective of this research but should be noted here.

8.6.1 Need for a National Incident Database

What became apparent throughout this study, especially when reviewing outdoor education literature in Chapter 4 and developing a profile of outdoor education incidents in Chapter 5, was the lack of reliable data on outdoor education incidents in New Zealand. What is required is a nationally coordinated system whereby outdoor education providers can input their incident data in a confidential manner, receive reports from their individual data but also receive information from the entire database about trends and incident rates. In this way the information that is being recorded can be consistent and useful for further research.

At a national level the information from this database could provide more sophisticated and comprehensive data which may support the finding of this study that accident rates are at or below levels accepted in other aspects of life.

A call for the creation of a National Incident Database for the outdoor education sector was made, based on these research findings, at the Risk 2002 Conference. This was a national conference organised for outdoor education managers, instructors and researchers sponsored by Sport and Recreation New Zealand, Water Safety New Zealand and the Sport Fitness and Recreation Industry Training Organisation. The result of this call was the development of a web-based database recording system for the sector, driven by a consortium of outdoor organisations but led by the New Zealand Mountain Safety Council and supported by Outdoors New Zealand. A version of this has recently (early 2005) been trialed before release throughout New Zealand.

8.6.2 Implications of the Taxonomy of Error for Outdoor Education Safety and Training Efforts

It is worth noting briefly here the implications of the findings of this research for the training of outdoor education instructors.

One of the criticisms of taxonomies of error is the, "...extent to which a taxonomy is useful only for analysis of errors after the event; while it is valuable for research and theory building, it cannot be used to predict the imminent occurrence of errors" (Senders & Moray, 1991, p.51). While there may be some truth in this, the taxonomy presented here points to efforts that can be made to prevent incidents occurring.

The first action that senior managers in any organisation can take is to audit their safety management system to ensure it is robust in all of the areas identified as potential weaknesses in Figure 60. From this a priority list can be established from identified weaknesses and a timeline documented in which to deal with each issue. The timeline would need to be cognisant of the individual organisation's resource limitations. Wherever possible priority needs to be given to those aspects of the safety management system that have greater elements of control over the front-line management who are the final arbiters of safety. These include: the setting and documentation of organisational policy that will clearly show the organisation's level of acceptable risk for various activities; the monitoring of instructional staff in the field to ensure their management of risk is aligned with the organisation's expectations; the systems to monitor the correct match of instructors to tasks – both on a programme-to-programme basis and on a day-to-day basis; and, the staff training systems to 'upskill' instructional staff in any deficiencies uncovered during the earlier monitoring process.

For those involved in the training of instructional staff in particular, whether that be on-job training within an organisation, or off-job training through a polytechnic or other training provider, the list of root causes leading to poor performance or judgment should be a guide to curriculum development. Most instructor training programmes involve elements of risk management training, often based around the hard skills of various activities. This risk management training is often structured on the concepts of identifying hazards, finding ways to manage these hazards and deciding if the final risk is acceptable. What this research has established is that the most common root cause of serious outdoor incidents is accepting higher levels of risk than required for the educational outcomes of the activity, due to subtle pressures on the instructor to take these higher risks. The second and third most common root causes are poor assessment of the risk present and poor situational awareness. Training in all of these points is therefore critical to preventing incidents in the future and rather than restricting this training to a one-off risk management session, is probably best done in an holistic manner across all aspects of the course.

While not new, the importance of what could be called 'judgment training' is starting to be highlighted through the outdoor education literature. Writers understand the limitations of training judgment skills through paper-based theory sessions and are suggesting more practical approaches. Priest & Gass (1997) prescribe training through case studies, horror stories of other leaders, self-analysis of personal mistakes and feedback from experts who observe trainee instructors in the field; Ewert & Galloway (2002) prescribe the use of interactive video simulation to mimic field experiences in the development of situational awareness, assessment and judgment; and, Garrett (2003) describes an instructor training curriculum used by Outward Bound USA based on intensive use of case study, analyses and discussion.

Based on the results of this research, I would endorse the approach of using the analysis of well-presented case studies (perhaps using the incident analysis approach outlined in Section 8.5.5) to introduce the concepts of situational awareness, risk assessment and the root causes of poor judgment and performance. The classroom-based exercises would then be reinforced throughout a longer training programme by continued exercises to test trainee's situational awareness and risk assessment, and their understanding of various subtle pressures to accept higher levels of risk. Feedback to those trainees in supervised leadership roles would be an important part of their training programme.

Based on the discussion above, the taxonomy not only gives a list of the root causes of outdoor education incidents, it also points towards training methods to put in place once those root causes have been identified following any incident. Possible corrective training methods are shown in Table 26

Table 26
Possible Corrective Training Methods for Instructors Once the Root Causes of Outdoor Education Incidents have been Identified

Root Cause(s)	**Training Method**
1 – 6 Overload Conditions	▪ The instructor being placed in overload conditions may be more due to poor safety management systems, or the poor implementation of those systems by management. ▪ Monitoring / observation of staff in the field and around base facilities is the only method to gauge if overload is occurring.
7 - 8 Poor Concentration	▪ Training and testing in organisational systems ▪ Monitoring / observation & feedback
10 – 12 Poor Judgment ▪ Poor situational awareness ▪ Inaccurate assessment of risk ▪ Snap decisions without considering options	▪ Training in the theory of good judgment and biases that can enter the judgment process ▪ Case study analysis ▪ Co-instruction with experienced peer ▪ Monitoring / observation & feedback ▪ Use of a journal in which an instructor notes cues and their decisions based on cues. These to be reviewed by an experienced mentor.
13 Poor Judgment ▪ Poor processing of past experiences	▪ Structured analysis of those past experiences with a respected peer involved.
14-16 Failing to Meet Judgment Responsibilities	▪ Review of organisational safety philosophies ▪ Structured analysis of past experiences with a respected peer involved ▪ Monitoring / observation and feedback
17 – 18 Misdirected Motivation / Attitude	▪ Review of organisational safety philosophies ▪ Interviews to establish alignment of personal to organisational values ▪ Monitoring / observation and feedback ▪ Cease employment if alignment in values can not be reached.
Management System Errors 1 - 19	▪ Not a training issue. Review specific elements of the management system, involving all levels of staff where possible

8.6.3 Considerations of a Hierarchy of Importance of the Root Causes of Error

The proposed taxonomy of error for the outdoor education sector shown in Figure 60 identifies 37 types of root cause and many more tokens of those types. Subsets of these root causes have been shown, through the analysis of 18 real-life incidents in Chapter 6, to come together throughout the chronology of an incident in a seemingly random manner, to create accident potential. Whether an accident actually occurs once the accident potential has developed, and the seriousness of any injuries that result, seems to be a matter of chance. The question arises then: are any of the root causes more important than others in increasing potential for an accident?

The answer to this question will require further research, although I believe there is preliminary evidence in Chapter 6 and also that there are logical arguments to support such a hierarchy.

As already discussed in Section 4.3.2, front-line managers (in this case the instructors) are critical to safety performance. Their decisions and actions can further exacerbate the adverse effects of poor decisions by senior management or even cause good decisions to have bad effects. Their competence and judgment can mitigate poor situations in which they find themselves, and lack of good judgment and competence can lead to bad outcomes even in seemingly benign situations. For this reason, a good case can be made for placing all of the root causes due to failures in the safety management system below all of the errors leading to poor judgment or performance of the instructor.

If the argument to place instructor errors ahead of safety management system errors in the hierarchy is accepted, then it also makes sense to prioritise those elements of the safety management system that focus on:

1. Organisational safety philosophies - these will dictate the type of staff that are sought;

2. Staff recruitment - if the criteria for selection is comprehensive and screening of staff against those criteria are robust, then the right people making competent decisions will be with groups in the field.
3. Staff induction and staff training – this provides further checks of competence and allows for alignment of new staff to organisational values.
4. Monitoring of instructor performance – this helps ensure that the person is competent and making good decisions.
5. Policies and standards of operation – these set limits in which the staff member should operate.

Focussing purely on the root causes leading to instructor error also points towards a hierarchy of importance for these root causes. As already discussed in Section 6.4.5.2., the most prevalent root causes of instructor error that lead to serious incidents are: the choice to accept higher levels of risk than required to meet programme goals; and, the misapplication of existing skills.

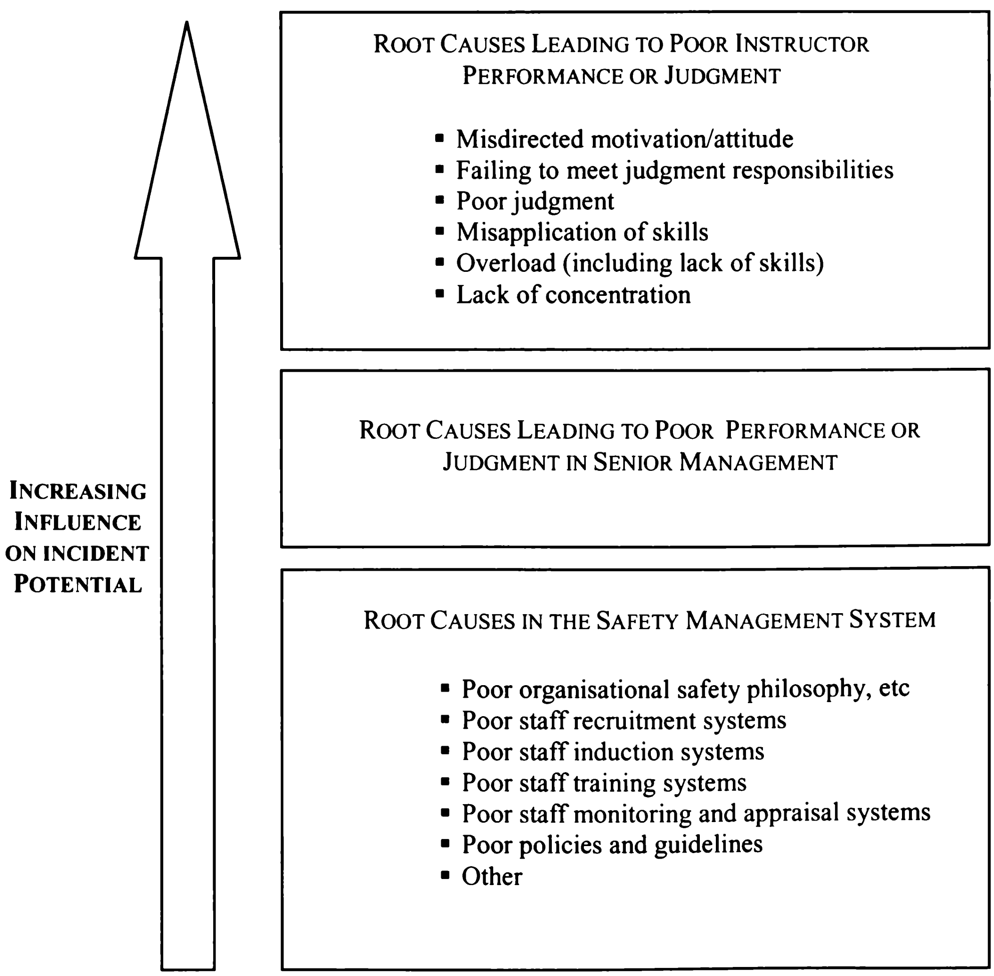
It seems sensible that those people who are willing to take higher levels of risk are more likely to produce the potential for an accident than those who are conservative. While it could be argued that higher risk could be mitigated by higher levels of skill and experience, my argument would be that these skills are taken into account when estimating the level of risk present. I believe a person who has a lower level of skill and experience, who is aware of his / her lower level of skill, and operates at a conservative level of risk because of this, is less likely to have an incident than someone who is highly skilled and experienced who purposefully seeks situations containing higher levels of risk.

Using the same argument, I believe that the need for good judgment surpasses skills in the hierarchy. Correctly assessing the situation, the risk and then making a good decision is critical to the safety of the group and more important than actual skill level. This is also supported in the empirical evidence with the root causes attributed to poor judgment being identified as contributory in the following number of incidents: "Poor situational awareness" (7); "Poor risk assessment" (12).

It could also be argued that deficiencies in skills and experience, if known, are not as likely to lead to an incident as believing you have those skills and experience and then misapplying them. Once again the empirical evidence supports this contention at an intuitive level in that more incidents were identified as having misapplication of skills and experience as a root cause (13) than simply lacking the necessary skills and experience (9). Although this difference may not be statistically significant due to small sample size, it does indicate the need for further research.

This leads me to propose the hierarchy of root causes leading to increased incident potential shown in Figure 69.

Figure 69. Proposed hierarchy of root causes leading to increased incident potential



As explained above, this hierarchy is based on the premise that errors in instructor performance or judgment are necessary and sufficient to create an incident, while errors made by either senior management in the design or implementation of the safety management system, or the safety management system itself, are generally necessary but not sufficient. This assumes that an instructor is supervising the group in situations where hazards exist. If no supervision is occurring then the only safeguards are those put in place by the safety management system.

One outcome of this proposed hierarchy is that instructor-related errors are more important than errors in the safety management system in that the impact of instructor errors are immediate and override other control mechanisms. Even though the safety management systems document the systems by which staff are employed, trained, monitored and other standards of operation, and therefore could be construed as more important, an error by front-line management can undo all of this work in seconds. Front-line staff are therefore the most important element of an outdoor education safety system. This is not unexpected. For as long as outdoor education has existed, it has been understood intuitively that having staff with sound judgment and good skills in the field with groups is a better way of managing safety than any number of manuals in the office outlining safety systems. This is counter to contemporary practice where the HSE Act places emphasis on documented systems as a way to ensure safe workplaces. The management of outdoor education centres must ensure that both the appropriate documentation is in place recording the safety management system, and also that their front line managers are being monitored and 'upskilled' on an on-going basis as part of the implementation of those systems.

8.6.4 Is Judgment a Transferable Skill?

Most outdoor education instructors are employed to provide safe educational experiences across a spectrum of activities and settings. It is very rare for instructors to be able to specialise in a particular activity as a full time occupation. Two questions arise from this observation:

- Are incidents more (or less) apparent when instructors are working in their less proficient activities?

- What is the most appropriate training for instructors working in multiple disciplines?

The first of these questions has been partially addressed in Chapters 5 and 6. While the data collected for this study did not allow the question to be considered in detail in Chapter 5, there is some indication through the analysis of the root causes of a number of serious incidents in Chapter 6 that both, being relatively new to an activity and being very experienced in an activity, can increase the potential for incidents. Those new to an activity will have less skills and experience to bring to bear in their instructional sessions to manage any hazards that exist. They are also likely to be less experienced at identifying cues in any situation that would indicate hazards being present and assessing the risk posed from those hazards. A tendency to defer to others for judgments would have to be guarded against. On the other hand very experienced instructors can also be remiss in their judgment. Over-familiarity with activities can cause a reduction in the search for cues to emerging hazards, and the successful completion of similar activities in the past can also lead to a lowered assessment of the risk in those activities. As stated earlier, further research into both of these categories of instructor experience and any correlation with incident rates is required.

What was not addressed in Chapters 5 and 6 was the issue of the transfer of judgment skills. If an instructor is skilled and experienced in one particular activity, and has a record of good judgment while supervising that activity as evidenced by a good safety record, can that sound judgment be transferred to activities where the instructor has less skills and experience? The taxonomy of root causes of outdoor education incidents implies that judgment is a separate skill set to the activity skills and therefore can be learnt and transferred. Intuitively it would be expected that an experienced instructor supervising a new activity would manage the risk better than a new instructor in that activity. This is because the experienced instructor is better at judgment skills and situational awareness, risk assessment and decision making. Further research is required to investigate whether or not this can be supported.

8.6.5 A Suggested Approach to Incident Analysis

My experience of using a Delphi technique and ECFA diagrams to analyse outdoor incidents for root causes was that the results were highly useful and valid. I have considered ways in which this approach might be adapted within a practical outdoor education setting so that root causes can be established following any incident. Once established the root causes can be used as the basis to design training sessions for staff and to correct inadequacies in the safety management system to prevent further incidents. I have experimented with the following procedure and found it to produce excellent results:

- Begin the incident investigation as soon as practical after the crisis is over, and once all parts of the organisational crisis plan and post-crisis procedures have been completed (or are under way).
- Obtain written narratives of the incident from as many eye-witnesses as possible.
- Gather a pool of 'experts' from inside the organisation and outside if warranted. These experts should provide a cross-section of organisational input: including instruction, management, operations, etc. Anyone whose role impacted the chain of events of the incident should be invited to contribute.
- Using "Post-it" notes and a big white board, allow the group of experts to construct a chronology of events for the incident. This will take into account the eye-witness testimony but will also include events involving management, maintenance, etc. that may have been important in the chain of events leading to the incident. Give people time to consider this list and give them the opportunity to come back to it on their own over several hours to add or suggest changes to it. In this way all people should feel able to contribute.
- Once the event sequence has reached a level of stability, invite contributions from the experts to what the immediate causes of the incident were. One structure to use here is to think in terms of the categories of people,

environment and resources. Link these immediate causes to the event sequence on the white board with arrows. Again allow time for people to consider and make alterations.

- The final stage is to look through the partially complete diagram to establish what the root causes were that led to the creation of the immediate causes and any instructor judgments or actions that were critical to the causal pathway. The taxonomy of error produced in this thesis will assist in this process.
- Once root causes have been established, the group can recommend corrective actions to improve safety management systems, and identify training needs for the instructional staff.

My experience of this process is that it is inclusive and empowering for all involved. The needs of any individuals who are identified in this process as having made errors should be handled with sensitivity. The completed ECFA diagram, or selected parts of it, can be used as a learning tool with the entire staff if permission is sought from those individuals most affected by the analysis.

8.6.6 Suggestions for Further Research

This study has revealed a number of areas where further research would advance knowledge in the outdoor education field. These include investigating:

- The relationship between the level of supervision and incident rates.
- The relationship between activity type and incident rate taking into account participation rates.
- The relationship between gender of instructor and incident rates.
- The relationship between time of day and incident rates.
- The relationship between level of instructor experience and incident rates.
- Overall incident rates (and the subcategory of accident rates) compared with other commonly accepted activities in New Zealand.
- The frequency of occurrence of the each identified root cause over a number of incidents from the outdoor education sector.
- Whether any hierarchy of root causes can be justified in terms of targeting efforts in reducing incident occurrence.

- Whether the proposed LTT decision-making is valid for the outdoor education sector.
- Whether the skills of judgment are transferable from an instructor skilled in one activity to other activities.

8.7 Conclusion

This study had the objective of constructing a model of an outdoor education incident that increased the understanding of the root causes leading to those incidents occurring. I believe that objective has been achieved and the outdoor education sector has gained new knowledge through the process of achieving the objective.

I have suggested a new model of outdoor education incident causation in Figure 61 (simplified version shown as Figure 62) that provides a much greater depth of knowledge of the underlying processes of incident causation than has existed previously. This is supported by a taxonomy of the root causes of error for outdoor education incidents (Figure 60) that categorises error as being due to either root causes leading to poor performance or judgment, or inadequacies in the organisation's safety management system. This binary categorisation system has not been used in the outdoor education sector previously and adds clarity to the identification of root causes of incidents. Both the incident causation model and the taxonomy of error have received support from a panel of outdoor experts from throughout New Zealand.

One of the more interesting findings to come from this research is that the most common forms of instructor error leading to serious incidents were: (1) choosing to take higher levels of risk than needed to achieve programme goals; and, (2) the misapplication of existing skills. These findings were counter to existing perceptions in the sector that instructor error is primarily due to poor judgment or the lack of skills and experience.

The taxonomy of error that was produced signaled that a revision of current outdoor adventure decision-making models was needed in order to incorporate this new knowledge. My belief is that the proposed Likelihood-To-Think model (Figures 65-67) will give greater understanding to practical decision-making in the outdoors, and the role of biases entering that process that can lead to incidents occurring.

Practical applications have been suggested in this research. One of these is a suggested process, based on the Delphi process that worked so effectively in this study, that will help outdoor education organisations to analyse any incident for root causes. An analysis such as this will help put in place improvements to safety management systems that will aid in preventing further similar incidents. There are also practical suggestions on how to focus training efforts in order to reduce possible instructor error.

In addition to this however, the research has presented important findings about accident rates that support and justify the continued use of outdoor education with young New Zealanders and show that we are as good at managing risk in New Zealand as our counterparts in the USA and Britain.

Finally, a number of suggestions for further research have been made that will further increase the collective knowledge in the outdoor education sector as to what incidents are occurring, at what rate and what the processes are that are driving them.

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APPENDICES

Appendix One

A detailed comparison of a range of outdoor education providers in New Zealand

Outdoor Education Example	Objective	Activities and sites	Staff	Participant Numbers	Participant Days
Voluntary – Award focused: The Young New Zealanders' Challenge (Formerly known as the Duke of Edinburgh's Award) Programme began in 1963. Information supplied by Naresh (2004)	Developing young people. The expedition section of the award has the goals of organizing, planning and training in order to carry out a venture in an unfamiliar environment requiring teamwork, self-reliance, determination and cooperation. There is also a focus on developing an awareness of the environment and importance of protecting it.	• Can involve any outdoor activity such as tramping, mountaineering, canoeing, kayaking, caving, sailing, etc. • Can take place anywhere in New Zealand	Any supervision must be organized by the participants. All practice and qualifying ventures must be supervised by an experienced and responsible adult who may in certain circumstances accompany the group. The experienced and responsible adult must be satisfied the participants are fully trained and properly equipped to undertake the venture.	Approximately 15,000 participating each year, but it is difficult to know how many carry out the expedition section. A conservative estimate can be based on how many finish the award each year. 1,500 Bronze Award with a minimum of 6 days on expedition section; 600 Silver Award with a minimum of 8 days on expedition section; 200 Gold Award with a minimum of 11 days on expedition section.	Approximately 16,000 per year.
Uniformed Youth Group: Scouting NZ Programme began in 1908. Information supplied by Knighton (2004)	The mission of World Scouting is to contribute to the education of young people, through a value system based on the Scout Promise and Law, to help build a better world where people are self-fulfilled as individuals and play a constructive role in society.	• Camping, tramping, confidence courses, orienteering, conservation projects, nature trails, water activities and other specialised outdoor pursuits • Can take place anywhere in NZ	All volunteer Scout leaders come from volunteers within local communities.	Approximately 18,000 young people enrolled in Scouting each year doing outdoor activities. Each Scout is likely to carry out a minimum of 5 days of outdoor activities per year.	Approximately 90,000 participant days per year
Outdoor Education Centre operating as a Private Training Establishment: The Sir Edmund Hillary Outdoor Pursuits Centre of New Zealand. Programmes began in 1973. Information supplied by Smith (2004)	Developing people's potential through: • Challenging outdoor adventures • Environmental education • Fun and support	• Tramping, kayaking, canoeing, caving, skiing, mountaineering, rock climbing, ropes courses, sea kayaking and other activities. • Most activities are based in and around the mountains, bush and rivers of the Central North Island, but some courses are run throughout NZ.	Approximately 34 full time equivalent staff of which 18 are instructional.	Approximately 6,600 participants per year. Over half are secondary school students on five day programmes. The remainder are made up of adults on skills programmes, adults on outdoor leadership programmes, contract OE courses and corporate training programmes.	Approximately 26,000 participant days per year.
Youth Sail Training: The Spirit of Adventure Trust Programmes began in 1973 Information supplied by Lister (2004)	To offer equal opportunity to young New Zealanders to develop qualities of leadership ,independence and community spirit through the medium of the sea.	• Sailing and some tramping and beach activities. • Carried out around the coast and coastal islands of New Zealand	10 fulltime sea staff, 5 on for 10 days and 10 days stand down rotating , 8 shore staff and 1 part time. In addition there are 3 cadets full time unpaid: 2 on 1 off and approx 1200	Approximately 5500 participants annually. 1200 15/19 year olds do the 10 day youth development voyage, 320 the 5 day Spirit Trophy voyage for 13/14 year olds, 30 on the disabled voyage and	Approximately 13,750 participant days per year.

			volunteer's nation wide who pay for their training, uniforms and travel to and from the ship's side.	about 3500 people sail on our 25 day or part day or evening public sailings.	
Adult Personal Development Centre: Outward Bound NZ Programmes began in 1963 Information supplied by Taylor (2004)	Vision: The Outward Bound Trust of New Zealand, through its vision has set itself the following goal – Helping to develop better people, better communities and a better world. Mission: The Mission of the Outward Bound Trust of New Zealand sets out how this vision will be achieved – Outward Bound NZ is a charitable trust inspiring personal and social development through value based experiential learning in an outdoor environment.	• Sailing, kayaking, (both white water and sea), map and compass, journeys, rock climbing, high ropes, creative days, drama, painting, music, service schemes, solo reflection, experiential team building activities. • Activities are run in and around the Marlborough Sounds	Approximately 49 staff, 22 of whom are instructional	Approximately 1065 students do 21 day courses annually and 355 do 8 day courses. Those on specially designed courses are not counted.	Approximately 25,205 participant days per year.
Polytech Vocational Training: Christchurch Polytech Institute of Technology Programmes began in 1994 Information supplied by Bailey (2004)	To provide leadership and scholarship in outdoor education and adventure recreation in order to enrich individuals and society; and to contribute to the sustainability of the natural environment. Learning opportunities will be provided in a supportive, holistic and challenging environment to inspire students to perform at the highest practical and academic level.	• Tramping, mountain biking, orienteering, sailing, surfing, rafting, skiing, snowboarding, kayaking, rock climbing. • Activities are run in Otago, Canterbury, West Coast, Nelson, Marlborough and Mt Arapiles (Australia).	12.5 Full time equivalent staff.	150 students on Certificate, Diploma and Degree courses.	Approximately 15,400 participant days per year.
School Residential OE Programme: Tihoi Venture School Programmes began in 1979 Information supplied by Firminger (2004)	In this unique and challenging environment, through the medium of community living, a quality academic programme and wide ranging outdoor pursuits we aim to provide the best possible opportunities to promote the personal and social development of our students.	• kayak, rock, sail, tramping, caving, solo, alpine skills, survival. • Activities are run in the central North Island.	12 fulltime staff, 10 of these are instructional.	128 students take place each year. This is a compulsory component of school life for year 10 students at St Paul's Collegiate Hamilton. All students spend five months at Tihoi. Each student gets approximately 80 days of OE during their time there.	Approximately 10,240 participant days per year.
School OE Programme: Nelson College Programmes began in 1964. School built a lodge in 1966. Information supplied by Cant (2004)	To teach students the skills of goal setting, communication, team work and environmental awareness while taking part in outdoor pursuits in New Zealand's outdoors.	• Fishing, tramping, bushcraft, adventure games, enviro studies, mountain biking, farm visits, open fire cooking, overnight camps, sea kayaking, snorkeling, rock climbing, white water kayaking. • Activities are	Two specialist OE teachers who also teach other subjects. Rely on other teachers and some contractors to run the programmes	Approx 453 students take part each year. A sequential OE programme is offered through the school: Year 7 – compulsory five day camp; Year 8 – compulsory five day camp; Year 9 – no OE; Year 10 – compulsory five day camp; Year 11 – optional 7 day	Approximately 4,280 participant days per year.

		run in the mountain ranges, rivers, bush and sea of the greater Nelson area.		expedition; Year 12 – full year Level 2 NCEA OE subject; Year 13 – full year Level 3 NCEA OE subject. Also Fish and Game course, International student induction, ski trips, indoor rock climbing team and a leadership programme.	
Community Programme: New Plymouth YMCA Programmes began in 2000 Information supplied by McKee (2004)	Personal development, recreation skills, training and qualifications - We build strong kids, strong families, strong communities. Me whakahangaia hangaia e matou, i nga tamariki, i nga whanau, i nga hapori e	• Adventure based learning, kayaking, rock climbing, abseiling, gym/swim, tramping, team building games, caving, high/low ropes course, orienteering, navigation. • Activities are run in the Taranaki and Wharepapa areas.	Four full time staff and the remaining programmes are run by contractors	Approximately 2100 participants per year in programmes such as Conservation Corps, Specialist youth services, school contracts, etc.	Approximately 8,000 participant days per year.

Appendix Two
The Computer Assisted Interview (CAI)

1) Introduction:
Hello and thank you for agreeing to take part in this study of outdoor education incidents. Along with this disc you should have received some paperwork. The paperwork contains an overview of the research and what the objective is, explaining who to contact if you have any further questions. There is also a consent form that should be completed and mailed back with this disc.

It is important to remember that participation in this research is voluntary and all names, place names and dates will be removed in any analysis to ensure anonymity.

2) Free time:
Before completing this computer interview, please make sure that you have set aside enough time so that you can complete it undisturbed. Depending on how complex the incident involved was, this may take an hour or more to complete. An evening after dinner would be a good time to complete this. If you haven't got the time now, that's fine, simply close down and come back to it when you have more time.

Also make sure that you are feeling relaxed and in a state of mind where you are OK about revisiting the incident. If you are not relaxed about this then leave it and come back to this interview when you are.

3) Just what happened:
During the following interview, you will be asked a number of questions about an incident you were involved in that you completed an incident report for in your organisation at the time. In answering the questions, try to stick to exactly what happened at the time and what you were thinking or feeling at the time that led you to make certain decisions. The natural tendency, when reviewing a critical incident some time after it has happened, is to include some details that in retrospect you would have liked to have done, and omit others that in hindsight you wouldn't do again. I would like you to try to avoid this and only include what actually happened. Remember, the point of this research is not to look for blame or to criticise, it is to look at what happens before and during incidents in the hope of finding patterns that will help others avoid those similar traps in the future.

4) Critical Incident: The incident that I would like you to reflect on is

Brief incident description here:

5) Setting the scene:
This incident probably took place at least two years ago. I want you to cast your mind back to that time. Remember as much as you can about what was happening for you that month, week and then day.....

Could you now write down as accurately as you can remember, what the background was for you going into that activity. Some cues to help...
- How were you feeling?
- How did this activity fit into the programme?
- Had you done this activity many times before?
- What was the group like?
- Were you looking forward to this activity?
- What were you hoping to get out of the activity?
- Were there any particular issues you had on your mind?
- Were there any time constraints?
- What was the weather like?
- What was your equipment/resources like?

Your thoughts on the background here....

6) The Incident:
Write a narrative of the incident as it happened through your eyes. Start at whatever point in the activity you think is appropriate and finish at the time when control has been re-established.

Your narrative here ....

7) Incident Timeline:
Now put together a simple timeline of the event, as accurately as you can, by building a list of approximate times with key events that were happening.

Your timeline here....

8) Decision Point Identification:
With the benefit of hindsight, can you identify points on the timeline at which key decisions were made that influenced the outcome in this case? Work backwards through your timeline and list the decision points, and for each decision point:
- What decision you made at the time
- What you were trying to do in making that decision
- What information you had that led you to make the decision
- What you would do differently, if anything, at that decision point given the benefit of hindsight?
- What other information\skills could you have had at the time that would have helped make the decision you would make given the benefit of hindsight?

List your decision points here....

9) Other Comments:
If you have any other comments you want to make about the incident in general that you haven't had the opportunity to do so already, then please do so here....

10) Where to now:
I will analyse this incident, along with many others to establish what might be the root causes of the incident to see if there are any trends that can help prevent similar incidents occurring in the future. As part of my research, some of the incidents will be studied further to see if more, or different, information emerges about the incident. Are you willing to participate in an:

> Email analysis – your incident will be converted into a diagram showing possible causal factors leading to the incident. This will be sent to you and a number of experts by email to get further input on what are believed to be causal factors. Remember that no names, place names or dates will be used and none of the experts, or you, will know who the others taking part are.
> ARE YOU WILLING TO PARTICPATE?

Thank you again for all your help in my research. Once you have completed all the questions, please save the file on the disc and return it along with the completed and signed consent form to:

Grant Davidson
Outdoor Pursuits Centre of NZ
Private Bag 37
Turangi.

Appendix Three
Instructions for Delphi Members

Hi there

Attached to this email is an incident file. The incident file contains a completed questionnaire from an instructor who was involved in an incident in the past that either resulted in, or could have resulted in, serious injury to one or more students in their care. The instructor has been asked to provide information as background to the incident, a narrative of the incident itself, a timeline, and what, given the benefit of hindsight, they may have done differently.

Some incidents may seem quite straight forward, others will be more complex.

I want you to read through the information provided and decide, based on your experience as an outdoor instructor, two things: 1) conditions present that were pertinent to the incident occurring; and 2) what you believe are the root causes of the incident. It is likely that in each incident there will be more than one root cause that combined with others to lead to the incident occurring. Not all root causes will be linked to conditions so don't get hung up by this.

Be careful not to confuse the prevailing conditions leading to the incident with the root causes.

Conditions that are pertinent to the incident are likely to fall into three main areas – people factors, equipment factors, environmental factors. Examples could be things like: The group were identified as at-risk students and had short concentration spans; or, the weather forecast indicated high winds would be present; or, their weren't enough large harnesses in the gear pool. I want you to think beneath this level to what caused those factors to be present – the root causes. To do this there may be clues in the incident file that point at what the root cause was, but alternatively you may have to make some subjective opinions based on your experience and what you "read between the lines".

For example: Let us imagine an incident where a student is lead climbing under instruction. They fall, a piece of protection pulls out of the rock, and there is no other protection so they hit the ground breaking their leg. The conditions are the badly placed protection, lack of further protection, poor level of supervision by the instructor. I want you to be thinking about the root causes. Why was the student allowed on such a climb with poor rock? Or allowed to get so high with so little gear? Or allowed to climb on with poorly placed gear? Etc? Were there suitable management policies in place to prevent this? Was the training and skill level of the instructor suitable? Were they tired and/or distracted? Had they been observed running such a session by senior staff? Etc.

Think as widely as you can about the root causes for the incident. Based on your experience in the outdoor sector you may even make guesses about causes that there is no direct evidence of in the incident report provided but seems intuitively "right" to you. This is completely valid and I welcome these thoughts being sent through. For any root cause you identify, I want you to decide whether there is any evidence in the incident file to support that finding or not. If there is, then quote the evidence along with the root cause. If there isn't, then state that it is a subjective decision.

For example:
Root cause 1: Instructor *too tired* to provide proper level of supervision for the climbing session. "I was feeling tired going into the course having just worked ten days in a row."

Root cause 2: I feel the instructor had a set of *personal values* that caused them to push their students to do things beyond their ability – subjective call.

You will therefore be sending me a list of:

1) Conditions present
2) Root causes with evidence statements from the text
3) Root causes based on our subjective opinion.

I hope this makes sense to you. Just keep asking yourself – why did they make that decision? And, what did management have in place, or not have in place, that would have prevented this from occurring.

When you believe you have discovered all of the root causes you believe led to the incident occurring, then send them to me. I will combine your results with those of other experts and send a diagram of the incident to you for a further round of feedback.

If you have any questions at any stage, then please get in touch. I think this will all make more sense as you start studying the incidents and working through them. You will get faster at the process!

Thanks again for your help.

Grant

Appendix Four

Instructions for Delphi Panel Members to Assist in Interpreting the ECFA Diagrams

Hello

I have now combined your incident analysis with that of several other outdoor experts - the result is a diagrammatical representation of the incident in the attached file. I hope that reading the diagram is fairly intuitive - but let me guide you through it.

1) The key events in the incident are outlined across the top of the diagram in a chronological fashion. These events are represented by rectangular boxes. If an event represents a critical judgment that the instructor made that, given a different decision could have resulted in no incident occurring, then this is represented by an octogon (stop sign).
2) Conditions present that could be pertinent to the incident are represented by ovals.
3) Root causes that are linked to why the instructor may have made certain judgment decisions are shown as parallelograms. If these are confirmed by evidence statements in the narrative then they are solid, if they are subjective without evidence statements then they are shown dotted.
4) Root causes that are linked to management practices are shown as rounded rectangles - again either solid or dotted dependent on whether there is confirming evidence in the narrative.

The diagram therefore moves chronologically across the page and moves deeper into the management of the organisation down the page.

The diagram, as already stated, is the synthesis of everybody's thoughts. Some of you will have identified more conditions and root causes than others. Don't worry about this.

Another point is that some of you may have identified an action/inaction/decision made by a student as a root cause. The analysis shown here assumes that the instructor has the responsibility of supervising the students and therefore student actions are not considered root causes, but can be conditions influencing the incident.

What I would like you to do now is consider the diagram and decide whether you agree with the analysis. If there is anything included in the diagram you disagree with, then let me know with your reasons. If there is anything you think is missing, then please do the same. If you believe the diagram is a fair representation of the incident, then let me know this as well.

I want to try to fit the incident analysis onto one page for ease of study – sometimes this may make them a little tight on the page - sorry! But better than running to more than one page I hope.

Please note: LTA stands for Less Than Adequate.

Thanks again.

Grant