# DECISION-MAKING AS A FUNCTION OF AVALANCHE ACCIDENT PREVENTION

Douglas S. Fesler
State of Alaska, Div. of Parks, Anchorge, Alaska

## Introduction

During the decade of the 1970's, 17 fatal avalanche accidents, resulting in 24 deaths, occurred in Alaska. An investigation of these accidents revealed that 92% of these fatalities were back country recreationists, that 80% of the victims triggered the avalanche which buried them, and that the average length of burial time for a person caught, killed, and recovered from an avalanche in Alaska was 140 days. In fact, 58% of the victims were buried longer than two months before recovery. Interestingly enough, men outnumbered women as victims by a ratio of 12 to 1 and the average age of the typical back country victim was 28½ yers old (Fesler, 1980).

A review of why these accidents happened seems to point repeatedly toward three broad reasons: (1) poor route selection; (2) inexperience in hazard recognition; and (3) inexperience in hazard evaluation. Data from other avalanche accidents in North America support these conclusions.

Perhaps the real question is not "why do avalanche accidents happen?", but "why do back country recreationists let them happen?" Obviously, the reasons are many, and it would be beyond the scope of this paper to attempt to explore them all. But one aspect deserves attention: the process of choosing a safe route. This paper is about decision-making as it relates to travel through avalanche terrain. A clearer understanding of the overall problem of back country safety can be gained by focussing on this important and often neglected subject.

## Getting Into Trouble

We can gain some insights into the problems of safety by first exploring the decision-making process in standard use today. If we were to hypothetically examine a representative cross-section of avalanche victims and explore the contributing factors which lead to their demise, we would discover, in the majority of cases, that the decision to follow a particular route was generally one based upon assumptions which were not verified. Interestingly enough, avalanche victims rarely base their decisions upon all the data available to them and actually seem to be unaware of what data to look for and how to assess it. For the most part, alternative solutions remain unexplored and trip objectives are rarely identified or assessed in terms of safety and risk considerations.

In short, people don't seem to exercise their capabilities to the fullest exent possible. No enlightening system for hazard problem solving is in common use today by back country travellers. The modus operandi for the typical victim seems to range from the confirmation by group consensus method to the ostrich "head in the sand" method. The significance of making decisions like these is that they can lead to trouble.

Each of us has a different level of consciousness and perception of surroundings. Each of us assigns different priorities to what we see or believe. We all have our own level of acceptable risk with which we feel comfortable. Each of us has his own level of experience and area of expertise. However, barring these limitations, each of us still has the basic capabilities for hazard problem solving: the ability to perceive, to think, and to act.

Perhaps the best piece of equipment that a man can carry into the back country is his brain. But as Fulcher (1965) points out, man is "intellectually lazy". Emerson said it another way: "The hardest task in the world is to think" (Fulcher, 1965). And therein lies the problem.

Decision-making involves hard work, stress, and doubt. It is not surprising then, that people tend to make important and even life-threatening decisions in a casual way which reflects their ignorance of the problem. By making decisions based upon assumptions which are not verified, people tend to leave the consequences of their actions to fate, thus decreasing their margin of safety and exposing themselves to unnecessary risk.

## Assumptions

Since assumptionsseem to be one of the primary causes of victims getting into trouble, they warrant close attention. Most assumptions made by victims of avalanche accidents seem to fall into one or two categories: (1) those based upon the rationalized expedience of the decision, and (2) those based upon the presumed safety of the situation. Rationalized expedience is defined as a rational or reasoned justification (whether founded or unfounded in reality) to attain a given goal. Examples of such justifications are:

1. "We decided to hug the left side of the valley so that we wouldn't lose elevation or time."
2. "Darkness was coming, so we pressed on to the pass."
3. "I had to be back at work by Monday morning."
4. "We had planned the trip for three years and we were not about to throw it all away because of one storm."

In each of the above cases, the victims felt compelled to make a decision based upon those factors which they perceived as important. What must be remembered is that what is important to us may not be important to Mother Nature.

What is important in decision-making is that we attempt to identify those assumptions upon which we are making our decisions, and get into the habit of verifying them. In nearly every back country situation, people are faced with impending pressures: some minute, some urgent, some real, some imaginary. These tend to bias their decisions in subtle or in drastic ways. Such concerns include: sickness and injury, fatigue and weakness, ego and peer group pressures, equipment failure, economic and time restraints, and weather conditions. Often these impending pressures produce expedient justifications fopr adopting a certain course of action. Often they get people into trouble.

In verifying these types of assumptions, people need only to ask themselves: "Is it worth it? What are the possible consequences of my action? Do we really need to reach that goal?" If they don't ask the questions, they may not find the answer until it is too late.

Other assumptions involve the presumed safety of a situation, defined here as a belief that conditions are safe based upon indications that safety is probable, but not conclusive. Some examples from actual cash histories are given below:

1. "We didn't think the slope was steep enough to slide so we cut across it."
2. "We followed the tracks of another party up the mountain figuring that if they made it, we could make it."
3. "We thought that we would be safe following a route through the trees."
4. "We took every precaution; each man carried a rescue beacon, a probe, and a shovel, and we spread out while crossing the slope."
5. "The snow ranger said that the hazard was rated low-moderate, so we didn't expect to get caught."

In each case, the victims decided to move across the slope based upon the presumed safety of the situation. In each case, the victims triggered the avalanche which buried them.

The fallacies of these assumptions become obvious only if we each ask ourself: "What can go wrong? Where is the error in my reasoning? Upon what assumption am I basing my decision?" Only by asking the questions can we begin to find the answers. It may be that there will be no safe route.

Consider briefly the first example. In March of 1979, three men were travelling on snowshoes along a broad valley floor at the base of a mountain to their right. Suddenly the snowpack settled with a "womp" and sucked its way up the slope fracturing across 10 m above them. The avalanche poured down on them, burying two of the men completely. They were travelling on a slope with a 12° incline. A three-inch thickness of depth hoar lay buried 0.5 m beneath the snow surface. Seventy km per hour winds the night before had significantly loaded the slope above. This loading, when combined with the sudden new weight of three men travelling along the compression zone of the slope, significantly overstressed the snowpack causing a sudden pivot in the equilibrium balance between strength and stress. The slope avalanched. "We didn't think the slope was steep enough to slide" was their response. In retrospect they might have said: "We didn't think...enough about the consequences of our actions."

An inadequate investigation of the evidence (slope angle well) and the false reasoning of the victims led them to believe that the slope was safe. Their decision to continue following along the base of the mountain was based upon one area of data input and even within this area of information they failed to fully explore the evidence before them. They simply lacked the knowledge of what data to look for and how to evaluate it.

Data

Many years ago in India, there were four blind men who were travelling through the forest when they cam upon a large elephant. Never having seen an elephant before, each man set about trying to examine and analyze what nature of beast was before them. One man touched a leg and concluded that an elephant must be very much like a log. Another man felt the tail and explained that an elephant must be like a rope. The third man stood by the ear as it moved back and forth and concluded that an elephant must be like a fan. The fourth man felt his way around the entire body and decided that an elephant is something without beginning or end.

This study is not unlike the situation a back country traveller finds himself faced with in attempting to evaluate potential avalanche hazard. An incomplete examination of available data leads him to draw erroneous conclusions concerning the degree of hazard present. The data in and of itself becomes not so important as the interrelationship of its various components.

Referring for a moment to the example of the three men who triggered an avalanche while travelling along the 12° slope, it is clear that it is the interrelationship of the data which determines the actual degree of hazard present. It is the recognition and understanding of this interrelationship that plays the key role in route selection decision-making. Had these men understood the interrelationship of critical slope angle, wind loading, snowpack stratigraphy, bonding, shear planes, path configuration, snow distribution, and anchoring, they might have picked another route.

It is beyond the scope of this paper to enter into a discussion of the data which the back country traveller needs to investigate in order to make sound decisions (Table 1). It is sufficient to say that, in its simplest form, all of the data required to make an evaluation of avalanche hazard falls into one of three categories: (1) the mountain weather, (2) the mountain terrain, and (3) the mountain snowpack. It is the interrelationship of these three areas which is important to the back country in his investigation of data.

LaChapelle (1980) emphasizes another concept important to back country "evaluationists" as well as forecasters: that of choosing data which has a high degree of certainty about it. The spectrum of available data ranges from inaccessible to obvious. By choosing data which provides a high degree of certainty (not ambiguous) and by seeking a variety of data sources which complement the message through redundancy, the back country traveller can obtain meaningful information quickly.

Another area worth focussing upon is the way in which we perceive data. It seems that man has forgotten how to use his senses as he travels through the back country, oblivious to the hundreds of clues Mother Nature is continually sending him. These signals are like passageways to the inner workings of on-going physical processes. Listening to the sound of his skis underfoot, feeling the resistance of his ski pole as he shoves it down into the snow, watching the surface patterns on the snow cover and the cloud formations developing in the sky, and smelling the moisture of warmer air moving into his region, are all important perceptions that the back country traveller needs to develop.

## Decision-Making

You've spent the better part of the day heading toward your objective, a mountain pass, still some two kilometres distant. You're tired. The other two members of your group want to reach the pass before darkness falls. Breaking trail through knee-deep snow has been difficult. The ridge route you've been following bends abruptly to the east and ends at the base of a steep snow-filled slope rimmed by a large cornice. Your objective is on the other side. Things don't look good ahead. A light breeze is picking up out of the southeast. The sky is clear except for a scattering of pink mare's tails high overhead. What should you do?

If you haven't done it already, it's time to start asking yourself (and your group) some important questions. They are:

1. Why am I here?
2. What is the problem?
3. What are the alternatives?
4. What are the probable consequences of these alternatives?
5. What data is available to me?
6. What are the impending pressures of my decision?
7. What assumptions am I making?

These questions collectively reflect the component parts of a sound decision and must be given further consideration.

Why am I here? This question really asks: what are the purposes or objectives to be achieved? Every decision needs to be measured against the yardstick of a purpose. The purpose may be to climb a certain peak. It may be to have a good time and get some exercise. It may be to hone climbing skills. Safety is usually an unspoken objective. Only by having a purpose does a decision become meaningful.

What is the problem? In the example of the group heading toward the mountain pass, the problem starts to surface when the good ridge route abruptly terminates at an ominous looking snow slope, a potential avalanche path. Is it safe to proceed further? The problem rapidly begins to compound itself when we take into consideration other impending factors such as: group fatigue, approaching darkness, goal-oriented pressure, deteriorating weather, and alternative routes. The problem now becomes not only the original problem, but all of its consequential ramifications. Explore the entire scope of the problem before you reach any final conclusions.

What are my alternatives? Only by identifying your options in terms of your trip objective can you begin to understand the scope of the problem. This part is easy. Your options are: (1) do nothing (2) continue on (3) stay put (4) turn around and backtrack or (5) take an alternate route. You also have the option of doing any of the above in haste, or after careful consideration.

What are the probable consequences of these alternatives? Which alternatives give you the best chance of success as measured by your objectives? What are the chances of getting caught, buried, or killed? Are you willing to bet your life on your decision? The real question is: "Is it worth it?"

What data is available to me? In essence, all that can be perceived in your surroundings is data which is available to you. Of this data, only a portion is relevant to your problem. Additionally, only a small portion will provide you with meaningful information. Only by understanding the physical processes at play can you know what data is relevant and only by understanding the technology available to obtain the data (e.g. hasty pits or shovel shear tests) can you retrieve the information. Therefore, only by educating yourself can you expect to optimize your decision.

What are the impending pressures? This question also asks: "Are these pressures really important?" Many times we tend to imagine the importance of a belief, which, when viewed in retrospect, becomes nearly meaningless. Try to sort out those impending pressures which have real significance from those which do not.

What assumptions am I making? We need only to say this? "When in doubt, check it out." What thinking person doesn't travel through avalanche terrain without doubts?

## Conclusion

Each of the above steps is based upon the premise that the best possible choice has been made, and that in every case a reasonable effort has been extended to reach the right decision. In addition, good communication between group members is essential. Perhaps the hardest word you can learn to say is the word "no"; perhaps the hardest word the group can learn to accept is the word "no". But in every case, the decision regarding safe route selection should be made based upon the facts, not upon assumptions. Is it safe, or is it not safe? That is the question.

## References

Fesler, Douglas S. 1980. Alaska Avalanche Fatalities 1970-1979. Note of Avalanche Safety Program, Div. of Parks, State of Alaska, Anchorage;5 p.

Fulcher, G.S. 1965. Common Sense Decision Making. Northwestern University Press, Evanston, IL.

LaChapelle, E.R. 1980. The Fundamental Processes in Avalanche Forecasting. Journal of Glaciology, Vol. 26, No. 94, pp. 75-84.

Table 1 Possible Data Sources Available to Back Country Travellers for Assessing Avalanche Conditions Through Decision-Making Process

| TERRAIN | SNOWPACK | WEATHER |
|---|---|---|
| Slope Angle | Distribution of snow | Precipitation (Amount, |
| Slope Aspect | Depth of snow | duration, intensity) |
| Terrain Roughness | Stratigraphy: | |
| Path Size & | Layer Density/Hardness | Snow |
| Configuration | Crystal Type/Size | Rain |
| Elevation | Metamorphic Trend | Wind (Speed, direction, |
| Latitude | Temperature | duration, loading) |
| Path History | Water Equivalency | Temperature (high/low |
| Vegetation Analysis | Mechanical State: | trend, freezing level) |
| | Strength/Stress | Storm (trend, duration, |
| | Relationships | intensity, direction) |
| | Shear (Shear-planes) | |
| | Compression | Sky Cover |
| | Tensil | |
| | Viscosity/Elasticity: | Energy Exchange at snow |
| | Glide rate | surface: |
| | Creep rate | Solar Radiation |
| | Settlement rate | Terrestrial Radiation |
| | Energy Exchange within | |
| | the Snowpack: | |
| | Convection | Condensation |
| | Conduction | Sublimation |
| | Sublimation | Conduction |
| | Condensation | Convection |
| | Mechanical, etc. | Mechanical |
| | Geothermal heat | |
| | Lunar Pull | Humidity |

## Discussion

McClung:

You stated that roughly 90% of the fatalities are back country fatalities. I wondered if you had looked into the question of what percentage of those fatalities would not have access to avalanche forecasts from an office. That is, do you have any information on the number of those that are expedition climbers out in the Alaska Range and that sort of thing?

Fesler:

In examining these Alaskan avalanche fatalities with regard to when and where back country avalanche forecasts were available to the public I found that 81.8% of the victims had no access to available avalanche forecasts for their area of travel and had to rely upon their own knowledge of conditions.

McClung:

It seems to me that in Alaska there are some fairly unique problems in terms of North American mountaineering. The avalanches from the big peaks there and the runout distances can be very great. I am wondering if it might be an idea to think about emphasizing some of the principles of avalanche dynamics and runout, rather than putting so much emphasis on the snowpack work in the education program in Alaska.

Fesler:

We do a variety of things but the reality of the situation is that people are not getting caught in the ones that are running seven and eight km. They are getting caught in the little ones that are, for example, 100 m by 100 m. About 70% were killed in avalanches below 1220 m in elevation. Twenty-two percent occurred below 455 m in elevation, 43% occurred between the 915 m and 1210 m in elevation, 87% occurred below 2440 m in elevation.

McClung:

How many people were killed sitting in their camps?

Fesler:

Only one person; a river boat operator who had just landed his craft on the beach and was preparing lunch.

Zylicz:

Could you expand on your average burial figure and its relation to rescue?

Fesler:

For the most part, the only meaningful avalanche rescue in the back country of Alaska is preventive rescue. Because of the great distances, the difficulty in travel, and the sparsity of trained rescue personnel and equipment, formal avalanche rescue, as we know it, really doesn't exist. The mountaineer must rely upon himself for getting out of any trouble he may encounter. The average elapsed burial time for avalanche fatalities in Alaska during the 70's is 139.86 days. This figure does not include the elapsed burial time of survivors and therefore doesn't accurately reflect the overall burial situation.