




Keynote Paper: Some Perspectives on Implications of Top Globally Ranked Factors Affecting Mining on the Future of Mine Planning

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Abstract. As of 2019, the ‘Big Four’ accounting and auditing global firms have been reporting annually for about a decade, on perceived top 10 factors affecting the mining industry. The reports refer to the factors as issues, trends or risks faced by the mining industry. The factors and their ranking order are both dynamic as both the list and ranking order change annually and across the firms undertaking the surveys. The factors have a direct or indirect bearing on the mine planning process since mine planning is central in informing high-level or strategic decision making for mining companies. Mining companies must continually adapt since the business environment changes due to the impacts of these factors. This paper considers how the most recently top-ranked factors can affect mine planning into the future and why it is important for the mine planning fraternity to keep track of these factors. This ensures that the mine planning process continues to deliver outputs that enable mining companies to continue to make robust business decisions.

Keywords: Mine planning · Risk · Strategic decision making · ‘Big Four’ accounting and auditing global firms

1 Introduction

As of 2019, the ‘Big Four’ accounting and auditing global firms namely, Ernest & Young Global Limited (EY), KPMG, Deloitte & Touché (Deloitte) and PricewaterhouseCoopers (PwC) have been providing guidance annually for about a decade on strategic or high-level key factors faced by the mining industry. For example, the 2019 Deloitte and EY reports are the 11th editions since inception of the report series by the two firms. Each of the firms generally reports these factors as being among the top 10 issues, trends or risks affecting the mining industry. The list of factors and their relative ranking change both annually and across the firms undertaking the surveys in any given year. The factors identified in these reports, inform strategy and decision making at mining company board, Chief Executive Officer (CEO) and executive management levels. Some of the factors either directly or indirectly affect how mining companies undertake mine planning. This is due to the central role that mine planning plays in

informing decision making in mining companies as CEOs of publically listed mining companies make public announcements predominantly based on the results of mine planning [1].

The factors straddle across the broad categories of technical, economic, social, legal, environmental and political factors. These categories reflect the categories of Modifying Factors used in the mine planning process to convert Mineral Resources to Mineral Reserves. It is therefore important for the mine planning fraternity to keep track of the global top-ranked factors affecting the mining sector as these have a direct or indirect bearing on the mine planning process. This will enable the mine planning process to adapt to future needs, and retain and relevance in informing robust decision-making by mining companies. The next section presents the rankings in 2019 of the different factors identified by the ‘Big Four’ as mostly affecting the mining industry.

2 Top-Ranked High-Level Factors in Mining in 2019

The accounting and auditing firms mentioned in the previous section, compile the list of factors from surveys that they undertake annually on a global scale. To derive balanced views and well-informed rankings that fairly reflect global perceptions and understanding, the firms conduct the surveys on a wide range of stakeholders. The list of factors and the ranking order change annually. This is due to several reasons such as perspectives of respondents changing with new knowledge and awareness of developments occurring within and outside of the mining sector, differences in the wording of the factors by each of the firms undertaking the surveys, and the different stakeholder databases polled in each survey by each firm. For example, the continual technological developments associated with the fourth industrial revolution (4IR) occurring outside of the mining sector affect how mining processes should be designed to remain aligned with changes in both upstream and downstream industries that have linkages with the mining sector as they affect how the mining industry should conduct its business. Any misalignment with upstream and downstream industries can have undesirable consequences to the mining sector. Table 1 illustrates the ranking order in 2019 of the factors by each of the four firms.

Table 1. Ranking of the perceived top high-level factors in 2019 [2–5].

Factor ranking	Deloitte	EY	KPMG	PwC*
1	Rethinking mining strategy	License to operate	Macro financial risks	Maximizing market returns for investors
2	The frontier of analytics and artificial intelligence	Digital effectiveness	Permitting risk	Safety and the environment
3	Managing risk in the digital era	Maximizing portfolio returns	Community relations and social license to operate	Technology adoption for automation and digitization

(continued)

Table 1. *(continued)*

Factor ranking	Deloitte	EY	KPMG	PwC*
4	Digitizing the supply chain	Cyber	Access to capital, including liquidity	Creating sustainable value for all stakeholders to fix 'brand mining'
5	Driving sustainable shared social outcomes	Rising costs	Economic downturn/uncertainty	Climate change
6	Exploring the water-energy nexus	Energy mix	Ability to access and replace reserves	Energy mix shift away from combustion engines to electricity & renewable energy
7	Decoding capital projects	Future of workforce	Political instability	Optimizing asset portfolios by disposing non-core assets to drive efficiencies and improve productivity
8	Reimagining work, workers, and the workplace	Disruption	Regulatory and compliance changes/burden	Regulatory and political uncertainties
9	Operationalizing diversity and inclusion programs	Fraud	Controlling operating costs	Social licence to operate
10	Demanding provenance	New World commodities	Environmental risks, including new regulations and access to key talent	Changing commodity mix due to changing consumer consumption patterns and increased use of technological devices

Note: *PwC did not provide a ranking order and it was reasonable to assume the order of presentation of factors in the report as a proxy for the ranking order.

It is apparent from Table 1 that each of the four firms can describe the nearly same factor in slightly different ways. In addition, one firm can identify a single factor, while another firm can split the same factor into more factors depending on the level of detail attached to the factor. The lists are dynamic, and so is the associated lexicon. For example, in the 3-year period spanning 2017 to 2019 the list of top factors compiled by Deloitte has changed as indicated in Table 2. It is apparent from Table 2 that the factor "Supporting strategic priorities" in 2017 could be nearly the same factor as "Rethinking mining strategy" in 2019, indicating the change in terminology to describe nearly the same factor.

Table 2. Ranking of the perceived top factors by Deloitte for the past three years (2017–2019) [2, 6, 7].

Factor ranking	2017	2018	2019
1	Understanding the drivers of shareholder value	Bringing digital to life	Rethinking mining strategy
2	Unlocking productivity improvement	Overcoming innovation barriers	The frontier of analytics and artificial intelligence
3	Operating in an ecosystem	The future of work	Managing risk in the digital era
4	The digital revolution	The image of mining	Digitizing the supply chain
5	Mapping the threat landscape	Transforming stakeholder relationships	Driving sustainable shared social outcomes
6	Creating a shared vision for the sector	Water management	Exploring the water-energy nexus
7	Re-earning the social license to operate	Changing shareholder expectations	Decoding capital projects
8	Supporting strategic priorities	Reserve replacement woes	Reimagining work, workers, and the workplace
9	Creating healthy and inclusive workforces	Realigning mining boards	Operationalizing diversity and inclusion programs
10	Adopting an integrated approach to reporting	Commodities of the future	Demanding provenance

It is also evident from Table 1 that mine planning will need some re-thinking to acknowledge the key high-level factors, which, if not addressed properly, pose serious risks to mining companies. Firstly, there is a growing impact of 4IR on the design and operation of mines, including adoption of associated technology. Secondly, there is increasing global emphasis on shared value perceptions by mining stakeholders. Shared value is achievable if mine plans are robust enough to maximize financial returns. If companies are cash-positive, they have the financial flexibility and capacity to address other value expectations from different stakeholders. Thirdly, there is a growing global demand for cleaner energy mixes, which can cause some commodities to experience a decline in demand if they have no role to play in the new or future energy mixes, unless the mining companies invest in downstream technologies to stimulate demand for their commodities. Lastly, mine planning must proactively account for the impact of the broad cluster of factors pertaining to regulatory, environmental, geopolitical and/or governmental factors. Table 1 does not indicate the time trend of some of the factors since it is a snapshot of the key high-level factors at the 2019 date stamp. However, some of the factors have tended to be perennial as can be inferred from Table 2, indicating that the mine planning fraternity cannot afford to ignore these factors when developing mine plans to support robust decisions by mining companies.

Based on the foregoing discussions, each of the factors can fall under broad groups of factors. For example, 4IR related factors include factors listed as “the frontier of

analytics and artificial intelligence”, “managing risk in the digital era”, “digitizing the supply chain”, and cyber-related risks indicated as “cyber”. The next section outlines some views on this broad categorization of the factors.

3 Implications for Mine Planning

A scan through the factors listed in Tables 1 and 2 shows that mine planning has to evolve in four broad categories. These are the following broad clusters of factors:

- Financial and economic factors to account for such issues as operating cost reduction, market dynamics, capital, funding, maximizing portfolio returns, mergers and acquisitions (M&A), and organic growth.
- 4IR factors that are focused on operational improvement through innovation, adoption of 4IR technologies including automation and digitization, productivity improvement, new energy mix and associated minerals emerging as new world commodities.
- Sustainable shared value factors that can ensure a clear value proposition for ‘brand mining’ through a commonly understood shared value metric (SVM), which can be measured easily and incorporates well-articulated stakeholder expectations, social license to operate, and address the growing demands for provenance.
- Governmental and geopolitical factors, which can cause disruption, introduce uncertainty arising from political instability, environmental risks and trade wars and/or tariffs.

The implications of these factors to mine planning into the future are:

- It is no longer sufficient to measure the economic or financial benefit accruing from a mining project in terms of the traditional valuation metrics which are net present value (NPV), internal rate of return (IRR), economic valued add (EVA) as these do not represent shared value to a wide range of stakeholders. The different stakeholder views can be contradictory or competing against each other, requiring some trade-offs to be made for a balanced shared value. It is important, as part of the mine planning process, to develop an alternative value measurement metric that addresses diverse stakeholder needs. Practically, such a metric could be the priority score derived from applying multiple criteria decision-making (MCDM) techniques in analysing outputs from mine planning concurrently with different stakeholder value expectations. The metric could also be a combination of a traditional value metric such as using a positive NPV in conjunction with expected utility (EU) from discrete choice analysis of different stakeholders as presented by Awuah-Offei *et al.* [8].
- Mine designs, should as far as possible, incorporate the use of 4IR-inspired equipment that allows for automation and present mine planning systems in ways that enable digitization. This includes incorporation of 4IR-related techniques such as data analytics and artificial intelligence.

- Government and geopolitical factors invariably introduce uncertainty especially when they are often changed requiring stochastic mine planning to be the norm rather than the exception in the future of mine planning.

4 Concluding Remarks

It is possible to draw some inferences from a review of the factors on how mine planning should adapt into the future. Some of these inferences are:

- It is necessary to develop an alternative shared value metric to measure value beyond the traditional value metrics such as NPV, IRR or EVA so that the mine planning process can adequately incorporate shared value among all stakeholders to ensure that ‘brand mining’ can resonate with all stakeholders.
- Mine planning must incorporate uncertainty since some of the factors indicate that uncertainty is inherent in decision making for the mining sector. Accordingly, stochastic mine planning should become the norm in future mine planning.
- The mine planning process should design energy efficient mining systems that are cognisant of the shifting energy mix towards electricity and renewable energy supplies.
- The mine planning process should cater for designing mining systems that incorporate 4IR technologies and associated techniques for improved automation and digitization. In addition, continual review of cyber risk mitigation ensures secure application of 4IR technologies.

The above inferences are not exhaustive, but indicate that the mine planning process can evolve into the future by tracking and incorporating the findings from the annual surveys undertaken by the ‘Big Four’ accounting and auditing firms. In this way, the mine planning fraternity can ensure that the mine planning process continues to provide outputs that enable mining companies to make robust business decisions into the future.

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