Overcoming Human Limitations in Managing Risk

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Introduction

Recently in Queensland, and more broadly across Australia, there have been a number of incidents in Mining that indicate the need for a renewed focus on risk management. Certainly, a lot has been done to design and implement thorough, robust risk management systems in Mining, yet many risks are still not managed as effectively or successfully as they should be.

Examining incidents such as that of the Pike River Coal Mine can help us to better understand the factors that result in incidents, particularly those of a catastrophic nature. Analysing this particular incident demonstrates that there is a failure at all organisational levels to adequately manage risks. Such events beg us to ask the questions: “Why aren’t risks taken more seriously and carefully attended to? What influences the decision-making processes regarding risk at all organisational levels?”

Furthermore, when we examine catastrophic events, it seems that the same root causes are reoccurring within inquiry findings. As employers, managers and workers we need to better understand “why?” Are we spending too much time on high frequency, low consequence incidents? Do we need to better understand the reasons for human failures?

Detailed below are a range of key human factors considerations in how individuals identify, assess and make decisions about risk and safety management. Of critical consideration is how organisations can more effectively engage employees, managers and other stakeholders in the risk management process, ensuring appropriate actions are taken regarding safety strategy and performance.

What are ‘human factors’?

There are many different understandings of human factors in the workplace. The Human Factors and Ergonomics Society defines human factors as “the scientific discipline concerned with understanding of interactions among humans and other elements of a system”[1], which results in the subsequent design and implementation of strategies to optimise employee health and wellbeing, and overall system performance. In further conceptions of human factors, there are three categories of factors considered, that is, how aspects of the organisation, the job and the individual interact, with resulting impacts to human reliability and performance and implications for safety and incident causation in the workplace. These factors are outlined in Figure 1 below.

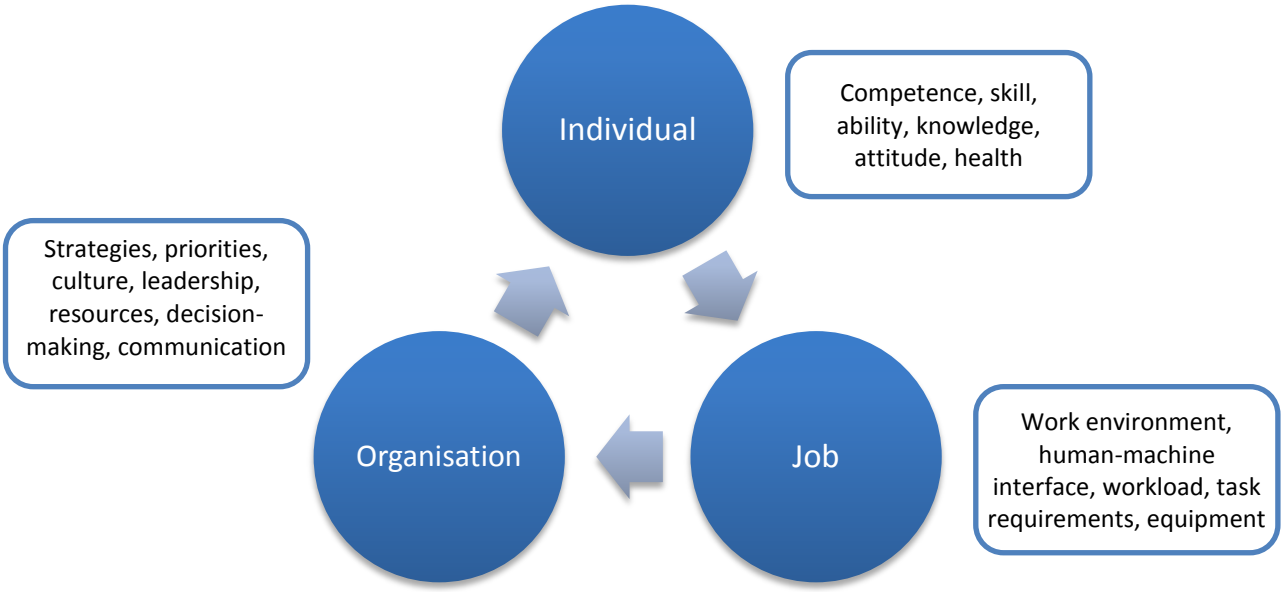

Figure 1. Three categories of human factors.

Considering the factors above, there are a number of tangible and intangible aspects of human factors that can result in complex issues for organisations to manage in driving safety performance. This spans everything from the technical design of plant and machinery to optimise human usage, through to safety culture and individual attitudes towards safety in the workplace.

Why human factors are a critical consideration in health and safety

Human error has long been considered as a key contributor in a range of minor through to catastrophic incidents, with common claims that human error is the leading cause of anywhere between 70-95% of safety incidents. Whilst individual factors are an important consideration, and many incidents ultimately result from a human action or active failure, these must be considered in light of other systemic factors and latent conditions that result in such errors occurring. Hence, in considering human factors, we consider the interaction of individual, job and organisational related factors that impact human performance.

Adequate identification and management of human factors is essential for the effective management of safety hazards and risks. By gaining a clear understanding of human factors and their relevance to health and safety management, organisations can better understand worker performance and design suitable solutions to improve reliability and reduce errors.

The ultimate issue is that humans are not perfect beings; we are not infallible. Thus it can always be assumed that workers will make errors, which may have catastrophic implications in high risk work environments. The aim of applying principles of human factors is then to increase worker reliability and ensure workers are capable of performing as expected. This is achieved by reducing the presence of factors that may reduce reliability and result in greater errors, with the primary considerations being those listed in Figure 1. These factors, when not managed effectively, are often referred to as error-inducing factors.

The Mining industry in Australia has invested greatly into the people aspects of health and safety in recent times. We have seen a considerable shift towards safety culture interventions, underpinned by research that has demonstrated the importance of these interventions. The importance of safety culture for the safety conscious organisation operating in a high risk environment cannot be underestimated. We know that implementing safe work procedures and providing personal protective equipment are not sufficient in sustaining safety performance. However, at times there is a gap between considering the physical work environment and the behaviour and performance of workers. It is not enough to consider the attitudes, beliefs, and actions of workers alone; we need to better understand the fundamental *ability* of the average worker to stay safe and make effective decisions regarding safety.

Human factors and risk management

In the 21st century, our environments are considerably more complex than they were in previous centuries and millennia. They have vastly different types of physical threat, and more complex cognitive processing demands and multi-faceted social interactions. Humans are not well equipped for the highly technical and dangerous environments that workers in the Mining industry operate in every day. Our cognitive and neurological functioning at times seems counterintuitive to our need for survival because of the ways in which we perceive dangers and threats. This effectively means that there are limitations of human performance that may result in failure to adequately identify and manage risks, and this may at times result in serious incidents.

Integration of human factors is considered to be a critical success factor in effective risk management[2]. The tasks associated with managing risks require human judgment and cannot be substituted or undertaken by a machine. Risk assessment often requires the careful evaluation of a range of inter-related and complex factors within the work environment, for which there may be a degree of ambiguity and difficulty. Thus in order to manage risks, workers need to use a range of knowledge, skills, abilities and experiences, largely relying on psychological factors including judgment, decision-making, perception, and intuition.

There are a number of elements that can then be considered in managing health and safety risks effectively. Four core elements, included in Figure 2, are further defined below. It is recommended that in order to implement robust risk management practices, each of these elements is considered in the risk management strategy employed by the organisation.

Figure 2. Core human factor elements in managing risk.

- *Risk attitude* – individual and organisational attitudes towards risk, and the degree to which these attitudes drive effective decision-making and behaviours regarding risk management.
- *Risk perception* – the capacity to adequately perceive or become consciously aware of hazards and risks
- *Risk analysis* – the ability to adequately assess risk, weighing up the likelihood of an incident occurring as compared to the likely consequences
- *Risk competence* – the ability to competently follow risk management practices and respond to risks, requiring sufficient training and skill

Risk Attitude

As individuals, we have our own beliefs, values, attitudes and motivations. Unhelpful attitudes towards risks result from our own belief systems and are further influenced by personality factors, individual differences, experiences, and interactions with others. Some individuals are naturally more risk averse than others, whilst some are natural 'sensation seekers', with a much higher tolerance for risk. Often the behaviour of workers in high risk industries is described as "over-confident", with a failure to respect the risks inherent in the work environment. The attitudes of such individuals can result in a lax attitude towards risk and violations of risk management practices.

Attitudes towards safety can be quite complex and difficult to understand. Experts have sought to better understand risk-taking behaviour through assessing a range of factors including personality, attitudes, perception and environmental factors. In a study of risky driving behaviours, researchers were able to determine that personality influenced attitudes towards safety, which in turn impacted behaviour. For individuals who profiled as more altruistic and anxious, attitudes were more positive in regards to traffic safety, and their perception of risk was high. In contrast, individuals who profiled as sensation-seeking, aggressive and normlessness (state of lacking standards, values or purpose) had much lower perceptions of risk, had poorer attitudes towards safety, and reported more risk-taking behaviours on the roads[3].

Our attitudes ultimately influence our behaviour. If we want to influence behaviour in order to improve safety performance, we need to focus on changing values, beliefs and the thoughts of employees, as well as the situation in which the individual is operating, i.e. their work environment and the systems and practices of the organisation.

This is of course easier said than done. Whilst it is certainly possible to change a person's attitudes, it is not always easy, particularly where there is an element of fixed personality involved. An individual's attitude, sometimes referred to as a mindset, is compiled of thoughts and feelings. It is very hard to know what a person is thinking and feeling; what is observable is their behaviour, and it is most often through a manifestation of risky behaviour that we identify poor attitudes towards risk. David Rock, world renowned expert on social neuroscience, introduces this concept through the analogy of an iceberg.

Figure 3. Iceberg Model

In understanding safety behaviour, managing performance and establishing a strong culture of safety, managers and leaders need to understand the attitudes that are driving this behaviour. This does not mean making assumptions; this means engaging the employee in a discussion that focuses on working together to understand why the behaviour is occurring. Working back the other way, consider attitudes such as: "It's ok to cut corners and break the rules." What sorts of feelings do these patterns of thinking lead to? What sorts of behaviours are likely to result from these thoughts and feelings? These are the questions that should be at the forefront of the minds of managers, leaders and employees. The only way to change behaviour is to change the thinking pattern that sits underneath it.

Risk Perception

Human perception of risk involves both an element of our attention, as well as our capacity to register that a task or situation is dangerous. When it comes to dangers in our workplace, we need to be able to notice the hazard (attend to it), perceive that there is an element of risk, and then take action to mitigate that risk. It is likely that for most workers in Mining, they would have experienced their work environment as relatively dangerous at some point in time. However, over time, our brain becomes accustomed to exposure to danger, and so we give less and less of our attention to noticing these factors in the workplace. This is often referred to as "habituation".

There is a series of stages involved in the way people process information. We experience our environment, we select what requires attention (whether consciously or subconsciously), we then process that information, and we work through a process of making sense of what we see. The challenge is that we are subjected to hundreds and hundreds of pieces of data every moment, and we do not have the cognitive capacity to process all of this information. Everybody's filter for information is different – it is based on our experiences and circumstances in life, our beliefs and value systems, our motivations, etc.

Cognitive Psychologist George Miller suggested that we can only consciously attend to approximately 0.3% of the stimuli in our environment at any one time.[4] This means

that we miss an overwhelming amount of information. Thus, it's not so simple to suggest that we need to pay more attention to the risks inherent in Mining, risks are not always going to be easy to identify, and this phenomenon may cause many of the human errors that result in safety incidents on our worksites every day.

There are many implications of our severely limited information processing capacity. Our drive for increased productivity means that workers are increasingly feeling the pressure to work harder, do more with less, and juggle multiple complex tasks simultaneously. These increasing demands are taxing on our systems and compromise our performance at work.

Many experiments have been conducted on a phenomenon known as "*inattentional blindness*", in which we miss important stimuli that appear right within our field of vision, but which we don't consciously attend to as our attentional resources are already being used up. Inattentional blindness can occur when we are overloaded, distracted, or we have directed the brain by giving it "instructions" to focus on particular items. To overcome the challenges associated with inattentional blindness, we need to find strategies to assist us in consciously focusing our attention on workplace factors that may be important, i.e. factors within our work environments that could pose potential risks to our health and safety.

Similar to inattentional blindness, there is another phenomenon referred to as "change blindness". Because it is hard to process much of what happens in our environment every day, it is very difficult to detect changes that occur without additional cues to direct our attention towards items that may have changed[5]. Hence the importance of repeated and regular risk assessments. Small and slow changes could occur on plant or equipment over a period of time, such as a bolt working loose, and because of the limitations of human perception, these changes may go unnoticed by workers.

Without stringent risk assessment practices, workers are losing a valuable opportunity to re-focus their attention on factors that might otherwise be overlooked or discarded as not presenting any risk. Failure to adequately perceive risks has further implications for our ability to effectively analyse risks and make subsequent decisions about a suitable course of action.

Risk Analysis

In addition to habituation, our perception of risk can be altered by complacency. When we are continuously exposed to danger, the brain becomes progressively desensitised. We trick ourselves into thinking "that will never happen to me" and thus can underestimate the potential for harm to occur. Complacency alters our ability to effectively evaluate the hazards that are present in our work environment by downplaying the level of risk. In order to more effectively perceive the risks that exist, conscious attention is required to reflect on potential consequences of incidents occurring, the continued need to maintain a high level of vigilance, and to follow health and safety procedures accordingly.

Whilst complacency is a phenomenon we often discuss in relation to human errors, there are a range of psychological factors regarding information processing that result in poor risk analysis and decision making. Other factors to consider include[6]:

- *Confirmation bias*: tendency to seek out information that confirms our pre-existing assessment or opinion of a situation, and to ignore information that is contrary to our point of view
- *Intuitive statistician*: tendency to overestimate the likelihood of low probability events occurring, and to underestimate the chance of a high probability event
- *Expectation*: tendency for perceptions to be shaped by what we do or do not expect, e.g. if you are not informed of safety incidents, you expect that the site is operating safely and effectively
- *Representativeness heuristic*: tendency to assume that a situation that is similar to a situation previously experienced is the same

However, other common rules of thinking and judgment could be used to one's advantage in managing safety. The availability heuristic involves the ease with which a particular idea can be brought to mind. When an infrequent or unlikely event can be brought to mind with apparent ease, people are more inclined to overestimate that events likelihood, and may then behave accordingly. If we encourage workers to focus on the possibility of a catastrophic event occurring, they may be more motivated to behave in a way that minimises the chances of such an event occurring.

The ability to make integral decisions in the workplace can be the difference between staying safe and being involved in an incident. Workers are constantly required to assess their work environments for risk, and make decisions about the best course of action. Decision-making requires conscious attention and a large proportion of our cognitive resources. We often find the task of making a decision or solving a complex problem quite taxing, and this experience of fatigue can continue to have an effect on our performance at work.

The quality and accuracy of our decision-making is influenced by many factors. Being overwhelmed with data to consider can make it difficult to cut through the noise and focus only on what is important. Furthermore, when workers experience high degrees of stress and pressure, the experience of a range of emotions can have an adverse impact on the decisions we make. For example, when we are experiencing looming deadlines or are feeling tired, we may make the evaluation that it's ok to cut corners or take shortcuts in completing tasks, without considering the consequences.

Furthermore, humans are not always good at thinking logically, which impacts our ability to trouble-shoot and problem solve. We are prone to misinterpreting data and making assumptions about information that don't always ring true, highlighting the importance of effective training and ensuring adequate information is available for decision-making[7]. This challenge has become apparent in a number of significant safety disasters. In the Three Mile Island nuclear incident of 1979, major damage could have been prevented had operators correctly detected that two reactor valves that should have been open were actually blocked shut. They falsely concluded that they were open as a result of failing to read their instrument display panel correctly. As a result of making these deductions, operators made a series of decisions to minimise danger that were in fact counter-productive.

We learn from our mistakes and reflecting on incidents that we have experienced can provide us with information to later draw on when making decisions. Many organisations experience under-reporting of health and safety incidents. This occurs

for many reasons, including perceived lack of management responsiveness to reports, fear of reprisal, loss of benefits, poor safety climate, and acceptance that incidents and injuries are just a part of the job. The issue with under-reporting is that employers and employees alike are cheated of opportunities to learn from near misses and incidents, and continue to improve practices and explore practical controls that could be implemented to prevent future incidents from occurring.

Risk Competence

The alibility of the average worker to assess and manage risks is then underpinned by their level of skill and the training provided in implementing risk management practices. Workers need to understand the importance of risk management practices, and be adequately trained in identifying and understanding hazards, and assessing the degree of risk and potential consequences of a particular incident occurring. This can be particularly challenging for inexperienced workers, who lack understanding of hazards through ignorance.

In the absence of training, workers are going to gain most of their education through on the job practices. The quality of the training they then receive is dependent on the degree to which workers in their environment are following appropriate procedures. Because humans are infallible and make errors from time to time (whether consciously or not) patterns of error and problematic behaviours could potentially be adopted by others.

Further to training, there are a number of human factors consideration in procedures and practices used on-site. Some health and safety documentation can be cumbersome and isn't fit for purpose, resulting in failure to follow practices. Issues include reading difficulties, literacy issues, language barriers and time pressures, which may all result in workers missing valuable information about the task at hand and the inherent risks involved that require management.

Many of the issues raised above can be overcome through simple training and education, and consideration of human factors in the design of safe work practices. We do not always have the power or means to prevent workers from making errors, but one of our best chances for successfully minimising the chance of errors is through training, education, mentoring and coaching both formally and on the job.

Key Recommendations

In better designing systems of work and health and safety practices, there are a range of recommendations that Mining organisations could consider in further improving safety performance. These recommendations include, but are not limited to:

Educate and train workers on human factors

Employees need to understand human factors and the limitations of human performance. This will help to influence worker attitudes towards safety practices that are designed to control for these limitations, such as conducting risk assessments.

Establish thresholds for risk

There is a degree of individual difference in tolerance for risks. Those who are quite inclined to seek risks may be more likely to overlook or under-evaluate risks. Organisations should seek to establish and reinforce thresholds for acceptable risks to influence behaviour and over-ride such individual differences, ensuring that risks are adequately reported.

Design risk assessments with consideration for human performance

Risk assessment tools are seldom changed, allowing workers to fill them out with generic information and do so automatically without actually conducting a thorough assessment of risk. Risk assessment tools should be regularly changed, refreshed and/or updated, and in conjunction with this, workers should be educated on the importance of risk assessment tools as a way to consciously focus attention to overcome the limitations of human performance.

Address poor attitudes towards risk management

When it is identified that workers/managers have a poor attitude towards risk management, or have unrealistic beliefs about risk, these should be challenged tactfully. Leaders and managers should be trained on how to manage performance and have effective conversations regarding safety behaviour.

Foster a positive safety culture

A culture of safety needs to be driven from the top of the organisation and fostered throughout the system, whereby there are shared perceptions and beliefs about the importance of safety, strong values, and a desire to stay safe and keep others safe on a day to day basis.

Ensure leaders and managers follow through on risk management practices

Often unhelpful attitudes towards risk management are born out of reactions to perceived failures to take action as a result of risk reporting. This reinforces believes that these activities are not important or a waste of time. Leaders and managers should report back to the workforce on remedial actions that have been taken to address risks, and there should be accountability for resolving issues.

Address human factors in risk assessment practices

It is easy to fail to attend to the risks that we cannot physically see. Risk assessments should address human and psychosocial factors as much as physical factors. We need to assess the likelihood of human error occurring. Of particular importance is considering whether or not there is consistency between the task requirements, system design and perceptions of the task.

Use information management tools

We are easily distracted and overwhelmed with information. In order to ensure we don’t miss important steps in a task or forget to check for potential safety issues, checklists can assist in successfully carrying out complex tasks.

Undertake department cross-over observations and inspections

When we become highly accustomed to our work environment, it becomes more challenging to identify risks. Having individuals from other work areas conduct safety observations and inspections can result in a fresh set of eyes picking up things that might have otherwise been missed.

Double-team workers that are new to work environments with those that have been at site much longer

Similar to cross-overs, though new workers are often less experienced, they have a different perspective on the work environment and in collaboration with more experienced workers may more successfully identify hazards and risks.

Conclusion

Whilst it is well understood that the Mining industry involves many risks, it is clear that there are a number of human limitations in effectively assessing and managing hazards and risks. In addressing these limitations, interventions based on principles of human factors can be applied to improve the effectiveness of risk assessments, incident reporting, investigations, communication, and the design of procedures and practices.

We need to develop an appreciation of how human factors contribute to safety incidents. Often investigations reveal a complex web of errors and violations driven by a range of physical, cognitive, behavioural, social and environmental factors that result in failure to adequately identify, assess and manage risks.

By continuing to develop and evolve interventions that attend to the people aspects of safety, and in combination with the systems and physical aspects of safety, the Mining industry will be able to more effectively and holistically optimise risk management practices and continue to improve safety performance.

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