APPLIED JUDGEMENT AND AVALANCHE INFORMATION TECHNOLOGY

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ABSTRACT: This paper and poster present a component of the larger paper described in the submitted abstract. It describes an avalanche forecasting work process that utilizes an electronic observation recording and data storage system. It is a combination of methodology and technology, conceived in the lineage of low to high entropy data classes, and grounded in current professional avalanche curricula and procedures. It incorporates nouveau hazard and risk perspectives. It establishes a connection between judgement and applied avalanche forecasting.

"*Everything flows and nothing abides; everything gives way and nothing stays fixed."* Heraclitus

"*If you can't describe what you are doing as a process, you don't know what you're doing*." W. Edwards Deming

"*I see it as the same issues and ideas coming around again and again, but each time at a more sophisticated and technically advanced level – hence the ascending spiral*." E. R. LaChapelle

1. INTRODUCTION

Applied avalanche forecasting is defined by McClung & Schaerer (2006) as a process; a dynamic risk assessment with decisions based on an information flow through time "and an ever-present residual risk". This definition supports portraying a forecast office as a process-centered organization (after Hammer 1997) that includes a defined set of activities that represent the steps required to achieve an objective, which includes the flow and use of information and resources.

Considerable attention has been given to the characteristics of avalanche forecasting (LaChapelle, 1980; McClung, 2002). A personal dialogue of ``just what it is we do?" and "what are the factors leading to being off-target?" has been present the duration of my career. Beginning with my radio first call after promotion to control route leader that the avalanche path I just finished working was safe for the public; continuing years later with post storm reflection when destructive events escalated to a magnitude greater than that of my forecast.

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Within the avalanche community, programmatic consideration has tended to focus on an in-vogue topic such as situational awareness, heuristic traps, expertise, intuition, and now - judgement.

2. JUDGEMENT MODEL

Marr (2006) presents a thoughtful model of geotechnical engineering that is fully transferable to avalanche forecasting (Figure 1). The practice of avalanche forecasting requires one to function with very limited data about a complex environment where conditions can change radically over a short distance and with time. To accomplish this, avalanche forecasters utilize scientifically acknowledged principles of extrapolation, interpolation, deductive and inductive logic together with their expertise to broaden this limited information to a generalized model of the state of the snowpack. Marr argues that it is thinking that moves one through the different phases of the process.

The definition put forth by Facione (1990) for critical thinking aligns with our understanding of the forecasting process; "purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based". Thus we establish the connection between thinking and judgement. Judgement as used in applied avalanche forecasting is critical thinking and critical thinking as used in avalanche forecasting is applied judgement.

Figure 1. Avalanche forecasting process model (after Marr 2006).

3. AVALANCHE INFORMATION TECHNOLOGY

Information technology has played an increasingly present and valuable role in the support for avalanche forecasting. Examples include automated observations, data bases, information exchange, and avalanche cartography. Improved computing power has supported the improvement of dynamics and processes modelling. Attempts to computer generate forecasts on par with existing practices have been from a practitioner's perspective, interesting and academic. There are no algorithms for judgement or critical thinking.

This poster illustrates an electronic format intended to capture and document the judgement so fundamental to the avalanche forecasting process. It presents an operational avalanche forecasting log (OpAFL) that is accessed using a web browser.

The OpAFL is a component of a larger weather and avalanche observation entry interface and database system. Data entered for weather observations and avalanche events supports the workflow generated in the OpAFL. The OpAFL is sequentially completed much like a checklist. However, it avoids the weakness of a checklist system (LaChapelle, 2005) and does not lock out unusual thinking demanded by unusual conditions.

Completing the log directs progress through the information organization and analysis that comprises an essential step in the applied avalanche forecasting process. In this manner it codifies the process and captures the resultant decisions / actions. There are links to open analysis pages to provide supporting information useful in completion of the log. Upon completion, it provides output for the customization of a Hazard / Risk Advisory for an operational zone.

A new log entry is created every time there is a change in the hazard rating, risk rating, or closure status. Three cognitive activities (discussion, analysis, and assessment) are captured at various stages of the OpAFL work flow. The following definitions guide the activity where the terms are used.

- Discussion is an interpretation, consideration, examination of the observations to explain, analyze, and compare them.
- Analysis - an investigation of the component parts of a whole and their relations in making up the whole.
- Assessment – a qualitative and or quantitative evaluation of the nature, quality, ability, extent, or significance.

The poster details the framework of the log along with the content guidance for each step. The log is divided into the following segments:

- Administrative details
- Class I Data Analysis
- Class II & III Data Analysis
- Avalanche Likelihood & Magnitude Factors
- Hazard Assessment Rating
- Exposure & Vulnerability
- Risk Communication Rating
- Operation Planning
- Active Measures

Within the log structure, priority is given to narrative, which captures the purposeful thinking of the forecaster. Data analysis incorporates trend assessment and specific summary fields meant for sharing judgement with neighbouring operations. Class II and III data analysis is organized in three segments Snowpack Factors, Storm Factors, and Meteorological Factors. Class I and III data is displayed in a manner that supports geographical visualization by the forecaster.

Likelihood and magnitude (Statham, 2008) includes narrative discussion of the spatial distribution, assessment of the present stability by zone or elevation band, a weather forecast and associated confidence, forecast stability by zone or elevation band, discussion of the avalanche character (size and dynamics), and concludes with terrain influences to the present hazard. This segment concludes with a hazard rating by zone or elevation band.

The next segment begins an identification of what is at risk and affects levels of associated risk. What measures are in place to reduce the exposure or strengthen the vulnerability. A rating is determined that allows risk communication to occur. Operationally, various practices are associated to various risk levels.

Operation planning entries are building blocks for creating the risk communication document. They include: a one line summary to get across the most salient points and elicit the desired response, the conveyance of uncertainties in the prediction, and what key things will indicate a forecast being on track or off. Specific topics for field personnel to address are recorded.

Lastly the where and what next is captured. This flags of the state of mind of the forecaster, points towards the subsequent action of applied avalanche forecasting, and returns the process back to the appropriate point in the uninterrupted loop.

4. ACKNOWLEGEMENT

The collaborative environment of avalanche professionals has made this work possible. Acknowledgement is made to many individuals whose expertise and experience have been shared in an effort to collectively improve the snowcraft. It is in that spirit of collaboration that this is shared for vetting and feedback. The OpAFL is but a piece of the process utilized in our organization, a process contributed to by many individuals including Phil Hein, Jim Bay, Ryan Gallagher, Steve Parsons, Tom Chalmers, and Dan Curry.

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