Maximising value: A digital approach to optimise decisions and avoid value leakage in mining value chains

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# ABSTRACT

Mining is a game where the objective is to extract a finite resource in the most economically efficient way possible. There are some unbreakable rules that must be followed – safety is never compromised, and the game is immediately over if the cultural, environmental or societal impact on communities exceeds the community’s expectation. A new unbreakable rule has recently been added: the operation must be carbon-natural by 2050.

To get a high score in this game, you must have a good strategy – a long-term plan (life of mine plan) that defines the sequence you will follow to extract the resource. This defines the theoretical maximum score you should be able to achieve, and the points you need to score in each ‘turn’ (i.e. planning interval) to get there. In the shorter term, you must plan the detailed allocation of resources and activities to attempt to score the full points on every turn. Assuming a player has optimised their long-term strategy based on what is known about the resource, altering the golden sequence of the strategy never results in higher overall score (it might steal forward a few points on the next turn, but always at the expense of a big points-penalty later!).

Therefore, the best tactic is to adhere exactly to the golden sequence and get a perfect score on each turn. The complication is that many circumstances (geological uncertainty, unreliable equipment, weather events, poor co-ordination, etc) conspire against the player, making it a seemingly impossible task to get the perfect score every turn. Most players recognise the correct tactic, but are unable to avoid losing lots of points each turn.

The barriers preventing the mine operators (i.e. the players) from maximising the value in each interval are:

* Decision makers can’t easily see (or understand) the full picture when they make a decision.
* Even if good data is presented (the full picture), inferring the outcome of decision is hard and takes too long.
* It is very hard to align all stakeholders on the objective or best-course-action across the entire value chain – resulting in tensions and inefficiencies and value loss.
* At an operational level, there is no universally accepted definition of what constitutes value (and therefore what to try to optimise for).

This paper describes an approach to monitoring and visualising operations, incorporating optimisation and simulation effectively, and an accompanying philosophy for managing the execution of activities in mining value chain so that value is not lost in each interval and operational decision making is aligned to a common goal of minimising value lost. The approach is validated through simulation to demonstrate that the improved over a baseline approach. The underpinning principles of the operating philosophy (the tactics used when playing the game) are:

* Target stable and predictable flow through the value chain
* Calculate the total value being lost, in real time, and make it an objective for decisions makers and optimisation engines to minimise the value lost in each interval.
  + Recoverable metal lost
  + Deviating from plans (or forcing future deviation)
  + Cost of carbon, energy, consumables
  + Penalty costs (such as off-spec grade or transport demurrage)
* Use simulation to predict (and avoid) up-coming bottlenecks, and help decision-makers objectively consider overall impact to the value chain when responding to deviations.