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Abstract

This paper presents the findings of a study conducted in 2011/2012 that investigated the skills of new entrants to the mining industry's skills in identifying workplace hazards from photographs of their work areas and strategies to improve these practices identified by health and safety managers. The findings of phase one of the study indicated that there was a greater ability to identify the hazards by those with 6–10 years experience and aged 34–45 years. Phase two of the study, which is the topic of this paper, identified training, communication and documentation as important to improve hazard identification skills. Other strategies suggested included incorporating hazard identification as part of performance management strategies, the role of safety inductions for new entrants (those new to working in mining), the importance of roles in improving organisational safety culture, the use of safety systems, specific training in hazard identification and the use of walkthrough workplace training to identify hazards.

Keywords: hazard identification, safety culture, mining, new entrants, supervisors.

Introduction

This study investigated the hazard identification skills of new entrants to the mining industry (those workers who have not worked in the sector before) and collected ideas of strategies to improve this process from Occupational Health and Safety (OHS) managers. The study collected data in two phases. In the first phase, data was collected from 54 newly hired managers and employees at a specialist underground mining contractor. The findings of phase one have been reported and have been submitted elsewhere. Phase two of the data collection, the topic of this paper, included in-depth, semi-structured interviews with 21 purposively selected OHS managers in the mining industry between May and July 2012.

Workplace hazard identification

There has been limited research nationally and internationally that has documented the hazard identification skills of managers and employees to improve practice, rather research has traditionally focused on reporting of hazards and risk management.[1] Australian health and safety legislation assumes that managers and employees have the appropriate knowledge to effectively identify hazards. Definitions of workplace hazards can be found in Australian and New Zealand Standards such as AS/NZS ISO 31000[2] (Standards Australia 2009) and AS/NZS 4804/01[3] , [4] (Standards Australia 2001a, b), who define a "potential for harm" or "potential to cause loss". Hazards contribute to workplace risk and include the actions of people and the

characteristics of equipment, dust, and chemicals, for example. However, how risks are perceived affects how they are managed and the effect on the organisation.[5]

Herein lies the problem, different people see the same risk situation in quite different ways.[6],[7],[8] This means there is generally "a lack of awareness of the nature of risk".[9] For example, Carter and Smith[10] conducted a hazard identification study on three UK construction projects and found that workers were able to identify 89.9% of all possible hazards for a construction project within the nuclear industry, 72.8% for a railway project, and 66.5% for a project that encompassed both construction and the railway. They concluded that "hazard identification levels are considerably lower than 'ideal' for three construction projects within separate industry sectors". They proposed that there are two types of barriers to improving hazard identification: knowledge and process. Similarly a project conducted in the construction industry in NSW revealed significant weakness in the formal process of hazard identification by contractors.[11] Harms-Ringdahl[12] developed an organisational Safety Function Analysis with six stages. The analysis requires users to select a set of hazards and identify the existing safety functions for these hazards. This is an example of a hazard identification process that firms could use to improve hazard identification knowledge in managers and employees. Another example of process is the work of Tsutsumi et al[13] who used participatory research techniques to improve the mental health of Japanese manufacturing workers and asked them to identify hazards based on the surveillance of stress using self-administered questionnaires. They found that workers improved their work environment by hazard identification based on stress surveillance, risk evaluation group discussion on workplace improvements, and planning to realise these goals. They argued that the results indicated that participatory intervention for workplace environment improvements was effective in preventing deterioration of mental health. Further examples of process include the work of Cromie et al[14] and Mattila[15] in the health sector who suggested that the use of checklists, workplace inspections, injury records and consultation with workers will assist with hazard identification.

These research studies assume that the participants have the skills and knowledge to successfully identify hazards. However, Rouhiainen[16] asked how well the analysis has identified hazards as one of four questions in relation to the quality of a safety analysis. Ramsay et al[17] investigated hazard analysis in the US nursing profession and found that although nurses are exposed to a number of hazards on a daily basis, the core competencies within their accreditation and training failed to mention a requirement to demonstrate competence in hazard identification or control. Industries and professions such as nursing, dental health, mail deliveries, nanotechnology, manufacturing, construction and mining were identified in the literature, raising the importance of good hazard identification in the workplace as a preventative injury mechanism.[18],[1],[17],[19],[20] However, training in Australia hazard identification is limited and predominantly the work of consultants. Work in the mining sector is often hazardous and this industry has a large number of workplace injuries and deaths.[21]

Organisational safety culture and the mining industry

There are many layers in an organisation's culture that have a direct influence on the safety culture.[22] Stephan[23] stated that "in an organisation that has a healthy safety culture everyone feels responsible for safety and pursues it on a daily basis". The dilemma is that safety culture is often seen as separate from the organisational culture, whereas safety should be situated at the core of the organisation's overall culture. Gherardi and Nicolini noted that there is a misconception of the notion of safety culture in that "safety culture is not something possessed by an organisation" but it is in fact an "organisational act".[24] The mining sector in Australia has placed a focus on improving safety culture which is reflected in the reduced number of injuries and fatalities that have occurred in the past few years[25] (Safe Work). Even though this industry sector is considered extremely hazardous, especially in the case of underground mining which is the focus of this study, they remain sixth highest over all industry sectors in terms of serious injury claims (p 5) and fourth in terms of fatalities (p 9).[25]

Study methodology and sample

This qualitative study had two data collection phases. At phase one the focus was on knowledge of hazards. Data was collected between November 2011 and February 2012 from 54 newly hired managers and employees at a specialist underground mining contractor in Western Australia (WA), who agreed to participate in the project and provide access to new recruits. A series of six pictures of underground scenarios was supplied by the mining contractor. These pictures displayed examples of their underground worksites and were issued to the participants at the end of their safety induction training. In-depth details of these results have been submitted to be published elsewhere. At phase two the focus was on the processes employed to identify hazards. In-depth, semi-structured interviews (17 telephone and three face-to-face) with 21 purposively selected OHS managers in the mining industry in WA who had been in their role between 3 and 20 years were conducted between May and July 2012 to determine successful strategies to identify hazards based on the findings in phase one.

The research questions for the study were:

      1. Do managers and employees have the knowledge to identify workplace hazards correctly?
      2. What processes can be used to increase managers and employees hazard identification skills?

The interview questions were approved by the University ethics committee and participants were invited to participate through email invitation. The interviews were audio recorded with participants' permission, fully transcribed and then checked for errors and paralinguistic information. The data was analysed using a template approach[26], which entails analysing the text through the use of a "guide" consisting of a number of relevant themes including future training needs, support mechanisms and attitudinal change, and NVivo will support data analysis.[27] The storage of the interview transcriptions was according to university ethics protocols on password-protected computers in locked offices.

Findings

At the time of the interview the findings of the picture survey results were fed back to the participants to gather feedback from them to confirm their significance. Many of those interviewed confirmed that the survey findings mirrored the analysis that they had conducted of the companies in which they worked. The examples of hazards within the pictures included those that were obviously hazardous, for example hoses laying on the floor that would constitute a trip hazard, and others that were controlled, for example meshing of tunnel walls. Most agreed that new entrants and those with many years experience were either unable to identify hazards in their workplace or had grown complacent in their assessment of the level of risk. However, there was not a consensus among the group regarding the link between age and the ability to identify hazards. Some indicated that younger workers were unable to perform this task; others disagreed and noted their high performance. Some noted older workers were less able to identify hazards where others noted that it was length of experience not age that determined levels of complacency.

The data indicated that 17 (80%) managers agreed that their staff can identify hazards with four (20%) stating they did not believe their staff could perform this task. In addition, only five (23%) managers stated that their staff actively identify hazards in their workplace with 16 (77%) managers suggesting that their staff do not. In summary, although most of the managers noted that their staff have the skills to successfully identify workplace hazards the majority are not actively performing this task.

Four of the OHS managers interviewed suggested that their staff had problems identifying workplace hazards. Some noted that this is especially the case for new entrants into the mining industry, particularly those working in underground mining, because they do not have a point of reference to determine what constitutes a hazard. Others indicated that hazard training might be in place in their organisation, however, they noted that the personalising of hazards and their possible impact is problematic for their staff:

    "[Staff] can't tell you what a hazard actually is.

I think generally we train poorly so they really understand what a hazard is poorly.

They're not going to be able to identify hazards unless they've been given a point of reference to work from.

The trainer obviously tells them what a hazard is, they can tell you there's all these different hazard types that can cause harm but being able to actually see what one is and how it could become a hazard to them is where … I think that's where that falls apart."

However, the majority of the sample (80%) reported that they believed that their staff can identify workplace hazards and have sufficient training to complete this task:

"I'm quite confident they do know how to identify hazards in the work place.

They are taught about what hazards are and what a hazard is and what a risk is and how the two link together and they know that hazards are out there all the time."

The OHS managers were quick to point out that training was not the only reason their staff can identify workplace hazards. A number of them expressed that past experience with near misses or workers involved in incidents that lead to injury or damage to machinery was a large determinant of future identification of hazards. This experience enables the worker to have a point of reference in that they can personalise the hazard (in that they been exposed or experienced the hazard in the past) and its effects. However, personal experience with hazards can have dire consequences in that serious injuries and fatalities can occur particularly when working in the mining sector due to the extreme working environment:

"They can go out, they can see something that is wrong because nine times out of ten they've probably done it themselves.

Hazard perception's pretty much driven by past experience and background training and risk tolerance.

I think some of it is based on the lack of experience so they've never been exposed to certain environments within which these hazards exist. Whilst we try and teach them these are the things that can go wrong unless they actually experience it and unfortunately the experience sometimes results in an accident."

Although the data collected for phase one of this study indicated that the younger, inexperienced new entrants to the mining sector were unable to identify a substantial number of hazards in the picture survey, the OHS managers interviewed argued that this group were keen to learn and participate. The more experienced worker was noted as often complacent in active hazard identification in their workplaces, which itself may be a reflection of the safety culture of the organisation:

"Working with such different age groups you can really see the younger ones and they're the ones that pick up hazards and only because the people in the later age groups they actually know how to work around those things, they actually know how to use those things that we call hazards and actually make them a working tool so they … they are quite complacent to it all.

I find that the young ones are not hesitant to bring things up and the only time that they are hesitant to bring those things up is normally when they're put in the environment with the older generation, which is quite experienced and then build that expectation of that younger person that they need to come into this industry and get their feet placed pretty quickly and less complaining but more working.

I think those that are experienced and more familiar with a particular role take some of the hazards for granted or they do it subconsciously or they are lazy and don't take it as seriously as perhaps a

younger person who comes into the role for the first time and is a bit more switched on and has a bit more of a safety culture perhaps."

However, the OHS managers interviewed for the study noted that new entrants to the industry are often underprepared for the working environment:

"They simply just don't know what underground looks like and most times when you take new underground inductees underground you drive into the portal they go oh this is not what I expected it to be. You hear that comment so many times."

Finally, the OHS managers stated that some new entrants to the industry (particularly the younger workers) view the high wages they are paid as "danger" money and had expectations that workplace injury was inherent with their job. Needless to say, this is an example of a poorly developed organisational safety culture that requires serious attention:

"They [younger workers] have almost an acceptance that at some stage I'll get injured."

Workers do not recognise the severity of the hazard

Manuele[9] argued that people perceive hazards differently in that the severity may be perceived as more or less depending on experience and previous exposure. The difference in risk perception of workplace hazards clearly emerged as a theme in the interviews with the OHS managers:

"People see a hose line on the floor some people see it as a hazard, some people see it as a necessity, it's easy access for me, I always do it, you know, it's just, you know, it's just one of those things; that's an untidy workshop you know?

When they first come into the mining industry it's not until they see someone get trapped by a runaway machine or put themselves in a position where they lose a limb or they have a rock fall on them and break a leg or fall off a set of steps leading into a piece of high equipment then it becomes a reality to them.

What one person sees as been a hazard and a threat and another person doesn't necessarily see that."

Coupled with the differing perception of risk was the view that the individual would not be harmed by hazards in their workplace (it would happen to someone else):

"I think hazard ID is good what we lack is the power to understand the 'it won't happen to me' attitude.

You get this I'm bulletproof or everybody talks about this. It becomes just background noise to them.

Blasé to the extreme and you couple that with a lack of awareness of what are the risks and hazards.

They either believe it's not going to happen to them or it's okay if I do it quickly."

Research by Coleman[28] indicated that younger male workers are larger risk takers, but it appears in this study that those with extensive experience become complacent with the risks of performing their work:

"I've worked with people that are a thirty year people and I've still got to stop them and say 'you're going to get hurt doing that the way you're doing it' or they haven't recognised an obvious hazard such as a rock about to fall off the wall or the roof on top of them.

> Complacency is 'I don't give a …' but these people just don't see it. Like white line fever, you know, you'd be driving five hundred kilometres and only see the road ahead of you. I just think that they just become automatic.
>
> It's this blindness comes from experience in the particular game that they're in be it construction, mining, electrical."

The complacency of the more experienced worker in mining may be due to a lack of personal injury. Alternatively, it could be argued that the more experienced worker has intrinsic knowledge of the work area that enables them to "know" which risks to take and when. However, this ability to remain unhurt can breed a false sense of security and encourage further risk-taking:

> "What I find a lot in the older guy or the more mature in the industry in the particular job that he's doing they tend to what I call roll the dice and they've said look I've done it this way for ten years. Always done this particular trick and it's never gone wrong and they teach the young guy that. They say look, you know, I've still got all my ten fingers and I've done it this way for the last years so it must be the right way but it isn't. It's like rolling a dice …
>
> They know what the hazards are, twenty years underground they go 'it's never happened to me; it never will'.
>
> You've done it so many other times before you knew the hazard was present but because you weren't affected by how far you pushed the boundary then you assumed you could push it further."

Long-term employees with extensive experience in mining have come through periods of time that were less regulated and may have worked in organisations with a less robust safety culture and are resistant to change. Improved safety in mining has occurred in the last 15 years supported by legislation that specifically regulates the industry:

> "Older people might have also escaped the scrutiny on safety within the mining industry itself, which is only really been, you know, a big push in the last decade.
>
> We've done it this way a hundred years and I've never been injured sort of attitude they resist a lot of risk assessment and safe work procedures and hazard identification. So there is a level of resistance still in the work force of I would say older, more mature operators or workers in the industry.
>
> They know it's a hazard, they know that if they do that it's going to have severe consequences. They could probably even get the sack but it's not enough to change the drive in that behaviour to make them do that task in a different way."

Some OHS managers questioned the level of their staff's understanding of hidden or inherent hazards and the potential for these hazards to create considerable harm:

> "When you sit up there and say this has the potential to cause harm you've got no real idea whether the people themselves understand that. And really you'll find that those that give it a cursory view will just find the simple ones, the hole in the ground, the oil spill, the wire, loose wire whatever. Will find those but there are more inherent hazards in things. You know things that have got potential energy, things that have got gravitation … their view is: I only need to know enough information to do what I have to do."

Others indicated that a false sense of safety pervades some mining workplaces in that workers feel they are fully protected by the safety systems that are in operation. Many leave hazard identification and risk assessment processes to others to complete. In some cases workers feel that safety in the workplace is the sole role of the health and safety professional:

"My impression is that they believe they are safe because the company's already identified all the hazards and put things in place so therefore I won't get hurt because they're good at safety. You then just become blasé because oh well someone else should have done the risk assessment prior, someone else should have identified the hazards, it's the supervisors role to provide me a safe place of work, the company's responsibility, so you know we just carry on thinking everything's fine.

It's the Supervisors role to get the production out and if they see something unsafe happening then have a quiet word in the person's ear but the safety is seen by some as a separate role for the safety officer, the safety consultant, the safety manager on site and they're there to get the job done."

Workers recognise the hazard but fail to make any changes

There was evidence from the interviews that the OHS managers believed that their staff could identify workplace hazards; however, 77% of those interviewed stated that they did not address hazards of which they were aware. Examples of such breaches include the failure to address obvious trip hazards as a result of poor housekeeping, vehicles left idling while unattended on inclines and the loosening of personal protective clothing such as a requirement to wear long sleeves (workers who roll their sleeves up):

"Some of them can recognise a hazard but will do absolutely nothing about it because it doesn't relate to them, it's not in their work area or they just can't be bothered.

We see people walking past hazards every day and I've walked around with safety advisors with years of experience and they've walked past the most obvious hazards.

I have actually stood there watching contractors doing their job in an exceedingly risky manner and I've stood there with supervisors and superintendents who watch them and aren't interested in saying anything about what they're observing."

There was evidence that younger inexperienced workers were less likely to address hazards that they encountered:

"Despite been grumpy [older workers] they'll identify things that a lot of the younger ones miss who'll gladly drive past a big sharp rock in the middle of the hall road rather than just calling it up to get the dozer to move it out, things like that."

The OHS managers noted that there were cases of general staff who identified hazards but were unaware of the process to address them:

"People wanting to do the right thing; but not necessarily knowing how to do it.

I ask them and say well what do you do at that instant that you saw the hazard? What did you take upon yourself? Did you make it safe? You know, did you mitigate the hazard? Did you remove the hazard all together and then they seem to fall into an area of not knowing. They don't have the skills to sort of assess the risks involved.

They've spotted the hazard but they haven't been able to mitigate it or assess the actual risk that it poses."

The lack of ability to address hazards in the workplace could be improved by training and mentoring by experienced workers to understand the steps in controlling and eliminating them:

"So the older more experienced guys are totally aware of the hazards but are they trained to be able to control those hazards, prevent them, eliminate them?

I've been in mines where people have overridden those controls [hazard controls]."

Finally, the OHS managers argued that there needs to be a culture of workers that have a focus on hazard identification at the forefront of their everyday activities:

"Either you go into an area looking for a hazard or do you go into an area thinking about something else and just want to get the job done and go home? Can people identify? Yes but it takes a trigger to make them stop and think about it."

Discussion and conclusions

This study set out to answer two research questions to determine the ability of workers in the mining sector to successfully identify hazards and to seek some strategies for improvement in this activity from OHS managers. In terms of the first research question: Do managers and employees have the knowledge to identify workplace hazards correctly? The findings are two-fold. First, for new entrants to the industry, phase one of the study showed that safety induction training had little influence on the participant's ability to identify hazards in pictures of their workplace. In fact, phase one of the study indicates that for new entrants, younger and older workers, and even those entering supervisory roles, specific training in workplace hazard identification is required. This is supported by the greater ability to identify the hazards in the pictures by those with more experience and aged between 34 and 45 years.

Second, phase two of the study revealed that 80% of the OHS managers interviewed agreed that their staff can identify hazards. However, only 23% of the managers stated that their staff actively carried out this task in their workplace. In short, although most of the managers noted that their staff had the skills, the majority are not actively identifying hazards in their workplace. Most agreed that new entrants and those with many years experience were either unable to identify hazards in their workplace or had grown complacent in their assessment of the level of risk. However, there was not a consensus among the group regarding the link between age and the ability to identify hazards. Some indicated that younger workers were unable to perform this task; others disagreed and noted their high performance. The OHS managers interviewed for the study noted that in general new entrants to the industry are often underprepared for the working environment. The managers argued that older workers were less able to identify hazards where others noted that it was length of experience not age that determined levels of complacency. The complacency of more experienced workers may be due to a lack of personal injury and this ability to remain unhurt can breed a false sense of security and encourage further risk-taking. A difference in risk perception was coupled with the view that the individual would not be harmed by hazards in their workplace (it would happen to someone else). Others indicated that a false sense of safety pervades some mining workplaces in that workers feel they are fully protected by the safety systems that are in operation. Many leave hazard identification and risk assessment processes to others to complete, believing this to be the role of the health and safety professional. There was also evidence from the interviews that staff did not address hazards of which they were aware, particularly from younger inexperienced workers. The OHS managers noted that there were cases of staff that identified hazards but were unaware of the processes to address them. They argued that there needs to be a safety culture in their organisations that has a focus on hazard identification at the forefront of their everyday activities.

The second research question sought to determine the processes that can be used to increase managers' and employees' hazard identification skills. The OHS managers interviewed for the study recognised a need to improve the hazard identification skills of their staff. Overall, the managers identified training, communication, processes for hazard/risk control and documentation as important to improve hazard identification skills. Strategies that they suggested to improve hazard identification included incorporating hazard identification as part of performance management strategies, the role of safety inductions for new entrants, the importance of roles in improving organisational safety culture, the use of safety systems, specific training in hazard identification and the use of walkthrough workplace training to identify hazards. Finally, this study shows that in order to reduce work-related injury and disease in the mining industry, more

needs to be done to train in, and emphasise the importance of, identifying hazards in the workplace as a mechanism to improve the safety culture overall.

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