

SKI ALP RACES. AVALANCHE HAZARD EVALUATION AND RISK ANALYSIS

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ABSTRACT: The organisers of sports events taking place outside managed areas, such as ski resorts, must understand the real local conditions of avalanche danger in order to evaluate the conditions of "acceptable risk" to which the athletes, the support staff and the spectators are potentially exposed.

Ski alp races in a "freeride" environment are part of this type of events and for their peculiarity they are carried out, for almost the entire route, along slopes located off the ski slopes served by ski lifts.

Starting from the experience gained in the field of avalanche danger evaluation at local scale as well as from the experience of civil protection in dealing with risk management, the proposed study presents a specific procedure for the analysis of avalanche danger and risk during the phases which are necessary for the preparation and carrying out of sports events taking place in mountain environments outside managed ski areas.

The study of a real case, in which the proposed procedure has been applied, will explain in more detail what has been dealt with in the field of local danger, risk management analysis and assessment of the legal responsibilities of the various parties involved both during the preparatory phases and during the "Periplo del Monte Rosso" ski alp race organized by the ASD "La Büfarôla" in the freeride areas of Sacro Monte di Oropa special nature reserve and Mont Mars nature reserve.

KEYWORDS: ski alp races, ski mountaineering, danger, risk, responsibility

1. INTRODUCTION

This work presents the procedural steps by which the authors assessed and managed danger and risk in the various phases of preparation and execution of ski alp races. In addition to the technical aspects dealt with, the legal aspects related to the responsibility of the various parties involved will be discussed, with particular reference to all the people who are legally held responsible in case of accident.

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The study concludes with a practical example that shows how the authors used the above mentioned procedural steps for danger and risk management during the "Periplo del Monte Rosso" ski alp race.

2. DANGER AND RISK

Commonly, the terms danger and risk are often confused or even worse considered synonyms. Actually, they have a different meaning and express different concepts, even if they are linked to each other by the concept of vulnerability and of value of the "asset" being involved.

Lexically, *danger* is defined as *a circumstance or a set of circumstances from which it is feared that serious harm may result*; *risk* is defined as *the possibility of suffering damage related to more or less foreseeable circumstances* while, from a quantitative point of view, risk level may be linked to the following relationship:

$$R = D \cdot Vu \cdot Val$$

where:

R → risk level

D → danger level

Vu → vulnerability

Val → value

As previously stated, vulnerability defined as *the attitude of a certain element to bear the effects linked to a dangerous phenomenon* and value defined as *the value that the element exposed to a danger assumes in terms of human lives, or in terms of economic, artistic, cultural value*, represent the quantities that, through the above mentioned relationships (or also, for example, through a matrix representation) express the level of risk (*R*) to which an asset of vulnerability (*Vu*) and of value (*Val*) is exposed if it is subject to a danger level (*D*).

In our specific case, the danger level is represented by the potential avalanche danger present in a given area at a certain moment, vulnerability is represented by the level of "protection" that the people exposed to the avalanche danger possess whereas value is mainly represented by value in terms of human lives.

With "protection" level we mean all the *knowledge* (e.g. of the places, snowy weather conditions, etc.), *psycho-physical preparation* (e.g. training, ability to react under stress, etc.) and *equipment* (e.g. appropriate clothing, airbag, artva, shovel, probe, etc.) that the people exposed to the danger possess.

In parallel with the concepts of danger and risk during sports activities, the concept of responsibility must also be considered. It refers to the responsibility the people in charge have to take in the accomplishment of his/her functions and represents *a situation deriving from a specific relationship or norm to which a person can be called to respond in case of violation of that relationship or that norm*.

3. DANGER, RISK AND RESPONSIBILITY IN SKI ALP RACE

The levels of danger, risk and responsibility of the parties involved in the planning of ski alp races vary according to the phase in which they are called to operate. The main phases in the organization of ski alp races are essentially four. They consist of: phase A *route design*, phase B *route approval*, phase C *route tracing* and phase D *execution of the race*.

Phase A / Route design

This is the phase in which the technicians, according to the snow characteristics of the area and the "snow cover data history", select the

probable route that, at the date of the assessments, presents acceptable characteristics of danger and risk in order to plan the event. This phase is carried out by technicians (mainly mountain guides, race experts and experts in snow science and avalanches) in a period within 3 to 4 weeks before the race. When the thickness of snow on the ground is important ($H_s \gg 1.00$ m) or when the degree of avalanche danger 4 - high has occurred several times in the season, in addition to the main route, other routes with very low danger levels are also detected. With regard to safety management, snow and weather analyses are carried out in order to analyze the "history" of the snowpack present on the ground and the evolution of the weather conditions that have influenced it over time. Those analyses aim at evaluating the type of mantle in the area of the route and at detecting potential problems that may occur over time (for example, fragile layers, slippage plans, etc.). In this phase, what is assessed is not the degree of danger in the areas, but only the changing scenario of the ground mantle.

Tab 1 - Phase A – Route design

Activity	Design of the route according to the characteristics of the snow cover, the snowpack and the hypothesis of mantle changes		
Period	3 - 4 weeks before the event		
People	Alpine guides, race experts, experts in snow science and avalanches		
Vulnerability	low	medium	high
	X		
Snow overload	low	medium	high
	X		

Phase B / Route approval

It is the phase in which the technicians who have selected the route in phase A adapt it to the real snow characteristics of the slopes and hillsides interested by the race and to the possible weather trends of the following weeks (medium-term weather projections, uncertainty and variability of the data). This phase takes place in a period within 1 to 2 weeks before the race. With regard to safety management, the snow characteristics of the mantle and its degree of stability are analyzed in detail along all the exposures considered significant. The analyses carried out are intended to provide the degree of danger at local scale for all the characteristic sectors.

Tab 2 - Phase B – Route approval

Activity	Adaptation of the route selected in phase A according to the real avalanche danger conditions and to the possible variations that may occur depending on the future weather evolutions		
Period	1 - 2 weeks before the event		
People	Alpine guides, race experts, experts in snow science and avalanches		
Vulnerability	low	Medium	high
	X		
Snow overload	low	Medium	high
	X		

Phase C / Route tracing

In this phase the technicians evaluate the real degree of avalanche danger in the area in relation both to the weather forecasts for the next 48 to 72 hours and to the snowpack conditions. At the same time, with reference to the assessments carried out by the technical group, the support staff (mainly non-technical) prepares the route tracing for the race: ascents, descents, change areas, etc. This phase takes place in a period within 2 to 3 days before the race. With regard to safety management, at this stage the characteristics of the snowpack on the slopes crossed by the race are evaluated in detail, analyzing its stability conditions site by site (even in the face of a heavy overload) as well as the local danger level and the possible changes referring to weather forecasts at 48 and 72 hours. At this stage the risk level to which the technical and non-technical staff is exposed is also analyzed.

Tab 3 - Phase C – Route tracing

Activity	The technicians evaluate the real safety conditions regarding the avalanche danger on the route due to weather evolution in the next 48 to 72 hours		
Period	2 – 3 days before the event		
People	Alpine guides, race experts, experts in snow science and avalanches, trackers and non-experts, support staff		
Vulnerability	low	medium	high
		X	
Snow overload	low	medium	high
		X	

Phase D / Execution of the race

In this phase, taking into account the real-time weather conditions, the snow technicians, the route director, the race director and the Fisi delegate evaluate the evolution of the avalanche danger conditions and the evolution of the risk levels to which competitors, spectators and the support staff to the race are exposed. With regard to safety management, at this stage the avalanche danger level is analyzed in the face of a high overload as well as the risk level. The aim is to constantly assess whether the residual risk level can be considered acceptable or unacceptable in order to intervene to reduce the amount of unacceptable risk.

Tab 4 - Phase D – Execution of the race

Activity	The technicians evaluate, in real time, the avalanche danger levels and the risk levels according to the evolution of the weather conditions		
Period	the day of the event		
People	Experts in snow science and avalanches, route director (Alpine Guide), race director, FISU delegate, non-experts support staff, athletes, spectators		
Vulnerability	low	medium	high
		X	
Snow overload	low	medium	high
			X

The main variables that govern the risk assessment for risks being equal are represented by the type of staff involved and by its vulnerability. Analyzing the vulnerability of the persons involved, the risk levels in the various phases assume the values indicated in table 5

Tab 5 – Risk level

risk level		low	medium	high
Phase A	Technical	X		
	Non-expert			
	Athletes			
	Spectators			
Phase B	Technical	X		
	Non-expert			
	Athletes			
	Spectators			
Phase C	Technical	X		
	Non-expert		X	
	Athletes			
	Spectators			
Phase D	Technical	X		
	Non-expert		X	
	Athletes		X	
	Spectators			X

Being the risk directly proportional to the level of vulnerability and considering the value of the asset being involved and the level of danger as a constant, we can see how the risk in the phases C and D reaches levels from medium to high. The direct consequence of risk assessments, which must direct the choices of the technicians, must be to authorize the competition exclusively with low local avalanche danger levels in order to mitigate the residual risk as much as possible.

4. THE RULES OF RISK

According to current Italian legislation, in case of an accident occurring during the event, the organizations of ski alp races (legal entities, associations, committees) can be held responsible to athletes, spectators and support staff of the organization (timekeepers, signalmen on the route, etc.).

Based on the belief that those who practice a sport such as competitive ski alp agree to expose themselves - albeit within certain limits - to events that could potentially cause him/her harm, the jurisprudence on the subject states that, in competitions, a possible liability arises only when, for unforeseeable and unavoidable reasons, this risk exposure threshold has been exceeded due to the organization's fault. In essence, if the level of danger remains within acceptable limits and the accident occurs, submitting to the inevitable negative consequences "is part of the game", it does not trigger any responsibility - neither civil nor criminal - for the organization and the athlete cannot request compensation. If, on the other hand, the organization, with its active or omissive behaviour, exposed the injured person to a greater danger than that inherent in the type of competition in ordinary conditions and an accident occurs, the organization itself will be held responsible in every seat.

Nothing can be attributed to the organization if, instead, the damage suffered by the athlete is due to his/her mere technical error.

As a result, the behaviour of the organizers must be based on the utmost diligence possible in order to avoid any charge in case of an accident.

That means, from a practical point of view, that regarding the safety of the athletes involved in the race, the organization must at least comply with the following guidelines:

- checking the suitability and safety of the race route with particular attention, preparing an alternative route in case of changed weather or snow conditions. Regarding the route, it will be necessary to highlight the points of greatest danger, prepare adequate signals, stairs to overcome crevasses, fixed ropes on the ridges, as well as highlight any obstacles in the descents. In relation to the snow conditions, on the other hand, it is noted that starting a competition despite the bulletins indicate danger 3 on a track with slopes above 30 degrees, or with adjacent steep slopes means, for the organization, to decide to expose themselves to a high risk. In fact, in the event of a claim for avalanche detachment, it will be very difficult to demonstrate that every precaution was observed to safeguard the competitors; it will be very difficult to prove that the event was completely unpredictable;
- strongly urging the athletes to attend the briefing, as it might be useful to demonstrate their informed consent regarding the risks existing on the race path. For that reason, it would be better to organize the briefing just

before the start of the race, after the "checking and verification" of the competitors;

- setting time barriers (commonly called gates) that do not impose on athletes - in relation to the type of competition - rhythms that might increase the dangers;
- checking the perfect efficiency of the equipment and its compliance with the necessary safety standards (provided in any case by national and international regulations) - attacks, skis, boots, artva, probe, shovel, crampons, ice ax, harness, suitably protective and thermal clothing. This checking may include punching and checks just before the start of the race and after finish line to prevent fraudulent behaviour by competitors;
- checking that the athlete is fit for the race from a psychophysical point of view and therefore he/she owns updated medical certificates specific for this type of sport;
- checking, immediately before the starting of the race, that the athlete is wearing the artva and that it is working in transmission mode.

Even the race directors, in conjunction with the organizers, are held responsible (both civilly and criminally) if the route is not in safety conditions or if it is not suitable for the type of event being organized. Jurisprudence has, moreover, repeatedly maintained that the inherent danger of an extreme sport must not be exacerbated by a negligent predisposition of the competition path, which must therefore be equipped with every possible post useful for the athletes' safety.

The responsibility of the organizers can also extend to the spectators attending the event. Generally, whoever attends a ski alp race is a ski mountaineer who has reached the path independently and upon whom the organization has no authority to impose any behaviour in the name of safety. Well, with regard to spectators, a possible responsibility of the organizers could therefore arise only if they allowed them to transit on the race path without signaling the existence of the competition and, because of that, the same spectators have reported some damage (maybe as the consequence of a collision with an athlete). Finally, the organization can also be called upon to answer for damages or injuries suffered by its support staff (timekeepers, signalmen, doctors, etc.). In fact, the support staff of the organization is on the path and, like the athletes, have the right not to be involved, following the choices of the organization, to greater risks than those faced during an individual excursion in the same places.

5. CASE HISTORY: IL PERIPLO DEL MONTE ROSSO

"Il periplo del Monte Rosso" (Race around Monte Rosso) is a ski alp race organized by the ASD company "La Búfaróla" in the freeride areas of Sacro Monte di Oropa, a special nature reserve, and of Mont Mars nature reserve. In 2018 the race reached the 41st edition. It is a classic technical race along a path of 15 km of which 90% off-piste and includes 2 ascents, 2 descents and a walking part for a total of about 1700 m of positive difference in height. Altimetrically, the route winds from an altitude of about 1150 m asl up to altitudes close to 2350 m asl. The athletes participating are around 150-200, while the spectators present along the course exceed 500 people.

The 2018 edition took place on 11/03/2018 and was characterized by optimal snowy weather conditions with low levels of avalanche danger during the phases of route design, route approval and route tracing and by prohibitive snowy weather conditions with increase of the dangerous conditions in the night before the race and in the morning of the race.

The phase of *route design* took place in February. In reference to the conditions of the mantle and the possible transformation of the snowpack over time, the technicians planned a very technical course with a projection of avalanche danger at a local scale not higher than grade 2 - Moderate which, combined with a low level of vulnerability for the staff present along the course, involved a low level of risk that was fully within the acceptable risk range.

Two weeks before the event, the phase of *route approval* validated the choices and evaluations previously carried out, maintaining the projection of the local avalanche danger no higher than grade 3 - marked which, combined with a low level of vulnerability for the staff present along the course, involved a low - medium level of risk that was fully within the acceptable risk range.

In the week before the event, the phase of *route tracing* was carried out with local avalanche danger conditions not higher than grade 3 - marked which, combined with a **low - medium** level of vulnerability for the staff present along the course, involved a **low - medium** level of risk that was within the acceptable risk range.

The projection of the weather evolution in the 12 hours before the race and during the race foresaw

... a depressionary movement moving towards the Iberian peninsula should bring moderate snowfall over the 1300-1400 m asl altitude ... with total accumulations close to 20-30 cm ... with an increase in the local avalanche danger level from grade 2 - moderate to grade 3 - marked which, combined with a medium level of vulnerability for the staff present along the course, involved a high level of risk that exceeded the acceptable risk range.

The snow technicians, the route director, the race director and the Fisi delegate, in reference to the predicted weather conditions and the snow conditions of the ground mantle, envisaged an alternative safe route in order to contain, for the day of the race, the extent of residual risk within the acceptable risk range.

On the day of the execution of the race, the adverse weather conditions both before the race ($H_N \approx 20$ cm in 12 hours added to an $H_S \approx 100$ cm at an altitude of about 1900 m asl and to an $H_S \approx 200-250$ cm at an altitude of about 2350 m asl) and during the race forced the route director and the snow technicians to modify the route. They eliminated the route portions involving a level of danger with grade 3 - marked and considered only the portions of route with a level of local danger with grade 2 - moderate which, combined with medium level of vulnerability for the staff present along the course, involved a low - medium level of risk that was within the acceptable risk range.

6. CONCLUSIONS

The reported procedure, which includes 4 phases of decision-making and assessment of the conditions of danger and risk has allowed, according to the experience of the undersigned, to optimize the information collected in order to simplify and speed up the decision-making phases of all the parties involved and to have a real time update of the local situation.

The accomplishment of the procedure concerning danger and risk management, such as the one proposed by the authors, certainly implies further aggravations in terms of commitment and resources, but it can represent a useful tool able to optimize the choices, to minimize the "Rules of risk" and to justify and trace the decisions made by the responsible parties in case of a claim.

7. CONFLICT OF INTEREST

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