

LIMITATIONS OF RISK ASSESSMENT: PERCEPTIONS OF RISK

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Summary

The tendency to introduce requirements for risk assessment in mining operations based on subjective estimates of risk has meant that the risk perception of individuals within the process can have a significant bearing on its outcome. The factors influencing risk perception are discussed with specific examples taken from a wide range of mining studies under five general headings: context, familiarity, control, "costs and benefits" and likelihood of being caught. The implications of these influencing factors on the development of reliable risk assessment programmes is considered.

Introduction

It has been generally accepted in those mining industries where risk assessment has been, or is being, introduced into the regulations that insufficient data is available for the use of quantified, probabilistic, risk assessment. As a result all the regulations have been based, of necessity, on the use of subjective risk estimation.

This has created two problems. Firstly and particularly in an industry used to prescriptive and detailed regulations, the change to a largely unstructured, subjective, approach has raised a number of methodological problems given that no specific procedures have been specified or even recommended. These problems have been reviewed, in some detail, in a recent paper by Simpson (1) and will therefore not be re-examined in this paper. The second problem is that if risk estimation is subjective then it will, inevitably, be influenced by the risk perceptions of both the risk assessor when conducting the assessment and by those of the manager when reviewing the priorities for action. In addition the effectiveness of many risk control measures could also be influenced by the risk perceptions of those faced with the hazardous situations.

An understanding of the factors influencing risk perception is, therefore, important to the effectiveness of risk assessment at, at least, three levels:

- The risk assessor's perceptions of risk may influence the conclusions drawn in the risk assessment.
- The manager's perception of risk may influence his decisions on appropriate/necessary action following from the completed risk assessments.
- The miner's and/or supervisor's perceptions of risk may reduce the effectiveness of risk control measures taken by the mine - if they do not feel the risk is significant they are less likely to consider the control measures important.

Factors Influencing Risk Perception

Unfortunately the perception of risk has little to do with reality. The "general public" is much more frightened of their safety in an aeroplane than in the family car despite the fact that all the objective evidence shows clearly that there is a much greater probability of being killed or injured in the family car.

Studies of the psychological factors governing the perception of risk have identified an extremely complex set of interacting factors which may contribute to an individual's behaviour in relation to risk (see, for example Simpson 2, ACSNI 3). For the purposes of this paper in considering the importance of risk perception in an industrial safety management context, five of the issues identified will suffice to highlight the problems which need to be considered:

- Context
- Familiarity
- Control
- "Costs and Benefits"
- Likelihood of being caught

Context

The context, or frame of reference, in which risks are considered will influence the relative perception of risk and, consequently, the behaviour at all of the three levels described above.

At the assessor level, an assessment conducted in a non-gassy mine may, given the context, underestimate the importance of, say maintaining the position of the ventilation ducting in a heading as a result of the low level of perceived methane risk. Such a decision may however overlook other issues which could involve risk, dust-make for example.

At the management level, the general history of mine safety may significantly influence the perception of risk. Mining has always been considered a high hazard industry and our history of occasional but spectacular and tragic disasters has created a public perception of the industry similar to that of air travel mentioned above. In both mining disasters and air crashes it is common for large numbers to be killed in a single incident. Such events tend to focus attention on what are, in reality, high hazard but low probability accidents, whereas in mining there is a much greater toll on life and limb in (relatively) low hazard, high probability accidents. The focus of concern on the high hazard, low probability risks such as major fires, explosions, rock bursts/falls, in-rushes etc. creates a perception of risk priorities which is, at least arguably, misplaced in terms of safety improvement.

Phillips (4) recently drew attention to the fact that the general society in which we live can influence risk perception in a way which could reduce the perceived importance of safety at work. By comparing the risk of injury/death in mining with similar risks from road accidents and criminal violence in South Africa, he makes a convincing case that, even allowing for the relatively poor safety record of South African mines, a typical South African miner is safer at work than during his "leisure". Phillips does not suggest that this should be seen as an "excuse" for lack of safety action on the mines but rather that it will influence the perception of risk at work for, perhaps perversely, the miner can with some justification, consider himself safer at work than almost anywhere else!

Familiarity

The first pre-requisite of safe behaviour in any risky environment is a detailed understanding of the hazards and a realistic awareness of the risk. This leads directly to the consideration of training. Mining industries generally and the major coal mining industries in particular, can be justifiably proud of the amount of time they have devoted to the safety training of their workforce. However, how many of these courses are systematically evaluated, in honesty, very few. Without any serious evaluation of their effectiveness, how can we be sure whether they have been successful in ensuring adequate risk perception and hazard awareness? All too often the safety training provision is, in reality, little more than an "act of faith" - it is assumed simply because training is given that, as if by magic, it will always work! The situation is even worse in terms of management training for it seems universally assumed that somehow managers are "above" the need for safety training.

If we do not know how effective our safety training for the workforce is and we do not provide any real safety training for management we cannot know what problems may exist in terms of incorrect or misguided risk perception.

A graphic and tragically comic example of this problem was identified in a study by Rushworth et al (5) into the factors influencing safe working in bunkers (silos) in British Coal. One of the main areas of attention in the study was the use of fall arrest harnesses. Although each bunker worker was issued with his own harness and the importance of the harness was enshrined in the rules and extensively covered in training, nine of the ten men killed in bunker accidents between the mid 70s and the mid 80s had not been wearing their harness and although the tenth had been wearing his it was not connected to anything! During the study a number of bunker workers were observed and interviewed. One was seen wearing his harness up-side down with his arms through the leg straps and his legs through the arm straps! When he was questioned about this, he knew he was wearing it upside down and said that he did so all the time because "it was much more comfortable that way"!!

Clearly despite the considerable thought and effort put into the training etc. it had failed.

Assuming that reasonable training is in place to ensure a basic familiarity with risk the next concern in relation to familiarity is summed up in the old adage "familiarity breeds contempt". In other words, the more often you are exposed to a risk without actually being damaged, the less real that risk becomes.

Other results obtained in the bunker study mentioned above were interesting in this context. Groups of men (e.g. trainee bunker workers, experienced bunker workers, safety staff, trainers etc.) were asked to rate risky activities associated with work in bunkers. After giving their initial rating, the safety hazards and risks were explained to them and they were given the opportunity to change their rating in relation to the extra information they had received. Trainee bunker workers tended to over-estimate risk initially (as might be expected) but tended to change their ratings considerably in response to the new information. Their revised responses were not dissimilar to the ratings obtained from the Trainers and Safety Specialists. Experienced bunker workers showed a very different pattern, not only did they significantly under-estimate risk initially but they made very little adjustment following the additional information.

The converse can also occur in that several studies have shown that the further "away" from the risk the more likely you are to underestimate it. In one study in South African mining by Talbot et al (6) this was shown by comparing the response of various groups e.g. workmen, team leaders, mine captains, underground managers etc. to a series of risk scenarios. In another mining study, Mason et al (7), it was shown that a reasonable proportion of supervisory electricians considered Permit to Work and similar systems to be less important to safety than did the electricians themselves.

Control

The first consideration of control relates to the extent to which an individual believes he can control the risk to which he is exposed. Clearly if he considers the situation is under control he will tend to underplay the risk. In the study of electricians mentioned above one element involved a questionnaire designed to specifically evaluate risk perception. It was clear from the results that electricians felt that they were so skilled and in control that they no longer even considered electricity to be dangerous. In such circumstances it is inevitable that you will under-estimate and behave accordingly.

Another way in which "in control" is often assumed is in relation to controlling the time that you are exposed to the risk "I'll only be there for a minute or two", or in terms of conducting the risk assessment "the job only takes a couple of minutes". This type of "excuse" shows very little understanding of probability! It's relevance to mining is shown, for example, in a study by Peters (8) in which it was shown to be one of the most common explanations of why men were willing to go under unsupported roof.

The second way in which control is influential in shaping risk perception is by over-estimating the effectiveness and reliability of risk control measures.

A study by Simpson et al (9) provided a classic example of this possibility. The study investigated the potential for transport and tramming accidents on mines other than coal, gold and platinum in South Africa. At one mine, which relied very heavily on underground trackless vehicles for both production and transport operations, the rules clearly specified a range of very justifiable speed limits which were clearly sign-posted at critical points throughout the mine and the driver training was comprehensive in its coverage of the importance of speed

restrictions. However, while conducting an ergonomic assessment of the vehicle fleet it was noticed that not one of the 150+ vehicles in the underground fleet was fitted with a speedometer! In effect, therefore, the rules, the training and the sign-posting were useless for the driver had no means of judging his speed. Without the ergonomic assessment however it would have been very easy to assume that an appropriate suite of controls were in place and, therefore, under-estimate the risk of over-speeding.

"Cost & Benefits"

When making a decision on what action to take in a potentially risky situation we go through a process of balancing the potential benefit with the potential cost to us as an individual. In very simplistic terms if you were deciding whether to cross a road you would judge the traffic in terms of closing speed and assess whether you could get through - as you are in a hurry, you decide you can just make it. However if you were faced with the same circumstance while carrying half a dozen bottles of beer, you'd probably decide not to risk it, not because you have any increased risk of being killed but just in case you dropped the beer!

The classic example in UK coal mining of imbalance in the cost-benefit aspect relates to illegal man-riding on conveyor belts. It must be remembered that in the UK many belts have been designed with sufficient clearance and purposely designed boarding and alighting stations for them to be officially used for man travel. Unfortunately it is not uncommon for men to ride belts which have not been so designed and so designated which is very clearly a definitely risky operation. The "justification" for almost all incidents of illegal man-riding on belts is almost always on the basis of "a second class ride is better than a first class walk" - the "benefits" of belt-riding say, 800 metres, on an upgrade are seen as outweighing the "cost" of walking it.

A study of safety on haulage systems in UK coal mines, Simpson et al (10), identified an interesting example of such balancing between two very clearly risky operations. It was noticed that on a particular loco run it was common for both drivers and guards to periodically lean out of the loco to look behind them. In the relatively narrow confines of the roadways concerned this was obviously a very risky activity and one which was specifically covered in driver/guard training. The study used a carefully designed questionnaire approach to attempt to understand why this was being done. The first element involved asking drivers and guards how risky they considered this to be in terms of likely severity (fatal injury, major injury etc.). All the men clearly recognised this as a potentially fatal activity and some pointed out that if it was the driver it could actually create multiple fatalities if men were riding. The next stage involved asking them how often they see other drivers/guards doing this and how often they did it themselves. On both counts, almost to a man, they admitted it happened very frequently. The third stage involved confronting the men with these results which, superficially at least, seemed patently stupid in that they knew they could be de-capitated but nonetheless did it "all the time". The explanation was very revealing. A new system of binding wood onto flat beds had recently been introduced and had proved far from reliable with several incidents of partial load shedding and the men were very concerned that, one day, this would cause a major de-railment. Rightly or wrongly their risk perception favoured what seemed to them to be the most likely of the two risks which they were having to deal with simultaneously. Because both risks were simultaneous and the control action exactly the opposite, they were forced into a trade-off.

Likelihood of being caught

Several studies including, in mining, the Talbot et al and Mason et al, reports referred to above have shown that risky behaviour is much more likely if the person perceives a low probability of being caught. This appears to be particularly relevant to the temptation to cut-corners on safety rules and procedures. In part this is a specific form of the balancing act described above, however, as it involves two separate aspects of risk perception it is useful to consider it as a separate element. The two aspects are, first the risk perception of the person deciding to take the risk and, second, the risk perception of the person who should be monitoring his behaviour.

If a particular supervisor is known to be unconcerned about safety rules, more rules will be broken on his shift. If a manager is known to "turn-a-blind-eye" to keep production moving, more rules will be broken on his shift. If you know that the manager always gets to your district last on his "tour" rules will be broken early in the shift.

It is clear, even from this brief analysis of a very complex and interacting problem, that the risk perception of staff on the mine can have profound effects on the risk assessment itself, its interpretation and on the effectiveness of risk control measures. The question which now needs to be addressed is what, if anything, can be done about it?

What can be done?

The first requirement is to recognise the importance of individual and group risk perception in relation to risk assessment specifically and safety improvement generally. Once this has been acknowledged, it becomes paramount that hazard awareness and risk perception become a central focus of all safety training. It also becomes necessary to begin seriously considering the safety training needs of management for if their perceptions are out of step with the men then conflict and confusion become inevitable. It is also clearly necessary to systematically evaluate safety training effectiveness to ensure that the training is delivering rather than just hoping/assuming it is. Hazard awareness and risk perception questionnaires are an excellent means of conducting such assessments for although they may only represent a relatively small element of the training they are, arguably, the most important - it is no good knowing the safety procedures off by heart if you don't believe they are necessary!

In relation to the actual risk assessment process, the variability of influence on individual risk perceptions makes it important not to rely on individual assessors. For example, from the results described above, if electricians do not believe electricity to be dangerous, the last person you want assessing electrical risk is an electrician! This is not to suggest that you should conduct risk assessment "by committee" but rather that small teams of two or three should be considered, backed-up by access to specific expertise where necessary. Without this there is the constant risk of being exposed to the bias created by an individual's risk perceptions.

We need to escape from the industry's traditional "obsession" with major hazards, and managers responsible for turning risk assessments into risk management need in particular to "break the mind-set". This is not to suggest that these concerns should be forgotten but rather that it should be recognised that in the overall accident pattern the "every-day" safety risks create the majority of our accidents and injuries.

It must be recognised that individual risk perceptions can totally negate the effectiveness of many apparently adequate risk control measures, especially the non-engineering controls. Unless the relevance and importance of a new control is carefully explained to all members of staff (including supervisors and managers) on its introduction with, in particular, specific emphasis on the consequences of failure to use the measure, it is highly likely that insufficient importance will be given to it in terms of risk perception.

Unless some understanding of the influence of risk perception is incorporated in the risk assessment/risk management programme, the outcome will be both variable and uncontrolled. In addition to contributing to the reliability of the risk assessment process the actions described above will help ensure, albeit gradually, the development of a common framework of agreed and understood risk perceptions which is a necessary prerequisite for the development of improved safety culture.

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