REPEATED MISTAKES BY AVALANCHE PROFESSIONALS

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ABSTRACT

This presentation is a look at the historical record and an attempt to help the assembled avalanche experts re-evaluate their own terrain, methods, and attitudes within this perspective. Many of the recorded incidents involve avalanche professionals. These show several recurring themes. Those incidents involving lack of experience and miscalculation of hazard are discussed briefly, but the emphasis is on the policy and attitude-related themes. These include:

Unsafe control routes
Over-dependence on ski-cutting
Partner dynamics
Supervisor pressures

By evaluating his or her home situation in the context of these repeated mistakes, the avalanche professional may be able to make adjustments that reduce the risk of becoming another example in the avalanche accident records.

1.0 INTRODUCTION

The historical records of snow avalanche accidents contain many cases that involve avalanche professionals. In addition to these are the far more numerous close calls which go unrecorded. The nature of some avalanche work requires personnel to work in hazardous terrain during high hazard conditions, and therefore some risk will be involved. But there are several recurring themes in the accidents and close calls, and by recognizing these, we may be able to modify our techniques and attitudes and reduce the risk of repeating some of these common mistakes.

This study looks at five inter-related categories where mistakes are made (Figure 1). These are: 1) terrain evaluation; 2) snowpack evaluation; 3) avalanche control practices; 4) partner dynamics; and 5) supervisor/organizational mistakes.

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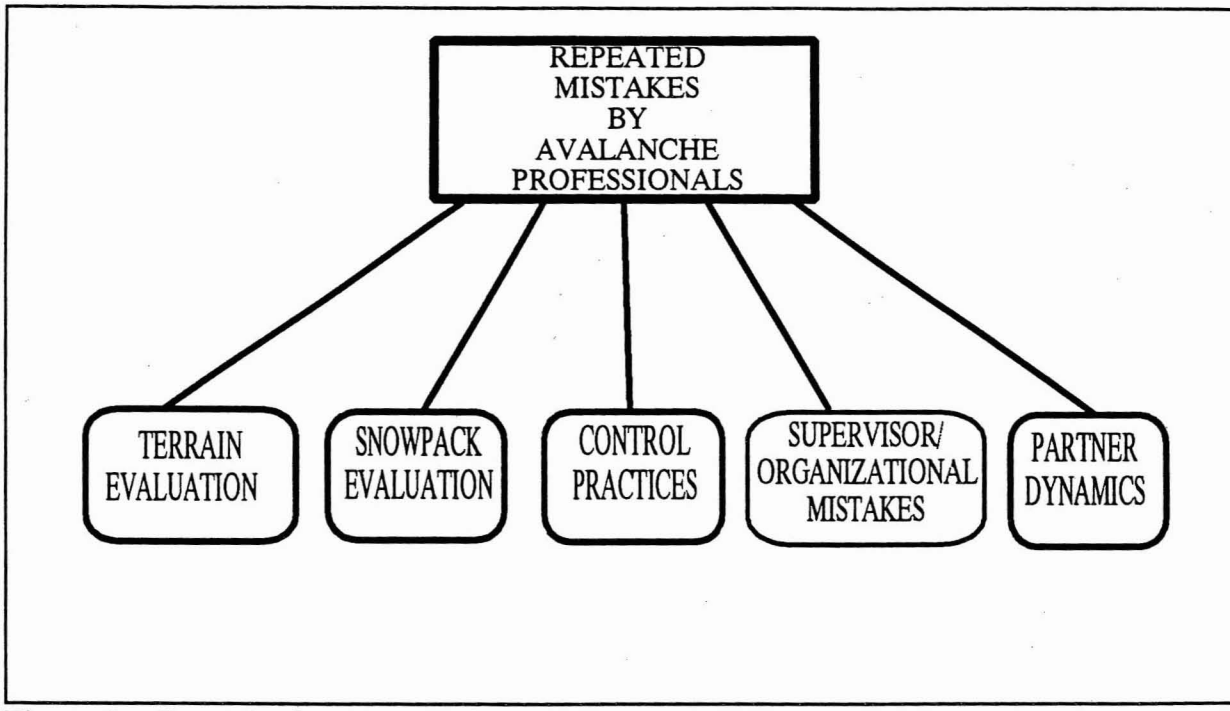

Figure 1: General mistake categories.

The discussion here relies heavily on the excellent accident documentation in the three volumes of The Snowy Torrents, as well as on the published proceedings of past ISSW's and on personal stories related by avalanche professionals.

2.0 TERRAIN EVALUATION

Terrain-related mistakes can fall in these three categories:

* Misjudgment of avalanche potential
* Ski cut suitability
* Inherently problematic terrain

One repeated theme is the avalanche accident in an area considered safe. These places may be overlooked because they are small, timber covered, or safe under normal conditions. The problems occur under extreme storm conditions, or under unusual conditions such as rare wind direction or extreme temperature gradient crystal (T.G.) development. It may be a slope that has no known avalanche history, such as Snowy Torrents case # 74-7 at Heavenly Valley, where five skiers were caught in an area that "was not designated as an avalanche area by either the ski area or the Forest Service", and where no slide activity had occurred during the past 16 years.

Or it may be an avalanche on a known slide path that outruns its normal stopping zone. Snowy Torrents # 69-10 at Alyeska, Alaska is such a case. Large slides occurred during morning avalanche control, so additional control began after the ski area closed. An artillery shot caused a class 5 avalanche that crossed the transition where it normally stops and caught

five patrollers on sweep below. Several other incidents involve unusually big slides that catch fellow workers; damage lifts, buildings, and gun mounts; and even one that hit a Forest Service powder cache, scattering explosives over the snow (Snowy Torrents # 71-3).

Avalanche hazard is sometimes overlooked on ski area slopes that are steep enough to slide but that are normally stable due to heavy skier traffic. These slopes may release on T.G. layers in the pre-season, or they may perform during unusual conditions.

Misjudgment of a slide path's ski cut suitability is another common terrain evaluation error. Ski cutting is one of the most dangerous activities in avalanche work, and it is often conducted on inappropriate terrain. Such terrain includes very large slide paths, paths that fall over cliffs, and paths with deep accumulation zones. Ski cutting is discussed further in some of the following sections.

The third topic, inherently problematic terrain, is listed here to emphasize that some terrain is not easily or safely controlled and will therefore periodically cause problems. Starting zone shape or the existence of anchors may help to hold an unstable slab in place during control efforts. And some terrain is problematic because it provides no safe points for control personnel. This may be due to large size, multiple starting zones, or mid-path entry points. Mistakes occur when these problem areas are not recognized and given special attention.

3.0 SNOWPACK EVALUATION

Snowpack evaluation mistakes fall in these categories:

* T.G. stability judgement
* Ski cut suitability
* Extreme loading events
* Post-control changes

T.G. layers are blamed for many of the post-control accidents and early season mishaps on record. If these layers are not dealt with aggressively before they are buried in the snowpack, they may present a lingering unpredictable hazard. Snowy Torrents # 71-21 at Jackson Hole describes a large avalanche in Rendezvous Bowl that occurred on the first day the upper mountain was opened. The bowl had been bombed with over 60 pounds of explosives including buried 4 pound charges. It had also been skied by over 100 skiers before it fractured 2 to 3 feet deep and 400 feet wide. The Snowy Torrents comments say: "... depth hoar provides an intrinsic weakness to the snowpack, weakness that is not corrected by the use of explosives." They advise boot packing and continuous skiing. These measures are effective, but they have limits due to time and accessibility, and hazard evaluators are left with difficult questions whenever T.G. layers are present.

Ski cut suitability may change with snowpack conditions and may become all together too hazardous under extreme conditions. Extreme loading conditions also precipitate other repeated mistakes when drastic measures are not taken in the face of uncommonly large

events. During these events, difficult decisions regarding control work, closures, and evacuations must be made based on rapidly changing conditions. Perceived over-reaction to one event may cause a reluctance to act the next time.

The last snowpack topic, post-control changes, includes loading during storms and temperature-related changes. Common mistakes during storms or high winds involve the failure to re-evaluate hazard once the initial morning control work has been completed. Several Snowy Torrents cases describe how lift skiers have been caught while skiing open runs that have loaded after morning control activity.

Isothermal instabilities must also be re-evaluated periodically throughout the day. The onset of unstable conditions may be rapid on hot spring days.

4.0 CONTROL PRACTICES

Mistakes and close calls during avalanche control are commonplace. Three recurring themes are discussed here:

* Bombing techniques
* Over-dependence on ski cutting
* Hard slab control

4.1 BOMBING TECHNIQUES

Mistakes in bombing techniques include ineffective locations, hazardous delivery methods, and ineffective bomb size. Ineffective locations may occur because shot points are inflexible, dictated locations that are hit repeatedly and are bombed regardless of indications on a given day that loading and instability are occurring elsewhere. Ineffective location may also happen when a thrown shot rolls after landing or when a long toss is required for effective placement.

Hazardous delivery methods may be used to counter the long throws or rolling charges by walking into starting zones. Also, the idea that air shots are more effective than thrown charges has increased the practice of walking out on starting zones to plant shots on bamboo or otherwise suspend charges above the snow surface.

Bomb size and bomb type may contribute to ineffective control measures. Standard 1 and 2 kilogram charges may not be sufficient in all situations. Past ISSW presentations have suggested that "doubling the shot size would approximately double the area that was affected by the shockwaves to the same degree." (Ueland, 1992). And that very large shots (>23 kg) are a valuable "hazard reduction tool" especially for deep slab instabilities such as the Jackson Hole T.G. problems discussed in Section 3.0 above (Livingood and others, 1990).

Jon Ueland compared shockwaves from cast primers and gelatin dynamite and found them to be similar. He did not compare these to the mix-together, binary type products which have some storage and handling advantages, but which may not produce comparable shockwaves.

4.2 OVER-DEPENDENCE ON SKI CUTTING

Figure 2 shows some of the repeated ski cutting mistakes. Terrain may be wrong for ski cutting where large starting zones funnel into narrow tracks, cliff bands, or deep deposition zones. Stubborn angle starting zones that gradually steepen may also increase risks for ski cutters. Snow conditions may be wrong after large loading events or when hard slab conditions greatly increase the risk of slab fracture above the skier.

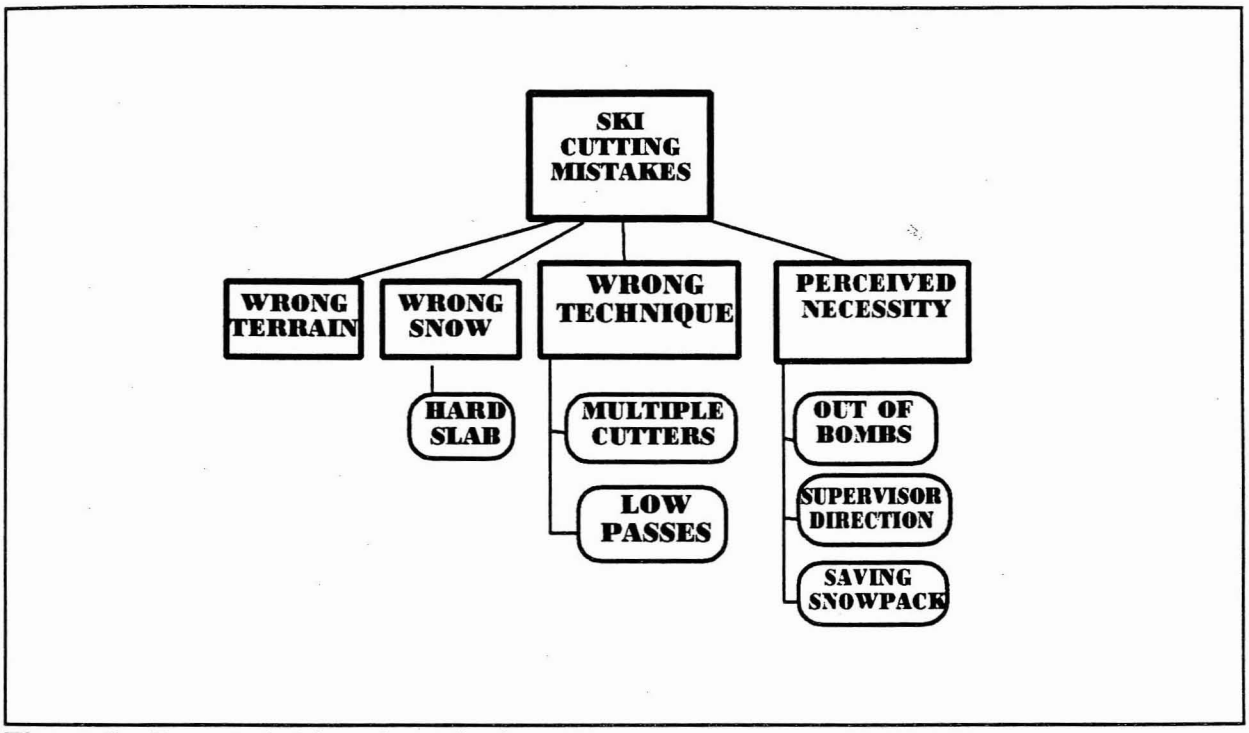

Figure 2: Repeated ski cutting mistakes.

Technique mistakes are prevalent in the Snowy Torrents. Several cases involve more than one ski cutter caught in the same slide. One patroller, caught while ski cutting, said he made the mistake of trying to do too much of the slope by making a long, shallow traverse so that he was moving too slow to ski out of the slide (# 75-20).

Kick-turns and additional low passes can also prove to be mistakes. While they may be suitable for "protective skiing" or "ski stabilization", these actions are less suitable in unstable starting zones.

Ski cutting is also employed out of perceived necessity. If control personnel have used all of their bombs because conditions are worse than expected, or because they had a dud or a bomb that rolled, they may see ski cutting as the preferred alternative to returning with more bombs or leaving some paths uncontrolled. Supervisors may direct control personnel to use ski cutting based on initial low hazard evaluation or on budget concerns. And ski cutting

may be used instead of bombs in the hope that it will stabilize the snow in place rather than removing it from high-traffic ski runs (Snowy Torrents # 75-20).

4.3 HARD SLAB CONTROL

Hard slab conditions provide several additional opportunities for mistakes. First, hard slabs may present the appearance of stability, and, in fact hard slab conditions are often stable, adding to the chance of misjudging the occasional high hazard.

Second, hard slabs have a greater potential than soft slabs to pull out above a ski cutter instead of at his skis. The cohesive strength of a hard slab may cause it to pull snow from perceived safe zones above or beside the normal starting zone, and thus catch not only the ski cutter, but also his or her partner. Once the skier is caught in a hard slab he or she has little chance of maintaining balance and skiing out through the hard, angular blocks.

Third, because thrown shots often roll away in hard slab conditions, mistakes are made during efforts to effectively place charges. Case # 72-5 is an example. Two members of a control team during Snowbird's first season were caught while they were burying a shot in a hard slab starting zone. This was the final control point on the route. "Because of the lack of activity and lack of any obvious buildup, they decided it was safe to ski out into the path." (Snowy Torrents # 72-5). Both workers survived a "fast, terrifying ride" that included a launch off a cat road. The combination of apparent stability, cohesive slabs, and difficulty with shot placement creates a high potential for mistakes during hard slab control work.

5.0 PARTNER DYNAMICS

Some of the pitfalls in this category are shown in Figure 3. Partner dynamics mistakes start with a poor "safe travel ritual". By far the most common way to make it into the Snowy Torrents is to ski out above your partner. To develop and practice a safe ritual requires communication. The lack of communication is most dangerous in control teams or groups who have not worked together before. There is a tendency to assume too much out of professional courtesy rather than to explain exactly what you expect from your new partner or from visiting experts.

Additional problems develop when friends, visitors, or trainees accompany control teams. These extras may do the unexpected as in Snowy Torrents case # 71-12, when a friend helping with ski cutting skied out under a cornice control blast and got a 1200 foot ride and a broken leg. Or a large number of extras may warrant a change in procedure. Case # 76-3 involved an eleven person class accompanying avalanche control at Jackson Hole. The two patrollers threw a shot uphill. They were sheltered behind some boulders, but all eleven students were hit by a 5 foot hard slab. No one was injured.

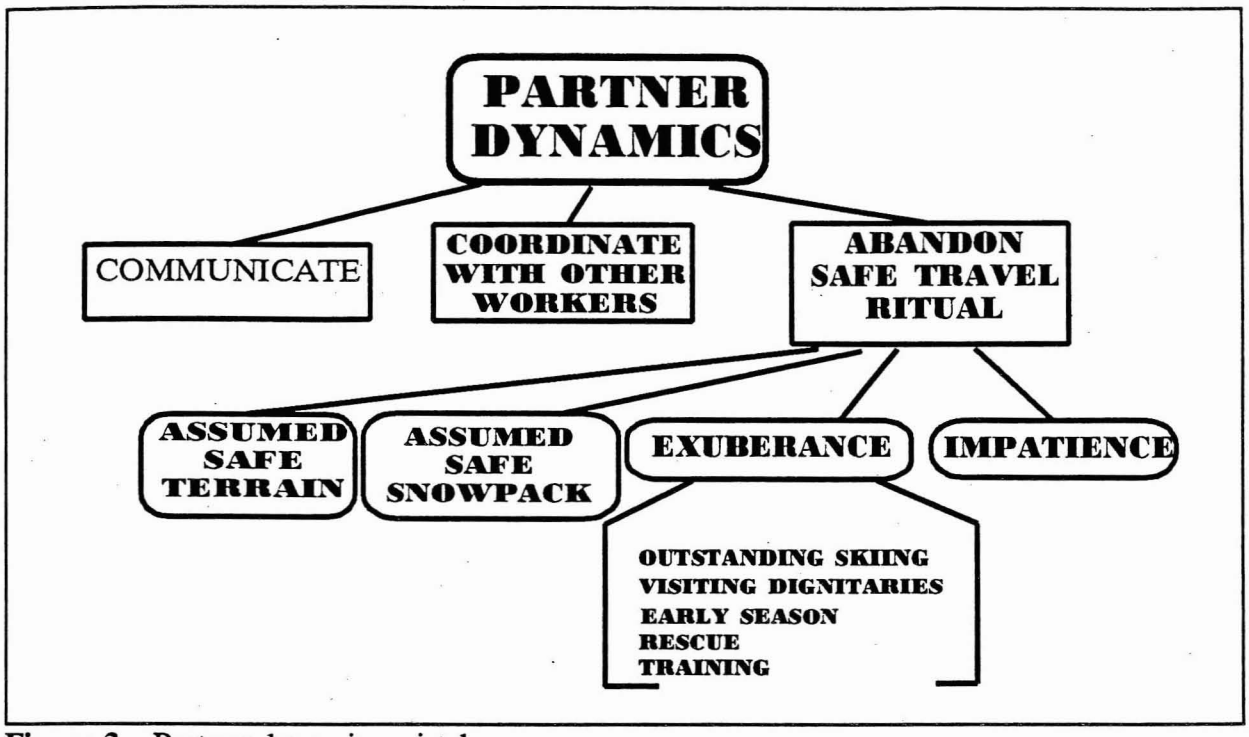

Figure 3: Partner dynamics mistakes.

Lack of coordination with other workers is a second common partner dynamics mistake. Lift operators, maintenance crews, snow cats, and ski instructors all have a history of being caught by intentionally set avalanches.

A third common mistake is the unwarranted abandonment of the safe travel ritual. Such abandonment is often warranted after terrain and snowpack evaluation, but it sometimes occurs due to impatience, perceived necessity, or over-exuberance. Impatience may lead a second or third team member to enter a slide path before his partner has reached safety. Perceived necessity to finish on time or to cover too much terrain may lead teams to split up or to cross under other teams.

And over-exuberance because of good skiing conditions, or the desire to impress fellow skiers can cause the abandonment of safe travel. Large groups seem to provide a false security, and ski patrol exchanges or other visiting dignitaries seem to bring out the dare-devil in some tour guides. Rescue parties and training groups are also susceptible to this lack of caution.

6.0 SUPERVISOR/ORGANIZATIONAL MISTAKES

The management structure of a ski area or other organization, and the individuals in charge will greatly affect the type and frequency of mistakes that are made. Many of the decisions about avalanche control measures and about closures of runs, lifts, and roads have significant financial implications. These concerns coupled with confusion over who is ultimately

responsible for making the call can further cloud an already difficult decision making process.

Most organizations with a serious avalanche problem will make a few of the mistakes discussed in the sections above during the first few years of operation. These will highlight the need to have, and listen to, experienced avalanche control program supervisors. During the first few years, they may also discover mistakes in facility placement. These mistakes can cost large amounts of time, money, and anxiety over the years as endless efforts are made to protect roads, lifts, parking lots, and buildings.

Figure 4 outlines some of the concerns of the avalanche control supervisor. It does not show the many other responsibilities a mountain manager, patrol director, or other supervisor may have. If these other responsibilities keep the boss too busy to effectively direct the avalanche control program, more mistakes will be made.

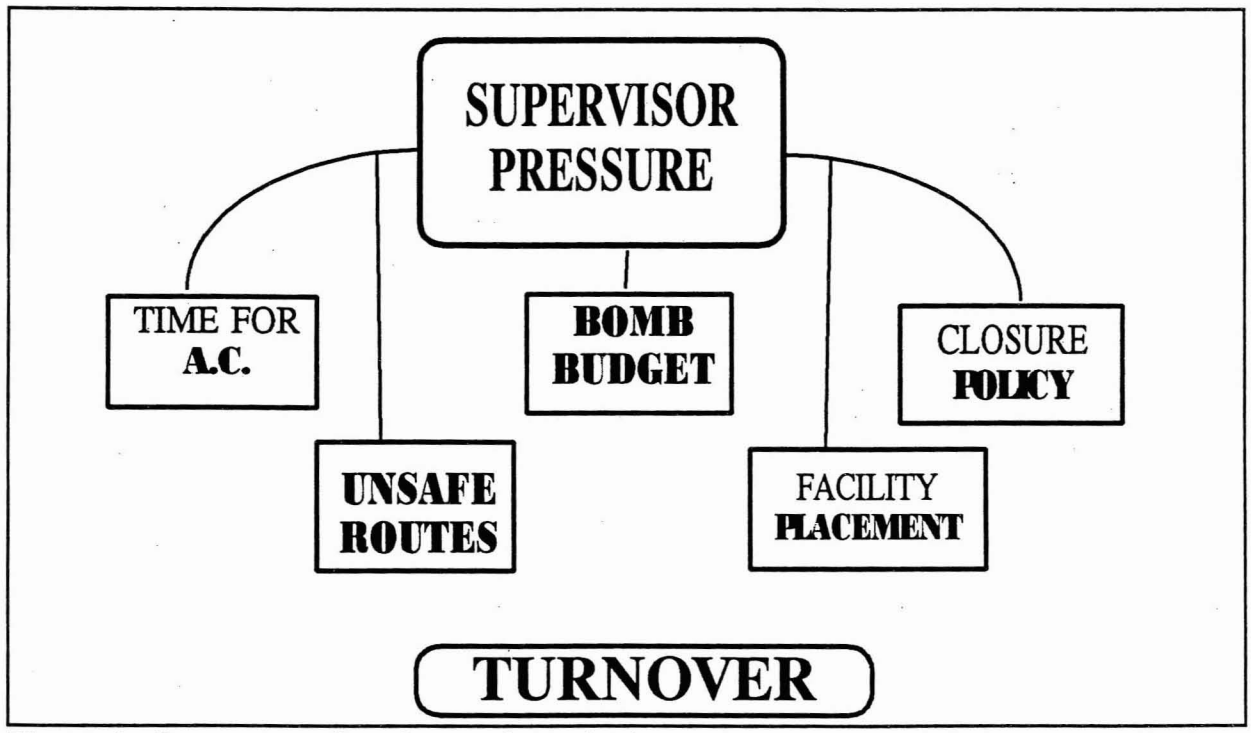

Figure 4: Some categories of supervisor mistakes.

Three of the topics in Figure 4: time for avalanche control, bomb budget, and unsafe routes, directly affect the safety and morale of field personnel. All three topics have budget limitations. The overall time allowed for avalanche control work influences the level of understanding of terrain and snowpack conditions. A common mistake is not allowing enough early season time to stabilize basal snowpack layers. During this critical time, avalanche hazard may be low and, at ski areas, bosses have other requirements such as training and mountain preparation.

The bomb budget is critical for avoiding ski cutting mistakes, post control releases, and other surprises. Provisions should be in place to expand the budget during seasons with more activity. The Jackson Hole people have demonstrated the advantages of very large bombs in some situations (Livingood and others, 1990).

Unsafe control routes may be made part of standard procedures out of perceived necessity. The alternatives to placing control teams in areas of high exposure usually cost money. These alternatives may be additional lifts, artillery, bomb trams or other delivery systems, or even helibombing. Many of the alternatives also take more time, such as climbing above exposed areas or waiting for one route to finish before dispatching personnel on a lower route across the same region.

Another dangerous supervisor policy is the over-structured avalanche control plan, where the supervisor dictates shot placement and shot size from his or her office instead of giving control teams enough bombs, time, and freedom to adapt to the conditions they encounter. All of these policies that impact morale contribute to the turnover rate. If turnover is too high, there are mistakes due to inexperience and unfamiliarity with terrain. The high turnover areas become training centers that constantly lose their good people to areas with better programs.

Finally, the greatest opportunity for supervisor error comes when they are required to perform under siege. The truly major storm events often require rapid, difficult decisions on several fronts. These decisions change from simple control measures and closures, to major closures, evacuations and possibly rescues. The large storms often cause equipment breakdowns, and they may limit avalanche control options, thus adding to the confusion. Without good communication and a clear understanding of major avalanche potential, serious mistakes will be made.

7.0 CONCLUSIONS

This paper presents a summary of some of the common mistakes committed by avalanche professionals. It does not attempt to present solutions. Rather the objective is to spotlight the various types of repeated mistakes so that practitioners and supervisors can evaluate their own programs in this context and reduce their risk of becoming a part of the avalanche accident record.

8.0 REFERENCES

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