1-1-2013

Mining workers ability to identify hazards using a picture survey

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Bahn, S. T. (2013). Mining workers ability to identify hazards using a picture survey. In Work, employment and employment relations in an uneven patchwork world: Proceedings of the 27th AIRAANZ Conference (pp. 2-10). Fremantle, Australia: Association of Industrial Relations Academics of Australia and New Zealand. Availablehere

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ABSTRACT

This paper presents the first phase on a study investigating the skills of workers in the resource sector at their safety induction to identify workplace hazards. This study questioned the ability of managers and employees to identify workplace hazards correctly (phase 1) and to determine the processes that can be used to increase hazard identification skills (phase 2). Fifty-four completed surveys that contained 6 pictures displaying complex and hazardous work environments in an underground mine in WA are analysed. The analysis sought to determine the average number of hazards that each participant could identify out of a possible 10 in each picture. The findings include that new entrants, and those with limited experience identified few hazards in the pictures. Exploration workers had the best hazard identification skills over their counterparts, and those in Supervisory roles performed lesser than expected. The study recommends specific training in hazard identification prior to beginning work in the mining industry.

Key Words: Hazard identification, mining, safety training.

INTRODUCTION

The ethical conduct and profitability of organisations relies in part on occupational hazards being identified and managed within competent risk assessment processes. These occupational hazards can be physical, chemical or physiological and can cause workplace accidents and impact on firms' productivity and profitability (Hollmann et al, 2001; Lees, 1996; Ramsay et al, 2006). But not all hazards are known and risk management is also about dealing with the unknown. Indeed, the revised Risk Management Principles and Guidelines for Australia and New Zealand ISO 31000:2009 defines risk in terms of "the effect of uncertainty on objectives" (Standards Australia, 2009:ii). Risk assessment processes and practices are used to identify hazards and manage risks. Harms-Ringdahl (2003:1) argues risk assessment is "a systematic procedure for analysing systems to identify and evaluate hazards and safety characteristics". Risk management within organisations is underpinned by managers and employees being proficient in identifying hazards in their workplaces. But are they?

Hazard identification requires the individual to recognise obvious hazards, but also emerging hazards. In short, if managers and employees are not skilled at hazard identification, then the risk assessment process will be incomplete and workplace safety cannot be guaranteed. Documenting the knowledge of, and process to identify, workplace hazards is important research that will underpin future safety training needs. This study questioned the ability of managers and employees to identify workplace hazards correctly and to determine the processes that can be used to increase managers and employees hazard identification skills.

OHS managers in the mining industry are at the forefront of safety practice as workers are exposed to hazardous working conditions requiring extensive hazard identification skills. The mining sector is significantly hazardous (Devine et al, 2008): 6 work related deaths, 386 injuries requiring 60 days or more off work, and 877 injuries requiring 5 days off work were provisionally recorded in 2008-09 (WorkSafe WA, 2011).

BACKGROUND

Australia strives to be a world leader in OHS practice (ILO, 2005). But this relies on proactive management of risk. The identification and management of risks is critical for safety (Bohle & Quinlan, 2000). It is the skills in identifying workplace hazards that contribute to risk to the manager and employee that forms the topic of this innovative research study and fundamental to good OHS practice (Biggs et al, 2006). 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 focussed on reporting of hazards and risk management (Biggs et al, 2006).

Australia is in the process of harmonising OHS regulation across the nation. The Work Health and Safety Act (WHS Act), Regulations and Codes of Practice and supporting Guidelines have been developed (SafeWork Aust, 2010). Underpinned by the 'duty of care' concept, the WHS Act requires employers to identify and implement appropriate measures to ensure a safe system of work and requires employees to follow that system. The Act permits workers to stop work if they consider themselves exposed to a serious risk, while OHS representatives are able to direct workers to stop work if exposed to a potential risk. Employers are required to exhibit due diligence in all activities including: identify the risks and hazards in the nature of their operations; examine their resources and processes to ensure a safe system of work is in place; have a knowledge of OHS matters; have practices that facilitate a timely response to incidents and a process that enables full legal compliance (SafeWork Aust, 2010). However the WHS Act assumes that managers and employees have the appropriate knowledge to effectively identify hazards. A hazard is “the potential for harm” and they exist in “all aspects of technology and activity that produces risk” (Manuele, 2010:33). 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 (Fung et al, 2010).

Herein lies the problem, different people see the same risk situation in quite different ways (Kahneman et al, 1982; March & Shapira, 1987; Tolbert 2005). This means there is generally “a lack of awareness of the nature of risk” (Manuele, 2010:30). For example, Carter and Smith (2006) conducted a hazard identification study on three UK construction projects and found 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” (Carter & Smith, 2006:205). 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 (Trethewy, 2000). Harms-Ringdahl (2001) 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 (2009) 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. Further examples of process include the work of Cromie et al (2001) and Mattila (1985) in the health sector who suggests 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 (1992) 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 (2006) 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, nano-technology, manufacturing, construction and mining are identified in the literature raising the importance of good hazard identification in the workplace as a preventative injury mechanism (Bentley & Haslam, 2001; Biggs et al, 2006; Ramsay et al, 2006; Reinhold & Tint, 2009; Schulte & Salamanca-Buentello, 2007). 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 (Devine et al, 2008).

METHODOLOGY

2.1 Research plan

Individuals' perceptions of risk and ability to identify workplace hazards, was the focus of this study. An interpretive, critical realist perspective (Sayer, 1992) informed the approach. Sayer (1992) defines the organisational structures as sets of internally related objects and mechanisms as ways of acting.

Objects are internally linked to the structure and their identity depends on their relationship with the other components of the structure. Risk management policies are structures (process) within organisations; hazard identification is the mechanism and action (knowledge) of managers and employees.

This qualitative study had two data collection phases. At Phase 1, presented in this paper, the focus was on knowledge of hazards. Data was collected from 54 newly hired managers and employees at a specialist underground mining contractor, who agreed to participate in the project and provide access to new recruits. With the growth in mining sector jobs and the current skills shortage in Australia, new recruits may not have worked in the industry prior to starting work. Using a technique that Bahn has successfully employed in a 2005 study with carpentry apprentices (Bahn & Barratt-Pugh, 2011); a series of 6 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 one day safety induction training. Participation was voluntary for the study. Demographic information such as job position and tenure in the industry was also collected. Their responses were analysed against a master list of all the hazards within the pictures to determine their level of competence in identifying hazards.

At Phase 2, presented in a future paper, the focus was on the processes employed to identify hazards. In-depth, semi-structured interviews with 20 purposively selected OHS managers in the mining industry were conducted to determine successful strategies to identify hazards based on the findings in Phase 1.

The key research questions for this 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?

2.2 Sample

New employees in the mining sector made up the sample for phase one of this study to determine knowledge about and the process of identifying workplace hazards. Pictures of workplace scenarios were shown to 54 participants and the hazards they identified were measured against the 10 known hazards in each picture. Table 1 shows examples of the types of hazards the study participants identified in the six pictures. This assessment was used to determine their knowledge of hazards and is used to inform the processes to develop more efficient hazard identification strategies. All participants who completed the picture survey had received a full day safety induction prior to beginning work in an underground mine in WA the next day. The survey contained 6 pictures of underground work areas supplied by the mining contractor that were examples of their current worksites. For each of the six pictures it was determined there was a possible 10 hazards within. Hazards were explained to be those that were obvious or hidden. The limitation of 10 possible hazards was set as it was deemed by the mining contractor that if the participants could identify this number in each picture that they had a comprehensive knowledge of their work areas and would be deemed competent in their hazard identification skills. It could be argued that the pictures may have contained more than 10 hazards, however in order to provide some boundaries, this was the agreed number of hazards in each picture that were we seeking for the analysis.

Table 1: Examples of hazards identified in the pictures by study participants

Picture 1	"Items left on ground present a trip hazard", "No mandatory pre-signage", and "drums of hydrocarbon materials not bunded".
Picture 2	"Insufficient bolts holding mesh", "Uneven surface – trip hazard" and "Back wall not meshed".
Picture 3	"Ladder not secure", " Ladder too far from wall", and "Unsupported ground"
Picture 4	"Rock fall risk", "Insufficient mesh on wall", and "No signage to indicate any hazard".
Picture 5	"Vent not active", "Electrical cable inadequately secured", and "No warning signs".
Picture 6	"Trailing cable", "Not enough mesh on walls", and "Pipe work on ground".

Of the 54 participants who completed the survey 6 were female and 48 male. This is a typical gender distribution for the mining sector in that overall only 10% of employees are female. Because of the low representation of females in the sample, gender has not been included as a variable in the analysis. The participants were from four working sectors: Administration, Production, Maintenance and Exploration. Table 2 shows the job roles for each of these four sectors and the numbers of each specific role in brackets besides the job titles. The sample contained 29 Production, 9 Maintenance, 14 Exploration and 2 Administration workers. Three of the sample held supervisory roles, 2 in production and 1 in Exploration. The Exploration workers are typically not viewed as ‘real miners’ by the remainder of the underground workforce as they drill small core holes in the tunnels underground to determine the extent of the ore content prior to the large scale removal by the production workers. However, the Exploration workers have their own specific site safety induction that they train other workers in prior to entering their work areas. It could be argued that experienced Exploration workers should be better able to identify workplace hazards. However, for this study all participants had completed the safety induction training immediately before completing the picture survey and so particularly for those entering the industry for the first time job role should have no bearing on the results.

Table 2: Job roles within the working sectors

Production (29)	**Maintenance (9)**	**Exploration (14)**	**Administration (2)**
Truck Operator (4)	Fitter (3)	Diamond Driller (4)	Site Administration (2)
Serviceman (1)	Electrician (3)	Drill Supervisor (1)	
Nipper Service Crew (12)	Auto Electrician (2)	Drillers Offsider (9)	
Paste Crew (1)	Maintenance (1)		
Offsider (1)			
Bogger Operator (6)			
Supervisor (2)			
Charge Up (1)			
Long Hole Driller (1)			

FINDINGS

The numbers of hazards in each picture identified by the sample ranged from a total of 4 out of a possible 60 to 60 out of a possible 60. In both these extreme cases the participants were new entrants to the industry having not worked in mining before. The average number of hazards identified by the participants over all pictures was 26 out of a possible 60 (43%). However, five of the participants were unable to identify any hazards in at least one of the pictures.

2.3.1 Number of hazards by job role

Table 3 shows the number of hazards for each of the six pictures that were identified by the participants according to the role that they were employed for. For the 29 workers in Production roles the average number of hazards they could identify over all 6 pictures was 4.28 (SD1.68) out of a possible 10. The Maintenance staff had an average of 3.96 (SD2.17). However, for Exploration staff this number increased to 5.21 (SD2.21). The Administration staff were only able to identify 1.67 (SD1.41) hazards out of a possible 10 hazards. Given that the Administration staff were two female employees who performed office duties, their inability to identify hazards underground is not unexpected.

Table 3: Number of hazards by Role

	Role											
	Administration			Production			Maintenance			Exploration		
	N	Mean	Sd	N	Mean	Sd	N	Mean	Sd	N	Mean	Sd
Picture1	2	4.00	2.83	29	5.59	2.24	9	5.56	3.47	14	6.64	2.50
Picture2	2	.50	.71	29	4.38	2.19	9	3.67	2.24	14	5.43	2.44
Picture3	2	1.50	2.12	29	3.62	2.13	9	3.11	1.69	14	4.43	2.56
Picture4	2	2.50	2.12	29	4.10	2.11	9	4.22	1.48	14	4.93	2.40
Picture5	2	1.00	.00	29	3.97	1.80	9	3.44	2.70	14	5.07	2.64
Picture6	2	.50	.71	29	4.00	2.36	9	3.78	2.73	14	4.79	2.36
Total Mean	2	1.67	1.41	29	4.28	1.68	9	3.96	2.17	14	5.21	2.21

2.3.2 Number of hazards by years worked

Table 4 analyses the previous data to determine the ability of the participants to identify hazards according to the number of year's experience they had working in the mining industry prior to participating in the study. The number of new entrants to the industry was 18 (33% of the sample), with a further 11 (20%) of participants who had worked in the industry for less than two years. Therefore the sample contained 53% of participants with less than two years experience working in an underground mine. The table shows that the ability to identify hazards from the pictures increased according to length of experience with ability, with those with 6-10 years experience identifying 5.61 (SD2.01) hazards out of the possible 10. However, once a participant had over 11 years experience their ability to identify the hazards within the pictures dropped back to equal those with 3-5 years experience, 4.65 (SD1.15) hazards. The new entrants identified 3.57 (SD2.26) hazards and those with 1-2 years experience were able to identify 4.27 (SD2.10) hazards.

Table 4: Number of hazards by years worked

	Years worked in mining														
	New entrant			1-2 years			3-5 years			6-10 years			11 years and over		
	N	Mean	Sd	N	Mean	Sd	N	Mean	Sd	N	Mean	Sd	N	Mean	Sd
Picture1	18	5.22	2.98	11	5.55	2.54	13	6.46	2.40	9	6.67	2.12	3	4.67	.58
Picture2	18	3.44	2.68	11	4.27	2.10	13	4.62	1.98	9	5.78	2.22	3	5.33	2.52
Picture3	18	2.83	2.31	11	3.45	2.21	13	3.92	1.26	9	4.89	2.71	3	4.67	2.52
Picture4	18	3.61	2.00	11	4.09	1.76	13	4.38	1.76	9	5.44	2.96	3	5.00	1.73
Picture5	18	3.22	2.39	11	4.09	2.59	13	4.15	1.63	9	5.67	2.29	3	3.67	1.15
Picture6	18	3.11	2.49	11	4.18	3.25	13	4.38	1.26	9	5.22	2.73	3	4.00	1.00
Total Mean	18	3.57	2.26	11	4.27	2.10	13	4.65	1.15	9	5.61	2.01	3	4.56	1.26

2.3.4 Number of hazards by age

Table 5 shows the number of hazards that were identified according to the participants' age. Those aged between 35 and 44 years were able to identify 5.55 (SD2.44) hazards compared to 55-64 year olds who identified 2.33 (SD1.89) hazards and 18-24 year olds who identified 3.52 (SD1.45) hazards out of a possible 10 in each picture. In order to understand what is occurring for workers according to age and length of experience tables 6-9 following analyse the data further.

Table 5: Number of hazards by age

	Age														
	18-24			25-34			35-44			45-54			55-64		
	N	Mean	Sd	N	Mean	Sd	N	Mean	Sd	N	Mean	Sd	N	Mean	Sd
Picture1	14	5.00	2.48	25	5.88	2.35	10	7.60	2.59	3	4.67	1.15	2	3.00	2.83
Picture2	14	3.50	1.83	25	4.56	2.36	10	5.60	2.84	3	4.00	2.65	2	3.00	2.83
Picture3	14	2.64	1.55	25	3.72	2.01	10	5.10	2.96	3	4.67	1.53	2	1.50	.71
Picture4	14	3.50	1.40	25	4.32	2.08	10	4.90	2.42	3	6.33	3.51	2	3.00	.00
Picture5	14	3.29	1.64	25	4.40	2.25	10	5.00	2.91	3	3.33	1.53	2	1.50	2.12
Picture6	14	3.21	1.93	25	4.20	2.29	10	5.10	3.31	3	4.33	2.31	2	2.00	2.83
Total Mean	14	3.52	1.45	25	4.51	1.85	10	5.55	2.44	3	4.56	2.06	2	2.33	1.89

CONCLUSION

All of the participants prior to completing the picture survey had spent the day in safety induction training. 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? 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. It could be argued that the purpose of a safety induction is not to train in identifying workplace hazards. However, given these new staff were being prepared to work underground the following day and 50% of them had little or no experience in this work environment it would be fair to suggest that better preparation is needed. In fact, 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. It is likely that these workers have picked up these skills as they learned on the job by observing others, but how many have learned through experiencing a near-miss? An additional concern is the poor performance of the three participants going into a Supervisory role. Their role is to manage the remaining cohort including the new entrants. Managers, supervisors and experienced workers have considerable influence over the new entrant and the practices in which they engage. Safe work practice needs the support of senior managers through their endorsement and engagement that flows down the hierarchy. The role of the supervisor as the front line manager to the workers is crucial; however supervisors are predominantly production driven. Why did they perform so badly on the hazard identification survey? Are they simply blasé about their working environment considering everything they do is highly hazardous? More research is required to tease out the reasons why their performance was so low and these findings could be duplicated across other sectors using a similar methodology. But most importantly, this study indicates 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.

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