An integrated safety risk monitoring process ('The Safety BMI') for the mining sector

Mental Awareness, Respect and Safety
(MARS) Centre Research Report

GOVERNMENT OF
WESTERN AUSTRALIA

MENTAL
AWARENESS
RESPECT &
SAFETY

Summary

Abstract

To determine organisational safety performance data and information ('information') are collected from operational areas. Information usually includes incident analysis and remedial action plans, and a variety of fieldwork observations. Whilst the information is used to report performance, often in response to a series of targets, it appears it is rarely used to assist in the development of a safety intervention narrative relevant to the leader's normal activities and area of responsibility.

This research aims to develop and validate a statistical process which can be used to assist organisations to improve their safety performance. With the working name "Safety BMI" the process analyses existing data to inform a level of injury risk tolerance, which can then be used for a variety of purposes, including forecasting risk and investigating organisational capability to control risk.

The research has shown the "Safety BMI" to be a potentially valuable tool.

Associate Professor Marcus Cattani

Mr Anton Fouche

GOVERNMENT OF
WESTERN AUSTRALIA

MENTAL
AWARENESS
RESPECT &
SAFETY

Everyone who works in the West Australian ('WA') mining industry has first-hand knowledge of the efforts their employer undertakes to prevent harm to all involved in production. In general, the industry has an effective "safety culture" which is a result of everyone being involved in the prevention of harm. Every person goes through an induction process, learns about the safe systems of work, and contributes information which demonstrates they have conformed with the safe way of doing their work.

With around 150,000 people employed in the WA mining industry, across 134 operations a considerable amount of information about safety performance has been collected.

Although the mining industry safety performance is amongst the best in the state and country, there is some frustration that recent performance, particularly fatality and serious injury rates, are not satisfactory.

The prevention of workplace injuries can be described as a 'risk-based' management system. This means we systematically look at what could go wrong, and if it is important, we do something about it. In effect, things that can cause fatalities are more important than things that can cause a minor finger cut. We do far more to prevent fatalities, than we do to prevent minor cuts to fingers. This is because we do not 'tolerate' fatalities, but we can tolerate minor cuts to fingers.

The word 'tolerate' has a specific risk-based meaning, being the level of risk which initiates change. We have used toleration in the Safety BMI because if we tolerate something, we leave it alone and do not initiate change. However, if we do not tolerate something, we do something about it and make sure it goes away, or its impact is managed. The "Safety BMI" explores various elements of toleration, to describe safety performance.

To develop the "Safety BMI" we are grateful to several organisations who have donated considerable amounts of safety related information. These organisations will remain anonymous in all communication related to this project.

Aim

This research aims to develop a statistical process which analyses existing safety data to enable monitoring of incident and injury risk.

Objectives

To address the aim, the research has the following objectives:

1. Develop a conceptual model which describes a risk-based approach to enable mining industry safety performance to be described.

2. Obtain and prepare industry safety data for analysis.

3. Develop a process to analyse organisation safety data based on the conceptual model.

4. Validate the process with several organisational data sets.

Objective 1: Develop a Conceptual Model

- The conceptual model integrates a series of risk management elements from ISO31000 and associated literature. We have purposefully adopted existing terminology, to improve acceptance of the project from the community.

- We developed a series of concepts based on the toleration of risk and associated risk elements including:

  - Organisations are divided into departments and teams, and each report data and information. This information can be used to determine the organisations toleration of various levels of consequence of incident.

  - If an organisation has an incident, and aims to prevent its recurrence, an investigation is conducted, and a series of actions implemented to prevent its recurrence. If the event is repeated and/or the actions are repeated this provides information about the capability of the organisation (i.e. a repeat incident may show ineffective prevention).

- The early conceptual model was a complex series of variables. Since this project aims to communicate the model to the community, it was simplified and named "Safety BMI". This aims to show that whilst the concepts maybe complex to manage, the conceptual model itself is relatively easy to understand.

- Research is continuing to develop and refine the model. At present the conceptual model can be summarise as an equation:

$$\text{Injury Risk} = \frac{T\,f(C) * T\,f(E)}{T}$$

T f(C) - The leadership attitude towards consequence determines the organisational approach.
T f(E) - The effectiveness of the organisation in controlling injury risk to below the toleration.
T – the toleration of risk

Objective 2: Prepare Data

The research team has been preparing donated data for analysis, and a process is being developed to prepare data from any organisation. This include building an interpretive model that will support the analysis and improve processing of large data sets.

Objective 3: Develop a Statistical and Natural Language Processing Model

Donated critical incident data and leader observational data from an open pit mine, underground mine, and surface mineral processing facility, for a 24 months period (July 2022 to June 2024), are being used to create the analytical process. This data has been particularly useful to describe the toleration of risk. This research is ongoing.

Objective 4: Validation

This objective has recently commenced, and outcomes will be reported in the next report.

Conclusion

The model uses a series of functions concerning the toleration of risk to describe incident and injury risk. The model has been named "Safety BMI" to reflect that whilst the management of risk is complex, it is relatively straight forward to describe the relationship of the associated variables.

The early testing of this model using donated data from industry has shown the model will be capable of detecting the toleration of risk.

Building an AI-model improve data quality and analysis , provide ongoing support in improving the event description, and guide the line leaders with relevant safety narratives to improve the safe execution of work.

Bibliography

1. *Brady, T. (2019). Review of all fatal accidents in Queensland mines and quarries from 2000 to 2019. Queensland Government (URL).*

2. *Cattani, M. (2024). Ten pathways findings and suggestions (Report No. 130224). Edith Cowan University.*

3. *Dekker, S. (2011). Drifting into failure: Complexity theory and the management of risk. Ashgate Publishing.*

4. *Hopkins, A. (2000). Lessons from Longford: The Esso gas plant explosion. CCH Australia Limited.*

5. *International Organization for Standardization. (2024). Occupational health and safety management systems—Requirements with guidance for use (ISO Standard No. 45004:2024). Selleck, R., Hassall, M., & Cattani, M. (2022). Determining the reliability of critical controls in construction projects. Safety, 8(3), 64 (DOI).*

6. *International Organization for Standardization. (2018). Risk management—Guidelines (ISO Standard No. 31000:2018).*

7. *Quinlan, M. (2014). Ten pathways to death and disaster: Learning from fatal incidents in mines and other high-hazard workplaces. Federation Press.*

GOVERNMENT OF WESTERN AUSTRALIA

MENTAL AWARENESS RESPECT & SAFETY

Contact

E: mars@ecu.edu.au

W: ECU MARS Website