Avalanche rescue and mission risk in Norway 1996-2010

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ABSTRACT: Well documented data from Norwegian avalanche rescue missions are evaluated according to risk assessment. Data have been collected from police records and logs from joint rescue coordination centres. Mission risk assessments described in the reports have been compared to actual conditions in hindsight.

KEYWORDS: Avalanche rescue, risk assessment, risk management

1 INTRODUCTION

The study aims to assess the risk for rescuers during Norwegian avalanche rescue missions in the period 1996-2010. The assessments are based on investigations of avalanche rescue missions documented by the Rescue Coordination Centres in Southern and Northern Norway.

The data includes 367 avalanche events. The information is based on the logged information from the Rescue Coordination Centre and the police. In addition, information based on reports from voluntary and professional rescue organizations is included. Some of the material comes from personal communication with participants in the rescues and some also from personal participation in such rescue missions.

The risk level for each rescue mission is based on the log entries and evaluated according to an Operational Risk Management avalanche mission risk rating model (Kristensen et al. 2008). This model involves the use of three initial "filters" for rating mission risk (figure 1). The model is intended as a simple decision making system to be used in a continuously changing environment.

Filter 1 contains four questions related to external conditions, such as weather, terrain, light / visibility and avalanche type. The answers will lead to a rough sorting of missions from "exclusive" or "inclusive" factors. This initial sorting determines whether the rescue teams can be deployed immediately ("GO!") without a more detailed risk assessment, i.e. a "green" mission, where the probability of natural avalanches is low. Alternatively, the mission is characterized as "red", with a high likelihood of natural avalanches. A red mission means that a comprehensive risk assessment must be undertaken before moving to the accident scene ("WAIT!").

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2 METHOD

	Including factors	Excluding factors
Local weather conditions?	*Good weather. Little new snow, no or little wind.*	*Considerable amount of new snow. Snow drift.*
Terrain conitions?	*Easy, few avalanche areas, easy and quick access.*	*Complex, several potential avalanche paths, difficult and long approach*
Light and visibility?	*Daylight. Good visibility*	*Darkness, low visibilty*
Incident type?	*Small to moderat size single avalanche. Human release.*	*Large, or several avalanches, some naturally released.*
Action:	**GO!** Instant call out to accident site.	**WAIT!** Possibly risky mission. Call out to safe meeting place, but await risk assessment before entering potentially dangerous terrain.

Figure 1. First filter to determine the nature of the mission regarding the general risk.

It is suggested that an initial mission assessment that results in a "red" mission should lead to a more thorough risk and benefit assessment of such missions. An example of this is given in figure 2. Here, the result is transferred to a traditional risk matrix for assessing the cost / benefit ratio in terms of the probability of saving a life versus the risk of injury to rescue crews. However, this part is outside the scope of the current paper.

From the data analysed, an attempt has been made to evaluate how the rescue managers initially have assessed the nature of each mission regarding risk. Three categories of risk management approaches are used; "Immediate rescue deployment" (or “GO!”), "Postponed rescue deployment" (or “WAIT!”) and "Other risk management". "Postponed rescue effort" is interpreted as when the rescue managers have considered the situation to be too dangerous for immediate deployment, while "Immediate rescue effort" means that the response teams

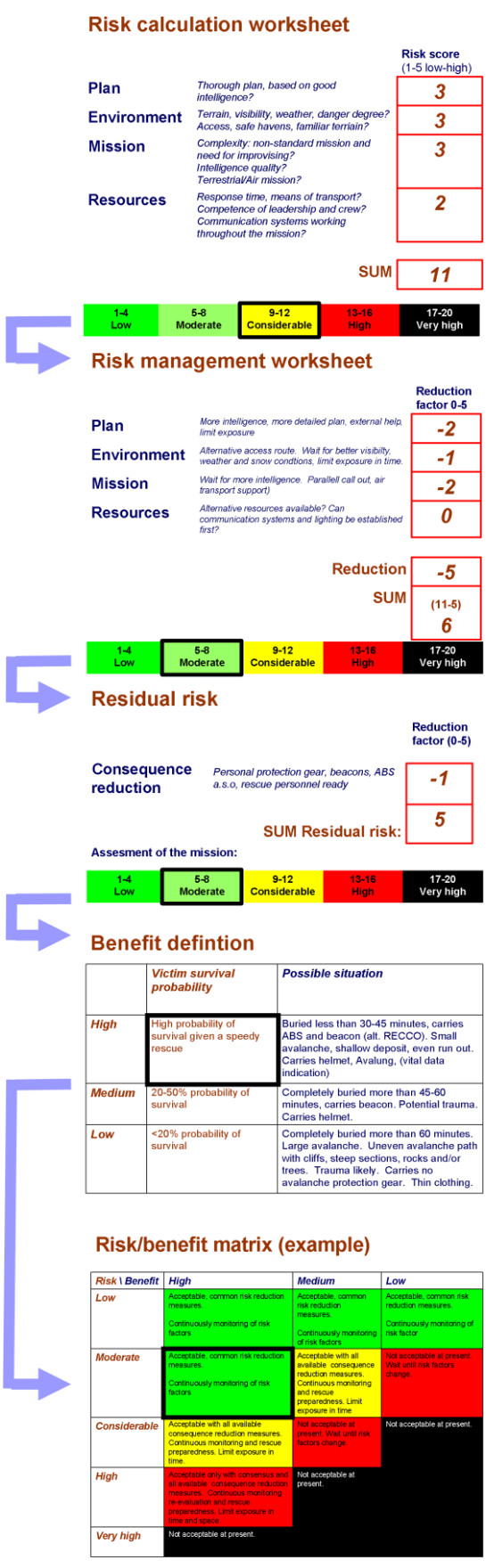

Figure 2. Example of a risk management worksheet for "red" missions.

immediately move to the accident scene and take action. "Other risk management" can be the use of alternative resources and methods like helicopter support or other airborne SAR resources, and including methods of reducing the exposure by restricting area for traffic, limit the number of rescuers exposed and employing special methods that contribute to a safer implementation of the rescue mission.

The evaluation method for the recorded missions has limitations, particularly since the study is based on secondary data, which may be inadequate. In some cases, the categorization of risk and risk management is based on our own understanding of the mission in question, and also to which extent the information has sufficient quality to be used in the analysis. Nevertheless, we can assume that the division into "red" and "green" actions are reasonably objective and precise, since the categorization is based on the four input questions in the "Filter 1". The answers are verifiable and have been checked using the records for the accident days, pictures and other technical information from the scene, including the time of day. The duration of the missions has also been considered with regards to whether part or all of the mission had to be conducted in daylight or in darkness.

The initial filter indicators are simple, and give only a rough idea of the safety consciousness of the rescue crews. We still feel that the material can provide a good basis for further investigations of the relevant cases and the results will increase the knowledge about the situations that involve the greatest uncertainty. To a certain extent, one could also get information about the management structure and the decision-making level.

This work does not attempt to compare risk management in different phases of the rescue missions, nor are possible trends in risk management over time investigated.

3 RESULTS

Out of 367 missions, 308 of were recorded in a manner that made assessment of the level of risk possible. Of these, 159 were categorized as "red" and 149 categorized as "green". In addition, 295 of the missions were described in such detail that it was possible to assess the risk management methods used.

The average duration of rescue missions was 3.0 hours, while some of the recorded missions lasted up to 36 hours (evacuations). Some of the "red" missions that were handled as "green" lasted for 8 hours.

4.1 "Red" missions

Of the missions categorized as "red", 14 cases were categorized based on the records as "Postponed rescue deployment" because of high risk. 39 missions were carried out immediately and 95 missions fell into the category "Other risk management".

During the period 1996 - 2010, no rescuers were involved in accidents. However, the 39 "red" rescue missions treated as "Immediate rescue deployment" missions indicate that the risks were not comprehensively assessed. It can be asserted that these were undesirable incidents (i.e. a "red" rescue mission is handled as a "green" mission). About 26% of the “red” avalanche rescue missions thus appear to have been carried out in high risk situations.

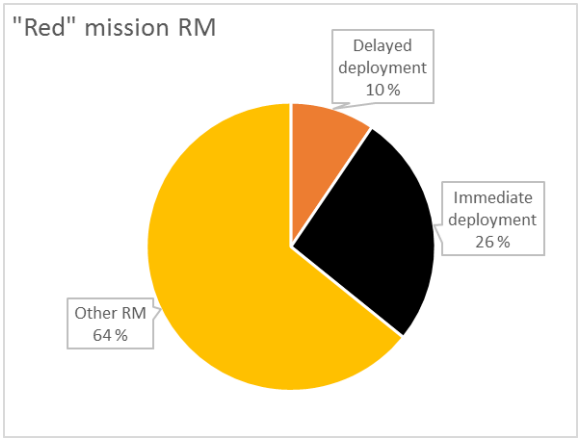

Figure 3. The risk management (RM) categories employed during "red" missions".

Of these 39 "red" rescue missions, 31 were carried out in connection with avalanches crossing roads that were open for public use. In one case an avalanche entered a residential area, while seven cases involved rescues in free mountain terrain. These were all severe accidents with fatalities or seriously injured patients.

14 of the road related rescue missions followed fatal accidents or accidents involving patients in need of immediate care. It is noteworthy however that in 17 of the road related missions, no subjects had been involved or been reported missing beforehand. This can be interpreted that in more than half the cases (54%) of these "red" rescue missions, the benefit was questionable (high risk mission with a likely low benefit).

64.2% of the "red" rescue missions were carried out using "Other risk management".

4.1 "Green" missions

Of the missions categorized as "green", two were assigned as "Postponed rescue deployment", 120 were carried out immediately and 25 missions fell into the category "Other special risk management". Only two of the 147 "green" rescue deployments were postponed.

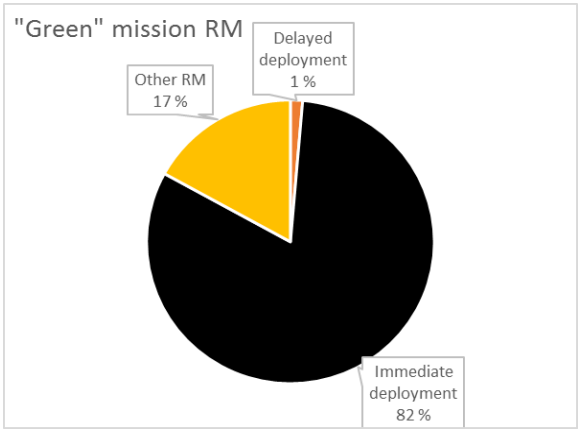

Figure 4. The risk management (RM) categories employed during "green" missions".

4 DISCUSSION

An overall assessment of the results provides a basis for claiming that most avalanche rescue missions were adequately and safely managed, since the majority of the green rescue missions were subject to immediate deployment effort, while the majority of the red rescues were either postponed or carried out using other special risk management methods. Several of the “green” rescues are also performed with other alternative risk management methods, although the situation judging from available records did not always require this. However, there is reason to believe that this is an expression of the standard of training of the rescue service, in combination with standard procedures more than a coordinated and communicated risk management. Examples of this is clear and comprehensive rescue management by the various rescue coordination centres, using parallel deployment of ground and air transport along well-known routes, experienced crews in particular the air rescue service, and, of course, vital knowledge of local conditions amongst volunteer rescuers. These “green” missions were therefore handled with a good safety margin.

If the special risk management methods employed in the "green" cases resulted in an unnecessary loss of time, then there may be a need to closely review these cases, to try to uncover whether the handling - and the subsequent loss of time – was due to organizational,

operational or purely training-related factors. Operational risk management aims to ensure the establishment of various barriers against accidents, and will always be a situational balance between cautiousness and time-efficiency. In this perspective, the active use of "Filter 1" (Figure 1) may as well lead to increased efficiency as to increased safety, through a more precise understanding of the situation at both the management and the executive levels. For example, we see that there were two "green" rescue missions with postponed rescue deployment, where this risk management may have led to a loss of time on behalf of the patient.

The fact remains that of all missions, 13% were deployed in high risk situations. 39 cases of "red" rescue missions were handled as "green". It is worrisome if every fourth rescue (26%) in dangerous avalanche conditions leads to an elevated risk level for rescuers (i.e. an undesirable incident). Examples of such events documented report of first responding rescue teams deployed in darkness and poor visibility, experiencing secondary avalanches in the same run out zone; avalanches crossing their route, and also avalanche events in adjacent run out areas close to the accident site. In the long term, this will lead to accidents. This is especially serious, when in almost half (43%) of these rescue missions there were no confirmed avalanche victims.

The main challenge is situations with avalanche danger levels 4 and 5, where natural avalanches frequently affect roads and other infrastructure. In these cases, the first responding rescuers have a shorter and easier way to travel, and the accident site is reached relatively quickly by non-specialized emergency agencies, often joined by road maintenance crews. Studies show that ordinary police patrols more often are the organized rescue resource to arrive first at the scenes of avalanche accidents (Lunde, A. 2011). It is also a fact that most officers do not have any systematic form of training in avalanche hazard assessment or avalanche rescue. There is reason to believe that the relatively high frequency of undesired incidents (here; rapid response to the scene, on the ground, in dangerous avalanche conditions) was a result of unconscious risk behaviour rather than deliberate willingness to accept high risk.

Average response time (time from scramble to arrival on the accident site) for avalanche rescue in Norway is 49 minutes (Lunde, A. 2011). Considering avalanches affecting roads and infrastructure, the first rescue units are probably arriving on site much faster than this, and the more important will be the emergency management (rescue co-ordination centres and local resources), in that early and competent personnel must be summoned quickly to assist with avalanche hazard assessment.

When 14 "red" rescue missions were reported as postponed, awaiting favourable conditions, this can be an expression of good and valid risk assessment. It can also indicate a lack of assessment skills, lack of alternative courses of action and technical limitations. Since 2007 we have seen the development of the "National Guidelines for Avalanche Rescue" (Nasjonalt Redningsfaglig Råd, 2012), which over time, is meant to increase the expertise and capabilities of the rescue service, as a whole. Further studies should aim to identify current improvement factors related to rescuer safety.

The data of this survey also contains information about the duration of the rescue missions, the number of involved rescuers and avalanche danger level. This may open up for further studies on risk exposure. Likewise, the number of hours of rescue effort can be used to calculate the fatal accident rate in avalanche rescue, while it will require better data and further investigation to say anything certain about personal injuries and undesirable incidents related to individual rescuers.

Regarding the method of initial categorizing of the mission risk, the results seem logical – and reliable. This is supported by the fact that the division of missions in "red" and "green" categories based on the ”Operational Risk Management” tool, correspond well with the documented action taken by the rescue services in most cases. The difference, in some cases, between expectations based on the risk management tool, and the actual action taken in each and every mission, can be seen as an expression of the uncertainty of risk, time-efficiency and cost-benefit ratio.

5 CONCLUSION

The factors in the ”Operational Risk Management” have been used for a retrospective assessment of risk and risk management in real life situations in Norway for 15 years. Assessment factors provide opportunities to evaluate completed actions, as part of the learning and experience transfer. The results of this study can be improved by the use of qualitative methods, but still gives an indication of the Norwegian rescue capers managing risk at stake for avalanche accidents.

The results indicate that an active and conscious use of filter 1 can provide a good basis for communication of situational awareness and risk management, while filter 2, in the hands of trained rescuers, may contribute to a structured decision-making process, ensuring that the relationship between risk and benefit is optimal.

6 ACKNOWLEDGEMENTS

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