Part 5: Choose Terrain and Travel Wisely

Learning Outcomes:

- Explain why a terrain choice is the most important hazard management decision, and should reflect everything one knows about the weather, snow and avalanche conditions.
- Relate group management and travel techniques to safe movement through avalanche terrain.
- Explain why small groups plan and decide more effectively with teamwork and organized communication.
- Relate how acknowledging and managing uncertainty can lead to safer decisions.
- Develop a better "eye for terrain"—make terrain choices that minimize consequence and likelihood of an avalanche.
- Bring the trip plan into the field, agree to a consensus process, and follow the communication checklist at critical field decisions to pre-empt human factors.
- Facilitate a constructive review of the day.

Artful terrain selection and skillful terrain management are essential to day-to-day safe travel in avalanche terrain. Easier said than done, as survivors of avalanche involvements will testify. Choosing terrain and travelling wisely are the critical steps after the preparation is complete, the observations made, and terrain options considered. The group makes a choice and implements a course of action. *You are making a decision in avalanche terrain.* The terrain option considered should reveal more than a compelling interest to descend a slope. This choice should reveal everything the group knows about how terrain and snow interact to create the mountain snowpack. Where is the snow unstable? Where could avalanches be triggered? And, if the avalanche occurs what is the size and consequence? Your **terrain choice**—the best option given the conditions—is therefore your *hazard forecast*. **Traveling wisely**—your terrain and group management and travel technique employed—is your *hazard management* and risk reduction strategy.

Part 1 introduced this process and the use of the Decision Making Framework (the DMF) to illustrate "the good decision," and Part 3 introduced Trip Planning as the foundation of the process. This chapter, Part 5, emphasizes the critical nature of terrain choices and suggests several tools and considerations to help balance human nature and assist the good decision. This section takes the decision into the field with the understanding that making good decisions is not easy. Case histories illustrate human error is common, even at the expert level. Failure to manage the avalanche problem can result in serious consequences.

Good decision makers employ common sense. Common sense is when one makes decisions that reflect his or her experience with similar conditions and similar terrain, and makes decisions that demonstrate an understanding of the potential risk, and importantly, simplifies the process. As the measure of unfamiliarity or complexity increases so does uncertainty. When in doubt, for any reason, increase the margin of safety - choose simpler, less consequential terrain that reduces the chance of an avalanche and manage the group more carefully.
Whether riding in the backcountry or embarking on a control route at a ski area consider:

- **"Where we go?"** (Route Finding)
- **"When we go?"** (Timing)
- **"How we go?"** (Group Management and Travel Techniques)

5.1 – Choosing Terrain – "Where we go?"

By the time a group departs into the backcountry, they make many important decisions using components of the DMF. The group collects observations and information about conditions. The trip planning process helps to rule out and select certain terrain options. The prior-to-departure decision that determines where not to go is the first and often most critical terrain selection of the trip.

Consider The Terrain Choices Of Others…And Ask Why?

Why do backcountry travelers go where they go? Experienced backcountry skiers and riders likely have specific and relevant reasons why given current conditions they choose particular routes and terrain. Terrain use may reflect years of observation and recognition of the patterns of avalanche occurrence. The experienced terrain choice may be valuable information indicating where avalanches are likely not to occur. Locals who are in the terrain all winter may know how much stabilizing skier compaction a "near country" slope has received. They may have watched the wind load a slope earlier in the week, or watched yesterdays sun crust get buried by the evening's storm. There could be a reason the locals are avoiding one slope, choosing another, and still having a fun day.

The *Catch 22* is an obvious one. People are creatures of habit. The terrain choice may suggest familiarity and lack of willingness to go elsewhere. The choice may result regardless of changing and deteriorating conditions. In addition, the conditions may be atypical or unfamiliar even to the experienced traveler. Persistent and deep slab conditions are the avalanche problems most often underestimated or missed by the experienced. Prudent observers ask why before committing to similar terrain chosen by others.

Reassess And Evaluate-

Use Reminders And Checklists To Support Field Decisions and Mitigate Human Factors

Once in the field the group reassesses its plan given current conditions and re-evaluates options. What is the best terrain that suits both conditions and the group objectives? At this point human factors such as desire, peer pressure, inexperience or poor observation skills can result in poor choices and a nasty consequence. Two key decision making support tools are available to improve the decision making process in the field:

1) Bring the Trip Plan into the field-
   The Trip Plan serves as the hazard forecast. Consider it "speculation" until field observations support the theory. The AIARE Trip Plan page contains the unanimous group decision as to which terrain the group planned to avoid given the current avalanche problem. Decisions made at home without the environmental pressures of fatigue, fresh powder, blue skies and unbridled excitement may be more accurate and rational—and may avoid creating a "wish list" approach to terrain.

2) Use the Communication Checklist-
   The AIARE Communication Checklist, found on the first page of the AIARE field book, is a fundamental decision making support tool designed for use in the field. The questions are inserted at key points—whether departing from the lift, on a control route, or on a tour—and promote individual and group commitment to a good process To combat the common but often benign human factors that combine to undermine the group decision, it is important prior to departure for the group to agree to use the checklist and to read the questions aloud. The group is asked to respect the pause, reflection, and the often silent voice—the devil's advocate—that the checklist promotes.

TEAMWORK
"Agree to travel together? Agree to decide together?"
"Agree to respect everyone's voice and anyone's veto! "

AT THE POINT OF DEPARTURE
"Is there anything wrong with our Trip Plan?"
"Transceiver check?" Batteries, SEARCH, SEND?"

CHOOSE TERRAIN
"Have we ID'd the avalanche problem? What's changed?"
"What's a realistic choice given what we see now?"
"Why should we go there?"
"What's the consequence if we have a problem"?
"What's the likelihood this problem will occur?"
"Would another route option be better?"

TRAVEL WISELY
"How are we going to move as a group?"
"Exactly, which terrain features will we avoid?"
"Can we see/hear each other?"
"Do we have an escape plan? Cell coverage?"

Develop An Eye For Terrain and Anticipate Consequence

Part 2 of this manual discusses the avalanche problem in terms of type, characteristics, motion and escape strategies. It also identified avalanche terrain and introduces terrain traps and trigger points where one is more likely to initiate avalanches. This chapter identifies the importance of knowledge and subtle observations when making terrain choices. Unlike the changing weather and snowpack the terrain shape is the constant throughout the season. One's ability to reduce and mitigate avalanche risk depends on the ability to assess both potential size and potential harm given the avalanche problem. Even small slopes may be problematic if the small avalanche runs into a creek, a canyon or off a cliff. Terrain traps include benches in the terrain where debris rapidly accumulates. Avalanches rapidly accelerate given a smooth start zone and tracks over 25 degrees. If the avalanche moves through even small trees and rocks the slide that is simply scary on an open slope becomes deadly if running through obstacles. Imagine the damage that would occur if one jumped out of a pickup truck at 20kph (12mph) and grabbed onto a telephone pole to slow himself down! It only takes a portion of an open slope for an avalanche to accelerate well beyond 20kph. Besides estimating the consequence of terrain it is important to develop an eye for terrain characteristics and to visualize how they interact with the avalanche conditions to create the problem.

See the avalanche path - not only the ski run


Photo: H. Schwartz


Photo: AIARE files

Every piece of terrain should be assessed with a mind to the potential consequence should an avalanche occur. Estimate where the slide would initiate, the width affected and the slope length involved. If one can't accurately guess at the nature of the problem it is always better to choose a less consequential option. Before entering a slope consider "Why should we go there" and "what's the consequence" should an avalanche occur! If in doubt...don't.

Identify "indicator" avalanche paths and "warm up runs" in each geographic area

Look for warning signs in the terrain. Often along a steep, complex ridge or cirque at the head of a valley, one specific slope is the first to avalanche during or following a storm cycle. Backcountry travelers can use this as an early warning sign that other slopes may have similar conditions, may be unstable and prone to avalanching.

Similarly, riders often choose a "safe and easy" warm-up run of comparable aspect and elevation to gather information, to correlate the opinions formed in the morning meeting, to see how things have changed since their last visit, and importantly, to gain a feel for the day's conditions.

Remember which slopes have slid previously this winter

Particularly when avoiding slopes with persistent weak layers like (depth hoar, facets or surface hoar), it is crucial to keep a record of when and if avalanches occurred on those slopes. One can assume that slopes that haven't slid on the weak layer are still suspect - even if no activity has occurred locally for days, a week or more. Photos are better than memory. Particularly when only a section of the start zone has slid leaving the weakness present on the rest of the slope.


Photo: N. Bardeen

Recognize when the wind has made changes

Chapter 2 described wind slabs and mentioned these conditions that may be challenging to forecast accurately. Lee slope wind slabs are often overlooked by newcomers to the backcountry and cross loaded features can be overlooked by even experienced riders. Looking for early warning signs is important to anticipating when the wind has made changes overnight:

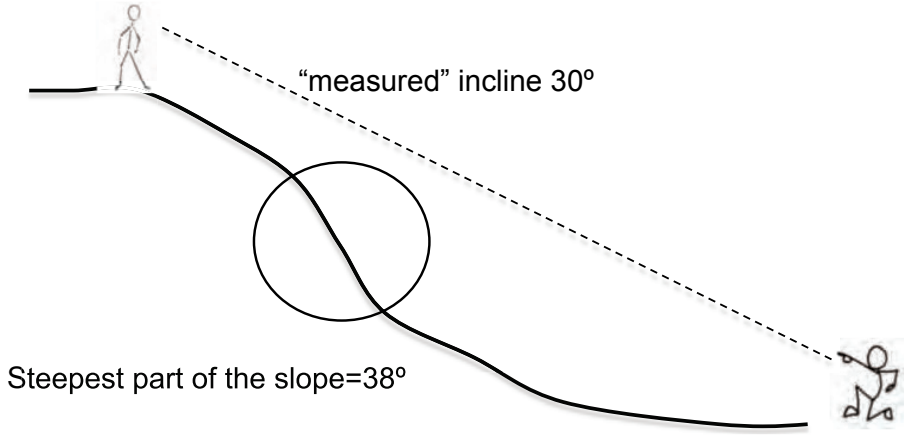
- Wind readings from the local ski area or highway are moderate or stronger
- Snow blown from trees
- Surface texture and ski penetration changes across terrain
- Snow blowing off ridgetop
- Fresh cornice formation at ridgetop
- Wind coming from a different direction than it was yesterday
- Clean thin avalanche fracture lines right below ridgetop


Photo: AIARE files

Measure The Slope: Accurately!

Slopes over 35 degrees are often where slab avalanches are most likely to initiate. Many “how to” avalanche books recommend carefully assessing slope angle and if in doubt avoiding those slopes in the 30-45 degree range. The problem is that only part of the start zone (>20m slope length) needs to be steep to initiate slab avalanches. Always record the *steepest part of the start zone*--not the average as the actual slope angle! Recognize why this measurement is hard to accurately and safely measure or estimate:

- Estimating slope angle from below or above the slope is challenging as the eye tends to *average* the slope angle
- From the top of the slope looking down, a small convexity in the terrain can cause a steep section to disappear
- Flat light from shade, snowfall or cloud averages or obscures slope angle
- Estimating from a safe spot away from the bottom of the slope also flattens the slope angle
- Placing an inclinometer on the steepest part of the slope can be hazardous!



Recognize where the terrain in the start zone creates weaker snow

Once terrain has been chosen the small-scale use of the terrain is critical. Avoid areas with barely exposed rocks or vegetation. Avoid freshly deposited wind slabs. Look for planar areas with uniform deeper snow. Look for the uninterrupted fall line with no terrain traps below. The photo to the left illustrates an experienced terrain choice in a shallow continental snowpack that likely has weak snow in spots. Name three reasons why the tracks avoided the fall line to the skier’s right.

Until the snowpack is deep enough to completely cover ground roughness - bushes, rocks and small trees are potential zones where larger facets and weaker snow areas can form.

Complex terrain without clear safer alternatives should be avoided unless LOW danger is known to exist.


Photo: T. Carter

Never pass up the opportunity to preview, analyze, and discuss terrain
Whenever there is visibility, view the terrain from different perspectives. Take photos from afar to review once on top. Note the character of the terrain changes with perspective. Constantly reassess and discuss as a group what has caused the snowpack to form layers—and where are the danger/safe areas. Never assume you've made the right choice, and always be prepared to error correct. Once back home, review your map, trip photos and discuss how individuals *see* the terrain. Opinions differ on the snowpack and terrain factors. Problem spots are often committed to memory during post trip discussions.

5.2 – Timing – "When we go?"

Experienced leaders factor in timing—when we go—as the priority during the decision making process. Weather, snow, avalanche and human factors (fitness, skills, wellness, and group dynamics) can change by the hour. Each trip plan considers whether any of these factors are time related. Trained decision makers monitor and review conditions and plan to be in the "right place at the right time" when reducing the avalanche risk and mitigating human factors.

Common planning considerations include:

- After a significant new snowfall wait a day for avalanche conditions to improve.
- On sunny days travel during the cool early morning before the sun and heat create more dangerous avalanche conditions.
- Be patient with persistent or deep persistent slab problems. Be prepared to wait a long time. Particularly in continental snowpack climates, backcountry riders commonly wait until spring before planning a favorite high mountain multiday tour or peak descent.
- When rain is in the forecast no time is a good time. Travel becomes immediately slow, tiring, and dangerous. Slopes may slide more than once if the rain continues.

Time related avalanche problems are complicated. Pay attention to time related suggestions in the public avalanche forecast discussion. Traveling with someone experienced at managing the time related hazard is always helpful.

5.3 – Travel Wisely – "How we go?"

Group management and travel techniques with terrain knowledge can further reduce the probability of triggering, of being caught, and decrease the consequences of an avalanche. How the group moves through the terrain can reduce their exposure and therefore further reduce the avalanche risk.

When choosing specific routes on a slope, groups discuss and clearly define their "safety margins." With respect to avalanche terrain, a margin is the physical distance the group decides to place between themselves and the avalanche. A narrow margin doesn't leave room for error: misjudging the extent of the avalanche, or misjudging the ability of the rider to stay within the boundary of safer terrain.

Example: Estimate the potential runout of the avalanche and allow a 100m margin in the terrain between your planned route and where the avalanche would likely come to rest.

Example: Deciding to descend a slope one at a time does not employ a margin of safety. This is described as a group management technique. Each group member is individually as opposed to simultaneously exposed to the consequence of the avalanche—including injury and death.

Remember to use the Communication Checklist:

TRAVEL WISELY

"How are we going to move as a group?"
"Exactly, which terrain features will we avoid?"
"Can we see/hear each other?"
"Do we have an escape plan? Cell coverage?"

Ensure the group has discussed the communication plan before entering hazardous terrain

- Verbal shouts can often be misinterpreted; discuss signals that clearly represent "stop", "don't ski past me", "come down/across one at a time", or "take the other line"
- Use personal radios to avoid miscommunication
- When skiing through the trees ski in pairs, adjacent but apart, and yell back and forth
- When discussing and agreeing on a travel strategy such as escape routes and safer zones, everyone in the group should make eye contact and nod in agreement to ensure everyone is listening, have heard and agree.

Establish the group travel strategy before entering hazardous areas.

- Check transceivers again; pros will often repeat the morning checks once during the day.
- Ensure all have the skills to manage the terrain/conditions and stay within the proposed route.
- Generous distance between skiers and riders is always a good idea—whether uphill or downhill; distance allows the descending rider an unobstructed view of the slope and the escape route, less effect on the snowpack, less likely two will collide, and less likely two would be involved in the same avalanche.
- Do all have visual contact or will the first person ski out of sight?
- Is the plan to ski or cross the slope one at a time, from safe point to safe point? Will the proposed distance apart only commit one person to the slope? Is there a better option in the terrain than crossing through what has been agreed upon as a potential threat?
- Plan to re-group on high ground or islands of safety with better visibility to reassess terrain ahead.
- Regroup with your skis or snowmobiles pointed towards an exit route. Snowmobiles have kill switches up.
- Allow a generous "safety margin" between safer and less safe terrain. The first on the slope can use his or her track to establish an obvious boundary in the terrain. Confirm the group knows for certain on which side of the track to descend!
- Use easily described terrain features to illustrate the terrain and control the group. For example, staying in the well spaced trees as opposed to the steeper wind affected open slope. Or, descend right of a group of trees. Or, stay out of the obvious gully.
- Stop and regroup in open spots away from hazards (benches, roads, large open glades) and before more complex terrain that may require a different group strategy.
- As your degree of uncertainty increases, increase the margin of safer terrain between the group and the hazard.

Applying techniques in the terrain:

Leave a spotter on the ridge with a good view of the decent and regrouping area. Note that the tracks in the photo on the left place a margin of safety between the skier and the steeper, unstable terrain and cornice hazard above and off on the lookers right. The spotter is experienced with emergency response and has a radio, cell phone and emergency/companion rescue equipment.

The photo on the right show tracks that avoid the wind loaded slope on lookers left and descends lower angle terrain that avoids the avalanche problem.

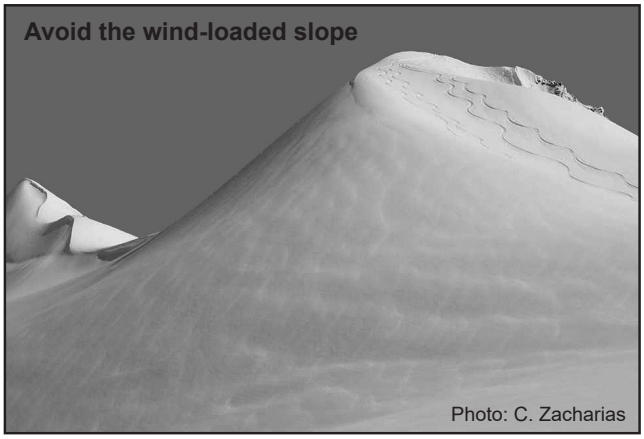


Photo: "Distance apart" Two group management strategies. What distance is adequate given the slope and stability?

Photo: "Cross high on the slope" If no other better route exists and the slope is short with no terrain trap, cross high on the slope so any fracture would occur below your track.

Photo: "Ski to the right of my track!" The first track establishes a boundary between steeper terrain that has more wind effect. The leader used the tallest trees as the obvious marker.

Group Management and Travel Techniques while important DO NOT supersede safe terrain choices

Proper application of group management and travel techniques is critical—"use the right technique, in the right place, at the right time." If the application is not appropriate for the terrain and conditions, the result may increase risk. What works in one situation may not work in another. These techniques are used to *further reduce the risk of terrain selection decisions.* Travel technique cannot be allowed to override terrain selection. For example: if a slope is unstable the slope should be avoided, rather than deciding to ride it one at a time. Ensuring the group is well practiced at companion rescue is no reason to further expose the group to avalanche terrain! Terrain selection is a far more effective way to manage avalanche risk than use of travel techniques. Even one person caught in an avalanche can have unacceptable consequences. The art of employing group management and the correct travel techniques requires experience and good leadership, good communication, a *willingness* to turn around and to error correct to a safer terrain option: a commitment to do the right thing!

Photo: "When in the trees, yodel to each other." Even in the trees keep ample distance between skiers to ensure each rider has a good visual of the terrain ahead, potential hazards,an eye to the exit and regroup location, and can hear any warning shouts or radio calls. Don't listen to the mp3 player!

5.4 – Managing Uncertainty

"When faced with uncertainty the good decision maker embraces uncertainty"

REALITY CHECK – "THE SAFE LINE"

Skiing downhill from the pass we approached a moderately angled flank splitting two bowls known locally as "the safe line." The weather had deteriorated during the day's tour. It was late in the day. I was nervous. The poor visibility meant it would be hard to find the safe line in the pea soup.

Legend suggests the route was nicknamed after a local guide's close call on the ridge in question. He had mid way down the ridge, heard a whump, and watched as both slopes on either side of the ridge slide to size 3 leaving him with a beating heart and perched on the only undisturbed snow in the bowl!

The danger was "considerable." The accompanying paragraph warned there were slopes that had slid one month earlier and were now "high" danger due to a post-storm cold clear period that left a sugary unstable base under the newly formed and shallow snowpack. Of course no one could tell you *which* slopes had slid. We had a great day of touring: up and over a pass, long run on the north side in perfect powder on a low-angled and fun glacier. Coming home we felt "the safe line" was a reasonable "short cut" back to the lodge.

As we approached the flank I took over the lead. I knew where the "safe line" was, and wasn't trusting of my friends to find it in the fog. I skied down one 20-degree pitch and stopped as the terrain steepened below. The skiing was fantastic! I could hear the hoots behind. But I was too far right. We regrouped. Leaving my friends to wait, I set a track left and found the flank. In the poor light it didn't look like much of a ridge. It was steep and blended in with the slope on either side. I was getting worried. I should have skinned back up. I yelled back, *"I found it. I'm on the ridge. Come on over….one at a time….and stay above my track."*

I wasn't clear ….too many words…I had said the most important thing last. My stomach clenched as they all left at once, *one traversing below my track.* There was a terrible "whump" and I watch in horror as the world fell apart. Fractures shot through the group's skis, across the ridge, and under my feet. The whole bowl slid. Size 3. To ground. When the dust settled we were all standing together, and on "the safe line". The slide was 1.5m deep, 300m wide with a 4-5m deposit in a terrain trap at the bottom. The ground on which we were standing was intact, except for the cracks and fractures.

In retrospect this slightly protruding feature was the safest way down and did save the day. Yet, if it was a slightly more unstable , or different slab condition we may have all been dead, piled together like cordwood under 4m of dense avalanche debris. When we talked about it afterwards we decided it a combination of mistakes but the main one was we were (I was) too confident. Given that we were told to be cautious due to the high degree of variability, our route was too steep and connected to surrounding terrain to be a safe line in these conditions. We had gained too much confidence in one past event—one story—and it almost killed us. There was too much uncertainty (variable snowpack, high danger areas, poor light, a terrain feature that is "safe" *sometimes*). Instead of threading the needle, we should have picked lower angled terrain with a smooth, deep, snowpack. A route we could be certain hadn't slid in the past storm.

Never underestimate how much info you lose as the light fades, and as uncertainty increases lengthen that long arm of caution.

Colin Zacharias
AIARE Technical Advisor

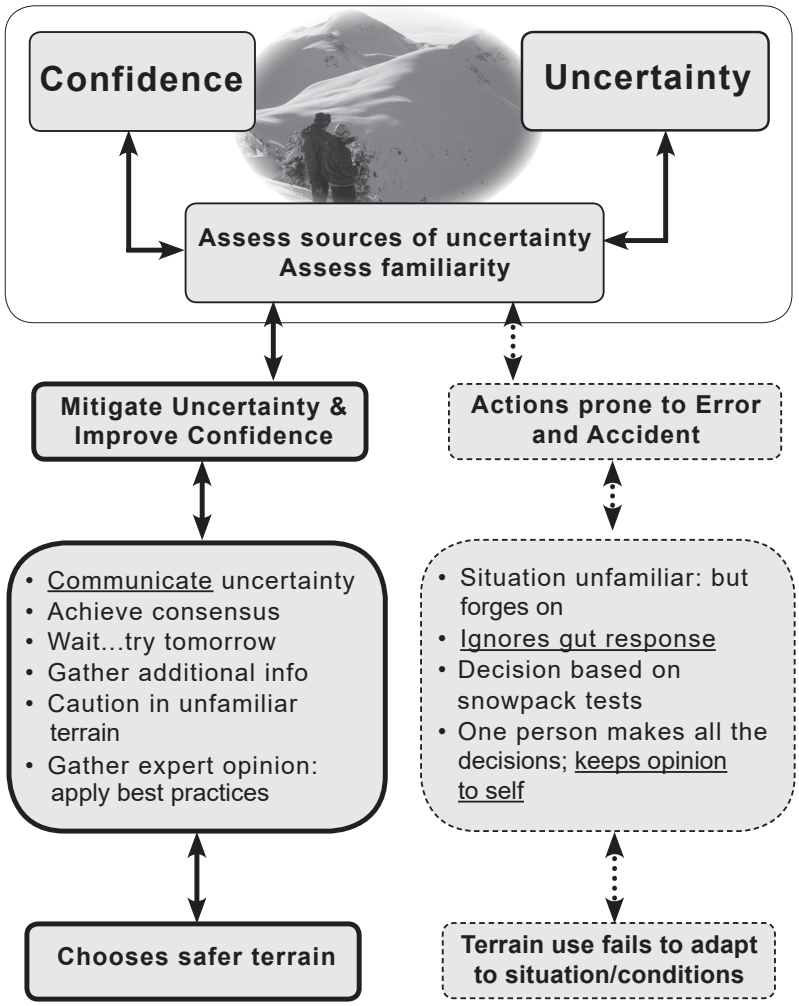
The previous chapters and discussions illustrate that when making decisions in the backcountry no one topic stands alone. The DMF shows that the components of backcountry decisions are all interconnected, and that analysis and action is ongoing.

Consider the possible consequences of any decision before you commit

The Communication Checklist asks the decision maker three important questions:

- "Why should we go there?"
- "What's the consequence if we have a problem"?
- "What's the likelihood this problem will occur?"

These above prompts question motivation, measure one's familiarity with the terrain and snow conditions, and ask one to be honest and consider probable consequence and likelihood of an event. Ironically those who have been caught or have had a close experience with avalanches are often more apt to assess a slope's potential consequence. If the decision maker struggles to answer any or all of the three questions, their inexperience with this particular circumstance becomes evident. Good decision makers assess their lack of confidence and communicate the degree of certainty as a measure of the reliability of their forecast and terrain decisions.



Assess Uncertainty

Keep decisions within your scope of experience and knowledge. Are the conditions unfamiliar (Atypical weather trend, unfamiliar snowpack layering, a new group, seeing avalanches in unfamiliar places)?

Be comfortable with any decision that will affect your risk exposure and vulnerability. Getting more information may help, but depending on one's ability to accurately interpret the information, new data may only confound the issue. When uncertain, seek an outside and expert opinion. As a default choose a simpler and more cautious option.

Factors contributing to uncertainty:

- Quantity and quality of information (relating to snowpack and terrain, as well as site selection and craftsmanship)
- Relevancy of information--relation to the extent of the problem
- Variability of snowpack characteristics over the terrain
- Variability of the mountain weather forecast
- Skills, ability and relevant experience of the decision maker
- Group Dynamic

Consider the Human Factor and Maintain a Margin Of Safety

"Small teams make better decisions than individuals."

Are your decisions being affected by personal bias? How is what you "want" affecting your perspective? Humans are the common element in all serious avalanche accidents. We all make mistakes and human factors play a key role. A detailed look at the human factor traps is listed in the Appendix following Part 7: Where To Go From Here. Throughout this manual there is an emphasis on learning to express one's own voice and importantly work as a team. It is well known that small groups make better decisions than even experienced individuals—if they employ a few checks and balances. The DMF asks the group to work as a team, to plan and prepare, to make important field observations and decisions as a group; it also points to using checklists such as the Trip Plan, the Field Observations page, Avalanche and Observation Reference and the Communication Checklist to ensure the decisions unfold as planned. Specifically, the Communication Checklist supports consensus decision making in the field. The Quick Reference: Companion Rescue checklist spells out critical tasks if the worst come into play and an A-Z response is required under the duress of looking for a lost friend.

The tools and knowledge provided in the course will assist you in making an informed decision. However, experience is the real teacher in the backcountry. It is very uncommon to be 100% certain in avalanche terrain. Each of us has to be vigilant to recognize avalanche terrain and be aware of the potential level of exposure and lay down an adequate safety margin that accounts for the likelihood of error.

Decisions made in the field will ultimately determine the success or failure of any trip—more than anything learned in this course. Good backcountry decision making takes practice. One convenient solution is to choose a travel partner and mentor who is an experienced and consistent decision maker. However some of the best have learned from their own errors. The next chapter, Part 6 is devoted to preparing to manage emergency situations in avalanche terrain.

5.4 – Review the Day

"We always make better choices when we ask ourselves what could we have done differently?"

Most people are pretty keen to improve their skill sets and increase their knowledge. One common and accepted method is to discuss and debrief significant aspects of decisions at each day's end. This can be an informal discussion or an operational style meeting where daily forms record the discussion. Use the prompts at the bottom of the AIARE field book Field Observations pages to facilitate the discussion and learn from the experience. Whether one is an experienced forecaster or heliski guide or a first timer in the backcountry the following four questions are helpful. They are condensed from common questions use by professionals.

REVIEW THE DAY:
"Were our choices in line with our forecast / plan?"
"When were we most at risk?"
"Where could we have triggered a slide?"
"What would we do different next time?"

QUESTIONS TO TEST UNDERSTANDING:

1. What are four key components to a functional team that is likely to make good decisions in the field?

2. Describe three human factor traps that you can recall from a backcountry trip. How did this affect your backcountry decisions?

3. Describe the human factor solution(s), using the tools described in this and other chapters that would have mitigated those issues.

4. Why is it so important to develop an eye for the subtleties of terrain shape in the start zone?