1.5.2. OH&S Regulations

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In this chapter, we looked at occupational health and safety regulations and the implications for safety engagement. Occupational health and safety is defined as the protection and maintenance of the health and safety of workers (Government of Saskatchewan, 1996). The hierarchy of occupational health and safety in Saskatchewan as it relates to the mining industry is shown in Figure 1. (personal communication, L. Alm, December, 2015).
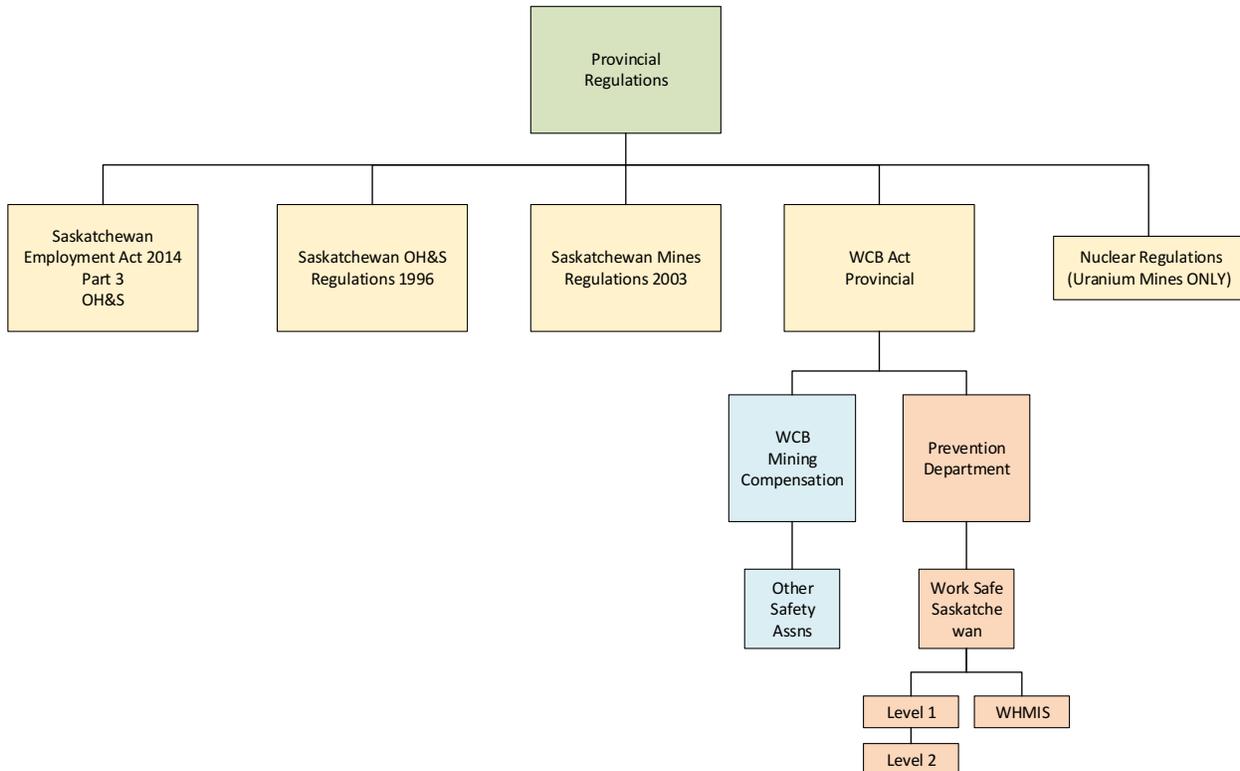

Figure 1. The hierarchy of occupational health and safety in Saskatchewan (personal communication, L. Alm, December, 2015).

The question that guided our scoping review of the literature was: What is the impact of OH&S regulations on safety engagement of employees in the mining industry?

Method

A scoping search of the literature was undertaken using the following key words:

1. Miners (miners or mining) and
2. OHS training ("OHS training" or "occupational health and safety" or "occupational safety" or "safety training") and
3. Safety behavior ("safety behavior" or "safety behaviour" or "risk taking" or safety or "high risk" or "safety engagement" or "safety rule violation" or "accident proneness" or "risk perception" or "perception of safety" or "safety devices" or "workplace safety" or "work safety" or "risk tolerance")

Search Strategy. The databases searched are listed in the results. From this search, we selected articles based on the inclusion/exclusion criteria. The inclusion and exclusion criteria were kept broad in that we did not specify the types of research methods to be included or excluded in order to capture as many research articles on the topic as possible.   In our search, we collected articles that were pertinent in this topic area. The broad inclusion and exclusion criteria allowed us to explore the literature in this area more completely, see Table 1.

Table 1. Occupational Health and Safety Inclusion/Exclusion Criteria for article selection.

Inclusion Criteria	Exclusion Criteria
• Articles with key terms in the title or abstract	• Editorials
• Peer reviewed	• Commentaries
• Within 5 years	• Book reviews
• English language articles	

Screening Strategy. The articles were checked for inclusion by two team members. The inclusion process was iterative in that the included/excluded articles were reviewed again for inclusion as the themes were developing. The team had final approval of the included articles. Those not applicable to the scoping review were excluded.

Results

A brief summary of each article including its location, population studied, main issue addressed, comparison group, and primary outcomes is provided in Appendix G. Table 2 is an overview of the scope of the review and articles identified.

Table 2. Occupational Health and Safety Databases and Articles Selected

Database	No of articles found from search	Articles Selected for Review	Final article selection from article summaries
Academic Search Complete	0	50	13
CINAHL	5		
Medline	0		
Nursing and Allied Health	10		
Engineering Village	16		
PsychInfo	13		
Embase	2		
Scopus	24		
Web of Science	26		

Description of Included Articles. Table 3 provides an overview of the types of publications, country of publication, and populations studied.

Table 3. Occupational health and safety: Populations, country of research, and type of study.

Type of Publications	Country of Researchers	Populations Studied
Quantitative Studies • Randomized trial (1) • Secondary analyses of data (2) • Cross-sectional survey studies (4) Qualitative studies • Mixed methods (2) • Qualitative interviews (1) Other • Theoretical papers (1) • Discussion papers (1) • Literature reviews (1)	India (1) Australia (2) South Africa (1) Chile (1) USA (5) China (2) UK (1)	• Stone quarry workers (1) • Construction site management and safety personnel (1) • Miners (5) • Firms (1) • Pulp and paper mill (1) • Injured workers (1)

Description of Identified Factors. In order to make it easier to describe the results of the scoping review, the articles were divided into three categories: education and training, perspectives on safety engagement, and factors affecting safety.

Education and training. Three articles were identified which related to education and training. The articles discussed particular training interventions. The researchers proposed enhanced or increased education increased the use of PPE, combining types of education is important, and education should match the organizations training needs. One article compared two types of education. In a cluster randomized trial with 204 stone quarry workers, Adams et al. (2013) compared the effect of two types of education (standard and enhanced) on use of protective eyewear and incidence of eye injuries. They found increased education over longer periods using locally appropriate media to communicate with workers was effective in increasing eye protection use and decreasing eye injuries. They also suggested periodic educational and motivational sessions with individuals and groups would be needed to facilitate the continued use of protective eyewear.

One article proposed different types of training should be used together. In a post-intervention survey of underground coal miners, Margolis, Westerman, and Kowaski-Trakofler (2011) researched training for refuge chambers. They found the miners had positive attitudes towards the training. In the study, participants reported high levels of awareness. The researchers found that although training about what miners can expect both psychologically and physiologically is important, this type of training should be used in conjunction with other types of training. Another article suggested training should complement the organization. Following the entrapment of 33 miner's, Chilean authorities doubled prevention investments as they prioritized safety training to reduce accidents. Brahm & Singer (2013) conducted secondary data analysis of data over 7 years to analyze the decision. The authors found that while training is effective in reducing accidents, no single training method should be superior to any other. They determined that managers should carefully examine which training methods are best suited for their firm.

Perspectives on safety engagement. Three articles were identified which looked at perspectives on safety engagement. The articles discussed theoretical perspectives, stages of organizational maturity, and industry-engaged collaborative research. The researchers found looking at safety from multiple perspectives would better explain safety behavior, interventions regarding safety would depend on the

stage of maturity the organization was currently in, and by engaging industry in research, and the safety culture of the organization could be improved. In a review of the literature on safety related behavior, Clissold, Buttigieg, and De Cieri (2012) argued that a comprehensive explanation of safety behavior must include an integration of person-based and behavior-based perspectives. They stated behavior-based perspectives would include incentives, rewards, feedback, goal setting, coaching, and training; person-based perspectives include attitudes and perceptions; and, safety climate is influenced by management's commitment to safety, leadership, communication, interaction at all levels, involvement of employees, policies, workforce abilities, industrial relations, safety systems, training and a positive work environment. They suggested creating a triadic approach which considers the person, the behavior, and the environment.

In a theoretical paper on compliance and effectiveness of safety management systems, Foster and Hoult (2013) presented a model for safety culture which identified organizations in different stages of safety maturity: emerging, managing, involving, cooperating, and continually improving. They suggested that the interventions taken would depend on the stage of maturity the organization is at. Foster and Hoult found the model was useful at identifying strengths and weaknesses within systems and as a means of assurance with standards. In a mixed methods study, Biggs & Biggs (2013) conducted three interlocking projects within the construction industry to gain perspectives on safety engagement from those in a managerial level. Outlining possible cultural outcomes by way of successfully implementing safety competency framework, the first project examined the development and implementation of such framework targeting safety critical positions. The development of guidelines to help leaders drive the safety culture down was the focus of the second project. The third project explored the use of safety effectiveness indicators (SEIs) as an industry-relevant assessment tool for reducing risk on construction sites. The researchers found that industry engaged collaborative safety culture research has many potential benefits for the industry.

Factors affecting safety. Seven articles were identified related to factors affecting safety behavior. Personal factors included job satisfaction, consideration of future consequences, needs and abilities of women, and perceptions of hazardous environments. Safety training impacts safety through collaboration and communication between trainees, and a resultant decline in injury rates. The involvement of the entire organization in safety may reduce injury rates as well. Three articles were related to personal factors affecting safety. In a cross sectional survey of coal miners, Liu, Wang, Li, and Li (2012), described a strategy to improve safety knowledge. They found job satisfaction had a positive influence on safety knowledge. They also suggested that rural safety knowledge should be strengthened, and regulations need to be implemented more by workers. In a cross sectional survey of pulp and paper employees, Probst, Graso, Estrada and Greer (2013) looked at the correlation of "consideration of future safety consequence" and safety outcomes. They found consideration of future safety consequences was associated with motivation, compliance, safety citizenship behaviors, accident reporting attitudes and behaviors, and workplace injuries. A limitation of the study was it did not directly tie the safety consequences to training. Cui, Fan, Fu, & Zhu (2013) developed a framework to reveal links between hazardous environment and safety climate. Using a qualitative design, survey results indicated that

employee's perception of hazardous environment impacted their safety behavior. Cui et al. stated that commitment of management to a safety climate is positively associated with employee's attitudes towards safety; and observation of a peer's safety behavior is effective in encouraging an employee to reproduce similar actions. They found employees follow a cycle of observation, which influences personal norms and beliefs resulting in their internalization of safety behavior. Cui et al. suggested management plays a crucial role in the relationship between employee's internal beliefs regarding safety and hazardous environments. Botha & Cronje (2015) studied perceptions regarding health and safety of women working in core mining positions in South Africa. In this mixed methods research, participants were found to be satisfied with the companies' applications of health and safety procedures in the work place. However, the researchers reported concerns regarding safety during the night shift, and alternative employment during early motherhood and breast feeding. Botha and Cronje reported positive responses to the provision of personal protective equipment but identified a challenge with the size and fitting of the equipment provided. They concluded that the differing needs and abilities of women must be taken into account when implementing health and safety measures.

Two articles were related to safety training and its effect on injury rates. In this qualitative study, Haas, Hoebbel, and Rost (2014), found that collaboration and communication enable students to practice and communicate during safety training. They also found that all mineworkers need to take on leadership roles when it comes to safety training, as well as responsibility and accountability for their own safety training. Results indicate all levels of the organization must be included in development and implementation of mining health and safety management systems. Monforton and Windsor (2010) evaluated the impact of safety training on injury rates through the secondary analysis of injury data. The researchers found the overall rates of injury declined, permanently disabling injuries declined markedly, and incidents with medical treatment followed temporal trends over the 12-year period. Monforton and Windsor reported that regulations affect the rate of injuries but do not predict injury severity, and that further analysis is needed.

One article identified the importance of including everyone in the organization in safety. In a book chapter, Cole (2012) explored current workplace practice regarding nonfatal and fatal injuries as well as prevention efforts. He covered numerous key topics including the general principles of occupational injury prevention such as modification of work environment, active participation, educational and behavioral interventions, and social capital. Cole also explored the impact of cultural narratives on employee's internal stories, beliefs and practices towards safety practices. He concluded workplaces with low occupational injury rates included every worker, manager, and supervisor in the safety process rather than assigning the role to specific individuals.

Discussion

In a scoping review of the literature, 13 articles were identified linking occupational health and safety to safety engagement in miners. The analysis identifies three key concepts related to a reduction in injury: personal factors, safety training, and organizational collaboration. Personal factors influencing safety include job satisfaction, future consequences, needs and abilities of the employee, peer modeling, and employee perceptions of the environment. There is not enough support in the literature related to this

topic to verify the personal factors.

Safety training was discussed frequently by the authors. Safety training may play a role in reducing injury. The researchers found safety training should be ongoing and multimodal, match the needs of the organization, use both behavioral and person-based approaches, and encourage collaboration and communication amongst trainees. There is not enough support in these articles to identify specific strategies for safety training.

The third concept was organizational collaboration. The stage of safety maturity the organization is in will affect safety within the organization, and it is important to identify the stage in order to implement change. When implementing change, engaging the organization in research may provide an impetus for change. Safety should involve the entire organization and include all levels when implementing change.

Figure 2. The intersection of the individual, the organization, and safety training.

Safety engagement may be influenced by factors related to the individual, the organization, and the safety training received by employees. There are many individual factors which impact an employee's safety engagement. The needs and abilities of employees, consideration of future consequences, job satisfaction, peer modeling, and individual perceptions of hazards in the environment may impact their safety engagement. The organization's stage of maturity, employee and managerial levels involved in safety, and engagement in safety research creates an environment which either promotes or detracts from safety engagement. Safety training which is multimodal, ongoing, meets organizational needs, encourages collaboration and communication, and uses a variety of theoretical

perspectives provides the knowledge and skills which may enable safety engagement.

In order to ensure safety engagement of Saskatchewan employees in the mining industry; the individual, organizational, and safety training factors will have to come together to provide the environment for a healthy safety culture. Individual needs and abilities must be considered, and peer modeling of appropriate safety behaviors should be encouraged. The individuals may need to be coached in order to understand future consequences and the hazards in the environment. As well, a healthy work environment with satisfied workers needs to be encouraged. The organization needs to involve all levels in safety discussion and policy-making. The organization should engage in safety research and strive to reach the highest stage of safety maturity. Safety training programs require the use of a variety of approaches and theoretical models, be ongoing, meet organizational needs, and encourage collaboration and communication amongst employees. These three levels of engagement (individual, organizational, and safety training) are required to ensure employee safety engagement.

Gaps in the Literature. The scoping review found 13 articles related to miners, OHS, and safety engagement. The articles spanned a broad range of topics within safety education and training, perspectives on safety, and factors affecting safety. The articles did not reflect OHS policy but did give a broad overview of the role the individual, the organization, and safety training have in reducing injuries. A conceptual framework was drawn related to the findings of the scoping review. Each of the concepts indicated in the conceptual framework require more research to confirm they have an effect on safety and safety engagement. The research studies from this scoping review included seven quantitative studies, two mixed methods, and one qualitative. More qualitative research will contribute to theory building which can then be tested through additional research. Three articles were included in this scoping review. These articles may point to additional areas of research.

Recommendations. From the scoping review, the following are recommendations for the mining industry:

- Safety training should be ongoing and multimodal, match the needs of the organization, use both behavioral and person-based approaches, and encourage collaboration and communication amongst trainees
- All levels of the organization should be involved when implementing change related to safety and training.

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