Mining geomechanical risk – should we be doing better?

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The short answer to the question posed in the title of this article is "yes" writes Dr Johan Wesseloo, senior research fellow - rock engineering, Australian Centre for Geomechanics, Australia

Within the mining community, geotechnical risk is often underappreciated, sometimes ignored and seldom properly quantified. In all areas of geomechanics, the uncertainty and variability that engineers need to deal with necessitate a rigorous process of quantification or, in the very least, robustly qualifying likelihoods and consequences.

There appears also to be a large gap between the state-of-the-art and the state of general practice when it comes to the qualification and quantification of geotechnical risk. For this reason the Australian Centre for Geomechanics is hosting the First International Conference on Mining Geomechanical Risk (MGR 2019). The aim of the conference is to provide a forum to discuss: the methods used to design for geotechnical risk and those used to manage these risks; to identify shortcomings; and to close the gap between the state-of-the-art and the state-of-practice.

The meaning of risk

The word risk may often be thought of as an emotive word carrying a negative meaning, with the reaction of having to be avoided at all cost and the idea that opportunity from the flip-side of the "risk coin" is often overlooked. The words "risk assessment" and "risk management" both carry a wide range of possible meanings throughout the mining industry.

On one end of the spectrum, risk is used interchangeably with hazard and is managed by implementing protocols aimed at avoiding any situation that may lead to an adverse outcome. These approaches are better termed "hazard avoidance". On the other end, the two components of risk, namely the probability of occurrence and the magnitude of its consequence, are rigorously quantified and decisions are based on considering the risk-reward from balance making use of opportunities that present themselves.

Geomechanical risk encompasses a wide range of probabilities and a wide range of outcomes with severe consequence occurrence often having small likelihood. As a result, geomechanical risk is best dealt with by using quantitative methods.

In general, risk management is a reactive response to geomechanical risk. Design, on the other hand, provides the opportunity to proactively address the geomechanical risks and making use of opportunities by balancing the risk and reward. Within mining, geomechanical risk-based analysis is seldom undertaken.

With geomechanical design, engineers have to design for uncertain and variable conditions and designs are deemed appropriate when they satisfy a defined design acceptance criteria, e.g. a specified factor-of-safety (FS), probability of failure or a risk level. All three design acceptance criteria have their place within the design and decision-making process as illustrated in Figure 1.

FS as a design criteria is well-known and generally always used even when the other two are employed. Probability of failure (PF) is used to quantify the reliability of a design when faced with uncertainty and variability in the design parameters.

Both the FS and PF focus on stability, i.e. defining a criterion to ensure that when a design is accepted it will be with sufficient reliability. A design acceptance criterion focused on stability is appropriate for civil engineering structures designed to be stable for long periods with the public having access to these structures.

In mining, personnel safety, rather than ultimate stability, is the aim. Improved safety can be achieved, not only with increasing stability, but with monitoring and the management of personnel exposure.

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Personnel exposure can be managed and significantly reduced with the effective use of monitoring. It can be eliminated by remote controlled or autonomously working equipment. In the latter circumstance, for example, a design acceptance criterion focused on stability is not optimum and should be replaced with a criteria that quantifies the financial risk associated with the design. In other circumstances, economic risk and safety risk needs to be evaluated in parallel.

If one considers the fact that mining is about managing the risk-reward balance for the shareholders without endangering its personnel, it is clear that design acceptance criteria in mining should be based on risk and not purely on FS or PF. Risk-based design is not a substitute for probabilistic design, but a continuation of the probabilistic design process taken to its natural conclusion.

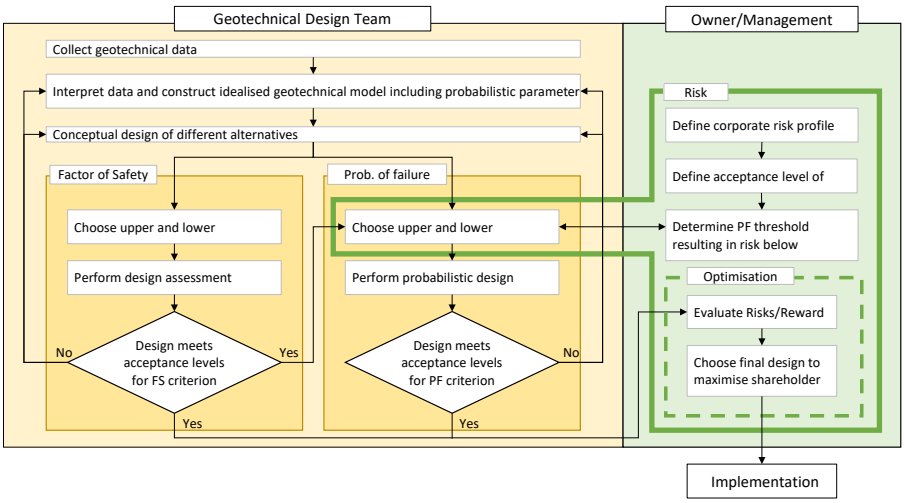

Figure 1 Relationship between FS, PF and risk as design acceptance criterion within the design process

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First International Conference on Mining Geomechanicak Risk Conference Chair

The First International Conference on Mining Geomechanical Risk will be held in Perth, Western Australia, 9-11 April 2019. For more details, see www.mgr2019.com