# Part III: Developing Expertise in Avalanche Judgment and Decision Making

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## INTRODUCTION

Several decades of Naturalistic Decision Making (NDM) research have shown that studying the skills experts use to make decisions in real world settings can form the critical foundation of highly effective decision skills learning and support programs for less-experienced decision makers. Using Cognitive Task Analysis and the Critical Decision Method, I studied the most significant decision making experiences of a group of expert Canadian avalanche professionals. My objectives were to: (1) examine and identify the judgment and decision processes of avalanche experts; (2) identify the human factors that influence avalanche experts' ability to make sound judgments and decisions; and (3) explore how these findings may be used to develop strategies for decision skills learning, decision support, and effective avalanche accident prevention.

In Part I of this series, I discussed the processes and strategies that avalanche experts use to solve the decision problems they face in their profession. In Part II, I discussed the human factors that negatively influence avalanche experts' ability to make sound judgments and decision actions. In this article, I examine the positive human factors that support sound avalanche decision-making. While human factors have received considerable interest in the avalanche field, most of the focus has been on their negative influence. I argue that human factors also exert positive impacts in avalanche judgment and decision making. For example, while low levels of motivation to solve decision problems may lead to decision error, high levels frequently lead to decision success. Thus, taking a strength-based approach to enhancing positive human factors is a tremendous tool for decision quality enhancement and support.

From this perspective, I will discuss the characteristics of avalanche expertise, and key methods for enhancing decision-making performance. I then offer a set of focused strategies for decision skills learning and training, and interventions for decision support.

## PART III HIGHLIGHTS

- Motivation to learn and improve avalanche decision-making is a critical component for the development of expertise, for those who lack motivation will never perform at the level of experts.
- The level of skill and expertise a person attains is directly related to the amount of deliberate practice in which they engage.
- By applying and practicing the key strategies used by avalanche experts in real world settings, decision makers can target their learning to develop the skills that are proven to really work.
- Well-designed scenario-based training approaches can provide more learning value than direct experience.
- High-quality communication enables decision makers to dramatically enhance their knowledge and expertise.

## 1. CHARACTERISTICS OF EXPERT DECISION-MAKERS

I found that expert avalanche decision makers have specific characteristics that differ from their equally experienced partners. They are motivated to learn, have high levels of personal mastery, approach their profession with an attitude of safety and respect, and are exceptional communicators.

### *Motivation to Learn*

The avalanche experts in my study possessed a deep motivation to learn and to improve their knowledge and decision-making capacities. For example, one expert related, “I’m constantly trying to expand my knowledge base by reading books, taking courses, and spending time with other experienced professionals.” Motivation to learn is the most cited condition in the literature for improving decision performance and developing expertise.

Avalanche experts are passionate about their work. They actively seek feedback and opportunities to learn, they read and discuss their experiences with other practitioners, and they reflect upon their experiences frequently. These experts are also highly motivated to solve the decision problems they face. High levels of motivation to reduce situational uncertainty frequently leads towards decision success, while low levels may lead to negative consequences (see Part II). The finding that participants were motivated, self-directed learners is an important result of my research, since this suggests that avalanche decision-makers of all levels can significantly improve their judgment and decision-making capacities by engaging in targeted activities and decision-skills training.

### *Personal Mastery*

Highly effective decision makers are distinguished by their ability to frame the decision problem well. However, as I have shown in Part II, avalanche judgments and decisions are subject to internal (cognitive, physiological, and psychological) and external (team, client, organizational, and socio-political) human factor influences. I suggest that successful avalanche decision-making requires decision makers to have a high level of personal mastery and leadership skill. Personal mastery involves making decisions based upon a strong set of core values and principles, continually learning to see the situation more clearly, and having the personal confidence to not be overly influenced by the words and actions of others.

These qualities are key to achieving an accurate perception of the factors influencing the decision problem, to being aware of the biases and assumptions that may be present, and making suitable decisions in light of this awareness. Personal mastery reduces the influence of negative human factors in the judgment and decision process, and incorporates mindfulness (metacognition) and situation awareness (see Part I). Thus personal mastery plays a significant role in the capacities of avalanche decision makers to make objective and principle-based decisions, and is a fundamental factor in the quality of competence for avalanche decision expertise.

### *Attitude and Approach*

*"Anticipate the unexpected, prepare for the worst case scenario, and be prepared to be wrong or fooled" (research participant).*

Knowledge of their limitations and a deep commitment to safety was fundamental to how these avalanche experts approached their practice. All of the experts in my study had experienced close calls during their careers as avalanche professionals. These experiences had increased their respect for the uncertainties associated with avalanche phenomena, for the serious consequences of involvement, and for the imperfect nature of human decision-making. For example, one study participant related, "I recognize I have made errors in the past and will do so in the future." Our ability to take our strengths and limitations into account is a key strategy (metacognition) to successful decision-making.

Experientially created knowledge enabled participants to objectively manage avalanche hazard and risk, and reinforced the importance of including a buffer zone of safety within their decision actions. For example, one expert suggested it was critical to "maintain a margin of safety that is just a hair bigger than what I think I need." The decision actions that resulted included increased mitigation, reducing terrain exposure, or choosing terrain closure or avoidance. These simple tactics require limited cognitive processing, and can be executed by decision makers of any level of expertise to result in higher levels of safety.

### *High-Quality Communication*

A key characteristic of expertise is the ability to communicate thinking and expertise to others. Additionally, high-quality communication results in high-quality decision making and team performance. For example, a ski area forecaster related; "Good communication and discussion is critical to my decision process. We always talk about what we are seeing and thinking before an action is taken."

I found that exceptional avalanche decision-makers were exceptional communicators. They encouraged an atmosphere of open communication, listened carefully, and showed respect and encouragement for different points of view. They also used critical thinking techniques extensively, such as raising vital questions, analyzing their own and their peer's assumptions to determine whether they were justified, or examining the reasoning process for consistency in interpretation when drawing conclusions.

High-quality communication enables decision makers to dramatically enhance their knowledge and expertise. Greater levels of communication results in richer mental models, reduced uncertainty, and higher levels of decision confidence. It also reduces subjective biases that may have been present in an individual decision maker. A key recommendation of participants in my study was that communication skills training should be a key focus in team decision-making environments, and should include an emphasis on leadership skills for those in supervisory positions.

## 2. ENHANCING DECISION MAKING PERFORMANCE

*"Experience, an unconscious feel for the situation, and a commitment to safety overriding all other factors – another day in the life of an avalanche professional" (research participant).*

Avalanche decision-makers of all levels can enhance their decision-making performance by learning from the successes of avalanche experts and engaging in the following targeted activities:

### *Deliberate Practice*

Avalanche experts have superior knowledge, skills, and information processing capacities acquired through experience. However, the accumulation of experience as a single factor does not necessarily produce decision expertise. It is what we do with our experiences that make the difference. Engaging in deliberate practice has been found to be the most effective way to improve decision-making performance. Exceptional mental conditioning results from engaging frequently in activities specifically designed to improve decision-making skill. These activities include practicing the key decision processes and strategies used successfully by experts, pursuing professional development and learning activities, seeking out coaching and mentoring, and engaging in critical thinking and reflection. Extensive research in performance acquisition shows the level of skill and expertise a person attains is directly related to the amount of deliberate practice in which they engage.

### *Mentoring and Coaching*

A key recommendation of participants in my research was to implement mentoring and coaching more formally into the avalanche domain. We all need external feedback to provide us with a realistic picture of our effectiveness. No matter how accurate we think we are, we are constantly challenged by the reality that our personal interpretative filters may lead us into distorted ways of thinking. In order to transform our experiences into expertise, we need to actively gather and interpret this feedback from others whom we respect.

Hearing the perceptions of our peers helps us gain a clearer perspective of our thoughts and actions, and alerts us to our judgmental ways of seeing. Sometimes, these conversations may also confirm the correctness of the instincts that we felt privately but doubted for a variety of reasons. Cognitive and process feedback are two techniques to improve high-stakes decision making. Cognitive feedback provides information about the interrelationships between the environment and the decision makers perceptions, while process feedback provides information on how decision makers can make effective adjustments to their decision-making approach.

### *Critical Thinking and Reflection*

It is widely recognized that learning and performance enhancement cannot occur without questioning and reflective processes. Critical thinking and reflection enables us to derive new insights, richer mental models, and an understanding of the causal influences that may not have been evident at the time. Utilizing questioning instead of answer finding,

considering how our assumptions are shaping our viewpoint, and searching for information that opposes our position, as well as supports it, are several examples. Building upon our knowledge and experiences with critical questioning and reflective insight can make the key difference to the quality of our problem solving and to deriving effective solutions.

## 3. DECISION SKILLS LEARNING AND TRAINING STRATEGIES

Well-designed decision skills learning and training strategies can help avalanche decision makers of all levels acquire and enhance critical skills, perceptual cues, and knowledge more quickly. Following are a set of strategies designed to help avalanche decision-makers achieve expertise more quickly.

### *Experiential and Action Learning*

Research in adult education identifies experience as the most valued resource in the learning process. In addition to field experience, exposure to new ideas and practices through well-designed learning strategies has a powerful impact upon our learning. These activities result in improved judgments and a greater capacity to gather, interpret, and communicate relevant information. I suggest the emphasis must be placed on action learning – learning how to learn in realistic situations. In addition, this emphasis must support and enhance the decision processes and strategies actually used in the real world, rather than generic skills that confirm to optimal procedures. These are key principles, since it is only through testing ideas and strategies in practice that we are truly able to know whether they are effective or practical in real-world situations.

### *Build Experience Learning Like an Expert*

A widely used strategy to develop decision expertise is to build experience learning like an expert. By applying and practicing the key strategies used by avalanche experts in real-world settings, decision makers can target their learning to develop the skills proven to really work. Avalanche experts use the decision strategies of pattern recognition to make effective judgments, and mental simulation to analyze if their planned actions will work. They utilize mindfulness (metacognition), situation awareness, and critical thinking to analyze whether their judgments are accurate, and they communicate effectively with others to gain additional insight and perspective to their decision processes (Part I). These strategies are integral to objective and sound decision making and offer powerful tools to counter the influence of potentially dangerous biases and heuristic traps in the decision process. An awareness and understanding of these key strategies can enhance our capacities to strategically apply them with greater accuracy and success.

However, it is important that decision makers utilize the appropriate decision-making *processes* for their level of knowledge and skill. As I explained in Part I, avalanche decision-makers evolve through a cognitive hierarchy of decision processes from rule-based to integral systems thinking. Thus, the use of higher-level processes such as intuition should not be encouraged in novice decision makers. While our intuitions can be valuable, we need to use them accurately, and make our decisions based upon informed gut feelings. Novices lack the rich experience base and mental models essential to perform at this level of cognitive function, and to accurately recognize and interpret complex patterns in a set of information or high-stakes decision. As a result, their intuitions may be strongly based in the affective (feeling and emotion) domain,

which may result in potentially dangerous biases in their judgment and decision processes. Thus, decision learning and training strategies should emphasize decision processes and strategies that are appropriate and effective for specific levels of knowledge and experience. For a further discussion on the hierarchy of avalanche decision modes and decision strategies, please see Part I of this series.

***Encourage Pre-Decision Making***

Pre-decision making is a fundamental part of the systems approach to decision making used by the avalanche experts in my study. Pre-decision involves anticipating and identifying critical decision conditions or points, and then planning strategies and options for associated decision actions prior to their occurrence. Pre-decision making is an extension of mental simulation. Examples include planning route options, making determinations about specific terrain use, and logistical planning. The run list is a typical example in the ski guiding industry.

This strategy serves a critical function in reducing cognitive workload in field situations, and reduces the influence of human factors that inhere in the avalanche decision process. Prior research suggests the more preparations and information analysis that decision-makers engage in before entering stressful situations, the less anxiety they experience. Since anxiety levels correlate directly with performance levels, pre-decision making is an important tool for sound avalanche decision-making.

***Increase Situation Awareness and Perceptual Capacities***

The key to effective avalanche judgment and decision-making rests in an ongoing, accurate perception of the conditions in the human, physical (terrain), and environmental (weather and snowpack) systems. Situation awareness, rich mental models, and metacognition (mindfulness) are the primary input into decision processes, and are the fundamental components that guide our selection of decision actions. Thus, increasing these capacities should be a key focus for avalanche decision-makers and for decision skills training strategies.

***Focus on Scenario-Based Approaches***

Lack of experience is often discussed as a fundamental barrier in enabling decision skill. However, we do not learn only through direct experience. Recent NDM research has shown that well designed scenario-based approaches can provide more learning value than direct experience. I recommend case studies and simulations as two key methods to build avalanche decision skills and to enhance leadership capacities and team communication:

**Case studies** combined with effective coaching enhances the learner's vicarious experience base and enriches their mental models through a process of studying and reflecting upon how decisions were made under specific circumstances. Creatively designed case studies enable judgments and decisions to be examined and learned in the context within which they naturally occurred. They also encourage learners to identify key vulnerabilities and human factor influences. They are an excellent method to develop perceptual expertise since decision makers can see how the cues appear within the context of a realistic situation, and receive valuable coaching from the facilitator.

By engaging in realistic and detailed **simulations**, decision-makers have the opportunity to critically assess situations, and build a sense of characteristic cues and common patterns (mental models) essential to intuition. Simulations are designed to capture the essence of difficult and uncertain situations, and challenge decision makers to utilize proven decision strategies to decide upon an effective course of action. Learners are encouraged to develop alternative explanations, identify conflicting evidence, and describe the actions they would take at specific points during the simulation. Simulations also provide insight into how different decision makers perceive the same situation, and provide learners with the opportunity to practice their skills for communicating essential information and working effectively in team environments.

***Integrate Human Factor Training***

Recognition processes are a key strategy used by avalanche decision-makers (Part I). Integrating human factor training into professional and recreational learning curricula will bring a critical awareness of the influence of positive and negative human factors in the avalanche judgment and decision process. Thus, avalanche decision-makers can strategically increase their capacities to recognize and manage their presence with greater accuracy and success. This strategy is of critical importance, since the more negative human factors present in a situation, the harder it is to apply good judgment and decision-making.

***Enhance Team-Decision Making***

Team decision-making can be enhanced through effective management of information resources and workload, coordination of actions, and more effective communication. Communication enhances predictability, which helps team members and stakeholders to set expectations, plan for future contingencies, share a common mental model, reduce ambiguities, and decrease stress levels. Improving communication is a primary strategy for improving individual and team decision-making performance and reducing human error.

**4. DECISION SUPPORT INTERVENTIONS**

As I have shown throughout this series, avalanche decision-makers use uniquely individual processes of decision making. Thus, interventions to support decision making and enhance decision performance need to be designed with flexibility and focus on methods that naturally lead to supporting appropriate choices. I offer four focused interventions for effective decision support.

***Capture Avalanche Domain Knowledge and Experience***

Knowledge is now being recognized as being the single, greatest asset of individuals, teams, and organizations. Recent research indicates that knowledge doubles every three to four years; therefore a focus on the acquisition, creation, storage, transfer, and utilization of knowledge (mentofacturing) is fundamental to support effective decision-making. Capturing key knowledge and information that describes historical and current avalanche system dynamics (human, physical, and environmental) provides a virtual mental model to support decision making, individual, team and organizational learning, and future systems design. Knowledge banks are key learning tools as they direct decision makers' attention to critical aspects of the decision problem, and illustrate

mental models of the avalanche domain. GIS is a particularly useful application enabling key information to be displayed spatially using visual displays that are easily understandable for users of varying levels of expertise.

***Identify the Architecture of Good Decisions***

Avalanche decision-making has a heavy reliance on tacit knowledge - knowledge that is not easily verbalized. Deliberating upon and deconstructing good decisions is necessary to expose this tacit knowledge and to understand the underlying architecture of good decision making. In addition, defining the qualities of good avalanche decision-making is necessary for constructing the models from which decision skills learning programs can be effectively designed. Debriefing exceptional decisions takes a strength-based approach to decision capacity enhancement and is a tremendous learning tool for individuals, teams and organizations.

***Record Human Factor Influences***

In Part II, I identified the human factors that negatively influenced the judgment and decision actions within my research participants. However, limited research exists in this area. In order to gain a deeper understanding of these influences, descriptive empirical data is needed. I suggest that defining criteria for the recording of human factor influences in avalanche accident and near-miss records, and implementing the capture of this information, will offer critical insight into avalanche risk assessment, decision skills learning initiatives, hazard communication, and decision support.

***Ensure Learning Initiatives are Accessible***

Learning is not only undertaken by individual decision-makers, it must also be encouraged and supported by organizations that are committed to foster individual, team, and societal learning through sharing information, creating a sense of community, and fostering creative and accessible learning initiatives.

As I have emphasized, decision makers need to have the motivation to pursue them. I suspect the benefits clearly outweigh the costs for professional avalanche decision-makers. However, it is unclear whether recreationists would be willing to devote the time, money, and effort required to engage in these activities. Creative avalanche decision skills learning programs are a critical tool to enhance recreational decision-making, and one that I suggest would be most effective in reducing avalanche involvements. Thus, ensuring these programs are accessible to the public by securing funding from industry sponsors and granting agencies should be a primary focus for decision support initiatives.

**CONCLUDING REMARKS**

Developing expertise in avalanche judgment and decision-making takes time and energy. However, we can train decision-makers of all levels to achieve expertise more quickly by learning from the successes of avalanche experts, and by engaging in targeted activities and decision-skills training. Motivation to learn and improve avalanche decision-making is a critical component for this development, for those who lack motivation will never perform at the level of experts.

Effective and successful decision-making is critically dependent upon attaining a good understanding of the situation. Thus, building strong mental models and developing accurate situation awareness through scenario-based approaches should be a key focus of avalanche decision skills learning strategies. Well-designed learning strategies can be more effective in developing good knowledge and skills than direct experience, since repeated experiences of poor decision-making or false-positive events can result in dysfunctional strategies for future decision-making.

The learning methods I recommend take a strength-based approach to facilitating the development of key decision skills and learning strategies used effectively by expert avalanche decision-makers in real world settings. These methods offer a meaningful opportunity to enhance individual, team and organizational learning, and to infuse avalanche training programs and decision support interventions with vital tools to support and enhance avalanche judgment and decision-making.

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**FURTHER READING**

Chi, M. T. H., Glaser, R. E., & Rees, (1982). Expertise in problem solving. In R. S. Sternberg (Ed.) *Advances in the psychology of human intelligence, 1.* (pp. 1-75). Hillsdale, NJ: Erlbaum.

Endsley, M., (1997). The role of situation awareness in naturalistic decision making. In C. Zsambok, & G. Klein (Eds.). *Naturalistic decision-making.* (pp. 269 – 284). Mahwah, New Jersey: Lawrence Erlbaum Associates.

Klein, G. (1998). *Sources of power: How people make decisions.* Cambridge, USA: The Massachusetts Institute of Technology Press.

Klein, G. (2003). *The power of intuition.* New York: Currency Books.

Orasanu, J., & Salas, E. (1993). Team decision making in complex environments. In G. Klein, J. Orasanu, R. Calderwood, & C. Zsambok, (Eds.). *Decision making in action: models and methods.* (pp. 327-345). New Jersey: Ablex Publishing.

Sexton, J.B. (Ed.). (2004). *The better the team, the safer the world: Golden rules of group interaction in high risk environments.* Ladenburg: Gottlieb Daimler and Karl Benz Foundation, & Swiss Re Centre for Global Dialogue.