



# Assessing and Mitigating Risk to Mining - Can we “Future Proof” the Industry?

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## Abstract

Mining operators throughout the world, and those looking to invest in mining, are exposed to **risk** on a daily basis. Analysts reflect on the “top 10 risks to mining” on an annual basis, and generally these are consistent year on year, albeit the order influenced by immediate political and/or economic forces. Realistically however, how many of these really are tangible risks that could (and should) hamper an appetite for investment? Can the industry navigate its way through inevitable **uncertainty** that comes with global macro-economic change, political will (or lack thereof), and predicted longer term changes to our **climate**?

This paper considers the potential risks to the mining industry, with a specific focus upon Africa. We reflect upon the **appetite** that we see for accepting risk across the junior, mid-tier and major operator base, and international investors. We consider the options for sensibly mitigating risk, and we look into the **future** to gauge how the industry might improve not only its own resilience to change, but at the same time protect the communities, the customers, and the environment that is directly impacted by mining.

## Introduction

Risk is an inherent trait of operating in the mining industry, from establishing the financial and legal framework for constructing the mine, to the inherent safety hazards that exist for our staff working on the ground.

Whilst the somewhat fatalistic approach to mine safety has certainly now largely gone, we have seen that the industry’s approach to appraising and mitigating risk has not fundamentally changed throughout our journey with the mining industry over the last 60 years. As engineers, we like to think that we are working with an exact science. This is not strictly true however – we are as susceptible to the cycle of trial and error as anyone.

In early 2016 I was called to Brazil as a lead engineer to support in the restoration of over 100km of river and protection of communities downstream of a major tailings reservoir. Nineteen (19) people were killed when the dam catastrophically failed. Relatively soon after the failure, discussions were being held about the restoration of the reservoir to enable production to re-commence - but the communities that had survived the breach were still living and working downstream.

Check dams were being constructed downstream to capture residual tailings following a rainfall event – but it was not rainfall that caused the failure, it was liquefaction. Had any lessons been learned at all?

The mining world did respond with immediacy to the failure, with many operators implementing audits of their tailings facilities. When you consider the ultimate cause of the breach in Brazil, it is clear that it was not simply the physical manifestation of the reservoir that was the root cause of the problem. Effective governance, knowledge management, clear responsibilities – all of these directly contributed to the collapse. Arguably these will not be captured by an audit of the tailings dam.

More fundamentally however, what will be the longer term implications for the mining world? In light of the fact that 19 lives were lost, thousands of people permanently lost their homes, hundreds of kilometres of a relatively pristine river system was significantly damaged – is there any case whatsoever for us to re-construct the tailings reservoir at the same location? Can we really engineer out all risk?



Conversely, a major contributor to the failure was the construction of upstream raises on the dam. It would appear that the Brazilian regulatory system is very unlikely to ever permit an upstream raise ever again in light of the disaster, and many governments have muted that they may follow suit. Is this an appropriate response? What would be the impact on the mining industry if such a dictate was introduced more widely?

As engineers we can exercise the benefit of hindsight and point to the state of the tailings on which the raise was being constructed in Brazil. Hindsight provides excellent 20-20 vision, and indeed we all know the importance of firm foundations for any structure, with or without an engineering degree.

And consider the injuries and deaths that occur in mining accidents around the world. These were generally all avoidable accidents, and the technology was in place in each circumstance to prevent these events from occurring. Do we therefore as the mining industry ultimately define risk in such a way that we accept that accidents will happen? And how do we define an “accident” if we can, in most circumstances, and again with the benefit of hindsight, explain why it occurred and that it should never have happened?

### Top 10 Risks to Mining, Today & Into the Future

A comparison between the top ten risks identified by the mining industry during the height of the boom in 2011/2, and in our current, more cautious situation, flags some unsurprising differences. The availability of both skilled and unskilled labour during 2011/2 was a key concern. When speaking to those that were involved in the mining industry at that time and are no longer, arguably their primary risk now will be the availability of a secure job.

Nevertheless, there are far more consistencies than differences in this comparison. Global macro-economic forces, government interactions, the availability of water and power – all continue to heavily influence the success (or otherwise) of a mining venture.

Looking into the future, how do we foresee these may change? How might they influence our appetite for risk? Or the way in

which we develop, operate and close mines, so as to mitigate these risks?

Current projections in relation to the way in which we live indicate that by 2050, as an example:

1. Prosthetics could get so advanced in the next 10 years they could give people new skills;
2. Self-driving vehicles could be ubiquitous in the next 10 years;
3. 3D-printing could be used to construct more houses in 20 years;
4. We could rely entirely on renewable energy by the year 2050.

(source: Ian Pearson, Futurist)

This would suggest that the demand for metals will continue well into the future, though arguably with a demonstrable shift away from bulk commodities. So mining is here to stay.

The UK Ministry of Defence has stipulated the following as their prediction of the state of play in Sub-Saharan Africa in 2045:

1. Sub-Saharan Africa will almost certainly remain a region of significant political and economic differences by 2045, but overall the region’s economy should grow.
2. Governance in the region is likely to improve and the current trend towards representative government is likely to continue, although this will probably be resisted by some authoritarian regimes, possibly leading to violence.
3. The risk of state-on-state conflict is likely to reduce but will almost certainly remain a concern. The African Union’s ability to deal with crises is likely to improve, but it will probably still require international assistance for more demanding situations.
4. Climate change is likely to have a severe impact on some parts of sub-Saharan Africa, with agriculture particularly badly affected.

Once again, this would suggest consistency in risk trends that we have seen in the recent boom bust cycle will inevitably continue into the future. The availability of water and energy will continue to be a challenge, whilst demand for them will increase. Governments will change, and uncertainty in security, regulation, and appetite to encourage international investment will remain. It is interesting to



therefore reflect on how industry navigates risk today, and whether there may be questions to ask in relation to the need for change looking ahead.

## **Appetite for Risk Today & Future Proofing the Industry**

### *The Market*

No industry exists without a customer base, and indeed the market has been one of the key risks to global mining in recent years. The only true certainty in the many analyses and predictions that underpin the market media is that uncertainty is inherent.

The management teams of majors are replaced, and mining juniors come and go, in response to changing market conditions that many feel should have been predicted. Was it really feasible for the changes that have occurred over the last 5 years to have been accurately foreseen however? Or is it more reasonable to expect organisations to exercise a degree of foresight that commodity prices do inevitably fluctuate, and hence exercise sensible limits on their unit cost of production, so as to protect their assets when prices begin to fall? Reflecting back on the rate with which money was being spent during the recent boom, one must question how much restraint was being shown in anticipation of a cooling of the market.

It is also recognised however that shareholders demand optimal profits. So where does the responsibility ultimately sit? The public call for CEO scalps is rapid when profits fall, yet the demand to optimise return while the market is strong will inevitably be the key measure of corporate success.

It has been increasingly evident that the recent boom also led to a rapid over supply in commodities. It is broadly accepted that a drop in key currencies, aligned with a dramatic fall in the price of oil, resulted in a favourable tail wind that enabled mines to continue operation when arguably they were no longer viable. This simply resulted in further flooding of the market, and finger pointing as commodities continued to slide as supply rapidly out-stripped demand.

We have unsurprisingly seen a rapid increase in the demand for closure support in recent years. Interestingly however, we are

also seeing a number of the mines being prepared for closure being given a last reprieve, in response to fluctuations in commodity prices. This has been particularly evident in copper, nickel, and iron ore (for example), where mines are being temporarily placed into care and maintenance, only to be rapidly re-started as the price point climbs back into the black.

Considering market risk therefore, what is a reasonable expectation? Is it one of flexibility, i.e. to be able to respond to the inevitable market fluctuations in an uncertain world? Should we be designing mines that can be “switched on and off”, varying production (or closing it down temporarily altogether) to meet market needs?

Indeed, is there a potential argument for market regulation to control the supply of ore to the marketplace? With OPEC representing a working example of what can be achieved when producers exercise ultimate control over what will be supplied to the markets, are there lessons that can be taken (and improved upon) to develop a working model for mining?

Considering regulatory frameworks, it is evident that there is an appetite for a legislative response to perceived inequity in mining practices across the globe. The European Union is introducing legislation that will come into force from 2020 under which manufacturers will need to ensure that their supply chain is demonstrably free of “conflict minerals”.

Currently the commodities affected are relatively few in number, however awareness is increasing in relation to the impact that western consumerism is having on working conditions in the developing world. The term “modern slavery” is becoming more and more actively used, and governments are responding proactively (if slowly) in an effort to identify and protect against it, both in their own countries and abroad.

### *Funding*

Securing funding for the development of a mine has become more and more challenging in recent years. Interestingly, the availability of money is not necessarily a constraint. Indeed investors have considerable funds and the appetite to invest remains strong.



Ultimately however, the appetite for risk has diminished, particularly where financing the junior space. Investors today are not looking for a quick return. They are seeking a longer term commitment that will involve taking the mine into operation, reflecting a tangible change in the management expertise required to progress a junior mining venture. For those that are willing to see it through, the financial backing is there.

It is evident however that there is a tangible shift away from the desire to seek “international funding”, in light of the increasing appetite for investment from China. Securing money from the western markets brings with it a requirement to satisfy international standards, and the cost and time implications that come with this. Generally however, the national legislative frameworks throughout Africa are robust, embracing the core intent of the international standards.

In our experience, whether the additional time and money invested ultimately alters the rigour with which the environment and the community is considered and protected through the design, construction and operation of the mine, fundamentally comes down to the integrity of the author and the operator. As we know is the case with many of our clients, we apply our global experience and expertise in all of the work that we do. Ultimately therefore, our recommendations for consultation, mitigation, and design will meet international best practice irrespective of the regulatory framework within which we are working.

There is a debate at play therefore as to whether organisations that choose to proceed with funding that avoids the need for formal compliance with international standards are taking “short cuts”. In doing so, they are perceived to be accepting an increased level of risk, and indeed imposing this on the environment in which they work.

We would argue that, in many circumstances, the integrity of the operator and their appointed engineers will inherently mean that the ultimate outcome will fundamentally be the same. As a result, the saving in time and money that will be achieved should not automatically be dismissed as an irresponsible approach that is fraught with risk. Instead, this

should reflect (under most circumstances) a considered decision, and a commitment to progressing the investment within the community in which the mine will be operating.

### *Energy & Water*

Energy and water have been identified as key risks to the mining industry, and indeed to the world in general, for many years. Security of supply is absolutely fundamental to the running of any operation, and competition for diminishing resources can be fierce. This is set within a backdrop of a rising global conscience in relation to the protection of the environment, both today and into the future.

### **Energy (Power)**

The availability of secure energy to fuel heavy industry is very limited, particularly on the African continent. This is a function of both geography, and limited available government investment in both capital spend and maintenance. When money is invested, not surprisingly there is a general consensus that this should be focussed towards enabling communities rather than industry, which holds relative wealth.

The result has for many years been a reliance on diesel fuelled generators – well tested, easily installed, and relatively straightforward to maintain. The competition for fuel is significant however, and many of us will have experienced the frustration of attempting secure a priority delivery in an environment that could, at times, be best described as rationing. And whilst the unit price of fuel to those in Europe will appear reasonable, the reality is that the cost in Africa is significant, reflecting a substantial proportion of the overall cost at any stage of the mining life cycle.

We have been working with investors and governments throughout the African continent (and globally), for many decades to develop long term sustainable power supply solutions. We have seen technology evolve, and the definition of “sustainable” change over time, lurching between social, environmental, financial, and longevity connotations. What is very evident however is that what we refer to as “renewable” solutions in the West are in fact now eminently workable solutions



for industry. Far from the small turbine installed on the corner of the mine office to power the lights, harnessing and storing solar power for the full time operation of a mine camp is now tried, tested and cheap. Needless to say, this also substantially contributes to the environmental credentials of the mine.

### Water

Water is also a very precious resource. It is also, at times, a damaging and disruptive waste product. Interestingly we often see water being considered at a relatively late stage in the planning of a mine, and yet without a secure water supply throughout the year, a mine simply cannot operate. There is generally an underlying perception that water can always be sourced by some means, irrespective of the topography and geology, and crucially irrespective of the existing demands that are already in place on the finite available reserves. This can often lead to a substantial unanticipated hike in capital and operating costs to bring water to and from the site. Water is a heavy commodity to move, and an energy intensive commodity to treat.

Water can also be extremely problematic if not catered for in the early planning of infrastructure throughout the site, no matter how arid the environment. Many of the most extensive retrospective drainage and erosion control measures that we have had to develop for mining clients are situated in the desert regions of North Africa and the Middle East. The effective sizing and placement of water storage facilities and drainage systems is a cheap and easy exercise when carried out at an early stage. This also allows informed decision making as to the investment that is wanted in relation to space and cost, against the likelihood of operational downtime and asset damage due to flooding. When this is carried out reactively, typically it will be in response to the magnitude of the event that triggered the problem.

Inevitably adopting a reactive approach following a significant rainfall event will also mean that uncontrolled flooding has occurred, mobilising material from the mine site and washing it into downstream environments. At best this is often significant base loads of silt, sand and mud. Generally howev-

er there will also be contaminants mobilised that have the potential to cause harm. Mining operators will very rarely allow this to happen knowingly, but one occurrence will typically draw the attention of the community and the regulators, bringing with it considerable scrutiny, criticism, and often hefty fines. It is a scenario best, and very easily (and cheaply) avoided.

### *Permitting & Taxation*

The risks and uncertainties associated with permitting and taxation is consistently flagged within the top ten to the mining industry, particularly when looking to develop and operate on the African continent.

From a permitting perspective, national legislation is generally very robust as alluded to earlier, and largely commensurate with international standards in most circumstances. The difficulty rests typically in the capacity and capability of the respective ministries to implement the legislation effectively. This can lead to a subjective application of legislative requirements that imposes greater restrictions on some operators than are required of others. This can include those that are seeking international funding, and therefore self-impose stringent criteria that must be met.

Ultimately however, our experience is once again that generally that there is a tacit intent from all parties to operate with integrity throughout the permitting process. Mining companies, irrespective of their size, typically hold a concerted commitment to their Corporate Social Responsibility credentials. In doing so, there is an inherent desire to comply with legislation, to operate without compromising the natural environment, and to support the local communities within which they are situated.

Indeed the corporate commitment to the communities within which the mines are being developed by international ventures is generally unquestionable. We see honest investment into education, medical support, upskilling and employment, and improving community infrastructure on a daily basis. The financial return is clearly a key priority, however this comes with a genuine desire to materially leave a positive legacy behind.



The payment of taxes and royalties is tacitly interlinked to this commitment, ensuring that a usually not insignificant proportion of the wealth generated remains in the country. The equitable application of this wealth is critical however, and this responsibility lies with the government departments that are the recipients of this money. Unfortunately it is evident that the money does not always reach the communities that are directly impacted by the mining, and/or in greatest need. This can undermine trust, particularly where criticism is then levelled at the mining company for not demonstrating material local investment.

Certainty in relation to the taxes that will be levied can also represent a key risk, and it is incumbent on governments to demonstrate consistency in the long-term if they are to encourage international investment in industry and infrastructure.

### Closing Comments

So how do we “future proof” the industry against risk? Some risks are relatively straightforward, for example energy and water. These can be scientifically appraised, and whilst as engineers we are yet to create rain, we can enable informed decision making. And we do have practical cost-effective alternatives to “de-risk”, both today and into the future, through the implementation of alternative technologies. This simply requires early engagement by the mines.

Nevertheless, the question of re-defining best practice, or perhaps introducing greater self-regulation within the industry, does remain. Is there a need to factor greater flexibility into our mines in the future, so that

they can be readily turned on and off to meet fluctuating market demands? Is there a responsibility for miners to diversify so that shareholder returns are protected during a downturn? Is there a need to introduce industry best practice that will pre-empt emerging legislation in relation to “modern slavery” and the sourcing of minerals?

Inevitably there are risks that ultimately cannot be mitigated against, and the government framework within which we operate will always be the gift of the host country. An effective and thorough due diligence process, and a steadfast commitment to act with integrity throughout the life of mine, is all that can be done to address this.

Irrespective of these risks however, the appetite to invest in mining in Africa remains strong. It is a continent with considerable untapped resources, and an extraordinary capacity for great things. We have had the privilege of working and living in Africa for many years, and we never cease to be amazed at the resourcefulness and resilience that we experience every day.

The risks that are inherent within mining will inevitably remain, and some will come and go as we continue through boom and bust commodity cycles. The industry is inherently a robust one however, and one that operates with a conscience. Lessons are learned with the benefit of hindsight, and time will tell whether these are applied should commodity prices soar to giddy heights once again in years to come. Either way, mining will continue to be a very important industry to Africa, and absolutely fundamental to global progress.

