

## A PROPOSED PARADIGM FOR ADVANCING HUMAN FACTORS RESEARCH: LINKING BEHAVIORAL AND AVALANCHE SCIENTIFIC DISCIPLINES

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### **Introduction**

**“One of the things we are trying to do with all this work is ultimately to save lives” –Dr. Ed Adams**

The avalanche industry understands that to save lives, we need to understand human behavior. The scientific discipline most directly affiliated with human behavior is behavioral scientists. The avalanche industry has a unique opportunity to collaborate with behavioral science leaders to reduce avalanche fatalities and increase safety. Much like the lessons learned by the aviation and other industries, it has been proven that training in human factors has positive effects. One study by the FAA found reduction of judgment errors were reduced by up to 50% through human factors training. Thus, linking the avalanche industry with the behavioral science and scientists can yield very positive benefits. Though it is unfortunate the linkage to date is weak, this paper outlines how to move forward and more tightly couple the avalanche and behavioral disciplines.

A quick history of the underpinnings of avalanche research will show why this collaboration is necessary.

### **Research History**

Avalanche scientific research began in 1931 in Switzerland, and in the United States in 1945. Initially, the effort was to mitigate large scale dangers; to save villages and maintain transportation hubs. For the next eight decades avalanche research has been focused on physical aspects of avalanches. The physical sciences have dominated both scientific minds and resource commitments.

It took five decades for the avalanche industry to truly recognize human factors:a transition from large scale problems to the small scale, namely, the individual victim. Beginning about 1980 the best the industry could do was try to understand the human factors discipline and leverage research from other industries into the avalanche domain. That is, an individual who is not a behavioral scientists reads a series of papers and makes a presentation at the biennial avalanche conference. Specialized research into avalanche Human Factors did not have much real development until 2002.

There have been two instrumental Human Factors projects by the avalanche industry.

1. Project Zero (just rebranded as The Avalanche Project is a partnership among AIARE, Snowsports Industries America (SIA), Friends of the Colorado Avalanche Information Center, Friends of the Utah Avalanche Center, Friends of the North West Avalanche Center and the Canadian Avalanche Centre). Project Zero is designed to unite the industry at large through a safety narrative that speaks to all backcountry user groups. The aim of Project Zero is to provide an effective safety message. Credible messengers representing the various user groups will deliver messages uniquely tailored to those in various industry segments, including snowboarders, skiers, snowshoers and snowmobilers
2. The Canadians through their Avalanche Decision Framework for Amateur Recreationists (ADFAR2 )project of the Canadian Avalanche Centre, which was funded through the New Initiatives Fund of the National Search and Rescue Secretariat (SAR-NIF) of the Government of Canada. Their \$600K funding of a field decision tool (Evaluator) is the exception, not the norm.

Given the impact and influence of human factors on safety and risk mitigation it is surprising how little has been done and how distant the industry is from the scientific discipline best equipped to assist in the solution.

The obvious next step is to combine the behavioral scientific discipline with the avalanche industry to pursue and improve our human factors understanding and more importantly the tools and training. And perhaps the best way to combine these disciplines is to conduct joint research. Perhaps then, the industry with its behavioral scientific partner will be more able to mitigate the dangers posed in the avalanche domain. I will outline the process and achievements generated so far by linking the avalanche and behavioral scientific interests.

### **Intellectual Transfer**

The avalanche industry does not have internal resources to do much human factors research. The research to date has been done by other fields and transferred into the avalanche industry. This makes perfect sense given the organization design and structure of the avalanche industry. There are only sixavalanche research centers; Davos at \$14M/year, Montana State at \$200k/yr. ,Simon Frasier at \$200K/yr.(just awarded as of December 2015) and Center for Snow and Avalanche Studies (\$140K/yr.), AINEVA (Italy) and about E758K ANENA (France) And all except \$100K (approx.) at Simon Frasier is dedicated to physical sciences. This represents one human factors researcher for the entire industry, without many resources for external efforts.

So if intellectual transfer is the mechanism, what is the best means? This has been studied by myself and others involved in the field of Technology Transfer. In the mid-80's, the United States made a concerted effort to transfer technology from public agencies to the private sector for economic benefit. Studies of technology transfer (then and now) list many mechanisms, including paper publication, conferences, and personnel exchanges. But they all conclude that the best means of technology transfer is to conduct joint research.

So how can the avalanche industry conduct joint research with the behavioral sciences within the constraints of internal resources?

### **Behavioral Science Research**

Human Factors is a large scientific discipline with several professional organizations. One of the most prominent is the Human Factors and Ergonomics Society. If the Human Factors disciplines in avalanche risk were to be more closely examined, they might include:

1. Decision-making (Naturalistic, Heuristics/Biases, Natural Dynamic Graded Continuum)
2. Cognitive Task Analysis
3. Sensemaking
4. Situation Awareness
5. Neuroeconomics
6. Risk/Communications
7. Group Behavior

### **Creating the Behavioral Science Linkages**

The constraints of the avalanche industry, (essentially one researcher with perhaps a small cadre of non-paid interested parties) suggests that the industry must rely in large part on the behavioral sciences; either leveraging findings from existing research, or developing relationships within the industry.

This means the avalanche industry has to radically move from its present practice of learning behavioral science from a distance to establishing more and closer strategic partnerships. To achieve this, the lead author has:

1. Completed three joint research papers
2. Presented at the IEEE CogSIGMA conference
3. Presented at the Center for Critical Risk Management
4. Attended the Human Factors and Ergonomics Society in 2015.
5. Developed two joint research proposals
6. Had a behavioral scientist specializing in Situation Awareness and Group Behavior audit my Avalanche Level 1 class.
7. Developed two proposals for the avalanche industry to evaluate: Shadowbox (Cognitive Training) and another for Cognitive Task Analysis (CTA).
8. Discussed leveraging findings from the neuroeconomics Lab into the avalanche domain.

9. Conducted more than fifteen key interviews with the thought leaders in all the above disciplines and contacted more than 45 behavioral scientists.

This is only the beginning. It will take a long time to make real progress, probably decades—not years unless a different avalanche industry organization and/or funding model appears.

### **Objectives**

Specifically, the author seeks to improve the following within the avalanche community:

- Improve Level 1 and 2 Human Factors training within the one hour allotted timeframe.
- Create risk profiles and link to group dynamics.
- Extend avalanche human factors learning beyond the classroom to an off-line framework.
- Either take the best field decision and enhance, or create a new field decision tool
- Develop a mobile application for real-time decision making
- Enhance the avalanche centers communication outreach to the public
- Leverage High Reliability Organization (HRO) protocols into the avalanche mitigation systems.
- Answer the most fundamental question of all “Can training/public outreach/decision aids make volunteer behavior in avalanche zones less risky?

### **Challenges**

To achieve the above objectives will either take a lifetime of dedication, or what the lead author calls an system of Avalanche Human Factors. The avalanche industry should no longer act in isolation from the behavioral sciences. Beyond immediate research engagement, the industry needs to create a pathway for young scientific professionals to use the avalanche domain as part of their professional development. To achieve this, the lead author has begun to work with graduate, doctorate, post-doctorate students and young academics just beginning their professional journey. By developing papers and research proposals with these individuals, the seed is planted for the next generation of scientific inquiry.

Since the avalanche industry does not have the resources to carry out the necessary research alone, it needs to create a Research Roadmap. This is much more difficult than a systems engineered approach for an engineered system. The human mind and behavior are non-systemic and no discipline can act as the Project/Program Manager. Thus, the avalanche industry must itself act in that capacity, which will require immersion in the behavioral sciences across the full panoply of disciplines.

### **Conclusion**

The avalanche industry can more efficiently and more rapidly achieve increased safety and improved operational objectives by combining the intellectual prowess of the avalanche and behavioral sciences. The industry can achieve its objectives without such collaboration, but the fact remains the behavioral sciences are willing to support our efforts. The industry should consider focusing its research efforts through a research roadmap to align all the interests of the avalanche community.