HIGH POTENTIAL INCIDENTS – DETERMINING THEIR SIGNIFICANCE

Tools for our trade and a tale or two

By Cathye Haddock

Abstract

This paper reports partial results of a qualitative study of incidents with high potential for harm (HIPO incidents). The research was carried out at Rotoiti Lodge Outdoor Education Centre in Nelson Lakes National Park in the South Island of New Zealand. The Centre caters for 13 secondary schools in the region. Approximately 2,000 students attend programmes involving 140,000 participant hours per year. Typically, groups of 40 – 60 students are in residence for five days (70 programme hours). An estimated 110-120 school staff (classroom teachers and outdoor educators) attend camps annually with four accompanying each group. The Centre employs two resident outdoor education instructors to develop, manage and instruct programmes with the assistance of school staff. Data was obtained from ten interviews and five focus groups involving 15 teachers and 15 outdoor educators or instructors. The interviews focused on 11 specific incidents with high potential for harm.

Results of the study reported in this paper are:

A determining the significance of an event using a risk assessment tool
B contributing factors to the eleven incidents and
C structuring causal factors into recognised models of analysis, fault trees and causal pathways.

A DETERMINING THE SIGNIFICANCE OF AN INCIDENT

Introduction

Delineating high potential 'near-miss' incidents from minor accidents and incidents with no relationship to major accidents, poses a challenge. Johnson (1980) highlighted the importance of *'the professional scan of minor injury reports and property damage reports ... to bring to light cases of potentially great significance.'* (p. 371). This relied on the input of someone with expertise in safety and the particular industry.

Several tools have been developed to assist the professional in this endeavour. One such tool was Albrighton's (1993) Risk Assessment Model (see Figure 1 below).

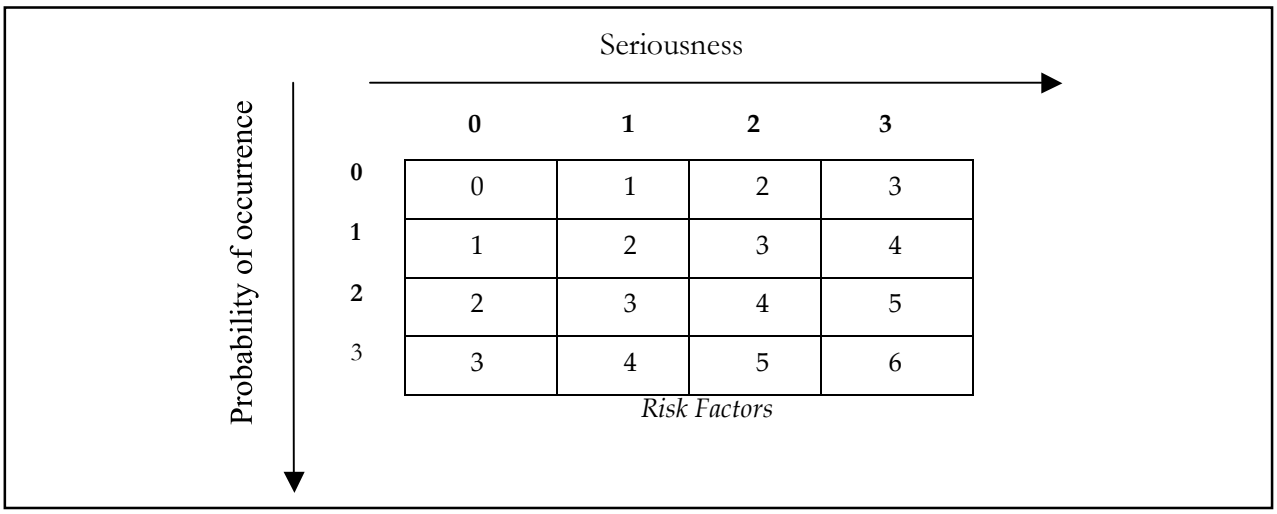

Figure 1 Risk assessment model. (Albrighton, 1993, p.18).

DESCRIPTORS FOR MODEL

Probability Ranking Points:		*Seriousness:*	
0	*Very unlikely*	*0*	*Of no consequence*
1	*Slight possibility*	*1*	*Marginal*
2	*Medium possibility*	*2*	*Quite serious*
3	*Highly possible*	*3*	*Catastrophic*

Probability Points + Seriousness Points = Risk Factor

The model ranks the probability and seriousness of events in order to produce a risk factor. Thus the significance of an individual event can be estimated. He recommended that incidents with a risk factor of three or more should generate further investigation, analysis and corrective action. Incidents with a risk factor of three or more were the focus of this study.

Incident ratings

I held ten interviews about 11 incidents. I asked respondents to rate their incident using Albrighton's model at the end of each interview. I explained how the model worked, taking care to go over each descriptor, as these had caused some confusion in a pilot study. I explained there were no right or wrong answers and where more than one respondent was interviewed, got them to assess the incident separately so they did not influence each other. During the discussion I explained that it didn't matter if they did not agree. To control for the limitations of self-reporting, an external consultant was engaged to rate all incidents independently. If an incident was rated three or more by the respondent, consultant or both, it was included in the study.

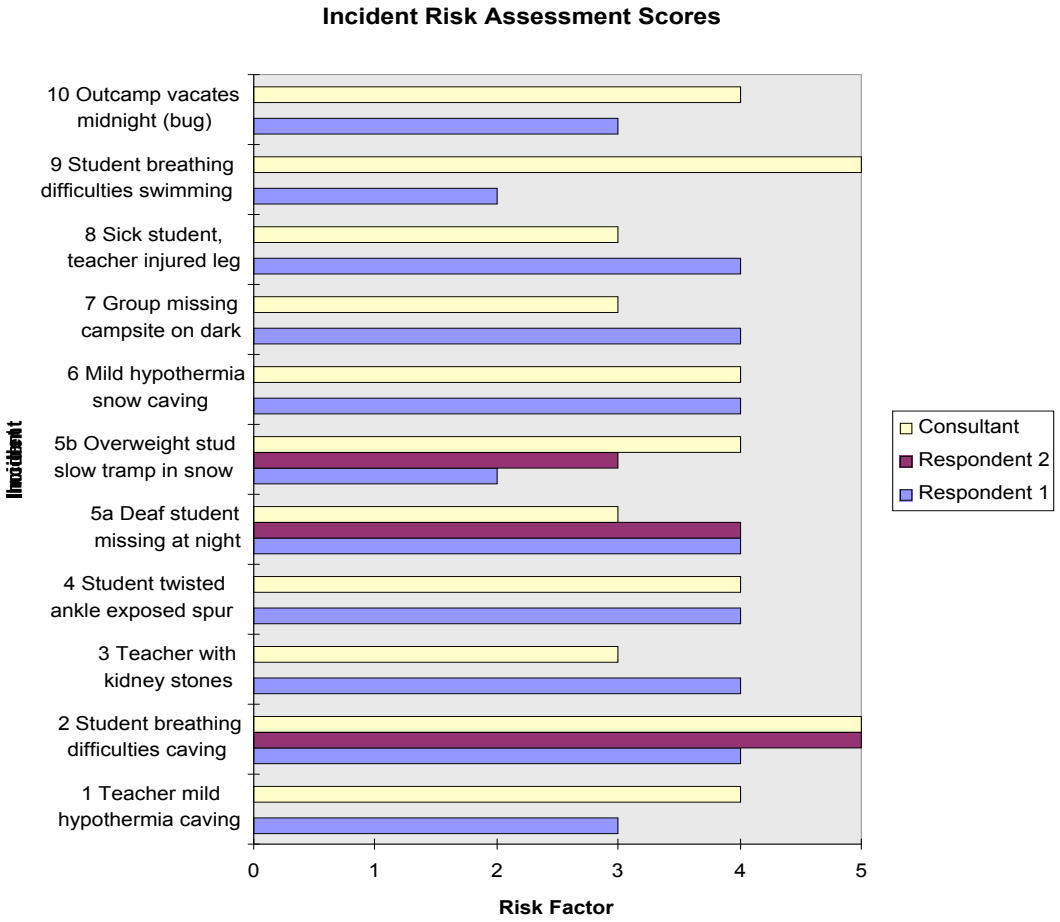

Figure 2 Incident Risk Assessment Scores (interviews)

Figure 2 above illustrates the risk assessment scores given by respondent/s and consultant (events are identified by incident description and number). In summary, there was general agreement in the risk assessment scores between consultant and respondent/s as they were within one rating point in all but one of the eleven incidents.

Focus groups

To test for reliability of the model, I gave five focus groups a case-study to discuss and rate using the Albrighton (1993) risk assessment model. They were all given the same case-study, based on an incident from one of the interviews (5a). Focus group one was involved in this incident the week of their discussion. I read the case-study, then gave them an opportunity to ask questions. I gave them the Albrighton model (see Figure 1) explained how it worked, and answered any questions. Respondents were asked to rate the incident separately so they did not influence each other. Finally, they were asked to share how they rated the incident and why. They did this in turn, then I told them the outcome of the incident. Scores are displayed in Table 2 below.

Table 2 Risk assessment scores - Focus group case study

RESPONDENT		PROBABILITY +	SERIOUSNESS =	RISK FACTOR
Focus Group	Name			
1	Greg	2	2	4
	Sue	0	2	2
	Ben	1	1	2
2	George	3	2	5
	Charlie	1	2	3
	Norm	3	2	5
	Baz	1	2	3
	Jackie	3	2	5
	Ralph	2	2	4
3	Lou	2	2-3	4-5
	Frank	1	2	3
	Eric	3	2	5
4	Ripena	2-3	2	4-5
	Jade	3	2	5
	Leila	3	2	5
5	Jane	1	2	3
	Juanita	2	2	4
	Janice	2	2	4
	Ezmerelda	3	2	5
Interview	Fred	2	2	4
Interview	Bill	2	2	4
-	Consultant	1	2	3

Figure 3 below shows a wide range of scores given for the probability of this event occurring. Scores covered the whole range possible, from zero to three. Similar numbers rated the probability as a one (6), two (7), and three (8). Such variation in the scores brings into question its usefulness for determining the probability of an event occurring.

An examination of why the variance may have occurred could assist refinement of the tool and interpretation of the results. First, I noticed that respondents found the probability rating the most problematic, indicated by most questions being asked about this variable during the exercise. Confusion arose where respondents tried to assess how *often* this type of event would occur. I emphasised that they needed to base their assessment on how *likely* it was that the event would occur, given the same set of circumstances. Second, further research would need to test whether better descriptors would improve agreement between scores.

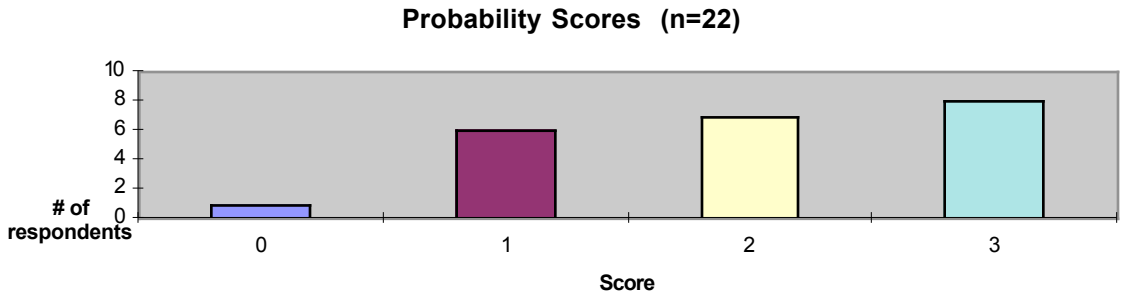

Figure 3 Probability scores

Seriousness scores were more consistent as shown in Figure 4 below. Twenty respondents (including the consultant) gave the incident a seriousness rating of two (quite serious), one gave a one (marginal) and one gave a three (catastrophic). The consistency of rating clearly indicated agreement that the incident was quite serious.

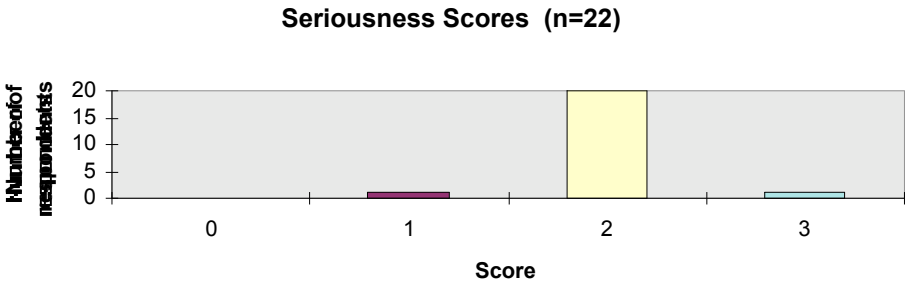

Figure 4 Seriousness scores

By adding the probability and seriousness ratings together, a risk factor score was obtained. Figure 5 below, shows the risk factor scores of respondents and the consultant.

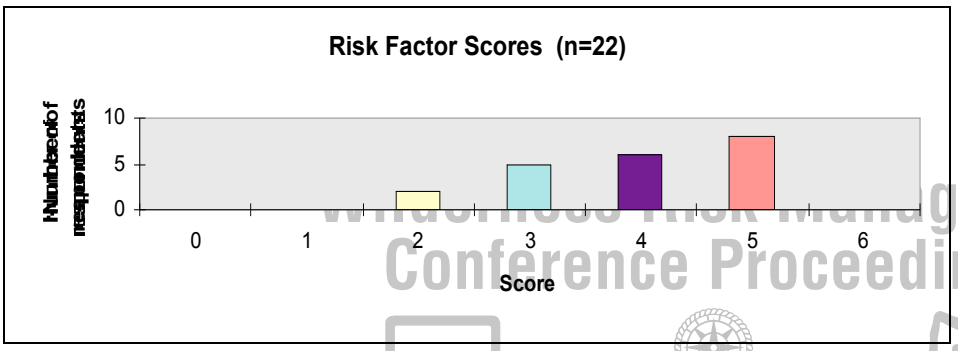

Figure 5 Risk factor scores

Risk factor scores ranged from two to five (two = 2; three = 5; four = 6; five = 8). The variance in scores reflected the variance in probability rating scores discussed earlier. In combining scores, a clear majority of respondents gave the case study incident an overall risk factor of three or more (20 of 22) as did the consultant. This indicated that respondents and consultant alike thought the event had significance.

B CONTRIBUTING FACTORS TO THE HIPO INCIDENTS

Introduction

Researchers have shown HIPO incidents and serious accidents to be similar, *"…the difference between a near hit and a fatality is often only a few millimetres or a fraction of a second"* (Mitchell, 1998, p. 40; also supported by Bird and Germain, 1992; Hale, 1989; Johnson, 1980). They stressed the importance of investigating contributing factors to HIPO incidents as they had similar causes to serious accidents. An objective of this research was to identify possible causes, ascertain patterns common to several incidents and structure them into recognised models of analysis. In doing this, I hoped to provide information to improve safety in Rotoiti Lodge Outdoor Education Centre and similar programmes and provide a basis for future comparison.

Contributing factors

To identify contributing factors to the eleven HIPO incidents, I listed factors identified by respondents, added factors from the story, then checked incident reports written at the time. Consistent with the literature reviewed, HIPO incidents in this study were the result of a multitude of factors. This is illustrated in Figure 1 which shows a range of six to twenty five factors contributing to the incidents.

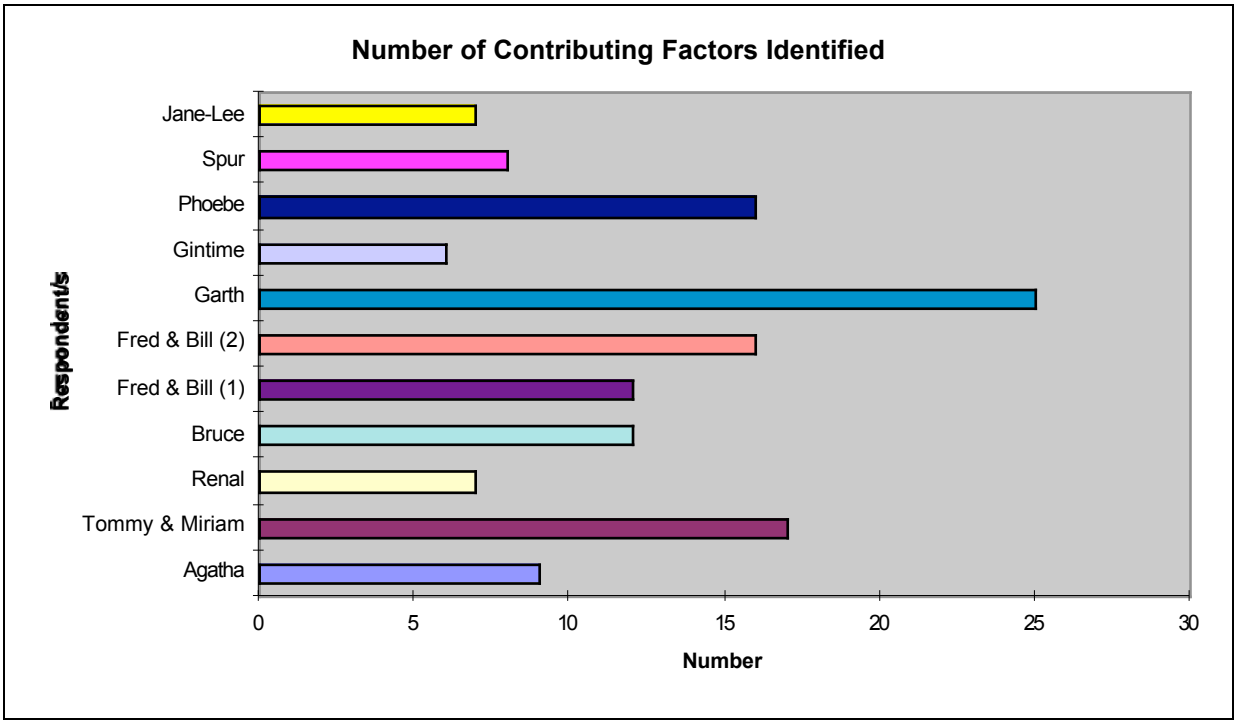

Figure 1 Number of contributing factors to incidents identified

The types of factors leading to incidents in the study included significant and common causes of outdoor accidents from the literature along with those derived from the data. These are displayed in Fig. 2 below and then explained more fully.

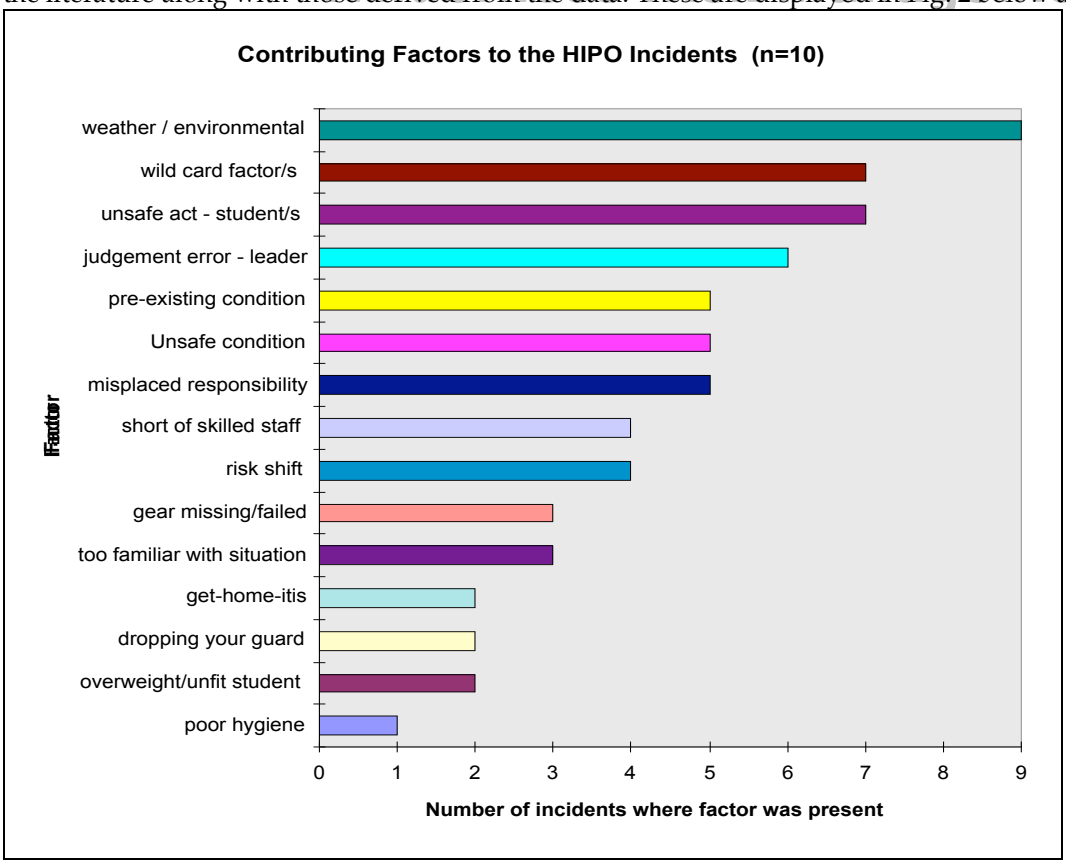

Figure 2 Contributing factors to HIPO incidents by themes

Significant causes from the literature

The following summary of factors, significant in the literature, featured in the stories. Factors are highlighted to relate them more easily to Figure 2.

Helms (1984) concluded that **risk shift**, **get-home-it is** (or trying to adhere to a schedule) and **familiarisation with the situation** were the three largest contributing factors to accidents. Like Helms, this study found accepting increased levels of risk contributed to many incidents. Bruce's comments illustrate several of these factors.

> *I think we had probably let our guard down a bit, because we were heading home ... we thought we were over the worst ... I was quite happy cruising along at the front of the group, thinking it was plain sailing, and maybe if I'd been stopping kids and cautioning them, it wouldn't have happened ... I'm really happy on that sort of country and I should have probably stopped and thought right, there might be some people here, although they're travelling alright ... they're not as aware of the dangers as I am.*

Meyer (1979) found that the majority of accidents in adventure programmes were the result of a combination of any of the following: an unobserved or underestimated **unsafe condition**, an **unsafe act** on the part of a student or an **error of judgement** on the part of staff. These factors contributed to many of the HIPO incidents in this study as illustrated in Table 1 below.

Table 1 Principal causes of major accidents in adventure programmes (Meyer, 1979), showing incidents where factor present (by respondent name).

Unobserved or underestimated Unsafe Condition		Unsafe Acts - Student/s		Errors of Judgement - Staff due to:	
Swift water	Gintime	**Poor position**	Bruce Tom/Miriam	**Unexpected or new situation**	Gintime
Loose rock		**Unauthorised procedure**	Gintime Phoebe, Spur Fred/Bill a	**Desire to please others**	Renal Phoebe Agatha
Inadequate area security	Tom/ Miriam	**Unsafe speed**		**Misperception**	Bruce Agatha
Unexpected water/ improper clothing	Agatha Garth	**Inadequate water/ nutrient intake**	Garth	**Fatigue/ distraction**	Phoebe Garth Fred/Bill b
Unexpected Snow[1]	Fred/Bill b Garth				

Haddock (1996) identified **wild card factors** in a previous study. These factors involved unpredictable behaviour which took you by surprise and put you in a reactive mode, often without all the information. Jane-Lee had a wild card factor in her incident. She was teacher in charge of a camp which was struck by a vomiting and diarrhoea bug. Some students were already sick by the day they left for out camp, so she and a colleague hiked with their group to a campsite five kilometres from the Lodge which had vehicle access. They had a car delivered there as back up. Late in the evening, Jane-Lee's colleague and two students came down with the bug. So she sent them, along with two healthy students, back to the Lodge in the car. An hour later, she was stunned when the two well students (14 year olds) arrived back in the car. They told Jane-Lee that only one parent was still standing back at the Lodge as all staff and many more students were sick. She spent the next two hours ferrying students back to camp in the car, whilst the remaining students walked along the 4WD road by themselves in the dark until they could be picked up. Jane-Lee said,

> *Well professionally I was a bit embarrassed about the whole thing, … about kids driving cars (laughing) in particular, that one I felt a bit sheepish about.*

Seven incidents had wild card factors, three of which had two, as illustrated in Figure 3 below.

[1] This category added to original table.

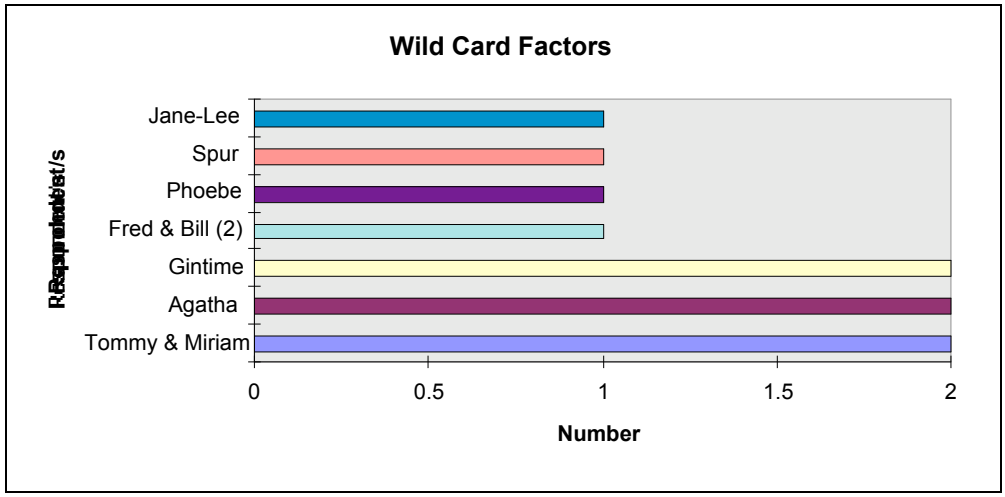

Figure 3 Number of wild card factors present in incidents

Significant causes derived from data

Further common significant factors were derived from the data as follows. **Environmental conditions**, particularly bad weather and cold contributed to ten of the eleven HIPO incidents. These factors are detailed in Figure 4 below:

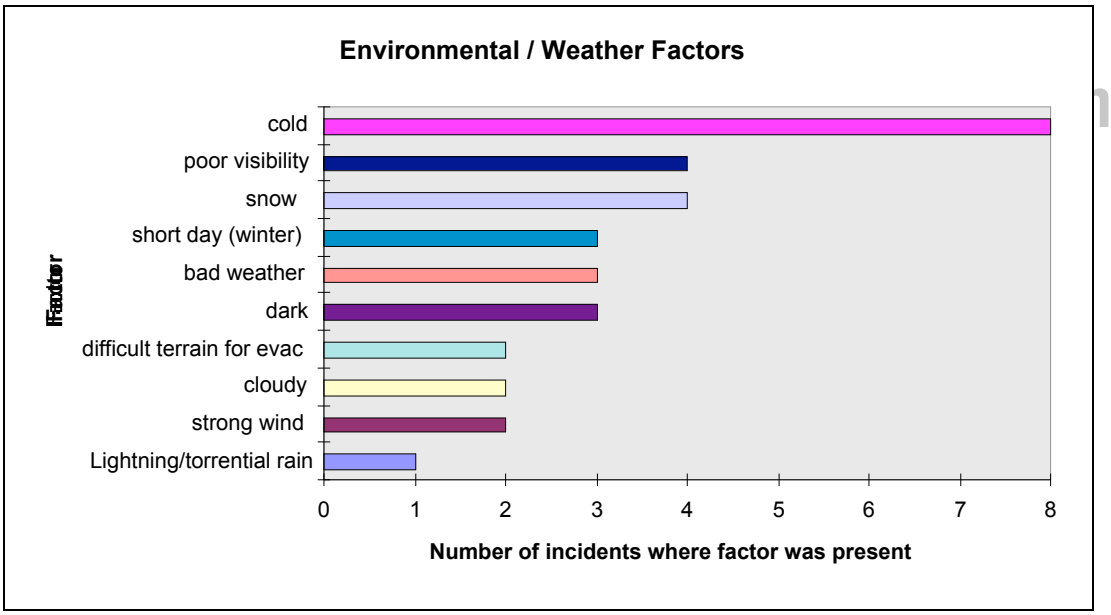

Figure 4 Environmental factors present in incident

Activities involving cold conditions, particularly snow, were significant in a previous analysis of accidents and incidents at Rotoiti Lodge Outdoor Education Centre (Haddock, 1993). It is important to emphasise the setting here. The Centre is situated at the northern end of the Southern Alps at an altitude of 620 metres above sea level, so it is not unusual to get cold and wet weather or snow at any time of year. Such conditions are challenging for novices to cope with so appropriate gear and experienced leaders are essential for safety. If an incident occurs, cold and wet conditions serve to exacerbate the circumstances, as does the remoteness of the area, as illustrated by Fred and Bill's story. They, with a teacher aid, took a group of fifteen learning development students, including an overweight student who was extremely slow, unfit and unmotivated, on a tramp around Lake Rotoiti in August.

> **Fred** *...on the way up he was dragging the chain, it was a nice fine day ... we got him up there after ... a fair amount of cajoling and grizzling ... The following day, it had snowed over night ... I made a decision to go ahead [and complete the Lakehead circuit] ... As we moved, it was starting to snow, it was only snow showers, flurries coming through ... we kept in tow most of the way until we got to about Whiskey Falls ... after Whiskey Falls the snow was starting to settle quite a lot. I decided, well there's no point in going back, because it's a lot longer to go back than to push forward, thinking that the mini-bus was going to be there [at the road end]. Eddie was really dragging the chain ... So we ended up with Sue [the teacher aid] ...walking with Eddie and Bill as well.*

Bill *... That put me in an awkward position, I ... didn't know whether to keep up with Fred and his group, or stay back with Sue. Sue kept saying 'you go on' but I kept worrying that, when the snow started, whether I should have stayed with her. In the end I kept going, I was quite a way behind you guys. You've walked that track many times, that's the first time for me, and when the snow come down, in that clearing, it's quite hard to follow ... I was walking back on my own, I had to really concentrate on where I was going ...*

Fred *... with the snow ... all the kanuka and stuff was just folded over ... we pushed right through [but] the mini-bus wasn't there, which complicated things as well ... they dumped their packs there ... on the road, and somehow, we hoped the van would've turned up ... and I turned around and walked back to pick up Eddie and Sue. His major problem was his mind ... he just winged and moaned and carried on ...*

Bill *... With the other group ... a couple of them weren't togged out properly ... it kept snowing and snowing ... and I was pretty tired by this time and I had that sore foot. And a couple of them wanted to lie down on the side of the road and they were quite serious about just having a rest ... had they been on their own, they wouldn't have got off their arses and they would've stayed there ... our group fractured, walking down the road. Damn hard to keep them together ... and I was getting knackered and grumpy.*

Many of the factors discussed so far are illustrated in the above story. The decision, at the beginning of the day to go ahead and complete the Lakehead circuit[2], in my view, pushed the group's limits. The more conservative option to return the same way would not have pushed the group's resources to the same extent as they would have been back at the Lodge by the time the snow really set in. The snow compounded their problems, particularly that of keeping the whole group warm. This could only be achieved by keeping them on the move, which meant splitting the party. Once split, the smaller party was weakened considerably and communication was affected. Another complication was that staff back at the Lodge assumed they would return by the quickest, easiest route, due to the weather and the nature of the group. So the van was sent to a different road-end, meaning that it was not awaiting the group at the end of their arduous tramp. The disappointment of not seeing the van and the further four kilometre walk in heavy snow meant students' morale and physical resources hit a low point at this stage.

On the positive side, this group had three staff members due to the nature of the group. Usually one staff member would be on their own or with an assistant. Fred and Bill contemplated this: *'We'd all be sitting there with Eddie, or leaving him behind ...'to hell with ya!' What would you do? Safety of the fourteen as opposed to one* (Bill).

The extreme weather conditions had not been experienced by Fred on this trip before, although Fred and Bill had experienced a strikingly similar incident on a previous trip to Bushline Hut which, being higher, is more prone to snow conditions. Again Bill remained behind the main group with two slow students on the way up. It was snowing and one student sat down and refused to go any further. After reaching the hut with the main group, Fred returned to assist the stragglers. They did not have far to go, and did make it. Fred said he did not expect such conditions on the Lakehead trip and was surprised to hear the resident teacher say it was not unusual.

This reiterates a theme already developed in this thesis. As Charlie pointed out, a particular kind of incident may only happen once in a person's experience, so they don't always see the bigger picture. Helms (1984) substantiated this in identifying that the majority of serious mountaineering injuries and fatalities examined in two studies, were preceded within one year by a near miss incident or an accident of a parallel nature in the same area. Although the same factors had been present in previous years the group had undertaken the activity, the leaders or institutions had failed to recognise them as important. Other authors also identified this (Brett, 1994; Kauffman, 1989).

This highlights the problem of having approximately 100 teachers who come to the Lodge once a year, leading trips in an environment where extreme conditions are possible at any time and for which they have little experience and are ill prepared. The two permanent instructors (resident teachers) at the Lodge experience many seasons and environmental conditions over time so are more prepared for extreme conditions and used to adapting their decisions more conservatively to suit. At the time of the research, the two instructors were shared among four groups of students, making it necessary to rely on teachers to supervise the other two groups. Thus the situation could result in staff exceeding their competence and possibly compromising their judgement abilities. Fred and Bill's story worked out happily, but things could have gone wrong.

Five respondents talked of **mis-placed responsibility** with staff or student/s when a staff member or student failed to carry out a responsibility given to them or proved to be irresponsible. When responsibility for managing certain risks is placed with someone other than the leader of the outdoor activity, this is called risk transfer (Ewert, 1984). It is a risk management strategy which is acceptable when the party competent to manage the risk, but problematic when they are not. Mis-placed responsibility was a factor in six cases in this study, as illustrated in Figure 5 below. Risk was transferred to staff in three cases students in three cases.

[2] Completing the circuit to the road-end would take a minimum of four hours tramping with an average party. A slow party in snow conditions could take an extra two hours. The road end back to the Lodge is an extra hour, a total of seven hours. The alternative was to return the same way, a three hour tramp with an average group. The Lodge was a further 15 minutes walk from the road end. A slow party in snow conditions could take four to four and a half hours to complete the trip.

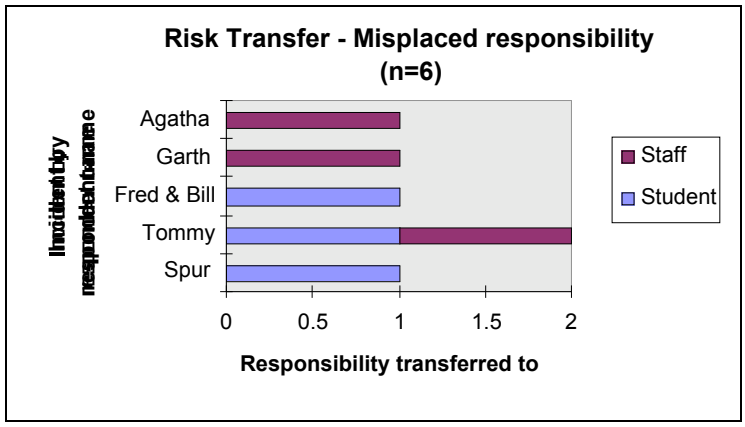

Figure 5 Incidents where responsibility was mis-placed with student or staff (by respondent name).

An example where responsibility was transferred inappropriately was in Tommy and Miriam's incident, where two cases of risk transfer proved to be mis-placed. One instance involved a student while the other involved a staff member. Tommy, Miriam (teachers) and a senior student assisted the instructor (Meg) on a day of caving. Approximately 25 students were divided into three groups. Meg took a group of eight students and one teacher or assistant into the caves at a time for one and a half hours. Meanwhile, the other two groups did an activity or got prepared for their caving trip with the other teacher, who had been briefed by Meg beforehand.

The incident occurred on the third trip into the caves. During the trip, a student slipped part way down a deep hole but was caught by Tommy just in time. Contributing factors to this were the student's Lodge hired torch went out as she approached the hole and the student assigned to guard the hole, did not do his job. Another student (Rosie) had an asthma attack as a result of being frightened by the first incident. She did not have her inhaler with her, but Meg had a spare in her first aid kit, although on its expiry date. Subsequently, Rosie had prolonged breathing problems, preventing her from getting out of the caves unassisted. Her difficult evacuation from the caves took three hours. Tommy reflected on possible contributing factors to the incident. First, where responsibility was mis-placed with a student:

> ***T.*** *…as we were going around the cave, Meg had at certain points asked people to volunteer to go in behind her or to do a particular activity. And within the group there was one boy that continually offered and nobody else did …and I said to one of the other boys, as we were going along, why don't you offer to be the next one. And ... leading up to the incident ... when Meg asked, this guy didn't respond at all. And no one did, it was all very quiet, and then, finally … this other boy ... said 'oh I'll give it a go' … I've felt bad about the pressure I'd put on that kid for a start … I was unhappy with myself, what I'd done.*
>
> ***I.*** *Was he the one guarding the hole?*
>
> ***T.*** *Yeah, now, in fact, [he has] not turned out to be ... a particularly ... reliable person, and subsequently ... his career is quite interesting… Right so, that's something that sort of gnawed at me a bit for quite some time, and I still think of that, did I do something, at that beginning, which contributed to this whole thing? And so ... he went in, and was there to guard the hole and to direct the people to go up into the 'Birth Canal' [a tight squeeze] part of the cave.*

Second, where Meg had transferred responsibility to Tommy to ensure the students had all the right gear *before* coming into the caves. Tommy said:

> *And then, this quiet little voice just further along said 'Mr Tommy and Rosie is having an asthma attack'. And I remember my reaction was Oh God! 'Is she an asthmatic?' 'Yes.' 'Has she got her inhaler?' And then 'No'. And I thought, did I ask? And you know, I didn't ask. I didn't check before we came in, didn't think about it.*

This situation reiterates a theme which has come up already, that of teachers who have limited outdoor experience, or who are not working in the outdoors regularly, failing to carry out responsibilities which are critical to safety. Furthermore, a 'trap' situation is prevalent because outdoor instructors *rely* on these teachers to carry out some responsible roles such as checking students have the right gear: clothing, torch and medication with them. At the time of the research, two instructors were usually shared among four groups over the week. On the caving day, one instructor guided three groups through the caves. So it is not surprising that responsibilities were not always carried out effectively, when teachers did not have the training, skill or experience for the job. Additionally, teachers often found activities like caving challenging themselves, so may not be in a position to cope with much responsibility outside of looking after their own needs. This is best illustrated by Martin and Priest's (1986) adventure experience model, which shows that if you are challenged, you need to concentrate on yourself as your competence barely matches the activity demands. In order to take responsibility for others during an activity, you need to be operating in a state of 'unconscious competence' (Raiola, 1990) or in A or B zones on the model.

Four respondents identified that a **shortage of skilled staff** contributed to their HIPO incidents (Jane-Lee, Agatha, Tommy, Garth). It was also apparent in several other stories that this was the case. I believe the two factors: *shortage of skilled staff* and *mis-placed responsibility* were specific to the NZ situation and were absent from the mainly North American

literature on the subject. I put this down to New Zealand being a country of do-it-yourselfers. Outdoor education has been going on in New Zealand for over a century and tradition has it that anyone can take kids into the outdoors, and many inexperienced people, including teachers, do. We do not have the litigious society that you have in North America either. Schools rely heavily on teachers' good will to run and support outdoor education programmes. Some employ specialist instructors but they also rely on their own staff to support programmes.

Five respondents' noted a **pre-existing health condition** contributed to their HIPO incidents. These were blood in urine (Renal), students infected with vomiting bug (Jane-Lee), flu (Agatha), torn muscle (Phoebe) and hyperventilation/asthma (Tommy). Some conditions were known to staff in advance while others were not. Tommy's school changed their medical consent form as a result of the incident he had to deal with. Staff felt there was not enough room for care-givers to write adequate information about health conditions on the form, leading to inadequate information about the student being available during the incident.

Missing or failed gear contributed to three incidents (Tommy/Miriam, Fred/Bill, Garth). Missing gear included an inhaler, polypropylene and other warm clothing, paper and pencil to write emergency information down and the non-availability of the mini bus. Failed gear included a torch and the inhaler on its expiry date.

Overweight and unfit students were central contributing factors in two of the HIPO incidents. Bruce said the student who injured her ankle was *'not as fit as some of the others ... [and being] overweight made it difficult to shift her'*. Her injury effectively immobilised the group for three hours on an exposed spur in bad weather until help arrived. Fred described Eddie as a slow, unmotivated student who was overweight but not the biggest kid in the group but he was physically unfit and a blob. Eddie's slow progress on a tramp led to staff splitting the party once snow began falling heavily, as it was difficult to keep everyone warm.

Poor hygiene led to the rapid spread of a vomiting bug on Jane-Lee's camp where approximately fifty students and staff fell ill, some on tramps away from the Lodge.

In summary, I have discussed just over half the factors identified as contributing to the HIPO incidents in the study. These were those found to be significant causes of accidents in the literature and others which were common to several events and/or seemed significant. Having done this, I will examine some models for incident analysis.

C TOOLS FOR INCIDENT ANALYSIS

A number of accident and loss causation models have been developed over recent years to analyse events, to determine causes and possible areas for remedial and preventive action. Such tools are useful for examining catastrophic events where losses have been high or HIPO incidents where losses have been minimal. Research shows that serious accidents and HIPO incidents are complex events resulting from a multitude of causes over several different stages.

Current work indicates that accident causation is more web or tree-like than sequential. As a result, Fault Tree Analysis (Johnson, 1980) has been designed to identify all possible hazards with new technology as a pre-emptive loss control tool. Or it can be used after an event to determine all possible causes.

Authors (Bird and Germain, 1992; Kates, Hohenemser and Kasperson, 1985) have attempted to simplify these models, retaining key points to enable the analyst to identify critical factors which led to the accident or incident. In doing this, they imposed a sequential framework by dividing causes into different categories or stages which take account of temporal and systemic influences. Bird and Germain's research identified that the causes of most accidents can be traced back to a lack of management control. The following is an examination of these tools.

Fault tree analysis

Fault Tree models begin with the incident. Causal factors are linked to the incident by 'or' or 'and' gates. An 'or' gate indicates that only one of the causes were present (either x or y or z). An 'and' gate indicates that all causes were present (x and y and z). Agatha's incident, where a teacher suffered mild hypothermia on his second caving trip, has been analysed using a Fault Tree model. One teacher had the flu' and was unable to go caving with her group at the last minute. Barry was asked to fill in for her which meant going in a second time after his own trip. Students would have missed out if he did not do this.

Barry suffered mild hypothermia on his second trip into the caves. The Fault Tree showed a multitude of factors, many involving social and professional pressures (shaded on graph), which led to Barry getting very cold. The first tree has three areas (A, B, C) which require trees of their own. This is a simplistic analysis, more investigation may reveal many more factors (fault trees of complex accidents can go over 100 pages). Social and professional pressures on staff to lead activities, highlighted in this simple analysis, signal an area for future research.

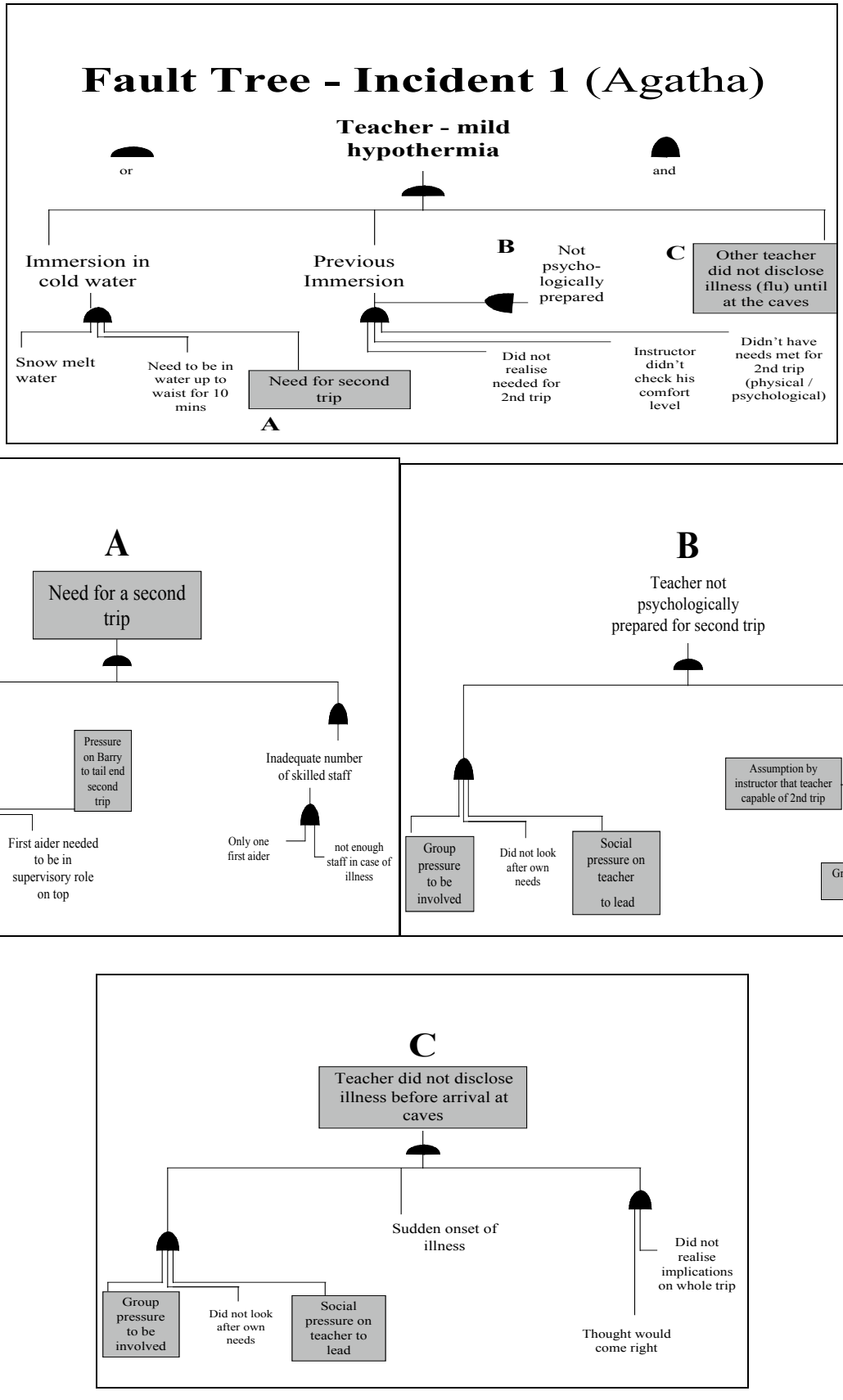

Figure 6 Fault tree analysis of incident 1 (teacher, mild hypothermia)

Causal pathways

Bird and Germain's loss causation model incorporated five stages of an accident/ incident, originating from a lack of management control.

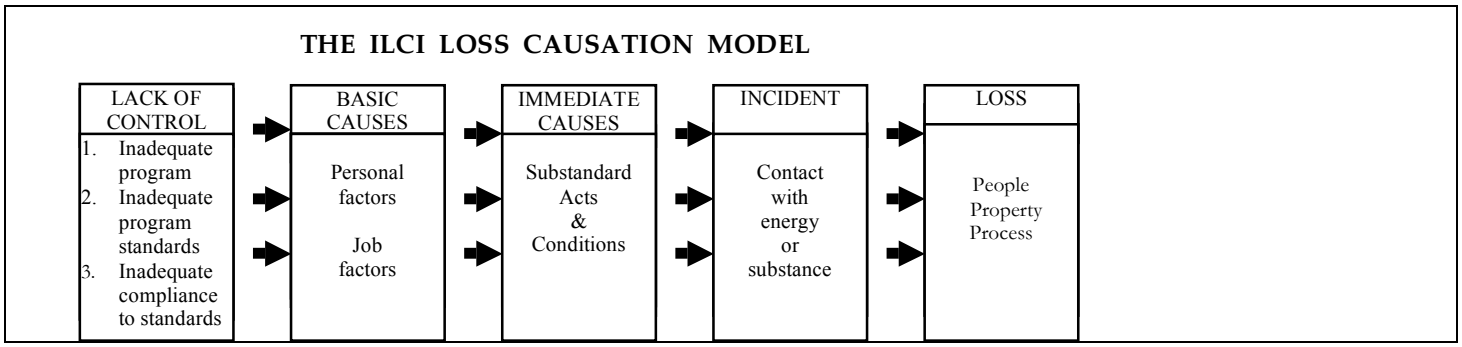

Figure 7 Loss causation model (Bird and Germain, 1992, p. 22)

Kates *et al*, identified six stages of an accident/incident and notably, identified pathways between each stage where action could be taken to block or mitigate events from culminating in a serious loss. Haddock (1993 p. 71) amalgamated these models to produce the Pathways to Change model (see Figure 7). These authors sought to simplify the web-like structure of an accident or HIPO incident into a linear model. In doing this, they recognised an accident or HIPO incident was not purely a sequence of events but acknowledged the multi-linear links between causes. Figure 8 below is an analysis of Agatha's incident using the Pathways to Change model.

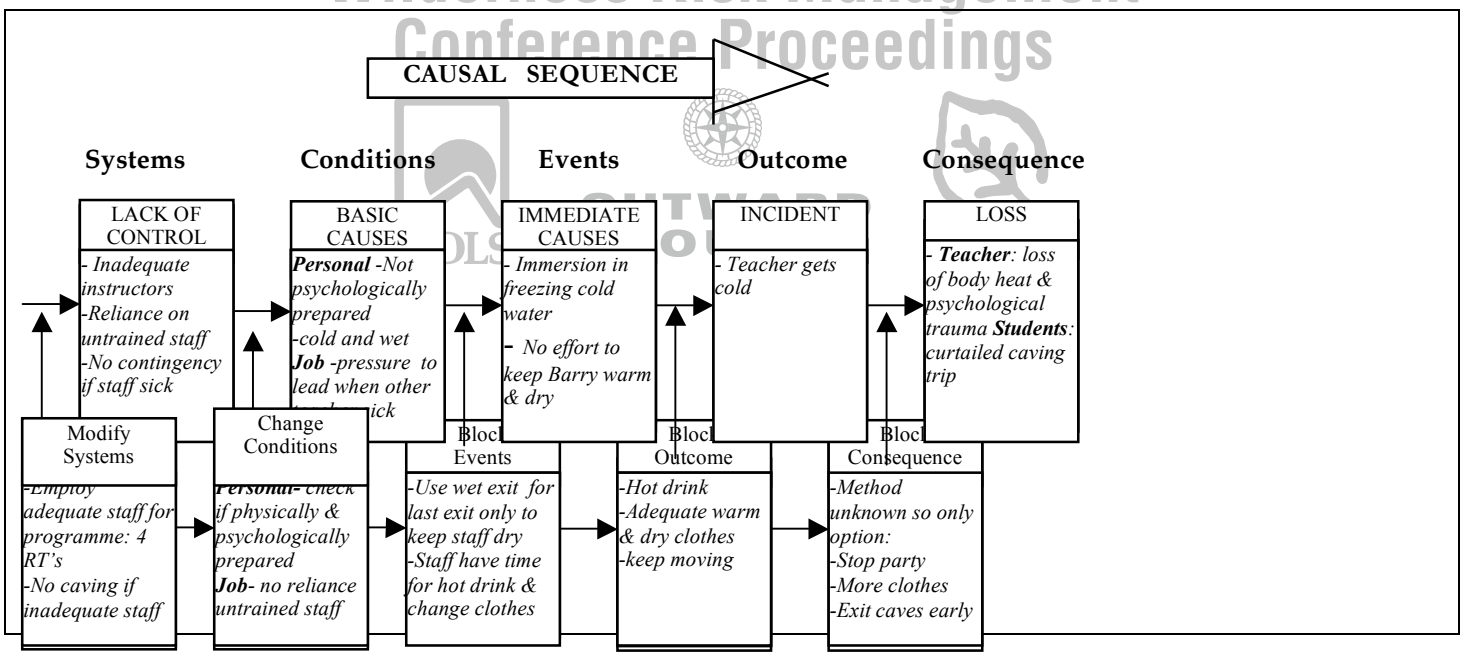

Figure 8 Pathways to Change – Incident 1 (Teacher, mild hypothermia). Adapted from Bird and Germain, 1992; Kates *et al*, 1985 by Haddock, 1993.

The analysis clearly showed that there were opportunities (pathways) between different stages of the event where strategies could have been used to block the progress of the incident and mitigate losses. Additionally, a lack of control at institution or management level was a systemic or root cause of the HIPO incident. Although staff did their best to lead students at Rotoiti Lodge Outdoor Education Centre, there was no guarantee that school staff were suitably experienced for the job, yet the programme relied on them leading some activities. So while standards and policies were in place for the activities, inadequate specialist outdoor staff to carry these out adequately was a weakness in the structure. This was a

management rather than a staff problem, as management have responsibility for ensuring national industry standards are met and that the programme is resourced adequately, which includes staffing. Causal pathway analyses of all incidents in this study can similarly be traced back to the management level of responsibility. This is consistent with industrial research, where the majority of serious events can be traced back to a lack of management control (Bird and Germain, 1992).

Summary

This paper reported on the use and usefulness of a risk assessment model to determine the significance of an event. Albrighton (1993) recommended that an incident with a risk factor of three or more should generate further investigation, analysis and corrective action. Incidents with a risk factor of three or more were the focus of this study. All interviewees rated their HIPO incidents using the tool as did the consultant. Most interviewees rated their incidents a three or more (12 of 14 ratings). The consultant rated all incidents a three or more. This indicated that the majority of respondents and the consultant thought the incidents were significant.

To test for reliability of the tool, five focus group respondents were given a case study to rate. A comparison of the probability scores showed a range of scores from zero to three, shedding doubt on the trustworthiness of the tool to accurately measure the *probability* of an event's occurrence. This variable may need some more work on the descriptors or respondent briefing. A comparison of the *seriousness* scores showed that most (20 of 22) gave a seriousness score of two, indicating the tool was more trustworthy in measuring the seriousness of an event. In combining scores, a clear majority of respondents gave the case study incident an overall risk factor of three or more (20 of 22) as did the consultant. This indicated that respondents and consultant alike thought the event had significance.

It is therefore useful in delineating HIPO incidents from other minor events with no relationship to major accidents and thus may be useful for preventive and safety purposes. I therefore recommend that outdoor programmes consider using such a tool to determine HIPO incidents which require reporting, analysis and remedial action, as part of its overall risk management plan.

This paper also described contributing factors to eleven HIPO incidents. Patterns common to several incidents were ascertained and structured using recognised models of analysis. Consistent with the literature, HIPO incidents in the study were not the result of a single cause. Interviewees identified from six to twenty five contributing factors to their incidents. Some factors identified were common and significant causes of outdoor accidents in the literature, for example: risk shift, familiarisation with the situation, get-home-itis, unsafe condition, judgement error (leader) unsafe act (student), and wild card factors.

Other factors were derived from the data. Not surprisingly given the setting, environmental conditions, particularly bad weather and cold featured in ten of the eleven HIPO incidents. Responsibility was misplaced with a student or staff member in five incidents. This was a feature of concern, as the way Rotoiti Lodge was staffed at the time of the research, necessitated that inexperienced staff or students were routinely relied upon to carry out tasks which were critical to safety. This situation was typical of many school outdoor education programmes in New Zealand at the time of writing. Other factors featuring in the data included pre-existing health condition, shortage of skilled staff, missing or failed gear, overweight and unfit student and poor hygiene.

Finally, incidents were structured using two recognised models of analysis, Fault Tree Analysis (Johnson, 1980) and a Causal Pathway (adapted from Bird and Germain, 1992 and Kates *et al*, 1985 in Haddock, 1993). Fault tree analysis showed HIPO incidents to be complex events involving numerous variables interacting in different ways, reinforcing that serious incidents were more web or tree-like than linear and therefore complex events which were difficult to manage and predict. The fault tree analysis reinforced the hindsight bias (Philipchalk, 1995), that we tend in looking back, to overestimate our ability to foresee actual consequences. The causal pathway analysis showed that incidents had multiple causes that were spread throughout several different stages of an incident. Between stages were pathways where intervention could mitigate losses. Notably, incidents were often the result of factors which only management had control over, for example, employing enough trained staff. This was identified as an underlying cause of several incidents in this study.

Cathye Haddock is a senior lecturer in recreation at the Central Institute of Technology in Wellington, New Zealand. Email: <haddock.simpson@xtra.co.nz>

REFERENCES

Albrighton, L. (1993). Emergency response – planning for crisis management. Safeguard: Journal of Occupational Safety and Health. July, 17-19.

Bird, F.E. Jr., & Germain, G.R. (1992). Practical loss control leadership. The conservation of people, property, process and profits. Institute Publishing, Loganville, Georgia.

Brett, C. (1994, February). Death by adventure. North and South. pp. 41-53.

Haddock, C.M. (1993). Managing risks in outdoor activities. Mountain Safety Manual 27, New Zealand Mountain Safety Council, Wellington, New Zealand.

Haddock, C.M. (1996). Teachers talking about their epics. Part II. Matauranga O Aoturoa, A Journal for Outdoor Educators and Instructors. April, pp. 3-7.

Hale, A. (1989). Close calls, ignore them at your peril. Journal of Adventure Education and Outdoor Leadership, 6(1) 11-13.

Helms, M. (1984). Factors affecting evaluations of risks and hazards in mountaineering. Journal of Experiential Education, 7(3), 22-24.

Johnson, W.G. 1980. MORT safety assurance systems. National Safety Council, Chicago, USA.

Kates, R.W., Hohenemser, C., & Kaspersen, J.X. (1985). Perilous progress: Managing the hazards of technology. Westview Press, Boulder.

Kauffman, R.B. (1989). Recognising the accident chain. Parks and Recreation, 24 Sept, 68-73.

Martin, P., & Priest, S. (1986). Understanding the adventure experience. Journal of the National Association of Outdoor Education, 3(1), 18-21.

Meyer, D. (1979). The management of risk. The Journal of Experiential Education, 2(2), 9-14.

Mitchell, P. (1998). Hits and myths. Safeguard: Journal of Occupational Safety and Health, March/April, 40-41.

Philipchalk, R. (1995). Introduction to social psychology. Fort Worth, Harcourt Brace, College Publishing.

Raiola, E. (1990). Outdoor leadership curricula. In J.C. Miles & S. Priest (Eds.), Adventure education. (pp. 233-240). Venture Publishing Inc. State College, P.A.